Innovation-Diffusion: A Geographical Study of the Transition of Family Limitation Practice in Taiwan

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ABSTRACT

Demographic analysis and theory regarding demographic transition has tended to focus on the perspective of innovation-diffusion of the practice of birth control. By comparison, relatively little attention has been devoted to the study of the geographical pattern of the innovation-diffusion of family limitation practice. This paper attempts to use map-analysis to study the transition of family limitation practice in Taiwan between 1961 and 1980.

Demographic Transition in Taiwan

In recent decades, demographers have used the demographic transition theory to study population change in the less developed countries. This theory, based on the demographic evolution of the countries in the Western society, is supposed to be a generalized explanation of the process of mortality and fertility decline in these countries (U.N. 1973: 58). According to demographic transition theory, the high birth rates and death rates of transitional societies will be affected by the social and economic developments in the society. The death rate will fall first, and size of the population will then increase substantially due to the still high birth rate. Finally, in a modern society the fertility rate will fail to a low level and complete the process of demographic transition. Coale has summarized a set of quantitative indices to measure change in fertility rates during the process of demographic transition between traditional to modern societies (1973: 64):

> A society was modern, in 1960, if at least 50 percent of the population lived in urban settlement of more than 20,000 persons, if more than 90 percent of the female population at ages 6 to 13 was enrolled in school, and fewer than 30 percent of the labor force was engaged in agriculture, fishing, and forestry. . . . High fertility and mortality could be defined as a total fertility of over 5.0 and

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an expectation of life at birth for women of less than 60 years; low fertility and mortality defined as a total fertility of less than 4.0, and an expectation of life at birth for women of over 68 years.

During the past 20 years, Taiwan has experienced the above fertility transition. The crude birth rate fell from 38 per thousand in 1961 to 23 per thousand in 1980, representing a shift in completed family size of from 5.6 children to around 2.5.[4] In the same period, significant socioeconomic changes occurred, which transformed Taiwan from an agricultural society into a predominately industrial one. By 1980, the life expectancy for women reached 74 years, more than 67 percent of the population resided in metropolitan areas, over 62 percent of all women aged 6 and over had received education above the primary school level and only 28 percent of the population remained in the agricultural sector (*1980 Taiwan Fukien Demographic Fact Book,* Tables 4, 6, 25, and 87). These figures indicate that Taiwan is one of several developing countries that have gone through rapid socioeconomic changes, and have completed the demographic transition. Based on the above criteria, by 1980 Taiwan had already become a modern society and completed the demographic transition.

Innovation - Diffusion

Previous studies of the demographic transition have emphasized both the historical patterns of demographic transition in developed societies and their implications for the developing countries. One of the major debates surrounding these studies is whether or not the pattern of the fertility decline is due to and innovation-diffusion process.

The innovation-diffusion perspective stresses that birth control, especially contraception, is a recent innovation and is essentially new in human culture. The innovation-diffusion theory assumes that the decline of fertility started in a setting where there was no, or at most very limited, previous practice of birth control. The theory emphasizes the importance of the spread of information. It also assumes that innovation starts in metropolitan centers, diffuses to other urban places with some delay, and penetrates to rural areas still later. Innovative behavior diffuses not only from urban to rural areas but also from one area to another which is culturally and linguistically similar.

An innovation is a new product, idea, technique, practice, or phenomenon to which people are introduced. Rogers and Shoemaker defined the concept of

innovation as follows (1971: 19):

> "An innovation is an idea, practice, or object perceived as new by an individual. It matters little, so far as human behavior is concerned, whether or not an idea is objectively new as measured by the lapse perceived or subjective newness of the idea for the individual that determines his reaction to it. If the idea seems new to the individual, it is an innovation."

Thus for a specific human population, it is possible that a particular idea is perceived by some as innovative while others have already incorporated it into their thinking and behavior.

One of the most interesting aspects of the introduction of an innovation to a population is the dynamic process by which the innovation diffuses. The concept of innovation-diffusion describes the spread of a new phenomenon, idea, or technique throughout a population or region, by taking into account basic geographical elements of distance, direction, and spatial variation (Brown 1977: 2). To study this process researchers have developed various analytical approaches. One of the major ones is the "demand perspective."

The demand perspective represents the traditional approach suggested by Hagerstrand (1967 and 1968), who called it the "adoption perspective." It focuses upon the spatial process by which the adoption or demand occurs, and it interprets the demand for an innovation as the result of a learning or communication process. The spatial characteristics of the demand perspective of innovation-diffusion process are that the adoption of new practices are stimulated by means of information dissemination via networks of social communication, such as the media and interpersonal contact. The most important aspect of this process is that it occurs with a spatial frame of reference. Thus, the initial and essential steps in the study of the diffusion process are the identification of the spatial characteristics of information flows.

The Analytical Framework

Having briefly introduced the demand perspective of innovation-diffusion, I will now discuss it in greater detail. Hagerstrand (1968: 174-177) elaborates four basic factors for the understanding of the demand perspective of the adoption of innovation: growth patterns, centers of innovation and diffusion, channels of spread, and receptivity factors.

Growth Patterns

The growth patterns of the adoption of the innovation-diffusion are observed by researchers to be similar to the S-shaped curve in empirical studies (Pemberton 1936; Griliches 1957; Anderson 1974). The growth of an innovation starts with very few adopters, followed by an intermediate period with a rapidly increasing rate of adoption, and finally reaching a decreasing rate of adoption, which is the concluding level of the adoption. Hagerstrand (1968) argues that the above three stages of growth pattern can be linked to the spatial distribution of adopters, with the gradual expansion of the areas of the adopters during each stage, from an initial concentrated area to the expansion in nearby areas.

It is commonly observed that innovation starts from urban centers, spreads to the suburban areas in the intermediate stage, and eventually reaches the rural areas. The availability of birth control -- the innovation -- in private doctors' clinics and drugstores, most of which are concentrated in the urbanized areas, should have contributed to the expected diffusion effects from urban-to-rural. Urban residents may enjoy more opprotunities to receive ideas and means of family limitation from the private sector than rural residents.

Although there was some urban to rural diffusion from the family planning program in Taiwan, the government supported program provided services more evenly between urban and rural areas, thus somewhat limiting the diffusion effect from the program. In fact, the government sponsored program actually emphasized the rural areas in order to encourage family limitation in the generally high birth rate areas.

For the diffusion of family limitation practice in Taiwan, I expect that the availability of information about and means of family limitation practice may affect the rate of the increase of small m values in an area. The regional differentials of family limitation practice during the various stages of the diffusion process will be the question under study.

Centers of Innovation And Diffusion

An innovation is usually developed through a combination of some pre-existing factors, and only when these factors are available can the innovation be produced. This cumulative principle of development emphasizes the importance of the roles of the centers to the creation of innovations. Centers of the spread of innovation-diffusion are often the urban centers in a given area. Urban centers diffuse innovations simply because of the various cultural and technological elements in these areas. In the case of family limitation, I believe the pattern of

diffusion originates from urban areas and spreads outward to the rural areas. However, the initiation of the 1964 family planning program in Taiwan might have altered the pattern somewhat. Although the initial increases of the values of Coale's m which were found as early as 1961 (Knodel and Van de Walle 1979) support the model for the traditional process of demand-side diffusion, the island-wide family planning program might have accentuated the spread of information and means of family limitation to both the rural and urban areas.

Channels of Spread

The spread of innovation is essential because people will adopt the innovation only after they have learned about it. Distance is an important variable in determining the ease with which information about an innovation is spread. People who live close to the urban centers are likely to receive information and adopt innovations earlier than those who live farther from urban centers. Geographical proximity, however, is apparently not the only factor. The family planning program efforts for diffusion means and knowledge of birth control, for example, could be distributed unevenly by emphasizing rural areas rather than urban areas. This function of supply-side diffusion will not be discussed in this paper. Diffusion of the ideas and means of family limitation also can happen through individual social contacts outside the community. Both types of personal diffusion are difficult to measure, although they can be treated as part of the geographical diffusion process by determining whether the activities occurred within a specific community or whether they occurred across communities. The proposed measurement of urban to rural diffusion, i.e., distance to urban centers with population 50,000 and above, can measure the personal diffusion between areas. However, measures of personal contact within a single area are not available and therefore this aspect will not be included in this study.

Public and private diffusion agencies, including road systems, newspapers, radio and television networks, are also important channels of information flow. However, the influence of the news media on innovation-diffusion cannot be measured directly for family limitation, because we do not have areal data on the level of mass media for this period. The above variable of distance to urban centers will also serve as a proxy measure for diffusion through all channels of information.

I will attempt to measure the spatial pattern of geographical diffusion on the spread of contraceptive use in order to evaluate the role of innovation-diffusion in the process of increasing family limitation practice in Taiwan. If the diffusion

of family limitation is to be found, I will be able to identify the following pattern the increase of family limitation will be related to the distance from urban centers, which presumably are the original centers of innovation.

