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Ecological Adaptation and Population Change: Semang Foragers and Temuan Horticulturists in West Malaysia

by Alberto G. Gomes

East-West Center
Honolulu, Hawaii

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CONTENTS

FOREWORD v

ACKNOWLEDGMENTS vii

ABSTRACT 1

INTRODUCTION 1

THE SEMANG FORAGERS 2
- Ethnology 2
- The Semang Population 5
- Semang Subsistence and Economic Activities 6

THE TEMUAN HORTICULTURISTS 10
- Ethnology 10
- The Temuan Population 12
- Temuan Subsistence and Economic Activities 14

FERTILITY AND ECOLOGICAL ADAPTATION: A COMPARISON OF SEMANG FORAGERS AND TEMUAN HORTICULTURISTS 16
- Hypothesis 1 21
- Hypothesis 2 22
- Hypothesis 3 23
- Postpartum Abstinence 26
- Sexual Abstinence 27
- Frequency of Coitus 27
- Contraception 28
- Conclusions: Ecological Adaptation and Fertility 29

MORTALITY AND ECOLOGICAL ADAPTATION 30
- Cause of Death 33

MIGRATION AND ECOLOGICAL ADAPTATION 38

CONCLUSION 38

REFERENCES 43

Tables

Table 1. Age and Sex Distribution of Rual Semang Population (1978) 6

Table 2. Age and Sex Distribution of Paya Lebar Temuan Population (1978) 13

Table 3. Fertility Rates and Ratios for Rual Semang and Paya Lebar Temuan Populations 18
Table 4. Number of Children Born to Living Ever-Married Semang Women 18
Table 5. Number of Children Born to Living Ever-Married Temuan Women 18
Table 6. Number of Liveborn Offspring of Semang Women Who Have Since Reached Menopause (Based on 1976 Data) 19
Table 7. Number of Liveborn Offspring of Semang Women Who Have Since Reached Menopause (Based on 1978 Data) 19
Table 8. Number of Liveborn Offspring of Paya Lebar Temuan Women Who Have Since Reached Menopause (Based on 1977 Data) 19
Table 9. Economic Contribution of Paya Lebar Temuan Children (March 1978) 24
Table 10. Average Energy Expended Per Day on Food Connected Activities As a Percentage of Total Calories Expended 25
Table 11. Average Percentage of Child's Total Amount of Time Per Day Spent on Food Connected Activities and Babysitting 25
Table 12. Surviving Offspring of Postmenopausal Rual Semang Women . . 31
Table 13. Surviving Offspring of Postmenopausal Paya Lebar Temuan Women 31
Table 14. Comparison of Surviving Children with Total Liveborn Children Per Postmenopausal Woman 31
Table 15. Age at Death and Cause of Death, Rual Semang (1910-1978) . . . 33
Table 16. Age at Death and Cause of Death, Paya Lebar Temuan (1927-1977) 33
Table 17. Deaths among Rual Semang (December 1974-April 1978) 34

Figures

Figure 1. Location of Sungai Rual Post (Semang resettlement) 3
Figure 2. Rual Semang population (1978) 7
Figure 3. Location of Kampung Paya Lebar (Temuan settlement) 11
Figure 4. Paya Lebar Temuan population (1978) 14
Figure 5. Factors affecting fertility 20
Figure 6. Causes of death 35
Figure 7. Growth in Rual Semang and Paya Lebar Temuan populations 40
Figure 8. Cumulative percentage increase in Rual Semang and Paya Lebar Temuan populations 41

FOREWORD

Human ecology is the study of human interactions with the environment. The objective is to understand both how human societies adapt to particular ecosystems and how people's activities cause the environment to change, often in ways having unfavorable consequences for succeeding human generations.

The Project on Human Interactions with Tropical Ecosystems at the East-West Environment and Policy Institute has, as one of its major concerns, the development of new conceptual approaches to human ecology. Particular emphasis is placed on trying to understand interrelations between Southeast Asian societies and the tropical agroecosystems on which they depend for their survival. The present report by Alberto Gomes is an important contribution to this effort, illuminating as it does the complex relationship between a social system's mode of adaptation to the environment and its rate of population growth.

Gomes' analysis, based on intensive fieldwork under difficult conditions with Malaysian aboriginal populations, brings empirical data to bear on one of the most fundamental issues debated by social scientists concerned with the study of human population dynamics: the nature of the relationship between food supply and population growth. As Gomes points out, the debate is usually presented in terms of the opposing theoretical positions of Thomas Malthus and Ester Boserup. The former, in effect, argued that increases in food production inevitably result in increased population size, and the latter argues the reverse case, that an increase in population provides the driving force for increased food production. The debate has, as is often the case with such fundamental questions in the social sciences, been pursued with much passion but few facts. This study by Gomes thus is of exceptional value in that it provides detailed empirical data collected specifically with the competing hypotheses in mind. Although they do not fully resolve the issues, Gomes' data lend support to the view that fertility is influenced markedly by changes in the character of human adaptation to the environment, a view certainly consonant with the Malthusian hypothesis.

It is with much pleasure that Alberto Gomes' monograph is published as the first of a series of research reports on human ecology in Southeast Asia written by participants in the East-West Environment and Policy Institute's Project on Human Interactions with Tropical Ecosystems.

A. Terry Rambo
Project Coordinator

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This paper is a revision of a master's thesis submitted to the Department of Anthropology and Sociology, University of Malaya. It was prepared while the author was a Research Intern in the Project on Human Interactions with Tropical Ecosystems (HITE) at the East-West Environment and Policy Institute, Honolulu, Hawaii. Support for the fieldwork was provided by an IDRC funded SEAPRAP grant and a Vote F staff research grant from the University of Malaya. The cooperation of the Malaysian Government's Department of Orang Asli Affairs (JOA) in carrying out this research is most appreciated as is the continuing advice and assistance, both in the field and while preparing this report, received from Dr. Peter N. Pirie, East-West Population Institute, and Dr. A. Terry Rambo, East-West Environment and Policy Institute.

Ecological Adaptation and Population Change: Semang Foragers and Temuan Horticulturists in West Malaysia

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ABSTRACT

This report is a comparative analysis of ecological adaptation and population characteristics among two Orang Asli (aborigine) groups in Peninsular Malaysia. These are the Semang (Negritos), a group employing a foraging adaptive strategy, and the Temuan (Proto-Malays), a group employing mixed horticulture as an adaptive strategy.

The hypotheses that have emerged from the debate between supporters of the opposing theoretical stances of Thomas Malthus and Ester Boserup are empirically tested.

INTRODUCTION

Is increasing population the cause or consequence of agricultural intensification? For the past decade a major debate has gone on between the followers of Thomas Malthus, who believed that growth in agricultural productivity inevitably resulted in increase in population size, and Ester Boserup, who argues the counter position that it is increasing population that causes agricultural intensification.

In more comprehensive theoretical terms relating to cultural evolution in general, this debate can be translated into the question of the relationship between ecological adaptation and population. This question has attracted considerable attention from anthropologists, particularly those concerned with studying hunting and gathering societies.

Birdsell (1968), for example, has discussed population controls among Australian hunters and gatherers. These controls operate to produce a relatively narrow range of family, band, and tribal size. His data indicate that there are coherent relationships between rainfall, food resources, local group size, and the size and density of tribes. Lee (1972) has observed the Kung Bushman

shift from nomadic hunting and gathering to sedentary cereal farming, which has had profound positive effects on the rate of procreation and, concomitantly, total population size.

Growing out of this theoretical orientation, the present study is a comparative analysis of ecological adaptation and population characteristics among two Orang Asli (aborigine) groups in West Malaysia. These are the Semang (Negritos), a group employing a foraging adaptive strategy, and the Temuan (Proto-Malays), a group employing mixed horticulture as an adaptive strategy (Rambo 1979). Comparison of these two groups makes it possible to investigate how and why the demographic structure and dynamics differ between a foraging society and a farming society, as well as how and why a population grows when it shifts from foraging to farming.

Information for this study was secured through field surveys. The main survey of the horticultural village, which covered social, cultural, environmental, and demographic characteristics, was conducted in April and May 1977. Two weeks of fieldwork in April 1978 and April 1979 were carried out with the foraging group to supplement and update information that had been collected in April 1976 (Gomes 1976), making it possible to compare forager demographic patterns and trends between the years 1976 and 1979.

Field data were collected with census forms, schedules, and interview guides. These data were supplemented by information collected through participant observation and nondirected in-depth interviewing.

THE SEMANG FORAGERS

Ethnology

The Semang described in this study were observed at Sungai Rual Post, a resettlement village in Tanah Merah district in Kelantan, located about 9 km west of Jeli, a small Malay town on the banks of the Jeli River in northern Kelantan (Figure 1). The Semang, a Negrito people who once existed primarily as nomadic foragers, were regrouped into a permanent settlement there by the Department of Aboriginal Affairs in 1972. Six Semang bands that had formerly occupied their own separate *saka* (territorial-subsistence zones) were regrouped at Sungai Rual, where health and educational facilities were introduced and agricultural projects were implemented for the Semang.

The Semang are Austroasiatic (Mon-Khmer) speakers who have been described by anthropologists as "Negritos"—short, dark-skinned, wooly-haired people with broad noses and thick lips. Their average height is about 150 cm for men and about 140 cm for women (Brandt 1961:134). The Rual Semang, however, display great individual variation in height, skin color, hair form, and facial features.

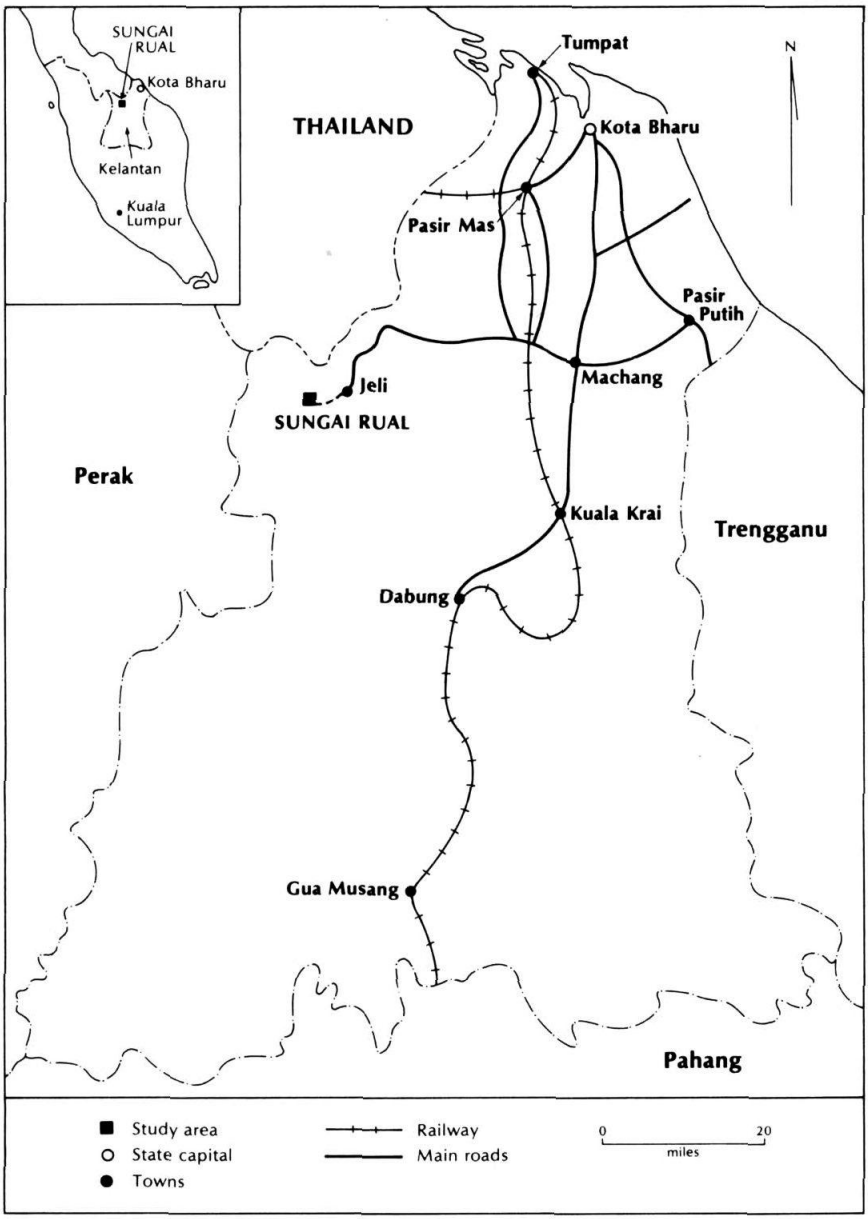

Figure 1. Location of Sungai Rual Post (Semang resettlement).

