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R.D. HILL

GEOGRAPHY OF WORLD AGRICULTURE

# AGRICULTURE IN THE MALAYSIAN REGION

AKADÉMIAI KIADÓ, BUDAPEST

R. D. HILL

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GEOGRAPHY OF WORLD AGRICULTURE

*From the reviews of the previous volumes*

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RESEARCH INSTITUTE OF GEOGRAPHY
HUNGARIAN ACADEMY OF SCIENCES

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AKADÉMIAI KIADÓ · BUDAPEST 1982

R. D. HILL

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# CONTENTS

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Nevertheless I would like to single out some for special mention:

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R. D. HILL

Hong Kong, July 1979

Unavoidable delays in publication have permitted the revision of certain statistical tables and the text based upon them. The latest available data have been used whenever possible though in the interests of valid comparisons, those for earlier years had to be used in some instances.

R. D. HILL

Singapore, July 1981

## PRELIMINARY NOTE

Such has been the degree of political change in the Malaysian region that some explanation is required. Prior to the late eighteenth century, political control was exercised by numerous Malay rulers. British control began with the settlement of Penang (now referred to as Pulau Pinang) in 1786. This was extended to the mainland Province Wellesley (now Sebarang Prai) early in the nineteenth century and in 1819 Singapore was founded by a British official. Malacca (now spelt Melaka), having been under Dutch and, earlier, Portuguese control, subsequently joined the British territories to form the Straits Settlements which became a British Colony in the 1860s. (Their earlier status had been as possessions of the British East India Company.) In the 1870s, the British established control in Perak, Selangor, Negeri Sembilan and Pahang, which became the Federated Malay States in 1895. The rest of the Peninsular States remained "independent" and "unfederated" while enjoying British "protection". Matters remained thus until after World War II when the Federation of Malaya was formed which comprised all the Peninsular States, including Malacca and Penang, but not Chinese-dominated Singapore.

As regards Borneo, Sarawak was under the personal rule of "white rajas" – the Brooke family – from 1841 until after the Second World War, Brunei being what it remains, an independent sultanate under British protection. Sabah, then North Borneo, between 1877 and 1901 gradually came under the control of the British North Borneo Company which remained the government until after the Second World War (and Japanese Occupation) when both North Borneo and Sarawak became British Colonies. This situation again changed in 1963 when the Federation of Malaysia was formed, comprising all the states of the Federation of Malaya, together with Sarawak, British North Borneo, now renamed Sabah, and Singapore, the last-named subsequently leaving Malaysia and becoming independent.

# INTRODUCTION

Malaysia may be grouped with the island republic of Singapore and the semi-independent Brunei sultanate partly because of a common experience of British colonialism and also because their economies are inextricably interlocked. Although neither Singapore nor Brunei is important agriculturally, their peoples are equally diverse culturally and, most importantly, so are their forms of agriculture.

In each country, except Singapore, may be found the five major agricultural types discussed in this book – tribal, peasant–semi-commercial rice-growing, peasant–commercial crop-growing, intensive commercial agriculture and commercial tree-crop agriculture. Similarly, each type of agriculture shows strong ethnic identifications. *Tribal agriculture*, mainly involving shifting cultivation as an integral part of the people's culture, is characteristic of the remoter upland areas of Peninsular Malaysia inhabited by diverse groups, and lying outside the political and cultural mainstream. *Peasant forms of production*, both partly-commercial rice-growing and the growing of commercial-crops (mainly rubber), are identified especially with the Malay peoples of the Peninsula and Brunei though increasingly the indigenous peoples of Sabah and Sarawak, while retaining their ethnic identity, are becoming sedentary cultivators. *Intensive commercial farming*, which includes pepper-growing, market-gardening and specialized livestock production (mainly of pigs and poultry), is largely the preserve of peoples of Chinese descent. *Commercial tree-crop agriculture*, largely concerned with the growing of rubber or oil palm on estates, is the preserve of the individual capitalist – Chinese, European, less often Indian and rarely Malay –, and the locally or foreign-owned joint-stock company.

The three countries also share a similar humid equatorial environment, one in which temperatures rarely fall below 20 °C and where annual rainfall ranges from 2,000 to 3,000 mm. Despite the abundance of rain, all areas experience at least one relatively dry period every year and lack of soil moisture rather than temperature is a constraint on agricultural production. Expectably, this is most severely felt by annual crops, especially cereals, grown on sloping ground and less severely by annual crops grown in the heavier clay-rich soils of the lowlands, but even perennial tree-crops, tapping soil moisture at some depth, experience slowed growth for six to eight weeks annually in February and March.

There is, therefore, a broad unity in diversity which also extends to the evolution of agriculture in the past. With scarcely an exception, the present major crop plants are introductions to the area. Even basic starch food sources such as rice *(Oryza sativa)*, yam *(Dioscorea* spp.*)* and taro *(Colocasia* spp.*)* are probably introductions to the region, albeit early ones, in the case of rice dating back perhaps only a thousand years or even less. Two other starchy crops, sweet potato *(Ipomoea batatas)* and manioc *(Manihot esculenta)* are introductions from Central America probably by way of the Spanish galleons which once plied from Acapulco in Mexico to Manila. Other common crops of American origin include maize *(Zea mays)*, tobacco *(Nicotiana tabacum)*, chilli and sweet pepper *(Capsicum* spp.), cashew *(Anacardium occidentale)*, groundnut *(Arachis hypogaea)* and fruits such as guava *(Psidium guajava)* and papaya (pawpaw) *(Carica papaya)*. Such has been the speed with which these introduced plants have spread that they are to be found in extremely remote areas, pointing incidentally to a system of exchange of plant material about which little is known. Perhaps the most important American import is Para rubber *(Hevea brasiliensis)*, still the mainstay of tree-crop agriculture despite the recent advances of the oil palm *(Elaeis guineensis)*, also an introduction, but this time from the Guinea coast of West Africa. From Africa, too, comes coffee *(Coffea* spp.*)*. Perhaps the only truly "indigenous" crop-plant is the ubiquitous coconut *(Cocos nucifera)* and some now rarely grown sugar-cane species. The noble cane of commerce *(Saccharum officinale)* is of Pacific origin and the finest of all palms, the sago palm *(Metroxylon sagu)* has its origin in the eastern Indonesian archipelago, along with cloves *(Eugenia carophyllus* syn. *E. aromatica)* and nutmegs *(Myristica fragrans)*.

This relative lack of truly indigenous crop plants reflects the fact that while mainland Southeast Asia was one of the earliest prehistoric hearths of agriculture, the Malay Peninsula and northern Borneo were amongst the last areas in the region to be populated by agricultural peoples. Even in colonial times, in the late eighteenth and nineteenth centuries, there were huge areas virtually unpopulated which were, therefore, attractive to European capitalists for the growing of tree-crops where accessible from the coast. But even today the total cultivated area in Malaysia of approximately 3·52 million hectares represents less than one tenth of the total land area. The cultivated land is mainly under rubber (57 per cent) and rice (16 per cent), while perennial oil-crops, coconuts and oil palm comprise 21 per cent of the area, occupying 9 and 12 per cent of the cropped area, respectively (see *Table 3*).

CHAPTER 1

# HISTORICAL BACKGROUND

Malaysia is above all an excellent example of a postcolonial dependent economy. While the proportion of agricultural land owned by foreign interests has steadily fallen since independence in 1957, the export economy still remains largely dependent upon the export of relatively little processed raw materials of agricultural origin. For example, in 1975 58 per cent of exports by value were agricultural in origin, mainly latex, crude rubber and palm oil. Dependence is further shown by the fact that four-fifths of all exports go to Western countries (including the Soviet Union) and Japan either directly or via Singapore. The markets to which Malaysia sells its agricultural exports are basically controlled by the consuming countries and, since these are mainly in the West, it may be concluded that these markets are largely controlled by the forces of international capitalism.

This, however, is only part of the story and it is also important to understand why and how export-oriented capitalist agriculture co-exists with only partly commercialized peasant agriculture, and how an intermediate type of agriculture based upon export crops but organized along peasant lines has come into existence.

Capitalist agriculture in Malaysia and Singapore began on the island of Pinang at the very end of the eighteenth century with the planting of spices such as pepper, nutmegs and cloves, though as early as the seventeenth century, Malays in Kedah had been growing pepper for export. The early European-owned plantations at Pinang and from the 1820s at Singapore failed to achieve any lasting success and it was Chinese entrepreneurs in Singapore and subsequently in Johor, Melaka and Negeri Sembilan who grew pepper and gambier *(Uncaria gambir)*[1] and subsequently manioc, with real success. Since production was for export, access to Singapore and Melaka was important and cultivation was, therefore, limited to hitherto vacant land along the valleys of southern and western Johor and to within a radius of some 40 km of Melaka town. These crops gave considerable profits for a relatively limited capital investment and required no great skill. But by nature the crops were exhausting of soil nutrients and this "robber economy" thus involved the abandonment of

[1] Gambier was used as an agent in the tanning of hides. The active ingredients are catechin and catechu-tannic acid.

planted areas as yields fell. New areas were then cleared of forest, leaving the formerly planted areas as barren wastes of secondary vegetation.

European agricultural entrepreneurs were much less willing than the Chinese to move beyond the confines of direct British political control which until the 1870s remained confined to Pinang, Melaka and Singapore. But with the extension of British political domination to what in 1897 became the Federated Malay States, British commercial interests expanded to Perak and Selangor especially. Rather less interest was shown in Pahang, where transportation difficulties and distance from established urban nodes hindered development, and in Negeri Sembilan, where much of the lowland was already densely populated. In the lowlands of Province Wellesley, European- and Chinese-owned sugar plantations enjoyed considerable success between 1870 and 1900, but by 1914 this industry had become moribund. It was largely in Selangor and Perak that from the 1880s European plantation interests, many originally from Ceylon, finally succeeded in laying the basis for subsequent developments. Coffee was the main crop and its cultivation was important in that land was cleared, minor roads were constructed, capital was invested and labour was introduced from southern India, mainly from Tamil Nadu. The colonial administration provided land on easy terms, since it was abundant and extremely cheap in the almost entire absence of economic infrastructure. Government also assisted the immigration of agricultural labour and provided basic transportation and administrative services.

These developments greatly assisted the spread of rubber-growing, which effectively began in 1898. Expansion was promoted by the rising demand for rubber in the industrial West particularly for use in the electrical and rubber clothing industries and, from about 1910, a strong demand for rubber vehicle tyres developed. By 1922, rubber in Malaya (now Peninsular Malaysia) occupied 915,000 ha representing 53 per cent of the world's area. Of this area 46 per cent was owned by Asians, both as estates and small-holdings. The areal dominance of the Straits Settlements (Pinang, Melaka and Singapore) and the Federated Malay States is illustrated by the fact that 70 per cent of the area under rubber was in these states, a dominance which persists to the present. Small-holdings comprised 37 per cent of the total area, though it is difficult to establish just what proportion of these was in the hands of Malays. Nevertheless, such was the ease with which rubber could be grown as a small-holder crop and despite the obstacles placed in their way by the British-supported state governments, Malays became deeply involved in the cash economy while simultaneously exposing themselves to the vagaries of the world market and international price fluctuations. Not all Malay small-holders, however, were (or are) entirely dependent upon rubber for their livelihood. In areas such as inland Melaka and the Negeri Sembilan where hill lands, often in secondary forest following abandonment by the earlier Chinese "robber economy", adjoined their traditional wet rice-fields, rubber-growing for cash was grafted onto the pre-existing subsistence base which remained as a supportative "floor" when rubber prices fell, especially in the 1930s. However, there were, and are, significant numbers of small-holders depending entirely upon rubber for income whose economic position was, and is, much more vulnerable.

Nevertheless, it was not only those Malays who took up the growing of rubber whose domestic economy was transformed by the impact of the colonial economy. The process had begun much earlier with the emergence of Pinang as a major urban centre early in the nineteenth century. The result of this was the creation of a strong demand for foodstuffs which was met by the partial commercialization of rice-growing especially in northern Province Wellesley from the 1830s and on the Kedah–Perlis plain especially from the 1880s. In the latter area, the traditional aristocracy took a major initiative in promoting land reclamation, mainly by drainage. Early in the century only those areas close to the few existing urban centres were cultivated annually. Further away, lands were cropped for rice only one year in three and in the intervening period the rough grass and herbaceous vegetation which sprang up during the fallow period was grazed by numerous cattle and buffalo. Under the stimulus of the developing Pinang market, intensification of production followed as rice surpluses began to have a commercial outlet. Yet production methods remained technically simple and the organization of production remained of a peasant type.

The Malay population was drawn into the capitalist system only to a limited degree, partly by choice and partly by lack of significant Malay entrepreneurial activity outside the rice-producing sector, and commercial and industrial activities were increasingly pre-empted by foreign entrepreneurs with ready-made connections to the international capitalist system. Thus in the rice-growing areas of the northwest and northeast, the transformation was limited and partial. Indeed, in Kedah and Terengganu there is strong evidence that competition from Chinese and European enterprises partly destroyed Malay commercial and craft-industrial activities, pushing Malay entrepreneurs and workers alike into the subsistence agrarian sector.

Attempts to transform rice-growers into truly commercial producers followed independence and though government assistance in this process continues to be generous, it is too early to judge the success of this necessarily long-term change. Assistance has taken a number of forms. Rice-growers have benefited from a guaranteed price since the late 1930s and in most years this has resulted in an effective subsidy, since the guaranteed price has usually been above world open-market prices and at times has been as much as double that figure.

Plans for the development of new rice areas and for the provision of irrigation in existing areas were made during the late 1930s, but most were not implemented until the late 1950s and 1960s. As a result, the rice area planted in

Malaysia rose sharply from 377,000 ha in 1955 to 760,000 ha in 1979 (including a minuscule 3,000 ha in Brunei). This increase, considerably though as it was, barely kept pace with population growth, and the area per person under rice had fallen slightly to about 0·06 ha by the end of the period. Production rose from 677,000 tons in 1955 to 2·16 million tons in 1979, reflecting a major increase in the area from which two crops of rice are taken annually. This area rose from under two hundred hectares in the 1930s to a Malaysian total of 221,500 ha in the 1976/1977 crop year when 52 per cent of all wet rice land was double-cropped (62 per cent in Peninsular Malaysia). Over the same period the proportion of rice requirements met from local production rose from about one-third (in Peninsular Malaysia) to 80 per cent of self-sufficiency in the mid-1970s.