Receptivity Factors

In addition to the channels of dissemination in the process of innovation-diffusion discussed above, I shall also discuss the factors which will influence the differences in resistance to and receptivity of the innovations. Hagerstrand (1968: 177) pointed out that personal characteristics of individuals constitute an important factor in receptivity. Anderson (1974: 26) also argued that individuals will not adopt a new pattern of deliberately limiting their fertility until certain levels of socioeconomic and demographic developments have been reached in the area. This implies that these developments are important to successful diffusion of the innovation. In this study. however, socioeconomic development will not be discussed since they are considered as part of the adjustment model.

Measuring the Level of Family Limitation Practice in Taiwan

The level of family limitation in each area at a given time is measured by Coale and Trussell's m, which is an index of family limitation based on the age structure of marital fertility and independent of the level of fertility. A greater value of m reflects a greater deviation of the marital fertility schedule under study from the "standard" natural fertility, and implies a greater control of fertility.

In several articles, Ansley J. Coale and T. James Trussell (1974 and 1978) introduced a summary measure that can be calculated based on marital fertility to describe the level of family limitation practice in a population. This summary measure is usually called Coale-Trussell's m or small m. The following discussion of the calculating method for small m is a summary of Coale and Trussell's research.

It is hypothesized that the ratio of marital fertility r(a) to natural fertility n(a) at a specified age of a population can be shown as

$$r(a)/n(a) = M \exp (m \cdot V(a)) \qquad (1)$$

Where,

M is the parameter of the scale factor.

m is the parameter indicating the degree of control of marital fertility.

n(a) and v(a) are five-year values which are derived from empirical data and are assumed to be invariant over time and population.

If we take the logarithms of both sides of equation (1), the following equation(2) can be derived

$$\ln [r(a) / n(a)] = \ln M + m\, v(a) \quad (2)$$

If, $\ln [r(a) / n(a)] = Y$, $\ln M = c$, and $v(a) = x$, a linear equation $Y = c + mX$ can be derived. Therefore, lnM and m can be estimated by fitting regression equations of ordinary least squares. In order to avoid the situation when r(a) values are zero, since ln(0) is not defined, we will estimate the two parameters by using values of r(a) from 20-24 to 40-44 by five-year intervals. The n(a) and v(a) values are provided in Table 1 (Coale and Trussell 1978: 205).

A computer program, provided by Dr. John Knodel of the Population Studies Center of the University of Michigan, is used to derive the m values based on the areal level age-specific marital fertility rates in Taiwan. The estimated m values for each areal units are considered as the summary measures of the level of family limitation practice.

Table 1: FIVE-YEAR VALUES OF v(a) AND n(a)*

	Age Group						
	15 - 19	20 -24	25 - 29	30 -34	35 - 39	40 - 44	45 - 49
n(a)	0.411	0.460	0.431	0.395	0.322	0.167	0.024
V(a)	0.0	0.0	-0.279	-0.667	-1.042	-1.414	-1.671

*Data Source: Coale and Trussell, 1978, pp. 203-222.

Ethnic Factor

Ethnic differences are important in Taiwan because Fukienese, Hakkas, and Mainlanders are dissimilar in terms of their language and social traditions. I will include percent of Hakkas (the only data available is from 1966 Census) in this analysis, while Fukienese and Mainlanders are excluded from the model. Hakka lineages tend to be segregated from Fukienese in residential areas and are more conservative than the other groups. Historically, Hakka people are the minority in Taiwan. For about two hundred years they reside in relatively poor and backward areas in Taiwan, pressures from Fukienese never really stop.

The inferior economic status of Hakka is mainly a historical result of Hakka migration history to Taiwan. While Fukienese came earlier than Hakka, most fertile plains were occupied by Fukienese. Hakka people, with no other choice,

settled at remote areas that had only marginal land left to cultivate (Chung 1970, Pasternak 1972, Cohen 1976). Therefore, the most densely populated Hakka areas in Taiwan, including Miaoli, Hsinchu counties and part of Pingtung county, are considered to be poor and less developed regions in Taiwan. In fact, there is no major city in these three counties and only a limited number of urban centers located in Hakka area. Generally speaking, Hakka people are considered as one of the oldest ethnic groups in China. The relatively conservative attitudes for Hakka about family limitation practice are thus expected.

Furthermore, there are reasons to believe that Mainlanders have a sex ratio, age structure, and occupational composition that differ from those of native Taiwanese, that is Fukienese and Hakkas (Lee 1968). This is expected to have substantial impact on the patterns of Mainlanders' nuptiality and fertility behavior. The increasing interaction among these three ethnic groups in Taiwan has reduced the differences to a certain extent, promoting more cultural homogeneity in general. Linguistic and cultural differences, however, persist as important barriers to the diffusion of contraception, especially for Hakkas who are still heavily concentrated in central Taiwan. I expect that the percentage of Hakka ethnicity will prove to be negatively related to the family limitation practice in the following map-analysis.

County-Level Variation Analysis in Taiwan

In this section, I will evaluate the variations of the levels of family limitation practice at the county-level before getting into township-level analysis. Excluding Penghu county (an off-shore county with 64 small islands, the five major cities and the other 15 counties of Taiwan island itself constitute 20 areal units according to city and county administrative boundaries.

Among the five major cities, Keelung, a sea port in northern Taiwan, is geographically and economically related to Taipei city. The other four cities, Taipei in the north, Taichung in the center, and Tainan and Kaohsiung in the south, in addition to functioning as the major metropolitan centers have also developed the most modern communication, transportation, and education systems for their city residents. Kaohsiung city, moreover, is the largest seaport in the south and has been emerging as the largest industrial city in Taiwan since the early 1970s.

Of the sixteen counties, two, Hualien and Taitung, are geographically isolated from the rest of the island mainly because of their locations in the east. Hsinchu and Miaoli counties, geographically located between Taipei city in the north

and Taichung city in Central Taiwan, are the areas with the highest concentration of Hakka people.

To illustrate the county-level areal variations of m values, maps based on the m values calculated from *Taiwan-Fukien Demographic Fact Book* from 1961 to 1980 are presented to show the changes of the trends of the m values. Figures 1 to 3 present the m values for cities and counties of Taiwan in 1961, 1970, and 1980. In Figure 4, the names and the geographical locations of cities and counties are provided to help in reading the map. In 1961, only Taipei city had reached a high level of family limitation practice, i.e., m value larger than 1.0. The other four major cities, Keelung, Taichung, Tainan, and Kaohsiung, all had medium-high m values which indicate some practice of family limitation. The northern counties (Taipei, Taoyuan, and Hsinchu), the southern counties (Yunlin, Chiayi, Tainan, Kaohsiung, and Pingtung) and the central Taichung county fell into the medium category with m values between 0.4 to 0.65. The north-eastern county of Ilan, the Hakka county of Miaoli, and the central counties of Changhwa and Nantou had only low level of family limitation practice with m values between 0.2 to 0.4. Natural fertility rates were observed among the eastern counties of Hualien and Taitung indicating that virtually no family limitation practice was adopted by the Taiwanese women in the east.

In the early 1960s the above variations of m values across regions suggest that Taipei city together with the other four major cities were the areas where significant family limitation was first parcticed in Taiwan. These cities could be considered as the diffusion centers of this new behavior at that time since surrounding conties had lower m values. Moreover, the western counties in between the major cities (like Miaoli, Changhwa, and Nantou) and the county in the north-eastern corner (Ilan) still remained at low m values. The low level of adoption of family limitation practice among these counties might be the result of geography because of their relatively isolated locations, made inter-county communication between their counties and the major cities difficult. Further evidence of the function for geography on the diffusion of family limitation practice can be seen from the two eastern counties that still had natural fertility rates in 1961 ($m<0.2$) These two eastern counties were geographically separated from the rest of the island and had only very few transportation channels to the major cities like Taipei, Kaohsiung, and Taichung.

In 1970, however, the pattern of m values across cities and counties of Taiwan is different from that of the 1961. A clear difference between northern and

southern Taiwan, with generally higher m values in the south and relatively lower m values in the north, shows that during the decade of the 1960s, residents in the southern counties had already adopted more family limitation practice than those who lived in the northern counties. Cities, despite their location, still had higher m values than their surrounding counties. Taipei and Keelung cities, for example, had only medium level m values (1.40-1.80), but had a higher level of family limitation practice than the nearby counties. Tainan city, the city that reached a high m value (2.0+) in 1970, shared the same level of family limitation practice with Tainan county, suggesting that practicing family limitation had become more popular in the Tainan area than in the rest of Taiwan. Hualien and Taitung, the two counties in the east, which had increased the practice of family limitation, still had low m values, smaller than 1.1.

In 1980 while Tainan city and county in the south remained at high m values (3.0+), four other cities and counties (Central Taichung city and Nantou county, Southern Kaohsiung city and Chiayi county) also reached m values higher than 3.0 (Figure 3). The northern counties had only low m values between 2.0 to 2.6, but cities like Taipei and Keelung reached medium and medium-high m values respectively. The eastern counties continued to be the regions with m values smaller than 2.0.