Semang populations traditionally live in small bands of 15 to 50 people. Schebesta (1928:279) states that "the Semang cannot live together except in small groups; it is impossible for the forest to feed large masses of human beings. We therefore find them living in family groups without strict tribal organization." The basic social structural unit is the nuclear family with a husband, a wife, and their children. A family normally occupies an individual shelter although a grown child may build his own house and place it quite close to his parents' house. Traditionally, the Sungai Rual families resided in leantos or windscreens that were easily constructed, temporary residences adaptable to a foraging lifestyle.

As in almost all societies, the Semang nuclear family is responsible for producing and socializing children, inculcating them with the basic cultural values of the group. The nuclear family is also the basic economic unit of Semang society. The products of hunting and gathering activities are shared among the members of the family; only surplus is shared with the rest of the band.

A number of closely related families form the band, which is, in a sense, the most "typical" social unit among the Semang. Each Semang band has its own territory or saka, an area roughly defined according to the location of the durian and ipoh trees that belong to its adult male members (Schebesta 1928: 279). Normally, each band has an acknowledged headman, commonly referred to as *penghulu,* who is usually chosen for his popularity, competence, and leadership qualities. A good penghulu must be fair because his primary duty is to mediate any quarrels or misunderstandings that arise among band members. In Sungai Rual, the penghulus are given official recognition and are paid salaries by the Department of Aboriginal Affairs (JOA). If the penghulu is considered incompetent by the JOA, it will pressure the band to replace him. Ideally, the penghulu is succeeded by his eldest son, although there are frequent exceptions. A new penghulu is selected by adult male members of the band who meet informally to elect a new leader. Women of the group normally are not consulted directly, although they do express their opinions.

The members of a band cooperate in economic and social activities, and its solidarity is strengthened by kinship and affinal ties. Virilocal postmarital residence appears to be the norm among the Rual Semang, although there are some cases of matrilocality. Virilocal postmarital residence ensures that all males of the band remain together. Growing up together and knowing their territory intimately, the men are better able to engage in cooperative hunting and thus to increase their chances of finding game (Rambo 1979). Descent among the Rual Semang is traced bilaterally.

Semang religious beliefs also appear to play a significant role in their ecological adaptation. According to Schebesta (1928), all Semang throughout Peninsular Malaysia fear three phenomena of nature: thunder, floods, and storms. Their principal deity, *Karei* (thunder god), is disliked because he is believed to

be cruel and wicked, and he is said to perform an important moral function by imposing punishments when tribal taboos have been broken. Many of these tribal taboos are related to the Semang population control strategies. For example, the Semang believe that Karei will punish them by causing death, injury, or illness through lightning and wild animals if they do not observe the postpartum intercourse taboo or if they indulge in sexual behavior during the day. They also believe that Karei will make one ill for showing disrespect to one's elders, torturing or mistreating a captured animal (especially Karei's pets such as snakes, leeches, and snails), or not immediately killing without pain any game that has been injured by one's blowpipe.

Karei, however, is not the only Semang deity. There are, as Dentan (1964: 185) writes, "numerous deities known as *orang hidop*." They are looked upon with awe and respect, but their functions are unclear. Schebesta (1928:184) notes that the Semang acknowledge another deity, *Ta'Pedn*, their creator god and that "serving *Ta'Pedn* are the *cenoi*, tiny elflike beings whose proper abode is heaven but who also inhabit flowers and other natural objects on earth." The *cenoi* are "well disposed towards man, and aid in the ripening of durians and other fruits on which the Semang depend for food" (Dentan 1964:185). The Rual Semang, with the exception of one band, however, say that they no longer believe in cenoi.

The Semang shamans, known as *halak*, have the dual function of officiating at rituals and performing magical rites as well as serving as medicine men who provide herbal and magical anecdotes for sickness. Dentan (1964:185) notes that there are three ways by which a man can become a halak: by dreaming, by finding a magic *cebu* stone, or by inheriting the powers from one's father. There was no halak in Sungai Rual at the time of this study as the Rual Semang did not have a replacement for their recently deceased halak.

The most important ritual practice among the Semang appears to be the blood-sacrifice ceremony performed during particularly violent thunderstorms, which are believed to occur when Karei is angered. The blood-sacrifice is initiated by the women to appease Karei. This rite involved drawing blood from the outer side of the right leg near the shin bone and casting it into the air as an offering to Karei (Evans 1937:171).

The Semang Population

A census taken by the author in 1978 numerated 195 Rual Semang (Table 1). The sex ratio was 95.9, which indicates a 1.6 percent excess of females in the total population. The Rual Semang can be characterized as relatively young. The mean age is 19.5 years, and some 50.8 percent of the population is under 14 years of age. The "youngness" of the population is further supported by calculations that show only 13 percent of the Rual Semang are over 40 years of age.

Table 1. Age and Sex Distribution of Rual Semang Population (1978)

Age Category	Male	Female	Total	
				%
60 over	2	2	4	2.1
55-59	3	2	5	2.6
50-54		5	5	2.6
45-49	1	1	2	1.0
40-44	7	2	9	4.7
35-39	4	2	6	3.2
30-34	6	8	14	7.2
25-29	9	4	13	6.7
20-24	6	13	19	9.8
15-19	7	11	18	9.3
10-14	13	11	24	12.4
5-9	19	18	37	19.2
0-4	18	19	37	19.2
TOTAL	95	98	193	100.0

The broad-based shape of the Rual Semang population pyramid (Figure 2) indicates a positive growth trend of the population. Because the proportion of young ages is very large, the population is doubtless in a phase of rapid growth. The pyramid indicates also that there are more females than males in the 15 to 24 age category. The relatively fewer females than males in the 35 to 49 age category may reflect the higher rate of maternal deaths during childbirth and their high susceptibility to fatal disease during menstruation.

Out of a total of 41 married Semang couples in Sungai Rual, 27 (66 percent) had taken their spouses from other Semang bands, while 14 (34 percent) had married within their band, that is, about two out of three marriages are band exogamous in nature. Nineteen (70 percent) out of the 27 band exogamous marriages were patrilocal in nature in that the female spouses joined their husbands' band, while 8 (29.6 percent) were matrilocal where the males left their band to join their wives' band. This suggests that, although there are statistically more exogamous and patrilocal marriages, these are not fixed rules among the Rual Semang.

Semang Subsistence and Economic Activities

Contrary to most accounts that describe the Semangs as deep-forest dwellers, in reality, they occupy a zone that ecologists refer to as an *ecotone,* the transitional zone between two or more distinct biotic communities (forest and agricultural areas) where resources tend to be particularly diverse and abundant (Rambo 1979). "Deep forest" (virgin jungle) has been described as a vir-

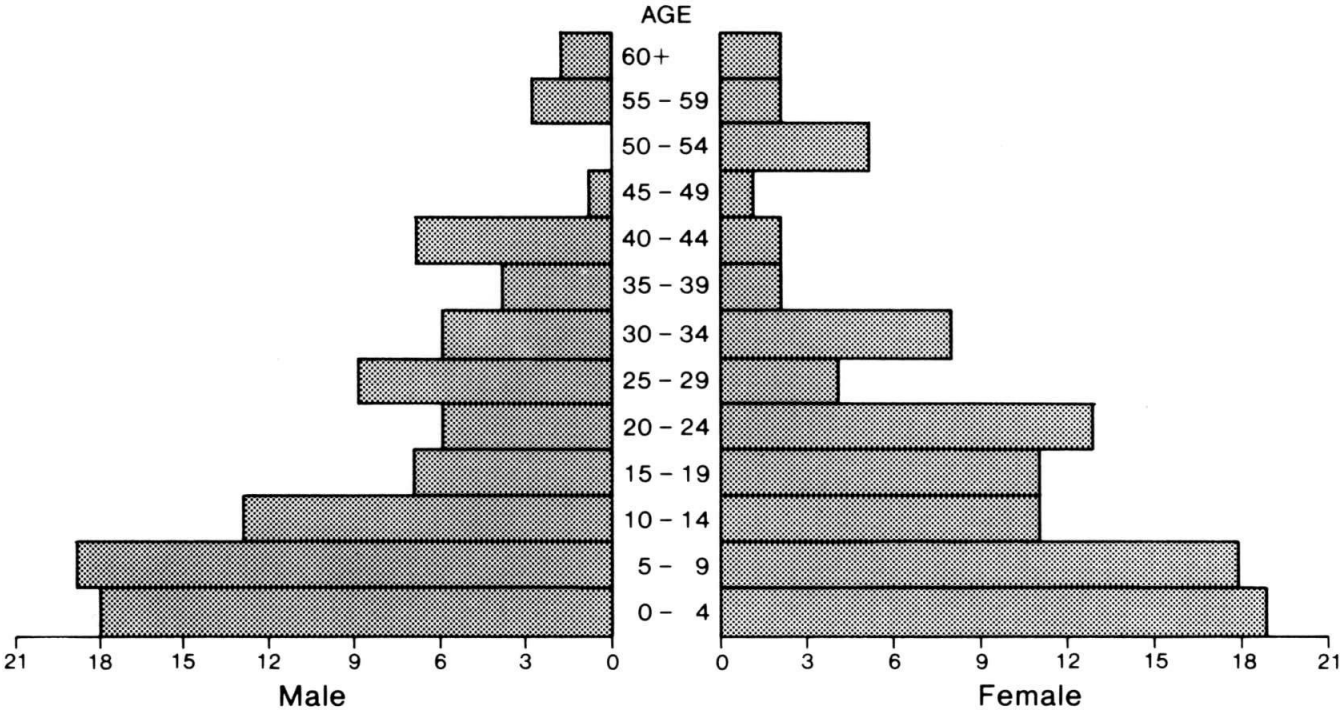

Figure 2. Rual Semang population (1978).

tual "desert" because the dense canopy tends to limit vegetation on the floor of the forest by allowing almost no sunlight to pass (Rambo 1979). This reduces the foraging possibilities for wild animals and man. The rich and luxuriant vegetative matter in the canopy of the deep forest, however, maintains an abundance of arboreal animals, such as squirrels, monkeys, tree shrews, and bats.

Foraging in the *belukar* or secondary forests, which represents an ecotone joining the forest and the cultivated lowlands, is preferred by the Semang as this gives them ready access both to wild goods of the forest and to opportunities to engage in trade and wage labor offered by the settled Malay farming village (Rambo 1979). The Semang, although often classified as hunter-gatherers, are more appropriately referred to as "opportunistic foragers." For as Benjamin (1973:viii) observes,

> they are neither "hunters" nor "nomads" at base, even though they frequently do engage in these activities. Rather, they turn their attention to whatever is available for the moment, as soon as one source of provender is exhausted they turn to something else. At various times any one group of Negritos [Semang] may jointly or individually trade, barter, undertake casual paid employment, beg, fish, gather, or live off the gifts of visiting anthropologists.

The Semang forage both for their own subsistence and for economic trade items. Various plant resources—wild tubers, vegetables, mushrooms, fruits, and leaves—are gathered mainly by the women for daily consumption and as medicinal herbs. Five different types of weapons—blowpipes, shotguns, spears, catapults, and bush knives—as well as animal traps and snares are employed in the Semang's hunting and trapping activities. The blowpipe is only effective for small game, such as squirrels, monkeys, bats, and birds. Shotguns and spears are used for the hunting of big game, such as wild pigs, goats, deer, and tapir, while catapults, made out of wood and elastic rubber, generally are used by young boys to shoot birds, bats, and tree shrews. Fish are caught from the rivers using bamboo fish traps, spear guns, hook and line, and poison. These various subsistence activities are performed throughout the year. Apart from this, the Semang also gather a number of forest materials for their personal use. Bamboo is gathered for use in house construction and in the manufacture of blowpipes, fish traps, cooking utensils, water containers, and ritual artifacts. Some rattan is gathered for various purposes ranging from tying cord to clothesline.

The Semang spend considerable time and effort in the collecting of forest products for trade with their Malay farming neighbors. These products include: wild fruits, *petai (Parkia speciosa), kerdas (Pithecellobium bubalinum), keranji (Dialium indicum), jering (Pithecellobium jiringa),* and durian *(Durio pinangianus)*;

rattan; and herbs, roots, and parts of wild animals for medicinal purposes. With the cash earned from these sales, the Semang purchase rice, cooking oil, tobacco, salt, clothing, bush knives, and other provisions from the shops in the nearby village-town.

Because wild products are seasonal and widely distributed in their saka, the Semang adhere to a nomadic existence during collecting. Petai and durian are collected from August to November, while kerdas is collected during February to May and keranji from October to January. This imposes a year-round geographic mobility cycle on the Semang. Their constant movement may also be adaptive from another standpoint. The Semang are said to have been captured for slavery in the past by Malays and Thais (Skeat and Bladgen 1906; Schebesta 1928; Brandt 1961). Being perpetually on the move may have made it more difficult for the slave traders to capture the Semang.