A leading area in the commercialization of rice production is the Muda Scheme in Kedah and Perlis where 101,200 ha of rice land, most of which was formerly cropped only once a year, is now 93 per cent double-cropped. As in other double-cropping areas, the off-season crop, grown in the dry season when insolation is usually greater than in the wet season, has a higher yield than the main-season crop. For 1976/1977 the average yield of the wet-season crop in Peninsular Malaysia was 2·62 t/ha, compared with 3·37 t/ha for dry-season cultivation. However, insolation is only one factor in explaining these differences which are also influenced by higher standards of husbandry on farms growing an off-season crop.

CHAPTER 2

# A STATISTICAL OVERVIEW WITH COMMENTARY

## AGRICULTURE IN THE ECONOMY

Agriculture in Malaysia contributes less to the Gross Domestic Product and to direct employment than in most other countries of Southeast Asia, reflecting the relatively high average annual income, about M$1927 per person in 1975[2] and a comparatively high level of economic development. In 1979 agriculture's direct contribution was 24 per cent of the GDP and this proportion has been falling steadily over the last two decades. In Singapore, the contribution to the GDP of the entire primary sector of the economy was only 1·3 per cent in 1980 and this has also been steadily falling. The contribution of agriculture was by no means negligible, since in 1975, total agricultural production (including inland fisheries) was worth S$371 million, roughly S$177 per head of population which compares with S$7,224 million for manufacturing, i.e. S$3,440 per head (at current prices).

As is the case in most countries where there is still a substantial peasant component in the economy, the direct contribution of agriculture to employment is much larger than its contribution to the GDP. The latest available figures which are given in *Table 1* show that less than half of those employed

*Table 1*

**Estimates of population and employment in Malaysia, Singapore and Brunei, 1979**

| | Population (1000 persons) | Total workforce (1000 persons) | Agricultural workforce (1000 persons) | Agricultural workforce (per cent) |
|---|---|---|---|---|
| Malaysia | 13,297 | 4,512 | 2,192 | 48·6 |
| Singapore | 2,370 | 942 | 22 | 2·4 |
| Brunei | 185 | 52 | 6[1] | 11·6 |
| Total | 15,872 | 5,506 | 2,220 | 40·4 (Av.) |

*Source:* Mainly from F.A.O. Production Yearbook 1979.
[1] Total primary sector.

[2] This compares with M$789 in 1960 (at constant prices of 1965). One Malaysian ringgit and one Singapore dollar are worth approximately US$0·40.

in Peninsular Malaysia, Singapore and Brunei work in the primary sector. But even in Sarawak, where two-thirds work in this sector, there had been a striking reduction from four-fifths ten years earlier.

A comparison of the data for the contribution of the primary sector to the GDP with the employment data suggests that labour productivity must be low relative to other sectors. Thus in Malaysia as a whole (1977), the agriculture employed about 50 per cent of all workers, yet contributed only some 23 per cent to the GDP. This discrepancy is largely to be explained by the existence of a substantial group, mainly Malays in the Peninsula and other indigenous peoples in Sabah and Sarawak, who are at or little above subsistence level, and mainly grow rice.

Unlike most other Southeast Asian countries, the growing of cereals is relatively restricted here, reflecting the limited area of suitable land and the fact that for a family farm the return from rice is about one half to one-third of that from tree-crops. The annual production (1973) represented only 187 grain equivalents per head of population per year (compared with a Southeast Asian average of 249 g.e./persons per year) is about half of that of Southeast Asia as a whole, in part reflecting the problems of animal husbandry in an equatorial zone and also the fact that the number of pigs is strikingly low by reason of Islamic sanctions. However, by Southeast Asian standards, the level of mechanization in agriculture is high though it is still far below that of mid-latitude agriculture. A rough measure is the ratio of people to tractors which, at 1,200 to one is four times above the Southeast Asian average though still far below that of a mid-latitude country, such as New Zealand, where the ratio of agricultural tractors to people is about one to 40. These data suggest that, on the whole, Malaysian agriculture is labour intensive by Western standards, is little mechanized and is one in which livestock plays a limited role.

## AGRICULTURE AND TRADE

Analysis of the role of agriculture in the trading economy of the region is somewhat complicated by the fact that Singapore, as the major entrepot, appears as a major exporter of agricultural commodities, though itself producing little for export (mainly a few thousand tons of rubber and orchids — the latter valued at S$2·3 million in 1973). Brunei has no agricultural exports worth mentioning since its export economy is overwhelmingly concentrated upon petroleum and natural gas (99·8 per cent of exports in 1974).

Intra-regional trade in locally produced agricultural commodities destined for consumption in the region is very limited and the great bulk of commodities is exported from the region, mainly to the capitalist West. One exception is the trade in locally produced rice which is exported solely from the northwestern "rice-bowl" areas to other states in the Peninsula, and is confined to short-distance trade within the various states. Another is the export of fruit and vegetables, mainly from Peninsular Malaysia to Singapore, a trade which was worth M$44 million in 1979.

Exports of agricultural commodities are overwhelmingly concentrated upon those derived from perennial tree-corps — crude rubber and liquid latex, palm kernel oil together with their residues, coconut oil and copra, black and white pepper and cocoa beans. In 1979 these made up about 95 per cent of all agricultural exports, whereas agricultural exports in turn comprised 23 per cent of all exports. The reasons for the dominance of tree-crop products has been discussed already, but the general dominance of agricultural products in the export economy has been steadily diminishing along with their relative importance in the economy as a whole. This is shown in ***Table 2***.

*Table 2*

Agricultural exports as proportion of all exports, selected years 1960—1979 (%)*

| Year | All agricultural commodities | Rubber |
|---|---|---|
| 1960 | 68 | 61 |
| 1965 | 52 | 44 |
| 1970 | 49 | 40 |
| 1975 | 42 | 22 |
| 1979 | 23 | 15 |

*Note:* Compiled from U.N. Yearbooks of International Trade Statistics.

* Data for 1960, 1965, 1970 are for Peninsular Malaysia only. Singapore's exports include an unknown quantity of agricultural re-exports of Indonesian origin.

Nevertheless, Malaysia (with Singapore) remains dominant in the world export trade. In 1979 they exported natural rubber worth US$1,678 million, equivalent to US$126 per person and vegetable oils worth US$775 million or US$57 per person. In 1978 Malaysia produced 45 per cent of the world's natural rubber and 44 per cent of its palm oil.

While exports are still very much those of a typical neocolonial economy with a heavy dependence upon a limited range of primary raw materials,[3]

[3] This dependence partly reflects the hard facts of transportation economics. For example, a small lorry tyre occupies roughly 0·028 $m^3$ of shipping space. An equal volume of crude rubber would weigh 100 kg.

recent agricultural diversification has tended to broaden the export base. This is indicated by the steady fall in the contribution of rubber, from 61 per cent of all exports (by value) in 1960 to 15 per cent in 1979. Correspondingly, there has been a sharp rise in the export of vegetable oils with the bulk of the increase coming from palm oils, copra tending to fall slightly. In 1960, vegetable oils accounted for only 5 per cent of all exports from Peninsular Malaysia, but twenty years later they reached 13 per cent.

### AGRICULTURE AND POPULATION

One of the most pressing concerns in many Third World countries is the relationship between agricultural production and population. In this concern Malaysia has fared better than most countries because of the strength of its tree-crop production.

At 163 kg per person, rice production in Malaysia in 1979 was substantially lower than the Southeast Asian average of 207 kg per person and much below that for Thailand (337 kg/person) and appeared to be fairly stable around that figure. In 1953, the Malaysian production was only 113 kg/person, rising 44 per cent by 1979 compared with only 18 per cent for Southeast Asia, and the country has now reached about 80 per cent of self-sufficiency. Singapore grows no rice and has not done so since the late nineteenth century while in Brunei, production is only about 7,000 tons.

Malaysia's advances in rice production have come about largely through rising yields per hectare (1·74 t/ha in 1953 and 2·86 t/ha in 1979), while the area harvested has barely kept pace with population growth, though rising slightly in the last years of the 1960s and early 1970s *(Fig. 1)*. At 0·057 ha per person in 1979, the area harvested is substantially lower than the Southeast Asian

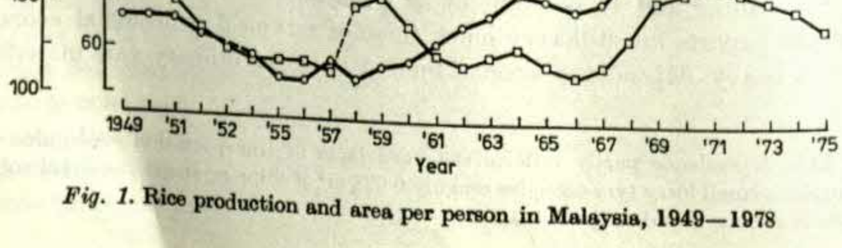


*Fig. 1.* **Rice production and area per person in Malaysia, 1949—1978**

average of 0·093 ha per person and much below that of the premier rice exporter, Thailand, where each person has 0·179 ha on the average. The total area under rice is also small, Malaysia having only 2·3 per cent of Southeast Asia's rice land, as compared with Thailand's 25·4 per cent (1979).

National wealth is not, however, to be measured by self-sufficiency in basic foodstuffs, as the production of industrial crops such as rubber, oil palm and copra can and do compensate for any shortfall in food. This is especially so since for the last 30 years (and more), except for the early 1970s, the growing of industrial crops on family farms has been two to three times more profitable than growing rice even though the latter benefits from subsidies and the former suffers from regressive taxation.

The production of rubber, the traditional industrial crop, in Peninsular Malaysia, fell very sharply in the early 1950s under the impact of serious insurgency and until the mid-60s barely kept pace with population growth *(Fig. 2)*. At the same time, the rubber area fell strikingly behind population growth, though much less rapidly than production. But in the late 1960s, despite a continued fall in the amount of rubber land per head of population (though in reality there was a slow rise in the total rubber area from 1·43 million ha in

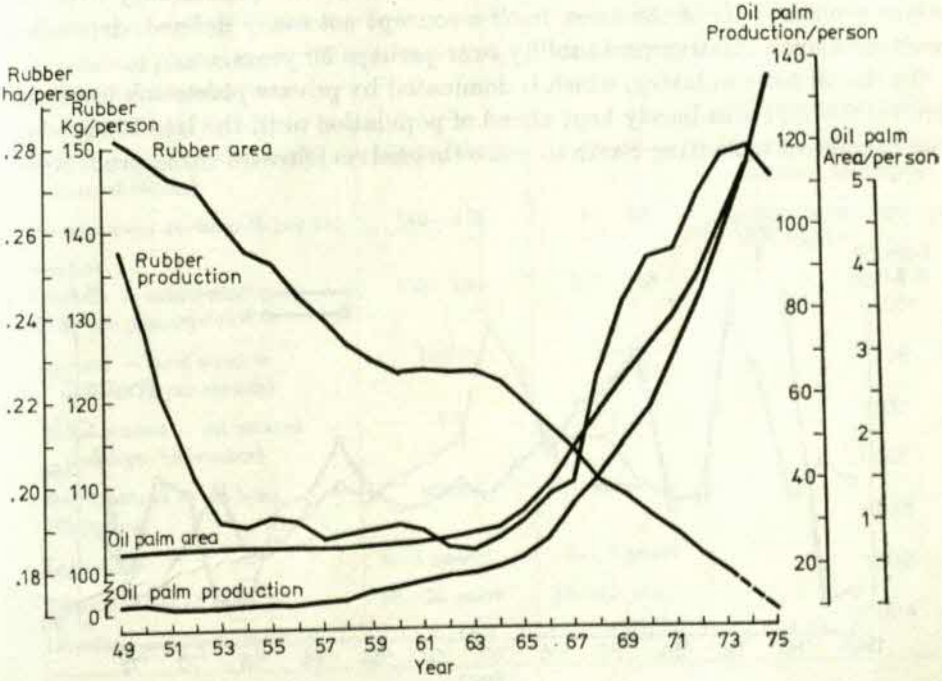


*Fig. 2.* Production and area of rubber and oil palm per person in Malaysia, 1949—1978

1948 to 1·77 million ha in 1976), production suddenly leapt ahead largely due to the widespread introduction of high-yielding clonal rubber planted from the late 1950s on.

This process began on the larger estates and spread to the smaller less-highly capitalized ones and to the small-holders, who received assistance from government through the Rubber Industry Replanting Board, and from 1973, the Rubber Industry Small-holders Development Authority (RISDA). At the same time, some of the larger estates began to diversify into oil palm which appeared to offer the prospect of more stable prices, a shorter "lead time" from planting to production, a reduction of dependence upon a single crop and avoidance of the threat of synthetic rubber produced in the major industrial countries which were also the major customers for natural rubber. Though the relative prices of rubber and oil palm are far from being the only factor in management decisions, the long decline in rubber prices during the 1960s coupled with an ageing stock of trees and the rising cost of labour undoubtedly encouraged many managers to plant oil palm even though palm oil prices were also falling *(Fig. 3)*. This swing clearly shows the somewhat speculative nature of planting decisions, since managers must base them upon their judgement not only on relative profitability in the short run, bearing in mind the 3 to 4 year lead time for oil palm and the 6 to 7 year lead time for rubber, but profitability over the whole economic life of the trees, itself a concept not easily defined, depending as it does upon relative profitability over perhaps 30 years.

In the oil palm industry, which is dominated by private plantation interests, production and area barely kept ahead of population until the late 1950s when the benefits of replanting began to make themselves felt with rising production.

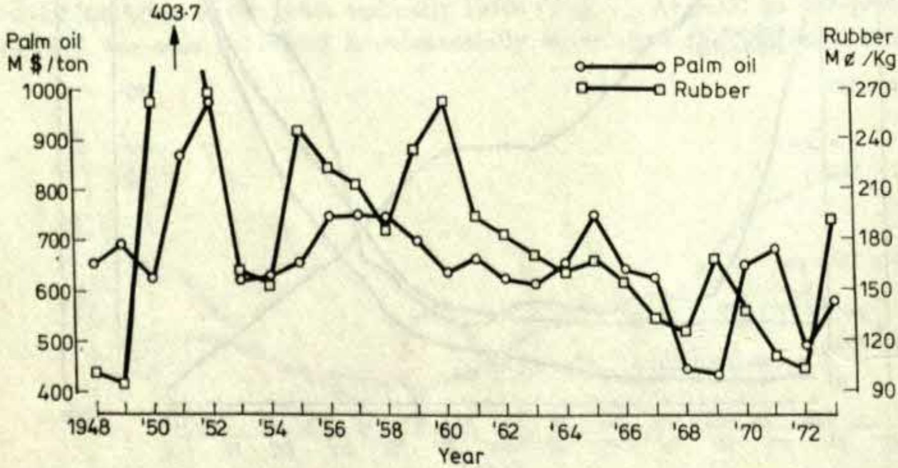


***Fig. 3.* Rubber and palm oil prices, 1948—1979**

This predated substantial rises in area by about six years. From the mid-60s, oil palm planting and production "took-off" with production rising at a somewhat faster rate than the area as young palms came into full bearing.