For both 1970 and 1980, there were three general regional trends of m values: the south and central areas had high or medium m values; the north had medium or low m values; and the east had very low m values. This differs from 1961 when only the major cities had the highest m values. It is true for all these three time points that the five major cities had higher m values in their regions and probably acted as the centers of the diffusion process. Careful examination of 1970 and 1980 patterns indicates that at these two points of time the roles of the major cities as the centers of diffusion had declined compared to the year 1961. While the cities had higher m values than their surrounding counties in 1961, Tainan county in 1970 and Tainan, Chiayi, and Nantou counties in 1980 actually reached m values that were either the same or even higher than the nearby major cities.

In other words, the importance of the demand-side diffusion model of family limitation practice first starting in the cities and then being disseminated to the surrounding counties had declined in the 1970s. This is, however, expected since the urban-to-rural diffusion occurred in the 1960s will reduce the gap of the levels of m values between cities and surrounding counties.

An Example of Township-Level Variation Analysis of Pingtung County

County-level m values can only provide basic information across the counties, the variations of m values of local areal units will require studies of township-level data. Therefore, I have selected Pingtung county for analysis of the geographical pattern of family limitation practice at the township-level. Pingtung, a county in southern Taiwan with a significant percentage of Hakka residents, is considered to be the best county for such analysis since its relatively isolated geographical location results in limited influences from major cities and the ethnic differences in adopting family limitation practice between Hakka and Fukienese can be tested across townships. Figure 5 presents the distribution of Hakka population in Pingtung county in 1966. Six of the 24 areal units had more than 50 percent Hakka residents, and another four townships had Hakka population between 20 to 50 percent. The Hakka people were heavily concentrated around the eastern part of the county and closely connected to the aboriginal area. Those six townships with 50 percent or more Hakka, however, are also geographically very close to the Pingtung city, the only *urban center* of the county.

Figures 6 to 8 present the m values for local areal units of Pingtung county in 1961, 1964, and 1967. In 1961, only Pingtung city had medium-high level of family limitation practice, i.e., m value between 0.9 to 1.2. The surrounding townships can be classified into two types: some with medium level of m values (0.2-0.9) and geographically close to Pingtung city; others with virtually natural fertility of m values (< 0.2) and geographically distant from Pingtung city. The Hakka townships had m values similar to those nearby Fukienese townships. In 1964, most Fukienese townships close to Pingtung city had significant gains of m values and reached medium-high or high levels, while a large part of the Hakka townships (east of Pingtung city) still had medium level m values. The southern Fukienese dominated townships of the county, where there were natural fertility rates in 1961, continued to stay at low m values. In 1967, most Fukienese dominated townships located in northern Pingtung county had high m values larger than 1.2; however the Hakka townships in the east, though geographically close to Pingtung city, lagged behind those of Fukienese townships had only medium-high m values. Distance from urban center still had an effect. Townships in the south again had the lowest level of family limitation practice, but by 1967 they already had m values above the natural fertility rate.

These findings suggest that there was an inverse relationship between levels

of m values and the distance to *urban center* in the 1960s. The southern Fukienese townships of Pingtung county, distant from the *urban center* of Pingtung city, had consistently lower m values than the Fukienese townships near the *urban center.*

However, the Hakka area, especially those townships to the east of Pingtung city with more than 50 percent Hakka, showed different patterns and increased their m values less than the Fukienese townships about as far away, or further from, Pingtung city. This suggests that the Hakka probably behave differently from the Fukienese in the process of the transition of the family limitation practice, as hypothesized earlier. Apparently in the decade of 1960s both ethnicity and distance to an *urban center* were important factors in determining the levels of family limitaion practice.

In order to explore the effects of ethnicity and distance to *urban center* on family limitaiton practice in the 1970s, maps similar to those of the 1960s are presented in Figures 9 to 11. In 1973 and 1976, eastern Hakka townships still had lower m values than the Fukienese townships surrounding Pingtung city. This, again, shows the negative Hakka effect on the level of family limitation practice. Although the southern Fukienese townships still had relatively low level of m values, the pattern of m values of the other Fukienese townships in the 1973 and 1976 indicates some differences from those of the 1960s, since townships with high, medium-high, and medium m values were mixed across the county while in the 1960s clusters of townships with these m values were clearly observed. This suggests a decline in the importance of the distance to urban center on the levels of m values. In 1980, Hakka regions to the east retained medium-high m values while most of the townships with less than 50 percent Hakka population reached m values larger than 3.1. Similarly, the two southern Hakka townships also had relatively lower m values. However, the most distant Fukienese township in the south had actually obtained the highest m values ($m > 3.1$), which is opposite to the hypothesized relationship between distance to urban center and m values, that is, areas distant from *urban centers* should have lower m values.

The discussion in this section of the changing patterns of m values in Pingtung county over the period 1961 to 1980 suggests that there were significant relationships between the levels of m values and the independent variables of ethnicity and distance to *urban center*. The strength of the negative influence of the distance to *urban center* on m values was, however, probably declining during the 1970s, since there appeared be townships far away from an *urban center* which

had higher m values than those located closer to the *urban center*. The ethnicity variable maintained its unique influence on the levels of family limitation practice in Hakka townships throughout these two decades.

Conclusion

Based on the above preliminary conclusions drawn from the case study of Pingtung county, it shows that the demand-side diffusion from urban-to-rural areas was important in the earlier decade of the transition of family limitation practice but as practice became more uniform throguh diffusion, distance from urban center was less important. Ethnicity, whether or not the township was dominated by Hakka or Fukienese, also appears to have played an improtatn role in determining the pace at which the local residents adopted family limitation practice. Hakka townships seem to have adopted family limitation practice more slowly than Fukienese townships about the same distance from the urban center. This is expecially true in the dates 1976 and 1980, when Fukienese townships in the south had already obtained medium level of m values the Hakka townships in the same area still had relatively lower m values. The above ethnical differences in adopting family limitation practice in Pingtung county can be considered as the result of dialect and cultural differences between the Fukienese and Hakkas.

The map analysis of Pingtung county provides descriptive evidence to support the diffusion of family limitation from *urban centers* to distant areas, while ethnic variables like Hakka population, tend to delay the adoption of family limitation practice. In general, the *urban center* had higher m values than the surrounding rural areas in Pingtung county and for areas other than the urban center the level of m values is a negative function of the distance to the *urban center*. As expected, this urban-to-rural diffusion diminished in improtance in the late 1970s, as the gap in family limitation practice between *urban centers* and rural areas narrowed.

The above findings have important policy implication for high fertility developing countries with or without organized family planning programs. Since natural diffusion of knowledge and means of family limitation practice through urban-to-rural process is possible, obstacles such as language and subculture that may delay diffusion should be taken into consideration by policy makers. The declining importance of urban-to-rural diffusion in the 1970s probably reflects the result of incresing socioeconomic developments which are experienced island-wide in Taiwna in the last decade. This also suggests that the strategy of using structural changes to reduce fertility level could be more effective in a develc ping

county in which basic developments are already available.

In this paper, the analyses are limited to the descriptive measures and map-illustrations which cannot serve satisfactorily to answer questions raised in multivariate perspective. To further evaluate the hypotheses proposed for diffusion model, analyses with better statistical techniques are necessary in the future.

BIBLIOGRAPHY

Anderson, John Ellis

1974 "Areal Variation in Fertility Trends in Taiwan, 1952-1970: Diffusion or Development Process," Unpublished Ph. D. dissertation, Department of Sociology, University of Michigan.

Brown, Lawerence A.

1977 "Diffusion Research in Geography, A Thematic Account," Studies in the Diffusion of Innovation Discussion Paper No. 53. Columbus: Department of Geography, The Ohio State University.

Chung Jen-shou

1970 Liu-tui hsiang-t'u k'ai-fa shih (History of the development of the Liu-tui's Homeland). Nei-P'u(Taiwan): privately published (mimeo).

Coale, Ansley J.

1973 "The Demographic Transition," in International Union for the Scientific Study of Population, International population Conference, 1973, Vol. I, pp. 53-72.

Coale, Ansley J. and James Trussell

1974 "Model Fertility Schedules: Variations in the Age Structure of Childbearing in Human Population," *Population Index*, Princeton, N. J., 40(2): 185-258.

1978 "Technical Note: Finding the Two Parameters that Specify a Model Schedule of Marital Fertility," *Population Index*. Princeton, N.J., 44(2): 203-212.

Cohen, Myron L.

1976 *House United, House Divided The Chinese Family in Taiwan.* Columbia University Press.

Griliches, Z.

1957 "Hybrid corn: an exploration in the economics of technological change", *Econometrica*, 25. pp. 501-22.

Hagerstrand, Torsten

1967 *Innovation Diffusion as a Spatial Process.* Allan Pred, Trans. Chicago: University of Chicago Press.

1968 "The Diffusion of Innovations," in David Sills, ed., *The International Encyclopedia of the Social Sciences,* Vol. 4, pp. 174-178.

Knodel, J. and Etienne Van de Walle

1979 "Lessons from the Past: Policy Implications of Historical Fertility Studies," *Population and Development Review,* June.

Lee, Tung Ming

1968 *A Study on Social Increase of Population in Taiwan.* Taiwan Population Studies Center, Taiwan Provincial Department of Health.

Pasternak, Burton

1972 *Kinship and Community in Two Chinese Villages.* Stanford: Stanford University Press.

Pemberton, H. E.