Ever since they were regrouped in Sungai Rual in 1972 and were introduced to agriculture, an occupation not totally new to them, the foraging adaptation of the Semang has changed. In the past, the Semang sometimes imitated their neighbors by burning off small plots of forest and cultivating crops such as tapioca, maize, and so on. At present, the Rual Semang are engaged in the various agricultural projects directed by a JOA field officer. According to the 1978 JOA records, about 31 hectares (ha; 77 acres) of forest have been cleared and planted with rubber trees (28 ha; 70 acres) and fruit trees (3 ha; 7 acres), such as durian and rambutan trees, coconut palms, and banana plants. The JOA provides inducements in the form of rations of rice and dried fish to the Rual Semang to participate in the agricultural schemes. The JOA intends to encourage the Rual Semang to practice a settled agricultural lifestyle rather than their traditional nomadic foraging way of life (personal communication with JOA officers).

These agricultural schemes have not been very successful in completely changing the Semang traditional way of life, however. The main reason for this is the Rual Semangs' habit of day-to-day living without much future orientation. Ideally, whatever activities the Semang carry out in a day relieve hunger for that day only; very seldom do they save surpluses or think of future needs. In contrast, the agricultural crops introduced in Sungai Rual resettlement, especially rubber trees, need long periods (at least 7 years) before any returns are realized. This "long wait" is contrary to their day-to-day living orientation and results in loss of interest in the agricultural schemes. Probably realizing this, the JOA gives out food rations to keep the Semang from abandoning the project. If there is a delay in the arrival of the food rations or if their food demands are not fulfilled, however, the Semang stop their agricultural work and some even return to the forests for their basic requirements. This results in irregularity in the agricultural work schedules, which is detrimental to the cultivation of the crops.

THE TEMUAN HORTICULTURISTS

Ethnology

The Temuan settlement of Kampung Paya Lebar is located in the Ulu Langat District of the state of Selangor, West Malaysia. The village is about 40 km from the capital city of Kuala Lumpur (Figure 3). *Paya Lebar* means "large swamp" in the Temuan language and Kampung Paya Lebar is appropriately located in a wide and marshy valley. This valley, which is approximately 100 m above sea level, is surrounded on three sides by steep mountain ridges rising about 1,100 m above sea level. Sungai Lui is the most important river to the inhabitants of Kampung Paya Lebar, as it flows right by the village.

The Temuans are Austronesian (Malayo-Polynesian) speakers belonging to the Proto-Malay group of Orang Asli. They often are described in ethnographic literature as having straight hair and light brown skin color but, like the Semang, the Temuan show great individual variation. Their average height is about 153 cm for the men and 142 cm for the women.

As in the case of Semang social organization, the basic social unit in Temuan society is the nuclear family. A number of closely related families form a village which has a recognized name and a recognized headman. It is common to find most of the families in one village bound together by kinship and affinal ties. In Kampung Paya Lebar a number of families related through kinship have their respective houses built close to one another.

As in Semang society, the Temuan nuclear family is responsible for both procreation and socialization of children, inculcating them with the basic cultural values of the group. The nuclear family is also the basic economic unit in the Temuan society. Each family owns its own rubber plantation, rice field, and fruit orchard. Because they are closely related, however, Temuan families do share the produce from their horticultural activities with other families in the village and sometimes with families from other Temuan villages. This aspect of Temuan life is exemplified by the sharing of any large game killed by any member of the village. As the animal is being chopped into pieces, each Temuan family places a plate or pot, *tempat,* around the chunks of meat laid in strips of banana leaf. The *pemangku* (deputy headman) then distributes the meat equally by putting each family's share into their tempat.

Just as families in a Temuan village are closely related, it is normal to find a number of Temuan villages with close communication through the *menteri,* whose role is quite similar to the role of a foreign minister. Marriage (which is mostly village exogamous) helps bind these closely related Temuan villages together.

Temuan social organization is more complex and less egalitarian than that

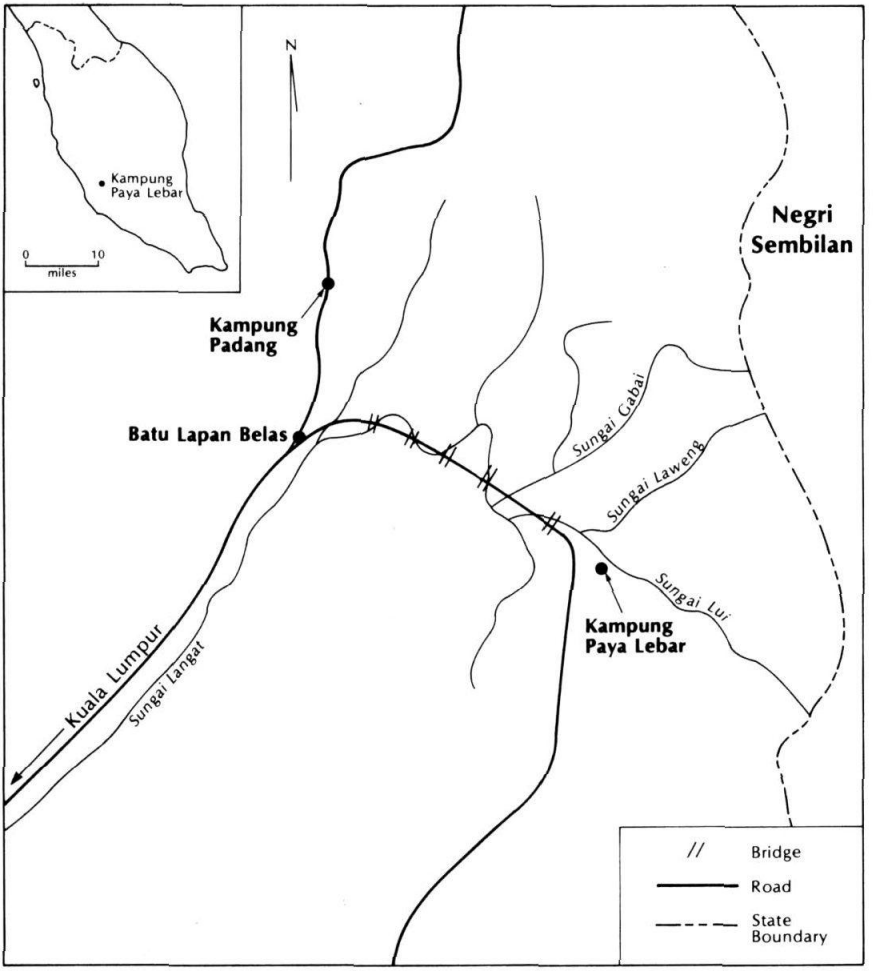

Figure 3. Location of Kampung Paya Lebar (Temuan settlement).

of the Semang. The Paya Lebar Temuan have seven leadership ranks: *batin, pemangku, jekara, jenang, penghulu balai, menteri,* and *panglima.* The batin holds the most authority. He is the supreme adviser, the last court of appeal, and is quite respected for his magical powers. Most of the Paya Lebar Temuan seek advice from the batin and go to him for magical cures of minor illness. The batin holds a prestigeous position, and, as a token of respect the villagers are required to give him a small share of their rice harvest and any large game killed. The main criterion for choosing a batin is that he must be a person with

a strong personality, with wide knowledge and experience, and who is just and fair. When a batin dies, he is almost always succeeded in office by his eldest son; if the son does not have the qualities of a leader, some more suitable villager may be chosen.

The pemangku helps the batin in the administration. It is the pemangku who distributes the shares from wild game caught by any villager. The jenang and jekara also help in administration of village affairs. They normally lead and supervise cooperative work. The jenang accepts the responsibility of administration in the absence of the batin and pemangku, and the jekara acts as his assistant. In general, the management and supervision of village feasts and ceremonial occasions is seen to by the penghulu balai (head of the hall). There are four panglimas *(Panglima Hitam, Panglima Putih, Panglima Hulu, Panglima Hilir)* who apparently were the village military leaders in the past. They were responsible for leading the warriors in the group, and each panglima was allocated a certain area to defend. With the imposition of the national government's control over their territory, warfare has ceased, and the panglimas' function has become redundant.

The Temuans in Kampung Paya Lebar adhere to a bilateral kinship system. However, some anthropologists (Carey 1976; Jimin Idris 1972; Baharon 1973) describe Temuan communities as having characteristics of matriliny with postmarital residence in most cases being matrilocal. In Paya Lebar only 5 out of 17 marriages are matrilocal. Polygamy is not prohibited, but at Paya Lebar there are no cases of such plural unions.

The Paya Lebar Temuan are basically animists. Skeat and Blagden (1906), Carey (1976), and Baharon (1973) provide conflicting descriptions and views of Temuan religious beliefs and practices. Paya Lebar Temuan believe in the existence of a high god which they refer to as *Tuhan.* They also believe that large stones, rivers, tall trees, and mountains are the abodes of ghosts and spirits, which they refer to as *hantu* and *gin,* each having its own abode and characteristics. Diseases and sickness in Temuan pathology are caused by evil spirits and their activities. In order to cure these diseases, the Temuan normally approach the medicine man or ritual curing specialist, who would perform certain rites to annul the ill effects of the evil spirits and would provide herbal remedies to the patient. This ritual curing specialist is also sometimes referred to as *Pa'Chik Tahu Tangkul* or *Pawang.* The Pawang at Paya Lebar is reputed to be powerful. He treats not only Temuan patients but also members of other races, who pay him for his services.

The Temuan Population

A Census of the Paya Lebar Temuans undertaken in 1978 numerated 86 people (Table 2). The sex ratio was computed as 138.9, which indicates a 16.3

Table 2. Age and Sex Distribution of Paya Lebar Temuan Population (1978)

Age Category	Male	Female	Total	%
60 over				
55-59	2		2	2.3
50-54	1		1	1.16
45-49	2	2	4	4.65
40-44	6	4	10	11.6
35-39		1	1	1.16
30-34		2	2	2.3
25-29	5	1	6	6.98
20-24	6	4	10	11.6
15-19	4	4	8	9.3
10-14	8	5	13	15.1
5-9	7	8	15	17.4
0-4	9	5	14	16.3
TOTAL	50	36	86	100.0

percent excess of males over females in the Temuan village. The mean age is 20.1 years, with 48.8 percent of the people in the village under 14 years and only 19.8 percent above 40 years of age. The Paya Lebar population pyramid is irregular (Figure 4). Irregularities in age structure as revealed in the pyramid may imply either wide variation in level of mortality, marked fluctuation in birth and mortality, or both factors. In the case of the Paya Lebar Temuan, however, it may simply reflect random variation inherent in such a small-sized population. The Paya Lebar pyramid indicates a notable deficiency in individuals in the 30 to 39 year age class for both males and females. This probably reflects low natality and high infant mortality associated with difficult times (malnutrition, disease, etc) experienced by the Temuan during the Japanese occupation and the emergency (1948-1960), since these times marked the height of disruption of Orang Asli life (Polunin 1953, Fix 1977). The deficiency of individuals 50 years of age onward possibly may be attributed to warfare with migrant Malays and to epidemics. One informant stated that during the early 20th century (1900 to 1920) the Temuan were harassed constantly by migrant Malays seeking to drive them off their land.

Out of a total of 17 married Paya Lebar Temuan couples, 9 (53 percent) had taken their spouses from other Temuan villages and 8 (47 percent) couples had married within the same village. Of the total of 9 exogamous marriages, 4 (44 percent) were matrilocal in nature (ie, the male spouses migrated from their home village to settle in their wives' village, Paya Lebar) and 5 (56 percent) were patrilocal where the brides took up residence in the village of her

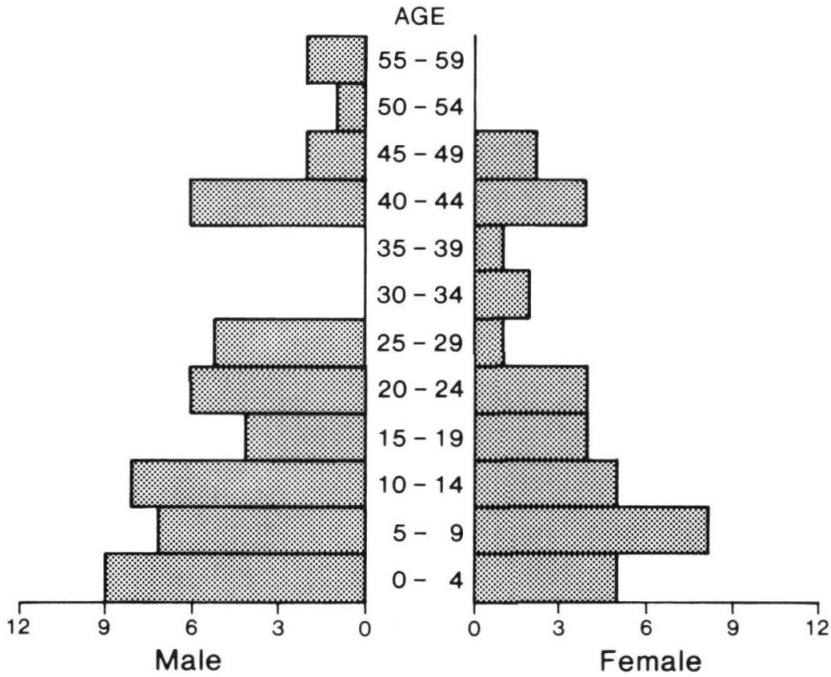

Figure 4. Paya Lebar Temuan Population (1978).

husband. Among the village endogamous marriages (8 marriages), 7 (87.5 percent) were neolocal, and there was only one case of matrilocal residence.