The only major crop which has failed to keep pace with population growth is coconut, partly because replanting with high-yielding varieties has not been pressed vigorously. Moreover, since copra and palm oils are substitutable for each other in many manufacturing processes, the expansion of oil palm production has tended to depress copra prices and production. The result has been that the production of copra per head fell from 25 kg in 1949 to around 13 kg in 1974.

H. S. Khera has shown that even leaving aside the social and economic desirability of reducing dependence upon rubber, oil palm is still likely to be more attractive even though prices are likely to decline as production increases *(Table 3)*.

These considerations suggest that the growth of oil palm production is likely to be much more rapid than that of rubber. However, oil palm is much more de-

*Table 3*

Comparison of oil palm and rubber (early 1970s)

| Criteria | Oil palm | Rubber | Remarks |
|---|---|---|---|
| Commercial profitability (internal rate of return) | 9·1—16·9% | 10·9—13·8% | For estate of 2,430 ha, ranges depend upon different assumptions |
| Social profitability (internal rate of return) | 13·2—29.8% | 15·4% | Ranges depend upon different assumptions |
| Government revenue ($ per ha) | 140—275 | 60—105 | Ranges depend upon price and yield |
| Income — estate workers ($ per month) | 130—160 | 130—160 | |
| Income — land scheme settlers ($ per month) | higher | lower | |
| Employment — on estates (average, ha/worker) | 7·6 | 3·0 | |
| Employment — on land schemes | same | same | |
| Lead time | 3—4 years | 6— 7 years | |
| Economic life of trees | 20—25 years | 25—40 years | |
| Development costs (M$/ha)* | 4,500 | 4,300 | |

*Note:* Based upon KHERA (1976, p. 294).

* Including public amenities and management.

*Table 4*

Estimates of agricultural land use

| | Rubber | | Oil palm (1977) | |
|---|---|---|---|---|
| | (ha) | (%) | (ha) | (%) |
| *Peninsular Malaysia* | | | | |
| Johor | 436,260 | 21·8 | 224,530 | 28·1 |
| Kedah and Perlis | 175,220 | 8·8 | 6,503 | 0·8 |
| Kelantan | 84,640 | 4·2 | 11,629 | 1·5 |
| Melaka | 103,020 | 5·1 | 7,225 | 0·9 |
| Negri Sembilan | 236,350 | 11·8 | 33,052 | 4·1 |
| Pahang | 181,000 | 9·0 | 215,686 | 27·0 |
| Pinang and S. Prai | 26,900 | 1·3 | 4,108 | 0·5 |
| Perak | 244,350 | 12·2 | 73,619 | 9·2 |
| Selangor | 155,130 | 7·7 | 89,053 | 11·1 |
| Trengganu | 59,260 | 3·0 | 46,597 | 5·8 |
| *East Malaysia* | | | | |
| Sabah | 108,179 | 5·4 | 69,473 | 8·7 |
| Sarawak | 193,052 | 9·6 | 18,195 | 2·3 |
| | 2,003,351 | 99·9 | 799,670 | 100·00 |

*Note:* Compiled from official sources.

[1] Official figures for rubber in the states of Peninsular Malaysia are not available. Those given are author's estimates based upon figures for 1972.

[2] Includes both wet and dry padi, wet season only.

manding of suitable soils than is rubber, so that the latter is likely to continue to be the crop of choice on the more leached upland soils, especially those derived from Mesozoic sedimentary rocks and from older (Pleistocene) alluvium. Moreover, since the fruits of the oil palm require rapid processing in a large factory, rubber will continue to be the crop of choice for small-holders, especially in remoter areas.

## LAND USE

Alone of Southeast Asian countries, Malaysia has a satisfactory land use survey. This has been based upon complete aerial photography of Peninsular Malaysia at a scale of 1 : 25,000 in 1966 and of East Malaysia in the 1970s.[4]

[4] The published material comprises reports on each state (for East Malaysia, each Residency of Division) accompanied by a coloured map. See, for example, SIEW, 1970a, 1970b, 1973a, 1973b; I. F. T. WONG, 1970a, 1970b, 1971, 1973a, 1973b, 1973c.

in Malaysia (1976/77)[1]

| Coconut (1977) | | Padi[1] (1976/77) | | Other crops[3] (1977) | Total | | Agricultural land as % of total land |
|---|---|---|---|---|---|---|---|
| (ha) | (%) | (ha) | (%) | (ha) | (ha) | (%) | |
| 66,835 | 19·1 | 2,090 | 0·7 | 43,884 | 773,599 | 19·7 | 40·3 |
| 12,916 | 3·7 | 146,020 | 25·8 | 26,062 | 366,721 | 9·4 | 35·8 |
| 18,465 | 5·3 | 64,390 | 13·2 | 20,967 | 200,081 | 5·1 | 13·3 |
| 5,301 | 1·5 | 9,720 | 2·0 | 4,017 | 129,283 | 3·3 | 78·4 |
| 3,019 | 0·9 | 7,680 | 1·4 | 9,127 | 289,228 | 7·4 | 43·4 |
| 6,691 | 1·9 | 16,240 | 3·7 | 18,047 | 437,664 | 11·2 | 12·2 |
| 15,498 | 4·4 | 13,700 | 2·8 | 4,769 | 64,975 | 1·7 | 62·2 |
| 52,637 | 15·0 | 42,800 | 7·4 | 45,334 | 458,740 | 11·7 | 21·8 |
| 49,149 | 14·0 | 20,140 | 3·6 | 27,216 | 340,688 | 8·7 | 40·3 |
| 11,484 | 3·3 | 31,960 | 5·5 | 18,227 | 167,528 | 4·3 | 12·9 |
| 53,875 | 15·4 | 49,201 | 8·2 | 11,755[4] | 292,483 | 7·5 | 4·0 |
| 54,113 | 15·5 | 131,339 | 5·7 | n.a. | 396,699 | 10·1 | 3·2[5] |
| 349,983 | 100·1 | 535,280 | 100·0 | 229,405 | 3,917,689 | 100·0 | 11·9 |

[3] Includes coffee, tea, pepper, cocoa.

[4] Figure for cocoa only.

[5] Excluding "other crops".

n.a. = Not available.

These surveys not only show that official land use statistics (which are available only for major crops) have a reasonable degree of accuracy but also provide much more detailed information than the annually published series.[5]

Overall, agriculturally used land does not occupy a significant proportion of the land area though the area is increasing by about 1·5 per cent every 5 years. In Malaysia, only 11·9 per cent of the land is being so used. Crude population densities are low by Asian standards — 84 per square kilometre in Peninsular Malaysia, in 1979, 13 per square kilometre in Sabah, in 1970 and

[5] A comparison of the land use survey data for Peninsular Malaysia in 1966 with official estimates for the same year showed that the latter ranged from less than 1 per cent higher for rubber to 23 per cent higher for oil palm. Similar data for Sabah in 1970 showed that the land use survey figure for rubber was 11 per cent higher than the official figure, but that for coconut and oil palm the figures were 37 and 23 per cent lower, respectively. Further complications arise through double-counting. Rice land from which two crops are taken annually is counted twice while coconut inter-planted with cocoa may be counted once as coconut and again as cocoa.

10 per square kilometre in Sarawak in the same year. However, agricultural densities are substantially higher, the corresponding figures being close to 340 per square kilometre in the Peninsula and Sabah, and around it in Sarawak. In Singapore, Y. K. Wong (1975) has reported that only 11,833 ha were farmed in 1973, representing about 2 per cent of the land area, but his survey was confined to market-gardening. R. D. Hill, basing his work upon aearial photographs and planimetry (1977, p. 28), reported that land under rubber, coconut and "mixed trees and crops" occupied 181·78 km² in the later 1960s, representing 36 per cent of the Republic's area although most of this area cannot be said to be farmed, being occupied at low densities by suburban dwellings.

The proportion of agricultural land varies greatly from state to state as indicated in *Table 4* which shows the markedly low figures for Sabah and Sarawak which have never been in receipt of large streams of agricultural migrants. Generally, in the smaller states close to urban nodes such as Melaka and Penang such land as is not used for urban purposes is close to being fully utilized forag riculture. The larger states such as Pahang, Terengganu, Kelantan and also inland Perak include large areas of remote mountainous terrain flanking the central ranges, while those with extensive but well-drained lowlands, such as Kedah (and its tiny neighbour, Perlis) or rolling hill country suited to perennial tree-crops, such as Johor, have a much higher proportion under cultivation. Extensive swamplands, occupied by mangrove and freshwater swamp under natural conditions, have been developed for agriculture only on their margins where the peat is not so deep as to prevent adequate rooting and plant nutrition or where "cat clays" are absent.[6] On the shallower peats, pineapples, especially in Johor, and the sago palm *(Metroxylon sagu)* as in the Kimanis district of Sabah, probably represent the agriculturally optimal use of these difficult soils, as does the rearing of marine fish and prawns in the difficult environment of the mangrove.

*Figures 4* and *5* together with *Table 4* show details of the pattern of agricultural land use by major crop from state to state. The general pattern, however, is not always dominated by the larger states. Johor, for example, is pre-eminent in tree-crops, ranking first in each case. The state contains 23 per cent of all tree-crops but comprises only 5·8 per cent of the area of the Federation. Similarly, Kedah (and Perlis) contain almost 27 per cent of all rice land (and the most highly productive) constituting only 3 per cent of the Federation area.

If the analysis is broadened to include states with over 10 per cent of any one crop, a similar pattern emerges. In the case of rubber, three states, Johor, Perak and Negri Sembilan together comprise 46 per cent of the total area com-

[6] "Cat clays" (acid sulphate soils — Sulfaquepts) are formed on marine (saline) alluvium in which free acids develop by oxidation following drainage.