1936 "The curve of culture diffusion gradients, *American Journal of Sociology,* 42, pp. 226-33.

Republic of China

1961 *Taiwan-Fukien Demographic Fact Book.* Ministry of the Interior, Republic of China, 1961-1980.

Rogers, E.M. and F.F., Shoemaker

1971 *Communication of Innovations: A Cross Cultural Approach.* New York, Free Press.

Taiwan Provincial Government

1956 *Taiwan Area Census.* Taiwan provincial government, Republic of China.

1966 *Taiwan Area Census.* Taiwan provincial government. Republic of China.

Taiwan Provincial Government

Taiwan-Fukien Demographic Fact Book. Taiwan provincial government, Republic of China.

United Nations, Department of Economic and Social Affairs

1973 *The Determinants and Consequences of Population Trends.* New York: United Nations.

新事物的擴散：
臺灣家庭限制行爲變遷的地理性研究*

(中文摘要)

丁 庭 宇

本文是以新事物的擴散（ innovation-diffusion ）理論爲根基，採用地圖分析法（ map-analysis ），來探討台灣地區在一九六一至一九八〇年，家庭限制行爲的變遷是否符合了人口轉型（ demographic transition ）過程中的需求擴散觀點（ demand perspective ）。

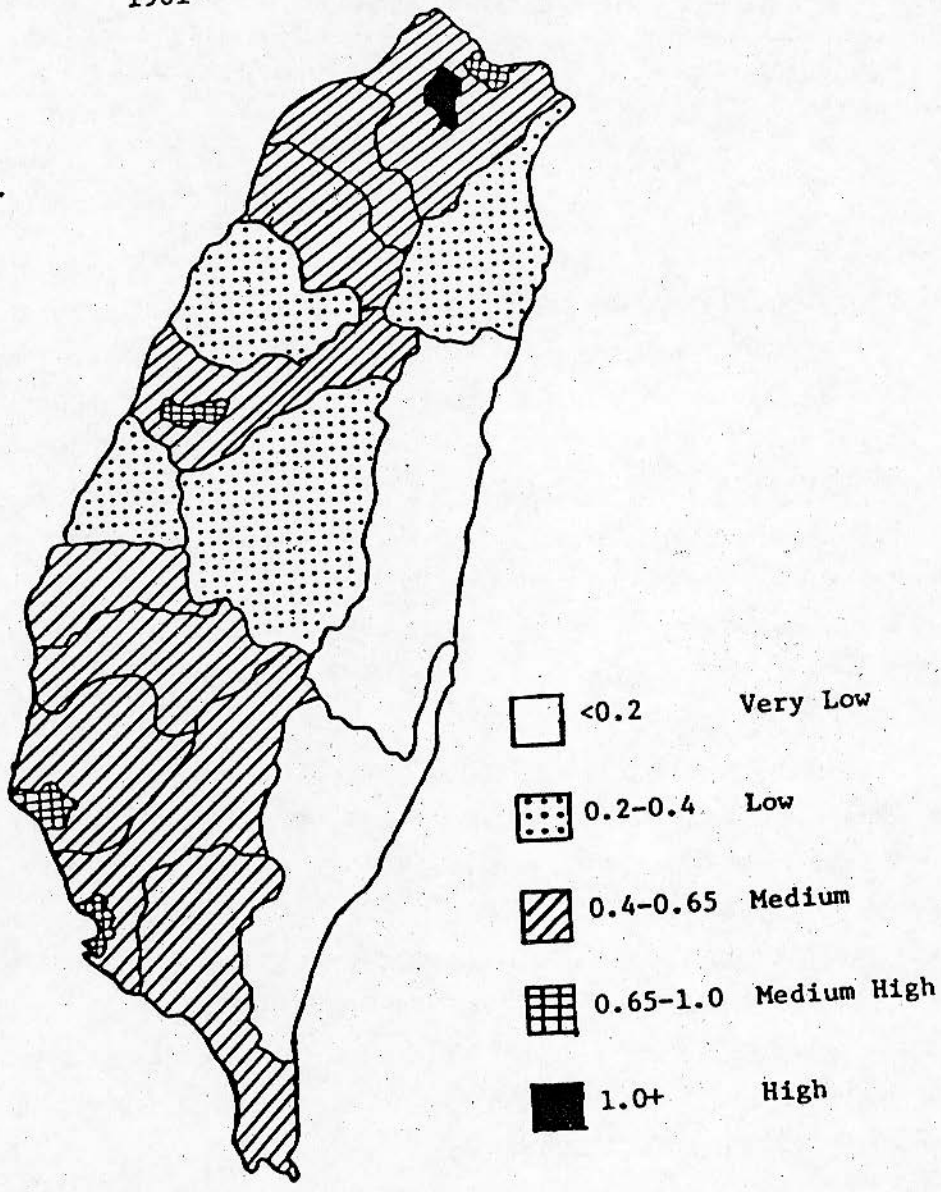
在分析的架構上，本文參考了Hagerstrand的觀點，對下列四項因素：成長模式（ Growth Patterns ）、新事物與擴散的中心（ Centers of Innovation and Diffusion ）、擴展的管道（ Channels of Spread ）以及易接受新思想的因素（ Receptivity Factors ）等，分別加以討論。並應用寇爾崔素m值（ Coale-Trusell's m ）公式，以各區域已婚婦女年齡別生育率，計算生育轉型過程家庭限制行爲之程度。

本研究對台灣地區縣市級及鄉鎮區級（屏東縣）的家庭限制行爲分析中發現：(1)家庭限制行爲存在著區域間差異：一九六〇年代時台北以及西部各重要都市呈現較高的寇爾崔素m值，而花東及非都市區却呈現偏低的m值；至一九七〇年代，各區m值均大幅增長，但以南部都市的成長較快，顯示了家庭限制行爲需求面的擴散模式已漸不顯著，亦即都市到鄉村的擴散過程已縮短了城市間m值的差距。(2)傳播擴散的程度即寇爾崔素m值，在以屏東縣爲範例的鄉鎮區級研究中，與距都會中心（ urban center ）的距離成負相關。但隨著時間的進展，距離的因素亦已不那麼顯著。(3)省籍因素代表了文化及方言在傳播成效上的差異，可反映出不同的語言習慣可能影響節育行爲接受程度。如客家人的保守性，在屏東縣的研究中，便顯示了較閩南人爲低的寇爾崔素m值，亦即較少家庭限制行爲的發生。

使用地圖分析方法，探討新事物的擴散模型，在台灣家庭限制行爲變遷過程中所扮演的角色，可說在方法上稍嫌薄弱。未來，對人口轉型過程中家庭限制行爲的研究，應側重多變項的分析方式，以更進一步驗證擴散模式的假設。