Temuan Subsistence and Economic Activities

The Temuan generally occupy the lowland plains where they cultivate rice, rubber, and other crops. Occupying a niche rather similar to their Malay neighbors has put them into direct competition with their neighbors. This competition has led to the Temuans' often holding a general dislike for the Malays. In the past as well as in the present, this dislike sometimes is expressed in fighting and violence. Despite this situation, the Temuan still engage in trade with the Malays. Some forest products and rubber are sold to the Malays in exchange for household provisions—rice, tobacco, clothes, and luxury items.

Approximately 5.6 ha (14 acres) of land is cultivated with three different varieties of wet rice *(mahsuri, pulut,* and *malinja)* grown largely for individual household consumption. Temuan families grow rice either once a year or once every two years, although some may even grow rice twice in one year. The av-

erage acreage of rice per family is about 0.3 ha (0.7 acres). Most Paya Lebar families do not obtain enough rice from their fields to meet their total annual rice demands so they still must purchase rice from shops in the nearby Malay villages.

Rubber tapping, which is carried out sporadically by the Paya Lebar Temuans, provides much of their cash income. They have an average of 1.2 ha (3 acres) of rubber holding per household and have been growing rubber trees for about 20 years. The processed rubber sheets and latex which are sold to trading centers close by are subject to great price fluctuations.

Apart from these major agricultural activities, the Paya Lebar Temuan tend small mixed fruit and vegetable home gardens, which provide important supplementary food to them. Although the produce from these gardens is mostly for their own consumption, they do sell the surplus to outsiders. The common fruit trees grown include rambutan *(Nephelium iappaccum)*, papaya, durian *(Durio zibethinus)*, bananas, jackfruit, *cempedak (Artocapus kemando)*, coconuts *(Cocus nucifera)*, *pinang (Areca catechu)*, *jambu aver (Eugenia aquea)*, *jambu batu (Psidium guajava)*, and starfruit. The vegetables and other plants grown in the home gardens are brinjal, chillies, tapioca, lemon grass, long beans, sweet potatoes, tumeric, french beans, *keldai (Colocasis)*, sugarcane, pandanus, cucumber, four-angled beans, maize, tobacco, and pumpkin.

Although the Paya Lebar Temuan are settled agriculturists, they also engage heavily in forest economic activities. Because their village is located close to the forest, the Temuan go into the forest during their free time to hunt, trap wild game, and gather various forest products. As with the Rual Semang, the Paya Lebar Temuan hunt and trap wild pigs, deer (sambar, barking deer, mouse deer), monkeys (macaques, leaf monkeys, siamangs, gibbons), squirrels, tree shrews, porcupine, monitor lizard, rats (bamboo rats, etc), and birds (jungle fowls, hornbills, coucals, pigeons, etc). They employ techniques and weapons for hunting and trapping similar to the Semang. If only large game are considered, the Temuan shot and trapped four wild pigs and two barking deer during the researcher's one-month stay in the village.

Forest gathering and collecting contribute both to the Temuan cash income and to subsistence. The Temuan gain substantial earnings from the sale of wild durians, petai, rattan, and bamboo. Besides this, the Paya Lebar Temuan gather a number of other wild plant materials (similar to the ones that the Semang gather) for their own consumption, medicinal purposes, and house construction.

The Paya Lebar people are very dependent on the streams and rivers, particularly the Lui River and its many tributaries, for bathing, laundry, toilet, and food. The Temuan seldom fetch their drinking water from the Lui River, however, but instead pipe it into their village through ingeniously constructed bamboo conduits from other less contaminated tributaries.

FERTILITY AND ECOLOGICAL ADAPTATION: A COMPARISON OF SEMANG FORAGERS AND TEMUAN HORTICULTURISTS

Four measures—child-woman ratio, total maternity ratio (TMR), maternity ratio (MR) and the crude birthrate (CBR)—were used to provide some idea of the fertility levels of the two populations. These rates and ratios are tabulated in Table 3, while Tables 4 and 5 indicate the age pattern of fertility of the Rual Semang and Paya Lebar Temuan. Tables 6, 7, and 8 show the number of liveborn offspring of women from the two populations who had passed menopause at the time of the study. The figures in Table 3 indicate a considerable increase in the fertility level of the Rual Semang over a span of three years (1976-1979). Both the child-woman ratio and the crude birthrate suggest this increase to be astronomical. There is an increase of 79 percent and 157 percent in Semang child-woman ratio and crude birthrate, respectively, as compared to an increase of only 4 percent and 35 percent, respectively, in the Semang total maternity ratio and the maternity ratio between the years 1976 and 1978. These great percentage increases of the Semang child-woman ratio and the crude birthrate can be explained in part as statistical artifacts.

First of all, both child-woman ratio and crude birthrate measures are affected by mortality patterns. The mortality figures presented in the following section indicate an increase in the deaths of women in reproductive ages without a comparable increase in the mortality of children below 5 years old. Secondly, there has been an increase in births to married women in the 15-19 age cohort. It can be inferred from Table 4 that women in the 15-19 age cohort had an average of one child each in 1978 compared to none in 1976. At the time of the 1976 survey, most of the Semang women in the 15-19 age cohort were just married and had had insufficient time for conception so that they only gave birth to their first children in 1977. Therefore, much of the apparent sharp increase in the levels of births is due to the birth performance of the newlyweds. Nevertheless, it is undeniable that there is a general increase in the fertility level of the whole Rual population, although the increase is not as astronomical as the increase in the child-woman ratio and the crude birthrate suggests. Unlike the sudden increase in Semang fertility, the increase in the Paya Lebar Temuan fertility level, in the span of two years (1977-1979), is relatively gradual.

Comparisons of the Paya Lebar Temuan and Rual Semang fertility rates and ratios show that all of the Temuan fertility rates and ratios are higher than the 1976 Semang rates, whereas only the Temuan total maternity ratio and maternity ratio are higher than the 1978 Semang rates. The mortality figures for the Paya Lebar Temuan (presented in the following section) indicate a high child mortality. The difference in percentage between dead women in reproductive age (14.5 percent) and children below 5 years old (41 percent) is

considerable. Therefore, if statistical adjustments are undertaken in consideration of the mortality patterns in the two populations, the Temuan child-woman ratio would be higher than 875 and the Semang child-woman ratio would be lower than 925. This would mean that the Temuan adjusted child-woman ratio will be higher than the Semang adjusted child-woman ratio (based on 1978 data). A Paya Lebar Temuan ever-married woman has an average of five liveborn offspring compared to an average of three liveborn offspring per ever-married Semang woman in Sungai Rual resettlement.

To conclude, two important points about the fertility levels of the two populations must be emphasized. First, the fertility level of the Rual Semang foragers sharply increased over the years 1976 to 1979, while the Temuan horticulturists experienced a relatively gradual increase. The increasing fertility of the Semang is most probably a response to their recent resettlement and the consequent shift from foraging to an agricultural mode of adaptation. Second, despite recent gains by the Semang, the Paya Lebar Temuan horticulturists still have an overall higher fertility rate than the Semang foragers. As the following discussion will show, this difference in fertility rates is probably due to the different ecological adaptations of the two populations.

Various studies on human fertility, particularly in primitive or nonindustrial societies, have suggested the existence of several sociocultural and biological factors affecting fertility patterns. These factors are described and discussed in articles and monographs by social scientists such as Davis and Blake (1956), Nag (1962), Benedict (1971), and Newman (1972). Nag's monograph is an excellent summary of investigations on the factors affecting human fertility in 62 nonindustrial societies.

Sociocultural factors, deriving from social customs, include postpartum sexual abstinence, age at marriage, ceremonial sexual abstinence, contraceptive practices, frequency of coitus, and abortion. Biological factors include general health conditions, disease and sterility, diet, and length of fertile period. Many studies have indicated the close link between these factors and ecological adaptation (Figure 5).

Studies have indicated that diet or nutritional status has both significant direct effects on the fertility or rate of procreation and indirect effects on mortality through disease and epidemics. Lee (1972:340) has observed that change in diet has led to an increase in Kung Bushmen fertility rates by shortening the interval between births. Lacking a reliable supply of soft foods, the Kung Bushmen woman in the past had to nurse her child far longer than her farming counterpart. Howell (1976) argues that the anovulatory effect of lactation is related to the amount of body fat and that women in hunter-gatherer societies are at reduced risk of pregnancy as long as they must nurse their infants. Among agricultural peoples, this effect is of limited importance because sufficient foods may be available for a woman's critical body fat level to be restored

Table 3. Fertility Rates and Ratios for Rual Semang and Paya Lebar Temuan Populations

	Rates and Ratios				
	Semang			Temuan	
Fertility Measures	'76	'78	'79	'77	'79
Child-woman ratio	520	925	1,026	875	737
Total maternity ratio	4.16	4.33	4.42	6.00	8.0
Maternity ratio	2.16	2.92	3.1	4.81	5.0
Crude birthrate	27.7	71.1	31.3	35.1	45.5

Table 4. Number of Children Born to Living Ever-Married Semang Women

Age	Number of Women			Number of Children			Mean No. of Children Per Woman		
Cohort	'76	'78	'79	'76	'78	'79	'76	'78	'79
15-19	10	7	7	0	7	8		1.0	1.1
20-29	13	18	18	28	41	44	2.15	2.3	2.5
30-39	8	10	9	28	48	49	3.5	4.8	5.4
40-49	6	3	3	24	15	15	5.0	5.0	5.0
TOTAL	37	38	37	80	111	116	2.16	2.92	3.1

Table 5. Number of Children Born to Living Ever-Married Temuan Women

Age	Number of Women		Number of Children		Mean No. of Children Per Woman	
Cohort	1977	1979	1977	1979	1977	1979
15-19	2	1	0	1		1.0
20-29	5	7	20	24	4.0	3.4
30-39	3	3	22	22	7.3	7.3
40-49	6	5	35	33	5.8	6.6
TOTAL	16	16	77	80	4.8	5.0

sooner. Howell also points out that Kung Bushmen foraging women need about 1,000 extra calories a day during lactation. Therefore, during the 3-4 years that a woman nurses a baby, she may have too little body fat for ovulation to take place.

The recent interest in measuring the value of children to families or house-

Table 6. Number of Liveborn Offspring of Semang Women Who Have Since Reached Menopause (Based on 1976 Data)

		Number of Offspring									
Mothers	No.	1	2	3	4	5	6	7	8	$\bar{X}$	SD
Alive (40 yrs)	12	—	3	2	2	2	2	—	1	4.10	3.5
Dead (25-60 yrs)	27	4	4	9	4	1	4	1	—	3.37	5.2
TOTAL	39	4	7	11	6	3	6	1	1	3.62	6.2

Table 7. Number of Liveborn Offspring of Semang Women Who Have Since Reached Menopause (Based on 1978 Data)

		Number of Offspring									
Mothers	No.	1	2	3	4	5	6	7	8	$\bar{X}$	SD
Alive (40 yrs)	12	—	1	5	1	2	—	1	2	4.50	3.5
Dead (25-60 yrs)	29	4	4	11	4	1	4	1	—	3.34	5.4
TOTAL	41	4	5	16	5	3	4	2	2	3.68	6.4

Table 8. Number of Liveborn Offspring of Paya Lebar Temuan Women Who Have Since Reached Menopause (Based on 1977 Data)

		Number of Offspring												
Mothers	No.	0	1	2	3	4	5	6	7	8	9	10	$\bar{X}$	SD
Alive (40 yrs)	6	—	1	—	1	—	—	—	1	2	1	—	6.0	2.5
Dead (25-60 yrs)	10	1	1	2	—	—	2	1	1	1	—	1	4.6	3.2
TOTAL	16	1	2	2	1	—	2	1	2	3	1	1	5.1	4.0

