A NUTRITION STUDY OF THE INTERIOR, WEST COAST AND KUDAT DIVISIONS OF SABAH

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1981

1.7 For the ethnic groups that were ecologically studied in detail the prevalence of malnutrition was highest among the Rungus Dusun and Muruts who are also socio-economically the poorest, are dependant upon hill padi as a staple crop, and have the highest percentage (100% and 82.1% respectively) of unsanitary bush latrines.

1.8 The prevalence of malnutrition was intermediate in the upland Kadazan community in Ranau and in the coastal plains Kadazan community of Tuaran, the two Kadazan communities being socio-economically intermediate between the Rungus Dusun and Muruts on the one hand and the Chinese on the other. Both the Kadazan communities are dependent upon wet padi as a staple crop, the yield from wet padi being two to three times higher than that from hill padi. The Kadazan communities also exhibited an intermediate percentage of sanitary latrines.

1.9 The prevalence of malnutrition among the Chinese was found to be lowest, with only 5% of Chinese children exhibiting "significant" malnutrition. The Chinese were found to be socio-economically best off, had the highest percentage of sanitary latrines and were dependant upon cash crops, namely, pepper and rubber, rather than upon rice.

1.10 For all other ethnic groups including the Bisayas, Kadayans, Bajaus, Orang Sungai, Malays, Brunei Malays, Illanun, Javanese and Suluks, malnutrition is also fairly extensive, the overall prevalence of severe malnutrition for all ethnic groups being 4.5%. However, these groups were not ecologically assessed.

1.11 There seems to be a direct association between the extent of poverty present in a community, the lack of sanitation and the community's dependance on hill padi on the one hand, and the extent of malnutrition seen in that community on the other.

1.12 Food taboos do not seem to be important as far as children of the Rungus Dusun, the Muruts, the Kadazans of Ranau and the Chinese are concerned. It is only among the Kadazans of Tuaran that food taboos are important bars to children. However, similar studies were not carried out in other ethnic groups such as the Bisayas, Kadayans, Bajaus, etc.

1.13 Food taboos seem to be an important bar to pregnant and lactating women, and the effect of such taboos in subsistence economies, particularly among the Rungus Dusun and Muruts, should not be underestimated. However, similar studies were not undertaken for other ethnic groups such as the Bisayas, Kadayans, Bajaus, etc.

2. RECOMMENDATIONS

It is recommended that:

2.1 A multidisciplinary programme involving, at the minimum, the Ministries of Health, Education and Agriculture, be undertaken on a wide geographical basis, particularly

among subsistence farming communities dependant largely upon hill padi, such as the Rungus Dusun and Murut communities, to reduce the extent of malnutrition present in rural Sabah.

2.2 Supplementary feeding programmes for school children, particularly at the primary school level, be initiated and strengthened.

2.3 In the context of the "International Drinking-Water Supply and Sanitation Decade, 1981 – 1990", efforts be directed to increasing the number of rural communities provided with clean water supplies and sanitary toilets.

2.4 Immunization efforts against communicable diseases such as diphtheria, whooping cough, tetanus, tuberculosis, poliomyelitis and measles, be strengthened particularly in the more isolated and rural communities of Sabah.

2.5 Health education efforts to improve nutritional knowledge, particularly in respect of food taboos affecting the mother and child, be strengthened.

2.6 Ecological studies to better understand the basis for malnutrition in other ethnic communities such as the Bajaus, Bisayas, Kadayans, etc. be undertaken so that action programmes can take into consideration the different cultural backgrounds of each ethnic group.

2.7 A similar nutritional study be conducted in the Sandakan and Tawau Divisions of Sabah where ecological conditions are vastly different.

2.8 The extent of malnutrition in the Kudat, West Coast and Interior Divisions of Sabah be re-measured at the time of the mid-term review of the Fourth Malaysia Plan to indicate if efforts have had any material impact in reducing malnutrition.

CHAPTER 1

INTRODUCTION

The attainment of good health by a population is fundamental to the success of any programme aimed at the socio-economic improvement of that population. The improvement of health status of a population will not only lead to a betterment of the "quality" of life in general but also to the reduction of loss of working hours through illness and thus to greater productivity. In the younger age groups of the population, the maintenance of a high health status would lay the foundation towards a better and more productive community in the future.

One aspect contributing to the maintenance and achievement of good health status is nutrition. Thus, one of the stated aims of the Third Malaysia Plan is the

> "promotion of the general health of the population through improvements in the nutritional status..."

However, in order to plan and implement programmes for the improvement of nutritional status, studies have to be conducted to determine the prevalence of nutritional problems, to assess the magnitude of such problems and to locate the communities in which these exist.

A search of the literature has so far failed to reveal any definitive study on the nutritional status of any of the communities resident in Sabah. However, cursory descriptions of the food items consumed by the Dusun (Williams, 1968), Rungus Dusun communities (Appell, 1963) and Murut (Lebar, 1972) are available as parts of wider agricultural or anthropological studies. Appell (1968) also reviewed social and medical anthropological studies relating to diseases but little mention was made of nutritional problems. On the other hand, Peninsular Malaysia has been studied fairly extensively with regard to clinical, biochemical, anthropometric and dietetic aspects of nutrition (Burgess and Laidin, 1950; Thomson, 1960; Dean, 1961; McArthur, 1962; Chong, 1969; McKay, 1969; Chen and Dugdale, 1970) and nutritional studies have also been initiated in Sarawak (McKay and Wade, 1970).

Personal observations by members of the research team during a visit to Sabah in 1977, however, indicated that malnutrition seemed to be an important problem in rural Sabah and that there is a definite need to measure the extent of this problem, to pinpoint the geographical areas where it is a major problem, and to determine the causative factors that underlie the problem. Such a study would then form the basis upon which an Applied Food and Nutrition Programme can be developed by the Sabah Government.

Accordingly, an agreement was reached between the Office of the Director of Medical Services, Sabah, and the Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, whereby a joint nutrition study would be conducted initially in the West Coast, Interior and Kudat Divisions of Sabah, which contain 62% of the total population of Sabah, and that the relatively urban districts of Kota Kinabalu and Penampang would be excluded from such a study (Fig. 1).

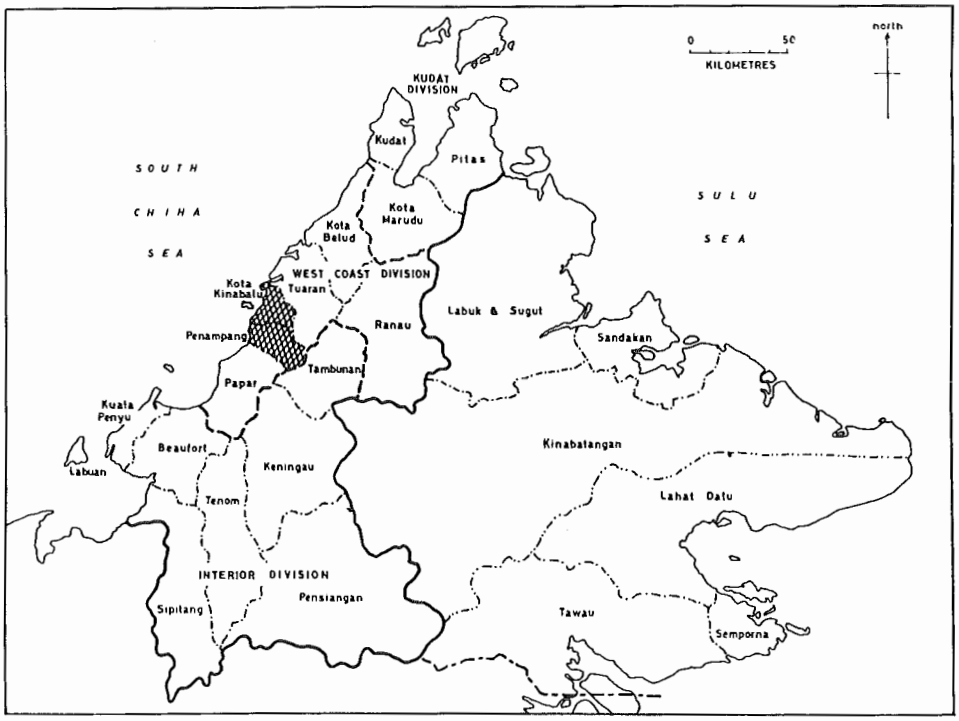

Fig. 1 *Map showing the Kudat West Coast and Interior Divisions in which the Nutrition Study was carried out.*

It was also agreed that the Department of Social and Preventive Medicine, University of Malaya, would contribute research expertise, some research equipment, and be responsible for data compilation and analysis, while the Office of the Director of Medical Services, Sabah, would furnish local transportation, field staff, laboratory equipment and facilities. Funds were obtained from both the University of Malaya and the Medical Department to conduct the study.

A research protocol was finalised in January 1978. Field work started in June 1978 and continued until April 1980. Compilation and analysis of the anthropometric, clinical and ecological data were completed by September 1980 and a draft report was completed by May 1981.

CHAPTER 2

THE STUDY AREA AND POPULATION

1. THE STUDY AREA

1.1 Geographic Location

Sabah covers an area of 29,388 square miles and occupies the whole of the north portion of the Island of Borneo. It lies between 115° and 119° 30′ longitude, and 7° 30′ and 4°N latitude. Its immediate neighbours are Sarawak, Brunei and Kalimantan, Indonesia. Sabah has a coastline measuring 900 miles. The South China Sea washes its western coast and the Sulu and Celebes Seas its eastern coast.

1.2 Terrain

Collenette (1963) described the four physiographic regions of Sabah which are now generally used (Fig. 2).

i) **The Western Cordillera** is a belt of mountainous country about 50 miles wide, parallel and close to the West Coast of North Borneo. It is the dominant physical feature of the country comprising four mountain ranges and the associated intermontane plains. The morphologic divisions of the Western Cordillera are:
(a) Crocker Range, (b) Trusmadi Range, (c) Witti Range, (d) Meligan Range part, (e) Intermontane Plains.

ii) **The Central Uplands** is a roughly triangular area of generally mountainous country enclosed by the Western Cordillera, the Eastern Lowlands and the Kalimantan border. It comprises (a) Labuk Highlands, (b) Melian Valley, (c) Kuamut Highlands, (d) Segama Highlands, (e) Kalabakan Valley, (f) Tawau Highlands.

iii) **The Western Lowlands** comprise the mainland and islands west of the Crocker Range. The subregions are (a) Crocker Foothills, (b) Crocker Plains, (c) Klias Hills, (d) Western Islands.

iv) **The Eastern Lowlands** is a broad irregular belt of country stretching from the Bengkoka Peninsula to Darvel Bay, the islands to the north of the Bengkoka Peninsula, and various islands and parts of the mainland to the south. The physiographic subregions are (a) Northern Islands, (b) Bengkoka Lowlands, (c) Kaindangan and Lokan Pene-plains, (d) Deltas (Eastern, Cowie, Sugut and Labuk), (e) Bongaya Hills, (f) Sandakan Peninsula, (g) Kinabatangan Lowlands, (h) Segama Valley, (i) Dent Hills, (k) Sebatik Island.

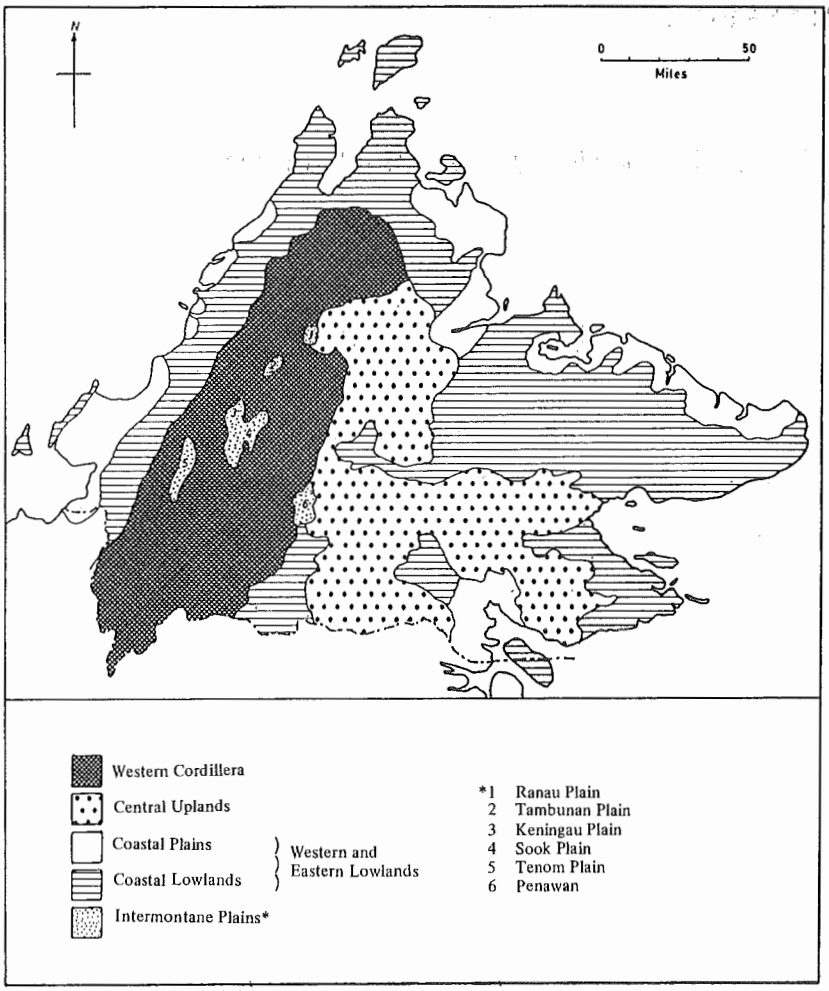

Fig. 2 *Main physical regions of Sabah.*

1.3 Climate

Sabah lies between 7° 30′ and 4°N latitude of the equator and therefore has an equatorial climate. The temperature generally is high with little variation. According to 1977 statistics the highest maximum temperature was 32.3°C recorded at the Kota Kinabalu aerodrome. The lowest minimum temperature of 1977 was 11.5°C recorded at the Kinabalu National Park, 1,622 metres above sea level.

1.4 Rainfall

During the months of December, January and February, the north east trade winds create heavy rains (over 30 inches) and are drawn south of the equator. This north east monsoon period causes heavy rains on the north east coast of Sabah, Sandakan, Semporna and Lahad Datu.

An intermonsoon period is experienced between March and May. During this time an inter-tropical front moves from the south and rain is experienced in the south western region of Sabah. During June–August, another monsoon period is experienced. This is due to the south east trade winds from south of the equator. These winds change direction from east to west as they pass the equator and cause heavy rains (over 20 inches)

Another intermonsoon period is between the months of September to November Winds are variable as the south west monsoon dies. Heavy rains are experienced on the coast of Sabah with the heaviest on the west coast (over 30 inches). The rainfall records for 1977 are shown in Table 1.

Table1

Rainfall records for 1977

	Total millimeters	Most in a day	Number of days
Labuan Aerodrome	3,193.5	110.0	208
Kota Kinabalu Aerodrome	2,465.5	123.3	179
Kinabalu National Park	3,364.7	120.6	239
Sandakan Aerodrome	3,385.3	330.7	209
Tawau Airfield	1,844.6	64.8	162

2. THE STUDY POPULATION

2.1 Some demographic data

Sabah has a population of 928,259 people (Sabah, 1977). Approximately 49% of the people live in the three divisions where this survey was conducted, namely, the Interior, West Coast and Kudat Divisions. This percentage is calculated with the exclusion of Kota Kinabalu and Penampang population which are considered too urbanized for the present study.

The overall sex ratio according to 1977 statistics is 116.4 males to 100 females. The age structure of the total population is shown in Table 2.

In the 1970 Census, rural areas are defined as all areas gazetted or otherwise, that had a population of 9,999 persons or less at the time of the census. On the basis of this definition, 83.5% of the people of Sabah live in rural areas and 16.5% live in towns (that have a population of 10,000 or more persons). The degree of urbanization of the various ethnic groups is given in Table 3 (Malaysia 1972).

Table 2

Age structure of population, Sabah 1970

Age group (years)	% of total population
0 – 14	47.2
15 – 24	16.5
25 – 34	13.9
35 – 44	10.4
45 – 54	6.4
55 – 64	3.5
65 – 74	1.5
75 & over	0.6

2.2 Ethnic Composition of Kudat, West Coast and Interior Divisions

Sabah has a great variety of indigenous groups along with a number of groups who have immigrated from other Asian countries. The predominant groups are the Kadazans 24.9%, Chinese 18.9%, Bajaus 11.2%, Malays 5% and the Muruts 4.1%. Tables 4, 5 and 6 show the ethnic group composition of each district of the three divisions concerned. Ranau and Tambunan Districts are almost pure Kadazan, with 96.6% and 96.7% respectively, the Pensiangan District is the home of the Murut people (99.8%) and the Bajau people predominant in the districts of the West Coast Division.

Kadazans

The largest ethnic grouping are the Kadazans (also known as Dusuns), who are subdivided into about 12 groups, named, in most cases, after a stream or river system (Lebar, 1972). They include:

1) On the west coastal plains:	2) In the interior foothills on upland areas:	3) On the east coast:
Putatan) the Papar) primarily Tuaran) irrigated- Penampang) rice Tempasuk) agrioulturists (Kadamaian)	Rungus (swidden agriculturists) Kiau Tegas (Tagas, Tahgas) Ranau) irrigated-rice Tambunan) on extensive upland plains	Idahan (who are Islamized Dusun)

Table 3

Population by community groups and degree of urbanization, Sabah 1970

Community	Urban area	Rural area
Kadazan	3.4%	96.6%
Other natives	6.2%	93.8%
Chinese	46.3%	53.7%
Others	22.4%	77.6%

Table 4

West Coast Division – ethnic group composition in each district

Ethnic Group	Ranau	Kota Belud	Tuaran	Kota Kinabalu	Penampang	Papar
Kadazan	96.6%	48.7%	58.1%	19.3%	61.3%	33.2%
Murut	*	0.8%	0.2%	0.6%	0.3%	0.2%
Bajau	0.3%	33.0%	26.2%	12.6%	9.8%	13.6%
Illanun	–	11.4%	*	*	*	*
Malay	0.2%	0.7%	0.9%	3.9%	3.0%	1.9%
Sulu	*	*	*	0.3%	*	*
Orang Sungai	0.4%	*	*	0.1%	*	0.2%
Brunei	*	*	0.5%	3.0%	1.2%	23.8%
Kadayan	*	*	*	0.2%	0.1%	2.1%
Bisaya	–	*	*	0.4%	0.1%	0.2%
Sino-Native	0.9%	0.4%	2.6%	4.2%	5.3%	2.8%
Others (Native)	*	1.6%	0.6%	0.5%	*	0.1%
Chinese	1.0%	2.8%	9.6%	47.0%	15.6%	15.8%
Others	0.5%	0.4%	1.6%	7.8%	3.0%	6.0%

* < 0.10%

Source: Annual Bulletin of Statistics, Sabah, 1977.

Making the situation more complex the Dusuns of the Kudat Division refer to themselves as **Momogun** (with the exception of the 'Banggi Dusun') and they are divided into sixteen or more different, localized and named subgroups differentiated from each other by dialectal differences and differences in customs. At the time of their work, Appell, G.B. and associates (1963) were able to locate and identify certain named sub-groups of the **Momogun** in the Kudat Division which include:

Lingkabau	Marigang	Nulu	Sensogun
Gansomon	Tobilung	Rungus	Tambanuva
Sinandapak	Tinagas	Garo	Talantong
Kavananan			

Table 5

Kudat Division – ethnic group composition in the three districts of Kota Marudu, Kudat and Pitas

Ethnic Group		Ethnic Group	
Kadazan	40.2%	Murut	*
Bajau	9.6%	Illanun	0.5%
Malay	0.7%	Lotud	*
Rungus	16.0%	Tambunan	0.7%
Dampas	1.2%	Maragang	0.8%
Paitan	*	Idahan	*
Minokok	*	Sulu	1.7%
Orang Sungai	4.5%	Brunei	1.0%
Kadayan	0.3%	Bisaya	*
Tidong	*	Sino-Native	0.9%
Others (Native)	4.1%	Chinese	14.3%
Others	3.6%		

$* < 0.10\%$

Source: Annual Bulletin of Statistics, Sabah, 1977

Boenisch-Burrough (1975 – 1976) in her discussion of the development of periodic markets in Sabah describes the Kadazans as being a people who for a long time have cultivated wet rice on irrigable sites on the coastal plains and in certain interior valleys, and have practised shifting agriculture (growing rice, tapioca, and tobacco) on the slopes of the mountain (Crocker) range. The Kadazans were and still are very well organised and a very stable indigenous group of Sabahans (Fig. 3 & 4). Probably because the dialects are similar and because those living on the coast had much to offer inland people and vice versa, a highland-lowland trade developed. It is not clear when the Kadazans arrived in Sabah but it is thought that they were part of a general drift of peoples out of Southern China to South-East Asia dating back to perhaps 3000 B.C.

Chinese

The Chinese people are the second largest group in Sabah. Fortier, (1958) discusses the origins of the Sabah Chinese. There are three major sub-groupings based on dialects and districts of origin: Hakkas from Kwang Tung Province are an overall majority, Cantonese comprise the second largest group, while Hokkiens and Fukienese from the Amoy area form the third group.

The Chinese are an industrious group of people and since their arrival have contributed greatly to the economy of Sabah. Most Chinese live in the urban areas and control most of the retail trade and transport facilities. They also provide clerical staff for commerce, technicians and labour in industry.

Table 6

Interior Division – ethnic group composition in each district

Ethnic Group	Kuala Penyu %	Beaufort %	Sipitang %	Tenom %	Pensiangan %	Keningau %	Tambunan %	Labuan %
Kadazan	41.8	14.7	3.3	9.1	0.1	58.0	96.7	3.1
Murut	0.5	3.0	28.3	55.1	99.3	24.4	0.1	0.4
Bajau	7.8	0.8	0.2	0.6	–	1.2	0.2	0.5
Malay	0.6	1.5	0.4	2.5	–	0.3	*	25.7
Paitan	–	0.5	–	–	–	*	–	–
Minokok	0.9	–	*	–	–	*	–	*
Sulu	–	*	–	*	–	*	–	0.2
Brunei	16.4	17.1	18.1	0.5	–	0.6	0.1	15.0
Kadayan	5.7	6.6	33.8	0.1	–	0.2	*	17.7
Bisaya	18.0	33.5	3.0	0.3	–	*	–	0.6
Sino-Native	5.0	2.6	1.8	0.8	*	2.7	1.4	1.0
Chinese	2.6	13.9	8.0	25.3	–	10.0	1.0	27.9
Others	0.5	5.8	3.1	5.6	0.5	2.3	0.4	7.6

* < 0.10%

Source: Annual Bulletin of Statistics, Sabah, 1977.

Bajaus

The term "Bajau" actually described a number of smaller sub-groups including the Illanun, Suluk, Obian and Binadan peoples. The Bajaus are united by their religion as

Fig. 3 *(right) Upland Kadazan bobolians (spiritual specialists) of Ranau treating a sick man.*

Fig. 4 *(below) Rungus Dusun dance being performed by a brightly attired man (left) and two girls.*

they are all Muslims. The Bajaus are said to have come from the Southern Philippine Islands. During the eighteenth and early nineteenth centuries the Bajau sea-farers with their pirate activities caused many problems in the Philippines-Celebes coast. The current situation of the Bajau people is described by Harrison, (1974). Over the years the Bajaus made a complete change from being "water gypsies" to expert rice farmers. Because of this, these people today are enjoying an earned period of prosperity and importance. In Sabah, the Bajaus have found a good amount of land for expansion around Kota Belud and today they are the largest population of that district.

Muruts

The Murut people (Fig. 5) are thought to have the same ancestry as the Kadazans. Like the Kadazans, a number of subgroups comprise the Murut people (Appell, G.N., 1968).

Fig. 5 *Murut children.*

The Northern Muruts are known as Tagal, Timogun, Semambu, Paluan, Nabai and Bokan. These groups are located in the Tenom, Pensiangan, Keningau and Sipitang Districts.

The Southern Muruts are known as Pa Matang and Mengalong Muruts, located at the uppermost reaches of the Padas River and the lower reaches of the Mengalong River. These two groups are referred to in Sabah as Lun Daya. Of unknown affiliations are the following:

Kolur Murut	– Head waters of Padas River
Bol Murut	– Middle Padas River area
Tengara Murut	– Upper Kuamut and Kinabatangan Rivers
Kalabakan Murut	– Kalabakan River, Tawau District and upper reaches of Kuamut River

Many of the Muruts, who are located in the Interior Division of Sabah, still depend on the forest for all their needs, for small game, root vegetables, fruits, tools and clothing. In recent times there has been concern over the Muruts as a dying race. This has been thought to be due to their poor health status and isolation. Their annual population increase is about half of that of the Kadazans and Chinese. Numerous attempts have been made by the government to relocate and resettle the Murut people so that more of the benefits of development can be enjoyed by them. It is uncertain as to the success of these efforts, although changing a people's way of life is bound to present numerous problems to all concerned.

2.3 Economic Status

According to the Sabah Annual Report, 1976 – 1977, the economy of Sabah is based mainly on agriculture and primary produce. Manufacturing industries are not abundant in the State. The objectives of the New Economic Policy are (1) to eradicate poverty, and (2) to restructure society. These objectives are hoped to be met through (1) improvements in productivity and the increase of employment opportunities for all Malaysians irrespective of race, and (2) correcting the present economic imbalance so as to alleviate and eventually eliminate the identification of race with economic function.

Sabah is similar to many developing nations of the world. Its economy is predominantly agricultural and trade orientated, and it has characteristics of dualism, market fragmentation and an uneven distribution of income.

The Third Malaysia Plan for Sabah was directed towards:

i) Achieving a rapid economic growth and a higher standard of living;
ii) Reducing socio-economic imbalance;
iii) Increasing employment opportunities;
iv) Building up an efficient infrastructure system;
v) Achieving food self-sufficiency.

2.4 Labour Force

The total labour force according to 1970 statistics is 50% of the total population. Table 7 shows the percentage that each race contributes to the labour force.

Kadazans contribute a greater percentage of people to the labour force than the Chinese do. However, for administrative and managerial tasks, the Chinese contribute 63.2% while Kadazans contribute 6.7% of the labour force, while their contributions in the field of agriculture and animal husbandry are 5.8% and 41.1% respectively.

2.5 Communication Problems faced by the People

Paramount to the rate of development of a nation is its ability to communicate with its people and for its people to have access to the world outside their town or village in the form of newspapers, radio, schools, medical facilities, marketing facilities, etc. An

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Table 7

Percentage of labour force by ethnic group

Ethnic group	Percent of labour force
Kadazan	31.4%
Murut	5.8%
Bajau	9.8%
Malay	3.6%
Other Indigenous	16.6%
Chinese	19.9%
Indonesian	6.5%
Others	6.3%

adequate infrastructure, systems of roads, airfields; railways, telecommunications and public services forming a basis for information exchange is conducive to a high level of communication.

There are many dimensions to the communication difficulties in Sabah. The mountainous terrain which slows down road construction, the tropical climate with unpredictable monsoon rains and the diversity of its people who contribute a multitude of languages are a few of the conditions which form communication barriers among the inhabitants of the State.

These barriers, of course, are not insurmountable and much has been done in recent times to meet the challenges and improve information exchange and market conditions.

Many miles of sealed roads have been constructed in the past few years to improve the transportation situation. Table 8 shows the increase in road mileage from 1968 to 1977.

Table 8

Road construction in miles during 1968 – 1977

Year	Road construction in miles			
	Total	Metalled and sealed	Gravelled	Earth
1968	1,592	299	922	371
1970	1,796	322	1,112	362
1972	1,954	375	1,217	362
1974	2,321	610	1,368	343
1976	2,453	740	1,450	263
1977	2,550	763	1,496	291

With the increase in metalled and sealed roads, the heavy monsoon rains will not so often impede transportation. Air transport is available to the major cities. Railways exist through the impressive Tenom Gorge in the south western region of the State. Radio and television have recently become available at an ever increasing rate to even the most remote areas of the State.

Few will doubt that the understanding of one's environment and the world outside one's country is enhanced by good communication systems. Sabah has much to overcome in this area but is progressing at a steady pace.

The government fully recognizes the communication constraints from ethnic differences and is doing much to improve this condition. This can be seen by the attempts to unify the different groups by encouraging the study of the national language among all persons especially those in the most remote areas so that they will have the ability to understand and contribute to community affairs throughout the State and Country.

CHAPTER 3

OBJECTIVES

It was decided that the purpose of the study would be:

1. **By Direct Nutritional Assessment**

to determine the status of nutrition amongst a sample population in the West Coast, Interior and Kudat Divisions of Sabah by the use of:

(1) anthropometric indices.
(2) clinical examinations.
(3) biochemical (laboratory) indices.

2. **By Ecological Assessment**

to determine the ecological factors which might have led to the occurrence of the above in a few selected communities by a study of:

(1) the dietary intakes of selected communities in the West Coast, Interior and Kudat Divisions of Sabah.

(2) the socio-economic levels of families in these selected communities.

(3) the socio-cultural practices influencing food consumption patterns.

(4) food production, food distribution and availability in these selected communities.

(5) the pattern of infections in these communities and the possible effect on their status of nutrition.

3. **By a Simplified System of Data Presentation**

to describe the "qualitative" and "quantitative" findings of the above studies so that these could be:

(1) simply presented to both health service personnel as well as administrators.

(2) used as base-line bench marks to be compared with findings of follow-up studies which may be conducted later on so that improvements or deterioration in nutritional status can be readily determined.

CHAPTER 4

METHODOLOGY

In order to fulfil the objectives outlined in Chapter 3, the study was divided into two parts, viz. (a) Direct Assessment of Nutritional Status, and (b) Ecological Studies. The first part consisted of three concurrent studies which attempted to determine the nutritional status of the study population by anthropometric, clinical and laboratory methods.

1. DIRECT ASSESSMENT OF NUTRITIONAL STATUS

1.1 Sampling Techniques

Since no detailed maps of the various rural areas of the three divisions and no detailed population figures were available, it was decided that a sample study population would be obtained by utilising government Village Group Sub-Centres (VGSCs) and primary schools as sampling "clusters".

Accordingly a list of all VGSCs in the three selected divisions was obtained. There were 113 VGSCs available. These VGSCs were arranged in alphabetical order by names and were then serially numbered. Utilising a table of random numbers, 35 VGSCs were then randomly selected for study (Fig. 6). This amounted to 31.0% of the 113 VGSCs available. Subsequently, as part of the ecological study, anthropometric, clinical and laboratory examinations were conducted on the under-13 population in the VGSCs and primary schools in three samples selected for the ecological study. The results from these additional three samples were amalgamated with those obtained from the random sample of 35 VGSCs originally obtained – thus making a total of 38 VGSCs used as sampling "clusters".

It was noted that the bulk of the population attending the VGSCs were those from infancy to about five years of age. In order to obtain the population from six to twelve years of age, it was decided to study the population in a "primary school which is located closest to the sampled VGSC".

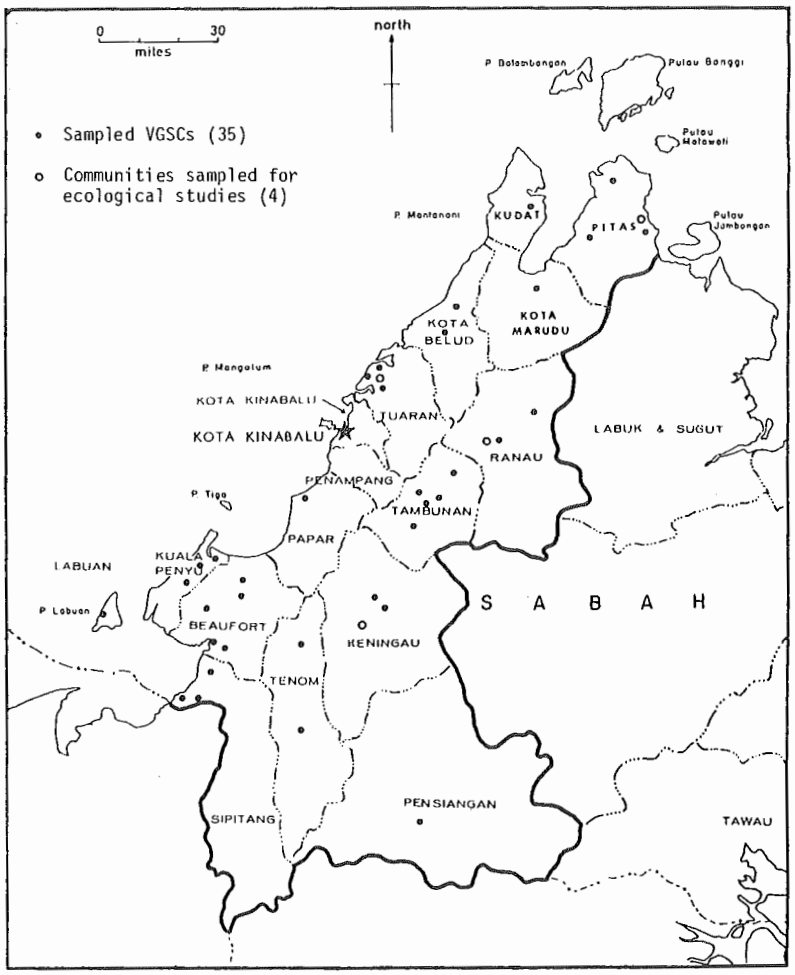

Fig. 6 *Map showing the location of the 35 village group sub-centres (VGSCs) which formed the sampling clusters for the anthropometric, clinical and laboratory studies, and the four sites sampled for ecological studies.*

1.2 The Study Population

A total of 3,672 children were examined in the following categories from both attendance at the sampled VGSCs and primary schools located closest to the sampled VGSC:

0 – 4 years	both sexes	795
5 – 12 years	male	1,475
5 – 12 years	female	1,402
	Total	3,672

The size and composition of each sampling "cluster" are shown in Table 9 and Table 10.

Table 9

Number of children according to geographical location, age and sex, who were sampled for anthropometric, clinical and laboratory studies

Geographical location	Number of children by age and sex			Total Number
	< 5 years	Males 5 – 12 years	Females 5 – 12 years	
Labuan	59	66	46	171
K. Penyu	125	114	133	372
Beaufort	75	182	179	436
Sipitang	17	91	104	212
Pensiangan	21	40	18	79
Tambunan	81	268	272	621
Keningau	49	109	87	245
Tenom	67	58	60	185
Pitas	43	139	99	281
Kota Belud	76	66	66	208
Tuaran	24	113	111	248
Kota Marudu	60	19	32	111
Ranau	82	139	143	364
Kudat	4	27	19	50
Papar	12	43	29	84
Indeterminate	0	2	3	5
Total	795	1,475	1,402	3,672

1.3 Anthropometric Measurements

Anthropometric measurements are direct reflections of environmental influences, particularly nutrition. These measurements are often used in nutritional surveys for the direct assessment of the nutritional status of a community. Various measurements such as weight, height, arm circumference, skinfold thickness, etc. are obtained and compared with some standards. The results are then presented, using accepted international classifications.

Standards

There has been considerable controversy over the choice of reference populations as standards for comparison. It was felt that international standards such as the Harvard standards should not be used in less developed countries, as the targets would be set at an unrealistically high level, which were beyond these children genetically. Local stan-

Table 10

Number and % of children, by ethnic group, age and sex, upon whom anthropometric, clinical and laboratory studies were performed

Ethnic group	Number of children by age and sex			Total	
	< 5 years	Males 5 – 12 years	Females 5 – 12 years	No.	%
Rungus Dusun*	18	50	36	104	(3.3)
Murut*	40	88	55	183	(5.0)
Kadazan*	382	696	705	1,783	(48.6)
Chinese*	26	29	37	92	(2.5)
Bisaya	42	162	152	356	(9.7)
Bajau	50	110	101	261	(7.1)
Kadayan	45	114	102	261	(7.1)
Malay	45	36	23	104	(2.8)
Brunei	45	26	23	96	(2.6)
Illanun	27	27	20	74	(2.0)
Orang Sungai	4	25	15	44	(1.2)
Sino-Kadazan	26	39	56	121	(3.3)
Javanese	12	11	10	33	(0.9)
Suluk	0	9	12	21	(0.6)
Other	33	53	53	139	(3.8)
Total No.	795	1,475	1,402	3,672	–
Total (%):	(21.7)	(40.2)	(38.2)	–	(100.1)

*Ethnic groups among whom ecological studies were carried out.

dards developed by individual countries, would be more appropriate. However, the construction of local standards would probably not be achievable by most developing countries in the near future. The use of local standards would also make international comparison impossible.

Various studies have shown that "well-fed people of various ethnic groups tend to approximate to standards..... similar to those found in well-nourished Caucasians in Europe and the United States" (Jelliffe, 1966). Other studies (MacWilliams and Dean, 1965; Greulich, 1957; Chong, 1967; Caasi, *et al*, 1964) have shown that well-nourished Africans, Japanese, Chinese and Filipinos approached remarkably close to the United States standards. With the above factors in mind, it was decided that international standards would be used in this study for the purpose of comparison. The standards used were obtained mainly from Jelliffe (1966) and also from Nelson (1964).

Selection of Anthropometric Indices

Of the many anthropometric measurements available, weight and height are probably the most sensitive measures of nutritional status, especially in the case of children (Waterlow, 1976).

The most widely used index is weight for age and this has been the basis of various classifications of protein energy malnutrition (Gomez, 1956; Jelliffe, 1966; Bengoa, 1970). However, this index is dependant upon obtaining the precise age of the subject. It also does not take into account the weight of the child in relation to its height, which may be retarded due to past malnutrition. Thus weight for age will measure both current as well as past malnutrition, while weight for height is a better reflection of current nutritional status.

The extent of height deficit in relation to age is a measure of the duration of malnutrition especially in terms of the past nutritional history. Other indices of value in the assessment of nutritional status, are the left mid-upper arm circumference and the left triceps skinfold thickness for age. The mid-arm circumference is an indirect and rough measure of muscle mass. The skinfold thickness, on the other hand, probably reflects the caloric reserve of the individual.

In this study, five indices were chosen to measure the nutritional status of the various communities, namely, weight, height, arm circumference and skinfold thickness for age, and weight for height.

a. Weight for age

Jelliffe (1966) used 90% of the standard weight for age (Harvard standards) as the cut-off point with four levels of under-nutrition. The first three levels from 61 to 90% of the standard were classified as mild-moderate malnutrition while levels below 60% were indicative of severe malnutrition. The Wellcome Working Party (1970), on the other hand, used 80% as the cut-off point. It is felt that the above two cut-off points are a little too high for our present study population. In this report, levels below 70% of standard will be considered as "significant" malnutrition while those below 60% are considered as severe malnutrition. The standards used will be the 50th percentile of the Harvard standards.

b. Weight for height

This index reflects the degree of wasting which can be graded into four degrees of severity (Waterlow, 1976).

Wasting:
- Grade 0 = 90% & above weight for height (Harvard standard)
- Grade 1 = 90 – 80% weight for height.
- Grade 2 = 80 – 70% weight for height
- Grade 3 = less than 70% weight for height

c. **Height for age**

Waterlow (1976) also classified height for age into grades of stunting.

Stunting: Grade 0 = 95% & above height for age (Harvard standard)
Grade 1 = 95 – 90% height for age
Grade 2 = 90 – 85% height for age
Grade 3 = less than 85% height for age

It is felt that 95% of standard is too high a level for the study population. The cut-off point is lowered to 90% of standard. Waterlow also suggested the cross-tabulations of the two indices, weight for height and height for age.

		Grade of wasting			
		0	1	2	3
Grade of stunting	0	Normal	Acute malnutrition		
	1				
	2	Nutritional dwarf	Stunted and wasted		
	3				

The children can thus be divided into four broad categories:

i) normal
ii) wasted but not stunted (acute malnutrition)
iii) stunted but not wasted (nutritional dwarfs, including children who have recovered from malnutrition)
iv) wasted and stunted

The last category tops the priority list for action, followed by the children with acute malnutrition. The nutritional dwarfs probably do not require any urgent attention but they would help to identify the vulnerable groups for future preventive programmes.

d. **Left mid-upper arm circumference for age**

Jelliffe and Jelliffe (1969) used 80% of standard as the cut-off point for malnutrition, which was further divided into three levels:

Mild = 80 – 71% of standard
Moderate = 70 – 61% of standard
Severe = 60% and below

The standards for arm circumference were obtained from Jelliffe's monograph (1966) where the tables were adapted from Wolanski's unpublished data.

e. **Left triceps skinfold thickness for age**

The malnutrition borderline was set at 30% below the standard (WHO; 1972). The standards were obtained from Jelliffe's monograph (1966).

Equipment

The equipment used to obtain these anthropometric measurements were as follows:

a. **Weight**

Although it was noted that beam balances were most accurate in weight measurements, no models were available which were portable enough for the use of the field team. Hence spring balances were used both for weighing infants as well as older children. However, at the start of each session, the spring balances were calibrated with standard weights to ensure accuracy as far as possible. Weights were measured to the nearest 0.1 kg.

b. **Height**

For the measurement of height for older and school children, a "microtoise" was used (Fig. 7). This is an instrument (manufactured currently by Stanley-Mabo of Besancon, France) which incorporates a steel measuring tape together with a right-angled plastic device for ensuring the proper angle of measurement is maintained vis-a-vis the top of the child's head and the wall or pillar against which, he is standing. The tape of the microtoise is hung two metres from the floor and readings are made directly via a window in the tape housing. Measurements to 0.1 cm are possible. For infants, a portable specially designed infantometer was used.