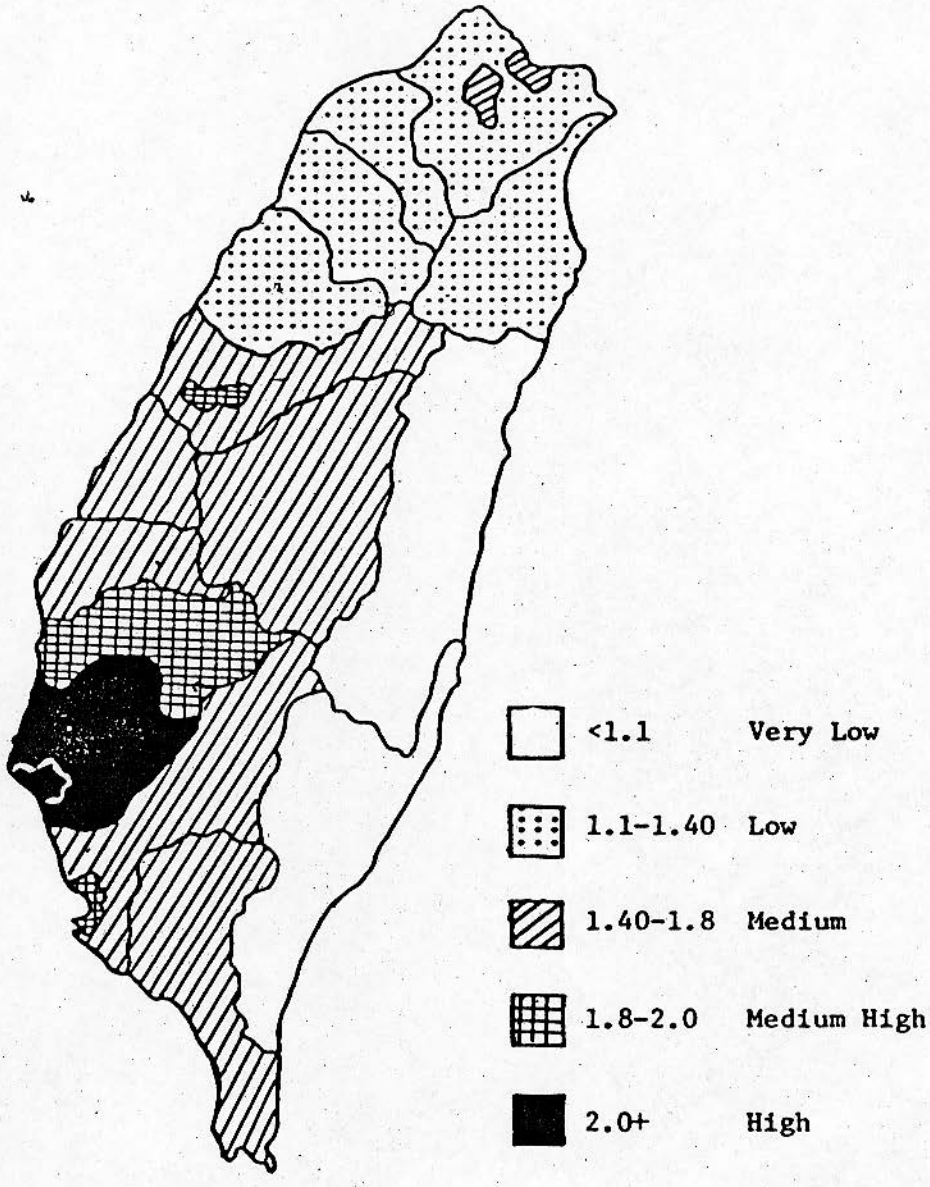
*本文之整理發表，受助於李蓓蒂小姐及陳金葉小姐謄抄、打字之處甚多，特此致謝。

Figure 1. Coale-Trussel's m Values by City and County of Taiwan, 1961*



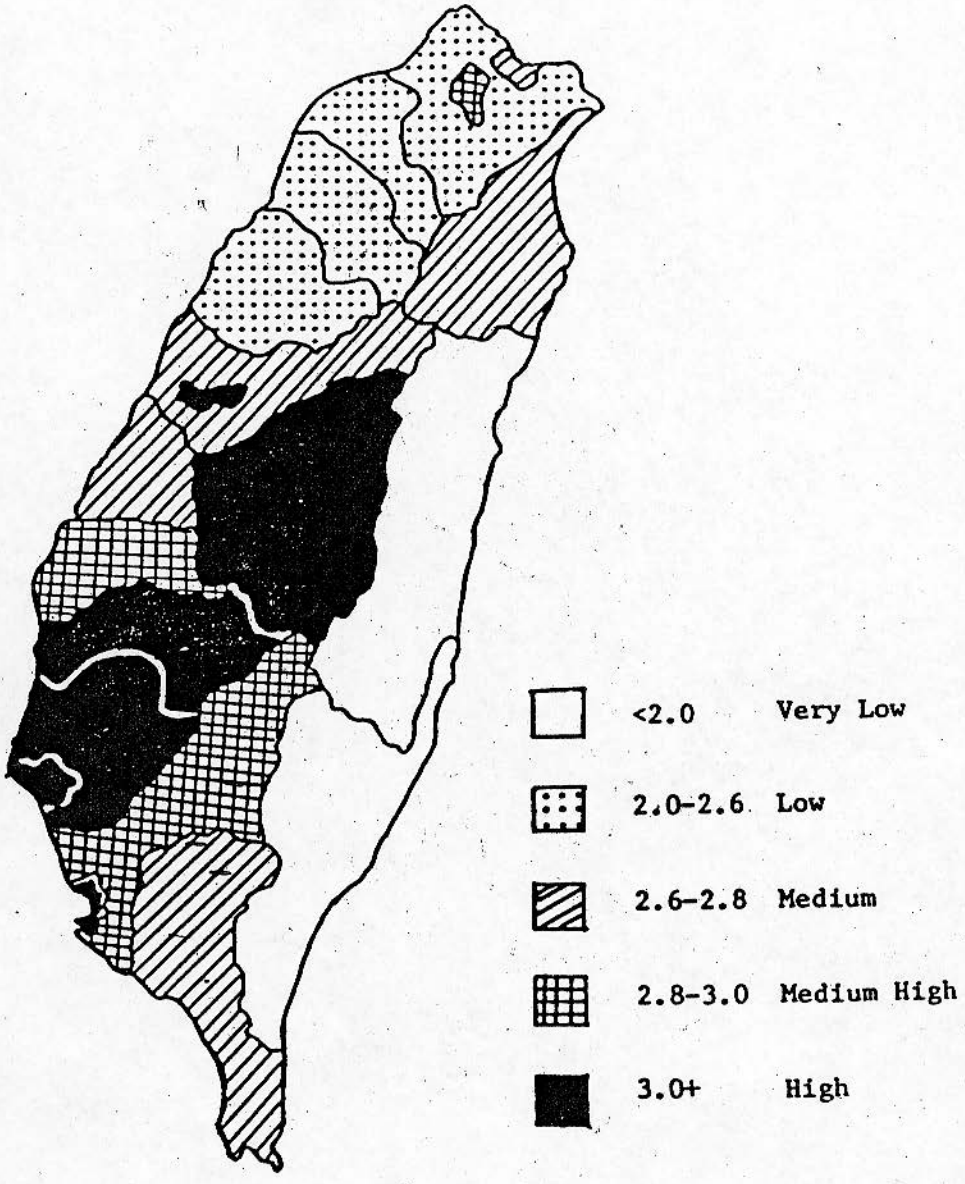
*Date Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1961.

Figure 2. Coale-Trussell's m Values by City and County of Taiwan, 1970*



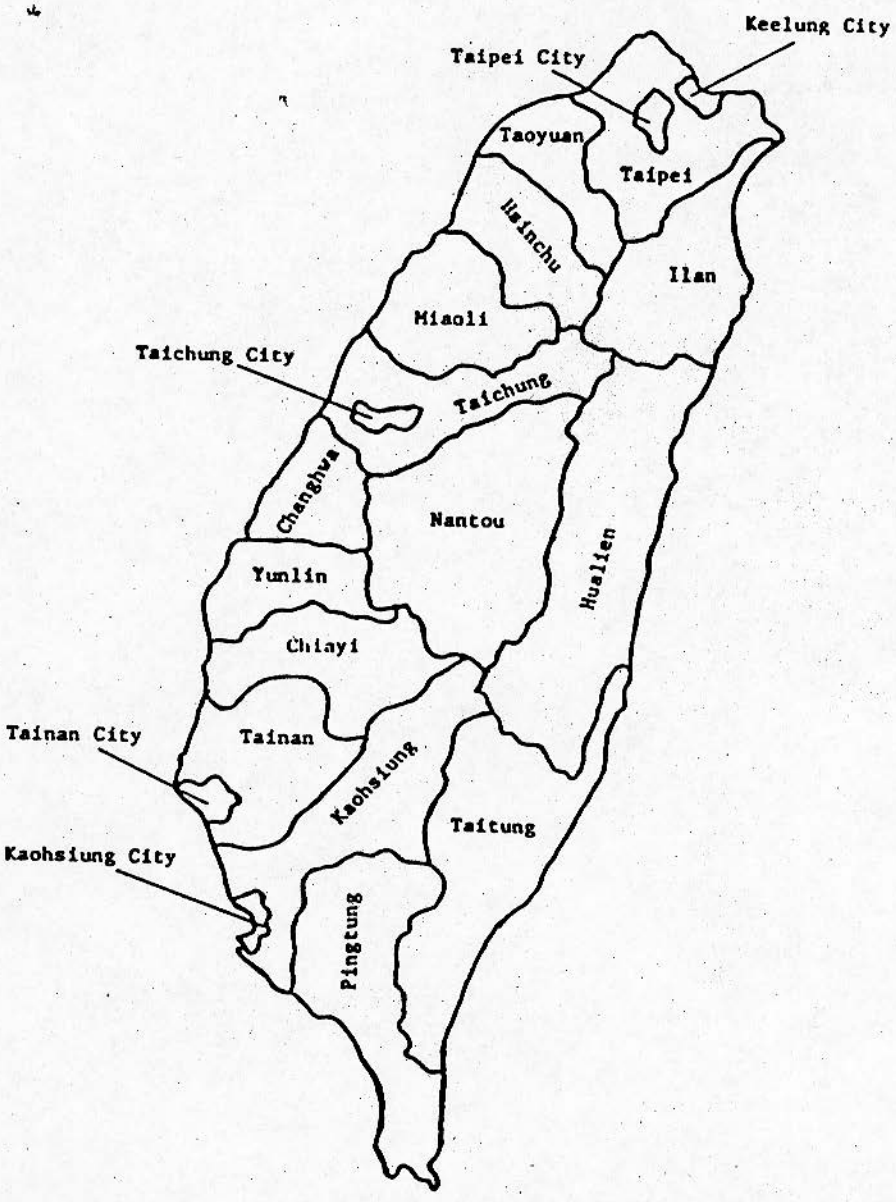
*Date Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1970.