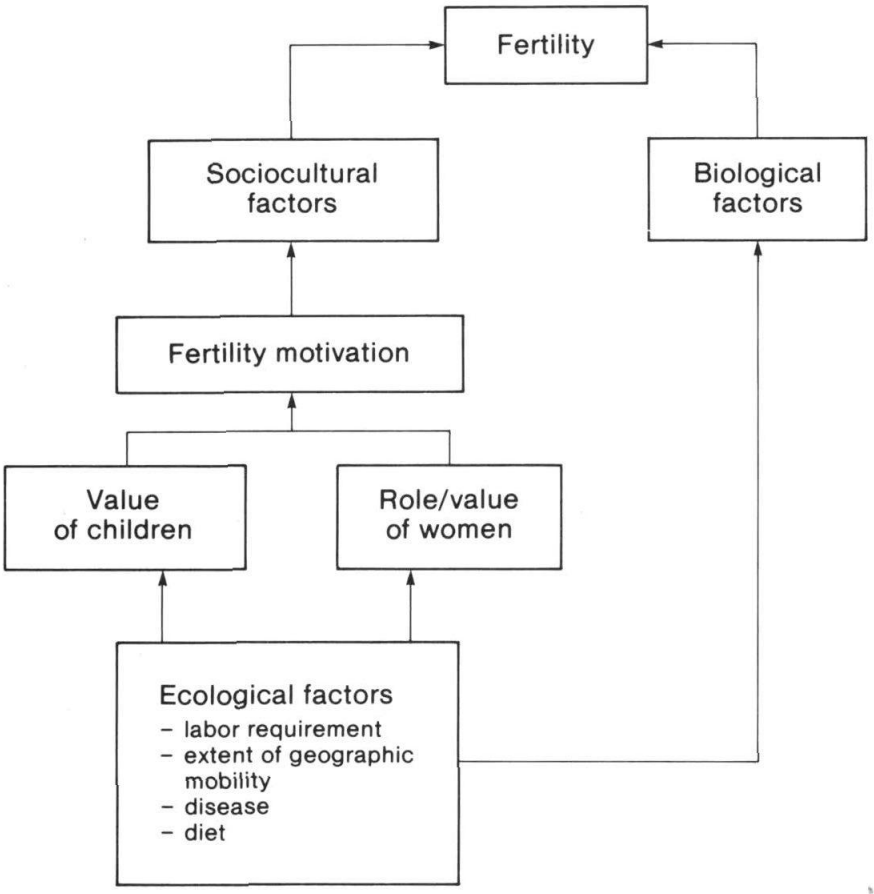

Figure 5. Factors affecting fertility.

holds was prompted by the popular idea that the value of children was closely related to actual fertility behavior. The main assumption was that couples made decisions regarding the family size they wanted to have, and these decisions then were carefully executed after much consideration of the actual or perceived value of children. A large number of social scientists believe strongly that the desire for children reflects economic attributes (see Demeny 1970, 1972; Leibenstein 1957; Becker 1960; Namboodiri 1972; Easterlin 1969; Schultz 1971; Nag 1972; Tarver 1956; Espenshade 1977; and White 1975). The general contention of these scholars is that couples desire many children if the children make significant contributions to the household production and income. Some other scholars, however, feel that the perceptions of parents on

children play an important part in the birth decision-making process (see Fawcett 1970, 1972; Arnold *et al* 1975; Hoffman and Hoffman 1973; and Pope 1972). Concomitant to this, other studies have indicated the importance of the role of women on fertility motivation (Lee 1972, Kolata 1974, Friedl 1975).

After reviewing much of the literature discussing these factors, three hypotheses as to the link between the value of children and the role of women to actual fertility behavior were formulated.

Hypothesis 1

Assuming other things are equal, couples have fewer children where the woman's time has a comparatively high value in alternative uses, that is, uses other than child care (Butz and DaVanzo 1975). Some studies have reported that foraging women make a very significant contribution to a band's food supply through their gathering activities (Lee 1972, Kolata 1974). Lee (1972: 329) states that the foraging Kung Bushmen women contribute about two-thirds of the band's daily food supply. As in most foraging societies, a Semang woman also makes a considerable contribution to the economic and health well-being of her family through her gathering activities. A rough estimate puts her contribution at an average of more than 60 percent of their daily subsistence. She specializes in the gathering of vegetable food and edible riverine fauna for consumption by her family. This takes up a lot of her time and energy and requires considerable wandering in the forest and rivers, leaving her very little time for childcare. If a Semang woman has a nursing infant or is pregnant, her efficiency in her gathering activity declines. The Semang have stated that caring for children is a difficult task as their women have to divide their time between childcare and foraging for food. This investigator has on many occasions observed the hazards, increased difficulty, and the reduced productivity of women who are either pregnant or have to carry their infants while wandering in the forest or wading through rivers foraging and fishing. On one fishing trip which involved 28 Semang (7 men, 13 women, and 8 children), 7 women carrying toddlers (24 percent of the fishing party) landed only 8 percent of the total catch. All the women were about 20 to 30 years old. These data indicate that women with toddlers are less productive than women without infants to care for.

In contrast, a Paya Lebar Temuan woman does not have to carry her children and household possessions around on a nomadic cycle nor does her family impose on her the responsibility of providing as much of the daily subsistence as her Semang counterpart. Her gathering activity does not take her far from the village; rather it is performed largely in the home-gardens around her house. As such, she has relatively more time for childcare although she does help out in farm work and carries out most of the domestic chores.

Hypothesis 2

Couples have more children if the children make considerable contributions to household production and income, both as children and as adults; that is, where the economic value of children is high (Butz and DaVanzo 1975). Unlike Semang children, Temuan children make a major economic contribution at an early age; some may even start contributing at the age of four. Paya Lebar Temuan expect their children of either sex to help in household chores, such as fetching water, doing laundry, taking care of younger siblings, cleaning the house and compound, and cooking. The children also are expected to help in such chores as weeding, harvesting, and chasing the rice birds and other pests; tapping rubber trees and processing rubber into rubber sheets; gathering wild tubers, plants, and fruits; fishing and shooting birds and collecting forest products such as rattan and bamboo for sale.

On a typical day for a Temuan family of five (parents, a daughter age 10, and two sons, 7 and 5 years old), the father would be out hunting squirrels or monkeys with his *sumpitan* (blowpipe), the mother with her 7-year-old son would arise at daybreak to tap and process rubber, the daughter would do the laundry, cooking, and cleaning, and the youngest child would be out in the nearby forest with his catapult shooting birds. The mother, therefore, is allowed more time for economic productive activities such as tapping rubber and gathering fruits and vegetables from her home-gardens because her daughter, who would not be as productive as the mother in tapping rubber, does the laundry and cooking. Even the youngest child, instead of being a burden to the household, adds birds that he shoots to the daily menu.

Various studies have pointed out that agricultural societies usually have a relatively higher labor requirement than foraging ones. Farm work, particularly during the peak labor periods such as planting and harvesting, requires a high labor input. To secure aid in farm work, the farmer usually hires farm hands or depends on his children. To avoid continued dependence on hired hands, most farmers desire large families with the expectation of help from their children. This implies that in a society with a high labor requirement a high economic value is placed on children, with a consequent high rate of procreation.

As to the influence of a labor requirement on the desire for children, Polgar (1971:56) states that "the vicious cycle of intensifying labor input, even in the face of declining yields per man days of work (Boserup 1965) requires larger numbers of children to help increase the size of the labor force in the household." White (1973, 1975) reports that Javanese peasants had large families because of the high value placed on children, who were expected to help in farm work. Therefore, in a highly labor intensive economy, Javanese peasants desired large families especially as a potential source of labor. I have observed

on many occasions that Paya Lebar Temuan children perform various types of farm work, particularly guarding the rice fields from pests.

A survey of the Temuan children working in the village is indicative of their economic value (Table 9). Another survey on the daily activities of a sample of three households in Paya Lebar for a period of seven days each by Koh Bee Hong (1977) also provides some notion of the economic value of Temuan children. This study included 8 children (23.8 percent of all children up to age 14 in Kampung Paya Lebar) in the three households. Tables 10 and 11, adapted from the report of Koh's survey, indicate the amount of time expended by Temuan children (excluding toddlers) in beneficial activities. The figures presented indicate the very considerable contribution Temuan children make to the household economy. This evidence allows us to conclude that Temuan children are, in fact, an important asset to their respective households.

In contrast, Semang children do not contribute substantially to their households, especially in terms of household production. Instead of giving a helping hand in household production, Semang children spend most of the day playing, usually games imitating the activities of adults of the appropriate sex. A group of young boys and girls will construct a small shelter of their own, catch fish and gather wild plants, and then cook the food, all copying in miniature what they have seen their parents do many times before. In recent times with the establishment of a school, however, children do make contributions by bringing back and sharing with the other members of their respective households the "extras" from food that is provided as part of the government's inducement to the children to attend classes. The food (rice, biscuits, and dried fish) that the school children take back to their respective homes is an important supplement to the household diet. For the Rual Semang, this appears to be the only major benefit of having children. It may relate to the increase in birthrate since resettlement.

Hypothesis 3

In situations where children interfere with the culturally or environmentally sanctioned lifestyle, there would be a tendency to limit the number of children. It has been stated earlier that foraging activity imposes some degree of nomadism. Many scholars have suggested that such nomadism acts as a limiting factor on childbearing because of the difficulty for mothers of carrying more than one infant at a time while on the move gathering food (Carr-Saunders 1922, Binford 1968, Birdsell 1968, Sussman 1972, Hayden 1972, Lee 1972, and Heider 1972). This is probably the main cause for the low birthrate and long birth spacing of the Semang, prior to sedentarization. As people on the move, a low birthrate and long birth spacing was adaptive and various sociocultural measures for birth spacing and birth control were employed. Being less no-

Table 9. Economic Contribution of Paya Lebar Temuan Children (March 1978)

Rubber Tapping					
Age	Sex	No. of Days Tapping Rubber	No. of Hrs a Day Tapping Latex	Amount Obtained from Sale of Rubber Sheets or Latex	Expenditure of Money Earned
14	M	9	6½	M$55.80 (US$24.26)	Gave father all the money to buy provisions for the household
8	M		helps mother to tap rubber		

Collecting Rattan					
Age	Sex	No. of Days Collecting Rattan	No. of Hrs a day Collecting Rattan	Amount Obtained from Sale of Rattan	Expenditure of Money Earned
12	M	15	5-6	200 stocks at 35¢ per stock M$70.00 (US$30.43)	Paid debts and bought a shirt and provisions for household with the remainder
7	M	6	3	50 stocks at 40¢ per stock M$20.00 (US$8.70)	Gave money to his father
11	M	4	6	40 stocks at 35¢ per stock M$14.00 (US$6.09)	Bought provisions for household
10	M	11	6	about 100 stocks at 35¢ per stock M$35.00 (US$15.22)	Gave money to his father
6	M	10	3	about 30 stocks M$10.50 (US$4.56)	Gave money to his father
12	F	10	3	about 120-130 stocks M$45.00 (US$19.56)	Bought provisions for household and a dress

madic at present, however, the Semang mothers do not face the difficulty of child transport, and long birth spacing is unnecessary. Unlike the Semang, the Temuan traditionally are sedentary agriculturalist, and, as such, Temuan mothers do not face the problems of child transport as mothers in nomadic societies do.

Therefore, it can be concluded that a low birthrate is adaptive for a foraging

Table 10. Average Energy Expended Per Day on Food Connected Activities As a Percentage of Total Calories Expended

Household	Children (ages)	Average Calories Per Day Expended on FCA	Percentage of Total Calories Expended (%)	Percentage of Total Calories Expended by the Whole Household on FCA (%)
1	Child age 14	132	8	6.4
	Child age 10	200	12	9.7
2	Child age 12	365	18	21.7
	Child age 9	253	14	15.0
	Child age 7	135	8	8.0
3	Child age 6	658	39	30.8
	Child age 4	38	10	6.5
	Child age 3	39	3	1.8
	Total	1,920	112	99.9
	Average	240	14	12.5

SOURCE: Table adapted from Koh's 1977 findings.

Table 11. Average Percentage of Child's Total Amount of Time Per Day Spent on Food Connected Activities and Babysitting

Households	Children	Food Connected Activities (%)	Taking Care of Younger Siblings
1	Child age 14	6	4%
	Child age 10	7	
2	Child age 12	14	
	Child age 9	11	
	Child age 7	5	
3	Child age 6	30	5%
	Child age 4	8	
	Child age 3	2	

SOURCE: Table adapted from Koh's (1977) findings.

population such as the Rual Semang for three reasons. First, the Semang woman's time has a comparatively high value for such uses as gathering food, fishing, and collecting forest products, all activities in which the need to care for small children lowers her efficiency. Second, the economic value of Semang children is low because they make little or no contribution to their

household's income and production. Third, as people on the move, having nursing infants is a major problem because the mother will be burdened by her infants on her gathering trips and during camp shifts. In contrast, a high birthrate is adaptive for an agricultural population such as the Paya Lebar Temuan population. A farming society has a higher labor demand, and children are seen as a potential source of labor. Obsvrvations reveal that the Temuan children do make substantial contributions to their household income and production and do help out in farm work and other domestic chores. Thus, having more children is adaptive in a farming society.