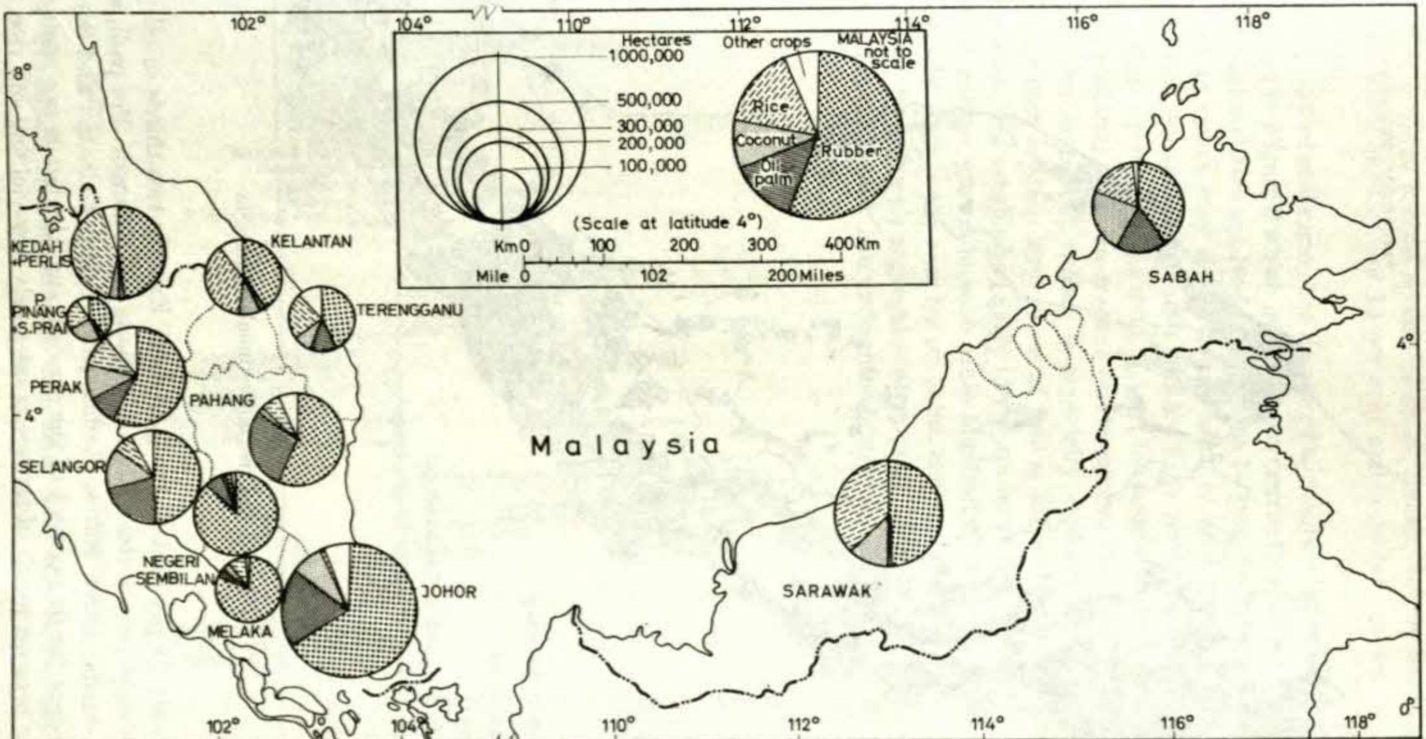


*Fig. 4.* **Area under cultivation and major crops in Malaysia, 1972**

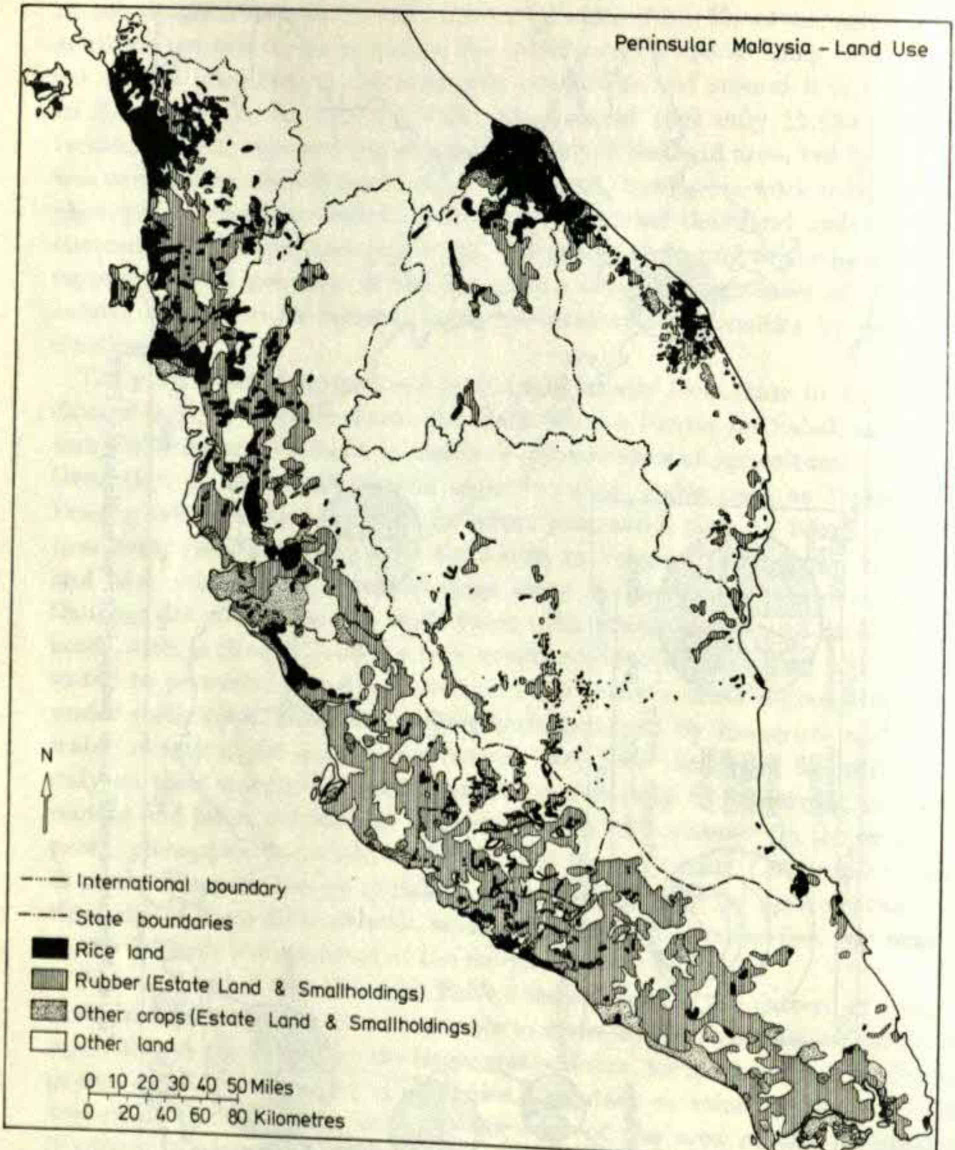


*Fig. 5.* Land use in Peninsular Malaysia

pared with only 14 per cent of the land area. Exactly two-thirds of oil palms are found in only three states – Johor, Pahang and Selangor. For padi, a similar pattern exists; three states, Kedah (with Perlis) Kelantan and Sarawak together account for 64 per cent of the area, though the last is not such a major producer because much of its rice is relatively low-yielding hill rice. Only for coconut is there a good spread of areas, Sabah, Johor, Sarawak, Selangor and Perak, each having over 10 per cent and together making up 79 per cent of the total.

Another way of measuring the degree of agricultural specialization in a state is illustrated in *Figure 6* which indicates the degree to which each state deviates from the national average land proportions by crop and state. This shows that while certain states may dominate in terms of area under a particular crop, they are not necessarily those in which a high proportion of the agricultural land is taken up by a single crop. Johor, for instance, does not deviate much from the national norm in respect of tree-crops, but falls much below it for rice. The dominance of rubber is especially striking in Melaka and Negeri Sembilan which contain large areas of rolling hill country and comprise areas where rubber was established early in the century. But on the whole, the proportion of rubber grown in each state approximates the national mean much more closely than is the case for oil palm, coconut and padi.

However, by using an aggregate category of "other crops", official statistics tend to over-emphasize the undoubted importance of the four major crops to

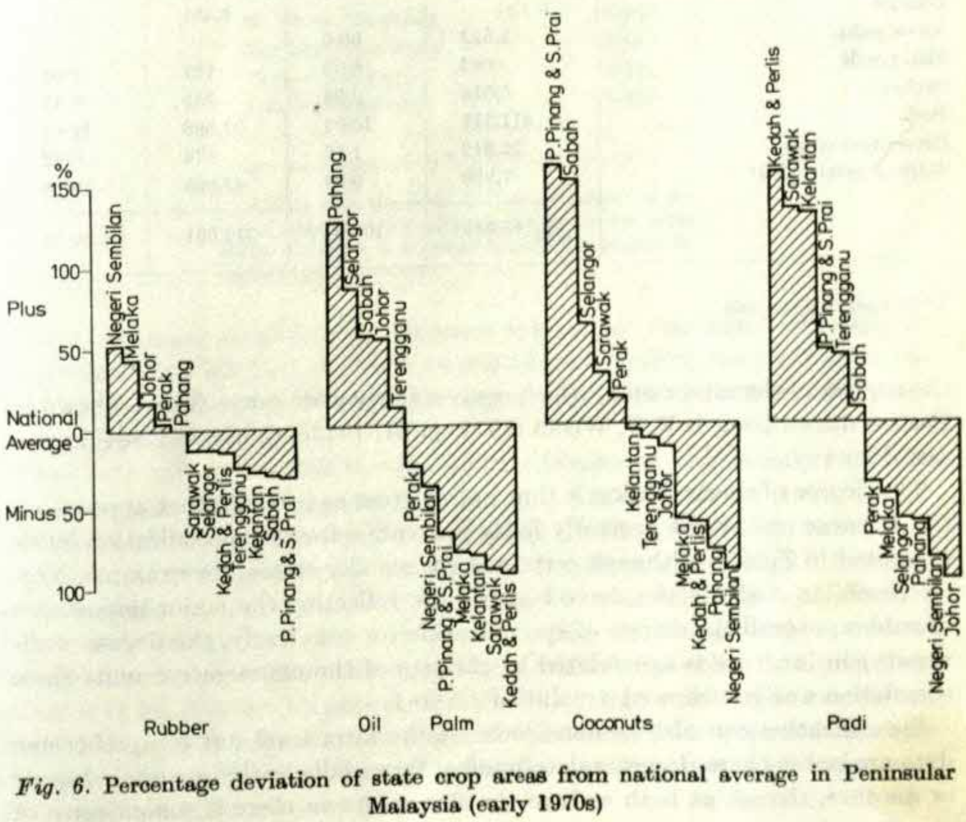


*Fig. 6.* **Percentage deviation of state crop areas from national average in Peninsular Malaysia (early 1970s)**

*Table 5*

**Land use by crop in Peninsular Malaysia (1966) and Sabah (1970)**

| Land use | Peninsular Malaysia | | Sabah | |
|---|---|---|---|---|
| | area (ha) | proportion (%) | area (ha) | proportion (%) |
| Mixed horticulture | 193,802 | 7·06 | 30,874 | 9·86 |
| Market-gardening | 5,077 | 0·18 | 535 | 0·17 |
| Agricultural stations | 1,167 | 0·04 | 859 | 0·27 |
| Rubber | 1,776,004 | 64·69 | 117,395 | 37·50 |
| Oil palm | 99,596 | 3·63 | 31,263 | 9·99 |
| Coconut | 175,883 | 6·41 | 40,171 | 12·83 |
| Pineapple | 17,296 | 0·63 | — | — |
| Coffee | 6,778 | 0·25 | 153 | 0·05 |
| Tea | 3,503 | 0·13 | 3 | — |
| Cocoa | 454 | 0·02 | 3,744 | 1·20 |
| Pepper | 1,135 | 0·04 | 58 | 0·02 |
| Sago | 3,833 | 0·14 | 3,285 | 1·05 |
| Fibre crops | 165 | 0·01 | 905 | 0·29 |
| Banana | — | — | 1,351 | 0·43 |
| Areca palm | 1,522 | 0·06 | — | — |
| Fish ponds | 643 | 0·02 | 137 | 0·04 |
| Orchards | 6,518 | 0·24 | 359 | 0·11 |
| Padi | 411,811 | 15·00 | 37,596 | 12·01 |
| Diversified crops | 32,242 | 1·17 | 674 | 0·22 |
| Shifting cultivation* | 7,920 | 0·29 | 43,669 | 13·95 |
| | 2,745,349 | 100·01 | 313,031 | 99·99 |

* Curr ent crop area only.

the neglect of the minor ones, which cover a fairly wide range. This is shown in *Table 5* drawn from I. F. T. WONG (1971, p. 61; 1973c, p. 51) and based upon aerial survey.

The degree of specialization is thus not as great as it would first appear and this is borne out by the generally fairly low values for the specialization index presented in *Table 6*. Although certain of the smaller states, for example, Negeri Sembilan and Melaka, have high values, reflecting the major importance of rubber, overall the degree of specialization (or conversely, the degree of diversity) in land use is not related to the size of the enumerative units since correlation analysis showed a value of $r = 0{\cdot}1$.

Specialization can also be considered at the farm level but comprehensive data are lacking here. In general, individual farms fall clearly into one category or another, though at both ends of the size spectrum there is some degree of

*Table 6*

Index of land use specialization in Malaysia

| Areal units | Index |
|---|---|
| *Peninsular Malaysia (1966)* | 0·452 |
| Johor | 0·605 |
| Kedah | 0·408 |
| Kelantan | 0·342 |
| Melaka | 0·640 |
| Negeri Sembilan | 0·752 |
| Pahang | 0·578 |
| P. Pinang and S. Prai | 0·279 |
| Perak | 0·404 |
| Perlis | 0·279 |
| Selangor | 0·105 |
| Terengganu | 0·369 |
| *Sabah (1970)* | 0·211 |
| W. Coast Residency | 0·250 |
| Sandakan Residency | 0·237 |
| Tawau Residency | 0·244 |
| Interior Residency | 0·327 |

*Source:* Computed from I. F. T. WONG 1971, 1973c.

• Since an index value of 1 would indicate that the whole cropped area was under a single crop, the higher the index, the higher is the degree of specialization. Data for Sarawak are not available.

mixing. Amongst small-holders, rice and rubber are combined especially in areas where both hill land (for rubber) and alluvial lowland (for rice) are available. These patterns are shown in the topographical map with extracts comprising *Figures* 7 and *8*.

Detailed studies show that rice farms not infrequently also include a subsidiary area under other crops. SELVADURAI and ANI bin AROPE (1969, pp. 25 and 28) reported for Sebarang Prai (formerly Province Wellesley) that mean farm size was 1·66 ha of which 0·32 ha on average was under crops other than padi, and that 35 per cent of rice farmers owned some non-rice land. NARKSWASDI and SELVADURAI (1967, p. 58), reporting on rice-growing in coastal Selangor, gave a mean farm size of 2·26 ha of which crops other than padi comprised 0·45 ha. Nor is this pattern of subsidiary crops confined to rice farms. HILL (1967, p. 19) reported that almost 30 per cent of the pepper farms surveyed in Johor received additional income from other crops, while 8 per cent also had income from livestock.

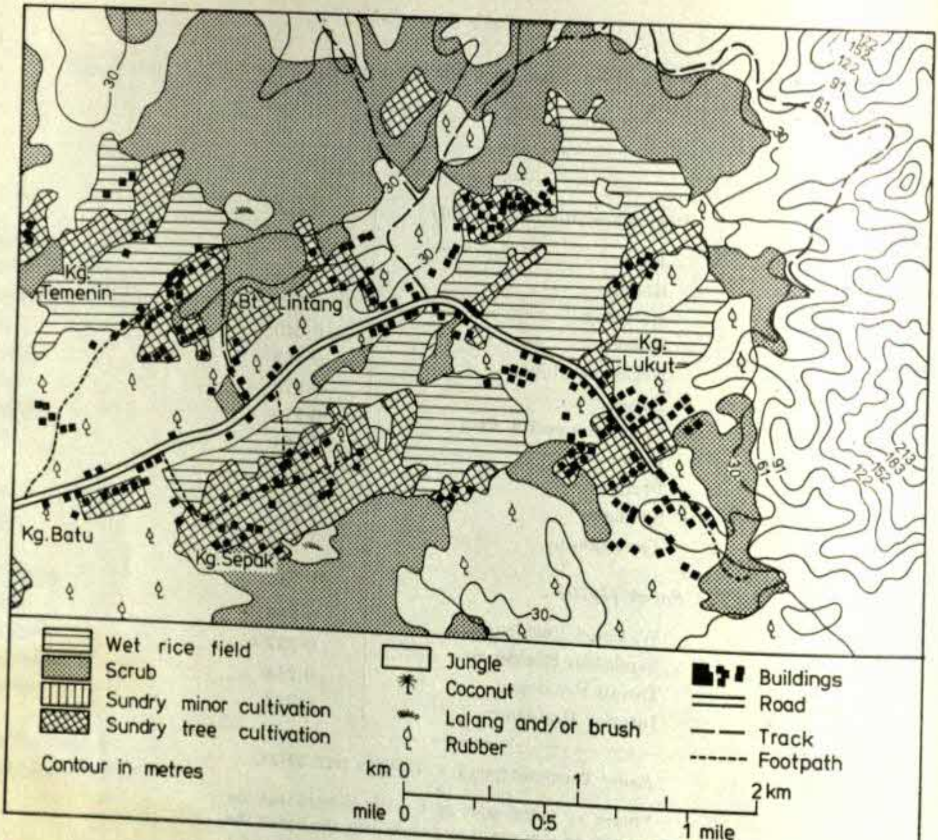


*Fig. 7.* Permanent rice cultivation on the lowland, with rubber-growing extending into the upland where shifting cultivation (marked by the presence of scrub) is also practised: Kota Tinggi, Johor

No matter what may be the primary crop, small-holders invariably grow a variety of crops around their houses. In *Table 5* these have been included as "mixed horticulture", a catch-all category of variable crop composition. In areas where the basic emphasis is upon padi, "mixed horticulture" comprises vegetables, maize, root crops such as sweet potato, taro and yam, bananas, pineapple (eaten ripe as a fruit or unripe as a cooked vegetable) and coconut (used especially in the preparation of curries). Away from the padi, areas of "mixed horticulture" are located on the periphery of larger blocks of commercial crops such as rubber, coconut, coffee and pineapple, with these crops being grown together in a form of promiscuous cultivation in which manioc is commonly an element providing starch food.