Figure 3. Coale-Trussell's m Values by City and County of Taiwan, 1980*



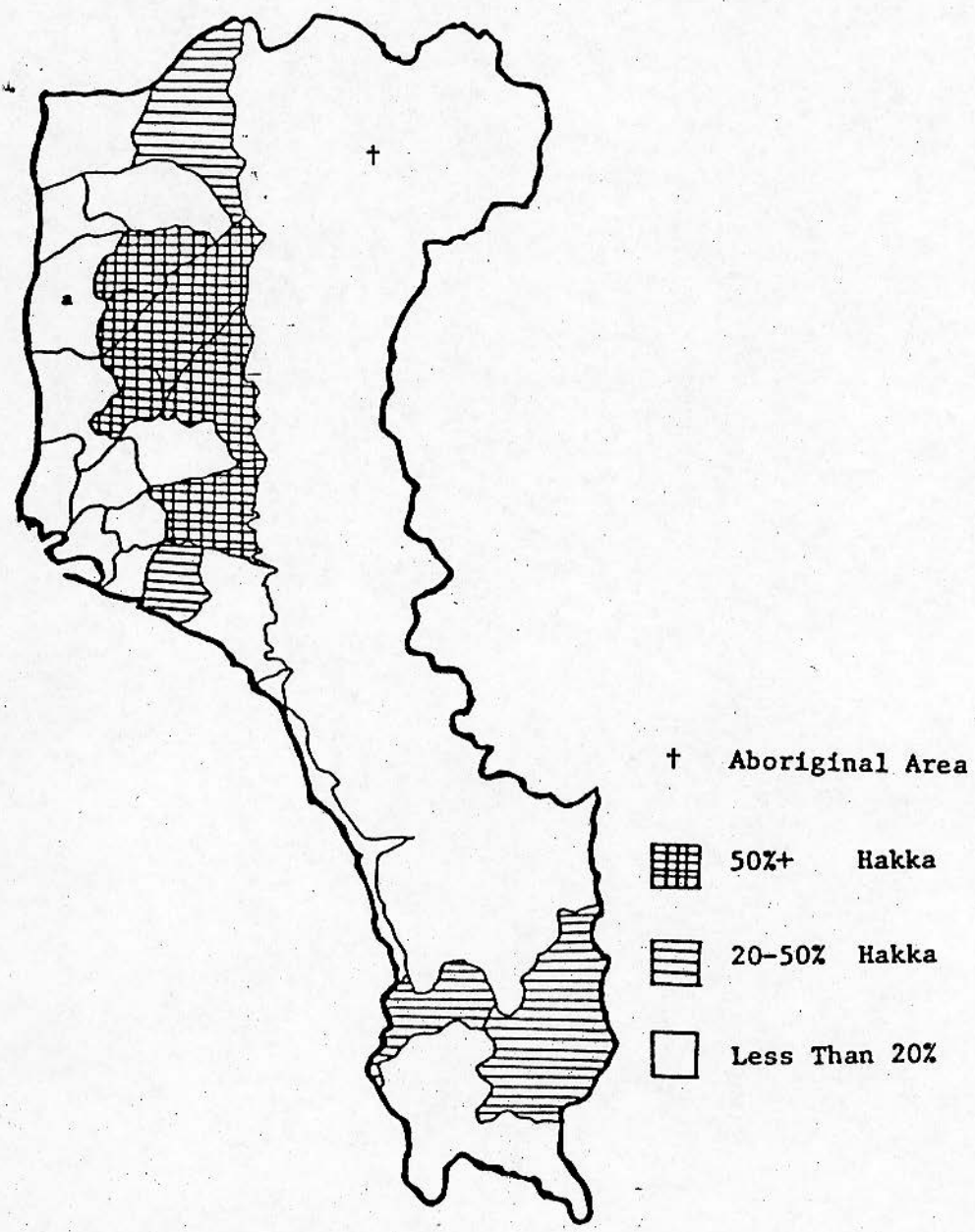
*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1980.

Figure 4. Names of Cities and Counties of Taiwan Area*



*Data Source: Taiwan-Fukien Demographic Fact Book, 1980.

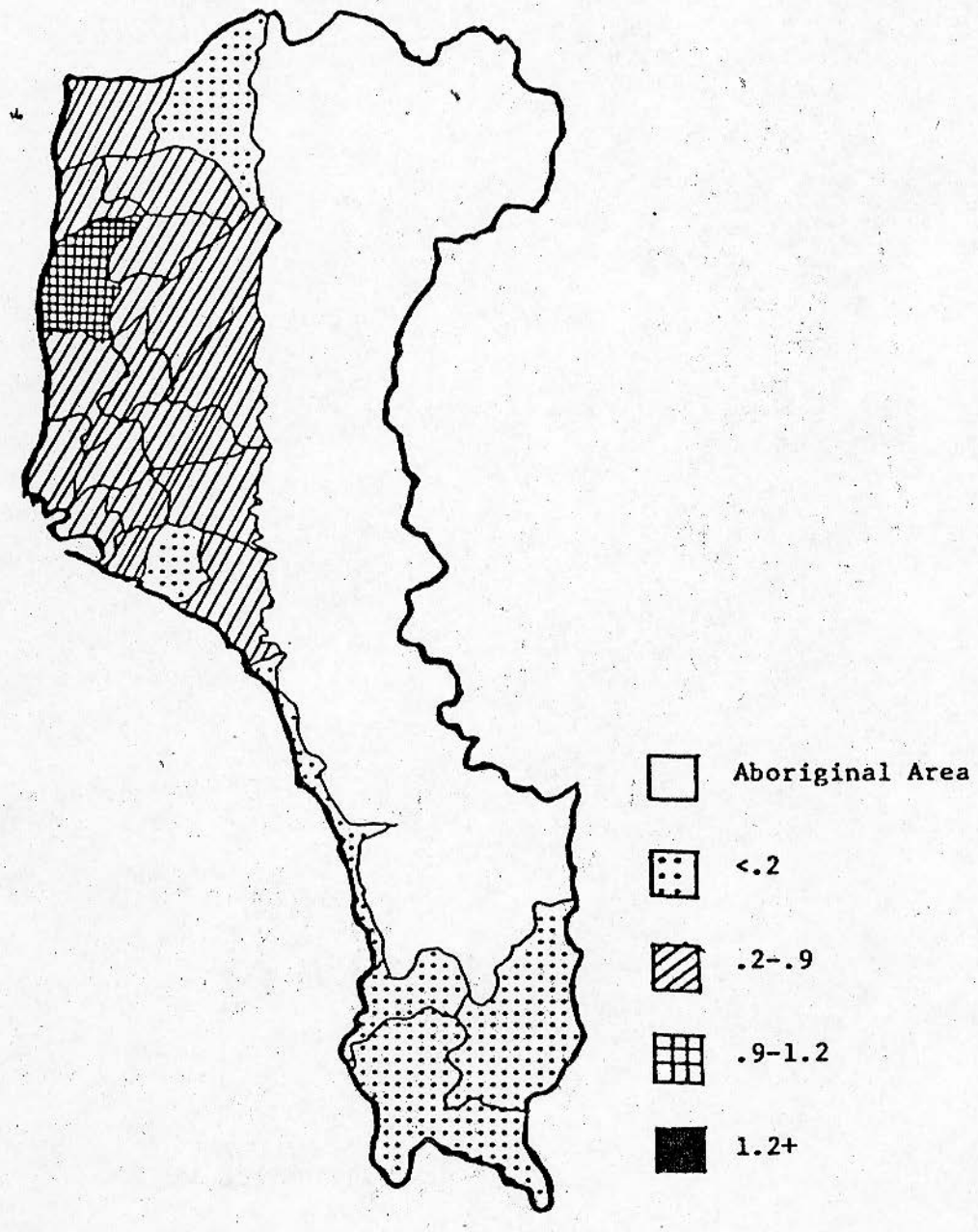
Figure 5. Distribution of Hakka Population in Pingtung County, 1966*



*Data Source: Taiwan Area Census, 1966.