If the value of children is high and the cost low, the fertility motivation is high, and there is great desire for children. On the other hand, a low value and high cost for children will result in a low fertility motivation. Of a sample of 18 Semang ever-married men and 15 Semang ever-married women, 44.4 percent (8) of the men and 60 percent (9) of the women preferred to have three or fewer children, whereas 50.8 percent (9) men and 40 percent (6) women preferred between 4 to 6 children. Only one man desired more than 6 children. For the Temuan, out of a sample of 10 married men and 10 married women, 20 percent of the men and 30 percent of the women preferred to have 3 or fewer children, 40 percent of the men and 40 percent of the women preferred 4 to 6 children while 40 percent of the men and 30 percent of the women preferred more than 6 children. These figures reveal that relatively more Temuan prefer large families and relatively more Semang employ a number of birth control and birth spacing techniques.

Social scientists generally agree that there is likely to be a high use of contraceptives or abortifacients if a high value is placed on women's time in uses other than childcare, if the economic value of children is low, or if children interfere with the culturally or environmentally sanctioned lifestyle. Contraception and abortion, which are voluntary methods of preventing pregnancy, are only two of the sociocultural measures that the Semang employ to limit family size or space out their births. Other possible determinants for the Semang forager's low fertility are the long period of postpartum abstinence, low frequency of coitus, and sexual abstinence during certain periods.

Postpartum Abstinence

Abstinence from coitus on the part of a mother for a few weeks immediately after parturition is common in all societies. The period of abstinence varies from society to society. In many societies, the period of abstinence is long and may even last for more than two or three years. Abstinence normally takes the form of a taboo in the sense that some kind of supernatural sanction is associated with it. Varied reasons have been given for the existence of the practice of postpartum abstinence. In societies such as Lesu, Masai, and Yako (Nag 1962:83), the people believe that pregnancy too soon after birth is harmful to

the existing child, so coitus with the parturient mother is prohibited; others believe that it affects the mother's health.

A broad consensus exists that a long period of postpartum abstinence reduces the fertility level (Carr-Saunders 1922:214, Krzwicki 1934:205, Kuczynski 1949:614, Ford 1952:766 as cited in Nag 1962:77). Nag (1962:77) states that there is a negative correlation between the length of observance of postpartum abstinence and fertility level. Carr-Saunders (1922:412) states that the function of postpartum abstinence is to reduce fertility, and it arose in nomadic hunting and gathering societies because of the heavy burden in transporting and suckling more than one baby at a time.

The period of abstinence varies considerably between the Rual Semang and Paya Lebar Temuan. Among the Rual Semang, informants stated that the period normally lasts until the child is weaned at an age of about two years. This custom, which is almost certainly a major factor in reducing the fertility level of the Semang, is generally strictly observed because it is ritually sanctioned. The Semang believe that they will be severely punished by Karei, their thunder god, if they do not observe this taboo. Abstaining from coitus for two years after birth ensures a birth spacing of at least three years which means that the child would be out of the weaning stage if and when the next child is born.

In contrast, the sedentary Temuan normally abstain from coitus only for about three weeks to a month, until the parturient mother is strong enough for coitus. This relatively short period of abstinence does not have any great effect on the fertility level of the Paya Lebar Temuan population.

Sexual Abstinence

Avoidance of coitus with a menstruating woman is widespread in general among the Rual Semang and the Paya Lebar Temuan. It is unlikely that abstinence during this period affects fertility, however, as ova are not released during menstruation. A man's sperm count might build up, however, increasing the probability of conception during subsequent intercourse.

Apart from sexual abstinence connected with menstruation, the Semang also abstain from any kind of sexual behavior during the day, as there is a belief that Karei would be angered if he observed a couple engaging in sexual activities in the day and would severely punish the couple. The punishment is believed to be a violent death either by lightning or by the attack of a tiger or other wild animal. The Paya Lebar Temuan do not observe such a taboo.

Frequency of Coitus

The frequency of coitus is a significant factor affecting human fertility because the life of the male and female germ cells in the female uterus and tubes is very short, necessitating fairly close timing for impregnation (Nag 1962:72).

It is a widely accepted contention among demographers that low frequency of coitus correlates with low fertility because the chance of the simultaneous presence of the ovum and the sperm in the genital tract of the female becomes slight. Some demographers, however, believe that excessive frequency of coitus can reduce fertility (Kuczynski 1948:230, Rommer 1952:369, Huhner 1943, Haire 1940:316, Biswas 1953:82, as cited in Nag 1962:73-74). Nag states that "it is extremely difficult to determine an average frequency of coitus that is optimum for reproduction," although Swyer (1954:138 as cited in Nag 1962:73) claims that an average coital frequency of two or three times per week is optimum for reproduction.

It is, of course, exceedingly difficult to obtain reliable information about actual frequency of coitus. The frequency of coitus is affected by the amount of privacy a couple has. The Semang in the past and sometimes at present, particularly during forest collecting trips, stay in lean-tos arranged in a circular form that do not give much privacy to a couple. The Temuan have relatively more privacy, as their houses are partitioned into two parts: one room is used as a sitting room and a bedroom and the other as the kitchen. A Temuan couple sleeps with the children in the same room.

Contraception

Nag (1962:129) defines contraception as "the adoption of certain devices which temporarily or permanently prevent the formation of the female egg or, although allowing normal intercourse, prevent conception." In Nag's (1962) sample societies, coitus interruptus is the most common form of contraception used. The Rual Semang and Paya Lebar Temuan do not employ coitus interruptus as a form of contraception, but they do employ certain traditional contraceptive drugs.

The Rual Semang employ two types of contraceptives, which are known locally as *ubat penjarang* and *ubat pemutus*. These two drugs are said to kill the fetus. The ubat penjarang is supposedly a temporary preventative measure, and the ubat pemutus is said to cause permanent sterility. There are two sorts of ubat penjarang. One is made out of a wild plant known locally as *daun tepus calun*. This plant is washed and then sun dried for about two days. It is then cut into thin shreds and consumed either by chewing with betel nut or drinking a decoction prepared by brewing the shredded leaves. To ensure effectiveness this contraceptive drug must be consumed by both the man and the woman. The other ubat penjarang is made from three wild roots of *pokok celaka, tijoh lawang,* and *tijoh penderal* (no scientific names available). These are cut into small pieces and randomly mixed together. The mixture is then brewed and the resultant decoction drunk by both men and women who practice birth control. Most of the Semang informants have faith in this contraceptive and rely on it for their family planning.

The ubat pemutus is supposed to be a permanent preventive measure for conception. Unlike the ubat penjarang, this medicine is made out of a particular single root known as *ubat pemutus* by the Semang. (As yet, no scientific identification is available.) These may be eaten with betel leaf or boiled in water and drunk as a decoction. Similar to the ubat penjarang, this medicine, according to the Rual Semang, must not be consumed during pregnancy as it is believed it can kill the fetus and endanger the pregnant woman's life. When asked whether the contraceptive at any time did not work, the Rual Semang answered quite strongly that the contraceptive does work and that they have not heard any cases where the contraceptive did not work.

The Paya Lebar Temuan also have traditional contraceptive drugs with the same alleged effects, but these are used to a lesser extent. Like the Semang, the Temuan recognize two types of contraceptive drugs, namely, *penjarang* and *penyambang*. These medicines, however, instead of being shredded leaves of wild plants and wild roots, consist of a variety of mushroom which is consumed with their food. In order for it to be effective, both the male and female must consume it. The penjarang is considered by the Temuan as a temporary preventive measure for conception whereas the penyambang is supposed to be a permanent preventive measure. Neither population employs modern contraceptives, such as condoms, diaphragms, spermicidal jellies, creams, or pills. Most Semang and Temuan are unaware of the existence of such contraceptives.

Conclusions: Ecological Adaptation and Fertility

The fertility of the Rual Semang population has increased in the span of two years probably because of the change in ecological adaptation which, through a chain reaction, has changed the other factors in the fertility mechanism. With the introduction of the JOA-directed agricultural projects, the Rual Semang are more settled, are relatively more future oriented, and require more labor to work in the projects. Being settled, the Semang women are no longer faced with the heavy burden of transporting more than one nursing baby at a time. Futhermore, the food rations that the school children bring home have increased the children's economic value. The increase in the value and decrease in the cost of children has increased the fertility motivation of the Semang. At the same time, the postpartum abstinence taboo and other sexual abstinence restrictions are not as strictly observed as in the past. There is a lesser use of contraceptives and abortifacients. These factors which once reduced fertility no longer operate and subsequently fertility rates have increased.

The remaining fertility difference between the Rual Semang and Paya

Lebar Temuan is probably because the Rual Semang have not completely changed their orientation from a foraging to an agricultural orientation, for it takes some time for this to occur.

MORTALITY AND ECOLOGICAL ADAPTATION

Mortality is the outcome of circumstances involving some risk of life-specific illness, levels of general health and vigor, old age, and accidents or violence. It represents an important factor in population dynamics. As in the case of fertility, ecological factors greatly influence the variation in mortality rates.

Many scholars have been particularly concerned with the study of mortality in Orang Asli populations. Some of them, such as Fix (1971) and Polunin (1953), have indicated that Orang Asli mortality, particularly among infants, is considerably higher than that found in other population groups in Malaysia.

A number of methods were employed in this study to measure the level of mortality in the two populations. The most common measure of mortality is the crude deathrate (CDR), which is the ratio of deaths for a specific period (usually one year) to the mid-point population (Barclay 1958). The crude deathrate of the Paya Lebar Temuan population is estimated at 24/1,000 persons, calculated on an annual basis over the period 1957-1979, while the Rual Semang annual crude deathrate is considerably higher, estimated at 32.6/1,000 persons over the period 1956-1979. These figures, however, are appreciably higher than the average crude deathrate of 9.7/1,000 persons over the period 1965-1974 for the Semelai population (Dobbins, 1979:9) and the Malaysian national average rate of 6.7/1,000 persons for 1970 (U.N. Demographic Year Book 1971).

Another method of indicating mortality in the absence of a system of vital information registration is to compare the survival rates of the offspring of women who have since reached menopause (Neel and Chagnon 1968, Fix 1971). Figures on total number of livebirths per woman are presented in Tables 7 and 8 (see previous section). Tables 12 and 13 present the number of surviving offspring of these women. The difference in means, that is, 2.45 surviving offspring compared with 3.68 liveborn offspring per woman for the Semang population and 3.25 surviving offspring compared with 5.1 liveborn offspring per woman for the Temuan population, indicates a lower mortality of the Rual Semang as compared to the Paya Lebar Temuan population (Table 14). This method of indicating level of mortality is defective in that it represents the survival of offspring to varying ages. An age-specific mortality indicator would be more valuable, but due to the smallness of the Paya Lebar Temuan population, age-specific mortality rates were not computed, nor can a life table model be constructed.

These two measures of mortality give conflicting views of the level of mor-

Table 12. Surviving Offspring of Postmenopausal Rual Semang Women

		Number of Offspring									
Mother	No.	0	1	2	3	4	5	6	7	8	$\bar{X}$
Alive (>40 yrs)	12			4	3	1	1	2		1	3.83
Dead (25-60 yrs)	30		9	16	4	1					1.90
TOTAL	42		9	20	7	2	1	2		1	2.45

Table 13. Surviving Offspring of Postmenopausal Paya Lebar Temuan Women

		Number of Offspring									
Mother	No.	0	1	2	3	4	5	6	7	8	$\bar{X}$
Alive (>40 yrs)	6	2				1		2	1		3.8
Dead (25-60 yrs)	10	1	3	2	2	1	1				2.2
TOTAL	16	3	3	2	2	2	1	2	1		3.25

Table 14. Comparison of Surviving Children with Total Liveborn Children Per Postmenopausal Woman

Total Number of Children	Rual Semang	Paya Lebar Temuan
Liveborn	3.68	5.10
Surviving	2.45	3.25
Dead	1.23	1.85

tality in the two populations. The crude deathrate of both these populations suggests that the level of Paya Lebar Temuan mortality is appreciably lower than that of the Rual Semang, but comparisons of the survival rates of the offspring of women who have since reached menopause indicate a relatively higher mortality rate in the Temuan population than the Semang population. Neel and Chagnon (1968) and Fix (1971) suggest the second measure of mortality, that is, comparing the survival rates of offspring of women of *completed* fertility, as a more reliable measure of the level of mortality in small populations lacking a system of vital information registration. Furthermore, the crude deathrate is more likely to reflect statistical errors due to misreporting of

deaths, which is most likely to occur in demographic surveys of small primitive populations. Thus, since the two populations in this study are small and without a system of vital information registration, the more reliable estimate of the level of mortality in these populations would be the second measure, which suggests that the mortality rate is appreciably higher in the Paya Lebar Temuan population than the Rual Semang population.