Fig. 7 *The height of a child being measured with the aid of a microtoise*

c. **Mid-upper arm circumference**

A fibre-glass measuring tape (in cm.) was also used for this measurement according to the method given in WHO Monograph No. 53 (Jelliffe, 1966). Measurements were made to the nearest 0.1 cm.

d. **Triceps skinfold thickness**

A Harpenden model skinfold calipers was used for this measurement (Fig. 8) and three readings were taken and the average accepted as the result. The method used is given in the WHO Monograph No. 63 (Jelliffe, 1966).

Fig. 8 *The triceps skinfold thickness being measured with a pair of Harpenden skinfold calipers.*

Field Work

In order to conduct the anthropometric, clinical and laboratory studies, a team was assembled. At each VGSC or school, the field team would rearrange the pieces of furniture to permit a flow of subjects so that measurements could be made as quickly as possible. The flow would begin with registration as a subject presented himself/herself together with his/her birth certificate and clinic card in the case of VGSC subjects, and in a school, the name of the school child was checked with the school register with regard to sex and date of birth. The child's name, sex, date of birth, and village were then recorded on the prepared data card (Appendix 1). The child with his data card was then directed along the flow so that anthropometric measurements could be made. Results of these measurements were recorded in the appropriate places on the data card. A clinical examination was then conducted on the child to determine the presence of any signs of malnutrition. Finally, a sample of blood was then taken for haemoglobin and haematocrit determinations. A urine sample bottle was then given to the child so that a sample may be obtained for later examination.

Results recorded on individual data cards were then transferred to group data sheets (Appendix 2) on which were recorded the results for 25 children. These group data sheets were then sent to the Department for punching onto IBM 80-column punch cards. Via these punch cards, the data was then stored onto magnetic discs. Programmes were formulated for various listings and calculations to be made. Output from the computer were then translated into a graphic format for clarity, ease of understanding and to show trends.

Data Presentation

Traditionally, anthropometric data are presented according to percentiles for scientific and academic purposes. Since this report is a working document, the traditional style is not used.

A graphic method of presentation (without the use of percentiles) would be the simplest and clearest way of indicating the results of the study both to health or nutrition personnel as well as to administrators. Thus this has been adopted as the method of data presentation and tables will be kept to a minimum.

The processed data will be considered under three headings:

a. Summary data of all the subjects examined, that is, average values together with ± one standard deviation by age and the proportion (percentage) of subjects examined who achieve anthropometric measurements below or above the standard for a particular age group.

b. Anthropometric measurements of all subjects according to ethnic group.

c. Anthropometric measurements of all subjects according to location.

1.4 Clinical Examination

Physical examination for clinical signs of nutritional or deficiency diseases was conducted for each subject following the sequence of anthropometric measurements. Each subject was fully examined and special attention was paid to finding signs of nutritional disease as detailed on the data card (Appendix 3). In cases of doubt, the illustrations given in WHO Monograph No. 53 (Jelliffe, 1966) were referred to.

1.5 Laboratory Examinations

Blood and urine samples were collected from subjects examined during the anthropometric survey (Fig. 9 & 10). Where possible, five ml. of venous blood were collected; where not possible, samples from finger pricks were collected.

Haemoglobin and Haematocrit

Haemoglobin and haematocrit determinations were carried out as soon as possible after the anthropometric examinations. Haemoglobin was determined by the use of a calibrated colorimeter, whilst the haematocrit was determined by the capillary-tube

Fig. 9 *General view of research staff and patients.*

Fig. 10 *A laboratory assistant collects a blood sample from a child for biochemical analysis.*

(Hawkes') method utilising a specially fitted centrifuge and a haematocrit value reader. The laboratory facilities of the dispensary or the nearest district hospital were usually utilised to conduct these determinations as electricity supply was normally available at these facilities.

Larger samples of blood (five ml) and the urine samples were preserved and stored in refrigerators available at the various dispensaries and district hospitals for transhipment as fast as possible back to the central laboratories at Kota Kinabalu. At the central laboratories, these samples were frozen for subsequent biochemical determinations.

Biochemical Determinations

Biochemical determinations conducted on blood and urine samples at the central laboratories included:

a. Serum protein
b. Serum albumin
c. Urine urea nitrogen
d. Urine creatinine

Biochemical Indicators of Malnutrition

Criteria used as indicators of malnutrition for the above were as follows:

a. A serum protein level below 6.5 gm % was considered low (ICNND, 1963)

b. A serum albumin level below 3.5 gm % was considered as below the satisfactory level (ICNND, 1963)

c. A ratio between urinary urea nitrogen and urinary creatinine of less than five would indicate a recent history of unsatisfactory intake of dietary protein (Dugdale, 1964 and Arroyave, 1966).

1.6 Limitations

A study of this dimension which involved the examination of some 3,700 children located in three divisions and which was planned and executed by two agencies (the Sabah Medical Department and the Department of Social and Preventive Medicine, University of Malaya) which are separated by some 800 miles would definitely incur some limitations, errors and pitfalls. It is the purpose of this section to discuss briefly these limitations and errors so that the reader will be able to appreciate the data and conclusions presented here.

The Study Population

Even though the VGSCs were randomly selected, the population who came and presented themselves for examination was, in a manner, self-selected. Similarly the school population could only be examined if the parents of the children gave permission for examination to be done. However, refusals were extremely uncommon.

The number of children who were presented for examination at the VGSCs varied from location to location, this being influenced by the following factors:

a. Some of the VGSCs included in the sample served small populations and as such children of five years and below were few in number.

b. Mothers brought mainly infants for examination and tended to leave the toddlers and pre-school aged children at home. Some who lived nearby were asked to go home to fetch the other children.

c. Inclement weather also prevented good attendance at some VGSCs as roads tended to become muddy in some areas.

d. Some of the infants and children brought to the VGSCs by the mothers were terrified of the various instruments used and some measurements had to be abandoned as it was not possible to obtain stable measurements from a crying and squirming child. Even older children exhibited such behaviour. Thus the total number of subjects for each measurement varied and this is reflected in the final data presented.

To minimise the above limitations, return visits had to be made both to VGSCs and schools in order to obtain a better response. In the same manner as in the original plan, these return visits could only be made during the "child health session" days of these VGSCs. Thus, the field studies took approximately 15 months to complete.

Anthropometric Measurements

The most severe limitation concerning the equipment used for anthropometric measurements was the unavailability of a suitable beam balance. Thus spring balances were used. However, they were "standardised" each day by checking with weights.

Laboratory Examinations

Although specimens of blood and urine were collected in bottles already containing preservatives, these had to be chilled for transportation. In some areas where electricity supply was not constantly available the whole day, kerosene refrigerators of the VGSCs had to be used. Occasionally, these were not functioning.

2. ECOLOGICAL ASSESSMENT

A nutritional assessment of a community is incomplete without a study of the various ecological factors which play a part in the aetiology of malnutrition in that community. Malnutrition is usually not due to a simple lack of food in a community, although it is an important contributory factor. It is more often due to various socio-cultural practices which influence the food consumption pattern of a community, socio-economic factors which determine purchasing power, factors influencing food production, food storage and food distribution and the effects of infections prevailing upon the people. These ecological factors are usually unique to each community and geographical region.

The effective prevention of malnutrition in a community calls for the identification of these factors and the adoption of a comprehensive and interdisciplinary approach to solve the problem. As an initial step, a research design was developed and a research protocol was prepared. It included the selection of samples, site visits and the training of research assistants. Questionnaires were developed for dietary studies, the study of food ideology and the study of socio-economic factors and factors influencing the production, distribution and availability of food supplies.

2.1 Sampling Techniques

Due to financial and time constraints, it was decided that only five communities could be ecologically studied, and that these would be identified in a two-stage process. In Stage I, the 15 districts of the three divisions would constitute a sampling frame from which four districts would be randomly selected. In Stage II, by means of cluster sampling, one cluster would be selected within each district, each cluster would then constitute the community to be studied ecologically.

In the above manner, four clusters composed of geographically well-defined communities were selected composed of the following communities shown in Table 11:

(1) A Rungus Dusun community in Pitas District composed of two long-houses located near each other in the village of Sinukab, situated on the northern end of the strip of coastal lowlands running along western Sabah (Fig. 11).

(2a) A Murut community composed of 89 households located in the village of Ulu Ansip in Keningau District.

(2b) An adjacent Chinese community composed of 27 households located in Kuala Ansip next to the Murut village in Keningau District.

Table 11

List of the five communities selected for ecological studies showing the number of households sampled and the number sub-sampled for detailed dietary studies

District	Ethnic group	No. of villages	No. of households sampled	No. sub-sampled for dietary studies
Pitas	Rungus Dusun	Sinukab	33	7
Keningau	Murut	Ulu Ansip	28	28
	Chinese	Kuala Ansip	10	10
Ranau	Upland Kadazan	(Libang) (Marakau) (Tudangan)	100	32
Tuaran	Coastal plains Kadazan	(Labuaya) (Roun)	100	29
Total			271	106

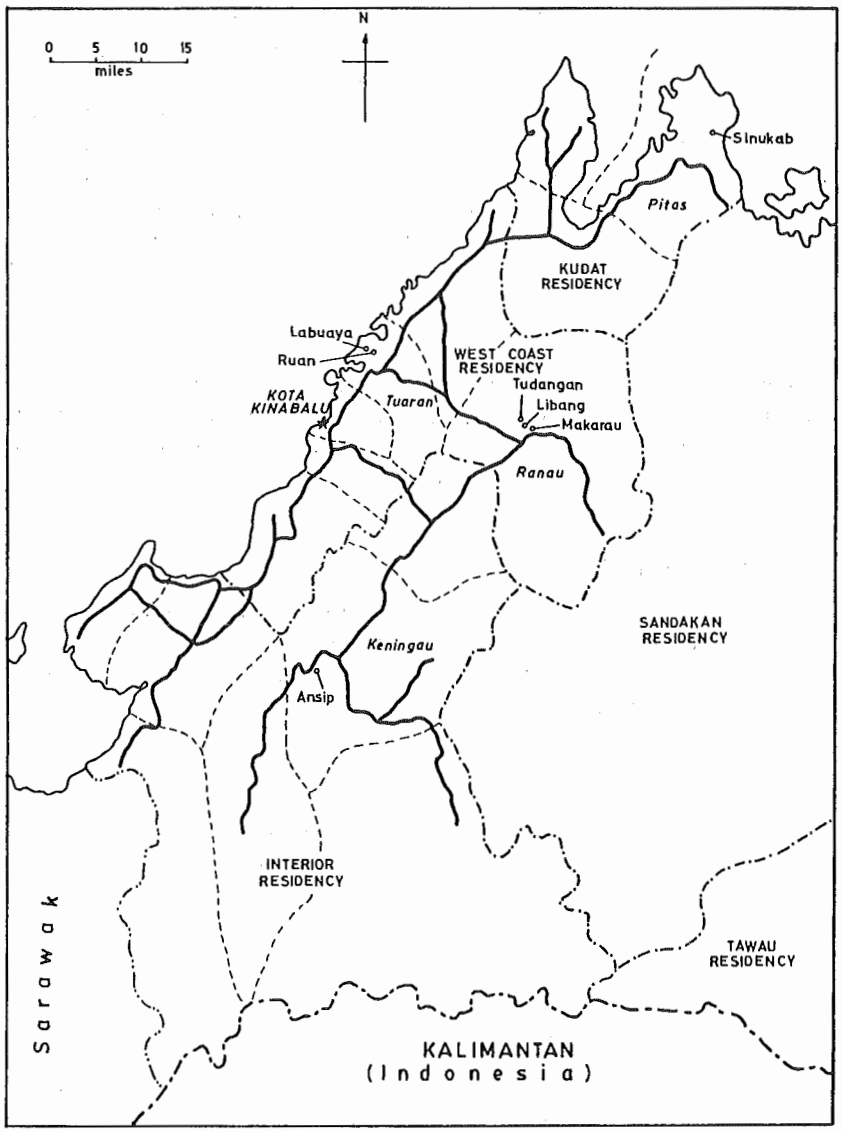

Fig. 11 *Map showing communities where ecological studies were carried out.*

(3) An upland Kadazan/Dusun community in Ranau District composed of 100 households located in a single valley and made up of the villages of Libang, Marakau and Tudangan on the edge of the Central Uplands.

(4) A coastal plains Kadazan/Dusun community in Tuaran District composed of 100 households located in a single area and made up of the villages of Roun and Labuaya.

Out of the five communities studied, the Rungus Dusun, Murut and Chinese communities are ethnically homogenous. In the case of the two larger Kadazan/Dusun communities in Tuaran and Ranau, there were a few Chinese and Bajau families, but these have been excluded from the study. Further, even though the bulk of those in Kadazan community in Tuaran are composed of coastal plains Kadazans while the bulk of those in Ranau are composed of upland Kadazans, a small proportion of the Kadazans have come from other districts such as Papar, Keningau and Penampang mainly through marriage. Nevertheless, it can be assumed that at least 97% of the Kadazans in the Tuaran community are coastal plains Kadazans while those from the Ranau community are upland Kadazans.

It should also be pointed out that for the Kadazan community in Tuaran 48% of the households adhere to the traditional religion, 44% are Christians and 8% are Muslims. In the case of the Ranau community, the households are equally split among those of Christian faith and those of the Islamic faith.

2.2 The Study Communities

Ecological assessment was thus carried out on five ethnic groups (Table 11) namely, the Rungus Dusun of Sinukab, Pitas; the Muruts and Chinese of Ansip in Keningau; the upland Kadazans of the villages of Libang, Marakau and Tudangan, in Ranau; and the coastal plains Kadazans of Labuaya and Roun villages in Tuaran.

2.3 Data Collection

Five research assistants were involved in these studies. Each of them was assigned to one of the five communities for two to six weeks and was supervised by at least one member of the research team. Of the five, three were graduates with a minimum of a Bachelor's degree while two were under-graduates in the final year.

2.4 Dietary Studies

The dietary intake of the households were carefully studied using a combination of techniques. A 24-hour recall method of the food consumed by the household was obtained using a standard dietary questionnaire (Appendix 4). Observations of food preparation and cooking methods were carried out by the research assistants whenever possible.

The weights of food portions were obtained using food balances. In the case of canned food, the weights stated on the labels were used. The quantities of food were often given in local household measures and were subsequently converted to grammes.

2.5 Food Ideology

Detailed inquiries were made into the various traditional beliefs and taboos prevalent in the different communities and the effects, if any, on the food consumption

pattern of the people (Appendix 4.5 & 4.6). Concepts of food and of food classification were inquired into, with special emphasis on the vulnerable groups, namely, the toddlers, pregnant women and women in confinement.

An extensive list of food items was used to interview the respondents (Appendix 4.7 – 4.10). The foods were classified as highly beneficial, neutral, negative or taboo, and highly negative or must taboo, according to the degree of belief held by the people.

2.6 Socio-economic Status

A questionnaire was used to obtain information on the socio-economic status of the selected households (Appendix 4.1 – 4.4). Data concerning household income, possessions, occupation, level of education and the use of land for cultivation were collected.

2.7 Food Production, Distribution and Availability

Data was obtained from the various government bodies such as the Department of Agriculture, Veterinary Department, Fisheries and the Marketing Authorities, to determine the levels of food production and distribution in the various communities.

A survey of the local markets and provision shops was conducted in each community. A price list of the food sold in these places was made and the range of food items which were available to the residents was also noted.

2.8 Pattern of Infections

Vital and morbidity statistics for the whole of Sabah were compared with Peninsular Malaysia to determine relative risks. Statistics from hospitals in three of the districts were also obtained to ascertain the burden of infection especially among the vulnerable group below the age of five years.

2.9 Data Analysis

Data collected in the field were analysed in Kuala Lumpur. The data was sorted out by hand and compiled. From the data on dietary studies a picture of the food consumption pattern of the different communities was obtained. This is reflected in the meal patterns, the common sources of nutrients and the adequacy of the various nutrients in the diets. Food items were classified according to their beneficial, neutral or harmful values. The types of food and the number of items which were forbidden to the three vulnerable groups will have an effect on the nutritional status of the affected group. Data on socio-economic status were analysed to obtain indices such as mean monthly household income, monthly income per head, incidence of poverty, occupational status, educational status and acreage of land under cultivation.

2.10 Limitations

Due to unforeseen circumstances, the original research assistants were not able to

conduct the study as planned. Of five research assistant who were finally used, three have at least a Bachelor's degree while two were final year under-graduates. However they came with varying backgrounds and expertise. Two were trained in nutrition and one each in social science, economics and health education. This may have given rise to differences from varying backgrounds, techniques, skills and experience. These differences have been offset to a certain extent by the use of standard formats and questionnaires for the study.

The reliability of the 24-hour recall method for the dietary studies is subject to certain errors such as memory lapse and some degree of under- or over-estimation, whether intentional or unintentional, may occur.

In some instances, food wastage, either during preparation, cooking or thrown as plate, waste, was not recorded. Some items such as cooking oil, which have high caloric significance, were not always recorded in the dietary studies. The study also assumes equal distribution of food within the family and therefore does not take into account variation in individual food intakes.

However, the most important limitation of the 24-hour recall method of dietary study is that seasonal variation will not be taken into account. Due to both financial and time constraints and the availability of field assistants, most of the dietary studies were carried out soon after the harvest. Consequently, the adequacy of nutrient intake is relatively high for the communities studied. However, it should be borne in mind that, particularly in respect of the Murut and Rungus Dusun communities that cultivate hill padi as opposed to wet padi, yields are low and there is usually only sufficient rice to last about half a year. Thus there is a need to repeat the 24-hour recall studies during different times of the year. However, this was not possible for the reasons stated.

CHAPTER 5

DIRECT ASSESSMENT OF NUTRITIONAL STATUS

The results of direct assessment will be presented in three sections, i.e. anthropometry, clinical examination and laboratory examination. In the case of anthropometry, summary data for the whole study population will be presented first to give an overall picture of the magnitude of the problem. This will be followed by a comparison of the results by ethnic group, with special emphasis on the four main communities included in the ecological assessment, the Rungus Dusun, Muruts, Kadazans and Chinese. The results of anthropometry by location will also be looked at in order to identify "problem" areas.

1. ANTHROPOMETRY

The results will be presented under each of the five indices, i.e., weight for age, weight for height, height for age, left mid-upper arm circumference for age and left triceps skinfold thickness for age. Each index will be described qualitatively as well as quantitatively; qualitatively by comparing the mean values with those of the standards chosen, and quantitatively in terms of the percentage of the study population who are considered malnourished according to the criteria chosen.

1.1 Summary Data for Study Population

a. Weight for age

Fig. 12 and 13 show the mean weight for age and standard deviations for the study population for males and females respectively. For children below the age of five years, the findings for both sexes are presented together.

Below the age of three years (Fig. 12), the mean weight ±1 standard deviation (S.D.) at the different age groups are well above 70% of standard, indicating that "significant" malnutrition is not a problem in this group. Above the age of three, the mean weight begins to falter, indicating that some of the children are probably suffering from malnutrition. In the age group five to twelve years, the mean weight for age for the males show further slackening in the rate of growth, although remaining above 70% of the standard. The mean weight minus 1 S.D., however, lies below 70% of standard in most age groups. The same trend can be seen among the females (Fig. 13), although the females seem to fare better than the males.

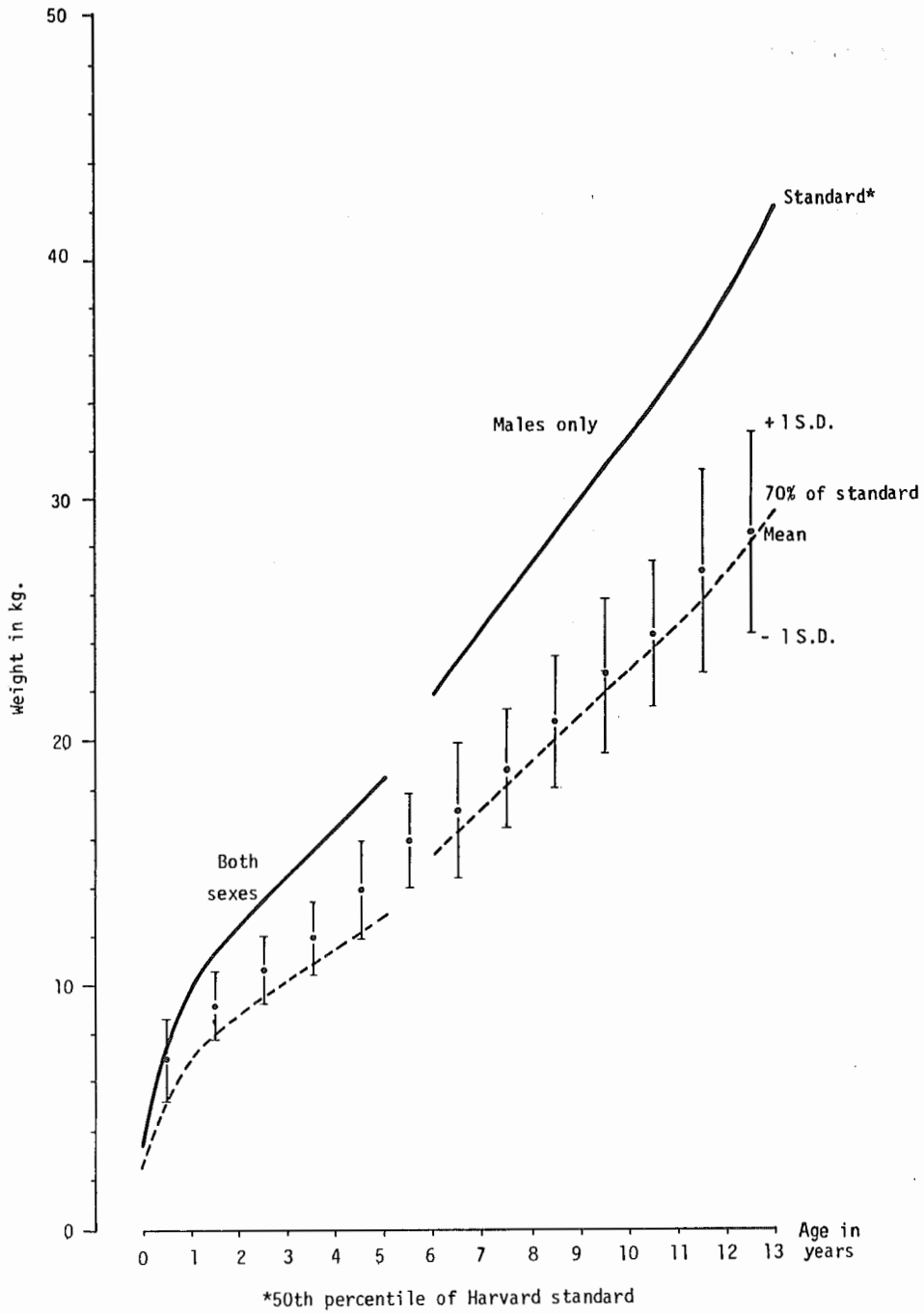

Fig. 12 *Mean weight for age for both sexes and males.*

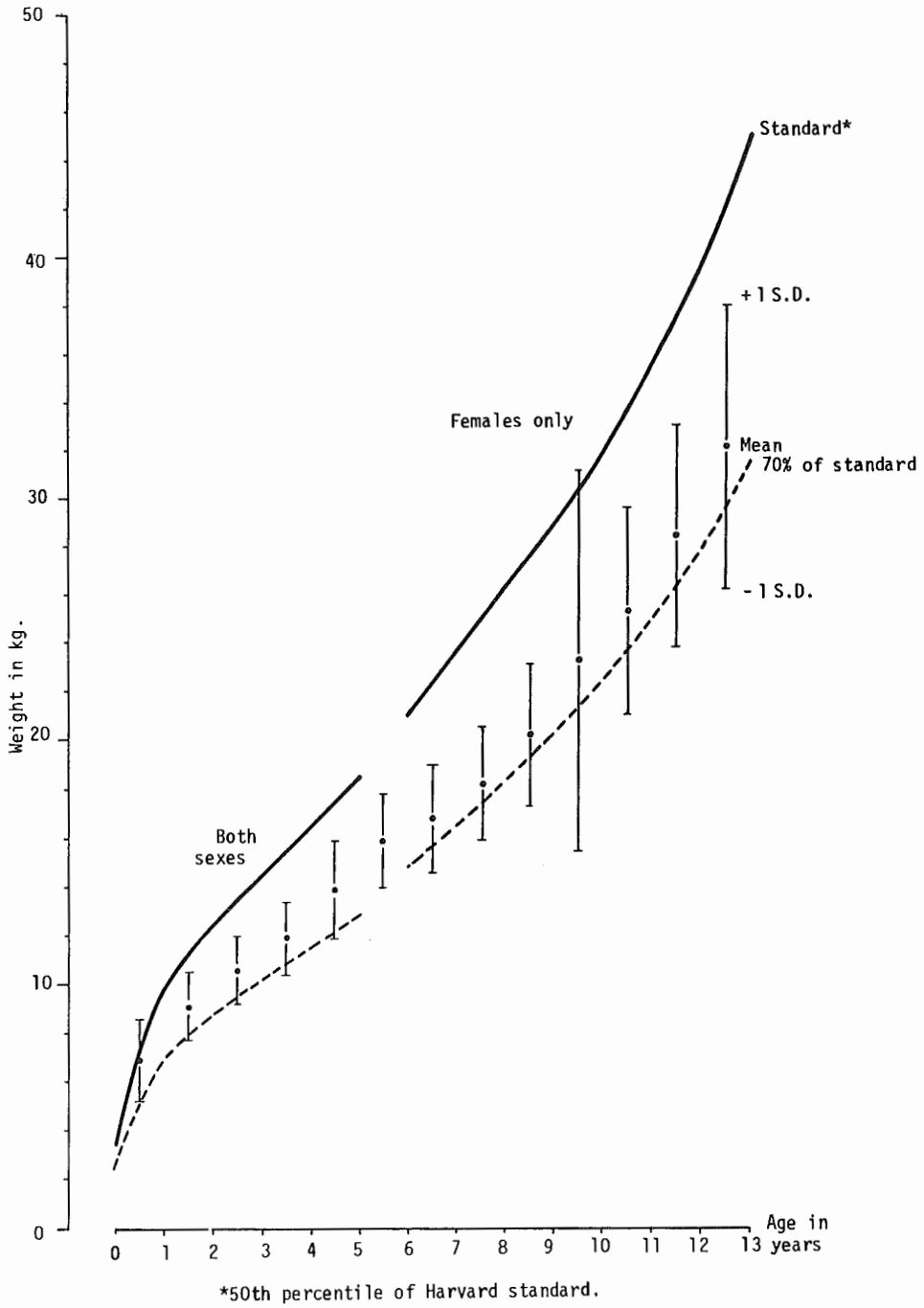

Fig. 13 *Mean weight by age for both sexes and females.*

Thus, for both sexes, the mean weight for age during the first two years of life appear to be within normal limits. Thereafter there is a slackening in the rate of growth which continues after the age of five. The females seem to fare better than the males in the older age group.

The overall prevalence of severe malnutrition is 4.5% (Table 12) while "significant" malnutrition accounts for 27.3%. The prevalence of "significant" malnutrition is lowest in the under five's age group, with only 8.8% being so affected. The highest prevalence is seen among the males in the older age group, with 35.4% suffering from "significant" malnutrition, while the females follow closely behind with 29.1%.

Table 12

Percentage of children by age groups according to their weight for age (as a percentage of the Harvard standards)

Age group	70% & above	*69 – 60%	**Below 60%
Below 5 years	91.2	7.3	1.5
5 – 12 years (M)	64.6	29.4	6.0
5 – 12 years (F)	70.9	24.5	4.6
For all children	72.7	22.8	4.5

*Below 70% = "significant" malnutrition
**Severe malnutrition.

b. **Weight for height**

Figure 14 shows the percentage distribution of stunting and wasting in the study population by age and sex. During the first six months of life, most of the children were able to achieve 90% of the standard weight for height. Thereafter, more of the children became wasted due to acute malnutrition, reaching a peak between the age of two to three years. After this, the weight for height of the children gradually picks up again, reaching low levels between the age of four to five years. After the age of six years, the trend for males and females follow similar patterns although the females appear to be slightly worse off. The prevalence of wasting in both groups fall gradually, reaching rather low levels by the age of twelve years.

The under five's age group have the highest prevalence of wasting (Table 13) with 29.5%, most of them suffering from Grade 1 wasting. The females in the five to twelve years age group rank next with 21.5%, followed by the males with 18.4%. Again, most of them show only Grade 1 wasting. The overall prevalence of wasting is only about 22%.

The overall prevalence of malnutrition using weight for age as an indicator was about 27%, which is only slightly higher than that obtained using weight for height. However, the picture presented by these two indicators with regards to age and sex distribution, differ considerably. In the under five's age group, the prevalence of malnutrition

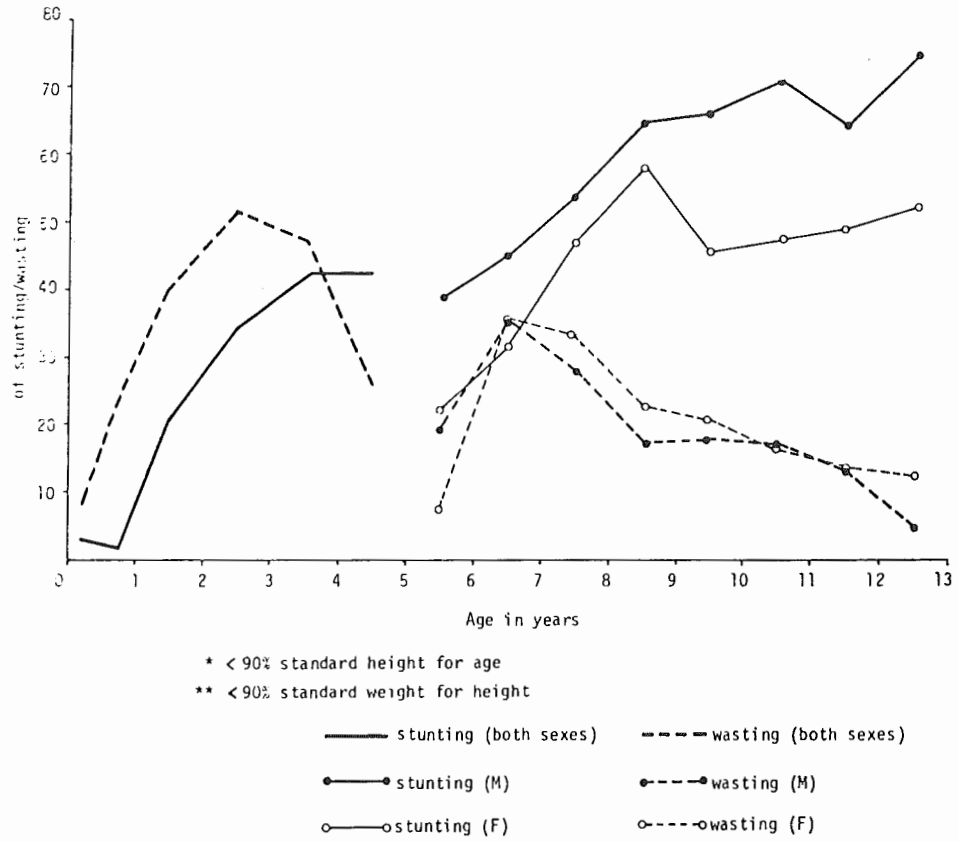

Fig. 14 *Percentage distribution of *stunting and **wasting by age group and sex.*

Table 13

Percentage distribution of wasting and stunting by age group and sex

Grade	0 – 4 years (M + F)	5 – 12 years Male	5 – 12 years Female	0 – 12 years (M + F)
Wasting:				
Grade 1	25.5	16.5	19.7	19.6
Grade 2	3.2	1.6	1.7	2.0
Grade 3	0.8	0.3	0.1	0.3
Total wasting	29.5	18.4	21.5	21.9
Stunting:				
Grade 1	29.6	29.4	36.6	32.2
Grade 2	14.5	43.3	34.8	33.9
Grade 3	2.3	18.8	12.0	12.7
Total stunting (Grade 2 and 3)	16.8	62.1	46.8	46.6

using weight for age was about 9% while that using weight for height was about 28%, a three-fold increase. In the older age group, the situation was reversed, in that figures for the latter were lower, especially in the case of males where it had fallen from 35.4% to 18.4%. The difference was not so great among the females, with the prevalence dropping from 29% to 22%. This anomaly will be explained after the presentation of data on height for age.

c. Height for age

The percentage height for age is used as an index of retardation of growth, which is usually indicative of past, chronic malnutrition. Fig. 15 and 16 show the mean length/height ± I.S.D. for age, for males and females respectively. In this study we have adopted 90% as the cut-off point for retarded growth.

During the first two years of life (Fig. 15), the mean length for age lies above 90% standard, after which it starts to falter. Above the age of two, the mean height for age lies very close to 90% of standard, indicating that some of the children are beginning to show signs of retarded growth. In the older age group, the males show further slackening in linear growth, more pronounced than that seen among the females (Fig. 16) where the mean height for age lies just below 90% of standard.

The overall prevalence of stunting is 46.6% (Table 13). The males in the older age group have the highest prevalence with 62.1%, followed by the females with 46.8%. The under five's age group have a rather low prevalence of stunting, accounting for only 16.8%. The prevalence of stunting increases gradually after the age of one (Fig. 14) until the age of eight years when it begins to level off. In the older age group, the males have a higher prevalence.

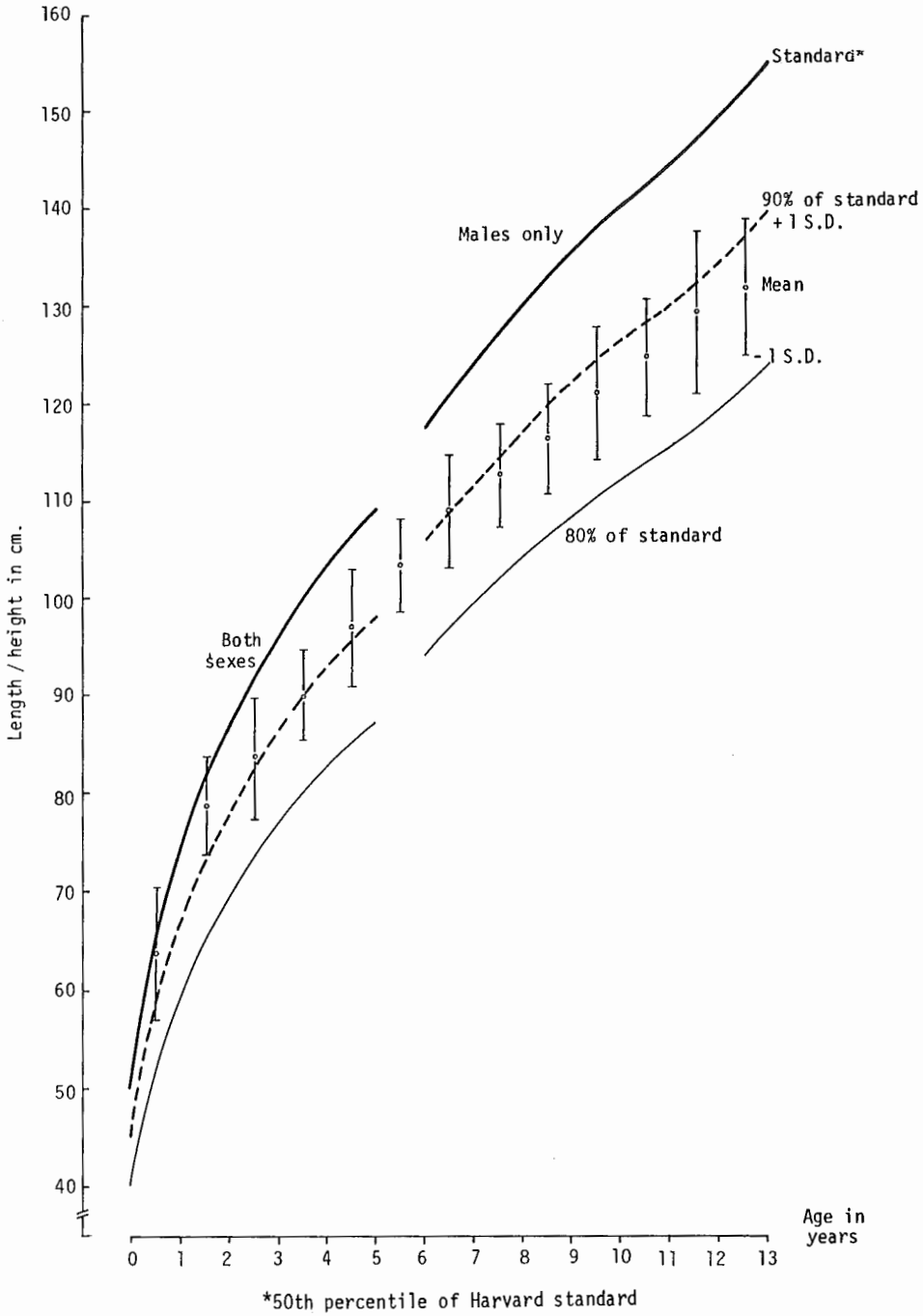

Fig. 15 *Mean height by age for both sexes and males.*

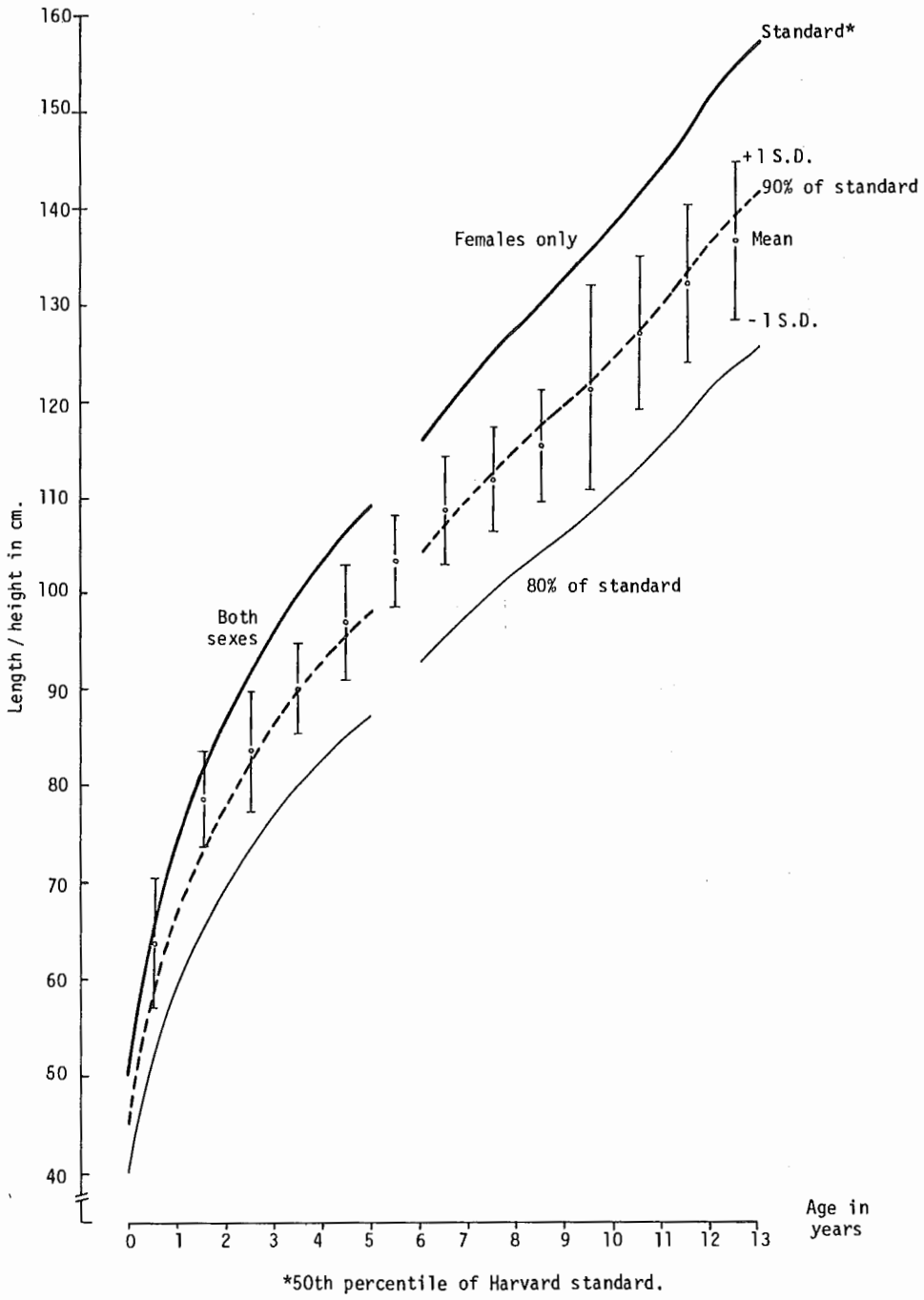

Fig. 16 *Mean height by age for both sexes and females.*

These findings help to explain the anomalous situation referred to in Section 1.1b. The children in the older age group appear to have a higher prevalence of malnutrition when weight for age was used as an indicator as most of these children were stunted due to chronic malnutrition during the preschool period. The under five's age group in fact have a higher prevalence of malnutrition as defined by deficit in weight for height, which is more indicative of current malnutrition. This relationship will be brought out more clearly when the degrees of stunting and wasting are cross-tabulated in a later section.

d. **Left mid-upper arm circumference for age**

Fig. 17 and 18 show the left mid-upper arm circumference for age, for males and females respectively. This is used as a rough indicator of muscle mass and indirectly the adequacy of protein intake. 80% of the standard represents the cut-off point for malnutrition (Jelliffe and Jelliffe, 1969).