"Mixed horticulture" is not to be confused with the category "diversified crops", found mainly in Perak where Chinese farmers especially grow manioc

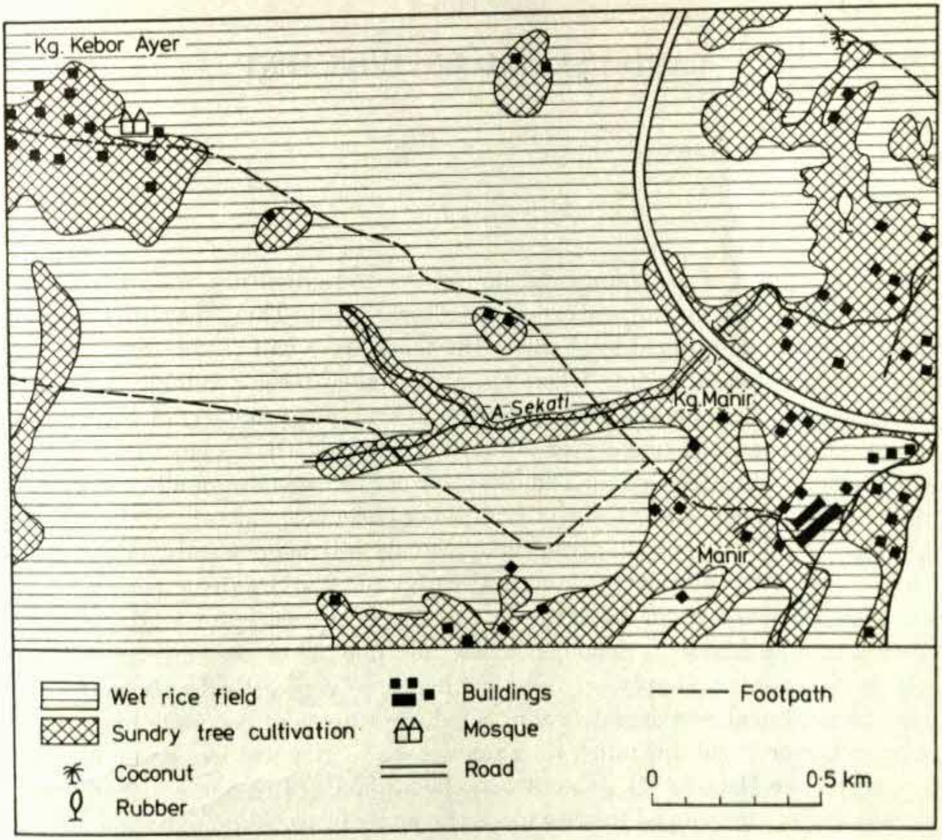


*Fig. 8.* Lowland permanent wet rice-growing with *kampung* cultivation, Terengganu Plain

for commercial sale, along with maize, bananas, sugar cane, sweet potatoes, groundnuts and yams. Like orchards, these areas are to be found on the outskirts of large towns, or on the peripheries of estates.

At the other end of the farm size spectrum, some of the larger estates have been diversifying away from rubber especially over the last 10 years. For example, Dunlop Estates, near Melaka, now grows oil palm and cocoa as well as rubber, but naturally in different blocks. Seafield Estate, at Batu Tiga, Selangor, grows both oil palm and rubber, while a number of small coconut estates in Sabah are beginning to plant cocoa under the shade of coconut palms, but generally this type of promiscuous cultivation is confined to small-holdings.

CHAPTER 3

# LAND USE AND ENVIRONMENT

The perception of environmental limitations to agriculture has varied from time to time and from cultural group to cultural group. Thus, the shifting cultivator prefers well-drained land where the felled trees will readily dry out and give a good burn and regions where clear, running water is available. The peasant rice-grower avoids the difficult soils and drainage problems of the coastal mangrove fringe and freshwater swamps, preferring the recent alluvial soils which are not deeply flooded. The estate-owner or tree-crop small-holder seeks rolling uplands, especially those of granitic or basic volcanic origin (though the latter are rare), not only because these provide satisfactory soils, but also because much of the alluvial lowland is already occupied, by rice especially. This situation does not occur everywhere, though; in Selangor, for example, tree-crops are to be found on Selangor series soils, one of the best alluvial lowland soils in the country, simply because they had been very little developed for rice when agricultural settlement began. Significant areas of coconuts and rubber exist in Lower Perak for much the same reason – rice was less economic than tree-crops (see HILL 1977). In contrast, the lowlands of Kedah and Perlis were already largely developed for rice when the phase of tree-crop expansion began at the end of the nineteenth century.

However, this is not to suggest that the physical environment does not set limits to certain crops at particular times and in particular places, but only that these limitations are relative rather than absolute. They are relative to the basic facts of free-enterprise economics, since the countries of the region have always been essentially capitalist, though governments have played a major role, especially in ameliorating environmental limitations by irrigation and drainage – the particular preserve of a whole government department in Malaysia.

Temperature is nowhere an absolute barrier to plant growth, though it is generally held that the yields of rubber and oil palm are sufficiently depressed at altitudes above 500 m to make it unprofitable to grow them. At the same time, land above this level (and sometimes below it) is often steep and broken, so that terracing or planting in pits becomes expensive while the reduced mobility of the workers also makes harvesting costly. The reduction of temperature with altitude favours the growing of temperate vegetables in areas above about 1,200 m which have ready access to urban markets. Market-gardening on soils of granitic or similar origin at Cameron Highlands (Peninsular Malaysia) and at Kundasan on the Gunung Kinabalu massif in Sabah are examples. These slopes, which may exceed 35°, are cultivated in tiny, sometimes terraced plots.

Water supply is the most important climatic limitation affecting annual crops much more seriously than perennial tree-crops. The shallow-rooting crops of shifting cultivators are most at risk, since run-off in jungle clearings is very rapid, at least in the early stages of growth. The result is a high degree of yield variability from harvest to harvest. In plain areas, rain is traditionally trapped on rice-fields by means of low mud bunds, but although yields are less variable than on hill-slopes, they are nevertheless less stable than on lands where water can be supplied on demand, usually by artificially flooding the whole controlled-irrigation area. Nevertheless, even artificial irrigation is not wholely free from the effects of variable rainfall, since in most schemes water storage capacity is limited and in some cases non-existent. The whole question of the relationship of rice yields to variations in rainfall has been studied little, perhaps because of the general difficulty of isolating this factor from others in an uncontrolled "field" situation.

In respect of rubber, however, WYCHERLEY (1963) has suggested that though it has yet to be conclusively shown that long periods of drought reduces the yield of latex, yields are nevertheless reduced in the third and fourth months of the year as a result of "wintering". Although *Hevea* is evergreen, mature trees usually defoliate regularly once a year following the dry spell, which in Peninsular Malaysia normally occurs early in the year. Refoliation follows and during this period yields may fall to between 30 and 80 per cent of normal in any one area depending upon the particular clone being grown. As a result, tapping may become uneconomic. Other things being equal, it would seem that wintering and subsequent yield depression are more complete and severe in the northwest of the Peninsula and around Melaka, lying in the rain-shadow of the northeast monsoon which prevails from about late October until early March.

A further influence upon the performance of *Hevea* is excessive rain, which, while not affecting the tree itself, interferes with the tapping and collection of latex. Roughly a third of lost production is caused by rain, that falling in the morning when latex flow is at a peak causing the most interference. The rest of the loss arises mainly from late (late morning or afternoon) tapping (or early collection). The loss ranges from 7 to around 30 days per year and is most pronounced in the northeast where rubber is not a major crop, and in the southwest of the Peninsula where it is. *Hevea* is not known to respond to day-length (unlike the more traditional varieties of rice which do).

Oil palm does not "winter" in the same way as rubber, though yields are adversely affected by dryness and also by waterlogging of the soil for which reason artificial drainage is essential in flat areas. On the whole, the yield over the economic life of the palm is about 20 per cent lower on average hill soils than on average alluvial lowland soils (Patterson in KHERA 1976, p. 14). The uniformity of the Malaysian climate relative to the more seasonal climate of the West African home of *Elaeis guineensis* means that, in Malaysia, production during the peak month is about double that of the lowest month, whereas in Africa the difference may be 10 to 15 times greater (KHERA 1976, p. 13).

Since the 1960s, the constraints of the physical environment in Peninsular Malaysia have played a significant role in determining land use planning, especially as related to major cash crops. Areas of forest marked for agricultural development have been surveyed by soil surveyors both in the field and from aerial photographs. These workers are responsible for the compilation of land suitability maps on the basis of which recommendations for particular crops are made, and usually followed (LEAMY and PANTON 1966).

Soil surveyors recognize the following features as very serious limitations to agricultural use:

- slopes steeper than 20°
- massive laterite (ferricrete) concretions at or near the surface
- extreme rockiness (many bare rock surfaces)
- disturbance by surface mining
- soil toxicity.

Serious limitations are those which are difficult to correct or which seriously reduce productivity or require special agricultural techniques to overcome. They are as follows:

- acute nutrient deficiences (both major and trace elements)
- poor drainage
- slopes 12°–20°
- massive laterite within 60 cm of the surface
- strong soil compaction
- sandy texture throughout the soil profile
- acid sulphate conditions ("cat clays")
- saline conditions.

Bearing in mind these and minor limitations such as acid peat within 60 cm of the surface, high pH (rather rare) and susceptibility to flooding which may slightly reduce productivity or the range of crops which can be grown, five soil suitability classes have been recognized and are illustrated for the Sandakan district, Sabah *(Fig. 9)*.

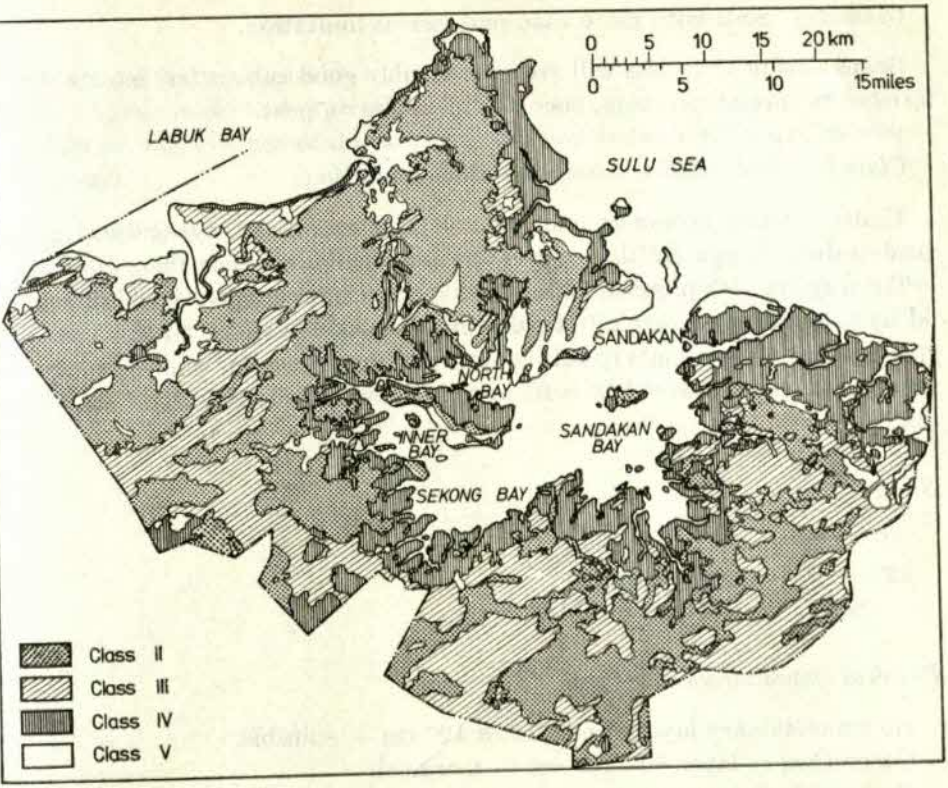


*Fig. 9.* Sample land suitability map, Sandakan District, Sabah

*Class 1* — Soils with no limitations to agricultural development.

These are deep, well-drained, with good structure on slopes less than 12°. While very suitable for rubber, economic considerations point to oil palm or other crops of similar value as first choice.

*Class 2* — Soils with few minor limitations.

These occur on slopes less than 12°. The range of suitable crops may be restricted by the type of limitation. Susceptibility to flooding or peat may limit exploitation. Rubber and coconut, for example, may be susceptible to windthrow for lack of adequate support by their roots.

*Class 3* — Soils with at least one serious limitation.

Only a restricted range of crops under skilled management is possible on these soils. Rubber is usually a possible crop, but yields may be limited.

*Class 4* — Soils with more than one serious limitation.

Some soils in this class will grow reasonably good rubber but most are restricted to specialized crops, such as pineapples on peat.

*Class 5* — Soils with at least one serious limitation.

Under existing economic and technological conditions, agricultural use is inadvisable, though shifting cultivators may sometimes use them fleetingly.

The way in which physical limitations on crop choice are perceived is illustrated by the particular case of oil palm. An unsuitable verdict for any one of a range of factors is enough to rule against planting this crop, while a number of "marginal" reports would be sufficient to throw serious doubt on its advisability.

*Slope*

0°—12° — mostly suitable
12°—20° — mostly marginal
>20° — mostly unsuitable.

*Physical impediments in the soil*

No concretionary layer or one below 120 cm — suitable.
Concretionary layer 60—120 cm — marginal.
Concretionary layer <60 cm — unsuitable.

*Drainage*

Gley horizon[7] below 90 cm — suitable.
Gley horizon 30—90 cm marginal.
Gley horizon <30 cm — unsuitable.

*Texture*

A sandy texture throughout is unsuitable, being too free-draining.

*Toxicity*

Soils of low pH, high salinity etc. are unsuitable.

[7] A gley horizon varies in intensity according to the degree of oxidation, being brownish with grey mottles under slightly gleyed conditions, greyish with brown mottles where rather more severely gleyed, and totally grey to dark grey where oxidation is absent and anaerobic conditions prevail.

*Peat*

0 – 60 cm thick – suitable.

60 – 120 cm thick – marginal.

>120 cm thick – unsuitable as palms fall over because of lack of mechanical support.

*Rainfall*

A distinct dry season in excess of two months, recurring every year, is unsuitable. This particularly applies to the north of the Peninsula and to parts of Sabah.