Tables 15 and 16 present the age/sex characteristics of the dead in the two populations. It is estimated from these tables that 29 percent of Semang deaths and 60 percent of Temuan deaths occurred when the individuals were under 14 years of age. This suggests that the Paya Lebar Temuan population experienced a relatively higher child mortality than the Rual Semang population. In both these populations, however, child mortality is higher among males than females, although the differential is more extreme among the Semang. About 6.3 percent of Semang children and 33.7 percent of Temuan children died before reaching one year of age. These figures indicate a much higher infant mortality rate among the Paya Lebar Temuan population than the Semang population. This high infant mortality rate of the Paya Lebar Temuan horticulturists probably is significant in influencing their fertility behavior. As discussed earlier, the Temuan, being agriculturists, assign a relatively higher value to children than to Semang foragers. However, since many Temuan children die in early childhood, they will have to assure more births in order to maintain a sizeable family. A high infant mortality rate will drastically cut the size of the family. Therefore, a high infant mortality rate in an agricultural society, where a high value is placed on children, would initiate a high birth rate to counteract the effects of infant mortality.

Also affecting fertility behavior is the mortality of females in their reproductive years (14–44 years). These females are particularly important to a population because they replenish the population by bearing children. Therefore, if many such females die, the fertility level of that population will be reduced drastically. It is estimated from Tables 15 and 16 that 20.5 percent and 14.5 percent of the dead at Rual and Paya Lebar, respectively, were females in their reproductive years (15–49).

In regard to the sex of the dead in both populations, more males than females died. Among the Semang, 55 percent of these deaths were of males and 45 percent were females, while among the Temuan 51 percent were males and 49 percent were females.

Table 17 presents demographic information on Semang who died between December 1974 and April 1978. This information was obtained from the JOA records on the deaths in Sungai Rual Post during that period. It is estimated from the table that 60.8 percent of the deceased were males and 39.2 percent were females. Out of the 23 deceased, 30.4 percent (7) died before reaching the first year, 17.4 percent (4) died before reaching 14 years of age, and 52.2 percent (12) died in their reproductive years (15–44 years).

Table 15. Age at Death and Cause of Death, Rual Semang (1910–1978)[a]

Cause of Death	0–1		1–14		15–44		45 +		Total	
	M	F	M	F	M	F	M	F	M	F
Disease	6	2	18	11	18	26	24	17	66	56
Accident					3		1		4	
Killed by wild animals						1				1

[a]People in the two settlements were asked the time of death and the probable cause of death of their relatives. The earliest times obtained in the series of interviews were 1910 for the Semang and 1927 for the Temuan.

Table 16. Age at Death and Cause of Death, Paya Lebar Temuan (1927–1977)[a]

Cause of Death	0–1		1–14		15–44		45 +		Total	
	M	F	M	F	M	F	M	F	M	F
Disease	12	16	17	5	1	12	11	4	41	37
Killed by wild animals					1				1	
Death during childbirth						4				4

[a]People in the two settlements were asked the time of death and the probable cause of death of their relatives. The earliest times obtained in the series of interviews were 1910 for the Semang and 1927 for the Temuan.

Cause of Death

There are three significant causes of death in preindustrial populations: disease, accidents, and homicide. These causes possess certain ecological attributes. Figure 6 highlights some of the major associations between mortality and these ecological factors.

Disease is the single most important cause of death among both the horticultural Temuan and foraging Semang. It is estimated that 96 percent of the Semang deaths and 88 percent of Temuan deaths were caused by some form of ailment. Among the most common diseases are malaria, amoebic dysentery, diarrhea, acute bronchitis, tuberculosis, cholera, and goiter. Most of these diseases are transmitted through physical contact or are carried by vectors such as the *Anopheles* mosquito.

Alland (in Lee and Devore 1968:244) feels that disease is not a factor in pop-

Table 17. Deaths among Rual Semang (December 1974-April 1978)

Age	Sex	Cause of Death	Band
1. 23 years	F	Disease. Symptoms: chest pain, vomiting blood	Meraju
2. 20 years	M	Disease. Symptoms: vomiting blood	Meraju
3. 1 month	M	Difficulty in breathing	Pusu
4. 5 months	F	Cold and difficulty in breathing	Mat Din
5. Newborn	F	Premature birth	Macang
6. 4 months	M	High fever	Meraju
7. 1 month	M	Diarrhea	Meraju
8. 29 years	F	Childbirth	Macang
9. 41 years	M	Diarrhea	Meraju
10. 31 years	F	Disease	Meraju
11. 3 years	M	Disease	Macang
12. 26 years	M	Disease	Macang
13. Newborn	M	Poor delivery leading to infected naval	Meraju
14. 41 years	M	Accident causing internal injury	Meraju
15. 26 years	M	Disease	Lanas
16. 1 year	M	Disease	Mat Din
17. 2 years	M	Disease	Teras
18. 8 years	M	Disease	Meraju
19. 3 years	F	Disease	Meraju
20. 36 years	M	Disease	Meraju
21. 30 years	F	Disease	Meraju
22. 40 years	F	Disease	Meraju
23. 45 years	F	Disease	Meraju

ulation control among hunter-gatherers for a number of reasons. First, he reasons that such small isolated populations are less likely to contact epidemic disease. Second, hunter-gatherer groups have coexisted with some parasites for a long time so that through natural selection they have developed genetic adaptations to these parasites. Third, the good diet of the hunter-gatherer societies ensures a balanced "immunochemical system." Fourth, diseases are less common in migratory peoples. Alland states that many of the contemporary hunter-gatherers are atypical, however, because they "have been pushed into areas that are marginal, not only in terms of productivity, but also in terms of their being unhealthy and uncomfortable."

Through centuries of natural selection, the Orang Asli have developed adaptations to some diseases. These adaptations are biological or genetic and

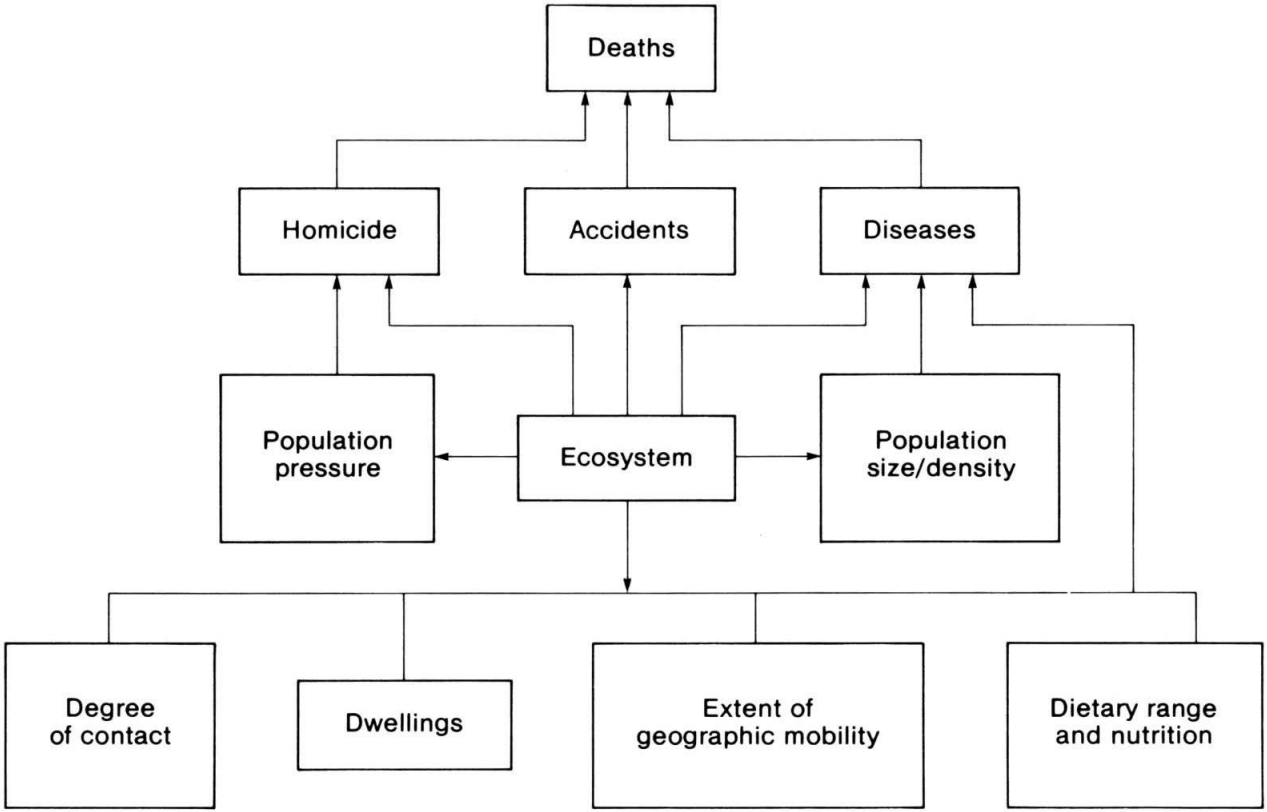

Figure 6. Causes of death.

cultural. A rather well-documented example of biological adaptation to disease is the occurrence of abnormal hemoglobins (in particular Hemoglobin E), G6PD deficiency, and thalassaemia in Orang Asli populations, which are probably biological adaptations to malaria (Rambo 1979).

Dunn (1972:108) suggests that "certain environmental and cultural variables interact with customary behavior to produce sanitary conditions." Demographic characteristics such as density, size, and extent of movement are important variables in the spread or containment of disease (Alland 1970). These characteristics have ecological attributes as they are different in a foraging society compared to a horticultural society. Among foragers, low population density and small group size restricts the spread of infectious disease. On the other hand, sedentary horticultural populations, such as the Temuan, with a relatively higher density allow disease pathogens to be disseminated more easily. In general, the higher the population density the greater the chance that disease microorganisms will make a successful transfer from host to host. Therefore, infectious diseases should spread more successfully among the sedentary Temuan villagers than among the nomadic Semang population. Nomadic populations, however, may also carry certain diseases over long distances. In any case, the situation has changed since the Rual Semang have more or less settled.

In addition to population size, the arrangement of living space plays an important role in the spread or containment of disease. Thus, the type and arrangement of houses, the number of rooms per dwelling, and the number of occupants per room all affect epidemiological patterns. For example, the Vietnamese hill people who have built their houses on stilts 2 to 3 m above the ground are able to protect themselves to a certain extent from the malaria mosquito *(Anopheles minimus)* because the flight ceiling of this mosquito is under 2 m (May 1954). The Semang traditionally stay in lean-tos which are arranged in a beehive formation, each usually occupied by one nuclear family. At present, although the Semang build houses, these are small and constructed close to one another. This type and arrangement of houses enables the easy spread of disease in the Semang population. In contrast, the Paya Lebar Temuans build their houses some distance away from the next house, and each house has on the average two rooms. The number of occupants per room is not large, averaging about three per room. Dunn (1972:108) suggests that pile-elevated housing ensures a living space above the contaminated surroundings of the house, whereas shelters built on the ground put their dwellers into daily and direct contact with contaminated soil. The Temuan live in pile-elevated houses, while the Semang erect their shelters on the ground. In the past, the Semang used to move so frequently that the soil did not become very contaminated. Now, however, after resettlement, the Semang stay in such dwellings for much longer periods.

Population movement is another important variable. As stated earlier, a

foraging adaptation requires a considerable amount of mobility. Nomads tend to leave their waste products behind them, while sedentary people live in more or less constant contact with their own refuse. Careless disposal of wastes can lead to easy breeding of disease microorganisms (Alland 1970). The sedentary Temuan dispose of their household refuse at certain places in the river; from there it is carried downstream. Since this contaminates the river, the Temuan obtain their drinking water either upstream or from uncontaminated streams or tributaries. In contrast, the Rual Semang habitually scatter their garbage around their houses. This may have seemed practical when they were nomads because long before the refuse had accumulated into heaps they would have moved to a new camp. The Rual Semang, at present being more or less settled, still practice their traditional habit of unhygienic scattering of wastes around their residences. Living in constant contact with their own wastes may be detrimental to their health.

In addition to these demographic and ecological factors, another significant factor affecting sanitary conditions, as suggested by Dunn (1972:108), is the "degree of contact with the soil," which is dependent on the type of exploitative strategy employed. Agriculturists are relatively more regularly exposed than foragers to pathogens that the soil may harbor. This implies that the Rual Semang foragers may be less exposed to pathogens in the soil than the Temuan horticulturists.