For both sexes, the mean percentage arm circumference for age, for all age groups appear to be well above the malnutrition border of 80% standard (Fig. 17 and 18). The overall prevalence of malnutrition, using percentage arm circumference as an indicator, is well below 2%, with 4% in the under five's age group and less than 2% in the older age group for both sexes (Table 14).

Table 14

Percentage of children by age groups according to their arm circumference (as a percentage of the @ standard)

Age group	80% & above	*79 – 70%	**Below 70%
Below 5 years	96.0	2.9	1.1
5 – 12 years (M)	98.4	1.5	0.1
5 – 12 years (F)	98.7	1.2	0.1
All children	98.2	1.6	0.2

@ from Jelliffe (1966)
* mild malnutrition (Jelliffe and Jelliffe, 1969)
** moderate malnutrition (Jelliffe and Jelliffe, 1969).

e. **Left triceps skinfold thickness for age**

The left triceps skinfold thickness for age is used as an index of caloric reserve. Fig. 19 and 20 show the left triceps skinfold thickness for age, for males and females respectively. 70% represents the cut-off point for malnutrition (WHO, 1972).

Below the age of two years, the mean skinfold thickness appear below 70% of the standard but subsequently the mean value picks up and remain above the malnutrition border (Fig. 19). Among the males in the older age group, the mean skinfold thickness remains within normal limits until after the age of 8, when it begins to fall below the mal-

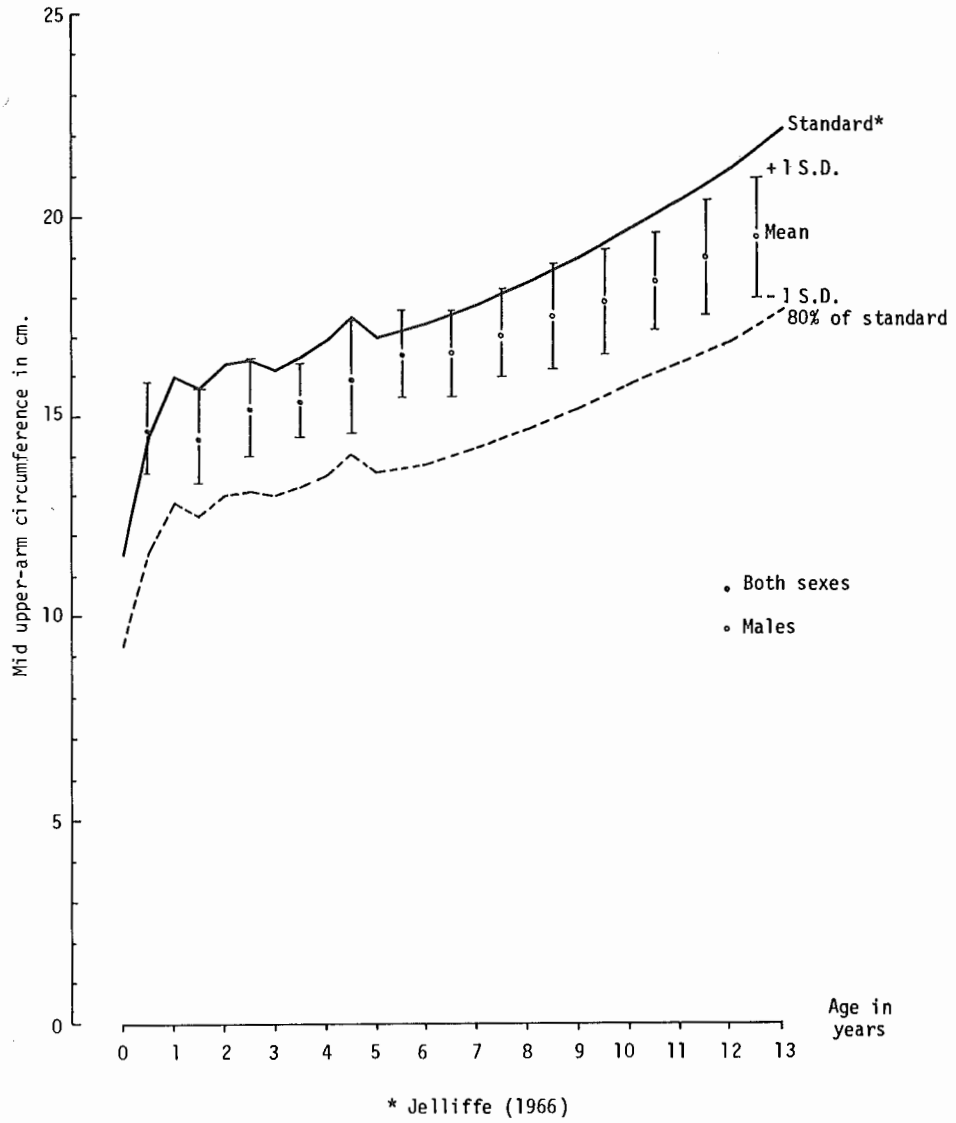

Fig. 17 *Mean left mid-upper arm circumference by age for both sexes and males.*

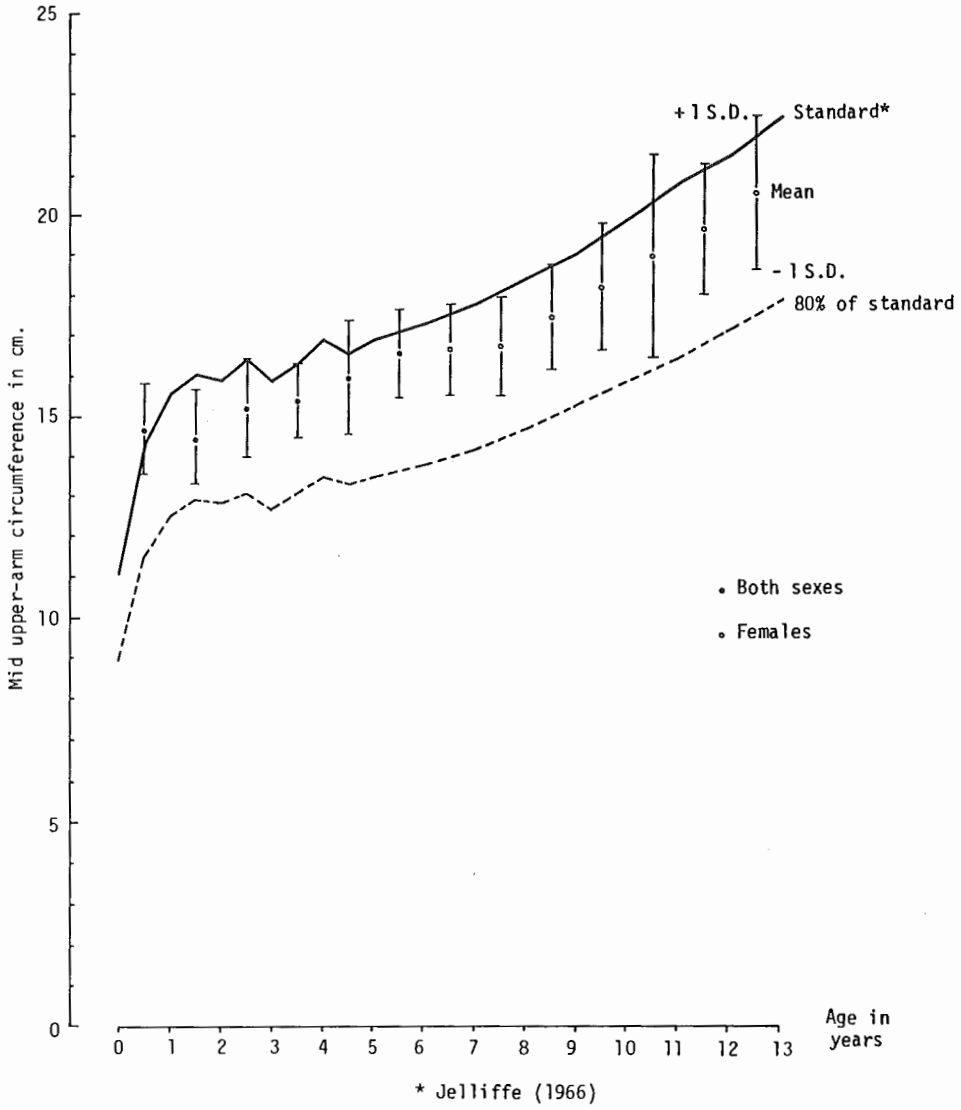

Fig. 18 *Mean left mid-upper arm circumference by age for both sexes and females.*

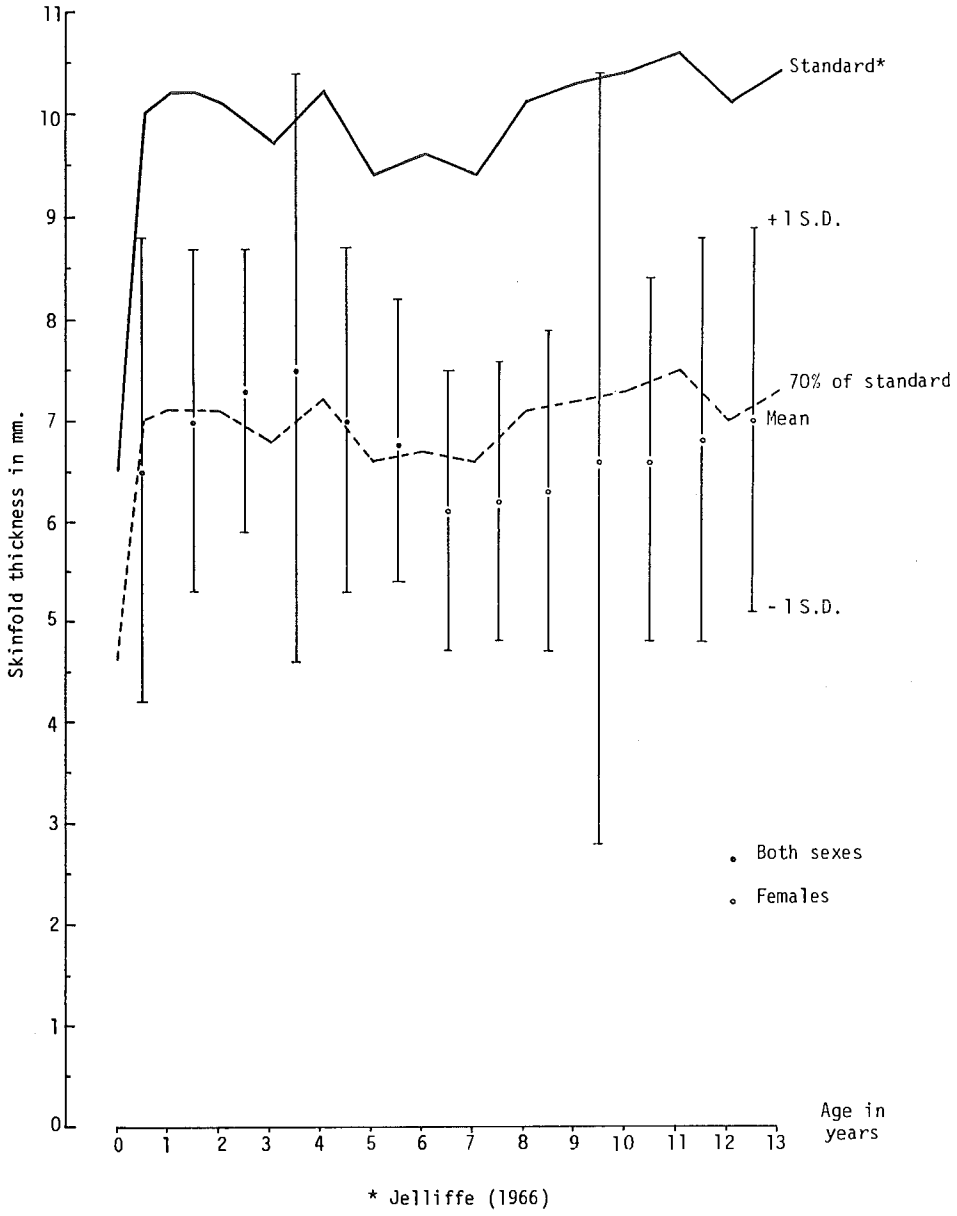

Fig. 19 *Mean left triceps skinfold thickness by age for both sexes and males.*

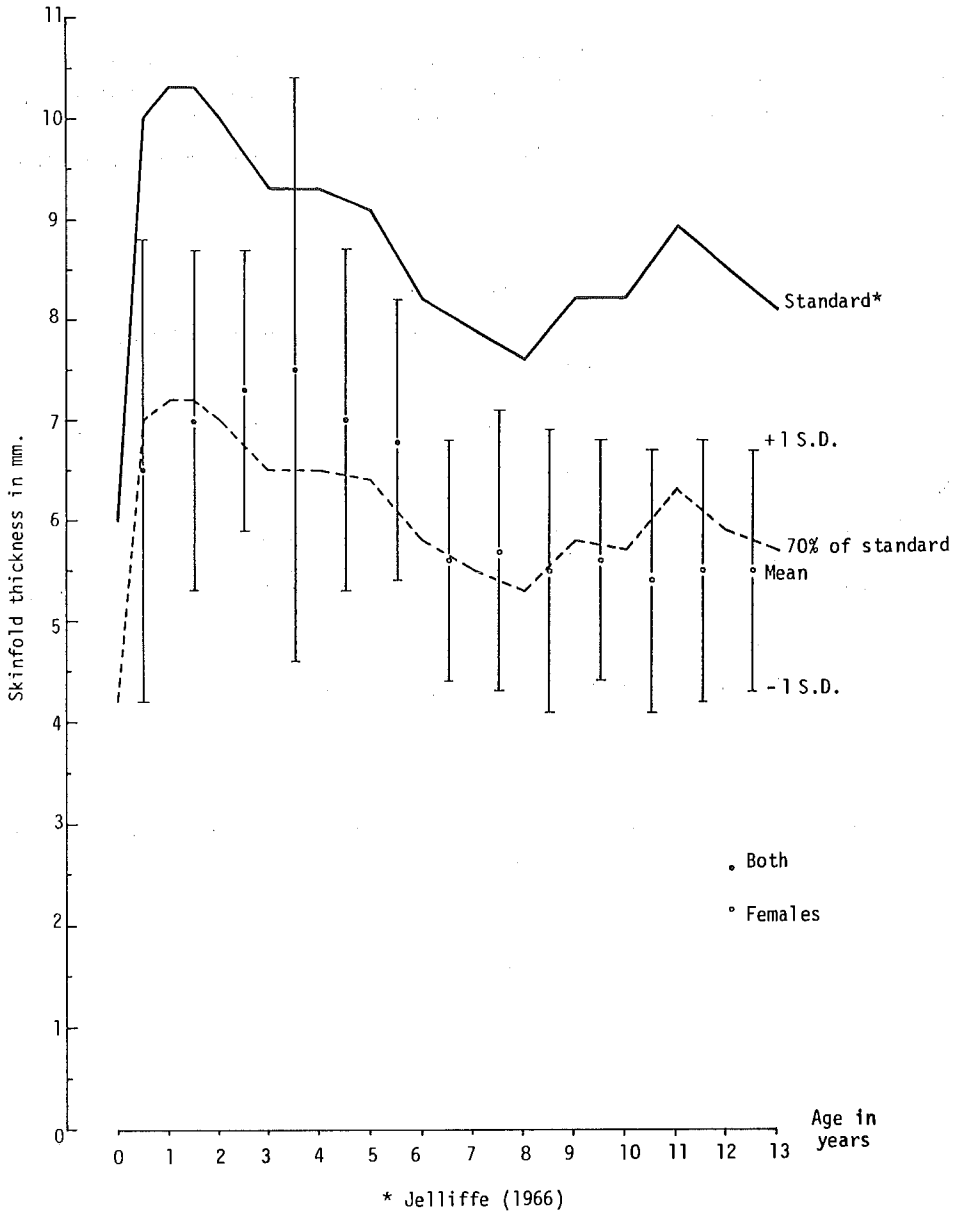

Fig. 20 *Mean left triceps skinfold thickness by age for both sexes and females*

nutrition border of 70%. Among the females of the same age group, however, the mean skinfold thickness starts to fall after the age of five (Fig. 20).

65% of the children can be classified as malnourished, with skinfold thickness below 70% of the standard (Table 15). The lowest prevalence of malnutrition is seen in the under five's age group with about 51%, while the females in the older age group have the highest with 72%. The males of the same age group have an intermediate prevalence of about 62%.

Table 15

Percentage of children by age groups according to their skinfold thickness for age (as a percentage of the @standard)

Age group	70% & above	*69 – 60%	Below 60%
Below 5 years	48.7	23.3	28.0
5 – 12 years (M)	38.1	26.4	35.5
5 – 12 years (F)	28.4	25.1	46.5
All children	35.5	25.4	39.1

@ from Jelliffe (1966)

* 70% of standard is the malnutrition borderline (WHO, 1972)

f. **Malnutrition grade-score**

A malnutrition grade-score can be established for each of the indices described above (WHO, 1972) using the following scoring system.

Score 0 = 90 – 100% of standard
1 = 80 – 90% (exclusive) of standard
2 = 70 – 80% (exclusive) of standard
3 = 60 – 70% (exclusive) of standard
4 = below 60% of standard

The average malnutrition grade-scores have been calculated for the four indices for the various age and sex groups (Table 16). High scores have been obtained for weight and skinfold thickness for all three groups as compared with the scores for height and arm circumference. This seems to suggest that in general, caloric intake appears to be inadequate as reflected by the deficit in skinfold thickness which is an indirect measure of subcutaneous fat. The very low grade-scores for arm circumference appear to indicate adequate intakes of protein. However, this is only a rough indicator and should be considered in conjunction with the results of the dietary studies. In general, the under-five's age group have the lowest scores, with the exception of the scores for left mid-upper arm circumference, where there is not much difference in the values obtained. In the older age groups, the females seem to fare better.

Table 16

Malnutrition grade-scores* for age/sex groups of the study sample – Sabah

Age/sex groups	Weight	Height	Left mid-upper arm circumference	Left triceps skinfold thickness
0 – 4 years				
Male	–	–	0.4	2.4
Female	–	–	0.4	2.3
Combined	1.0	0.2	0.4	2.4
5 – 12 years				
Male	2.1	0.7	0.3	2.7
Female	1.9	0.5	0.2	3.0
Combined	2.0	0.6	0.3	2.8
All ages				
Male	–	–	0.3	2.7
Female	–	–	0.3	2.9
Combined	1.8	0.5	0.3	2.8

*Adapted from method given in The Health Aspects of Food and Nutrition, 2nd Edn., WHO-WPRO, Manila, 1972 (pp. 146 – 147).

g. Classification of malnutrition

Using Waterlow's classification (1976), the study population was divided into four broad categories as described on page 21. 59.1% of the children in the study population were classified as malnourished but most of them were nutritional dwarfs (37.1%) i.e. stunted but not wasted, indicating past malnutrition (Table 17). 12.5% were not stunted but suffering from acute malnutrition while only 9.4% were stunted as well as wasted. In the under five's age group, only a small proportion were nutritional dwarfs (9.1%) while 21.8% were suffering from acute malnutrition. 7.7% were both stunted and wasted. The males in the older age group have the largest proportion of nutritional dwarfs. Only 8.2% of the children in this group suffered from acute malnutrition while 10.2% were stunted and wasted. The females have values which were intermediate between the two groups. 37.2% were nutritional dwarfs. Acute malnutrition accounted for 11.8% while 9.7% were both stunted and wasted. Fig. 21 shows the detailed distribution of nutritional status by age and sex.

These findings seem to indicate that malnutrition during the preschool period was severe and long-lasting enough to cause a marked deficit in height which persisted throughout the early school years. Thus the under five's age group appear to be more vulnerable to malnutrition. Nutritional status appeared to improve during the school-going age, as indicated by catch-up growth in weight for height, while linear growth was only slightly improved. Most of the schoolchildren were shorter than their contempora-

Table 17

Percentage distribution of nutritional status by age group and sex

*Nutritional status	0 – 4 years (M + F)	5 – 12 years (M)	5 – 12 years (F)	0 – 12 years (M + F)
Normal	61.5	29.7	41.3	40.9
Nutritional dwarf	9.1	51.9	37.2	37.1
Acute malnutrition	21.8	8.2	11.8	12.5
Stunted and wasted	7.7	10.2	9.7	9.4

*see classification on page 21.

ries but their weight for height were satisfactory, indicating that acute malnutrition was less of a problem in this age group.

1.2 Anthropometric Results by Ethnic Group

For the purpose of discussion, the fifteen ethnic groups will be divided into three categories (Table 10):

(i) The four main communities included in the ecological assessment, i.e. the Rungus Dusun, Muruts, Kadazans and Chinese.

(ii) The other native groups comprising the Bisayas, Bajaus, Kadayans, Malays, Brunei people, Illanun, Orang Sungai and Sino-Kadazans.

(iii) The remaining ethnic groups, namely, the Javanese, Suluks and "Others" such as foreigners.

Graphic presentation of the data in each section are available as bar charts in Appendix 5.

a. Weight for age

Among the four ethnic groups included in the ecological assessment, the Muruts have the highest prevalence of malnutrition, with about 34% of the children having weight for age below 70% of the standard (Table 18), while 7% of the children were considered severely malnourished with weight for age below 60% of the standard. They are followed by the Rungus Dusun and the Kadazans with prevalence of 33% and 22% for "significant" malnutrition respectively, while severe malnutrition constituted 4.8% and 2.4% respectively. The Chinese children fare much better with only 5.4% "significant" malnutrition and no cases of severe malnutrition.

Among the other native groups, the Bisayas and the Kadayans have the highest prevalence of "significant" malnutrition of 47.5% and 38.3% respectively. The prevalence of severe malnutrition is also highest among the Bisayas with about 14% while the other groups have prevalence below 6%. The Illanun and the Sino-Kadazans have the lowest prevalence of 13.5% and 19.0% respectively. In the case of severe malnutrition,

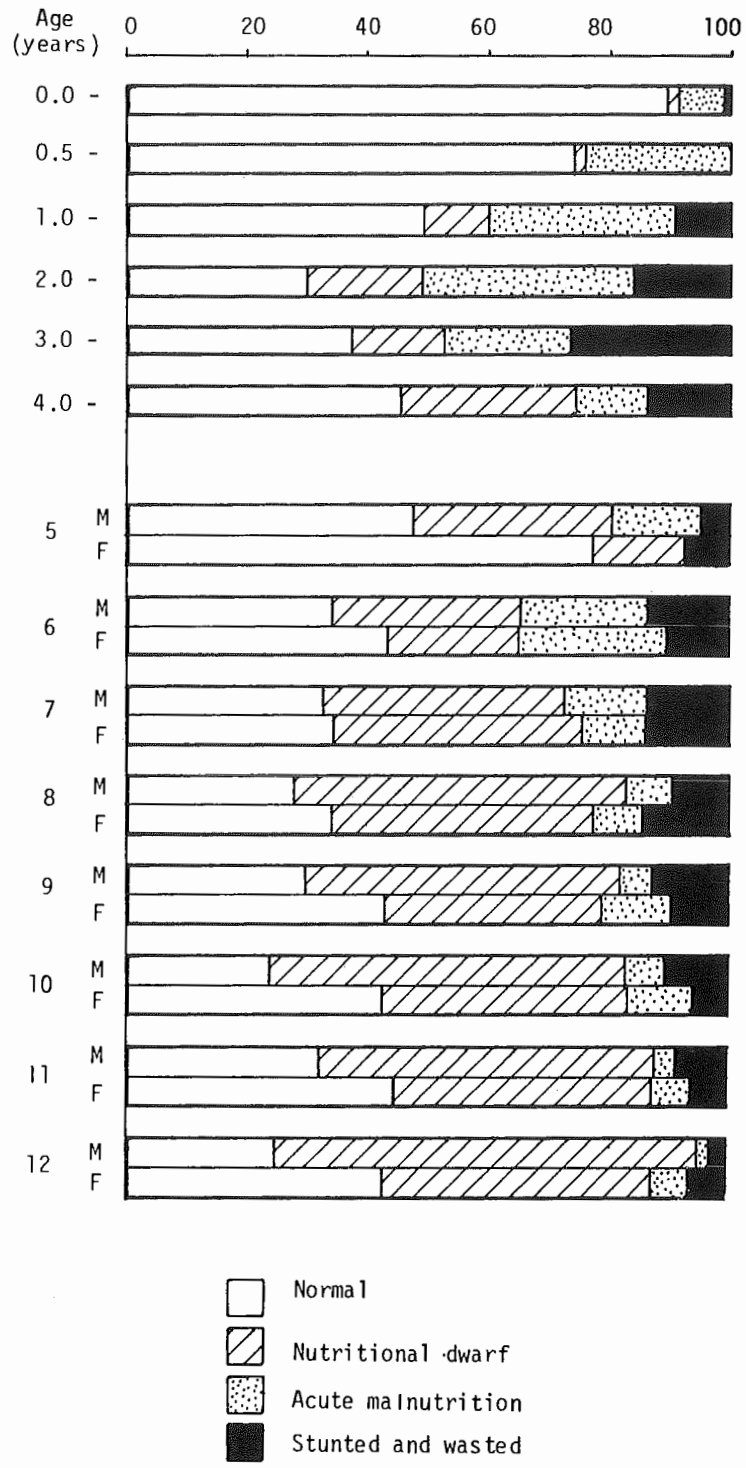

Fig. 21 *Percentage distribution of nutritional status by age group and sex.*

Table 18

The prevalence of malnutrition by ethnic groups according to weight, height, arm circumference and skinfold thickness for age

Ethnic group	Weight for age [1] "Significant"	Weight for age [2] Severe	[3] Height for age	[4] Arm circumference for age	[5] Skinfold thickness for age
Rungus Dusun*	32.7	4.8	44.2	2.4	76.4
Murut*	33.9	7.1	60.4	2.1	71.7
Kadazan*	21.7	2.4	51.6	2.2	72.2
Chinese*	5.4	0	6.6	0.8	41.5
Bisaya	47.5	13.8	75.9	4.2	40.2
Bajau	36.5	4.2	37.6	0	73.0
Kadayan	38.3	5.7	54.7	4.5	46.2
Malay	19.2	3.8	33.0	0.5	28.6
Brunei	23.2	3.1	34.7	3.9	52.1
Illanum	13.5	0	27.1	2.3	55.3
Orang Sungai	20.4	4.5	15.9	1.8	53.6
Sino-Kadazan	19.0	3.3	21.5	0	61.0
Javanese	36.4	15.2	48.5	5.4	51.6
Suluk	33.3	4.8	42.9	0	57.1
Others	32.4	7.9	38.8	3.2	63.8

*Ethnic groups among whom ecological studies were carried out.
[1] percentage of children with weight for age below 70% of standard.
[2] percentage of children with weight for age below 60% of standard.
[3] percentage of children with height for age below 90% of standard.
[4] percentage of children with arm circumference for age below 80% of standard.
[5] percentage of children with skinfold thickness for age below 70% of standard.

the prevalence among the Illanun is zero, while the other ethnic groups with the exception of the Bisayas have prevalence ranging from 3.1 to 5.7%.

There is not much difference in the prevalence of malnutrition in the last group, with prevalence of "significant" malnutrition ranging from 32.4% to 36.4%. On the other hand, the Javanese have the highest prevalence of severe malnutrition, with 15%, which is also the highest for all the groups studied.

The detailed percentage distribution of the children according to weight for age is shown in Table 19.

Table 19

Percentage of children by ethnic group according to weight for age (as a percentage of the Harvard standards)

Ethnic group	70% and above	[1] 69 – 60%	[2] Below 60%
Rungus Dusun*	67.3	27.9	4.8
Murut*	66.1	26.8	7.1
Kadazan*	78.3	19.4	2.4
Chinese*	94.6	5.4	0
Bisaya	50.5	33.7	13.8
Bajau	63.5	32.3	4.2
Kadayan	61.7	32.6	5.7
Malay	80.8	15.4	3.8
Brunei	76.9	20.0	3.2
Illanum	85.4	13.5	0
Orang Sungai	79.5	15.9	4.5
Sino-Kadazan	81.1	15.7	3.3
Javanese	63.7	21.2	15.2
Suluk	66.7	28.6	4.8
Others	67.6	24.5	7.9

*Ethnic groups among whom ecological studies were carried out.
[1] Below 70% = "significant" malnutrition.
[2] Severe malnutrition

b. **Height for age**

The pattern here is similar to that seen in the previous section dealing with weight for age, with the Muruts leading with 60% of the children showing retarded growth, with height for age below 90% of the standard (Table 18). The Chinese have the lowest prevalence with only 7% of the children showing retarded growth. The Kadazans and the Rungus Dusun have intermediate values of 52% and 44% retardation respectively.

In the other native groups, the Bisayas and the Kadayans again lead with 76% and 54% respectively. The lowest prevalence are seen among the Orang Sungai, the Sino-Kadazans and the Illanun with 16%, 22% and 26% respectively.

Among the three remaining ethnic groups, the prevalence of retardation range from 39% in "Others" to 49% among the Javanese.

Table 20 shows the detailed percentage distribution of height for age by ethnic groups.

Table 20

Percentage of children by ethnic group according to height for age (as a percentage of the Harvard standards)

Ethnic group	90% & above	**89 – 80%	Below 80%
Rungus Dusun*	55.8	40.4	3.8
Murut*	39.5	60.4	0
Kadazan*	48.4	49.1	2.6
Chinese*	93.4	6.6	0
Bisaya	24.1	75.9	2.5
Bajau	61.4	37.6	0
Kadayan	45.3	53.5	1.2
Malay	67.0	33.0	0
Brunei	65.3	34.7	0
Illanum	73.0	25.7	1.4
Orang Sungai	84.1	15.9	0
Sino-Kadazan	78.5	21.5	0
Javanese	51.6	48.5	0
Suluk	57.2	42.9	0
Others	61.2	38.8	0

*Ethnic groups among whom ecological studies were carried out.
**Below 90% height for age = Grades 2 & 3 stunting.

c. **Arm circumference for age**

Using the left mid-upper arm circumference for age as an indicator of nutritional status, the prevalence of malnutrition appears to be rather low, ranging from 0 to 5.4% (Table 18). With these low percentages, there are not much differences to be seen among the various ethnic groups

Table 21 shows the prevalence of malnutrition with arm circumference for age as an indicator, for the three age and sex groupings. Using Jelliffe and Jelliffe's classification, most of the cases are only mildly malnourished. There does not seem to be any clear-cut pattern with regard to differences between ethnic groups.

d. **Left triceps skinfold thickness for age**

Table 18 shows that among the four ethnic groups included in the ecological studies, the three native groups again have the higher prevalence ranging from about 72% among the Kadazans and the Muruts to 76% among the Rungus Dusun. The Chinese have a much lower prevalence of 42%.

In the second group, the Bajaus have the highest prevalence of 73% while the lowest

Table 21

Percentage distribution of @malnutrition by ethnic group, according to their arm circumference for age.

Ethnic group	Below 5 years (M + F)	5 – 12 years Male	5 – 12 years Female
Rungus Dusun*	0	10.0	0
Murut*	13.3	0	0
Kadazan*	1.0	0.4	0.6
Chinese*	0	0	5.0
Bisaya	4.8	5.5	3.3
Bajau	9.1	1.8	1.0
Kadayan	0	0.9	1.0
Malay	2.9	2.9	0
Brunei	13.6	0	0
Illanum	0	0	5.0
Orang Sungai	0	0	0
Sino-Kadazan	10.0	0	5.4
Javanese	40.0	0	0
Suluk	–	0	0
Others	0	3.8	3.8

* Ethnic groups among whom ecological studies were carried out.
@Malnutrition borderline is 70% arm circumference (Jelliffe & Jelliffe, 1969).

is seen among the Malays with 29%. Among the foreigners, the prevalence range from 52% among the Javanese to 64% among the "Others".

The prevalence of malnutrition as defined by the percentage skinfold thickness for age does not follow any discernible pattern in that there is not much difference between the three age and sex groupings (Table 22).

e. Identification of communities with nutritional problems

Data from the previous sections on weight, height, arm circumference and skinfold thickness seem to indicate that, among the four main ethnic groups studied, the three native groups have a rather high prevalence of malnutrition, both past and current whereas the Chinese fare better nutritionally. However, with regards to the other ethnic groups, the picture is not so clear-cut.

In order to identify these problem groups, it was decided to give scores to the four ethnic groups with the highest prevalence of malnutrition/retardation according to each of the four parameters (Table 23).

Table 22

Percentage distribution of @malnutrition by ethnic group according to their skinfold thickness for age

Ethnic group	Below 5 years (M + F)	5 – 12 years Male	5 – 12 years Female
Rungus Dusun*	57.2	76.0	80.6
Murut*	93.3	55.7	84.5
Kadazan*	53.2	70.9	78.7
Chinese*	60.0	27.3	40.0
Bisaya	23.8	39.5	43.1
Bajau	68.2	70.9	76.3
Kadayan	21.2	40.4	61.3
Malay	17.6	26.4	47.8
Brunei	56.5	36.0	64.0
Illanum	33.3	59.2	60.0
Orang Sungai	50.0	60.0	46.6
Sino-Kadazan	50.0	46.1	73.2
Javanese	80.0	27.3	50.0
Suluk	–	33.3	75.0
Others	61.1	58.5	72.2

* Ethnic groups among whom ecological studies were carried out.
@ The malnutrition cut-off point is 70% of the standard (WHO, 1976).

Table 23

Scores for the top four malnourished ethnic groups in descending order of prevalence

Weight	Height	Arm circumference	Skinfold thickness
Bisaya (4)	Bisaya (4)	Javanese (4)	Rungus Dusun (4)
Kadayan (3)	Murut (3)	Kadayan (3)	Bajau (3)
Bajau (2)	Kadayan (2)	Bisaya (2)	Kadazan (2)
Javanese (1)	Kadazan (1)	Brunei (1)	Murut (1)

Using the above method, the total score for each ethnic group can be obtained:

Bisaya	10 points
Kadayan	8 points
Bajau	5 points
Javanese	5 points

Murut	4 points
Rungus Dusun	4 points
Kadazan	3 points
Brunei	1 point

Thus it can be seen that, among the other native groups, the Bisayas and the Kadayans are the worst off nutritionally, followed by the Bajaus. In the last group, the Javanese have a rather poor nutritional status. Among the three main native groups studied, the Muruts appear to be the worst off nutritionally, followed closely by the Rungus Dusun. The Kadazans are better off in terms of anthropometric criteria.

1.3 Anthropometric Results by Location

a. Weight for age

The prevalence of malnutrition, using weight for age as an indicator, range from 17% in Kota Belud and Ranau (Table 24) to about 51% in Papar.

Table 24

Prevalence of malnutrition by location, according to weight, height, arm circumference and skinfold thickness for age

Location	[1] Weight for age	[2] Height for age	[3] Arm circumference for age	[4] Skinfold thickness for age
Labuan	22.9	40.4	0.6	27.7
K. Penyu	21.7	36.4	1.6	53.9
Beaufort	41.0	48.9	4.2	30.3
Sipitang	29.3	45.2	1.2	68.1
Pensiangan	23.3	73.7	7.2	62.3
Tambunan	22.4	66.4	0.6	84.8
Keningau	26.4	40.1	0.4	65.5
Tenom	33.1	52.5	3.0	80.5
Pitas	31.3	34.3	4.7	67.6
Kota Belud	16.8	30.3	1.8	73.6
Tuaran	29.4	32.4	0.4	75.3
Kota Marudu	21.6	28.1	1.2	31:4
Ranau	16.9	52.4	0.3	68.0
Kudat	30.0	26.3	0	72.9
Papar	50.6	41.4	1.3	77.6

[1] percentage of children with weight for age below 70% of standard.
[2] percentage of children with height for age below 90% of standard.
[3] percentage of children with arm circumference for age below 80% of standard.
[4] percentage of children with skinfold thickness for age below 70% of standard.

In the under five's age group, the prevalence of "significant" malnutrition range from 0% in Kudat and Papar to 16% in Tenom (Table 25). Only one-third of the locations have children with severe malnutrition, ranging from 1.7% in Kota Marudu to 9.5% in Pensiangan. Among the males in the older age group, the prevalence of "significant" malnutrition range from 23% in Kota Belud to 65% in Papar. In Labuan and Ranau, there are no children with severe malnutrition, while the prevalence in the other districts range from 1.8% in Tuaran to 16% in Kota Marudu. The prevalence of "significant" malnutrition among the females in the same age group is lower, ranging from 18% in Ranau to 50% in Papar and Pensiangan. Severe malnutrition shows a prevalence ranging from 0% in Kota Belud to 17% in Pensiangan.

b. **Height for age**

The prevalence of retarded growth among the children range from 26% in Kudat to 74% in Pensiangan (Table 24).

In the under five's age group, about 8% of the children in Papar and Tuaran have mild retardation of growth, while Pensiangan has the highest prevalence of 47% (Table

Table 25

Percentage of malnutrition according to @weight for age, by location, age group and sex

Location	Below 5 years		5–12 years (M)		5–12 years (F)	
	*69–60%	**Below 60%	69–60%	Below 60%	69–60%	Below 60%
Labuan	6.9	0	30.3	0	21.7	10.9
K. Penyu	7.3	0	24.8	5.3	23.5	4.5
Beaufort	5.3	2.7	39.6	15.4	30.2	10.6
Sipitang	11.8	0	23.1	9.9	26.0	2.9
Pensiangan	4.8	9.5	42.5	7.5	33.3	16.7
Tambunan	11.1	3.7	21.3	4.1	19.5	2.2
Keningau	2.0	0	31.8	2.7	26.4	3.4
Tenom	10.4	6.0	43.1	5.2	28.3	11.7
Pitas	9.3	0	27.5	8.0	31.0	4.0
Kota Belud	10.5	0	16.7	6.1	18.2	0
Tuaran	4.2	0	31.0	1.8	28.8	2.7
Kota Marudu	8.3	1.7	36.8	15.8	21.9	3.1
Ranau	3.7	0	24.3	0	16.1	1.4
Kudat	0	0	33.3	3.7	21.1	5.3
Papar	0	0	55.8	9.3	46.7	3.3

* Below 70% = "significant" malnutrition.

** Severe malnutrition.

@ As a percentage of the Harvard standards.

26). In the older age group, the males have a prevalence of 42% in Kota Marudu while the highest prevalence is found in Pensiangan with 87%. In females, the prevalence is generally lower, ranging from 26% in Kudat to 74% in Pensiangan.

Table 26

Percentage of retarded growth by location according to age group and sex

Location	Below 5 years	5 – 12 years		0 – 12 years
	(M + F)	Male	Female	(M + F)
Labuan	10.5	56.9	40.4	36.7
K. Penyu	8.8	45.2	36.4	29.8
Beaufort	16.5	67.6	48.9	51.3
Sipitang	5.9	50.6	45.2	44.3
Pensiangan	47.4	87.0	73.7	74.0
Tambunan	30.8	77.3	66.4	66.5
Keningau	16.3	64.2	40.1	46.1
Tenom	28.8	75.4	52.5	51.1
Pitas	11.6	46.8	34.3	37.0
Kota Belud	18.6	51.5	30.3	32.7
Tuaran	8.3	54.9	32.4	25.3
Kota Marudu	12.1	42.1	28.1	22.0
Ranau	18.3	71.2	55.9	53.3
Kudat	25.0	63.0	26.3	46.0
Papar	8.3	51.2	41.1	41.7

*Height for age below 90% of Harvard standards.

c. **Left Mid-Upper Arm Circumference for Age**

The prevalence of malnutrition, using the left mid-upper arm circumference for age as an indicator, is again rather low, ranging from 0% in Kudat to 7.2% in Pensiangan (Table 24). The range is rather narrow and no definite conclusions can be made from the values obtained for the various locations.

Table 27 shows the distribution of malnutrition using arm circumference for age as an indicator, for the three groups of children by location. No obvious differences can be detected between the various locations.

d. **Left Triceps Skinfold Thickness for Age**

85% of the children in Tambunan can be classified as malnourished using skinfold thickness for age as an indicator, while Labuan has the lowest prevalence of 28% (Table 24).

Table 27

Percentage of *malnutrition according to arm circumference, by location, age group and sex

Location	Below 5 years (M + F)	5– 12 years		0 – 12 years (M + F)
		Male	Female	
Labuan	2.3	0	0	0.6
K. Penyu	5.5	0.8	0.9	1.6
Beaufort	4.3	3.4	4.9	4.2
Sipitang	11.1	1.2	0	1.2
Pensiangan	25.5	0	0	7.2
Tambunan	2.2	0.4	0.8	0.6
Keningau	0	1.1	0.	0.4
Tenom	8.3	0	1.7	3.0
Pitas	0	5.0	5.1	4.7
Kota Belud	0	1.5	3.0	1.8
Tuaran	6.7	0	0	0.4
Kota Marudu	0	3.1	0	1.2
Ranau	0	0.7	0	0.3
Kudat	0	0	0	0
Papar	0	0	2.3	1.3

*Arm circumference for age below 80% of Harvard standards (Jelliffe & Jelliffe, 1969).