CHAPTER 4

# AREAL DISTRIBUTION OF CROPS

Despite the various limitations to cultivation discussed in the previous section, the existence of large tracts environmentally suited to the major crops people wish to grow has meant that the availability of land at particular times and places has been the major influence upon the distribution of crops. To quote only one example: the markedly inland distribution of oil palm in the Peninsula reflects the fact that the expansion of oil palm plantings is quite recent and much of the environmentally suitable land with good access had already been taken up for rubber. Replacement of rubber by oil palm has not been on a scale sufficient to alter this basic pattern.

## RUBBER

It has been remarked that "rubber is a weed". This simply reflects the ease with which it will grow, though not necessarily flourish, on a wide range of soils. Rubber has been cultivated to such an extent that it is found in large contiguous blocks on estates, where it is invariably a monoculture, and on small holdings where it may be intercropped with bananas, pineapples and coffee. The grass and herbaceous vegetation under the trees may be grazed by cattle or buffaloes though this is not common, partly because the animals are likely to dislodge the cups attached to the tree to collect the latex.

Rubber has been cultivated on steep mountainous land where the physical difficulties of walking from one tree to another to tap and collect the latex are considerable. At the other extreme, rubber has been grown on peat and in other wet-lands, where stunting and mechanical collapse are common consequences. In less-developed areas, poorly-maintained and abandoned rubber quickly takes on the appearance of scrub savanna or even "secondary forest with *Hevea* dominant". The 1966 land use survey reported that in Kedah some 29,200 ha fell into these categories, representing 16 per cent of the total area.[8] These areas are not entirely a productive loss, however, since changes

[8] Corresponding figures for Kelantan and Terengganu were 14,076 ha (17 per cent of the state rubber area) and 13,116 ha (22 per cent), respectively.

in the price of rubber may make tapping economic for the small holders concerned.

*Table* 7 gives details of the area of rubber owned by estate interests, under land development schemes and owned by small-holders. While Johor is dominant in the first two categories, Sarawak is the most important state as far as small-holders are concerned, where a significant proportion derives from the practice of planting rubber in the abandoned clearings of shifting cultivation. Most of this rubber is comprised of unselected seedlings which gives much lower production than the selected clonal variety now planted on estates and on many small-holdings in Peninsular Malaysia. This variation is illustrated by the strikingly different latex production figures for 1973 when the average for Sarawak was only 214 kg per ha (only 166 kg/ha in 1974), compared with an average of 862 kg per ha in Peninsular Malaysia where some plantings have achieved yields in excess of 2,750 kg/ha (BARLOW 1978, p. 131).

A further striking feature is the marked southwesterly concentration of the areal distribution of the crop in the Peninsula and in particular the concentra-

*Table 7*

**Estimated area under rubber in Malaysia; estates, land development schemes and small-holdings, 1972**

| | Estates | | Land development Schemes | | Small-holdings | |
|---|---|---|---|---|---|---|
| | (ha) | (%) | (ha) | (%) | (ha) | (%) |
| *Peninsular Malaysia* | | | | | | |
| Johor | 150,438 | 23·4 | 185,647 | 26·4 | 100,211 | 15·4 |
| Kedah and Perlis | 78,743 | 12·2 | 54,555 | 7·8 | 42,381 | 6·5 |
| Kelantan | 16,411 | 2·6 | 37,350 | 5·3 | 30,895 | 4·7 |
| Melaka | 38,636 | 6·0 | 48,597 | 6·9 | 15,844 | 2·4 |
| Negeri Sembilan | 96,202 | 15·0 | 95,735 | 13·6 | 44,362 | 6·8 |
| Pahang | 47,539 | 7·4 | 83,249 | 11·9 | 50,303 | 7·7 |
| P. Pinang and S. Prai | 9,272 | 1·4 | 10,468 | 1·5 | 7,130 | 1·1 |
| Perak | 80,117 | 12·5 | 101,296 | 14·4 | 62,978 | 9·7 |
| Selangor | 85,258 | 13·3 | 47,763 | 6·8 | 22,181 | 3·4 |
| Terengganu | 8,069 | 1·3 | 31,432 | 4·5 | 19,805 | 3·0 |
| *East Malaysia* | | | | | | |
| Sabah | 28,107* | 4·4 | — | — | 71,321 | 10·9 |
| Sarawak | 2,997 | 0·5 | 5,792 | 0·8 | 184,275 | 28·3 |
| | 641,789 | 100·0 | 701,884 | 99·9 | 651,686 | 99·9 |

* Includes a small area owned by Co-operative Land Development Societies and land settlement schemes.

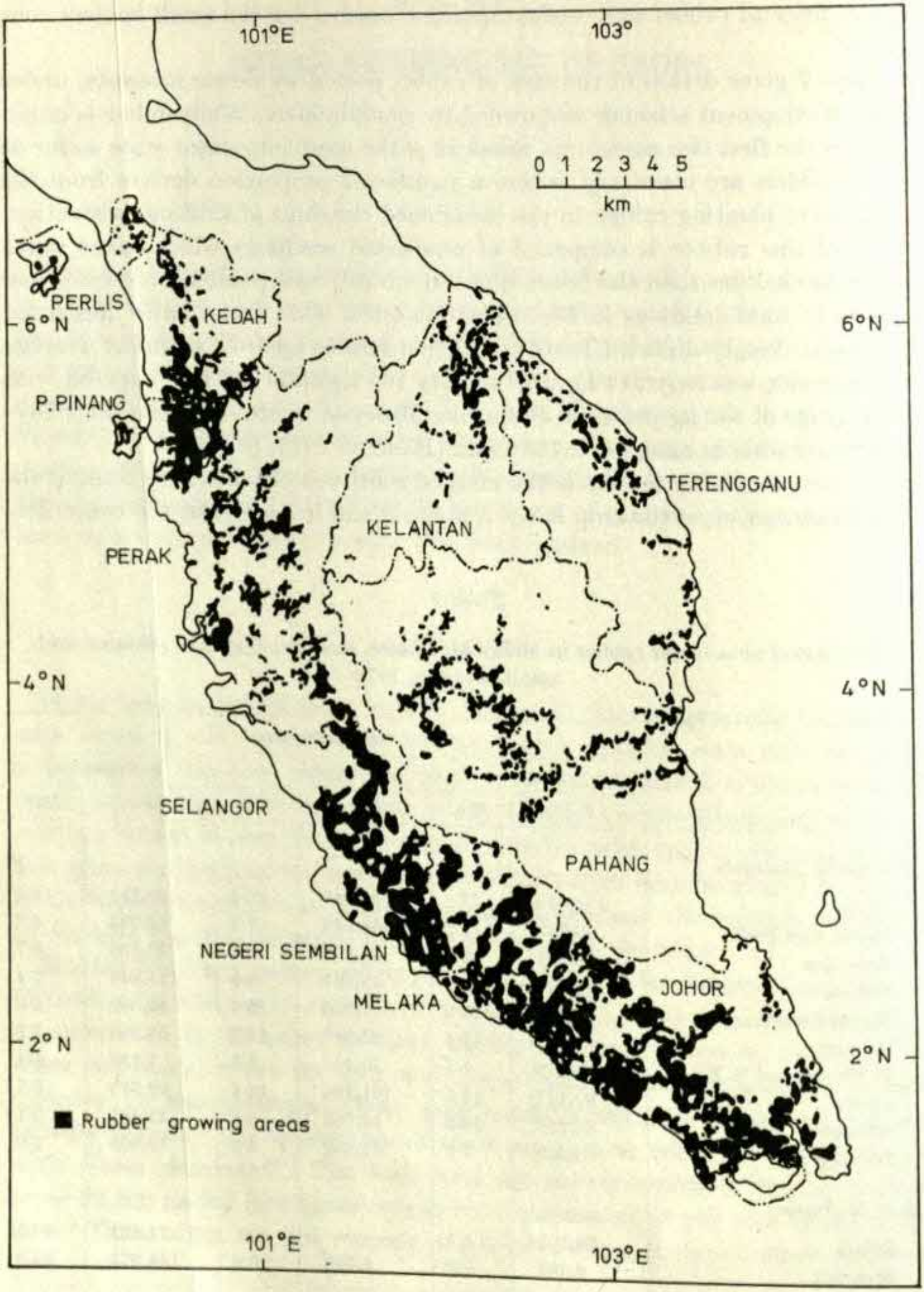


*Fig. 10.* **Rubber areas of Peninsular Malaysia (after WONG 1971)**

tion in southern Kedah and Sebarang Prai (Province Wellesley) in central and southern Selangor, Negeri Sembilan and Melaka and western Johor, all linked by the former Federated Malay States Railway[9] with British *points d'appuy* on the Straits of Melaka *(Fig. 10)*. The existence of a basic transportation infrastructure, together with the availability of virtually empty and environmentally suitable land and the ease with which this could be obtained by both estates and small-holder interests, together with the development of a network of marketing and financial services help to explain this pattern. The development of the rubber industry in the eastern sections of the Peninsula from Kelantan to Johor was hindered by a general lack of adequate transportation infrastructure during the colonial period. The pattern of development in Pahang clearly follows the main river basins where initial development was founded upon riverine transport supplemented by roads. Most of eastern Johor, except the centre, was entirely roadless until the 1960s and the few river ports were available only to small craft. In Kelantan and Terengganu, especially in the latter, the Malay rulers discouraged estate enterprise during the colonial period and it is only in the last two decades that land development schemes have begun to redress the balance. Within each state there is also a general pattern of concentration in the foothill districts although in Johor, the coastal Muar and Batu Pahat districts contain 24 and 17 per cent of the state total, respectively. This pattern is illustrated by the belt of districts stretching across the Peninsula from Kuala Selangor in the west to Kuantan in east. The proportion of the state total in each district is as follows:

| | |
|---|---|
| Kuala Selangor | — 12·5 per cent of Selangor total; |
| Ulu Selangor | — 23·3 per cent of Pahang total; |
| Temerloh | — 31·0 per cent of Pahang total; |
| Kuantan | — 7·8 per cent of Pahang total. |

In Sarawak, for which land use maps are not available, rubber is grown mainly in the Third Division (41 per cent of the state total) and the First Division (22 per cent). Most of the rubber is low-yielding, except in the Fourth Division (Sarawak, Dept. of Agriculture, 1970, p. 17). A similar areal concentration occurs in Sabah where 45 per cent of the rubber is grown in the coastal foothills of the Crocker Range of the West Coast Residency. A further 34 per cent is grown in the Interior Residency (Sabah, Dept. of Agriculture, 1968, p. 5).

[9] Johor and Kedah were never part of that political unit while Malacca (with Penang and Singapore) was part of the British Colony of the Straits Settlements.

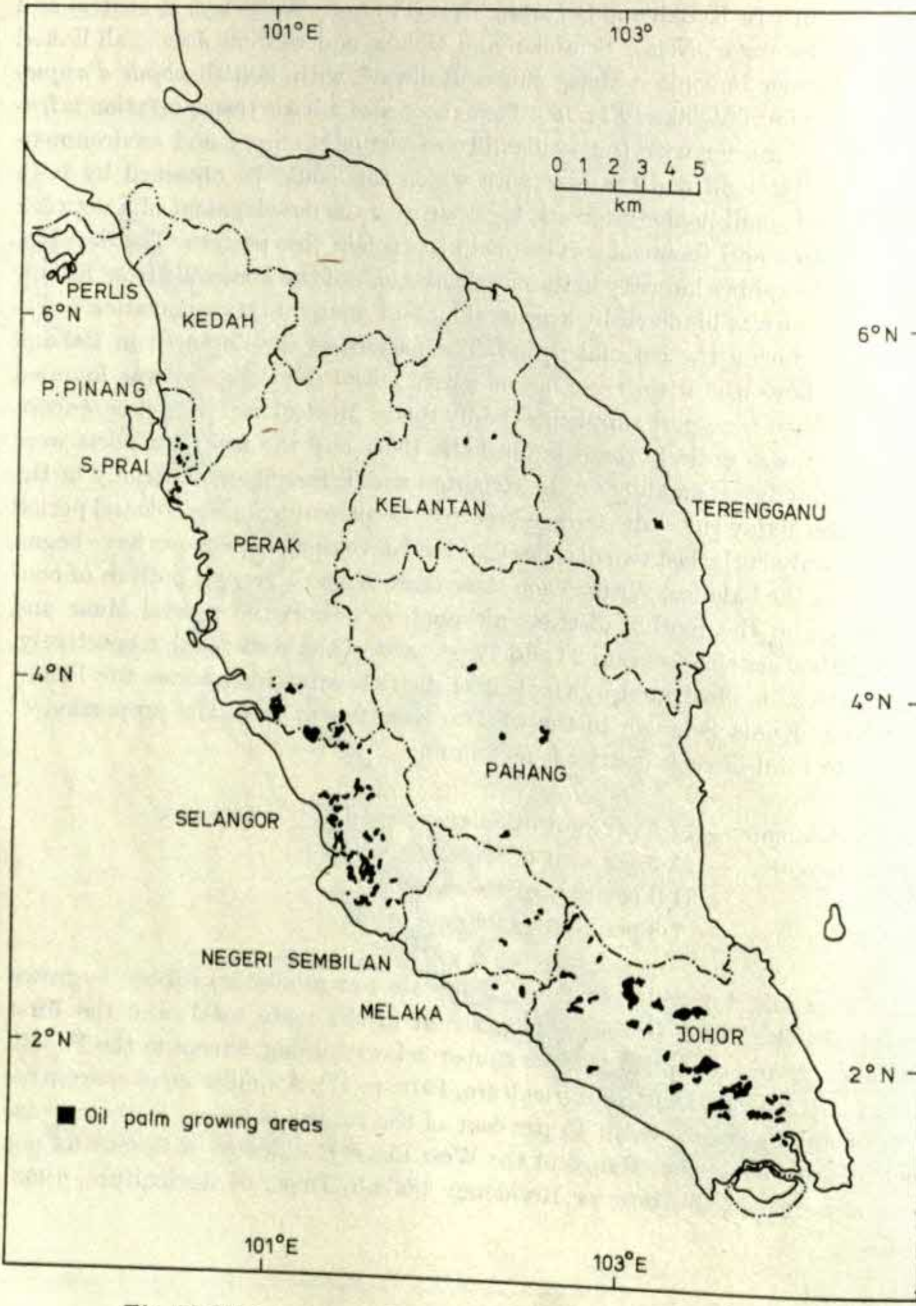


*Fig. 11.* **Oil palm areas of Peninsular Malaysia (after WONG 1971)**

Such has been the recent growth of the oil palm area that *Figure 11*, though based on the latest available data, is definitely outdated. Nevertheless, it does indicate a broad pattern of concentration in the inland areas of Johor, Pahang and the Perak/Selangor border area. In Selangor, where lowland areas of alluvial and muck soils were still available in the 1950s, the distribution is more coastal. Generally, land has been developed for oil palm from virgin or secondary forest mainly in the inland areas, especially central Johor (and increasingly, eastern Johor) and central Pahang where major land development schemes based upon oil palm are being developed most notably in the Jengka and the Johor Tenggara project areas *(Table 8)*.