As to the effect of diet on disease, Alland (in Lee and DeVore, eds., 1968: 244) in the symposium on *Man the Hunter* states that "one of the factors that affects the severity of disease, particularly in agricultural peoples, is the nutritional factor—especially a high-starch, low protein diet, where the immunochemical system is unbalanced." Among hunters and gatherers, on the other hand, where there is an adequate supply of animal protein of high quality, one would expect the nutritional substratum to be good. Dunn (1968), in his survey of the general health, disease, nutrition, and cause of mortality among the Kalahari Bushmen, the Australian Aborigines, the Eskimo, the African Pygmy, and the Semang, suggests that the apparently better diet of these groups relative to most farming peoples makes them less susceptible to disease, concomitantly lowering their deathrates. A study of the Hadza hunters-gatherers of Northern Tanzania attributes the generally good health of the Hadza children to prolonged breast feeding, early supplementation with a range of foods including meat chewed to softness by the mother, and a reduced risk of exposure to intestinal parasites due, at least partially, to the group's continual nomadic movements.

Becoming settled appears to have increased the incidence of disease in the Rual Semang population. Estimates indicate an increase of 59 percent in mortality caused by disease in Rual. During the period April 1974 to April 1976, only 8 Rual Semang died because of some form of disease. But during the period of May 1976 to April 1978, the death toll due to disease increased to 12.

The figures in Table 17 also show that about 69 percent of the people who died between December 1974 and April 1978 belonged to one band. The high incidence of death in this band probably is due to the poor sanitary conditions with which it lives. The members in the band stay in lean-tos built close to each other in a somewhat circular formation and still, as was traditionally done, scatter their waste around their lean-tos. Furthermore, as their camp is located downstream, the water they use has already been contaminated by the members of bands staying upstream. Therefore, the type and arrangement of residences, careless disposal of wastes, and use of contaminated water without much concern for hygienic practices may have promoted the spread of disease microorganisms in this band.

Mortality due to warfare, homicide, and accidents, which are common in a number of societies, is virtually absent in these two Orang Asli populations. The Paya Lebar Temuan, however, have told of violent incidents in the past between their forefathers and the migrant Malays. According to some informants, the main cause of these conflicts, which supposedly claimed many Temuan lives, was the quest by the migrant Malays for land.

MIGRATION AND ECOLOGICAL ADAPTATION

In demographic usage, migration is the relatively permanent movement of an individual or a group over a significant distance. Migration must be distinguished from population mobility. Movement involving only a temporary change of residence generally is considered nonmigratory. Ecological factors generally play an important role in migration, but among the Rual Semang and Paya Lebar Temuan these factors are relatively unimportant in explaining migration. Almost all migratory movements among the Rual Semang and Paya Lebar Temuan are caused by sociocultural factors, particularly marriage. All the in-migrants (12.8 percent of the Paya Lebar population) settled in Kampung Paya Lebar because of marriage and 13 out of 16 out-migrants have settled elsewhere because of marriage. Similarly, marriage is also an important reason for Semang migration. In the recent past, when each band occupied its own territory, there were a number of mate exchanges among the bands, as they are generally band exogamous. Since the Semang in general are patrilocal, there normally is movement of newlywed girls from their home campsite to their husbands' campsite.

CONCLUSION

In this paper, an attempt has been made to explore possible relationships between the population patterns and the ecological adaptations of two different Orang Asli groups. The data reveal considerable differences between the pop-

ulation structure and dynamics of a foraging Semang population and a sedentary Temuan population. The study also reveals that the demographic structure and dynamics of the Semang population have changed in the direction of the Temuan pattern following the shift from a foraging adaptation to one of settled agriculture.

The horticultural Temuan population increased at a much higher rate than the foraging Semang during the last 22 years (1957–1979). According to a fundamental statement in demographic theory, population growth is a function of births, deaths, and migration. The migration patterns of both these populations are more or less similar so that fertility and mortality are the main factors explaining the differences in demographic structure and dynamics of the two populations. In the span of 2 years (1976 to 1978), the Rual Semang population experienced 27 births, 18 deaths, and no migration. The Sungai Rual population in April 1976 was 184 people and the April 1978 census numerates 193 people, an increase of 9 people, which is concomitant to the result of the B - D (27 births - 18 deaths) computation. This gives an average rate of 2.39 percent population increase per annum, whereas prior to settlement the average rate was about 1.25 percent per annum based on the population increase (20) in a span of 10 years from 1966 to 1976 (Gomes 1976:58).

In comparison, the Paya Lebar population experienced a population increase of 1.52 percent from March 1977 to March 1979. This increase was due to 7 births which offset the only death and two cases of out-migration. A retrospective analysis of the Paya Lebar population for the past 20 years reveals considerable fluctuation in the growth rate. From 1957 to 1967, the population increased by 10, an increase of 19 percent or 1.9 percent per annum. This rate soared higher within the years of 1968 to 1978 to 3.8 percent per annum (an increase of 24 or 38 percent).

A number of significant points about the growth trends and patterns of the two populations can be deduced from Figures 7 and 8. These are as follows:

1. The Paya Lebar horticulturist Temuan population experienced a gradual population increase between the years 1957–1979. As the figures presented earlier indicate, this increase appears to be at a much higher rate between the years 1967–1977 than the earlier period of 1957–1967.
2. In contrast, the Rual Semang population increased gradually from 1957 to 1975 and then surged sharply up after 1976. This sudden increase in population is probably due to the effects on Rual Semang fertility of sedentarization and of their adoption of agriculture. Similarly, Lee (1972) observed that once the nomadic Kung Bushmen shifted to a sedentary life and became partially dependent on agriculture and dairying their birthrate increased.
3. The Paya Lebar Temuan population has increased at a much higher rate than the increase in the Rual Semang population. This is deduced

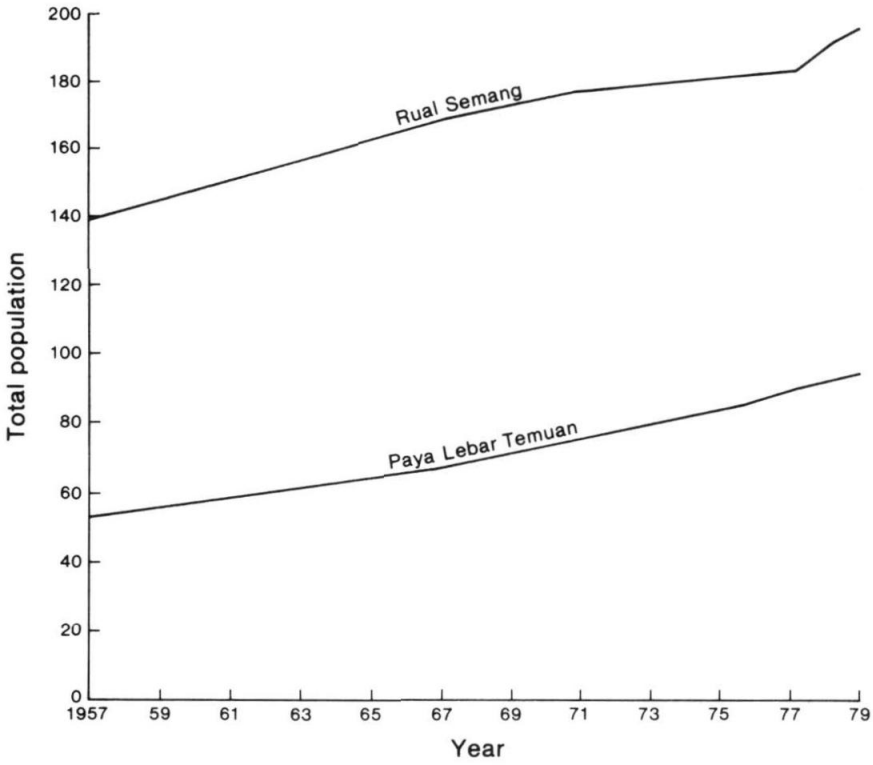

Figure 7. Growth in Rual Semang and Paya Lebar Temuan populations.

by the difference in the gradient of the two slopes which represents the cumulative increase of the two populations over the years 1957–1979 (Figure 8). The line indicating the cumulative increase of the Paya Lebar population is much steeper than the line representing the cumulative increase of the Rual population. The Paya Lebar Temuan population increased by about 65 percent from the years 1957–1979, while the Rual Semang population increased by only 40 percent. This appears to support the widely accepted notion that agricultural populations grow at a much faster rate than foraging or hunting-gathering populations.

Fertility and mortality patterns are affected greatly by a population's ecological adaptation. In particular, aspects of a population's ecological adaptation, such as the value assigned to children, the activities of women, labor requirements, and the extent of geographic mobility, may all directly or indirectly affect fertility behavior. Observations of other societies by many scholars reveal that the value a population assigns to its children, which is impor-

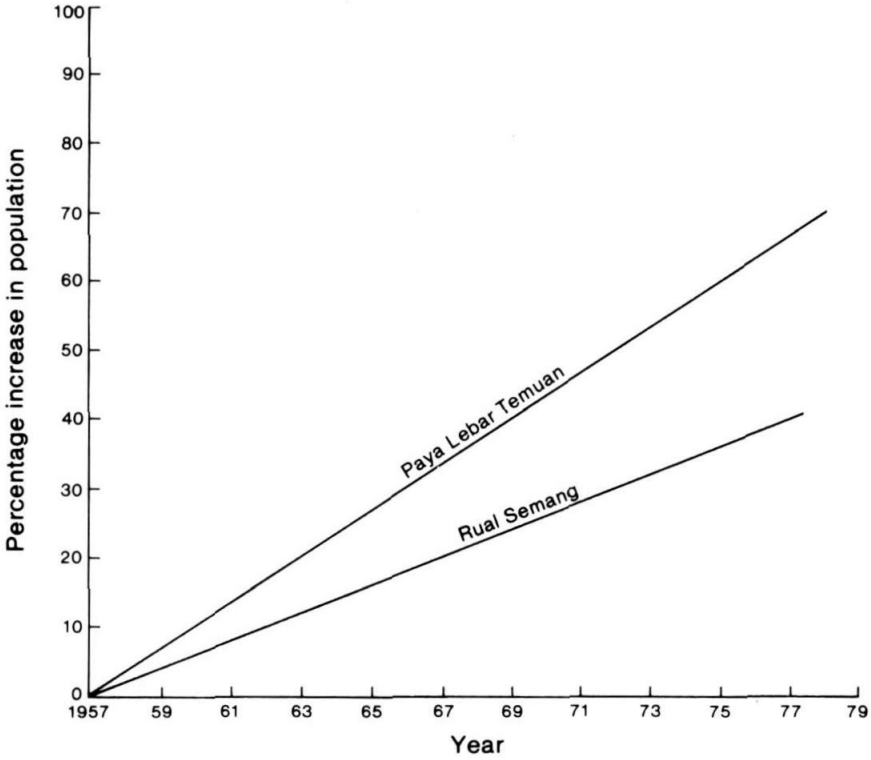

Figure 8. Cumulative percentage increase in Rual Semang and Paya Lebar Temuan populations.

tant in determining its fertility behavior, is influenced by the type of ecological adaptation. Specifically, farming societies assign a higher value to children than foraging or hunting-gathering societies. This general proposition is supported by this study as the horticultural Paya Lebar Temuans assign a higher value to children than the foraging Semang because, in their agricultural society, children are perceived as a potential source of labor. In contrast, the high demand for the women's time and effort in foraging activities and the difficulties of child transport in a mobile society favor the foraging Semang assignment of a low value to children.

The mortality patterns of these two populations also differ significantly, with a higher mortality rate for the horticultural Temuan population than for the foraging Semang, although this higher mortality rate is insufficient to offset the very high fertility rate of the Temuans. Disease is the single most important cause of death in both these populations, but the nature of the diseases afflicting such populations is influenced by demographic characteristics such

as density, size, and extent of movement. It is suggested that the sedentary horticultural Paya Lebar Temuan settlement with its relatively high population density allows disease pathogens to be spread more easily. In contrast, the traditional Semang foraging population was both very mobile and widely dispersed so that there was little opportunity for contacting and spreading disease. However, the situation changed after their resettlement. At present, the Rual Semang have a much higher population density than before. Moreover, the people are living in unhealthy conditions (overcrowded houses built close to one another, unhygienic scattering of wastes around their dwellings, and use of contaminated river water), which may have contributed to the high number of deaths in the past two years.

This study also provides some support to a number of theories relating population growth to ecological changes during the Neolithic period, such as the hypothesis that the increase in food supply, which followed the adoption of agriculture, initiated population growth (see Spooner 1972 for discussion of some of these theories). An alternative hypothesis (Lee 1972, Spooner 1972) suggests that the sedentarization that followed the adoption of agriculture may alone be sufficient to trigger population growth, because women may have children more frequently without an increase in work on their part and without reducing their ability to provide for each one. Data on the resettled Semang suggest that it may have been a combination of both agriculture and sedentarization that brought about Neolithic population growth. Adoption of agriculture, with its high labor requirement, has changed the value the Semang assign to their children and reduced the workload of women. Sedentarization, which accompanied their resettlement at Sungai Rual Post, has made it easier for women to have more children as they no longer face difficulties in child transport.

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