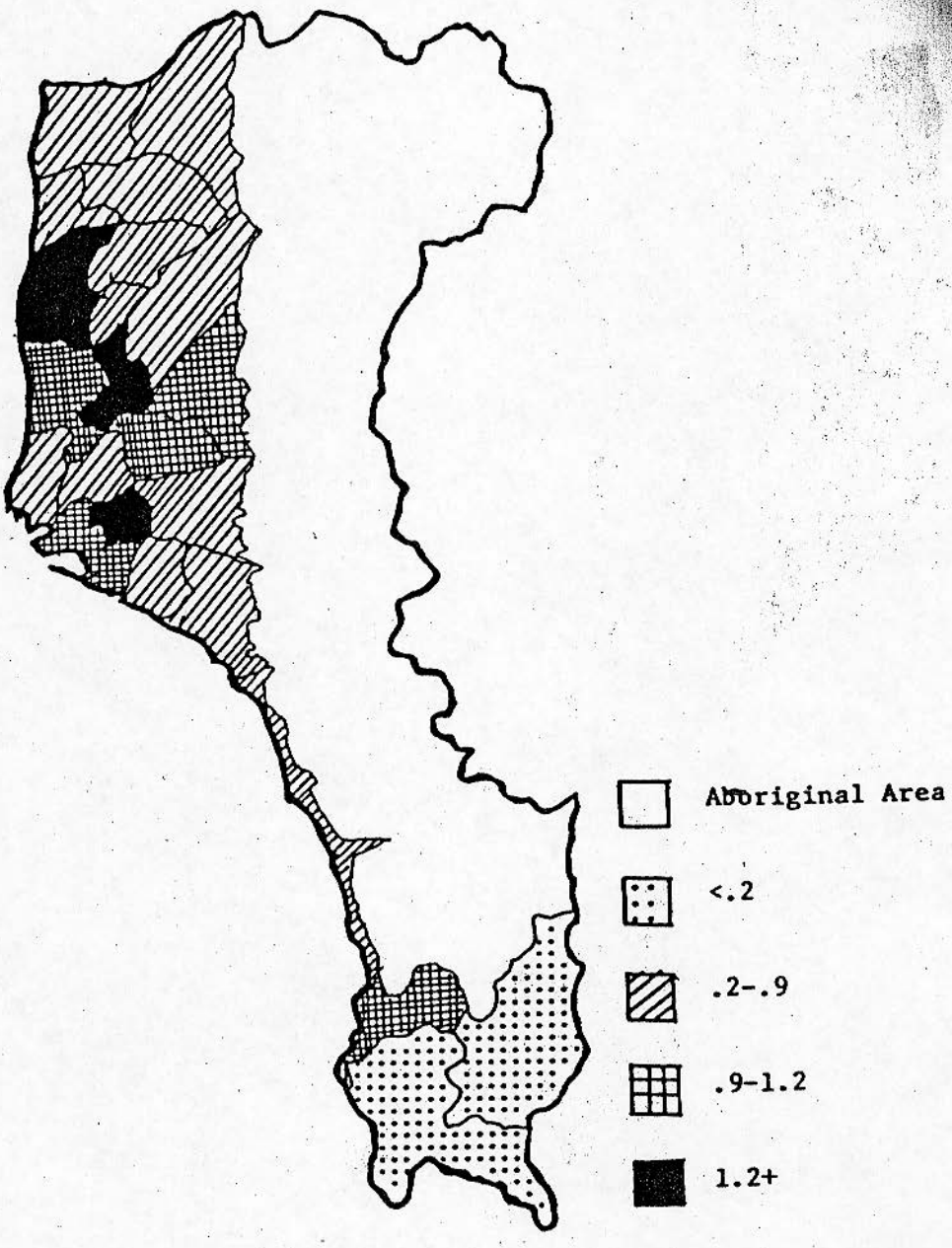
a. Pingtung City, the only urban center of the country.

Figure 6. Coale-Trussell's m Values by Township of Pingtung County, Taiwan, 1961*



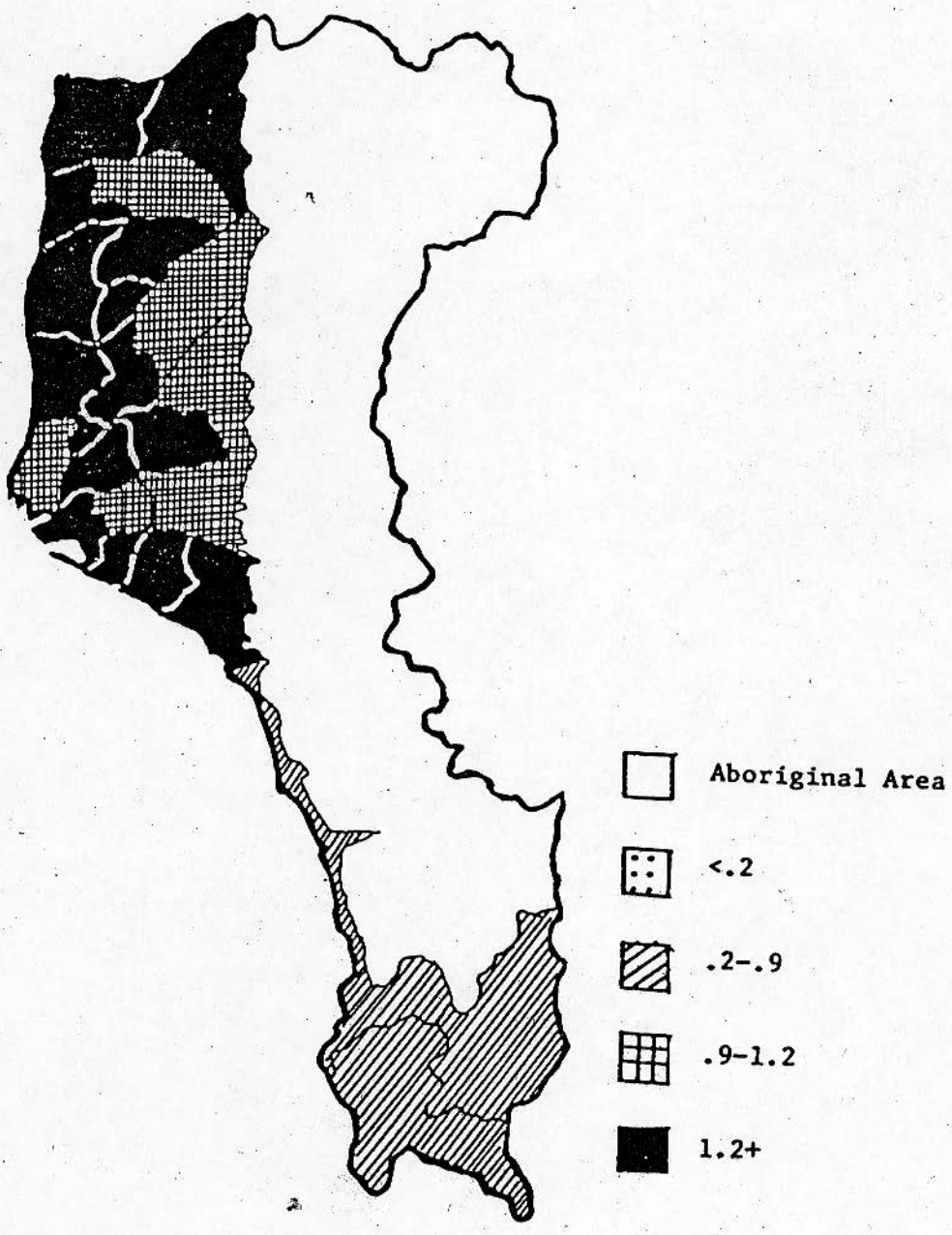
*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1961.

Figure 7. Coale-Trussell's m Values by Township of Pingtung County, Taiwan, 1964*



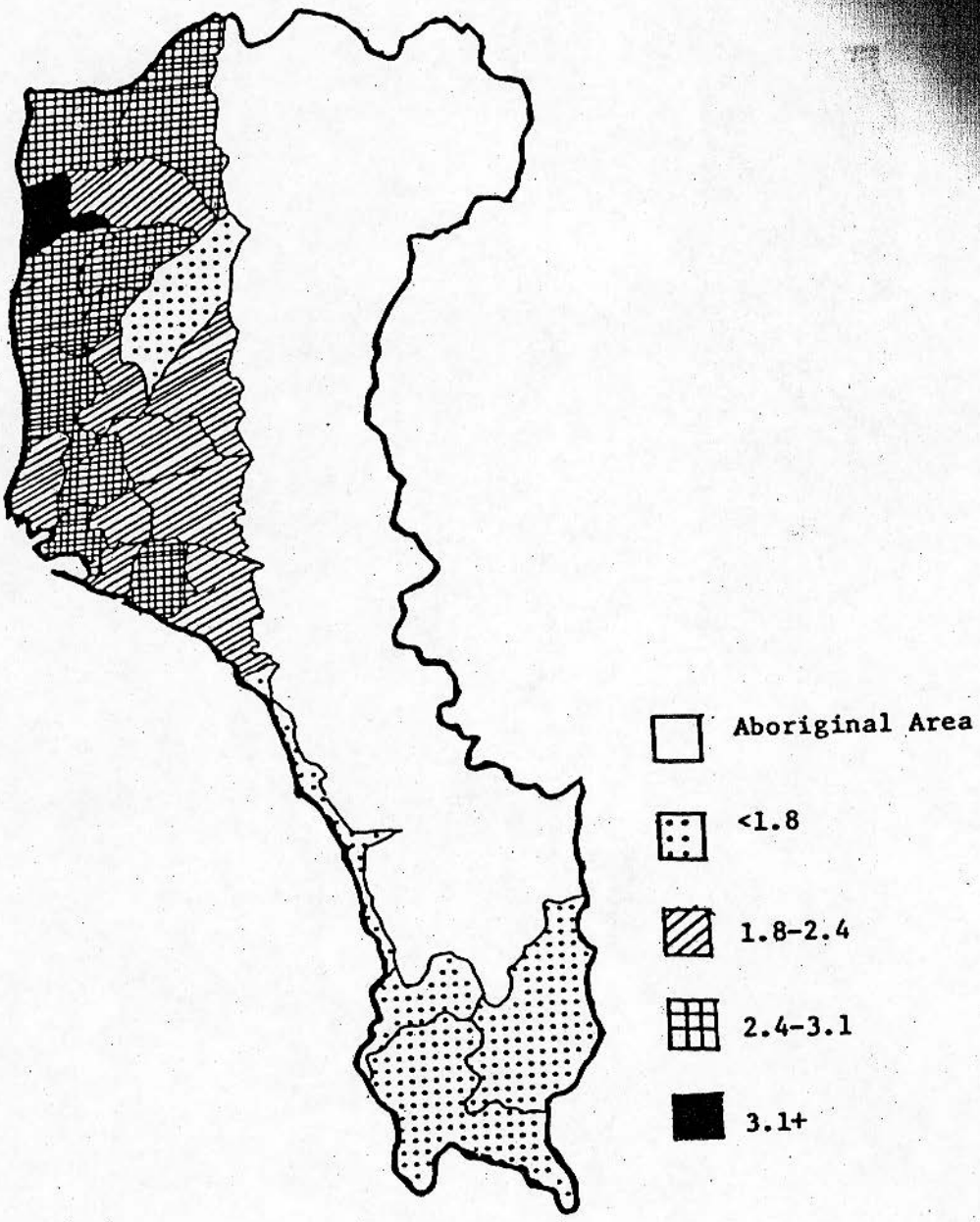
*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1964.