The 1966 land use survey showed a strong concentration of oil palm in Johor which contained 41 per cent of the Peninsular total at that time, but since then this proportion has fallen (by 1978 to 28 per cent). Obviously, other states have increased their proportion, most notably Pahang, rising to 27 per cent from 5 per cent in 1966, while the proportion in Selangor fell sharply from 32 per cent in 1961 to 19 per cent by 1978.

*Table 8*

Estimated area under mature oil palm; estates and national land development schemes in Malaysia, 1978 (ha)

| | Estates | Schemes | Total | Per cent |
|---|---|---|---|---|
| *Peninsular Malaysia* | | | | |
| Johor | 129,685 | 50,049 | 179,734 | 27·8 |
| Kedah and Perlis | 5,343 | — | 5,343 | 0·8 |
| Kelantan | 5,236 | 4,730 | 9,966 | 1·5 |
| Melaka | 4,914 | 605 | 5,519 | 0·9 |
| Negeri Sembilan | 20,076 | 8,451 | 28,529 | 4·4 |
| Pahang | 44,583 | 100,446 | 173,556 | 26·9 |
| P. Pinang and S. Prai | 2,556 | — | 2,556 | 0·4 |
| Perak | 49,284 | 12,359 | 61,643 | 9·6 |
| Selangor | 65,953 | 5,494 | 71,447 | 11·1 |
| Terengganu | 20,781 | 19,269 | 40,050 | 6·2 |
| *East Malaysia* | | | | |
| Sabah (1975) | 26,697 | 23,983 | 50,680 | 7·8 |
| Sarawak | 4,135 | 12,263 | 16,398 | 2·5 |
| | | | 645,421 | 99·9 |

Details of the district-by-district pattern are not readily available for later years, but it may be surmised that the high degree of concentration in particular districts observed then has continued (I. F. T. Wong 1971, pp. 36–37), though this is probably less marked than formerly. Then, Temerloh district accounted for 86 per cent of the Pahang state, reflecting an important thrust in land development then just beginning in the Jengka area. A major factor in accounting for strong localization of oil palm is the fact that it is still largely an estate crop (56 per cent of total area), though this is being challenged by land development schemes. However, the latter are mainly operated on estate lines, even though the settlers will ultimately receive title to their small-holdings. More significant is the fact that in Malaysia (unlike West Africa) the lower threshold area large enough to feed a processing plant is considered to be just over 2000 ha.

Statistics concerning the local pattern of distribution of all oil palm areas in East Malaysia are not available, but in Sabah, the 92 per cent of the oil palm is to be found on areas developed mainly from forest in the East Coast residencies of Tawau and Sandakan. Like the Federal Land Development Authority (FeLDA) in Peninsular Malaysia, the Sabah Land Development Authority has been particularly active both in planting oil palm and in providing processing and storage facilities. Formerly, much of the planted area in Sabah was immature, and this is reflected by the fact the average yields in 1972 were only 0·92 tons per hectare, compared with a Peninsular-wide average of 1·77 tons per ha, but by 1977 the average yield of 2·08 tons per hectare was exactly the same as that of the Peninsula.

## COCONUTS

The versatility of the coconut has led to its being grown in and around all settled areas including the suburban areas of large cities. This fact means that estimates of the area under coconuts are invariably low, since only blocks of some size can be readily delineated. The 1966 land use survey, based upon aerial photographs, ignored blocks of less than 0·8 ha, for example. *Figure 12* shows the major areas.

The flesh of the nut may be eaten raw or cooked but the milk expressed from the grated flesh and employed in the preparation of curries of various descriptions is the commonest domestic use. The residue is fed to livestock. Commercially, the flesh is dried, usually by the sun, to form copra, from which coconut oil is extracted by heat and pressure, the residue also being used for the feeding of livestock. The trunk can be used for rough construction purposes, while the ribs of the fronds may be used for brooms or skewers. The actual fronds, however, are not generally used for the making of thatch, since they contain natural


*Fig. 12.* Coconut areas of Peninsular Malaysia (after Wong 1971)

sugars and do not resist insect attack. The inflorescence may also be tapped for toddy which rapidly ferments into palm wine, a popular drink amongst the Tamil population, while fresh toddy may be quickly sterilized and boiled down to make palm sugar *(gula melaka)*.

As explained earlier, the area under coconuts in the Peninsula has risen very slowly. In 1966 the total planted area was around 202,000, but by 1978, it had reached only 245,000 ha, a rise of 21 per cent. In Sabah and Sarawak, on the other hand, planting has expanded significantly — in Sabah from 42,500 ha in 1966 to 52,000 ha in 1975 — an increase of 24 per cent, and in Sarawak from 32,800 ha to 54,100 ha in 1976, a growth by 65 per cent *(Table 9)*. However, significant areas may not be in production. For instance, in 1978 16 per cent of the estate coconut was not producing, and estates generally are declining. In the Peninsula and Sabah their area had fallen from 31,660 ha in 1972 to only 19,360 by the late 1970s.

Like rubber, coconuts do not suffer seriously from being temporarily abandoned and when copra prices fall, small-holders especially may reduce the collection of nuts and allow scrub to regenerate, reversing the process when prices rise. In some cases, the coconut plot may act as a form of "insurance", should

*Table 9*

Estimated area under coconut in Malaysia; estates and small-holdings, late 1970s (ha)

| | Estates | Small-holdings | Total |
|---|---|---|---|
| *Peninsular Malaysia (1977)* | | | |
| Johor | — | 66,835 | 66,835 |
| Kedah and Perlis | — | 12,916 | 12,916 |
| Kelantan | — | 18,465 | 18,465 |
| Melaka | — | 5,301 | 5,301 |
| Negeri Sembilan | — | 3,019 | 3,019 |
| Pahang | — | 6,691 | 6,691 |
| P. Pinang and S. Prai | 473 | 15,025 | 15,498 |
| Perak | 11,503 | 41,134 | 52,637 |
| Selangor | 3,702 | 45,447 | 49,149 |
| Terengganu | — | 11,484 | 11,484 |
| *East Malaysia* | | | |
| Sabah (1975) | 3,681 | 48,917 | 52,598 |
| Sarawak (1976) | 54,113 | | 54,113 |
| | 73472 | 275234 | 347,706 |

more remunerative employment cease to be available, when the small-holder can return to work his plot. This pattern is illustrated in Sabah where production varies markedly from year to year.

Much of the coconut is grown in mixed stands, mainly by small-holders, the more commonly associated crops being coffee, especially in Selangor, pineapples, mainly in Sebarang Prai (Province Wellesley) and, increasingly, cocoa, in Sabah and southern coastal Selangor. WONG's land use analysis of the 1966 aerial photographs of the Peninsula showed that only 3·7 per cent of a total area of 175,900 ha mapped as being under coconut was inter-cropped, although the bulk of the land designated as "mixed horticulture", a further 30,400 ha, included coconut as an important component (I. F. T. WONG 1971, p. 37 and 42). In Singapore, coconut occupies some 23,000 ha, most of which is either undercropped or has been abandoned so far as commercial production is concerned (HILL 1977, p. 28).

*Figure 11* shows the strongly coastal location of coconut cultivation in Perak, Selangor and Johor, where coastal sands and clays have been extensively planted mainly by small-holders, except in Lower Perak and northern Selangor, where estate interests are of some importance. Most estates are established upon coastal clay soils rather than sands. This coastal concentration is not to be explained by any preference of the plant for coastal areas, though it can withstand saline conditions for short periods, but by the fact that it is one of the few crops which will produce anything on the very free-draining coastal sands (cashew, *Anacardium occidentale*, is another). On such soils, establishment to the point at which fruiting begins may take up to 8 years or even more, compared with the usual 4 years for dwarf breeds and 5 years for the tall varieties. In Sabah, for example, which ranks second to Johor in the Federation, palms are grown far inland on sedentary soils rather than on recent marine alluvia as is usually the case in the Peninsula.

## RICE (PADI)

In Peninsular Malaysia, the most striking feature of the areal distribution of wet rice lands is the concentration on the alluvial lowlands of the northern states. Kedah and Perlis, in the northwest, occupy what is essentially a single plain extending from the foot of the hills along the crest of which lies the Thai border in the north, to the foot of Gunung Jerai in the south *(Fig. 13)*. This great rice plain is separated from the sea by a belt of mangrove which is slowly being colonized by rice-growers. In the east of the Peninsula, the cultivation of wet rice forms a rather less compact block on the Kelantan plain which has a rather steeper gradient than the Kedah–Perlis plain and is interrupted by hills, unreclaimed swamps, terrace lands lying too high for irrigation and, near

*Table 10*

**Estimated rice areas and yields**

| | Wet rice – Main season | | | | | Wet rice – | |
|---|---|---|---|---|---|---|---|
| | Area (ha) | Proportion (%) | Yield (t/ha) | Production (tons) | Proportion (%) | Area (ha) | Proportion (%) |
| ***Peninsular Malaysia*** | *345,260* | *77·8* | *2·62* | *904,466* | *81·7* | *212,500* | *99·2* |
| Johor | 2,090 | 0·5 | 1·98 | 4,143 | 0·4 | 1,670 | 0·8 |
| Kedah | 118,110 | 26·6 | 3·10 | 366,654 | 33·1 | 89,900 | 41·9 |
| Kelantan | 62,440 | 14·1 | 1·89 | 118,267 | 10·7 | 27,460 | 12·8 |
| Melaka | 9,720 | 2·2 | 1·96 | 19,073 | 1·7 | 1,420 | 0·7 |
| Negeri Sembilan | 7,680 | 1·7 | 2·36 | 18,118 | 1·6 | 2,320 | 1·1 |
| Pahang | 15,880 | 3·6 | 1·88 | 29,870 | 2·7 | 1,820 | 0·8 |
| P. Pinang and S. Prai | 13,700 | 3·1 | 2·91 | 39,797 | 3·6 | 13,220 | 6·2 |
| Perak | 42,290 | 9·5 | 2·67 | 112,733 | 10·2 | 38,090 | 17·8 |
| Perlis | 26,580 | 6·0 | 3·17 | 84,183 | 7·6 | 12,560 | 5·9 |
| Selangor | 20,140 | 4·5 | 3·34 | 67,198 | 6·1 | 20,120 | 9·4 |
| Terengganu | 26,630 | 6·0 | 1·67 | 44,430 | 4·0 | 3,920 | 1·8 |
| ***Sabah*** **(Residencies)** | *31,298* | *7·0* | *2·40* | *75,245* | *6·8* | *2,056* | *1·0* |
| West Coast and Labuan | 23,149 | 5·2 | 2·12 | 49,097 | 4·4 | n.a. | — |
| Interior | 7,722 | 1·7 | 3·24 | 25,050 | 2·3 | n.a. | — |
| Sandakan and Tawau | 427 | 0·1 | 2·57 | 1,098 | 0·1 | — | — |
| ***Sarawak*** **(Divisions)** | *67,788* | *15·3* | *1·88* | *127,370* | *11·4* | — | — |
| First | 11,604 | 2·6 | 1·69 | 19,660 | 1·8 | — | — |
| Second | 22,314 | 5·0 | 1·96 | 43,641 | 3·9 | — | — |
| Third* | 19,499 | 4·4 | 1·79 | 34,840 | 3·1 | — | — |
| Fourth | 10,032 | 2·3 | 2·23 | 22,378 | 2·0 | — | — |
| Fifth | 4,339 | 1·0 | 1·58 | 6,851 | 0·6 | — | — |
| ***Malaysia*** **(Total)** | 444,346 | 100·1 | 2·49 | 1,107,081 | 99·9 | 214,556 | 100·2 |

*Note:* Compiled from official sources.

the coast, by sand ridges which, while offering dry sites for settlement, are not suited by topography or soil for rice. These three states account for almost 47 per cent of the total wet rice area and 61 per cent of the off-season area *(Table 10)*. Corresponding figures for production are 51 per cent and 67 per cent, respectively, indicating that not only is there a fairly high proportion of double-cropping in these states, but also that average yields tend to be slightly higher than in the other states.

in Malaysia, 1976/1977

| Off-season | | | Proportion of wet rice area double-cropped (%) | Dry rice | | | | |
|---|---|---|---|---|---|---|---|---|
| Yield (t/ha) | Production tons | Proportion (%) | | Area (ha) | Proportion (%) | Yield (t/ha) | Production tons | Proportion (%) |
| *3·37* | *715,643* | *99·2* | *62* | *9,480* | *10·4* | *1·01* | *9,573* | *14·2* |
| 2·12 | 3,538 | 0·5 | 80 | — | — | — | — | — |
| 3·95 | 354,617 | 49·2 | 76 | 1,210 | 1·3 | 1·16 | 1,407 | 2·1 |
| 2·74 | 75,268 | 10·4 | 44 | 1,950 | 2·1 | 1·38 | 2,692 | 4·0 |
| 2·19 | 3,112 | 0·4 | 15 | — | — | — | — | — |
| 2·97 | 6,899 | 1·0 | 30 | — | — | — | — | — |
| 1·40 | 2,543 | 0·4 | 11 | 360 | 0·4 | 1·23 | 442 | 0·7 |
| 2·80 | 37,071 | 5·1 | 96 | — | — | — | — | — |
| 2·98 | 113,459 | 15·7 | 90 | 510 | 0·6 | 1·37 | 696 | 1·0 |
| 4·02 | 50,472 | 7·0 | 47 | 120 | 0·1 | 1·59 | 191 | 0·3 |
| 2·83 | 56,911 | 7·9 | 100 | — | — | — | — | — |
| 3·00 | 11,753 | 1·6 | 15 | 5,350 | 5·9 | 0·78 | 4,145 | 6·1 |
| *2·58* | *5,306* | *0·7* | *6·6* | *17,904* | *19·7* | *0·74* | *13,180* | *19·5* |
| n.a. | 5,053 | 0·7 | n.a. | 10,534 | 11·6 | 0·73 | 7,734 | 11·4 |
| n.a. | 252 | — | n.a. | 3,649 | 4·0 | 0·77 | 2,820 | 4·2 |
| — | — | — | n.a. | 3,721 | 4·1 | 0·71 | 2,626 | 3·9 |
| — | — | — | — | *63,550* | *69·9* | *0·71* | *44,820* | *66·3* |
| — | — | — | — | 5,000 | 5·5 | 0·70 | 3,520 | 5·2 |
| — | — | — | — | 11,157 | 12·3 | 0·53 | 5,872 | 8·7 |
| — | — | — | — | 30,157 | 33·2 | 0·60 | 18,121 | 26·8 |
| — | — | — | — | 14,322 | 15·7 | 0·92 | 13,231 | 19·6 |
| — | — | — | — | 2,914 | 3·2 | 1·40 | 4,076 | 6·0 |
| 3·36 | 720,949 | 99·9 | | 90,934 | 100·0 | | 67,573 | 100·0 |

* Including newly created Sixth and Seventh Divisions.