In the under-five's age group, the prevalence of malnutrition range from 0% in Kudat to 94% in Tenom (Table 28). In the older age group, the prevalence among the males range from 27% in Labuan to 84% in Tambunan. The prevalence among the females, on the other hand, appear to be higher, ranging from 32% in Beaufort to 89% in Pensiangan.

Table 28

Percentage of *malnutrition according to skinfold thickness, by location, age group and sex

Location	Below 5 years (M + F)	5 – 12 years Male	5 – 12 years Female	0 – 12 years (M + F)
Labuan	16.3	27.3	39.1	27.7
K. Penyu	35.1	44.7	70.4	53.9
Beaufort	23.9	31.1	31.5	30.3
Sipitang	77.7	57.3	76.2	68.1
Pensiangan	81.8	40.3	88.9	62.3
Tambunan	68.8	84.3	88.2	84.8
Keningau	82.8	54.1	74.7	65.5
Tenom	93.5	64.9	84.2	80.5
Pitas	53.3	64.3	74.8	67.6
Kota Belud	55.3	80.3	80.7	73.6
Tuaran	73.5	57.8	84.5	75.3
Kota Marudu	12.5	52.7	37.5	31.4
Ranau	53.5	63.6	78.2	68.0
Kudat	0	74.0	78.9	72.9
Papar	66.7	79.1	76.7	77.6

*Skinfold thickness for age below 70% of Harvard standards (WHO, 1972).

e. Identification of Districts with Nutritional Problems

Using the same scoring system described in the previous sections, the various districts were arranged in descending order of prevalence for the four parameters:

Table 29

Scores for the top four malnourished districts in descending order of prevalence

Weight		Height		Arm circumference		Skinfold thickness	
Papar	(4)	Pensiangan	(4)	Pensiangan	(4)	Tambunan	(4)
Beaufort	(3)	Tambunan	(3)	Pitas	(3)	Tenom	(3)
Tenom	(2)	Tenom	(2)	Beaufort	(2)	Papar	(2)
Pitas	(1)	Ranau	(1)	Tenom	(1)	Tuaran	(1)

The four districts with the highest total scores are Pensiangan and Tenom (8 points), Tambunan (7 points) and Papar (6 points). The district of Pensiangan has a predominantly Murut population (99%) while in Tenom the Muruts account for 55%. Tambunan, on the other hand, has a Kadazan population of about 97% while Papar has a more varied ethnic composition with 33% Kadazans, 24% Brunei people and 14% of Bajaus. Thus, the high prevalence in these districts could be a reflection of the ethnic composition of each district, but other ecological factors will probably play an important part, as will be discussed in a later chapter.

2. RESULTS OF THE CLINICAL EXAMINATION

All the subjects included in the study sample of 3,672 children were subjected to a clinical examination as part of the field study. These procedures centred only on examination for signs of malnutrition. Only unequivocal signs were accepted as positive. The procedure and criteria are as given in the section on Methodology.

However, it was found that clinical examination as a tool for locating and identifying the presence of malnutrition was not sensitive in the context of the study sample examined as no clear or frank case of any form of nutritional deficiency was identified with unequivocal signs. There were however some rather suggestive but not unequivocal signs noted.

The only consistent sign noted was that almost all children examined had dental caries.

Because of the above, although some signs suggestive of malnutrition were noted, the data of the clinical examination was not analysed for this report. They are, however, available for any further enquiries at a later date.

3. RESULTS OF THE BIOCHEMICAL STUDY

3.1 Haemoglobin and Mean Corpuscular Haemoglobin Concentration

In this study the prevalence of anaemia among the children is used as an indicator of nutritional status. The WHO standards (1972) have been adopted as guidelines for the characterisation of the study population (Table 30).

The mean haemoglobin concentration and standard deviation values for each age/sex group are presented in Fig. 22. All the mean haemoglobin concentration values lie above the WHO standards. There are no obvious differences between the two sexes in the older age group.

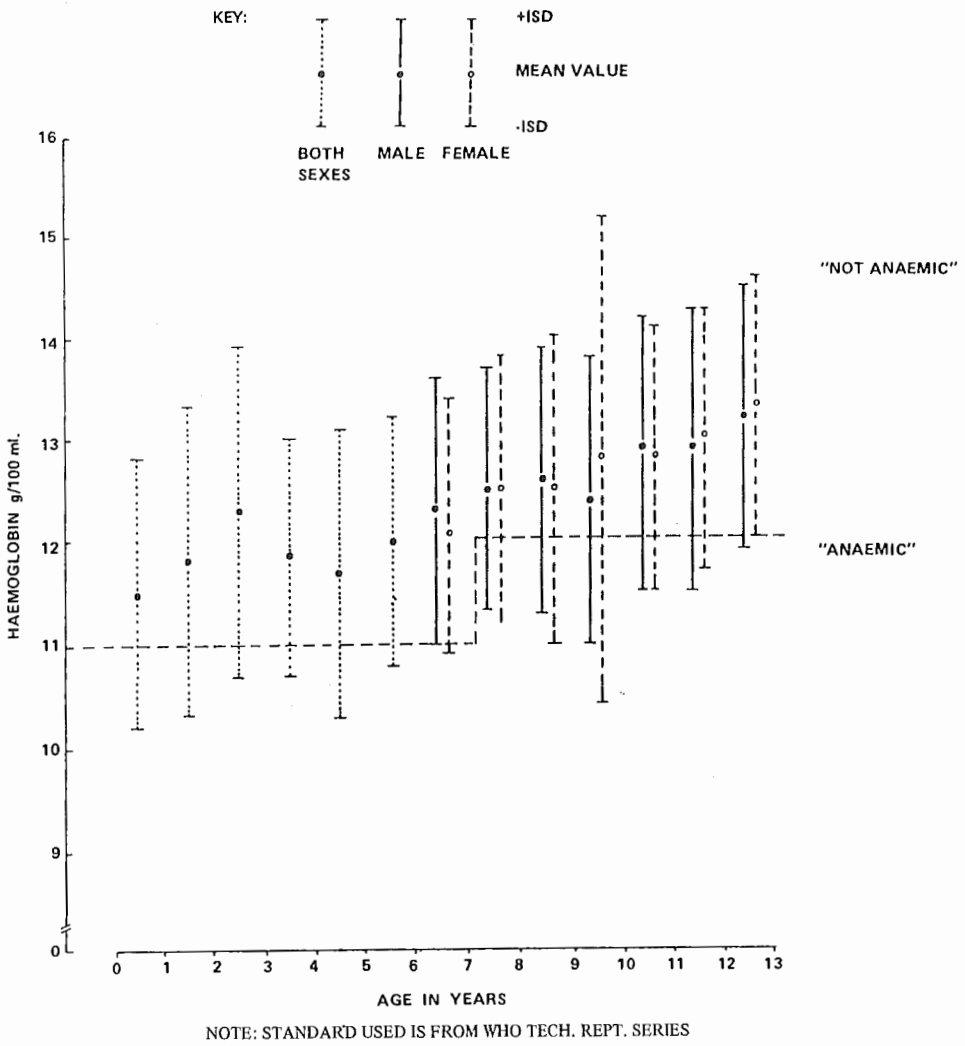

Fig. 22 *Distribution of mean haemoglobin by age and sex.*

Table 30

WHO standards for the diagnosis of anaemia and iron deficiency. Haemoglobin concentrations below which anaemia is likely to be present at sea level:

Children 6 months to 6 years	11 g/100 ml
Children 6 – 14 years	12 g/100 ml

Mean corpuscular haemoglobin concentration:

Levels below 31% are likely to indicate iron deficiency.

The overall prevalence of anaemia is 26.0% (Table 31), with the males having a prevalence of 26.4% and the females 25.6%. The children start off with a high prevalence of more than 30% (Fig. 23), falling to about 20% by the age of three years. Thereafter, the situation worsens and reaches a peak between seven to nine years of age. The prevalence starts to fall gradually, reaching a low of 15% by the age of 13. The males start off with a prevalence of about 35%, falling to 15% around the age of three. The females, on the other hand, start off with a lower prevalence of about 27%, falling after the age of three, to reach about 20% around the age of five. The trend is similar in both sexes but the females lag behind in the first phase. In the second phase, there is no appreciable difference between the two groups.

Table 31

Percentage prevalence of *anaemia by age group and sex

Age group (years)	Male	Female	Total
0.5 – 2	34.5	27.4	30.9
2 – 4	14.8	26.4	20.2
4 – 6	32.4	19.1	25.0
6 – 8	28.1	31.7	29.8
8 – 10	29.6	27.4	28.5
10 – 12	22.8	23.3	23.0
12 – 13	17.6	13.5	15.8
Overall prevalence:	26.4	25.6	26.0

*According to WHO classification (1972).

14.8% of the study population had mean corpuscular haemoglobin concentrations below 31%, with 14.1% among the males and 15.5% among the females. This suggests that probably about 15% of the study population are likely to suffer from iron deficiency.

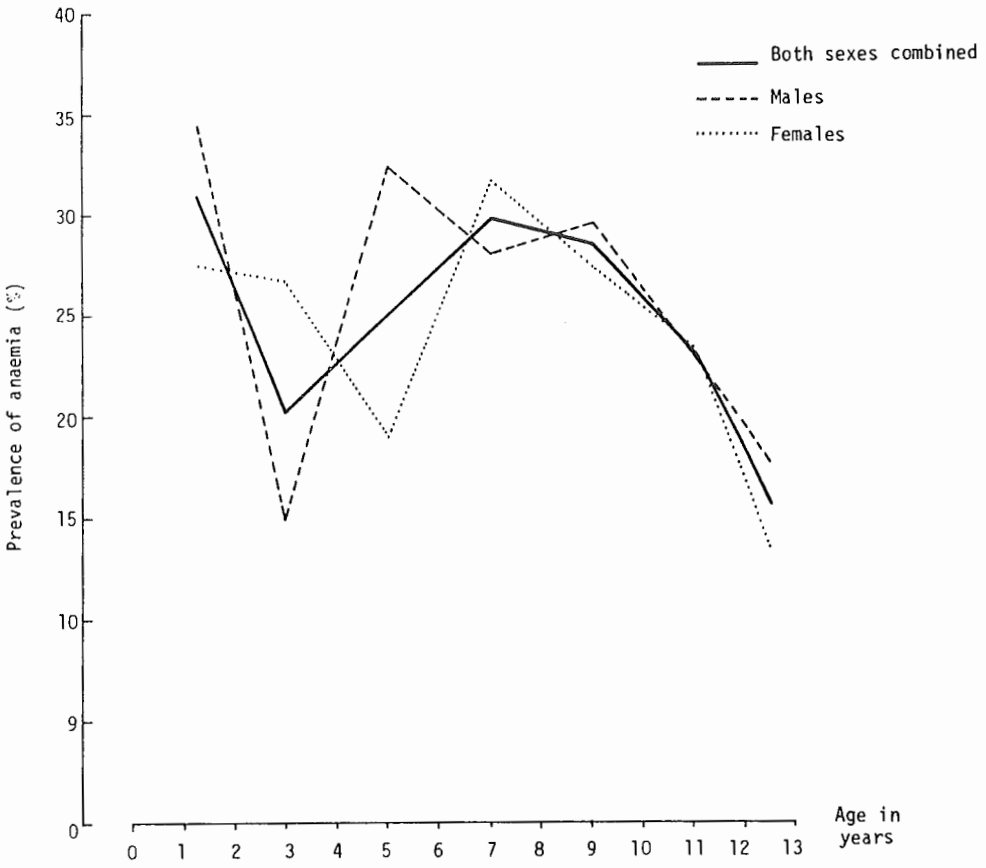

Fig. 23 *Prevalence of anaemia by age and sex*

3.2 Serum Protein, Albumin and Urinary Urea Nitrogen/Creatinine Ratio

Table 32 shows the percentage of the study population on whom the above biochemical values were obtained. In the younger age group the percentage of blood samples collected is rather low. Urinary specimens are easier to collect. The mean serum protein values are within acceptable limits in infants and the older children (Table 33). In the toddler group, the value is slightly low. With regard to serum albumin, the mean values for the three groups are within acceptable limits. The mean values for the urinary urea nitrogen/creatinine ratio are also satisfactory for the three groups.

Table 32

Percentage of study population on whom the following biochemical tests were conducted

Age group (years)	Serum protein	Serum albumin	UUN/creatinine
0 – 11/12 (n = 376)	1.1	1.1	19.4
1 – 5 (n = 501)	9.2	9.2	28.3
6 – 12 (n = 2932)	58.0	67.8	79.4

Table 33

Mean and standard deviation of the three indices by age groups

Age group (Years)	Serum protein (gm%)		Serum albumin (gm%)		UUN/creatinine	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
0 – 11/12	6.9	0.8	4.0	0.8	11.9	8.7
1 – 5	6.4	1.1	3.7	0.7	10.8	17.5
6 – 12	7.2	0.9	4.1	0.6	7.1	3.7

The toddler age group have the highest prevalence of hypoproteinaemia, with about 28% of the children having low levels of serum protein (Table 34). In the other two groups, the prevalence are rather low. This pattern is repeated in the case of serum albumin (Table 35). The toddlers have a prevalence of about 24%. In the older age group, the prevalence is less than 1% while none of the infants examined had low levels of serum protein. The low levels of serum protein and albumin in the toddler group confirms the anthropometric results discussed earlier, that acute protein energy malnutrition is more prevalent in this group.

Table 34

Percentage distribution of children by age groups, according to serum protein levels

Age group (years)	* Low	* Acceptable	Total
0 – 11/12	0	100.0	100.0
1 – 5	28.3	71.7	100.0
6 – 12	1.7	98.3	100.0
Total:	2.4	97.6	100.0

*Classification according to ICNND (1963)

Table 35

Percentage distribution of children by age group, according to serum albumin levels

Age group (years)	* Low	* Acceptable	Total
0 – 11/12	0	100.0	100.0
1 – 5	23.9	76.1	100.0
6 – 12	0.8	99.2	100.0
Total:	1.3	98.7	100.0

*Classification by ICNND (1963)

CHAPTER 6

THE ECOLOGICAL ASSESSMENT OF THE COMMUNITIES

Ecological studies were carried out on five communities distributed in the four districts of Pitas, Keningau, Ranau and Tuaran, and made up of 33 Rungus Dusun, 28 Murut, 10 Chinese, 100 coastal plains Kadazan households of Tuaran, and 100 upland Kadazan households of Ranau, distributed in seven villages. In the paragraphs that follow, these five communities will be described in terms of their individual socio-economic status; food production, distribution and availability; and the food ideology and practices each follows.

1. THE RUNGUS DUSUN OF SINUKAB, PITAS

1.1 Introduction

Kampung Sinukab is located on the eastern side of the Pitas Peninsula, approximately ten miles inland (Fig. 11). It can be reached by boat from Kudat, a journey taking four to six hours. The distance by land is about 100 miles but the road is rarely used as it is not well maintained.

The altitude of the area is low, not exceeding 450 feet above sea level. As a result, a large proportion of the coast is lined with mangrove swamps and cannot be cultivated.

The village consists of two longhouses and five individual houses (Fig. 24, 25 & 26). A Protestant church is located in the village. All the families living in longhouse B are Christians while those living in longhouse A consider themselves as traditionalists from the point of view of religion.

The people of Kampung Sinukab are Rungus Dusun, one of the subgroups of the broader group of Kadazans. There are 16 or more of these subgroups, differentiated from each other by customs and dialects.

Kampung Sinukab is one of the most isolated villages included in the study. Communication is difficult and transport to the local capital of Kudat is expensive.

1.2 Socio-economic Status

Kampung Sinukab is one of the poorest communities. The Rungus Dusun have the lowest mean household income of $23.86 per month (Fig. 27). None of the households

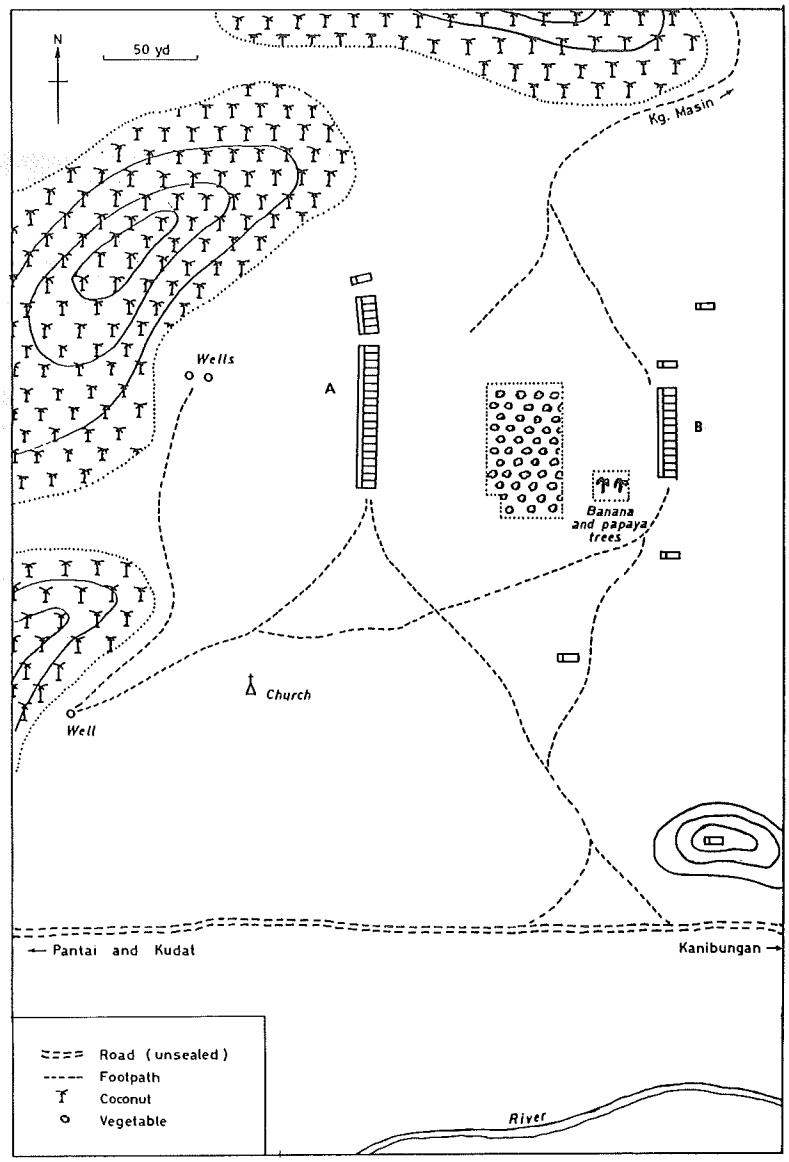

Fig. 24 *Map of the Rungus Dusun village of Sinukab, Pitas.*

in Kampung Sinukab earned more than $200 per month (Fig. 28). About 85% of the households earned less than $50 per month, 12% earned between $50 to $99 per month and only 3% earned between $100 to $199 per month. 100% of households had a per capita income of less than $25 per month (Fig. 29), the mean per capita income being only $5.73 (Fig. 27).

Fig. 25 *General view of a Rungus Dusun longhouse*

Fig. 26 *Inside of a Rungus Dusun longhouse showing people in the common corridor of the longhouse.*

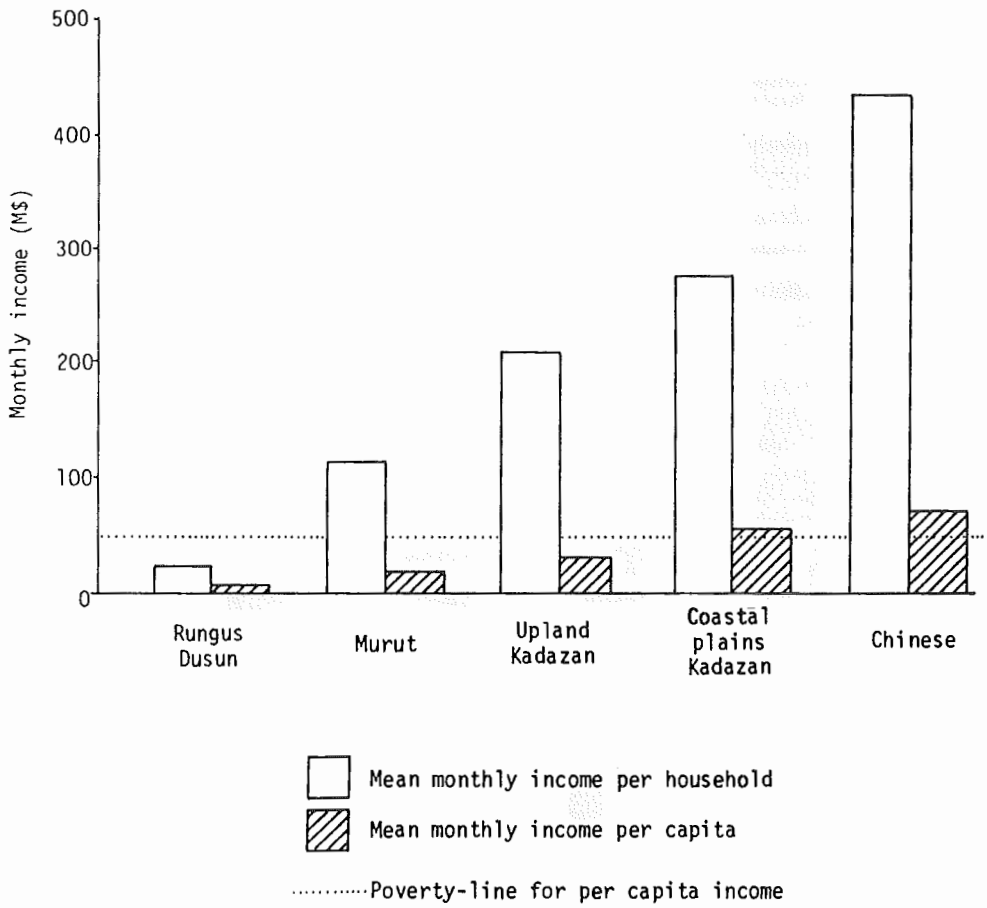

Fig. 27 *Mean monthly household and per capita income of the five communities.*

In Peninsular Malaysia, the poverty line is fixed at $255 per household of five (Prime Minister's Department, 1978) and this works out to be about $50 per head. However, this standard may not apply in Sabah because of the vastly different conditions prevailing in this region. Wages in Sabah are generally higher but this is also accompanied by an increase in the cost of living. However, in the rural setting of Sabah there is considerable supplementation of the diet through the gathering of wild plants, fishing, hunting as well as the cultivation of home produce. This reduces the amount of cash needed for the daily necessities of life and offsets to a certain extent, the higher cost of living in terms of the more expensive foods. However, in the absence of a more suitable figure for

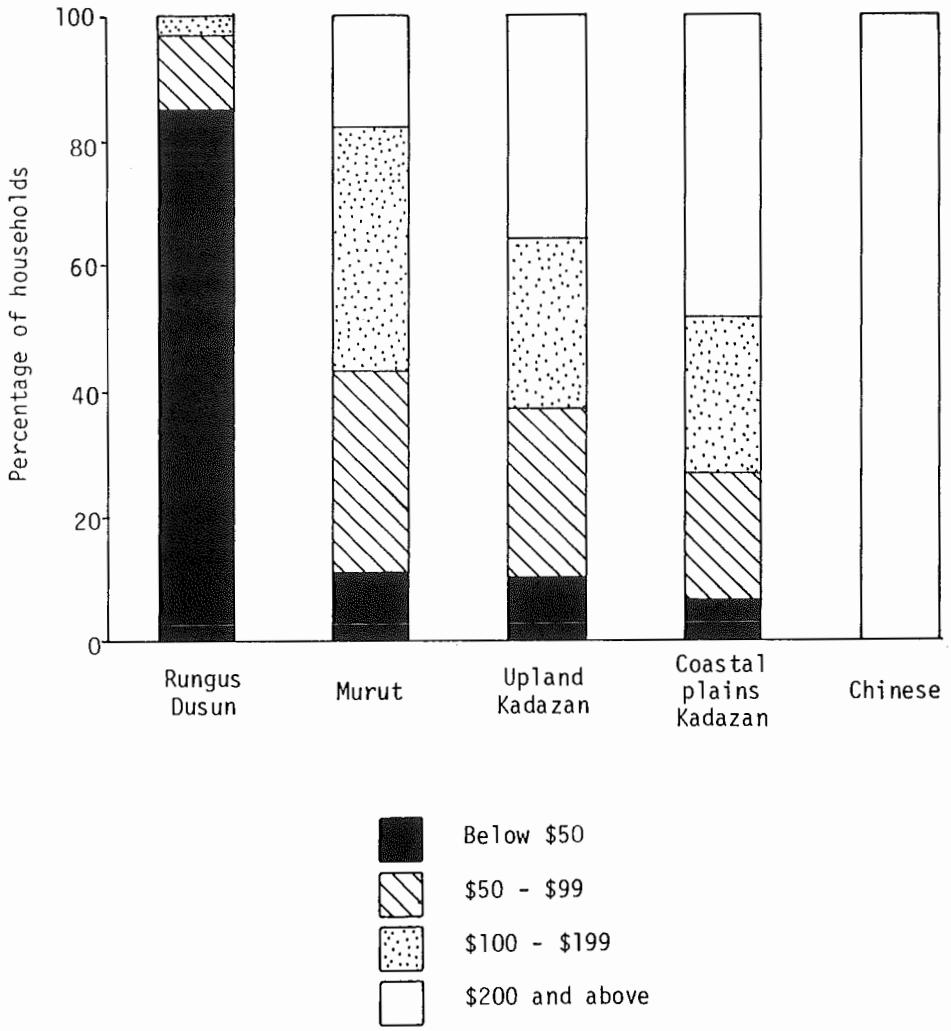

Fig. 28. *Percentage distribution of households by mean monthly income for the five communities.*

local conditions, the Peninsular Malaysia figure of $50 as the poverty-line is used here for comparison purposes. Using the standards set for Peninsular Malaysia, the incidence of poverty in this community is thus 100% (Fig. 27).

The Rungus Dusun own their apartments in the longhouse. The majority (88%) also own agricultural land with a median of three acres per family with about 30% of them owning more than ten acres (Table 36 and Table 37). However, only 33% of the residents were engaged in agriculture, planting hill padi and maize. About 15% of them were engaged as labourers and semi-skilled workers, 24% as white collar workers and ano-

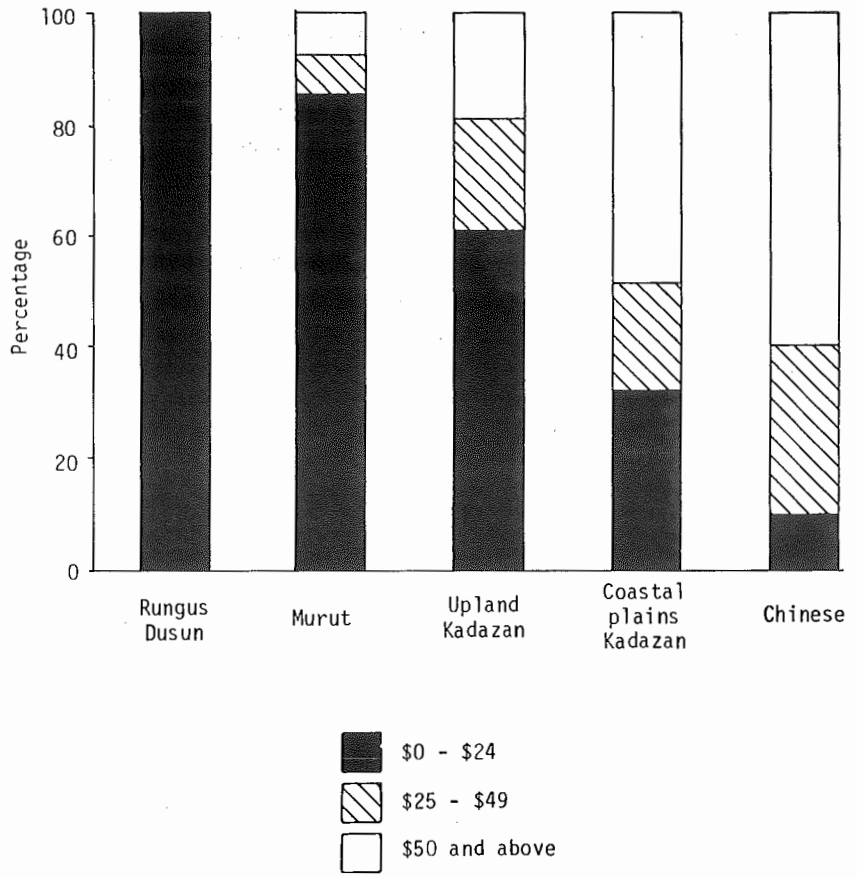

Fig. 29 *Percentage distribution of households by per capita monthly income for the five communities.*

ther 15% work in other occupations such as sawmill workers, etc. (Table 38).

Beyond the house and land that they own, the Rungus Dusun do not have any radios or motor-cycles, there being few motorable roads in the area (Table 36). Since Kampung Sinukab is situated in such an isolated location, the lack of radios is a great disadvantage. This means that the people are out of touch with the outside world and may not have easy access to new ideas and health education.

No latrines are available in this community (Table 39). The use of bush latrines means that there is increased likelihood of diarrhoeal diseases and helminthic infection in the community.

Table 36

Number and percentage of households according to possessions

Possessions	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
Motor-cycle	–	–	6 (6.0)	10 (10.0)	–
Radio	–	17 (60.7)	66 (66.0)	77 (77.0)	8 (80.0)
House	31 (93.9)	27 (96.4)	96 (96.0)	87 (87.0)	7 (70.0)
Land	28 (84.8)	27 (96.4)	94 (94.0)	78 (78.0)	6 (60.0)
Agricultural land	29 (87.9)	26 (92.9)	97 (97.0)	78 (78.0)	8 (80.0)

Table 37

Number and percentage of households by acreage of land for self-cultivation

No. of acres	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
0	6 (18.2)	2 (7.1)	–	22 (22.0)	2 (20.0)
1 – 3	14 (42.4)	7 (25.0)	22 (22.0)	52 (52.0)	–
4 – 6	2 (6.1)	13 (46.4)	55 (55.0)	21 (21.0)	1 (10.0)
7 – 9	1 (3.0)	1 (3.6)	15 (15.0)	5 (5.0)	3 (30.0)
10 & above	10 (30.0)	5 (17.9)	8 (8.0)	0 (0.0)	4 (40.0)
Median acreage	3 acres	5 acres	3 acres	3 acres	10 acres

The number of people with some form of formal education in this community is also the lowest out of the five communities studied (Fig. 30). The percentage of women without formal education is 85%, with 9% having had some primary education and only 6% having reached secondary school level. With the men, there were 79% who had never had any formal education, 12% having had primary education only, while 3% have had secondary education and a further 3% have had post-secondary education.

1.3 Food Production, Distribution and Availability

The main problem in this community is the scarcity of suitable land for agriculture because of the low-lying nature of the terrain. The Rungus Dusun practise shifting agriculture, planting hill padi and maize. Only one crop of each is produced per year, padi being harvested in June while maize is harvested in December. The yield is poor and there is sufficient rice to last only about half a year.

Table 38

Number and percentage of heads of households by occupations

Occupation	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
Farmer	10 (30.3)	7 (25.0)	78 (78.0)	32 (32.0)	–
Rubber tapper	–	1 (3.6)	–	4 (4.0)	5 (50.0)
Farmer/rubber tapper	1 (3.0)	20 (71.4)	–	–	–
Labourer & semi-skilled worker	5 (15.2)	–	3 (3.0)	16 (16.0)	2 (20.0)
White collar worker	8 (24.2)	–	8 (8.0)	14 (14.0)	2 (20.0)
Government officer	1 (3.0)	–	–	20 (20.0)	–
Others	5 (15.2)	–	11 (11.0)	12 (12.0)	–
Not applicable	1 (3.0)	–	–	2 (2.0)	1 (10.0)
Unknown	2 (6.1)	–	–	–	–
Total	33 (100.0)	28 (100.0)	100 (100.0)	100 (100.0)	10 (100.0)

Table 39

Number and percentage of households according to types of latrines

Type of latrine	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
Bush latrine	33 (100.0)	23 (82.1)	12 (12.0)	20 (20.0)	1 (10.0)
Drop latrine	–	1 (3.6)	–	–	–
Pit latrine	–	4 (14.3)	83 (83.0)	80 (80.0)	6 (60.0)
Septic tank	–	–	–	–	3 (30.0)
Unknown	–	–	5 (5.0)	–	–
Total	33 (100.0)	28 (100.0)	100 (100.0)	100 (100.0)	10 (100.0)

A large vegetable garden is situated between the two long-houses and provide an assortment of fruits and vegetables. Various types of leafy green vegetables, long beans, brinjal, chilli, pumpkin and cucumber are grown here. Fruits such as banana, papaya, lime and pineapple are also planted in the plot. However, most of the fruits and vegetables may be sold for cash instead of being kept for home consumption. Tobacco is also grown in the plot.

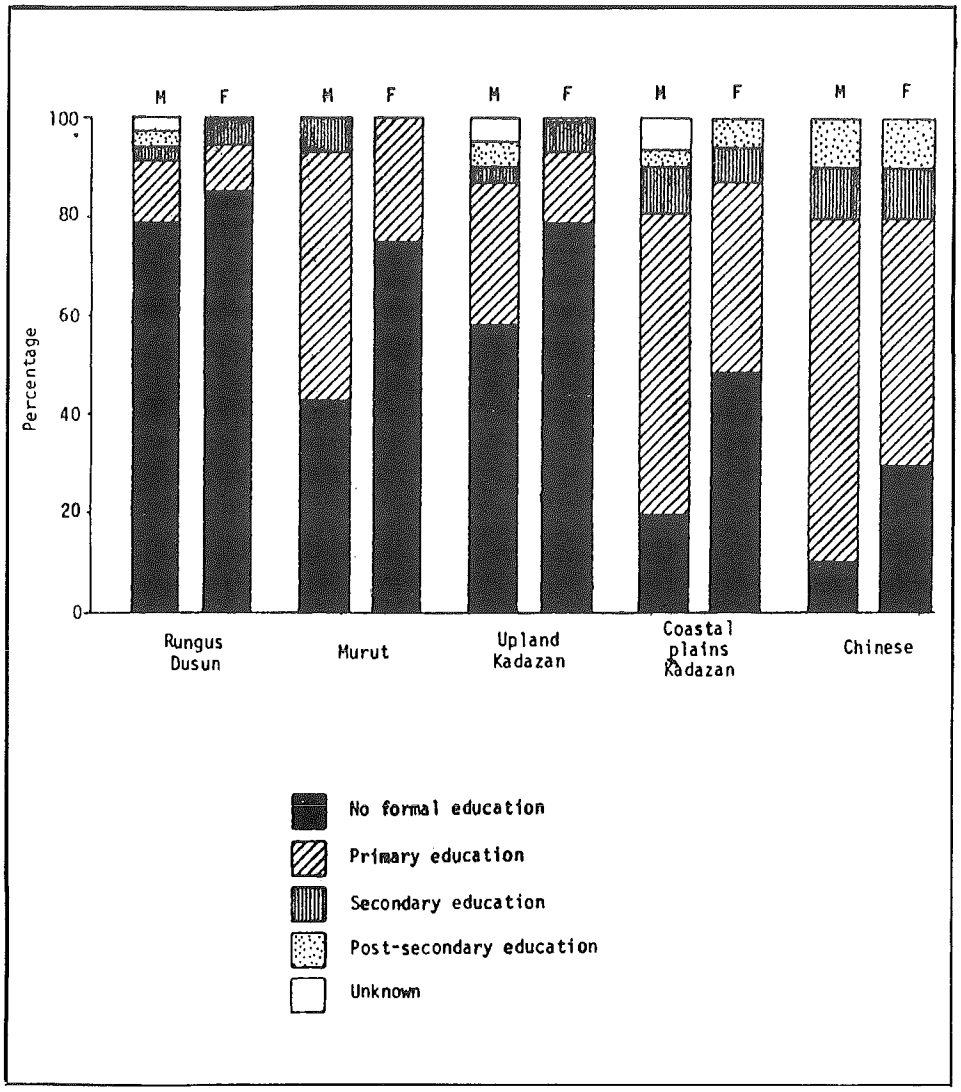

Fig. 30 *Educational status of respondents and spouse by ethnic group*

Coconut trees are found around the village on the north-eastern as well as the north-western sides. This is part of the coconut scheme implemented by the Department of Agriculture. 15 acres of land were provided for each family together with subsidies for planting and maintaining the trees over a five-year period. This scheme has not been successful and has had little effect on the economic status of the residents.

The Rungus Dusun do a fair amount of fishing and gathering in the jungle but very little hunting. This serves to supplement their otherwise monotonous diet. The people rear water buffaloes, pigs and chickens but these are mainly kept for festive occasions.

The nearest provision shops are located in Kampong Kanibungan. There are five of them and a narrow range of food items such as canned foods, biscuits, rice, maize and cooking oil are sold here. On Saturday mornings, a *tamu* (outdoor market) is held here and an assortment of fruits, vegetables, fish and meat are sold here. Appendix 6.1 shows the various food items which can be purchased at the provision shops and the prices at the time of survey. The range of food items which are sold at the *tamu* are shown in Appendix 6.1.

1.4 Food Ideology

The Rungus Dusun of Kampong Sinukab appear to have very few food taboos (Table 40). Rice is considered as highly beneficial for all three vulnerable groups, composed of toddlers, pregnant women and women in confinement, as is commonly observed amongst most rice-eating communities.

Table 40

Classification of four important foods by the Rungus Dusun of Sinukab according to whether these foods are taboo, neutral or beneficial to toddlers, pregnant women or women in confinement

Food item	Toddlers	Pregnant Women	Women in confinement
Tapai	Taboo	Taboo	Neutral
Deer meat	Neutral	Neutral	Taboo
Rice	Highly beneficial	Highly beneficial	Highly beneficial
Pepper	Neutral	Taboo	Taboo

The Toddlers

The toddlers are not allowed to take *tapai* (rice-wine) except for an occasional sip from the *tajau* (jar). Other than this, there are no other food restrictions.

Pregnant Women

In this group, *tapai* and pepper are considered taboo. Foods which are hot, spicy and contain a lot of chillies have to be avoided as they are presumed to cause discomfort to pregnant women.

Post-partum Period

Deer meat is forbidden during this period as it is believed that the mother and newborn child will be disturbed by the soul of the deer. Hot, spicy foods should also be avoided during this period. However, most fish, vegetables, fruits and meats found in the region are regarded as beneficial for these women. Thus, on the whole, food taboos do not appear to play a significant part in affecting the food consumption patterns of the Rungus Dusun, who are quite happy to eat most foods available in the area.

1.5 Dietary Studies

A sample of seven Rungus Dusun households were studied in detail. The types of food items taken by these seven households during breakfast, lunch and dinner are shown in Table 41. This community of Rungus Dusun do not take any snacks in between these three main meals. It was also noted that, on the whole, the diet is fairly monotonous there being little variation from day to day or from meal to meal, and that very little animal protein, other than some fish, is consumed. Further, it was noted that the range of vegetables were also limited and that fruits were rarely consumed.

Table 41

Food items taken for breakfast, lunch and dinner by a sample of seven Rungus Dusun households of Kampung Sinukab

No. of households consuming food item shown					
Breakfast		Lunch		Dinner	
Rice	7	Rice	6	Rice	6
Fish	4	Chinese cabbage	5	Chinese cabbage	3
Chinese cabbage	2	Green leafy vegetables	2	Fish	3
Green leafy vegetables	1	Cucumber	1	Green leafy vegetables	1
		Long beans	1		
		Carrots	1		
		Terap	1		
		Fish	1		

A detailed analysis of the diet will be separately presented when the diets of all five study communities are compared.

2. THE MURUTS OF ANSIP, KENINGAU

2.1 Introduction

Kampung Ansip is located in the district of Keningau. It is situated about six miles from Keningau town, the seat of the Interior Division (Fig. 11).

There are two distinct communities in Kampung Ansip and they shall be considered separately. The Chinese community is located in Kuala Ansip which is nearer Keningau town. It is made up of 27 houses with a population of 202 (figures taken from a census conducted by the Malaria Control Programme) and will be separately discussed in a following section. The Muruts live in Ulu Ansip which is further up the gravel road connecting Ansip and Keningau (Fig. 31 & 32). There are 89 houses with a population of 560 (census by the Malaria Control Programme).

Fig. 31 *General view of a Murut longhouse in Ulu Ansip*

Fig. 32 *Single family dwelling of a poor Murut in Ulu Ansip*

2.2 Socio-economic Status

Among the Muruts of Ansip, only 18% of the households earned more than $200 per month while 43% earned less than $100 per month (Fig. 28). Among the five communities that were studied, the Muruts had the second lowest mean income averaging on $127.14 per household per month (Fig. 27), the mean per capita income being a mere $17.84 per month, most of it being derived from the sale of some surplus rice and other produce such as fruits and vegetables. In this Murut community, 85.5% of the households had per capita incomes of less than $25 per month, and 93% live below the poverty-line (Fig. 29).