Figure 8. Coale-Trussell's m Values by Township of Pingtung County, Taiwan, 1967*



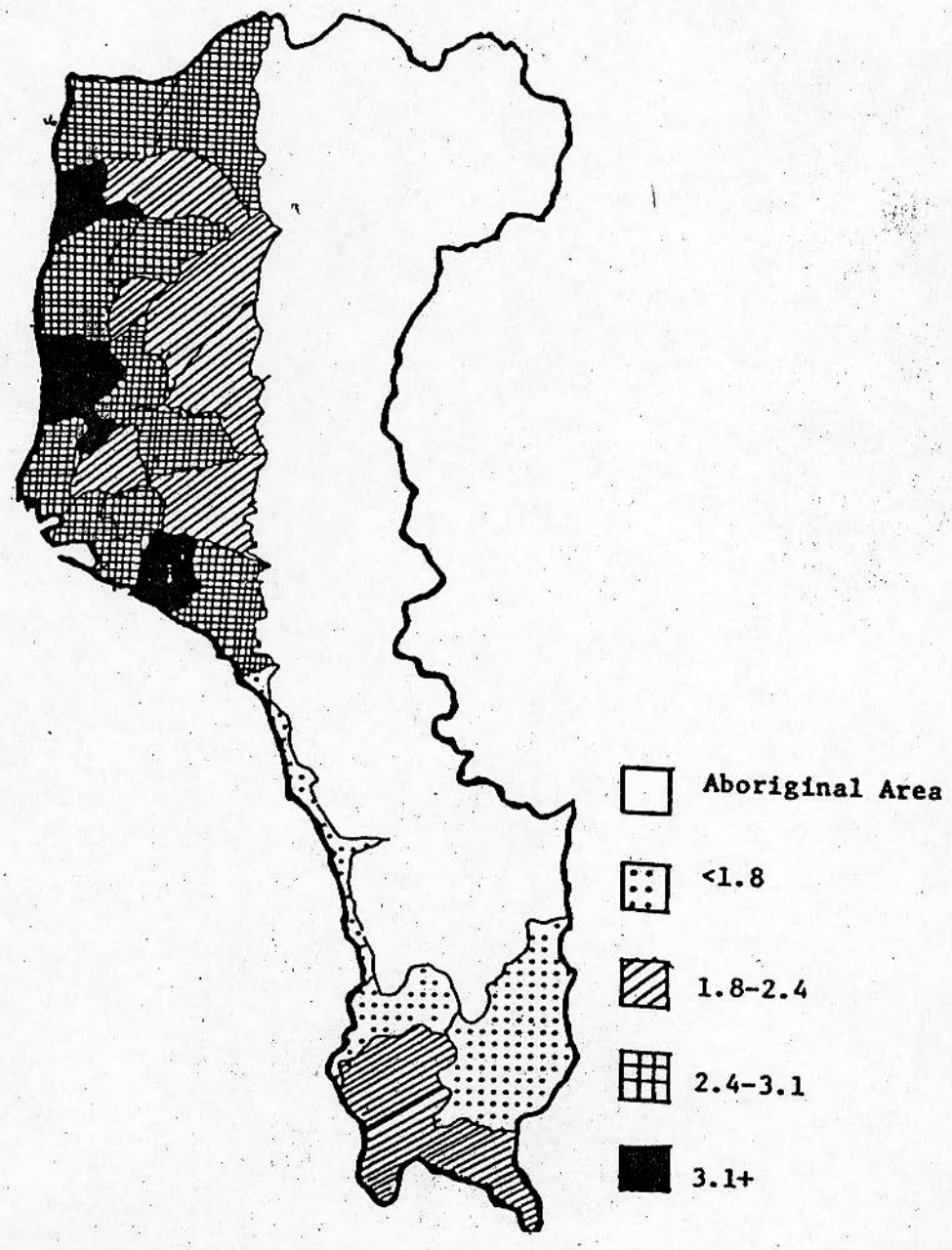
*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1967.

Figure 9. Coale-Trussell's m Values by Township of Pingtung County, Taiwan, 1973*



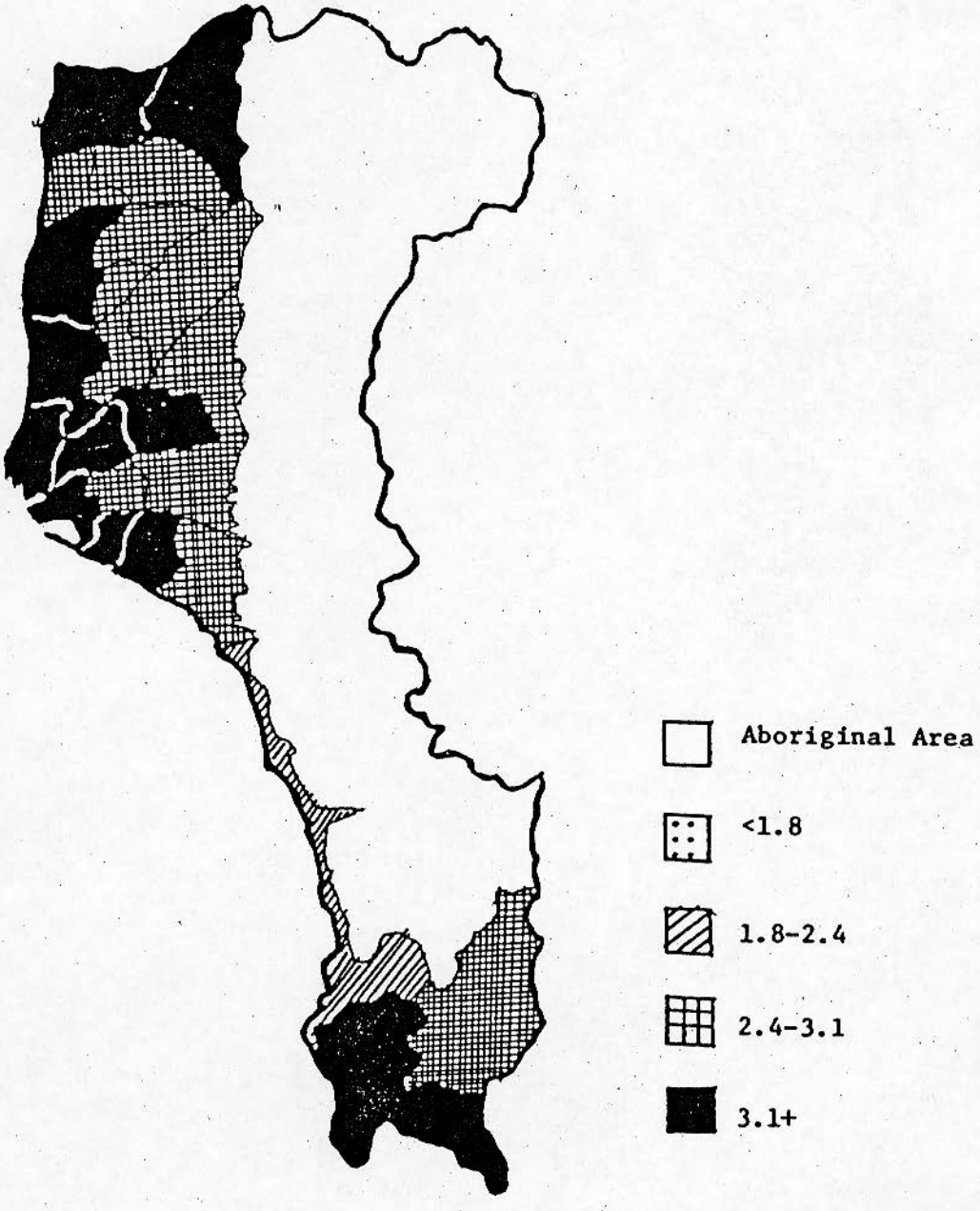
*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1973.

Figure 10. Coale-Trussell's m Values by Township of Pingtung County, Taiwan, 1976*



*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1976.

Figure 11. Coale-Trussell's Values by Township of Pingtung County, Taiwan, 1980*



*Data Source: All the m values are calculated from Taiwan-Fukien Demographic Fact Book, 1980.