Most of the residents are farmers practising shifting agriculture and grow hill padi as well as other staples (Table 38). In addition 75% are engaged in tapping rubber, and 78.6% do some fishing or hunting as a subsidiary activity. 96% of the Murut households own the houses they live in, while 93% own agricultural land as well, with a median of five acres per household, which is the second largest acreage after the Chinese. 60.7% of households own a radio (Table 36). 82% do not possess a latrine and use the bushes for excreta disposal (Table 39).

75% of women had had no formal education, while 25% of them had had some form of primary education (Fig. 30). Among the men, 43% had had no formal education while 50% had had primary education and 7% had had some secondary education.

2.3 Food Production, Distribution and Availability

a. Food Production

Most of the Muruts practise shifting agriculture, growing mainly hill padi (Fig. 33) as well as some crops such as tapioca, maize and sweet potatoes. However, rainfall tends to be low and agricultural production will remain poor as long as there is inadequate irrigation.

Vegetables such as *kangkong, cekur manis,* brinjal, bitter gourd and tapioca are planted around the house. There are also some fruit trees such as bananas, papayas and jackfruit. Hunting is an important activity in this community and helps to supplement their diet. The river also provides an important source of protein in the form of fish and prawns.

The main concern in this community is the production of enough food for home consumption and very little surplus is available for sale. Agriculture is at a subsistence level since traditional methods of cultivation of relatively low yielding hill padi produces yields that are insufficient to meet local needs. On the average rice crops last only half a year.

b. Food Storage

Since there is little sale of food, the main concern is storage of food meant for home consumption. This is important since the amount of food produced may be barely

Fig. 33 *Murut women pounding rice*

enough. Attempts are made to minimise the loss of food through destruction of pests. Padi is stored in guni sacks or *tong* which are locally woven open containers and kept in a special storage hut. Padi for immediate consumption is kept in flour sacks and laid on the kitchen floor (Fig. 34). These storage facilities are, however, highly inadequate and the padi is readily attacked by pests such as weevils and rats.

c. Food Distribution

Transport facilities for market produce is provided by the Sabah Marketing Corporation Sdn. Bhd. (SAMA). Lorries call at a village according to a schedule and the produce is purchased from the farmer with cash. SAMA also fixes the prices of certain food items on a weekly basis.

2.4 Food Ideology

There are more food taboos observed in the Murut community as compared with their Chinese neighbours. However, only sweet potatoes and the shoots of cashew nuts are considered taboo for all three vulnerable groups (Table 42). Furthermore, toddlers and pregnant women are restricted by only a few food taboos. Thus, for the toddlers, only *tapai* and rattan shoots are forbidden in the diet (Table 43). Other than the shoots of sweet potatoes and cashew nuts, there are no food which are considered taboo specifically during pregnancy.

Fig. 34 *Corner of Murut longhouse showing jars, baskets and other worldly possessions.*

Table 42

Foods considered beneficial, neutral or harmful for toddlers, pregnant women and women in confinement by the Muruts of Ansip

Classification	Food group	Food item
Beneficial	Cereals	(Rice, *pulut,* bread, biscuits, noodles, (cakes
	Fish and sea-foods	(Fish roe, fish fry, anchovy, prawn, (squid, *tunggol*
	Meat and eggs	Beef, poultry, eggs
	Vegetables	(*Cekur manis,* long beans,*kangkong,* (bitter gourd, okra, cabbage, bean (sprouts, french beans, brinjal
	Fruits	(*Terap*, bananas, papaya, jackfruit
Harmful	Vegetables	(Sweet potatoes, and cashew nut shoots

Table 43

Foods considered as taboo specifically for toddlers, pregnant women, or women in confinement by the Muruts of Ansip

Type of person	Food group	Taboo food
Toddler	—	*Tapai,* rattan shoots
Pregnant women	—	Nil
Women in confinement	Fish	(Sting-ray, salted fish, *budu, belacan* (*ikan baung*
	Vegetables	(*Pucuk paku, pucuk ubi,* bamboo shoots, (rattan shoots, cucumber, *labu puteh,* (pumpkin
	Fruits	(Pineapple, lemon, *ciku,* guava, *belimbing* *Tapai,* tapioca

During confinement, however, the women have to observe more restrictions. Some fish such as sting-ray and *ikaŋ baung* and some preserved fish products such as *budu,* salted fish and *belacan* are considered taboo during this period. Various vegetables such as wild shoots, bamboo shoots, pumpkin, winter melon and cucumber are considered harmful and have to be avoided. Fruits such as pineapple, lemon, *ciku,* guava and *belimbing* are also taboo. *Tapai* and tapioca are also in the same category (Table 43). However, there seems to be great variety in their diets and there are thus sufficient substitutes available to negate the effects of these taboos (Table 44).

Table 44

Foods considered beneficial specifically for toddlers, pregnant women, or women in confinement by the Muruts of Ansip

Type of person	Food group	Beneficial food
Toddlers and pregnant women	Cereals and starch roots	(Maize, sago, tapioca, sweet potatoes
	Fish and sea-foods	(*Ikan selar, ikan kembong,* sting-ray, (*ikan baung,* salted fish, *budu, belachan*
	Vegetables	(*Pucuk paku,* sweet potatoes and bamboo, (*labu puteh,* pumpkin, cucumber
	Fruits	(Pineapple, lemon, *ciku,* guava, water-melon, (mangoes, *bachang*
Pregnant women		*Tapai,* spinach

2.5 Dietary Studies

The Muruts take three main meals a day together with three snacks (Table 45). The three main meals consist of rice, fish and vegetables, which is the typical diet for the native communities. A large variety of food items are included in the diets of this Murut community which thus has the most varied diet from among the five communities studied.

Table 45

Food items consumed for breakfast, lunch, dinner, and as snacks by 28 Murut households of Ulu Ansip

No. of households consuming food item shown:					
Breakfast		Lunch		Dinner	
Coffee	28	Rice	28	Rice	28
Tapioca	11	*Pucuk ubi*	12	*Pucuk ubi*	13
Fried rice	10	Fish	11	Brinjal	12
Porridge	9	Brinjal	9	Fish	10
Bread	8	Coffee	7	Coffee	8
Sweet potatoes	6	Sardines	6	Salted fish	6
Maize	4	*Terap*	6	Sardines	6
Cake	4	*Jeruk ikan*	6	*Jeruk ikan*	6
Nestum	3	*Jeruk daging*	6	Spinach	6
		Pucuk paku	6	Long beans	5
		Bamboo shoots	5	Bamboo shoots	4
		Eggs	4	*Kangkong*	4
		Green leafy vegetables	4	*Jeruk daging*	4
		Spinach	3		
		Long beans	3		

No. of households consuming food item shown:					
Mid-morning Snack		Tea		Supper	
Coffee	19	Coffee	19	Coffee	24
Langsat	14	Guava	12	Milo	4
Guava	12	*Langsat*	7	*Tapai*	3
Mangoes	9	Bread	5	*Jeruk daging*	2
Bread	6	Milo	4	Papaya	2
Oranges	4	Mango	4	Bananas	2
Milk	3	*Terap*	3	Milk	2
Cake	3	Sweetened condensed milk	3		
Biscuits	3	Biscuits	2		
Prawn crackers	3				

Vegetables and fruits play a prominent part in the diet, especially during the fruiting season. Wild plant shoots are also an important source of green vegetables in their diet and can be gathered from the surroundings or are available from the local markets at relatively low prices. Fish caught from the rivers are also an important source of protein.

As in the case of the diets of the other four communities, a detailed analysis of the nutritive value of the Murut diet will be presented when all five diets are compared in a section that follows.

3. THE UPLAND KADAZANS OF RANAU

3.1 Introduction

A relatively large community consisting of 100 households spread out in three villages, named Marakau, Libang and Tudangan, sited in a valley situated two to four miles from Ranau town, forms the community representing upland Kadazans (Fig. 35). The valley itself is situated in undulating land flanked on its sides by the Western Cordilleras (Crocker Range), the Ranau intermontane plain and the Central Uplands. Easy access to Ranau town is provided by an unsurfaced gravel road. About half the residents in the study community are Christians, while the other half are Muslims.

Fig. 35 *General view of upland Kadazan village of Libang, showing padi fields in the valley and rubber plantations on the hillsides.*

3.2 Socio-economic Status

Economically, the upland Kadazans of Ranau rank third amongst the five communities studied. They have a mean household income of $208.60 per month, which ranks third in the series (Fig. 27). 36% of the households have a monthly income above $200 while 37% have incomes below $100 (Fig. 28), the mean income per capita being $32.77 per month. However, 81% of the households studied were considered as living below the poverty-line (Fig. 29). Thus their economic status is intermediate between that of the Chinese and the coastal plains Kadazans of Tuaran at one end and the Muruts and Rungus Dusun at the lower end.

There were very few motor-cycles and these were distributed among 6% of the households, however, about two-thirds (66%) of the households owned radios (Table 36). Most of them owned their houses as well as agricultural land with a median of 3 acres per family (Table 37). 83% of households possessed a pit latrine while 12% used the bushes (Table 39).

78% of them are engaged in agricultural activities while the remaining are involved in outside employment (Table 38). The existence of a subsistence level of agriculture means that most of their cash income is derived from employment sources.

79% of the women in Ranau had had no formal education, 13% primary education, 7% secondary education, and 1% post-secondary education (Fig. 30). 58% of the men had had no formal education, 29% primary education, 3% secondary education and 5% had had post-secondary education.

3.3 Food Production, Distribution and Availability

Padi is the main crop of the region, being of the wet type which gives a better yield than hill padi. However, traditional methods of planting are still being followed, buffaloes being used for ploughing. A single crop of rice is grown each year. Other staples such as maize, cassava and sweet potatoes are also grown. The cool wet climate of the region supports a great variety of fruit and vegetables, e.g. broccoli, cabbage, french beans, chinese cabbage, strawberries and apples.

Only a small number of animals are reared, and these include pigs, goats, chicken and buffaloes, all of which are only slaughtered on festive occasions. Hunting and fishing help to supplement the diet, fish being obtained from the padi fields, rivers and ponds. However, hunting for small animals is a less common activity as there are no jungles nearby.

3.4 Food Ideology

Foods considered either to be beneficial, neutral or harmful to toddlers, pregnant women and women in confinement are listed in Table 40. It will be noted that there are no particular foods which are considered to be taboo to all these three vulnerable groups. Foods that are specifically taboo or beneficial to any one of the three groups of vulnerable people are listed in Tables 47 and 48. It will be seen that toddlers and pregnant women have less food restrictions. The toddlers are not allowed some fish products

Table 46

Foods considered beneficial, neutral or harmful for toddlers, pregnant women and women in confinement by the upland Kadazans of Ranau

Classification	Food group	Food item
Beneficial	Cereals	Rice, noodles
	Fish, meat and eggs	(*Ikan selar*, beef, mutton, poultry, eggs
	Vegetables and fruits	(Spinach, *cekur manis, kangkong,* cabbage, (*sawi,* bean sprouts, papaya
Neutral	Cereals	Bread
	Fish	*Ikan selayang, budu*
	Vegetables	*Pucuk ubi, pucuk keladi*

Table 47

Foods considered as taboo specifically for toddlers, pregnant women, or women in confinement by the upland Kadazans of Ranau

Type of person	Food group	Taboo food
Toddlers	–	(Anchovy, *jeruk ikan, belacan,* (pineapple
Pregnant women	–	Bamboo shoots, pineapple
Women in confinement	Fish and meat	(Anchovy, *ikan kembong,* prawns, (*jeruk ikan, belacan*
	Vegetables	(Bamboo shoots, pumpkin, soya beans, (french beans, long beans, bitter gourd, (cucumber, brinjal
	Fruits	(Bananas, lime, jackfruit, water-melon.
	–	*Tapai*

such as anchovy, *jeruk ikan* and *belacan,* and must also avoid pineapple. In the case of pregnant women, it is bamboo shoots and pineapple.

During the post-partum period, *tapai* is not allowed. *Ikan kembong,* prawns and fish products such as *jeruk ikan* and *belacan* are considered harmful. A number of vegetables and legume products such as bamboo shoots, pumpkin, bitter gourd, cucumber, brinjal, soya beans, french beans and long beans must also be avoided. Bananas, lime, jackfruit and water-melon are also considered harmful during this period.

Table 48

Foods considered beneficial specifically for toddlers, pregnant women, or women in confinement by the upland Kadazans of Ranau

Type of person	Food group	Beneficial food
Toddlers	Cereals	Maize, biscuits, cakes
	Vegetables	(Shoots of bamboo, *pucuk paku,* (pumpkin, soya beans, french (beans, long beans, bitter gourd, (cucumber, brinjal
	Fruits	(Bananas, lime, jackfruit, guava, (water-melon
	Fish	*Ikan kembong*
	Milk	(Powdered milk, sweetened (condensed milk
Pregnant women	Cereals	Maize
	Fish and sea-foods	(Anchovy, *ikan kembong,* prawns, (*jeruk ikan, belacan*
	Vegetables	(*Pucuk paku,* pumpkin, soya (beans, cucumber, long beans, (french beans, bitter gourd, brinjal
	Fruits	(Bananas, lime, jackfruit, *langsat,* (guava, water-melon
Women in confinement	–	*Pulut,* wild game

3.5 Dietary Studies

Food items consumed by a sample of 32 upland Kadazan households of Ranau (Fig. 36) for breakfast, lunch, dinner and as snacks are shown in Tables 49 and 50. It will be noted that for breakfast, rice is most commonly consumed with dried fish and some vegetables (Table 49).

The range of fish and vegetables consumed for lunch by the households in Ranau is very wide. The fish consumed is mainly dried fish and sometimes sardines and fresh fish. Vegetables consumed consist mainly of non-green vegetables such as cabbage, cucumber, brinjals, etc. Some green leafy vegetables such as spinach and *sawi* are also consumed but wild plant shoots are less often consumed. Fruits are sometimes taken for lunch.

It will also be noted (Table 50) that snacks are varied, consisting usually of some form of staple such as noodles, porridge, tapioca or sweet potatoes. About one-quarter

Fig. 36 *View of kitchen and hearth of upland Kadazan household showing arrangements to facilitate drying of firewood.*

of the families have powdered milk as well, but this is usually reserved for the younger children. Thus it would seem that the households studied in Ranau consume a large variety of cereals such as rice, biscuits, noodles, local cakes and maize. Both green leafy vegetables as well as other vegetables are consumed. Local fruits are also a common item in their diets. The main source of animal protein is dried fish followed by fresh fish as well as processed fish products such as *ikan bilis,* sardines and *jeruk ikan.* Beef and eggs are less often consumed. About one-third of the households use powdered milk for the younger children.

Table 49

Food items consumed by a sample of 32 upland Kadazan households during the three main meals of the day

Meal	No. of households consuming food item shown:											
	Cereals and starchy foods		Legumes and vegetables		Fruits		Meat, eggs and fish		Beverages	
Breakfast	Rice	20	Long beans	2	Papaya	2	Eggs	2	Coffee	18
	Porridge	10	Cabbage	4	Bananas	2	Dried fish	13	Milo	4
	Biscuits	2	*Pucuk paku*	2	*Terap*	1	*Ikan bilis*	2	Tea	2
	Noodles	2	Cucumber	2			Sardines	1		
	Maize	1	*Pucuk ubi*	1			*Jeruk ikan*	1		
	Nestum	1	*Cekur manis*	1			Powdered milk	4		
	Cake	1	*Ketola*	1			Sweetened condensed milk	3		
	Sweet potatoes	4	Brinjal	1						
	Tapioca	2								
Lunch	Rice	32	Long beans	4	Papaya	2	Meat	1	Coffee	2
	Porridge	11	Cabbage	5	Pineapple	1	Eggs	1		
	Noodles	3	Spinach	3	*Terap*	1	Dried fish	21		
	Nestum	1	*Sawi*	2			Sardines	6		
	Sweet potatoes	1	Brinjal	2			Fish	4		
			Pucuk ubi	1			*Ikan bilis*	2		
			Cekur manis	1			*Jeruk ikan*	1		
			Spring onions	1			*Basau*	1		
			Pucuk paku	2						
			Ketola	1						
			Pumpkin	1						
			Tomato	1						
Dinner	Rice	30	Long beans	2	Papaya	3	Dried meat	1		
	Porridge	13	*Kangkong*	5	Jackfruit	2	Meat	1		
	Noodles	2	Cabbage	4			Mousedeer	1		
	Biscuits	1	Fern shoots	3			Eggs	1		
	Nestum	1	Brinjal	3			Fried fish	9		
			Cekur manis	2			Sardines	9		
			Ketola	1			Fish	16		
			Banana shoots	2			*Ikan bilis*	5		
			Spinach	1			*Jeruk ikan*	3		
			Sweet potato	1			Powdered milk	1		
			Sawi	1						

Table 50

Food items consumed as snacks by a sample of 32 upland Kadazan households of Ranau

No. of households consuming food item shown:					
Mid-morning Snack		Tea		Supper	
Powdered milk	8	Rice	7	Powdered milk	2
Fried mee	3	*Terap*	5	Milo	2
Porridge	3	Powdered milk	3	*Terap*	2
Terap	3	Biscuit	3	Mango	1
Sweetened condensed milk	2	Vegetables	2		
Tapioca	2	Sweetened condensed milk	2		
Sweet potatoes	2	Rambutan	2		
Maize	1	Dumplings	1		
Biscuit	1	Porridge	1		
Cake	2	Cake	1		
Prawn crackers	1	Tapioca	1		
Egg	1	Sweet potatoes	1		
Bananas	1	Pumpkin	1		
Coffee	1	Coconut	1		
		Cempedak	1		
		Guava	1		
		Bananas	1		
		Apple	1		
		Prawn crackers	1		
		Dried fish	1		
		Sugar	1		
		Syrup	1		

4. THE COASTAL PLAINS KADAZANS OF TUARAN

4.1 Introduction

A community of 100 households of coastal plains Kadazans composed of the villages of Roun and Labuaya located along the Tuaran River forms the community representing coastal plains Kadazans (Fig. 11). The community itself is situated across the river from Tuaran town, two to six miles away and is made up of a mixture of 48 households of traditional religion, 44 households of Christian faith, and 8 of Islamic faith. Wet padi is an important crop with 41 households engaged in planting wet padi, while 8 households are occupied with growing hill padi, and 12 in rubber as a cash crop.

Communication within the community is by means of a network of unsurfaced laterite roads passable to motor-cars during most of the year. A ferry connects the community with a road that leads to Tuaran, while pedestrian traffic has access to two suspension bridges across the Tuaran River (Fig. 37 & 38).

Fig. 37 *View of suspension bridge linking Kampung Labuaya to Tuaran town-ship.*

4.2 Socio-economic Status

Economically, the coastal plains Kadazans of Tuaran rank second after the Chinese. The mean monthly income is the second highest being $277.10 per household. 48% of the households have monthly incomes exceeding $200 while 26% have monthly incomes below $100. The mean per capita income of $56.13 per month also ranks second. Here, using the criterion described, only 52% of the households are considered to be living below the poverty-line (Fig. 27, 28 and 29).

The Kadazan households studied are also quite well off with regard to possessions, with about 10% of the households owning motor-cycles and 77% owning radios (Table 36). About 87% own their houses while 84% have agricultural land with a median of 3 acres per family, which is similar to the average acreage of the Rungus Dusun of Kampong Sinukab and the upland Kadazans of Ranau (Table 37). About 87% of the community studied are involved in agriculture while the rest are involved in other occupations (Table 38).

Fig. 38 *General view of Kampung Labuaya*

80% of households possessed pit latrines while the remaining 20% used the bushes for excreta disposal (Table 39).

In the Tuaran community, 56% of the women had not had formal education, about 32% have had some primary education and 10% have had some secondary education (Fig. 30). Among the men, 41% have had no formal education, while 43% have had primary education, 16% have had secondary education, there being a significant difference in the educational achievement of the traditionalists, Christians and Muslims of this community (Table 51).

4.3 Food Production, Distribution and Availability

a. Wet Padi

Wet padi is the main crop planted here. It is planted once a year, using traditional methods. Motorised ploughs are also available for hire but it costs $60 to plough an acre of land. In July, the fields are cleared and the seeds are planted. The fields are ploughed using buffaloes and by August or September, the seedlings are transplanted. The time of planting depends on the rainfall since there is no irrigation system.

Table 51

Number of years of schooling of heads of households and their wives in the Tuaran community

No. of years of schooling	Women			Men			Total
	Christian	Traditional	Muslim	Christian	Traditional	Muslim	
0	26	28	2	20	19	2	97
1	3	2	0	3	2	0	10
2	1	1	0	3	3	0	8
3	2	3	3	4	4	1	17
4	0	1	1	2	0	0	4
5	0	0	0	0	1	0	1
6	8	6	1	8	9	3	35
7	0	0	0	0	1	0	1
8	1	0	0	0	0	0	1
9	3	2	1	3	3	2	14
10	0	0	0	0	0	0	0
11	0	3	0	1	6	0	10
12	0	2	0	0	0	0	2
Total	44	48	8	44	48	8	200

The padi can be harvested after three and a half to four months. While the padi is growing, the fields have to be weeded and insecticides have to be regularly applied. Padi is harvested between January and April using padi knives called *pias kopioh* and *pisau lenggaman.*

The padi grains are separated by thrashing, after which the padi is dried, aired and stored. The yield ranges from 120 to 200 gantangs per acre for those cultivating their own land. Those cultivating other people's land obtain half to one-third of the total yield. The harvest is usually insufficient to last the whole year, and this is further aggravated by the fact that some of the padi has to be sold for cash.

b. **Hill Padi**

Only eight families in the Tuaran community plant hill padi, cultivating about two to four acres each in combination with some fruits and vegetables. They practise shifting cultivation. The undergrowth is cleared and the trees are then felled. When the tree trunks are dry, they are burned. Holes are then dug in the ground at fairly regular intervals using a *kayu tunggal* and seeds are placed in the holes. Later on, some of the seedlings are transplanted to avoid overcrowding.

Vegetables such as pumpkin, cucumber, ketola and maize are grown in between the padi plants as cover crops. Less fertile land is planted with tapioca which serves as an emergency food in case of crop failure.

The hill padi can be harvested after four months and this is done using a knife. The yield varies from 75 to 112 gantangs per acre, depending on the weather and other conditions such as the soil.

c. **Rubber**

In the Tuaran community, 12 families grow rubber or tap the trees for other people. Most of these are smallholdings of less than two acres and are thus uneconomical.

d. **Other Crops**

Other crops grown here include fruits such as bananas, *mempelam,* pineapple, sugar cane, papaya, *buah kuini, terap, cempedak,* coconut, *bambangan,* jackfruit and red guava. These are grown mainly for home consumption although a portion is sold. Vegetables such as *cekur manis,* brinjal, spinach, *ketola,* pumpin, long beans and pepper are grown around the house.

e. **Animal Husbandry**

Chickens, goats, buffaloes, pigs, geese and ducks are kept for home consumption as well as for sale. Most families rear chicken (Table 52), goats (Table 53) and buffaloes. The other animals are kept in lesser numbers.

f. **Hunting and Fishing**

The people hunt wild boar, deer, mousedeer, tapir, *musang, lelawar* and birds using shotguns or home-made guns called *bakakuk.*

Table 52

Number of chickens being reared by a community of 100 coastal plains Kadazan households in Tuaran

No. of chickens reared	No. of households
1 – 10	50
11 – 20	21
21 – 30	13
31 – 40	6
41 – 50	4
51 – 60	4
61 – 70	2
Total	100

Table 53

Number of goats being reared by a community of 100 coastal plains Kadazan households in Tuaran

No. of goats reared by each household	No. of households	Total number of goats reared
0	33	0
1	8	8
2	18	36
3	13	39
4	14	56
5	3	15
6	2	12
7	4	28
8	1	8
9	2	18
10	2	20
Total	67	240

Fresh water fish such as *ikan koruk, ikan sepat* and *ikan duri* are caught in the padi fields using nets. *Ikan gamato, ikan lomih, ikan kombura, ikan duri* and sometimes prawns are caught from the river.

Occasionally, the people make trips to the coast to collect hardwood for fence poles and also *mengkuang* (pandanus leaves) for mats and baskets. At the same time they will fish in the sea, hunt and also collect turtle's eggs.

g. Food storage

Padi is stored in the same way as among the Muruts of Ansip. Onions, flour, bread, sugar and coffee are kept in their original containers or in plastic bags, glass jars or milk tins. Cooked food is kept in bowls or closed basins and stored in closed bins or in cupboards to prevent access by cats.

h. Food Availability and Prices

Food items are more expensive in the provision shops of the village than in Tuaran town (Appendix 6.2 & 6.3). Sea fish such as *ikan merah, ikan pari* and *ikan tenggiri* are sold in the markets. Fish is not sold according to weight, but rather according to size and number. The price will also vary according to the bargaining power of the customer and availability.

The licensed hawkers sell vegetables according to weight while the unlicensed hawkers sell them in *tumpah* (bunches) and at lower prices (Fig. 39). The people also

Table 54

Foods considered beneficial, neutral or harmful to all three vulnerable groups composed of toddlers, pregnant women and women in confinement by the coastal plains Kadazans of Tuaran

Classification	Food type	Food item
Beneficial	Cereals	(Rice, *pulut*, bread, biscuits, cake
	Vegetables	(Shoots of sweet potato and yams, *sawi,* (soya beans, french beans, long beans, (bitter gourd, bean sprouts
	Fruits	Bananas, papaya, lemon
	Meat, eggs and milk	(Beef, mutton, chicken, eggs, milk
Harmful	Vegetables	(Spinach, *kangkong,* bamboo shoots, (pumpkin, okra, cucumber
	Fruits	Pineapple, *belimbing*
	Fish and sea-foods	(*Ikan selar, ikan kembong, ikan* (*selayang, ikan sembilang,* sting-ray, (shark, prawn, squid, *jeruk ikan, budu*
	–	*Tapai*
Neutral	Cereals	Noodles
	Vegetables and fruits	*Daun tiri, petai, jering, ciku*
	Meat, eggs and milk	(Rabbit, fresh cow's milk, sweetened (condensed milk, buffalo's milk

Table 55

Foods considered taboo and harmful for toddlers, pregnant women or women in confinement by the coastal plains Kadazans of Tuaran

Toddlers	Pregnant women	Women in confinement
Anchovy	Maize	Maize
Cockles	Turtle's egg	Turtle's egg
Belacan	Brinjal	*Cekur manis*
Pucuk peraga	Jackfruit	*Pucuk peraga*
Cashew nut shoots	Guava	Cashew nut shoots
	Water-melon	Brinjal
		Jackfruit
		Guava
		Water-melon

Fig. 39 *Tamu (Bazaar) in Tuaran showing Kadazans selling fresh fish, vegetables and fruits from open-air sites.*

trade food items such as bananas, coconut and vegetables with the fish-mongers. The prices of vegetables vary from $1 to $1.40 a kati. The prices of fruits tend to vary according to size and the season. In general, the prices of foods are rather high.

4.4 Food Ideology

Foods that are considered beneficial, neutral or harmful to all or any one of the three vulnerable groups of people composed of toddlers, pregnant women, and women in confinement are listed in Tables 54, 55 and 56. It will be noted that all three groups appear to be subjected to a wide range of food taboos. A large number of fish and seafoods are considered as taboo for the three vulnerable groups, including a number of sea fish, which are cheap sources of protein, and preserved fish products such as *jeruk ikan* and *budu* (local delicacies which are frequently consumed by the community). The taboo foods also include a number of vegetables such as spinach, *kangkong,* bamboo shoots, okra, pumpkin and cucumber. *Tapai* and fruits such as pineapple and *belimbing* are also considered harmful for all the three vulnerable groups.

For toddlers, anchovy, cockles and *belacan* are considered taboo. Some wild shoots such as *pucuk peraga* and cashew nut shoots are also included in this category.

Table 56

Foods considered beneficial for toddlers, pregnant women or women in confinement by the coastal plains Kadazans of Tuaran

Toddlers	Pregnant women	Women in confinement
Tuna	Fish fry	Fish roe
Cekur manis	Anchovy	Fish fry
Cabbage	*Cekur manis*	Anchovy
Brinjal		Tuna
		Cabbage

Table 57

Food items consumed for breakfast, lunch and dinner by a sample of 29 coastal plains Kadazan households of Tuaran

	No. of households consuming food item shown:				
Breakfast		Lunch		Dinner	
Coffee	18	Rice	26	Rice	26
Rice	9	Fish	17	Fish	17
Banana cake	6	Dried fish	7	Dried fish	6
Mango	5	Groundnuts	5	Sardines	5
Bread	4	Eggs	4	*Ikan bilis*	3
Banana	4	*Cekur manis*	3	Cabbage	2
Sweetened condensed milk	4	Pumpkin	3	*Jantong pisang*	2
Milo	4	*Jantong pisang*	3	Long beans	2
Biscuit	2	Coconut		Beef	2
Guava	2	Green vegetables	2	Spinach	1
Lime	2	Buffalo meat	2	Green vegetables	1
Sago	1	Sardines	2	*Sayur nangka muda*	1
Sweet potatoes	1	Dried prawns	1	*Sawi*	1
Papaya	1	Cabbage	1	*Cekur manis*	1
Durian	1	*Kangkong*	1	Pumpkin	1
Jackfruit	1	*Sayur nangka muda*	1	*Pucuk paku*	1
Pineapple	1	*Pucuk ubi*	1	Bamboo shoots	1
Sugar cane	1	*Pucuk paku*	1	Tomato	1
Water-melon	1	Cucumber	1	Ketola	1
Tea	1	Chicken	1	Ladies fingers	1
Cocacola	1	Deer	1	Wild boar	1
Beer	1	Beef	1	Buffalo	1
Tapai	1	Cockles	1	Deer	1
				Dried prawn	1

During pregnancy, maize, turtle's egg and brinjal are to be avoided, as well as some fruits such as jackfruit, guava and water-melon.

During the post-partum period, maize and turtle's egg are also considered harmful. Vegetables to be avoided during this period are *cekur manis, pucuk peraga,* cashew nut shoots and brinjal. Jackfruit, guava and water-melon are also thought to be harmful.

4.5 Dietary Studies

Food items consumed during the three main meals over a 24-hour period by a sample of 29 households are shown in Table 57. It will be noted that cereals such as rice, bread, biscuits and noodles constitute the main staple in the diet of the households studied. Starchy roots and tubers are less common items of the diet. Both green leafy vegetables as well as shoots of wild plants are included in their diets.

As in the case of the other four communities, the nutritive value of the diets of coastal plains Kadazans of Tuaran will be examined in a section that follows.

5. THE CHINESE OF ANSIP, KENINGAU

5.1 Introduction

As described earlier, Kampung Ansip is located in the district of Keningau and is six miles from Keningau town, the seat of the Interior Division. The Chinese live in Kuala Ansip which is nearer Keningau town while the Muruts live in Ulu Ansip further up the gravel road. Kuala Ansip is made up of 27 houses with a total population of 202 but only 20 houses were selected for detailed study.

5.2 Socio-economic Status

The Chinese community have the highest economic status among the five communities studied. Both their mean monthly income per household of $435 as well as the per capita income of $69.19 are the highest. All the households have mean incomes exceeding $200 per month, showing a fairly uniform economic standard within the community. This income is derived mainly from the sale of rubber and also from salaries in the case of those who are employed. Using the criterion described earlier, the incidence of poverty among the Chinese of Ansip is 40%, which is still the lowest when compared with the other communities studied (Fig. 27, 28 and 29).

The economic status of the Chinese is further reflected by the fact that 80% had radios, while others possessed cars, sewing machines and television sets all of which are rarely seen in the other communities. 70% of the families own their house while 80% of the families own agricultural land with a median acreage of ten acres per family (Table 36 and 37).

Most of the Chinese households use sanitary latrines, with 60% using pit latrines and 30% using flush systems connected to septic tanks (Table 39). This indicates the economic ability to afford these systems and also their cultural background where latrines are a necessity. These sanitary excreta disposal systems also lessen the chances for the spread of diarrhoeal diseases and helminthic infections in the community and indirectly have a beneficial effect on the nutritional status of the community, especially the children.

Among the Chinese women in Ansip, 30% of them had had no formal education, 50% had had primary education, 10% had had secondary education, and another 10% had had post-secondary education (Fig. 30). Only 10% of the men had had no formal education while 70% of them had had primary education. The percentages with secondary and post-secondary education was the same as in the case of the women.

5.3 Food Production, Distribution and Availability

In the Chinese community, 80% of the families own agricultural land with a median of ten acres of land under self-cultivation per family. However, most of the land is used for planting rubber, a cash crop, with only one of the ten families devoting three out of its total of nine acres of land for planting maize.

Some vegetables are grown in fenced enclosures around the house and most households rear chickens. Very few fruit trees are found in this community. Only a few households grow more vegetables than they need and sell the surplus, whereas most households have to buy vegetables to supplement their diet. Thus, there is limited production of food for home consumption or sale. Fishing and hunting do not play any significant part in the community life of the Chinese. There is very little utilization of the wild plants common to the area, even though they are cheap and nutritious sources of protein, vitamins and minerals.

The Chinese community of Ansip is based on a cash economy, their main concern being to produce cash crops or to earn cash through employment. Most of their food and other necessities are obtained through purchases from outside sources.

Appendix 6.4 shows the wide range of food items which can be purchased from the Keningau market and *tamu* and the current prices as on the 20th of March, 1980. There is a wide range of foodstuffs available but the prices are higher than prices in Peninsular Malaysia.

5.4 **Food Ideology**

All the respondents reported that there were no food taboos except during pregnancy and the post-partum period of one month (Table 58). The toddlers appear to be unrestricted by any food taboos.

Table 58

Foods considered beneficial, neutral or harmful for pregnant women or women in confinement by the Ansip Chinese community

Food items	Pregnant women	Women in confinement
Tapai	Neutral	Beneficial
Poultry	Neutral	Beneficial
All vegetables	Neutral	Taboo
Goat	Taboo	Neutral
Turtle	Taboo	Neutral
Snake	Taboo	Neutral
Monkey	Taboo	Neutral

During Pregnancy

The pregnant woman is allowed to take most foods with the exception of goat's meat, sow's meat and the meat of some wild animals such as turtle, snake, eagle, monitor lizard and monkey.

On questioning some of the respondents, the following reasons were given for the taboos:

a) The consumption of turtle may result in the baby wanting to go in and out like a turtle's head. This would result in a difficult labour.

b) The meat of snakes and monitor lizards are avoided during this period of fear of producing a baby with a face resembling these creatures.

c) The consumption of eagle's meat may cause the baby to be born shivering.

d) The consumption of goat's meat during pregnancy may cause the baby to be sickly or insane.

e) Sow's meat is avoided as this may result in a baby who is susceptible to all kinds of illnesses.

f) It is believed that the consumption of monkey's meat will result in a baby who will look and act like a monkey.

Post-partum Period

The Chinese women of Ansip have to observe certain taboos during the first thirty days after delivery. They are not allowed to eat any vegetables and some fruits such as jackfruit and pineapple due to the belief that these foods are "cooling" and may thus result in "coldness" of the body and cause backache during old age.

During this period, the main dish allowed is chicken, cooked with lots of ginger, and rice wine or brandy. This is to prevent air from coming inside the body and to prevent body aches and pain which may occur later on. These foods are considered "heaty" and will thus counteract the "coldness" of the body and give strength to the women.

5.5 Dietary Studies

The food items taken, over a period of 24 hours, by a sample of ten Chinese households in Kuala Ansip are shown in Table 59. It will be noted that the Chinese have a fairly simple meal pattern with only three main meals and no snacks. Breakfast is relatively light consisting of coffee and bread. Lunch and dinner consist of rice, meat and some vegetables. In this community unlike the other native communities, pork is the most popular meat consumed, followed by eggs and chicken. Pork is also the most expensive meat in the market, selling at $4.50 a kati, while the price of fish ranges from $1.50 to $2.80 a kati depending on the type of fish.

The range of vegetables consumed in this community is limited. Fruits are a rare item in the typical Chinese diet. Legumes, vegetables and fruits together contribute only 10% of the total protein intake.

6. DIETARY INTAKE STUDIES OF THE FIVE COMMUNITIES

The study communities vary considerably with regard to their dietary pattern,

Table 59

Food items consumed by a sample of ten Chinese households of Kuala Ansip

No. of households consuming food item shown:					
Breakfast		Lunch		Dinner	
Coffee	9	Rice	10	Rice	10
Bread	5	Eggs	3	Pork	5
Rice	1	Pork	3	Eggs	4
Porridge	1	*Sawi*	3	*Sawi*	3
Milo	1	Tea	2	*Cekur manis*	2
Lactogen	1	*Cekur manis*	1	Cabbage	2
		Kangkong	1	Long beans	2
		Cabbage	1	*Kangkong*	1
		Bitter gourd	1	Spring onions	1
		Soya bean cake	1	Cucumber	1
		Long beans	1	Chicken	1
		Chicken	1	Beef	1
		Beef	1	Tea	1
		Porridge	1		

No. of households consuming food item shown:					
Mid-morning snack		Tea		Supper	
Stout	1	Milo	1	Lactogen	1
Orange	1	Cakes	1		

the types of food consumed and the qualitative and quantitative adequacy of their respective diets.

6.1 Pattern of Food Usage

Among the communities included in the study, the Rungus Dusun of Pitas District had the most monotonous diet with little variation in the food items consumed (Tables 41 and 60). The diets of the Chinese community of Ansip showed slightly more variety in the range of food items consumed (Table 59). They consumed more meat than the Rungus Dusun households but the preference here is for pork, eggs and chicken rather than fish. Only a limited range of vegetables are consumed and fruits do not appear to be a common item in their diet.

Table 60

Common food items taken during the five meals of the day according to ethnicity

Meal	Rungus Dusun	Murut	Upland Kadazan	Coastal plains Kadazan	Chinese
Breakfast	Rice Fish Vegetables	Coffee Rice Bread Starchy roots	Coffee Rice Porridge Fish Vegetables	Coffee Rice Bread Kueh Pisang	Coffee Bread
Mid-morning snack	None	Coffee Fruits Bread Biscuits	Mee Porridge Tapioca Sweet potatoes	None	None
Lunch	Rice Vegetables	Rice Fish Sardines *Jeruk* Eggs Vegetables	Rice Porridge Dried fish Sardines Fish Vegetables	Rice Fish Salted fish Eggs Vegetables	Rice Pork Eggs Vegetables
Tea	None	Coffee Milo Bread Biscuits Fruits	Rice Left-overs Fruits	None	None
Dinner	Rice Fish Vegetables	Rice Fish Vegetables	Rice Porridge Fish Dried fish Sardines Anchovies Vegetables	Rice Fish Eggs Vegetables	Rice Pork Eggs Vegetables
Supper	None	Coffee	None	None	None

The two Kadazan communities of Ranau and Tuaran exhibit dietary patterns which are intermediate, between that of the above two communities on the one hand, and the Murut community on the other (Tables 50 and 57). In these two communities rice is still the main staple but other cereals such as bread, biscuits and noodles are also common items in their diets. Vegetables and fruits are also more frequently consumed. Fresh fish as well as processed fish products are the main sources of animal protein in their diet.

The Murut community of Ansip appear to consume the largest variety of food items in almost all the food groups (Table 45). Cereals as well as starchy roots and tubers feature prominently in their diets. Wild plant shoots are also frequently gathered and consumed (Fig. 40).

Fig. 40 *View of a Murut kitchen and hearth, showing householders preparing a meal of fern shoots.*

6.2 Adequacy of Nutrient Intake

The daily dietary requirement for the household was estimated, taking into account the age, sex, physiological state and activity of the members. The actual dietary intake for the household was obtained by the 24-hour recall method. As noted earlier, most of the dietary studies were carried out in April, May and June soon after the harvest. Consequently, nutrient intakes will tend to be "high". The dietary intake was converted into essential nutrients using food composition tables. The percentage nutrient requirements met was derived thus:

$$\text{Percentage nutrient requirement met} = \frac{\text{Actual dietary intake of the nutrient}}{\text{Estimated requirement of the nutrient}} \times 100$$

The intake of a particular nutrient was considered adequate when the percentage nutrient requirement met exceeded 100%. Values between 50 to 100% indicated that the

intake of that nutrient was low but acceptable. With values below 50% the diet was considered to be deficient in that particular nutrient.

The percentage nutrient requirements met in the diets of the five communities are shown in Figures 41 to 45. A quick glance at these figures seem to indicate that the Muruts and the Rungus Dusun seem to fare better with regard to the percentage requirements met for the various nutrients, when compared with the other communities. However, it should be borne in mind that most of the studies reported here were conducted soon after the harvest. The other three communities show varying degrees of inadequacies in their diets.

All the Murut households achieved more than 50% of the nutrient requirements, with the majority consuming more than 100% of the estimated requirements (Fig. 41). In about 40% of the households, the diets had low but acceptable levels of riboflavin. Among the Rungus Dusun, only one household had intakes of calcium and riboflavin at levels which were below 50% of the estimated requirements (Fig. 42). In the case of riboflavin, all the households had intakes below 100% of the estimated requirements. About 70% of the households had caloric intakes below 100% of the estimated requirements. At least 30% of the households had low levels of protein, iron and vitamin A as well.

In Tuaran, 72% of the coastal plains Kadazan households had deficient intakes of riboflavin (Fig. 43). Deficient levels of vitamin A, calcium and iron were also found in the diets of 56%, 38% and 13% of the households respectively. Between 40 to 95% of the households consumed diets which were low in calories, calcium, iron, vitamin A and riboflavin as well.

The pattern in Ranau seem to follow that seen in Tuaran, where the diets were mainly deficient in riboflavin, vitamin A and calcium, with 72%, 56% and 38% of the households involved respectively (Fig. 44). In addition, about 70% of the upland Kadazan households had low caloric intakes while 60% of them consumed diets which were low in iron.

In the Chinese community, the diets appear to be deficient in riboflavin, calcium, calories and iron with 60%, 30%, 20% and 20% of the households involved respectively (Fig. 45). 10% of the households had deficient intakes of the remaining nutrients. In at least 80% of the households, the dietary intake of calories, iron and riboflavin were low.

Thus it would appear that during times of "plenty", the diets of the Murut community was generally satisfactory and that the dietary intake of the Rungus Dusun seem to be fairly adequate with the exception of riboflavin and calcium. However, it is likely that during times of "shortage", the reverse would apply to the Muruts and the Rungus Dusun. Among the two Kadazan communities, the diets were mainly lacking in calcium, vitamin A and riboflavin, and also to a slight extent, in calories and iron as well. The diets of the Chinese community appear to be lacking in all nutrients, especially riboflavin, calcium, iron and calories.

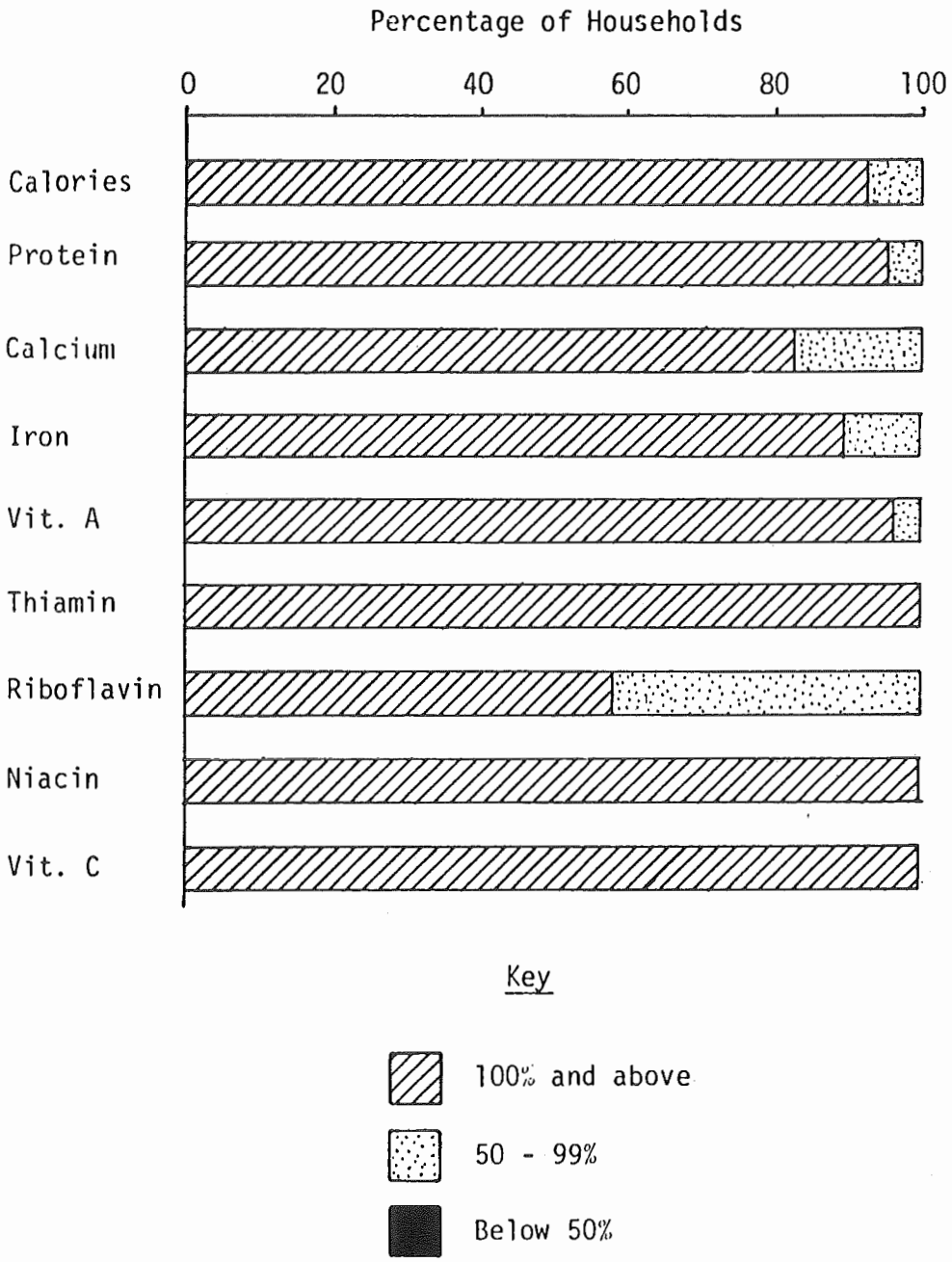

Fig. 41 *Muruts: Households by percentage nutrient requirements met*

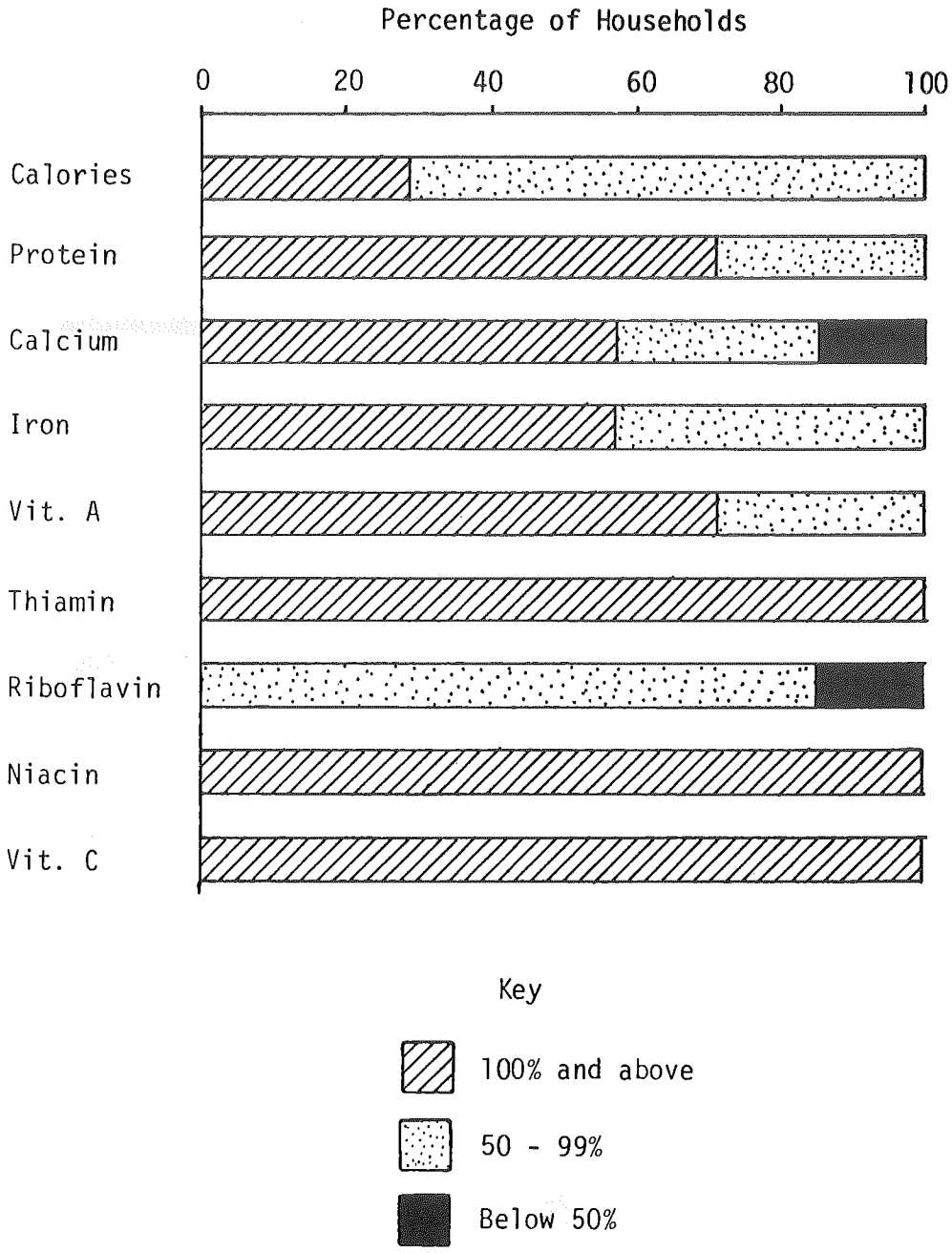

Fig. 42 *Rungus Dusun: Households by nutrient requirements met*

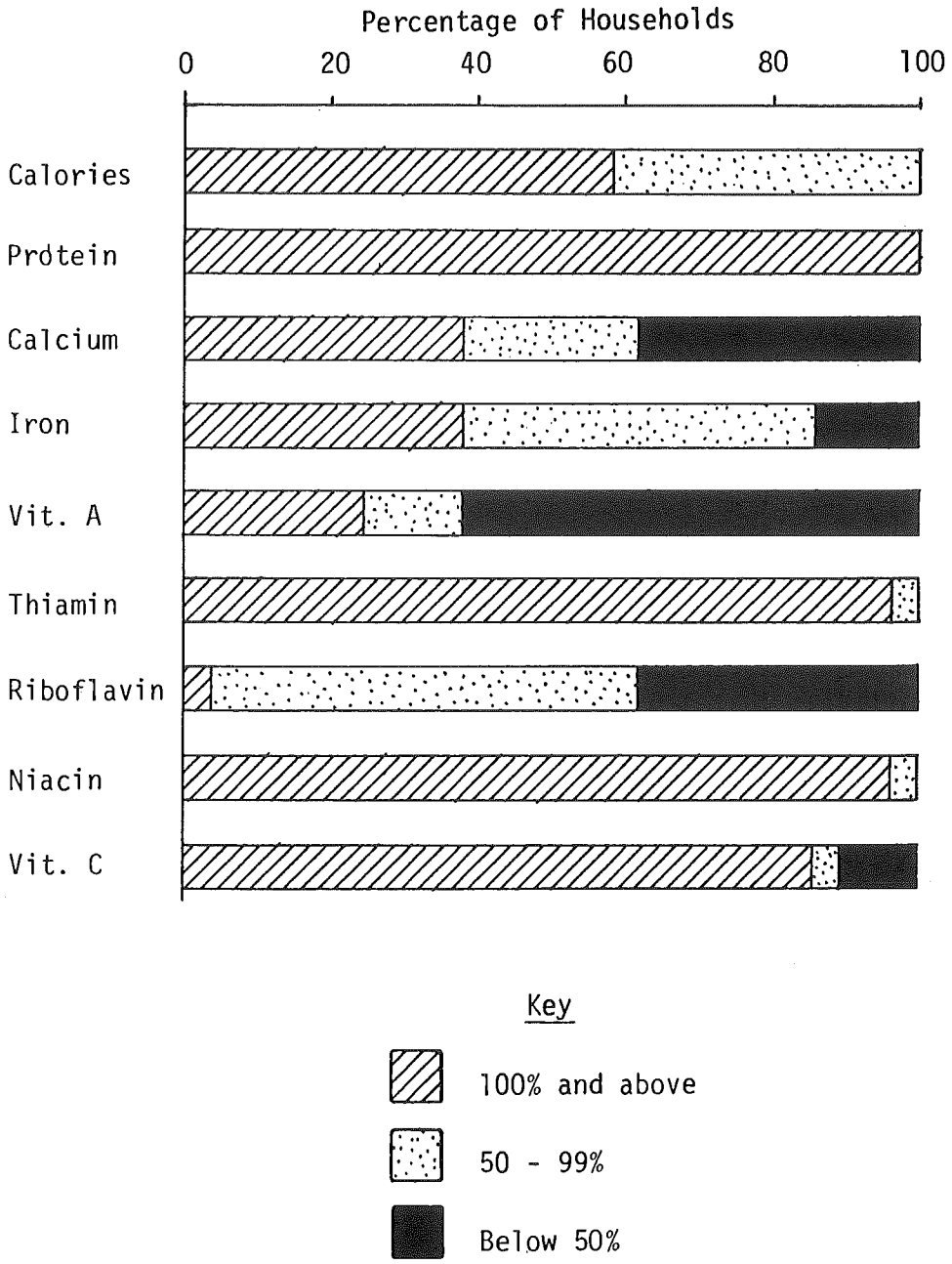

Fig. 43 *Coastal plains Kadazan: Households by percentage nutrient requirements met*

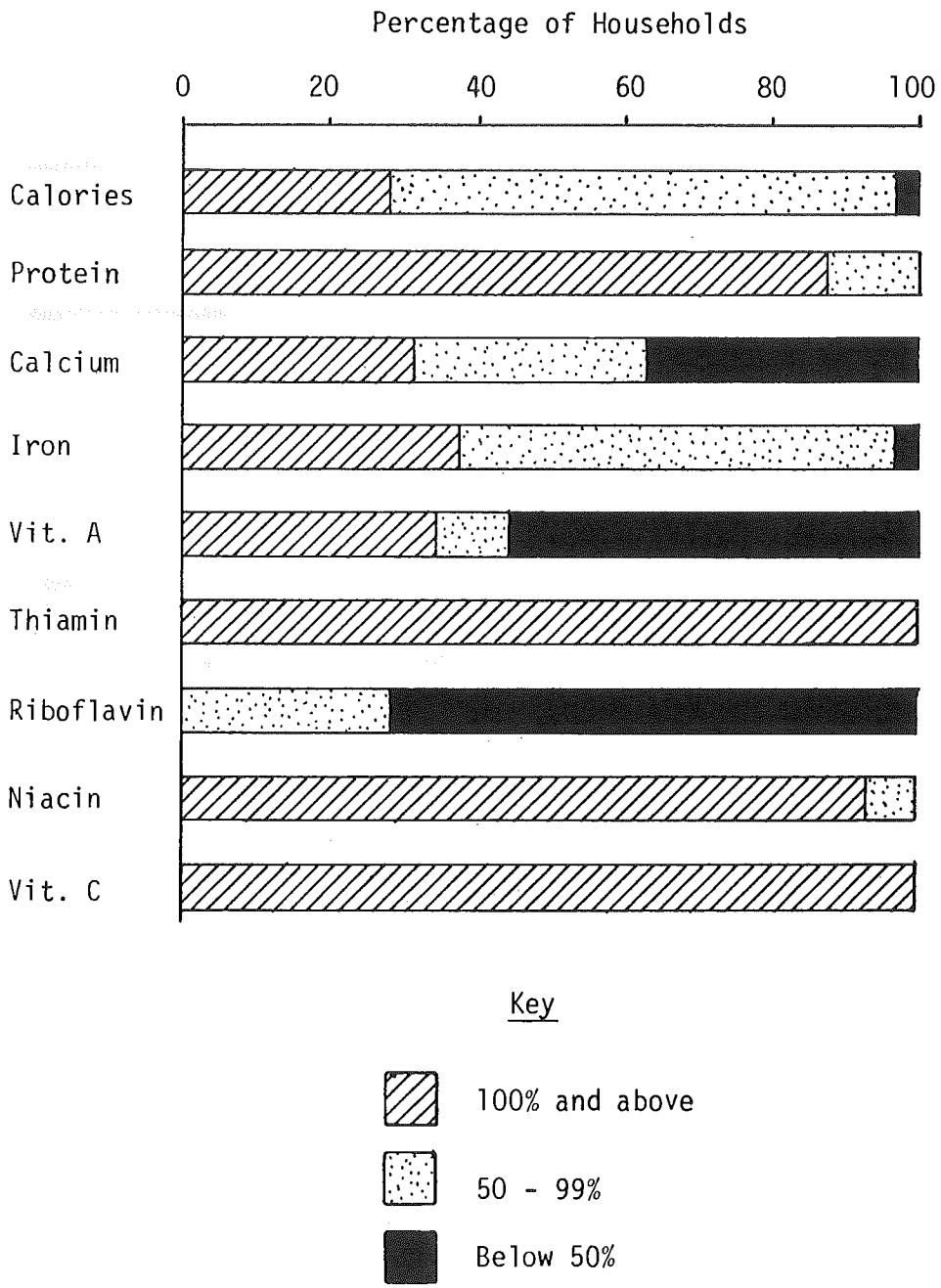

Fig. 44 *Upland Kadazan: Households by percentage nutrient requirements met*

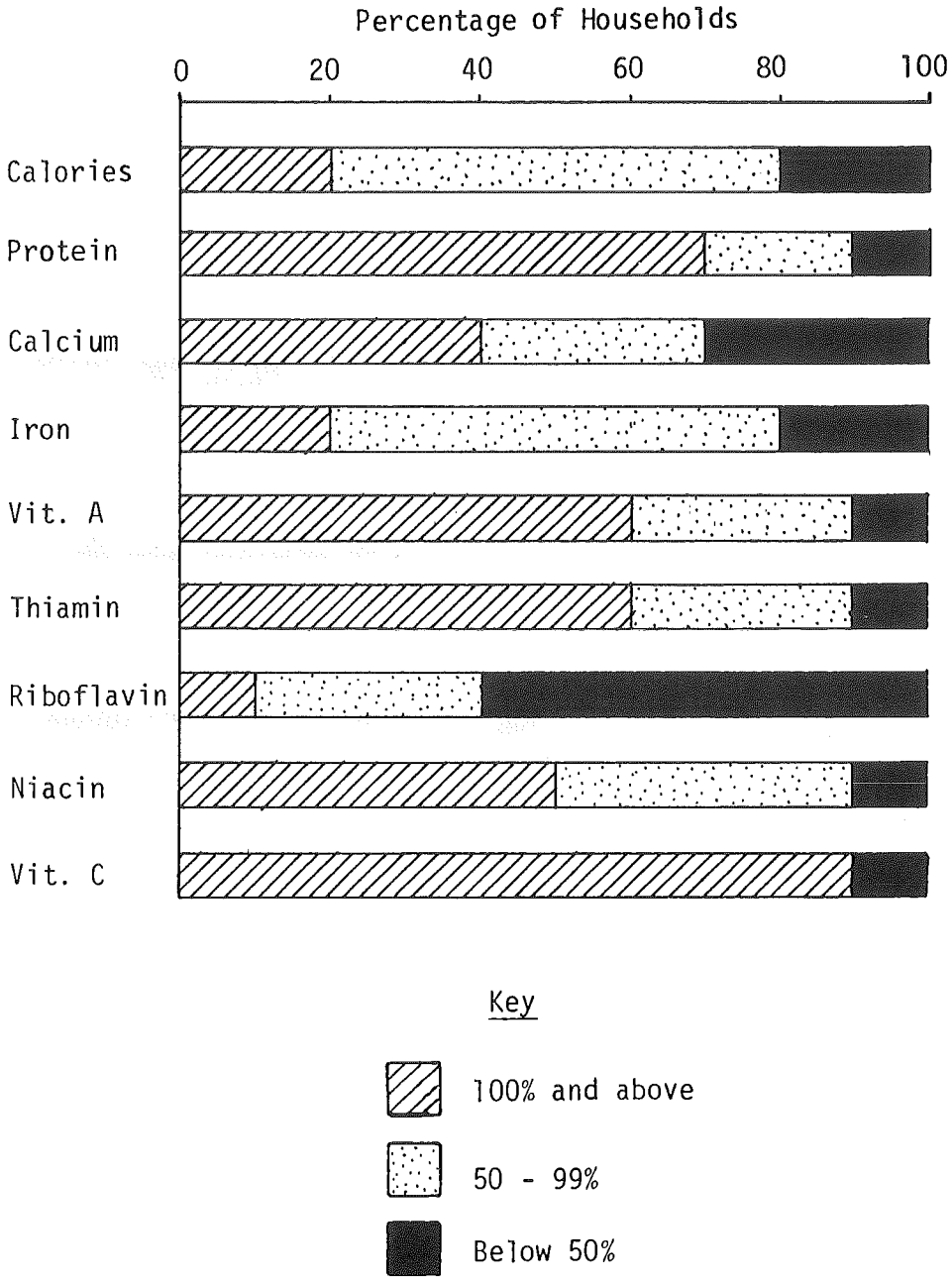

Fig. 45 *Chinese: Households by percentage nutrient requirements met*

6.3 Median Percentage Requirement Met

The values of the percentage requirements met for all the nutrients showed a rather wide range with very skewed distributions. Thus, it was felt that the median values would be a better measure of central tendency to represent the distribution in the various communities. The median percentage requirements met for the various nutrients in the diets of the study communities are shown in Table 61.

Table 61

Median percentage nutrient requirements met and the range in the dietary intakes of the five communities

Nutrient	Rungus Dusun	Muruts	Upland Kadazans
Calories	96.6 (52.7– 144.7)	153.0 (71.3– 263.0)	86.1 (47.0–158.5)
Protein	139.7 (79.7– 206.7)	261.0 (93.4– 714.0)	131.6 (76.9–210.4)
Calcium	109.6 (42.7– 164.8)	130.0 (70.9– 503.5)	58.4 (31.2–229.1)
Iron	104.4 (68.5– 125.4)	161.6 (69.0– 578.0)	89.0 (48.0–328.4)
Vitamin A	152.7 (80.7– 281.1)	320.4 (61.7–1025.0)	41.6 (2.6–485.4)
Thiamine	246.0 (151.3– 345.2)	319.8 (136.7– 814.0)	177.1 (109.6–254.0)
Riboflavin	78.8 (31.1– 90.0)	111.0 (53.1– 632.0)	39.1 (21.7– 79.2)
Niacin	210.7 (122.1– 302.1)	274.0 (109.2– 961.4)	153.1 (90.5–285.1)
Vitamin C	693.0 (268.0–1060.0)	861.0 (181.7–2877.0)	286.7 (116.4–583.0)

Nutrient	Coastal Plains Kadazans	Chinese
Calories	102.7 (74.5 – 152.0)	82.8 (42.4 – 98.0)
Protein	161.9 (112.0 – 756.5)	129.5 (45.0 – 208.0)
Calcium	73.9 (18.0 – 278.2)	67.8 (31.0 – 205.0)
Iron	81.1 (31.0 – 271.9)	66.8 (14.9 – 134.0)
Vitamin A	68.6 (5.0 – 422.0)	104.2 (19.7 – 075.0)
Thiamine	151.9 (93.5 – 493.0)	139.0 (33.4 – 295.0)
Riboflavin	60.2 (26.7 – 116.6)	47.9 (16.7 – 420.3)
Niacin	150.0 (70.8 – 281.8)	93.6 (24.8 – 131.3)
Vitamin C	366.7 (16.0 – 877.8)	259.8 (12.8 – 605.0)

It will be noted that during times of "plenty" the diets of the Murut community appear to be highly satisfactory where the median percentage requirements met for all th the nutrients exceeded 100%, and that the Rungus Dusun follow close behind, with diets which are only lacking in riboflavin and calories but where the median percentage requirements met are quite satisfactory. The coastal plains Kadazans of Tuaran consumed diets with low but acceptable levels of riboflavin, vitamin A, calcium and iron, where the median percentage requirements met for these nutrients exceeded 60%. The diets of the Chinese community were mainly deficient in riboflavin, with a median percentage requirement met of about 48%. Levels of calcium and iron were also low with median percentage requirements met below 68%. Among the upland Kadazans, the diets were deficient in vitamin A and riboflavin with levels below 42%. Calcium came next with a median percentage requirement met of 58%. However, it should be noted that for the last three communities (Kadazan and Chinese), seasonal variation is less wide and there are no distinct seasons of "plenty" and "shortage".

Table 61 also shows that there is a wide range of values for the percentage requirements met for all the nutrients in the five communities. This aspect will be discussed in a later chapter.

6.4 Sources of Nutrients

So far, we have dealt with the quantitative aspects of the dietary intakes of the five communities. The qualitative aspects of the diets would also have to be looked into especially with regard to calories and protein.

a. Calories

In all communities, the main contribution to the caloric intake is from cereals, with contributions ranging from 62% among the Chinese and the Muruts, to about 94% among the Rungus Dusun of Pitas (Table 62). The two Kadazan communities have intermediate values of 74% and 70% for the upland Kadazans and the coastal plains Kadazans respectively.

Carobhydrates such as starchy roots, sugars and sweets form only a small portion of the caloric intake. Starchy roots contribute only about 5% of the caloric intake among the Muruts, while the contribution to the caloric intake in the other communities is negligible. Contributions from sugars and sweets range from negligible proportions among the Rungus Dusun to about 9% among the Muruts.

The contribution of oils and fats to the caloric intake is also minimal, with about 7% among the Chinese community, 4% among the upland Kadazans of Ranau, to negligible amounts in the other communities. In the Chinese community, meat and eggs contributed about 24% of the caloric intake, unlike the other communities where animal proteins do not contribute much to the caloric content of their diet.

Table 62

Average percentage contribution of Calories in the diets of the five communities

Food Groups	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
Cereals	93.5	61.6	73.6	70.1	62.0
Starchy roots and tubers	–	4.9	–	0.4	–
Sugar and sweets	–	9.1	2.7	2.5	4.9
Legumes	–	–	–	2.1	–
Vegetables and fruits	4.2	11.5	3.7	6.1	1.6
Meat and eggs	–	3.9	1.0	4.7	24.2
Fish	1.6	8.9	4.6	4.1	–
Oils and fats	–	–	4.3	0.8	7.3
Condiments	0.5	–	5.9	7.0	–
Milk	–	–	3.4	1.0	–

b. **Protein**

Cereals appear to be the main source of protein in all the communities studied, contributing about 44% among the Muruts, 49% among the coastal plains Kadazans, 53% among the Chinese, 55% among the upland Kadazans, while the largest contribution is from Pitas where 73% of the protein intake of the Rungus Dusun is derived from cereals (Table 63).

Table 63

Average percentage contribution of protein in the diets of the five communities

Protein Source	Rungus Dusun	Muruts	Upland Kadazans	Coastal plains Kadazans	Chinese
Cereals	73.2	44.2	55.2	48.6	53.0
Starchy roots and tubers	–	1.5	1.2	0.4	–
Sugars and sweets	–	–	–	–	–
Legumes	–	3.9	0.8	3.1	3.5
Vegetables and fruits	13.0	16.8	6.5	7.3	6.4
Meat and eggs	–	10.3	2.7	12.3	37.1
Fish	13.3	20.5	31.0	27.2	–
Oils and fats	–	–	2.4	0.3	–
Condiments	–	2.9	–	–	–
Milk	–	–	0.6	0.8	–

Animal protein comes next, with contributions of about 41% among the coastal plains Kadazans, 37% among the Chinese, 36% among the upland Kadazans, 31% among the Muruts and the lowest is among the Rungus Dusun, with only 14% of its protein intake from animal sources (Table 64). In the Chinese community, the main source of animal protein is from meat and eggs while in the other communities, it is derived mainly from fish with a smaller contribution from meat and eggs.

In the Murut community, legumes, vegetables and fruits contribute about 21% of the total protein intake (Table 63). Among the Rungus Dusun, the contribution from this food group is 13% which is almost equal that of animal protein. Among the coastal plains Kadazans and Chinese, 10% of the protein intake comes from legumes, vegetables and fruits. The lowest contribution is seen among the upland Kadazans, where only 7% of the protein intake are from these sources.

Table 64

Average percentage contribution of protein from plant and animal sources to the diets of the five communities

Community	Plant sources	Animal sources
Rungus Dusun	86.2	13.8
Muruts	69.2	30.8
Upland Kadazans	63.6	36.4
Coastal Plains Kadazans	59.4	40.6
Chinese	62.9	37.1

c. **Protein Calories Percentage**

This is the percentage contribution of protein to the total caloric intake and gives some indication of the adequacy of the diet with regards to protein.

Protein calories percentage

$$= \frac{\text{No. of calories from protein}}{\text{Total no: of calories in the diet}} \times 100$$

The Rungus Dusun have the lowest mean protein calorie percentage of 10.7% with a range of 2.4% (9.4 – 11.8%) (Table 65). Among the Chinese and the upland Kadazan communities, the mean protein calorie percentage is 11.3% with ranges of 13.1% (7.7 – 20.8%) and 5.7% (9.0 – 14.7%) respectively. Next comes the coastal plains Kadazans with a mean of 12.3% and a range of 9.6% (8.9 – 18.5%). The Muruts have the highest mean of 12.8% and a range of 19.3% (4.8 – 24.1%). There is only some slight difference between the mean values for the five communities, with the lowest among the Rungus Dusun with a narrow range and the highest among the Muruts where the range is the widest.

Table 65

The mean and range of *protein calorie percentage in the five communities

Community	Mean	Range
Rungus Dusun	10.7%	2.4% (9.4 – 11.8%)
Muruts	12.8%	19.3% (4.8 – 24.1%)
Upland Kadazans	11.3%	5.7% (9.0 – 14.7%)
Coastal plains Kadazans	12.3%	9.6% (8.3 – 18.5%)
Chinese	11.3%	13.1% (7.7 – 20.8%)

*The protein calorie percentage is the percentage contribution of protein to the total energy intake.

6.5 Summary

The fore-going dietary studies were largely carried out during the post-harvest months of "plenty" and must therefore be seen in that context. From the ecological point of view, the two communities that are particularly affected by wide seasonal variations of "plenty" and "shortage" are the two hill padi-growing communities of Rungus Dusun and Muruts. It would appear that the Rungus Dusun community, which has the lowest mean household income ($23.86 per month), is the worst off, even though dietary studies carried out in the months of "plenty" indicate that most of their dietary requirements appear to have been met. However, the Rungus Dusun diet was found to be highly monotonous and that their nutrient requirements were met by the consumption of large quantities of rice (at least during the months of "plenty"), this being supplemented by small quantities of fish, vegetables and fruits. However, unlike the Muruts, the Rungus Dusun do not have the same access to wild game and consequently consume a highly monotonous diet with a relatively low mean protein calorie percentage.

On the other hand, at least during months of "plenty", it appears that the diets of the Muruts of Ansip are the most satisfactory both quantitatively as well as qualitatively. They consumed a wide range of food items from all food groups and their dietary intake seem to fulfil their requirements for all nutrients. Their protein intake appears to be satisfactory with the highest protein calorie percentage of 12.8%, with about 30% of this from animal sources, most of which is obtained by hunting and fishing. It is likely, however, that dietary studies carried out during months of "shortage" among the Rungus Dusun and Muruts will show relatively inadequate intakes.

The availability of foods in the two Kadazan communities and the Chinese of Kuala Ansip is much less subject to the vagaries of "plenty" and "shortages". As such, the dietary studies carried out in these three communities are more likely to be representative of the diets taken by these communities on an all-round-the-year basis. As the Chinese purchase most of their foods, the dietary intake of the Chinese are the least

likely to be subject to the wide seasonal variations seen, particularly among the Rungus Dusun and the Muruts.

It will be noted that the dietary patterns of the two Kadazan communities are similar in many respects. Both have a fairly wide range of food items in their daily diet, with adequate representations from most food groups. The mean protein calorie percentage for the upland and the coastal plains Kadazans are about 11 and 12% respectively, while the contribution from animal sources are 36% and 41% respectively. The diets of both communities are lacking in riboflavin, calcium, iron and vitamin A.

Unlike their neighbouring Muruts, the Chinese do not supplement their diets by hunting and fishing. Consequently, the variety of food items featured in the diets of the Chinese community is rather narrow but the Chinese do consume sufficient quantities of protein and other foods to supply their dietary requirements except for one or two households where the diets are lacking in most nutrients.

CHAPTER 7

THE ROLE OF INFECTIONS

The ecological studies have established the part played by the various socio-economic and cultural factors in determining the dietary patterns of the various communities and in turn their nutritional status. These studies will not be complete without examining the quantum of infections in these communities and their possible effects on the nutritional status of the people.

The synergism between infections and malnutrition has been well-established. On the one hand infections have an adverse effect on nutritional status. It has been shown by Beisel (1972) that prolonged ninfections are associated with a fall in plasma amino acids. This gives rise to a negative nitrogen balance. This is further supported by a longitudinal study in Uganda (Frood, *et al,* 1971) where it was found that combinations of respiratory tract infections, malaria and gastroenteritis were associated with a fall in serum albumin. These changes often herald the appearance of clinical kwashiorkor in some children.

In a study on the effect of severe measles on African children, Morley (1973) found that 90% of the children had lost weight as a result of measles and that 50% of them lost more than 5% of their body weight.

Hookworm infestations also have an adverse effect on the nutritional status of children via intestinal blood loss. It has been shown (WHO, 1968) that faecal blood loss is approximately 0.03 ml/worm/day or 2.1 ml/1,000 eggs/gm. of faeces for Necator americanus infection and 0.15 – 0.26 ml/worm/day or 4.5 ml/1,000 eggs/gm of faeces for infection with Ancylostoma duodenale. Therefore a moderate infection with 250 Necator worms or 5,000 eggs will result in an intestinal loss of about 5 mg of iron daily of which 70 – 80% will be lost in the faeces and the rest is reabsorbed.

Conversely, malnutrition lowers the body's resistance to infection or it may alter the course of the infection once it occurs. It has been shown that there are defects in antibody formation, macrophage activity and also other aspects of the body's defence mechanism (Smythe, *et al,* 1971; Chandra, 1972).

In summary, it can be said that infection has an adverse effect on the nutritional status of a child and conversely the malnourished child is less able to withstand infection or to overcome it.

1. VITAL STATISTICS

Table 66 shows the vital statistics for Sabah and Peninsular Malaysia for the years 1966 and 1976. There has been little decrease in the crude birth rate of Sabah during the ten year period and its rate is higher than that of Peninsular Malaysia, where the drop is more significant. The crude death rate is lower than that of Peninsular Malaysia and it has declined from 6.0 per 1,000 population to 4.6. The neonatal mortality rate shows a rise from 14.0 per 1,000 live births in 1966 to 18.2 per 1,000 live births. This rate also appears to be lower than that of Peninsular Malaysia. The infant mortality rate has dropped from 39.0 per 1,000 live births to 34.0. Whereas in Peninsular Malaysia, it has dropped from 47.9 per 1,000 live births to 30.7, a drop of 36% compared with a drop of 13% in Sabah. In both countries the toddler mortality rate has dropped by about 50% although the rate in Sabah is still higher than that of Peninsular Malaysia.

Table 66

Vital statistics for *Sabah and *Peninsular Malaysia for the years 1966 and 1977

Rate	Sabah			Peninsular Malaysia		
	1966	1976	% change	1966	1977	% change
Crude Birth Rate	37.6	35.2	− 6.4	37.3	31.7	−15.0
Crude Death Rate	6.0	4.6	−23.3	7.6	6.2	−18.4
Neonatal Mortality Rate	14.0	18.2	+30.0	24.9	19.1	−19.7
Infant Mortality Rate	39.0	34.0	−12.8	47.9	30.7	−35.9
Toddler Mortality Rate	6.7	3.2	−52.2	5.1	2.6	−48.7

***Source**: Vital Statistics for Sabah and Peninsular Malaysia.

In general, the mortality rates for Sabah has declined gradually over the ten year period with the exception of the neonatal mortality rate which showed an increase over the period. This paradox could be due to improvements in the health information system which has previously been poorly developed due to the scarcity of trained personnel and also the widely scattered population in the rural areas. Such a situation will give rise to a certain degree of under-reporting, but notwithstanding this, both the infant and toddler mortality rates are higher than that of Peninsular Malaysia. This shows that the mortality risks in Sabah are probably much higher than that of Peninsular Malaysia, with the difference being much higher than that reflected by the figures shown in Table 66.

2. COMMUNICABLE DISEASES

Table 67 shows the incidence of communicable diseases notified in the two countries for the year 1977. Malaria tops the list in Sabah with an incidence of 5,120.1 per 100,000 population compared with 69.3 in Peninsular Malaysia, in spite of the

Table 67

Incidence of communicable diseases notified for Sabah and Peninsular Malaysia, 1977 (rate per 100,000 population)

Disease	Sabah	Peninsular Malaysia
Malaria	5,120.1	69.3
Measles	171.2	35.9
Tuberculosis	*157.8	**43.4
Gonorrhoea	69.9	7.0
Infectious Hepatitis	23.7	19.7
Cholera	22.9	4.2
Dysentery	129.0	5.7
Enteric Fever	56.0	20.3

* All forms of tuberculosis.
** Pulmonary tuberculosis.

existence of a malaria control programme in the state. Figures for the other communicable diseases such as measles, tuberculosis and the enteric infections are also higher than those for Peninsular Malaysia. Thus the burden of infection in Sabah is much heavier than that seen in Peninsular Malaysia.

The load of infections suffered by the toddlers is also another important factor to examine since toddlers are a more vulnerable group as far as nutrition is concerned and they are also more prone to infections as they are within the transitional period when they are shifting from a largely milk diet to an adult-type diet.

3. HOSPITAL ADMISSIONS

Table 68 shows the leading causes of hospital admissions for the three districts of

Table 68

Leading causes of hospital admissions among infants in Ranau, Kudat and Keningau Districts, 1979

Disease	Ranau	Kudat	Keningau
Gastroenteritis	20.3%	24.8%	25.0%
Pneumonia	15.0%	13.1%	44.0%
Malaria	7.4%	18.6%	5.4%
Bronchitis	12.0%	8.9%	1.3%
Measles/Chicken Pox	0.8%	1.4%	5.3%

Ranau, Kudat and Keningau among infants, for the year 1979. Gastroenteritis was the leading cause of admission accounting for 20 to 25% of the admissions among infants. In Keningau hospital, the leading cause of admission was pneumonia, followed by gastroenteritis. For the Kudat hospital, malaria was the second cause of admission with about 19% of the admissions being due to it.

The admissions among the toddlers in the three hospitals showed a similar pattern with gastroenteritis, pneumonia and malaria being the three leading causes for admissions (Table 69). In Ranau hospital, gastroenteritis topped the list while malaria appears to be a problem in Kudat with 38% of the admissions being attributed to this condition. In Keningau, pneumonia dominated the list, accounting for 28% of the admissions.

Table 69

Leading causes of hospital admissions among toddlers in Ranau, Kudat and Keningau Districts, 1979

Disease	Ranau	Kudat	Keningau
Gastroenteritis	14.6%	15.0%	15.8%
Malaria	8.4%	38.0%	6.3%
Pneumonia	8.8%	7.8%	27.7%
Bronchitis	11.5%	7.0%	8.4%
Accidents	10.6%	7.4%	5.3%
Measles/Chicken pox	—	0.9%	11.9%

In general, the above data shows that the common communicable diseases such as gastroenteritis, pneumonia and malaria are still a major problem in the three districts.

These figures reflect the heavy burden of infection faced by toddlers who are at the same time in a most vulnerable condition with regard to nutrition. Their precarious nutritional balance can easily be tipped by superimposed infections which synergistically can cause further deterioration in their nutritional status and lowered resistance to further infections.

4. MORTALITY

It can be seen from Table 70 that the major killers of toddlers are respiratory infections, gastroenteritis, measles and malaria, accounting for about two-thirds of the total deaths.

The under-five mortality has been used as an indicator of the development of a nation with regard to socio-economic factors, health services and nutritional status affecting children. In Sabah, the under-five mortality accounts for 27.4% of total deaths or an in-

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Malaria	7.4%	18.6%	5.4%
Bronchitis	12.0%	8.9%	1.3%
Measles/Chicken Pox	0.8%	1.4%	5.3%

Table 70

Leading causes of death among toddlers in Ranau, Kudat and Keningau Districts, 1978

Cause of death	No. (%)
1. Bronchopneumonia	26 (31.0%)
2. Gastroenteritis	13 (15.5%)
3. Measles	9 (10.7%)
4. Malaria	8 (9.5%)
5. Cardiovascular diseases	5 (6.0%)
6. Helminthiasis	4 (4.8%)
7. Pyrexia of unknown origin	3 (3.6%)
8. Accidents	2 (2.4%)
9. Other causes	14 (16.7%)
Total	84 (100.2%)

cidence rate of 12.44 per 1,000 children in the 0–4 age group, as compared with per 1,000 in Peninsular Malaysia, again bearing in mind the degree of under-estimati in the former (Table 71).

Table 71

Under-five mortality as a percentage of total deaths in Sabah and Peninsular Malaysia, 1975

	Sabah	Peninsular Malaysia
No. of deaths in under-five age group	1,498	14,046
Total deaths	5,469	64,372
% of total deaths	27,39%	21,82%
% of under-fives in population	16.12%	14.94%

Thus it can be seen that Sabah has a heavier burden of infection as compared wit Peninsular Malaysia. The common communicable diseases such as malaria, respirator diseases, diarrhoeal diseases and measles account for the bulk of the morbidity and mo tality seen in the state, with the main burden on the under-fives.

5. INFECTIONS AND ENVIRONMENTAL SANITATION

There are no figures available on the status of water supply to the rural areas in Sabah. In Keningau, the Pengalan River serves as a source of water for most of the people in that region.

In Kampung Sinukab, there were three wells for the two long-houses, where the people bathe at the wells and water for cooking and cleaning was carried home in plastic containers. In Tuaran, water from various sources was used, e.g. rain water, ponds, rivers, springs or wells.

Thus, there appears to be a lack of safe sources of water supply in the rural areas of Sabah. Comparatively safe sources such as wells and rain water are available but the methods of construction and storage may not be satisfactory.

Data from the ecological studies seem to indicate that the bush is the most common mode of excreta disposal especially in the more remote areas such as Kampung Sinukab and also among the Muruts. In the other localities, the pit or bore-hole latrines are more frequently used. Modern sanitary excreta disposal systems are found only in urban areas.

Environmental sanitation in the rural areas are highly unsatisfactory and conditions are conducive to an increased incidence of worm infestation and diarrhoeal diseases.

CHAPTER 8

DISCUSSION AND RECOMMENDATIONS

1. THE EXTENT OF MALNUTRITION

The results of anthropometry indicate that malnutrition is fairly extensive in Sabah, particularly in respect of the pre-school child. Table 72 summarises the extent of malnutrition using the five anthropometric measures of weight for age, weight for height, height for age, arm circumference and skinfold thickness for age.

Table 72

Percentage of malnutrition seen among 3,672 children below the age of 13 years

Age	Percentage of malnutrition according to:				
	Weight for age	Weight for height	Height for age	Arm circumference	Skinfold thickness
Below 5 years	8.8	29.5	16.8	4.0	51.3
5 – 12 years (M)	35.4	18.4	62.1	1.6	61.9
5 – 12 years (F)	29.1	21.5	46.6	1.3	71.6
For all children	27.3	21.9	46.6	1.8	64.5

It will be noted that 27.3% of the children who were examined were "significantly" malnourished with only 4.5% of them suffering from severe malnutrition. 22% of the children were wasted, with the highest prevalence in the under five's age group, indicating that most of these children were acutely malnourished, as were the school-going age group, although the prevalence is slightly lower. The degree of stunting in the latter group, however, is much more severe with 62.1% among the males and 46.8% among the females, most of them being nutritional dwarfs. Thus, malnutrition appears to be fairly extensive in all age groups but especially in the pre-school age group where the brunt of acute malnutrition falls upon.

Relatively high malnutrition grade-scores (Table 16) obtained for weight and skinfold measurements and relatively lower malnutrition grade-scores obtained for height and arm-circumference would seem to suggest that the problem of malnutrition encountered in the study sample was one of caloric deficiency rather than protein deficiency.

2. ETHNIC DISTRIBUTION OF MALNUTRITION

Among the four ethnic groups that were ecologically examined, the Muruts and the Rungus Dusun exhibit the highest prevalence of malnutrition, both past and present. The Muruts have the highest prevalence of severe malnutrition (7%) while the Rungus Dusun rank second with a prevalence of 4.8%, followed by the Kadazans with 2.4%. The Muruts also have the highest prevalence of retardation (60%) while the Rungus Dusun show the highest prevalence of malnutrition (76%) when skinfold thickness is used as the indicator.

The Kadazans are intermediate while the Chinese show the lowest prevalence of malnutrition. Nevertheless it should be noted that in terms of "significant" malnutrition, based on weight for age, the prevalence of malnutrition among the Chinese is 5.4%.

It will also be noted that (Table 18) all other ethnic groups, namely, the Bisayas, Kadayans, Bajaus, Orang Sungai, Malays, etc. also exhibit a fairly high prevalence of malnutrition indicating that rural children from all the communities suffer from malnutrition to some extent, the overall prevalence for severe malnutrition being 4.5% for the 3,672 children examined in the Kudat, West Coast and Interior Division of Sabah.

3. THE ECOLOGICAL BASIS OF MALNUTRITION

A review of the ecological factors outlined in Chapter 6 will show that malnutrition is of a multifactorial origin. Nonetheless, a few major factors seem to stand out more clearly than others as important ecological factors and these will be discussed in the paragraphs that follow. However, this does not mean that other factors not specially identified are not relevant in the present context, but that no special associations have been identified.

3.1 Socio-economic Status

It would seem that the extent of malnutrition is directly associated with the extent of poverty exhibited by each of the communities studied in detail. Thus it will be noted that malnutrition is most extensive among the Rungus Dusun and Muruts, less so among the Kadazans and least among the Chinese, and that the mean monthly per capita income of each of the communities is $5.73 (Rungus Dusun), $17.84 (Muruts), $32.77 (upland Kadazans), $56.13 (Coastal plains Kadazans) and $69.19 (Chinese).

3.2 Hill Padi, Wet Padi and a Cash Economy

It will also be noted that both the Rungus Dusun and the Muruts are largely dependent upon hill padi and that the relatively poor yields of hill padi means that rice crops will only last about half a year. Data from Tuaran indicate that the yield from hill padi varies from 75 to 112 gantangs per acre while wet padi yields range from 120 to 200 gantangs per acre. It is more likely that, in the less fertile soils worked by the Rungus Dusun and the Muruts, the yields are more in the region of 60 to 80 gantangs per acre. Consequently, it is not surprising that the extent of malnutrition noted among the Rungus Dusun and Muruts is higher than that seen among the Kadazans of Ranau and Tuaran.

Reliance on cash crops such as pepper and rubber seems to be a more economically productive use of labour than its use in the planting of hill padi as exemplified by the Chinese of Kuala Ansip next to the Murut community of Ulu Ansip in Keningau. However, it should be noted that the price of cash crops are subject to extensive fluctuations brought on by international market conditions.

It is also interesting to note that for the communities studied in detail, the median acreage of land under self-cultivation by the household was three acres in the case of the Rungus Dusun, the upland Kadazans of Ranau, and the coastal plains Kadazans of Tuaran, while that for the Muruts and the Chinese were five and ten acres respectively.

3.3 Food Ideology and Malnutrition

It will be noted that, as far as children are concerned, there are very few taboos among the Rungus Dusun, the Muruts, the Kadazans of Ranau and the Chinese. Thus among the Rungus Dusun, a child is only, most sensibly, barred from taking *tapai* (rice-wine). Among the Muruts the same custom is observed together with a taboo on the consumption of sweet potato, rattan and cashew nut shoots. Among the Kadazans of Ranau, children are only barred from eating anchovy, *jeruk ikan* (salted raw fish), anchovy paste and pineapple, whilst the Chinese do not have any food taboos for their children. It is only among the coastal plains Kadazans of Tuaran that fairly extensive food taboos seem to operate among the children. Consequently, it would appear that food taboos among children do not seem to play a particular important rule in the aetiology of malnutrition.

However, as far as pregnant and lactating women are concerned, the number and variety of food taboos seem to be far more extensive. With few exceptions all the communities require that important sources of foods be barred. For example, the Rungus Dusun, the Muruts and the Kadazans place a ban on various sources of protein such as deer meat or fish, while the Muruts, Kadazans and Chinese consider that most vegetables are taboo. The effect of such taboos on maternal health and eventually on child health should not be underestimated in subsistence economies particularly in those, such as the Rungus Dusun and Murut communities, in whichthe staple crop lasts for only about half a year, and members are subjected regularly to seasons of "shortage".

3.4 Infection and Malnutrition

The synergistic effect of infection on malnutrition, and malnutrition on infection, is a well established fact. It can be seen from Table 70 that the major killers of toddlers are bronchopneumonia, gastroenteritis, measles and malaria which account for 66.7% of deaths among toddlers admitted to Ranau, Kudat and Keningau hospitals in 1978. It will also be noted from Table 70 that about 5% of deaths among toddlers is due to helminthiasis, a usually non-fatal parasitic problem that is extremely common in children.

It will be noted from Table 39 that there seems to be a direct association between the extent of prevalence of malnutrition and the percentage of unsanitary bush latrines in the community in question. Thus, among the Rungus Dusun and the Muruts, who

exhibit a high prevalence of malnutrition, the percentage of bush latrines are 100% and 82.1% respectively, whilst among the upland and the coastal plains Kadazans, with an intermediate prevalence of malnutrition, the percentage of unsanitary bush latrines is 12% and 20% respectively. On the other hand, among the relatively better off Chinese, only 10% do not have a sanitary latrine.

4. CONCLUSIONS

The present study documents, in terms of anthropometric indices, the extent of malnutrition that exists in the Kudat, West Coast and Interior Divisions of Sabah and provides a bench-mark against which changes for the better or worse can be measured. The ecological studies carried out in the five selected communities provide an insight into the factors that contribute to malnutrition in these rural communities. On the basis of this data it should now be easier to plan a rational food and nutrition programme to reduce the extent of malnutrition among the people of Sabah. What is abundantly clear is that not only is malnutrition a fairly extensive and important problem in Sabah, its causation is multifactorial and hence its management must be multidisciplinary in nature. At a minimum, a food and nutrition programme for Sabah must involve the Ministries of Health, Education and Agriculture. The impact of better communications and roads, and the availability of improved marketing facilities on malnutrition are just a few examples of the complexity of the problem and the role other agencies can play in the reduction of malnutrition. However, for the purposes of this report, only recommendations directly related to the Ministry of Health will be made, but this should not be taken to mean that the role of other agencies is less important or negligible.

5. RECOMMENDATIONS

In respect of the role of the health sector, it is therefore recommended that:

5.1 A multidisciplinary programme involving, at the minimum, the Ministries of Health, Education and Agriculture, be undertaken on a wide geographical basis, particularly among subsistence farming communities dependant largely upon hill padi, such as the Rungus Dusun and Murut communities, to reduce the extent of malnutrition present in rural Sabah.

5.2 Supplementary feeding programmes for school children, particularly at the primary school level, be initiated and strengthened.

5.3 In the context of the "International Drinking-Water Supply and Sanitation Decade, 1981 – 1990", efforts be directed to increasing the number of rural communities provided with clean water supplies and sanitary toilets.

5.4 Immunization efforts against communicable diseases, such as diphtheria, whooping cough, tetanus, tuberculosis, poliomyelitis and measles, be strengthened particularly in the more isolated and rural communities of Sabah.

5.5 Health education efforts to improve nutritional knowledge, particularly in respect of food taboos affecting the mother and child, be strengthened.

5.6 Ecological studies to better understand the basis for malnutrition in other ethnic communities such as the Bajaus, Bisayas, Kadayans, etc. be undertaken so that action programmes can take into consideration the different cultural backgrounds of each ethnic group.

5.7 A similar nutritional study be conducted in the Sandakan and Tawau Divisions of Sabah where ecological conditions are vastly different.

5.8 The extent of malnutrition in the Kudat, West Coast and Interior Divisions of Sabah be re-measured at the time of the mid-term review of the Fourth Malaysia Plan to indicate if efforts have had any material impact in reducing malnutrition.

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GLOSSARY

FRUITS AND VEGETABLES

Native Name	Scientific Name	Remarks
Belimbing	Averrhoea *belimbi*	
Bachang	Mangifera *foetida*	horse mango
Cempedak	Artocarpus *champeden*	a type of jackfruit
Cekur manis	Phyllanthus *oxyphyllus*	
Ciku	Achras *sapota*	
Daun teri	Caesalpinia *digyna*	leaves of teri-pod plant
Jantong pisang	*Musaceae*	flower of banana
Jering	Pithecellobium *lobatum* or *jiringa*	
Jeruk	Citrus *maxima*	pomelo
Kangkong	Ipomoea *reptans*	
Ketola	Luffa *acutangula*	angle petola
Kuini	Mangifera *odorata*	a variety of horse mango
Kulat kayu	Lentinus	a large genus of fungi found on wood
Labu besar	Cucurbita *spp.*	a type of melon
Labu merah	Cucurbita *moschata*	musk melon (red gourd)
Labu puteh	Lagenaria *leucantha*	bottle gourd
Mempelam	Mangifera *indica*	a native mango of India
Nangka	Artocarpus *integra*	a type of jackfruit
Petai	Parkia *speciosa*	the matured seeds are eaten
Pisang mas	Musa *acuminata*	
Pisang tandok	Musa *paradisiaca*	
Pucuk keladi	Colocasia *esculentum*	shoots of yam
Pucuk paku	Stenochlaena *palustris*	fern shoots
Pucuk pegaga	Hydrocotyle *asiatica*	a creeping plant
Pucuk ubi	Manihot *utilissima*	cassava leaves or tapioca shoots
Sawi	Brassica *juncea*	mustard leaves
Terap	Artocarpus *elastica*	a type of jackfruit

FISH

Native Name	Scientific Name	Remarks
Ikan baung	Macrones *spp*	catfish
Ikan bilis	Stolephorus *spp.*	white bait
Ikan duri	Macrones *nemurus*	a genus of catfish
Ikan gamat	Holothurians *spp.*	a type of sea-slugs

Ikan kembong	Caranx *kalla*	chubb mackerel
Ikan pari	Trygon *spp.*	skate (ray)
Ikan selar	Caranx *spp.*	horse mackerel
Ikan selayar	Histiophorus *gladius*	
Ikan sepat	Lobotes *surinamensis*	
Ikan tamban	Clupea *perforata*	
Ikan tenggiri	Cybium *guttatum*	tunny

MISCELLANEOUS

Native Name	**Remarks**
Belacan	Anchovy paste
Budu	Local delicacies made from fish
Jeruk daging	Salted raw meat
Jeruk ikan	Salted raw fish
Lelawar	Bat (flying foxes)
Musang	Fox
Pulut	Glutinous rice

RESIDENCY	NO	RESIDENCY	NO	RESIDENCY	NO
NAME	AGE / DOB	NAME	AGE / DOB	NAME	AGE / DOB
VILLAGE	ETHGRP	VILLAGE	ETHGRP	VILLAGE	ETHGRP
DISTRICT	SEX M☐ F☐	DISTRICT	SEX M☐ F☐	DISTRICT	SEX M☐ F☐

PHYSICAL EXAMINATION

HAIR	Depigmentation	☐
EYES	Xerosis conjunctivae	☐
	Bitot's spots	☐
LIPS	Angular lesions	☐
	Angular scars	☐
	Cheilosis	☐
GUMS	Bleeding	☐
TEETH	Carious teeth	☐
TONGUE	Geographic	☐
	Furrows	☐
	Fissures - ulcers	☐
GLANDS	Parotid	☐
	Thyroid - visible	☐
SKIN	Xerosis	☐
	Hyperkeratosis	☐
	Dermatosis	☐
ABDOMEN	Liver	☐
	Spleen	☐
LOEXTR.	Oedema	☐
	Knee jerk loss	☐R ☐L
SKELTL.	C/Chondral beading	☐
	Bowlegs	☐
HEART	Murmur	☐

ANTHROPOMETRY

WEIGHT	kg			
LENGTH	cm			
SKINFOLD (Triceps)	mm			
CHEST CIR	cm			
HEAD CIR	cm			
TRICEPS CIR	mm			

LABORATORY

Mother _____ NRIC _____

Bottled fed ☐ Breast fed ☐ Weight _____

In school ☐ At home ☐ _____

Haemoglobin	☐
Haematocrit	☐
Serum iron	☐
Serum transferrin	☐
Serum albumin	☐
U urea nitrogen	☐
U cretinine	☐
U OH prolin	☐
Serum transketolase	☐
Serum Vit. A	☐
_____	☐
_____	☐

Ankytostoma	☐
Ascaris	☐
Trichuris	☐
_____	☐
_____	☐

VGSC/SRK: _____ DATE OF EXAMN: _____

DISTRICT: _____ SHEET NO. : _____

NO	SERIAL NO	DATE OF BIRTH	AGE	SEX	ETH	WGT	LTH	SFT	CHC	HDC	TCC	CLIN	Hb	HCrit	LOCN	EXAM	NOTES

RESIDENCY	NO	RESIDENCY
NAME	AGE / DOB	NAME
VILLAGE	ETHGRP	VILLAGE
DISTRICT	SEX M☐ F☐	DISTRICT

PHYSICAL EXAMINATION

HAIR	Depigmentation	☐	
EYES	Xerosis conjunctivae	☐	
	Bitot's spots	☐	
LIPS	Angular lesions	☐	
	Angular scars	☐	
	Cheilosis	☐	
GUMS	Bleeding	☐	
TEETH	Carious teeth	☐	
TONGUE	Geographic	☐	
	Furrows	☐	
	Fissures - ulcers	☐	
GLANDS	Parotid	☐	
	Thyroid - visible	☐	
SKIN	Xerosis	☐	
	Hyperkeratosis	☐	
	Dermatosis	☐	
ABDOMEN	Liver	☐	
	Spleen	☐	
LOEXTR.	Oedema	☐	
	Knee jerk loss	☐R ☐L	
SKELTL.	C/Chondral beading	☐	
	Bowlegs	☐	
HEART	Murmur	☐	

WEIGHT kg _

LENGTH cm _

SKINFOLD (Triceps) mm _

CHEST CIR cm _

HEAD CIR cm _

TRICEPS CIR mm _

KAJIAN PEMAKANAN SABAH

Residensi .....
Daerah .....
Kampong .....
Rumah .....

Nama Penemuduga .....
Bangsa .....

Tarikh .....

A. KELUARGA

No.	Nama	Jantina		Bersaudara dengan Ketua rumah	Bangsa (Rungus Dusun, Dusun, Murut, Bajau, Sino-Kadazan, dll.)	Tarikh lahir			Umur (tahun)	Orang yang:			Pekerjaan
		Laki-laki (M)	Perempuan (F)			Hari	Bulan	Tahun		Tinggal sementara	Keluar sementara	Tidak makan di sini	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Appendix 4.2

H. LATARBELAKANG

(Please use your own discretion. Innovate your own system of data collection if this section is inappropriate.)

H.1 Sekarang,. kami hendak bertanya puan berkenaan benda-benda yang ada di rumah puan.
Adakah puan mempunyai benda-benda yang berikut?
(TANYA SETIAP ITEM DAN REKODKAN BILANGAN ITEM YANG DIMILIKI)

	Ada	Tidak
Motor-scooter/motosikal	☐	☐
Radio	☐	☐
Rumah sendiri.....	☐	☐
Tanah sendiri	☐	☐

H.2 Sekarang, saya hendak tahu serba sedikit tentang puan, dan suami puan.
Berapa tahunkah puan bersekolah?
(NYATAKAN BILANGAN TAHUN TAMATNYA PERSEKOLAHAN)

darjah/tingkatan ..... ATAU tahun .....

H.3 Berapa tahunkah suami puan bersekolah?

darjah/tingkatan ..... ATAU tahun .....

H.4 Sekarang saya hendak mengetahui serba sedikit berkenaan pekerjaan suami puan. Adakah ia bekerja sekarang?

Ada ☐ Tidak ☐
(Langkau ke H.6) ↓

H.5 Sudah berapa lamakah ia tidak bekerja? .....

H.6 Apakah pekerjaan yang biasa dibuat oleh suami puan?

Nama pekerjaan: .....
(PEKERJAAN UTAMA)

Keterangan-keterangan berkenaan pekerjaan:

(KETERANGAN LANJUT) .....

Cara-cara perniagaan:

(MASUKKAN JENIS PERNIAGAAN) .....

.....

H.7 Adakah dia bekerja dengan kerajaan atau tidak?

Kerajaan ☐ Bukan kerajaan ☐
(Langkau ke H.9)

Appendix 4.3

H.8 Adakah suami puan mengambil orang untuk bekerja, atau kerja sendiri atau kerja dengan orang lain?

mengambil orang-orang kerja	kerja sendiri	bekerja dengan orang lain
☐	☐	☐

H.9 Adakah keluarga puan mempunyai tanah?

Ada ☐ Tidak ☐
(Langkau ke H.12)

H.10 Adakah keluarga puan menyewakan tanah ini kepada orang lain?

Ada ☐ Tidak ☐
(Langkau ke H.11)

Berapa ekar.....

H.11 Berapa relongkah tanah ini dikerjakan oleh keluarga puan?

ekar .....

H.12 Adakah keluarga puan menyewa tanah orang lain untuk bertanam?

Ada ☐ Tidak ☐
(Langkau ke H.13)

H.13 Selain daripada kerja yang tersebut, adakah suami pun membuat kerja-kerja yang lain?

Ada ☐ Tidak ☐
↓ (Langkau ke H.14)

Pekerjaan yang lain .....

.....

.....

H.14 Berapa semua pendapatan seisi rumah?

Bolehkah puan sebutkan? .....

(REKOD PENDAPATAN PURATA BULANAN)

Tidak	☐	$140 – 159.....	☐
$1 – 19.....	☐	$160 – 199.....	☐
$20 – 39	☐	$200 – 299.....	☐
$40 – 59	☐	$300 – 499.....	☐
$60 – 79	☐	$500 & above.....	☐
$80 – 99	☐		
$100 – 119	☐		
$120 – 139	☐		

Appendix 4.4

H.15 Akhir sekali, bolehkah puan tunjukkan saya tandas yang puan gunakan?
(PERIKSA DAN REKODKAN JENISNYA)

"Belukar"/Rata-rata (Bush) ..... ☐
Atas tanah/Parit (Surface) ..... ☐
Hanyut (Drop) ..... ☐
Lobang/Tangki limbah (Pit) ..... ☐
Lobang korek (Bore-hole) ..... ☐
Jamban curah Siam/Jitra ..... ☐
Tong (angkat) ..... ☐
Tangki Septik ..... ☐
Lain-lain (NYATAKAN)..... ☐

Appendix 4.5

B. INGATAN MAKANAN YANG DIMAKAN KELMARIN OLEH KELUARGA

B. Bolehkah puan terangkan makanan/minuman yang dimakan/diminum kelmarin (24 jam).

Makanan (masa)	Jenis makanan/ minuman (Bahan mentah)	Berapa banyak*	Orang yang makan/ minum	Orang yang tidak makan/ minum
Makan pagi				
Makan peran-taraan				
Makan tenga-hari				

*Gunakan sukatan sebagai camca, sudu kecil, sudu besar, mangkok, tahil, dll.)

(Please use your own discretion. Innovate your own system of data collection. If possible, weigh the raw foods consumed during the last 24 hours.)

Appendix 4.6

Makanan (masa)	Jenis makanan/ minuman (Bahan mentah)	Berapa banyak*	Orang yang makan/ minum	Orang yang tidak makan/ minum
Makan petang				
Makan malam				
Selepas makan malam				
Lain-lain				

Appendix 4.7

C. KECENDERUNGAN KEPADA MAKANAN-MAKANAN TERTENTU*

Di kampung ini, orang-orang kita percaya setengah-setengah makanan bawa angin, "tajam" dan yang lain-lainnya "bisa-bisa". Kita juga percaya setengah-setengah makanan itu baik dan adalah mustahak dimakan. Ada makanan yang baik kepada seseorang tapi boleh jadi tidak baik kepada yang lain. Saya mahu puan tengok kad yang saya beri ini dan nyatakan pada tiap-tiap makanan samada ia:

banyak faedahnya/mustahak	(highly beneficial)	++
sedikit faedahnya/mustahak	(beneficial)	+
tidak berfaedah tetapi tidak "tajam" atau "bisa-bisa" ataupun "sejuk"	(neutral)	0
tidak berapa baik/lebih baik dipantangkan	(negative value/taboo	–
sungguh tidak baik/mesti dipantangkan	(highly negative/must taboo)	––

C.1 Kanak-kanak berumur 1 – 4 tahun

C.2 Ibu yang mengandung

C.3 Ibu yang baru bersalin

*(Please use your discretion. If you find Section "C" to be inappropriate, please innovate your own system to collect data.)

(Please note that the section on fishes and sea-foods (iii) should be simplified if your community is an inland one.

Please add other foods not listed, particularly, "local vegetables", ferns and fruits).

In addition to this statistical survey of foods, please enquire regarding the reasons why some foods are ++, +, 0, –, ––, i.e. why some foods are taboo, etc.

Also enquire as to the conditions (e.g. sickness, pregnancy, etc.) when these taboos (– ,or ––) are most important.
KEEP WRITTEN NOTES OF ALL YOUR OBSERVATIONS.

Appendix 4.8

Butir-butir makanan/minuman	Kanak-kanak 1 – 4 tahun	Ibu yang mengandung	Ibu yang baru bersalin
I. **Biji-bijian dan seumpamanya** (Cereals and Cereal Products)			
Beras (Rice)			
Beras pulut (Glutinous rice)			
Tapai (fermented rice)			
Roti (Bread)			
Mee, Meeswa, Beehoon (Noodle)			
Jagong (Maize)			
II. **Susu** (Milk)			
Susu tepong (Milk powder)			
Susu lembu (Fresh cow's milk)			
Susu manis pekat (Sweetened condensed milk)			
Susu kerbau (Fresh buffalo's milk)			
III. **Daging, telur dan ikan** (Meat, eggs and fish)			
Daging lembu/kerbau (Beef)			
Daging kambing (Mutton)			
Daging itik/ayam (Poultry)			
Daging arnab (Rabbit)			
Telur itik/ayam (Eggs)			
Telur penyu (Turtle's eggs)			
Telur ikan (Fish roe)			
Anak ikan (Fish fry)			
Ikan bilis (Anchovy)			
Ikan selar (Scad (Selar spp.))			
Ikan kembong (Chubb mackerel)			
Ikan selayang (Scad (Decapterus))			
Ikan pari (Sting-ray)			
Ikan sembilang (Catfish eel)			
Ikan aya (Tuna)			
Ikan yu (Dogfish/Shark)			
Udang (Prawn)			
Sotong (Squid)			
Kerang (Cockle)			
Ikan jeruk/kering (Salted fish)			
Budu (Fish paste)			
Belacan (Prawn paste)			

Appendix 4.9

IV.	**Sayur-sayur hijau** (Leafy vegetables)			
	Bayam (Spinach)			
	Cekur manis			
	Kangkong (Ipomoea leaves)			
	Kobis (Cabbage)			
	Daun turi			
	Pucuk ubi (Tapioca shoots)			
	Pucuk keledek (Sweet potato shoots)			
	Pucuk/Daun peraga			
	Pucuk jambu golok (Cashew nut shoots)			
	Rebong (Bamboo shoots)			
	Sawi (Mustard leaves)			
V.	**Sayur-sayuran buah** (Vegetables)			
	Kacang bendir (Okra/Ladies fingers)			
	Labu (Gourds)			
	Kacang soya (Soya beans)			
	Kacang buncis (French beans)			
	Kacang panjang (Long beans)			
	Kambas/Persia (Bitter gourds)			
	Petai/Jering (Parkia speciosa)			
	Taugeh (Bean sprouts)			
	Timun (Cucumber)			
	Terong (Brinjal			
VI.	**Buah-buahan** (Fruits)			
	Nenas (Pineapple)			
	Pisang (Banana)			
	Betek (Papaya)			
	Limau (Lemon)			
	Ciku (Sapodilla)			
	Nangka (Jackfruit)			
	Jambu (Guava)			
	Belimbing (Averrhoa bilimbi)			
	Tembikai (water-melon)			
VI.	**Manis-manisan** (Sweets)			
	Biskut (Biscuits)			
	Kueh (sebutkan) (Cakes)			

BAR CHARTS OF ANTHROPOMETRIC INDICES ACCORDING TO ETHNICITY

5.1 Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage weight for age.

5.2 Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage weight for age.

5.3 Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage weight for age.

5.4 Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage height for age.

5.5 Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage height for age.

5.6 Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage height for age.

5.7 Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage mid-upper arm circumference for age.

5.8 Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage mid-upper arm circumference for age.

5.9 Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage mid-upper arm circumference for age.

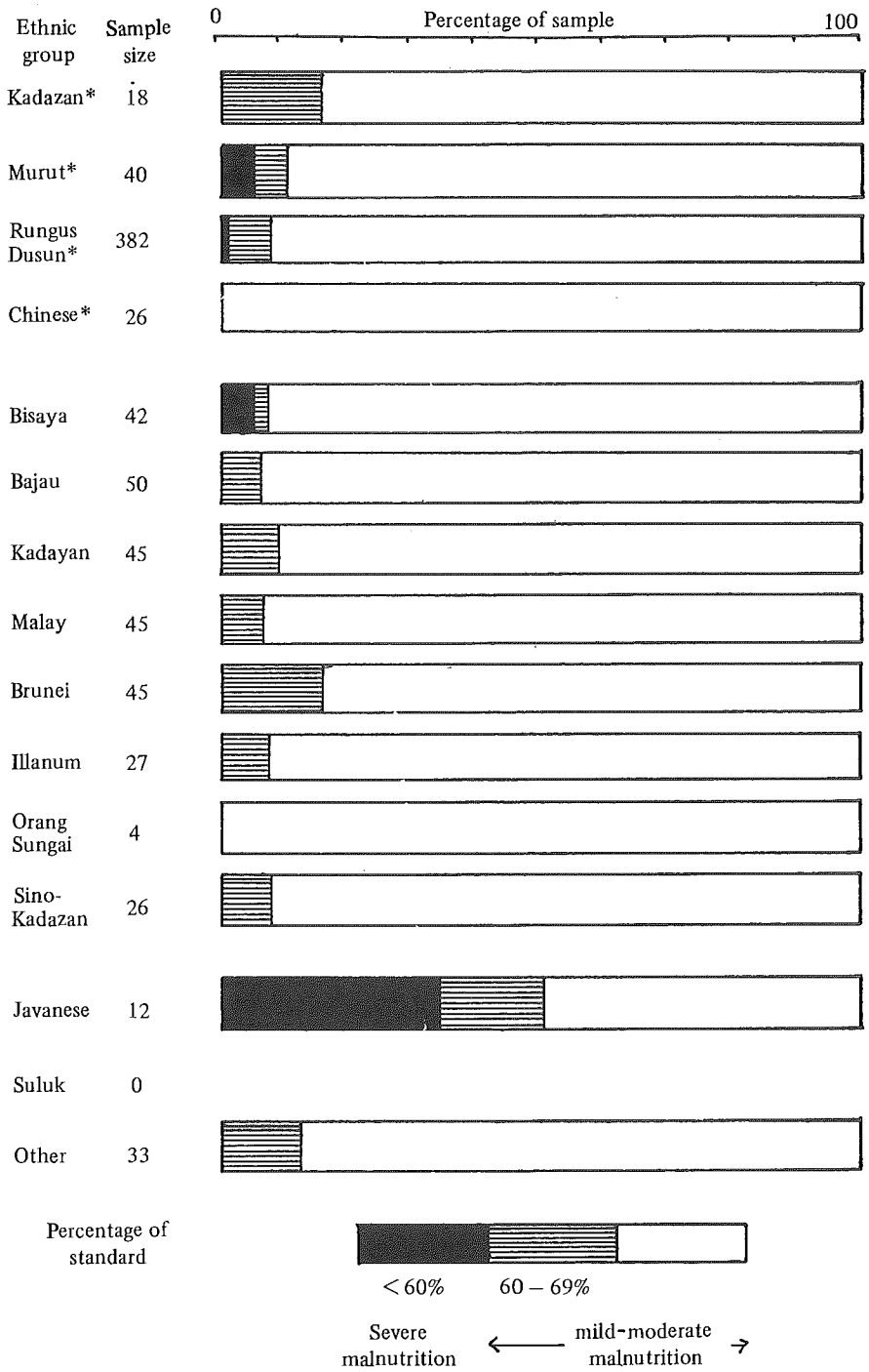
5.10 Percentage distribution of children of both sexes under five years of age by ethnic group, according to percetage skinfold thickness for age.

5.11 Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage skinfold thickness for age.

5.12 Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage skinfold thickness for age.

APPENDIX 5.1

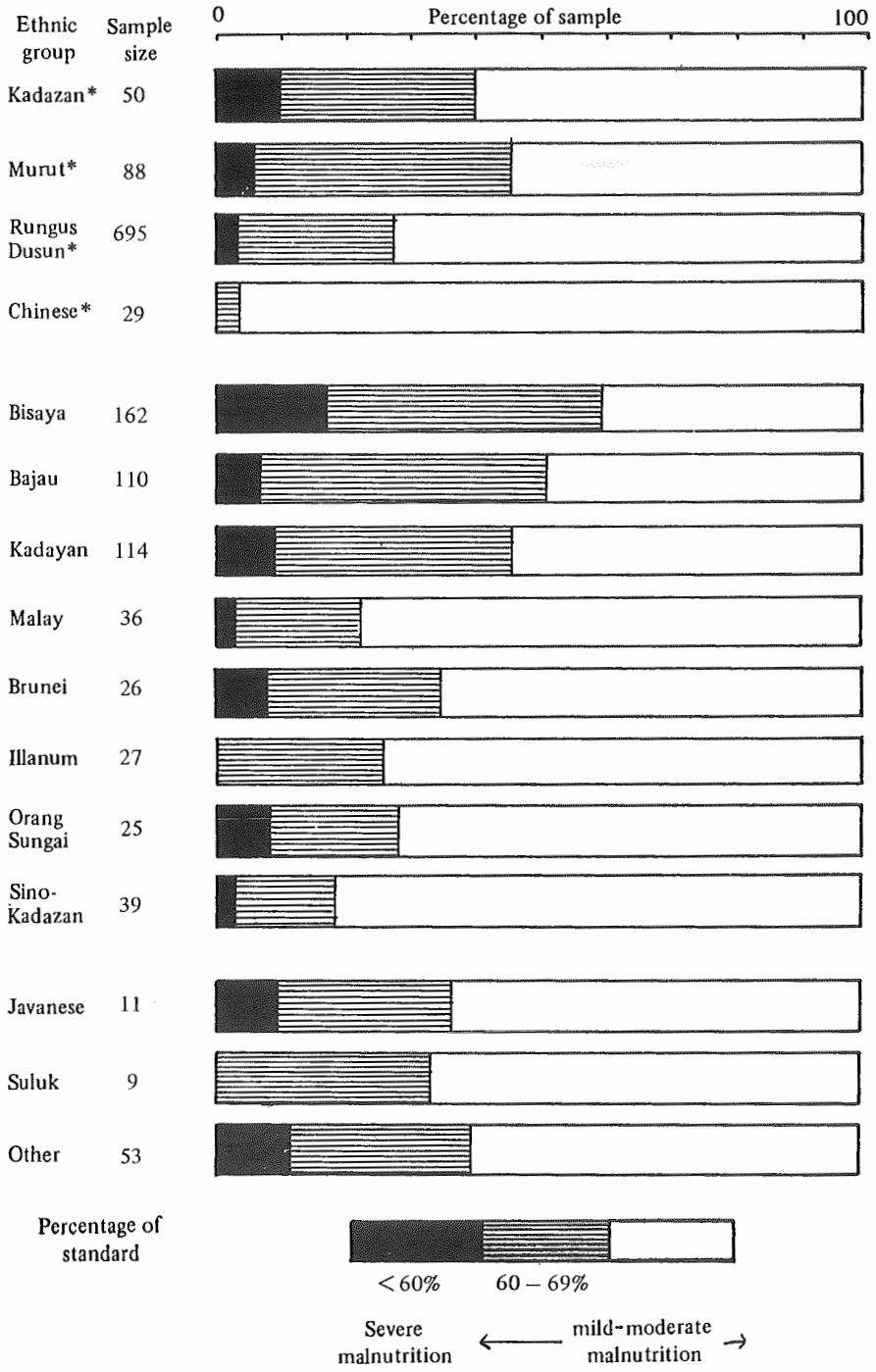
Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage weight for age



*Ethnic groups among whom ecological studies were conducted.

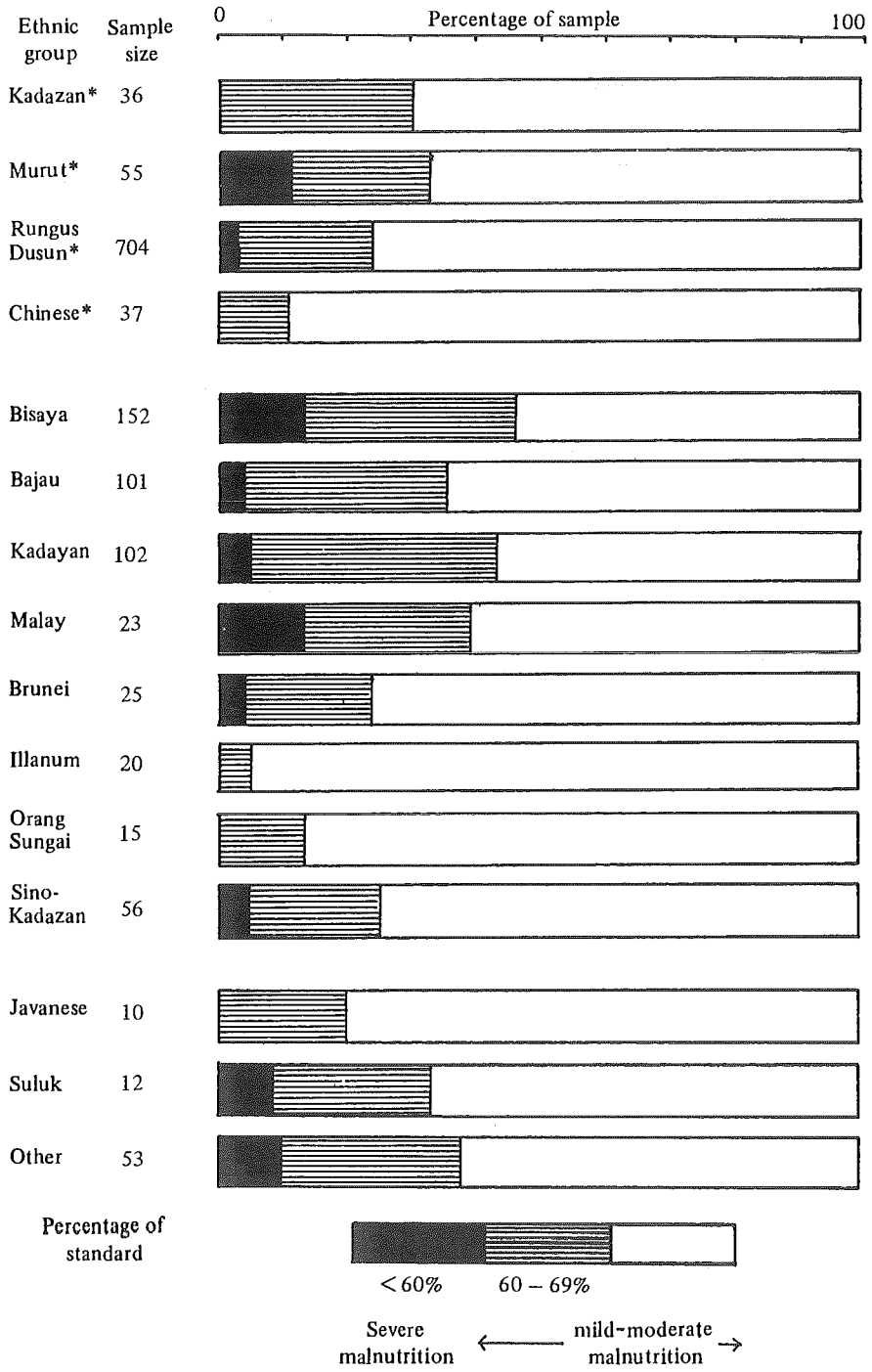
APPENDIX 5.2

Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage weight for age



*Ethnic groups among whom ecological studies were conducted.

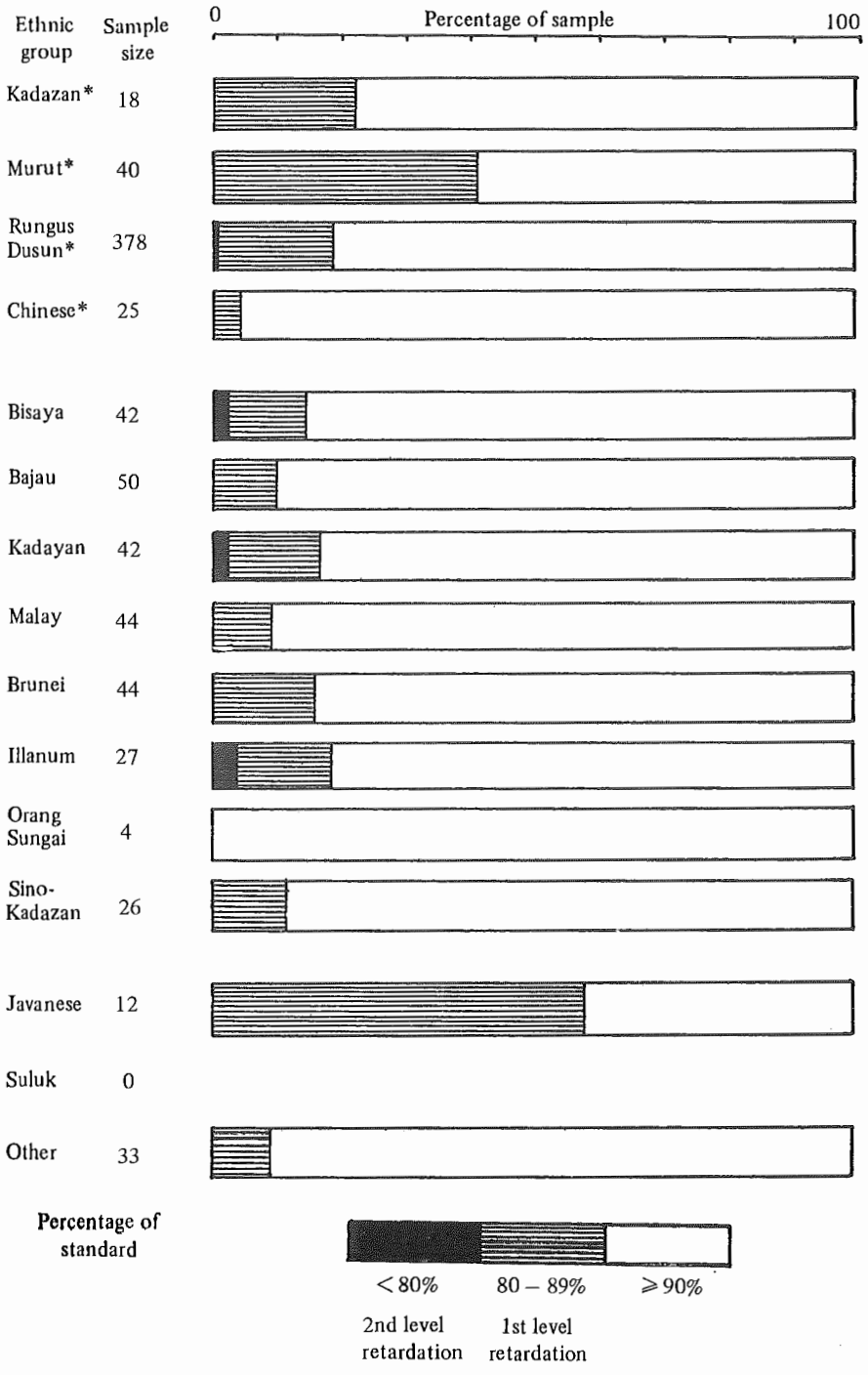
Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage weight for age



*Ethnic groups among whom ecological studies were conducted.

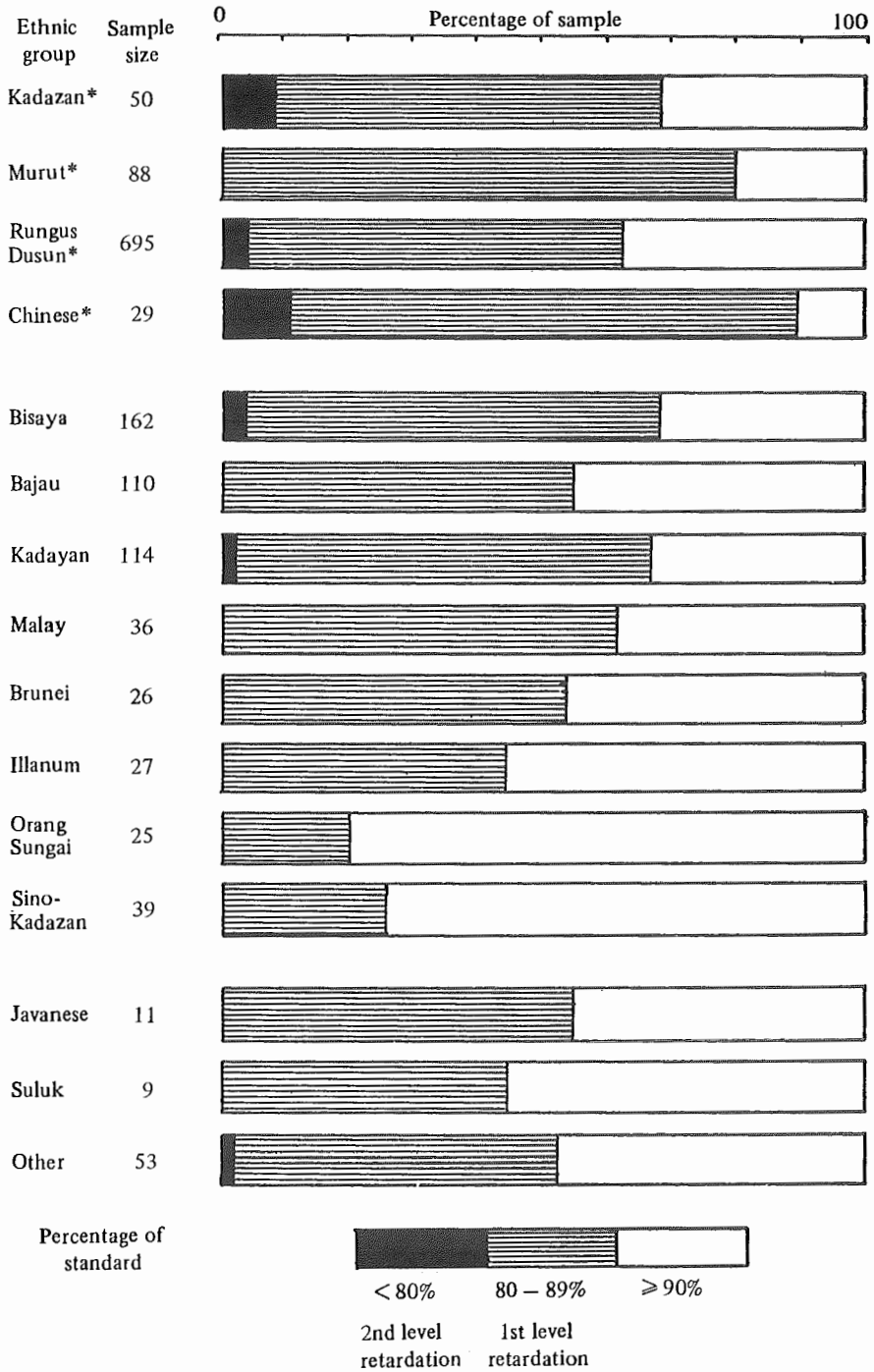
APPENDIX 5.4

Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage height for age



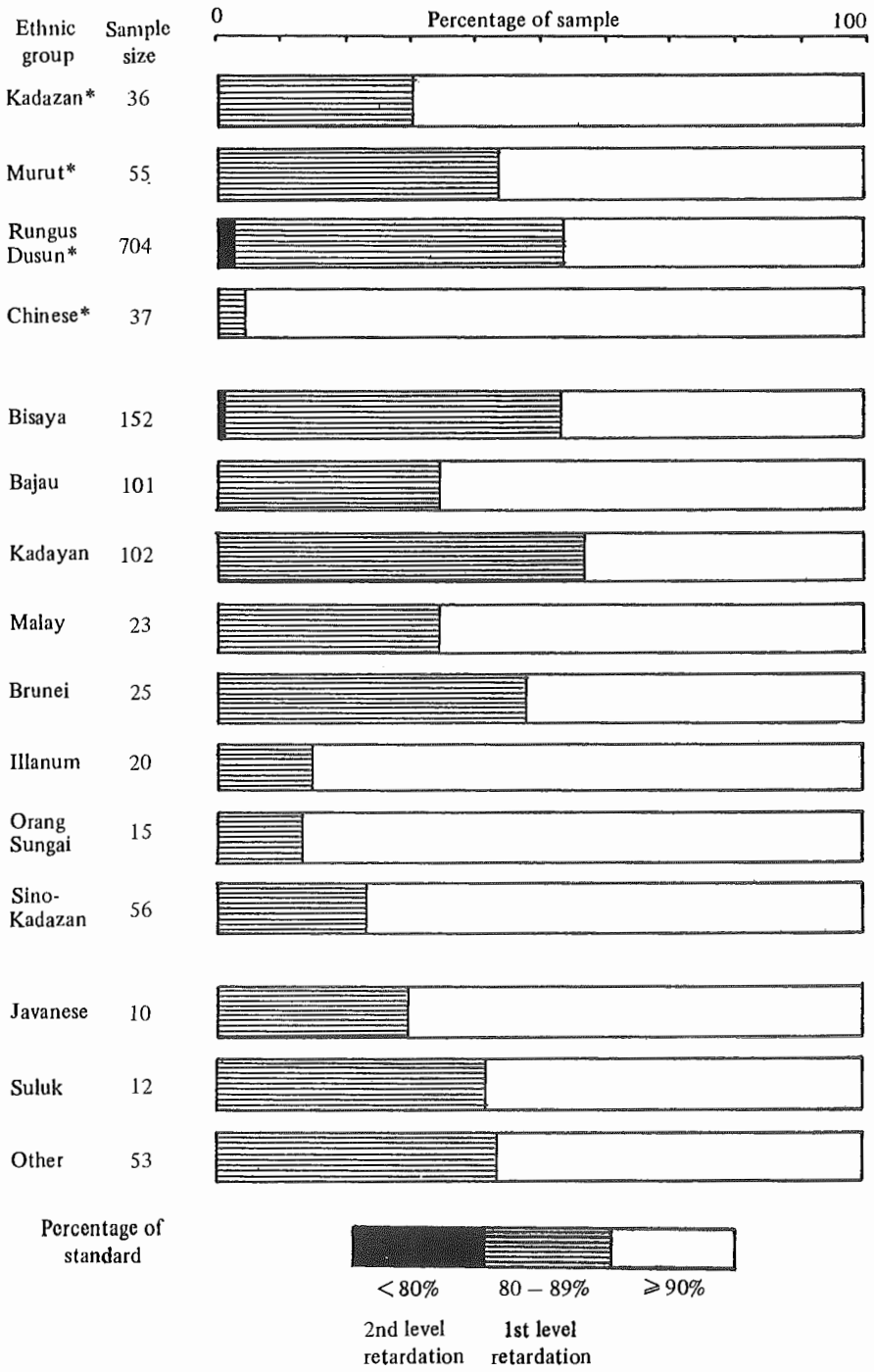
*Ethnic groups among whom ecological studies were conducted.

Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage height for age



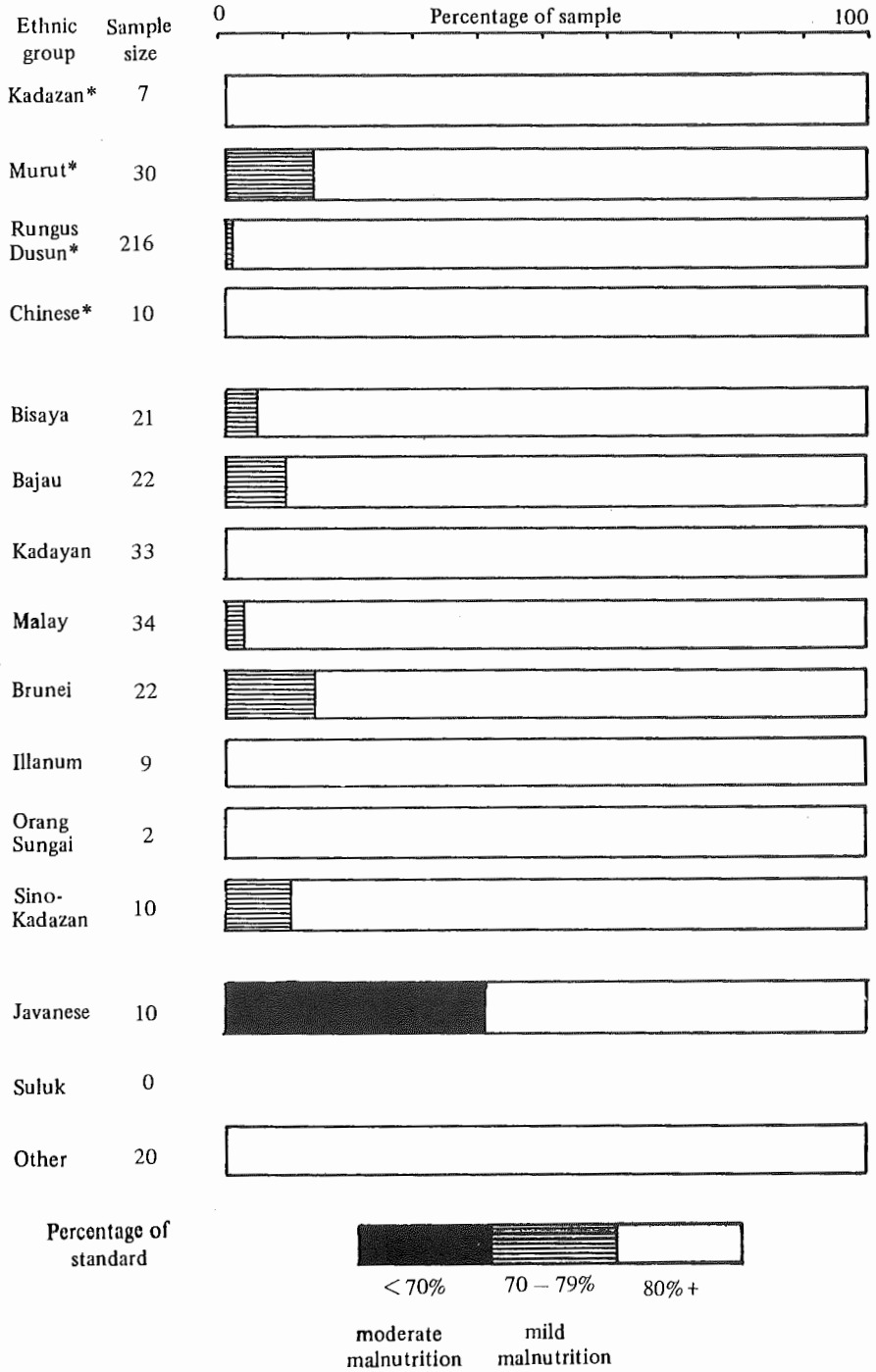
*Ethnic groups among whom ecological studies were conducted.

Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage height for age



*Ethnic groups among whom ecological studies were conducted.

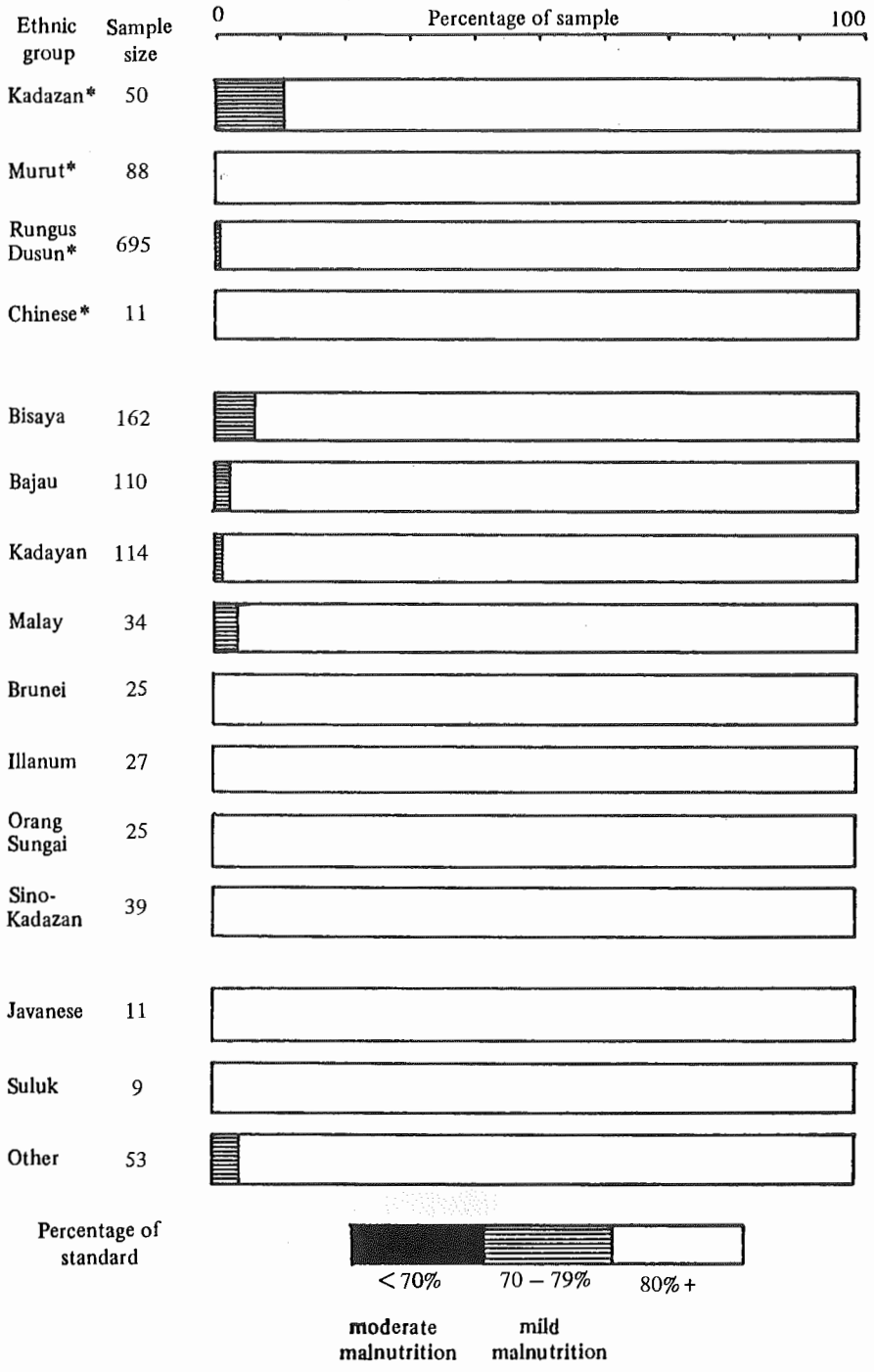
Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage mid-upper arm circumference for age



*Ethnic groups among whom ecological studies were conducted.

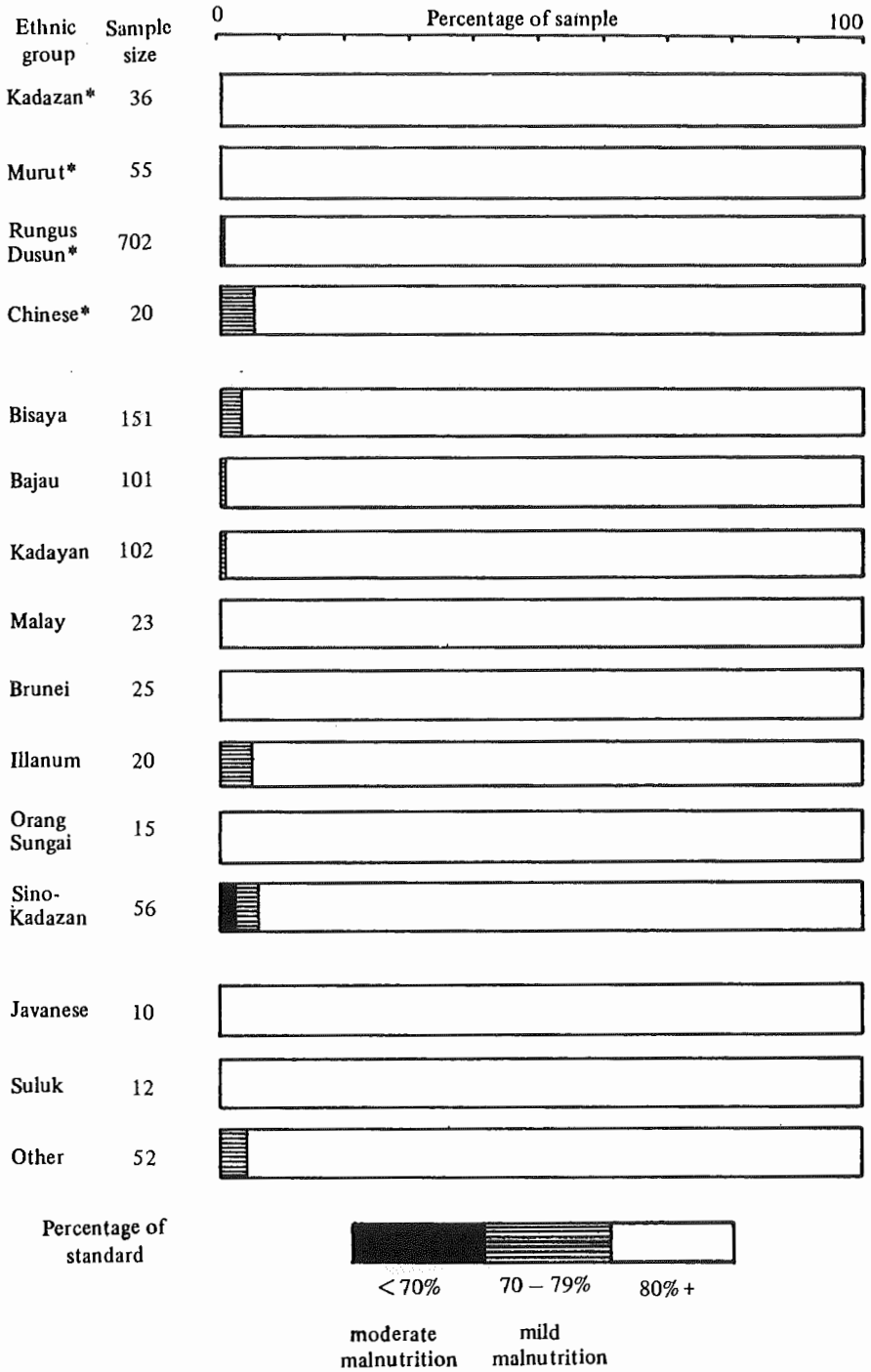
APPENDIX 5.8

Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage mid-upper arm circumference for age



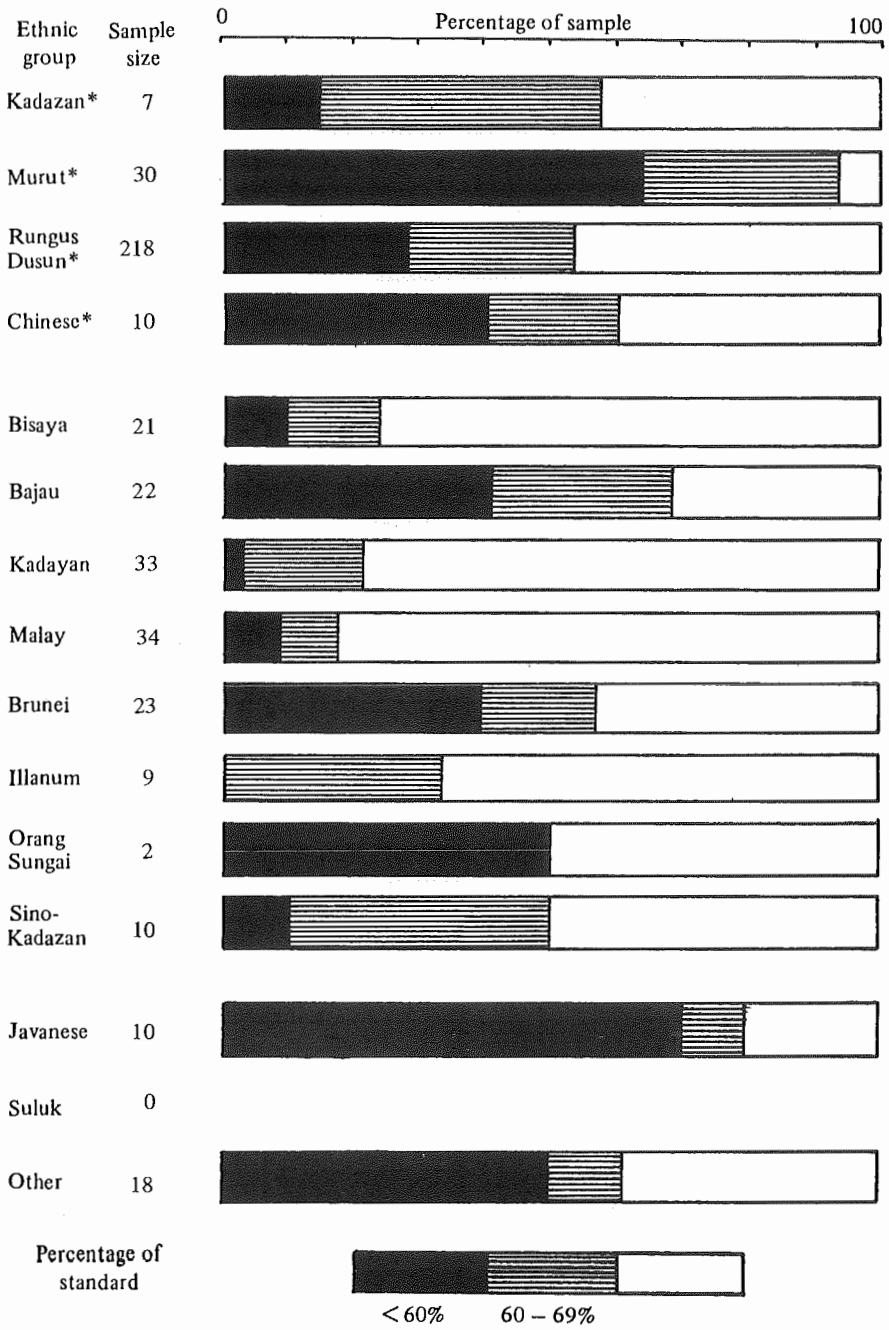
*Ethnic groups among whom ecological studies were conducted.

Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage mid-upper arm circumference for age



*Ethnic groups among whom ecological studies were conducted.

Percentage distribution of children of both sexes under five years of age by ethnic group, according to percentage skinfold thickness for age

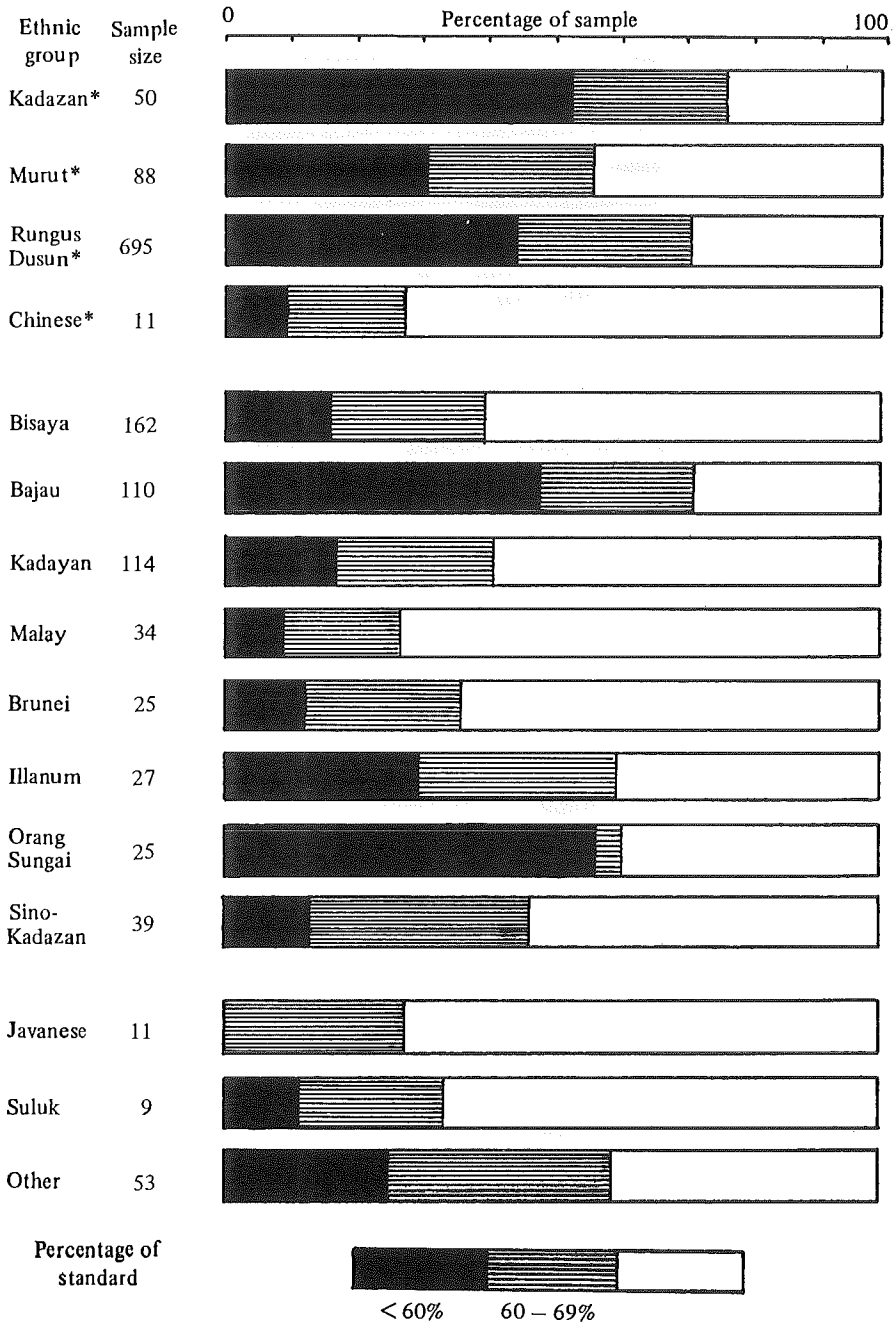


Cut-off point for malnutrition is 70% of Standard

*Ethnic groups among whom ecological studies were conducted.

APPENDIX 5.11

Percentage distribution of boys aged five to twelve years by ethnic group, according to percentage skinfold thickness for age

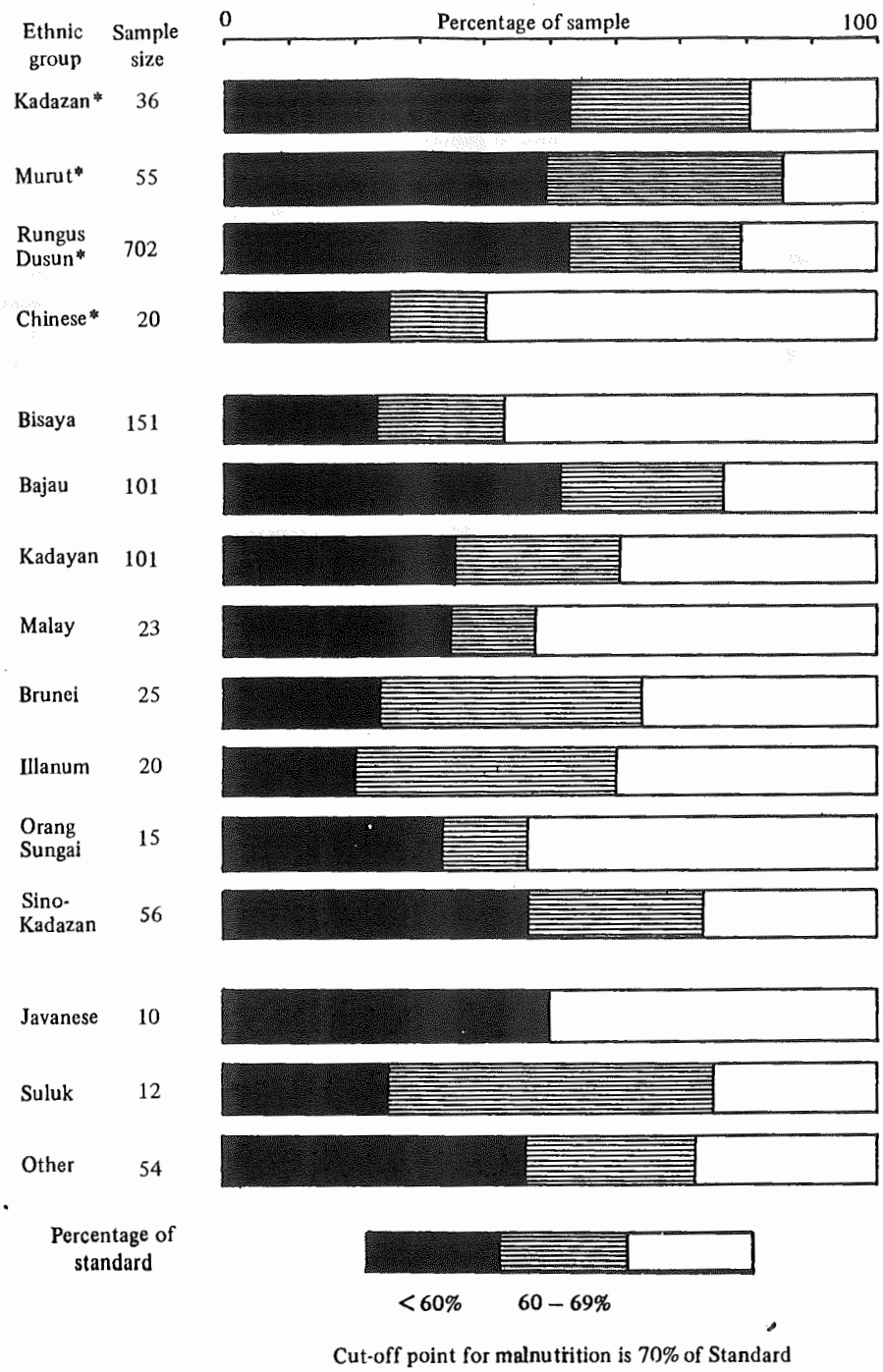


Cut-off point for malnutrition is 70% of Standard

*Ethnic groups among whom ecological studies were conducted.

APPENDIX 5.12

Percentage distribution of girls aged five to twelve years by ethnic group, according to percentage skinfold thickness for age



Cut-off point for malnutrition is 70% of Standard

*Ethnic groups among whom ecological studies were conducted.

APPENDIX 6.1

FOOD PRICES IN PROVISION SHOPS OF KAMPONG KANIBUNGAN

Food item		
Rice	Sold in gantangs	58 cts/kati
Onions	–	$1.30 for 4
Beef	Tin of curried beef weighing 170 gm.	$1.20/tin
Ikan bilis	Approx. 184 gm. per tin	$1.00/tin
Maggi mee	–	50 cts/packet
Pineapple	Approx. 451 gm. per tin	$1.70/tin
Hen's egg	–	25 cts each

FOOD ITEMS AVAILABLE AT THE *TAMU,* KAMPONG KANIBUNGAN

VEGETABLES/FRUITS	MEAT/FISH	OTHER ITEMS
Brinjal	Deer	*Kueh* (sweet cakes)
Sweet potatoes	Chubb mackerel	Biscuits
Long beans	Sting-ray	Tobacco
Tapioca	Dogfish/shark	Betel nut
Terap	Prawns	Betel leaves
Banana	Crabs	
	Squid	

APPENDIX 7

MEMBERS OF THE D.M.S. RESEARCH TEAM

PRINCIPAL INVESTIGATORS

1. Professor Paul C. Y. Chen,
   Professor of Social and Preventive Medicine,
   Faculty of Medicine,
   University of Malaya,
   Kuala Lumpur.

2. Dr. Michiel K. C. Chan,
   Director of Medical Services, Sabah,
   Kota Kinabalu,
   Sabah.

MEMBERS OF THE UNIVERSITY RESEARCH TEAM

1. Professor Teoh Soon Teong,
   Associate Professor

2. Dr. Yap Sim Bee,
   Lecturer

3. Ms. Felicia P. T. Ong
   Dietitian

MEMBERS OF THE RESEARCH TEAM

1. Ms. Barbara Bent
   State Nutritionist

2. Mr. Thomas Fong
   Chief Biochemist

3. Ms. Mary C. C. Lee
   Biochemist

9. FATS AND OILS

Coconut oil	24 oz. per bottle	$2.00/bottle
Margarine	Small tin of Planta margarine approx.500 gm.	$1.40/tin
	Big tin	$2.80/tin
Cooking oil	Approx. 20 oz. per bottle	$2.30/bottle
Coconut oil	—	$1.80/bottle

10. CONDIMENTS AND SPICES

Salt	—	35 cts/kati
Chilli	5 chillies per bundle	20 cts/bundle
Shrimp paste	1¼ oz. per block	20 cts/block
Ajinomoto	72 gm. per packet	$1.00/packet
Tamarind	100 gm. per packet	80 cts/packet
Ginger	Approx. 1 kati 4 tahils	80 cts/kati
Small onions	—	$2.20/kati
Big onions	—	$1.20/kati
Garlic	—	$4.80–$5.00/kati

11. BEVERAGES

Coffee powder	—	$6.00/kati
Nescafe	100 gm. per bottle	$2.60/bottle
Coffee beans	—	$3.80/kati
Milo	250 gm. per tin	$2.30/tin
Sugar	—	80 cts/kati

Sayur tutan	Approx. 7 tahils per bundle	46 cts/kati
Pumpkin	Approx. 4 kati per vegetable	50 cts/kati
Chinese cabbage	Approx. ½ kati per bundle	$1.20/kati
Spring onions	Approx. 6 tahils per bundle	50 cts/kati
Ladies fingers	Approx. 6 tahils per bundle	88 cts/kati
Bean sprouts	Approx. ½ kati per pkt.	60 cts/kati

5. FRUITS

Pisang tandok	–	50 cts/fruit
Pisang mas	–	10 cts/4 fruits
Orange	Medium-sized fruit	70 – 80 cts.
		$1.80/kati
Apple	Medium-sized fruit	70 – 80 cts.

6. MEAT AND EGGS

Lean pork	–	$4.50/kati
Fatty pork	–	$3.50/kati
Beef	–	$1.20/kati
Chicken	–	$3.50/kati
		$2.60/kati
Hen's egg	Small to medium-sized	30 cts/egg

7. FISH AND OTHER SEA-FOODS

Dried prawns	–	$9.50/kati
Dried fish	Depending on type and grade	$1.00 – 3.50/kati
	Ikan gagok	$1.80/kati
	Sting-ray	$1.00/kati
Ikan bilis	Depending on quality	$1.80–6.00/kati
Ikan tenggiri	–	$2.60–2.80/kati
Ikan merah		$2.40/kati
Ikan puteh		$2.60/kati
Ikan kayu	–	$1.80/kati
Ikan kerusi		$1.50/kati
Cuttlefish	Approx. 6½ oz. per tin	80 cts/tin
Sardines	–	60 cts/tin

8. MILK AND MILK PRODUCTS

Sweetened condensed milk	14½ oz. per tin	$1.10/tin
Powdered milk	2 kg. per big tin	$13.00/tin
	Medium-sized tin	$3.80/tin

APPENDIX 6.4

FOOD PRICES IN KENINGAU MARKET AND *TAMU*, 20.3.80

	Food item	Description	Price
1.	CEREALS		
	Rice	Sold in gantangs	60 – 63 cts/kati
	Pulut	Sold in gantangs	$1.00/kati
	Wheat flour	–	70 cts/kati
	Bread	4 small buns per pkt.	20 cts/bun
	Maggi mee	Approx. 85 gms per pkt.	45 cts/pkt.
	Rice noodles	–	$1.00/kati
	Maize	Cooked corn, 7 – 8"	40 cts/ear
		Uncooked corn	$1.00/12 ears
	Nestum	Approx. 250 gms.	$2.80/tin
2.	STARCHY ROOTS AND TUBERS		
	Potatoes	–	80 cts/kati
	Tapioca	Approx. 3 kati per bundle	33 cts/kati
	Ubi manis	Approx. 3 kati per bundle	20 – 50 cts/kati
	Ubi rambat	Approx. 1.6 kati per bundle	38 cts/kati
	Yam	Approx. 3 kati per bundle	33 cts/kati
3.	LEGUME AND PRODUCTS		
	Long beans	Approx. 8 oz. per bundle	53 cts/kati
	Red gram	–	$2.20/kati
4.	VEGETABLES		
	Kangkong	Approx. ½ kati per bundle	$1.40/kati
	Sawi	–	$1.20/kati
	Cekur manis	Approx. 6 oz. per bundle	$1.06/kati
	Cabbage	Approx. 2 kati per head	80 cts/kati
	Brinjal	–	80 cts/kati
	Cucumber	–	60 cts/kati
	Pucuk ubi	–	30 cts/bundle
	Kale	Approx. ½ kati per bundle	$1.20/kati
	Bamboo shoots	–	80 cts/kati
	Pucuk paku	Approx. 9 tahils per bundle	36 cts/kati

FOOD PRICES IN TUARAN MARKET, APRIL 1979

	Food item	Description	Price
1.	LEGUMES		
	Long beans	—	80 cts/bunch
	French beans	—	$1.00/bunch
2.	VEGETABLES		
	Jantung pisang	—	70 cts each
	Kulat kayu	—	$1.00/bunch
	Labu besar	—	$2.00 each
	Pucuk paku	—	80 cts/bunch
	Pucuk ubi	—	$1.00/bunch
	Bean sprouts	—	50 cts/bunch
	Brinjal	—	$1.00 for 4
	Cucumber	—	25 cts each
	Red chillies	—	$1.50/pile
3.	FRUITS		
	Papaya	—	$1.00 each
	Coconut	—	50 cts each
	Buah kuini	—	60 cts each
	Mangoes	—	40 cts each
	Mempelam	—	20 cts each
	Jackfruit	Sold per seed	30 cts/seed
	Pineapple	—	80 cts each
4.	MEAT AND EGGS		
	Pork	—	$5.00/kati
	Beef	—	$4.80/kati
5.	FISH		
	Ikan basung	—	$1.20 for 7
	Ikan tenggiri	—	$3.00/kati
	Ikan pari	—	$2.00/kati
	Ikan tamban	—	$1.50/kati
	Ikan merah	—	$2.00/kati

FOOD PRICES IN PROVISION SHOPS OF TUARAN, MAY 1979

	Food item	Description	Price
1.	CEREALS		
	Rice (broken)	–	63 cts/kati
	Rice *(Kampong I)*	–	80 cts/kati
	Rice *(Kampong II)*	–	80 cts/kati
	Pulut	–	93 cts/kati
	Wheat flour	–	70 cts/kati
	Maggi mee	–	45 cts/packet
2.	FISH AND OTHER SEA-FOODS		
	Ikan bilis	–	$4.80/kati
	Salted fish	–	$3.40/kati
	Sardines	Small tin	55 cts/tin
		Big tin	$1.20/tin
	Sambal bilis	–	75 cts/tin
	Sambal udang	–	95 cts/tin
3.	FATS AND OILS		
	Cooking oil	Small bottle	$1.10/bottle
		Big bottle	$1.40/bottle
4.	CONDIMENTS AND SPICES		
	Vinegar	–	50 cts/bottle
	Salt	–	30 cts/kati
	Soy sauce	–	70 cts/bottle
	Sugar	–	80 cts/kati
	Big onions	–	$1.40/kati
	Small onions	–	$3.20/kati
	Garlic	–	$4.80/kati
5.	BEVERAGES		
	Milo	8 oz. per tin	$2.80/tin
	Coffee		$2.80/kati