While no state, or in East Malaysia, no major subdivision entirely lacks wet rice, areas are notably small in Johor state and the eastern residencies of Sandakan and Tawau in Sabah, as well as in the Fifth Division of Sarawak, where perennial tree-crops are of much greater importance. In the Tawau Residency, wet rice scarcely exists, there being only 40 ha in 1977.

A question of some significance is whether yields are higher (or lower) in areas where there is a great deal of rice land. Analysis of data for the early

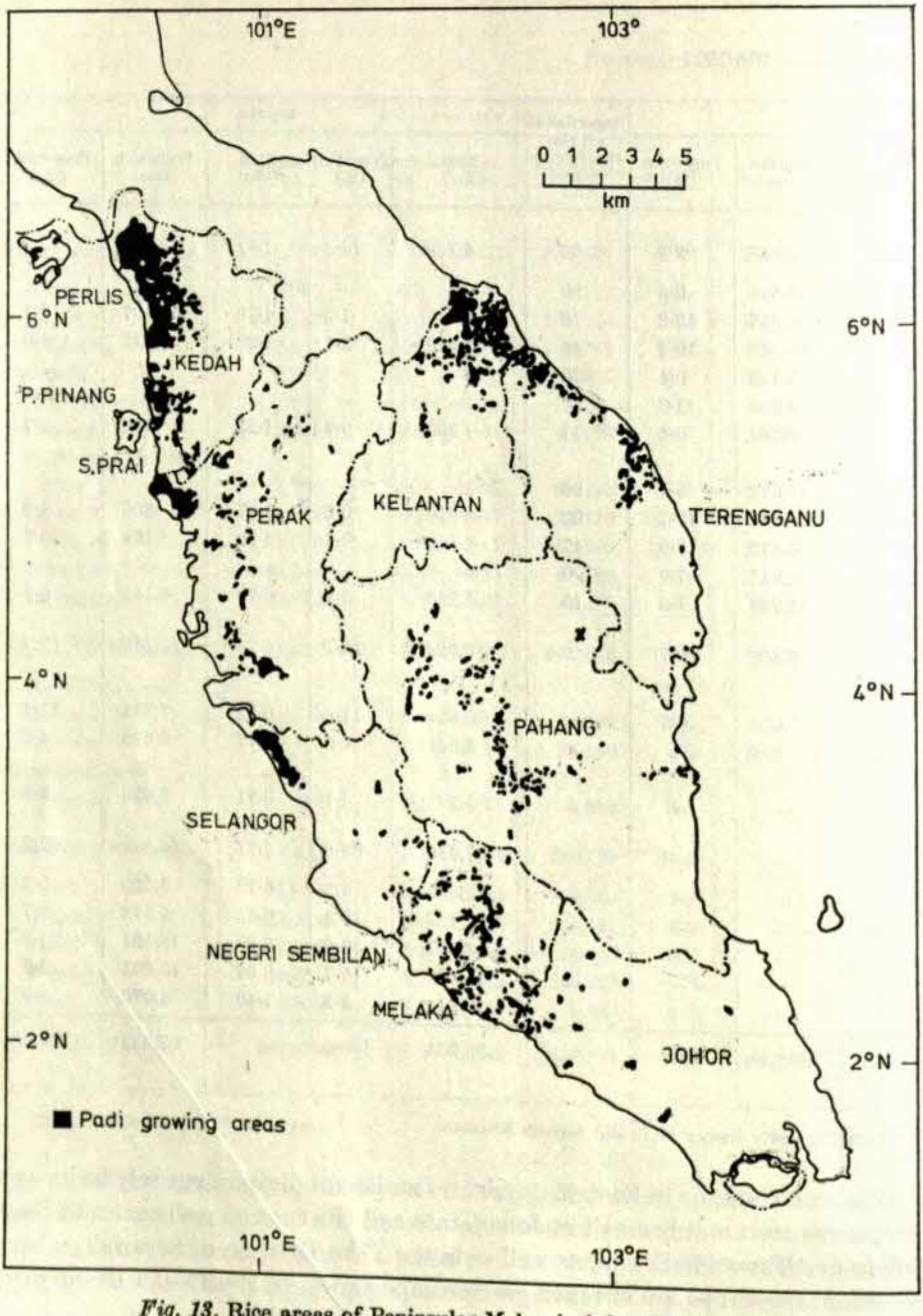


*Fig. 13.* **Rice areas of Peninsular Malaysia (after WONG 1971)**

1970s at the state or major subdivision level shows that for the main season crop, there is no statistical correlation between area planted and average yield ($r = 0{\cdot}076$), but for the off-season a fair correlation exists ($r = 0{\cdot}512$), meaning that regions with a good deal of land planted in the dry season generally obtain better yields than those where the planted area is small. A possible reason for this is that where areas are small, birds and rats especially cause damage disproportionate to their numbers, even though small areas may represent the efforts of the better (or better-supervised) farmers. At the same time, there is no statistical association between the sizes of the areas planted in the main season and in the dry season. Kedah with a large area planted (27 per cent of the national total) has almost two-thirds double-cropped, while in Selangor (4·5 per cent of the total) Negeri Sembilan, Pulau Pinang and Sebarang Prai, also on the west coast of the Peninsula, equally have notably high proportions double-cropped. However, Kelantan, Terengganu and Pahang on the east coast have notably low proportions. The reasons for this undoubtedly relate to the pattern of government investment in irrigation facilities, these being essential to the successful raising of two rice crops a year. In Sabah, double-cropping has scarcely begun, and recent reports suggest that pest problems are sufficiently difficult to seriously hinder or even reverse the spread of double-cropping, which has yet to reach the neighbouring Sarawak.

The yields from the off-season crop tend to be higher than those from the main crop. In 1976/77 the national average for the off-season crop was 3·4 t/ha compared with 2·5 t/ha for the main crop. It has sometimes been held that off-season yields are greater because the better farmers double-crop and because inputs of fertilizers and insecticides are higher and there is greater use of high-yielding varieties not to mention use of the best land; but important as these factors may be, they do not necessarily explain why off-season yields in those states in which virtually all the land is double-cropped are often higher than the yields of the main season. One likely factor, however, is the greater amount of sunshine during the dry season.

The areal pattern of dry rice is totally unlike that of wet rice. In the Peninsula dry rice is unimportant both as to area and production, though there, as in East Malaysia, the category "dry rice" includes both rice grown in dry fields on hill slopes *(padi huma)*, and that grown in dry fields on flat or gently rolling land — *padi tenggala* in Pahang, *padi taboran* and *padi tugalan* in Kelantan and Terengganu, and *padi kendinga* in Sabah. Sarawak accounts for 78 per cent of all dry rice and this is particularly concentrated in the inland areas of the Third Division. This high proportion accounts for Sarawak ranking with Kedah in terms of total area under rice, although overall production is very much lower. The average dry rice yield in Sarawak is only 0·71 t/ha compared with the lowest main season wet rice yields. Much of the dry padi is grown on hill slopes under shifting cultivation, for every hectare under crop at any time, perhaps 8 to 15 hectares are under scrub or regenerating forest fallow — a fact which explains why 2·3 million hectares are stated as being under wet and dry rice in one major source (Sarawak, Dept. of Agriculture, 1970, p. 1).

Over the last decade or so, the pattern of rice production has been steadily changing away from the less intensive forms which have decreased both relatively and absolutely *(Table 11)*. In the Peninsula, for example, dry rice fell

*Table 11*

Estimated area and production of rice in Malaysia (selected years, 1964/65 to 1976/77)

| | 1964/65 | 1967/68 | 1970/71 | 1976/77 |
|---|---|---|---|---|
| *Peninsular Malaysia* | | | | |
| Wet rice — planted area (ha) | 399,549 | 458,156 | 532,818 | 557,760 |
| — production (tons) | 1,015,157 | 1,174,975 | 1,496,427 | 1,620,109 |
| — yield (t/ha) | 2·54 | 2·56 | 2·81 | 2·90 |
| Dry rice — planted area (ha) | 21,643 | 20,756 | 20,052 | 9,480 |
| — production (tons) | 26,322 | 24,270 | 24,967 | 9,573 |
| — yield (t/ha) | 1·22 | 1·17 | 1·25 | 1·01 |
| — as % of total area | 5·14 | 4·33 | 3·63 | 1·68 |
| Dry rice as % of total production | 2·53 | 2·02 | 1·64 | 0·59 |
| *Sabah* | | | | |
| Wet rice — planted area (ha) | 26,053 | 28,761 | 31,059 | 33,354 |
| — production (tons) | 73,900 | 80,427 | 95,739 | 80,551 |
| — yield (t/ha) | 2·84 | 2·80 | 3·08 | 2·42 |
| Dry rice — planted area (ha) | 11,116 | 12,016 | 10,952 | 17,904 |
| — production (tons) | 9,700 | 9,373 | 8,621 | 13,180 |
| — yield (t/ha) | 0·87 | 0·78 | 0·79 | 0·74 |
| — as % of total area | 29·91 | 29·47 | 26·07 | 34·93 |
| Dry rice as % of total production | 11·60 | 10·44 | 8·26 | 14·06 |
| *Sarawak* | | | | |
| Wet rice — planted area (ha) | 48,156 | 51,883 | 61,572 | 67,788 |
| — production (tons) | 72,027 | 67,885 | 95,581 | 127,370 |
| — yield (t/ha) | 1·50 | 1·30 | 1·55 | 1·88 |
| Dry rice — planted area (ha) | 74,158 | 84,899 | 73,267 | 63,550 |
| — production (tons) | 45,094 | 53,499 | 58,936 | 44,820 |
| — yield (t/ha) | 0·61 | 0·63 | 0·80 | 0·71 |
| — as % of total area | 60·4 | 62·07 | 54·34 | 48·39 |
| Dry rice as % of total production | 38·50 | 44·07 | 38·14 | 26·03 |

*Note:* Compiled from official sources.

* Figures for wet rice include double-cropped area.

from around 5 per cent of the area (2·5 per cent of production) in 1964/1965 to 1·7 per cent in 1976/77 (0·6 per cent of production). In Sarawak a similar fall occurred, though from a much larger areal and production base. Simultaneously wet rice area rose sharply, by 40 per cent in the Peninsula, 28 per cent in Sabah and 41 per cent in Sarawak. Production rose by 60, 9 and 41 per cent for the same areas, respectively. However, in terms of land use, it is only the rice area (some of which is planted twice yearly) which is of greatest interest, so that the statistical trend of the main-season data is a truer reflection of the actual rice area. On this basis, the evidence suggests that in the Peninsula, at least, the area of rice land is falling. Between 1967/1968 and 1976/1977, for example, the area under rice fell from 367,169 ha to 345,260 ha – a decline of 6 per cent. In the latter year, by contrast, the "planted area" was 557, 760 ha, indicating that 62 per cent of the wet rice land in the Peninsula was double-cropped.

The average yield of wet rice (in both seasons) rose substantially over the period 1964/1965 to 1976/1977; by nearly 14 per cent in the Peninsula, 25 per cent in Sarawak; it fell slightly in Sabah. In Sarawak, the gains were proportionately larger because the base was lower, only 1·5 t/ha, and advance through the usual tried of improved water control, seeds and fertilizer was relatively easier. The other process responsible for rising yields has been the intensification by double-cropping, especially in the Peninsula where the double-cropped area rose from 90,987 ha in 1968 to 212,500 ha in 1977, an increase of 134 per cent. Perhaps the most spectacular change was in Kedah and Perlis where the double-cropped area rose from 14,228 ha in 1968 to 102,460 ha in 1972 – an increase of more than six times.

## OTHER CROPS

Though production and area are dominated by the "big four" – rubber, oil palm, coconut and rice –, a great variety of other crops are cultivated which may be of local importance, often supplying the country with a substantial proportion of its requirements. These include pineapples, tea, coffee, cocoa, basic starch crops such as manioc and sago, spices such as pepper, nutmegs, cloves, chilli, areca and tobacco, some of which are produced in quantities sufficient for export, as is the case with pineapples (in cans) and pepper. Most of these crops may be grown in the same plot so that the figures given in *Table 12* are for the equivalent "sole crop" area. Comparable data for East Malaysia are unobtainable, but available figures are given in *Table 13*.

*Pineapples* thrive under a wide range of soil conditions, but since they are one of the very few crops capable of thriving on freshwater peats, where cultivation can be permanent, commercial production has tended to be confined to

*Table 12*

Estimated area under minor crops in Peninsular Malaysia, 1978

| Beverages | Area (ha) | Fruits | Area (ha) |
|---|---|---|---|
| Tea, highland & lowland *(Camellia sinensis)* | 3,192 | Pineapple *(Ananas comosus)* | 19,527 |
| Coffee *(Coffea spp.)* | 9,067 | Banana *(Musa spp.)* | 16,605 |
| Cocoa *(Theobroma cacao)* | 26,409 | Durian *(Durio zibethinus)* | 13,507 |
| *Starch foods* | | Rambutan *(Nephelium lappaceum)* | 13,266 |
| Sago *(Metroxylon sagu)* | 2,230 | Mangosteen *(Garcinia mangostana)* | 3,401 |
| Manioc *(Manihot esculenta)* | 17,815 | Citrus *(Citrus spp.)* | 2,188 |
| Sweet potatoes *(Ipomoea batatas)* | 2,782 | Duku & langsat *(Lansium domesticum)* | 2,262 |
| Taro *(Colocasia spp.)* | 194 | Cashew *(Anacardium occidentale)* | 5,425 |
| Yam *(Dioscorea spp.)* | 662 | Melons *(Cucumis spp.)* | 2,170 |
| Maize *(Zea mays)* | 4,053 | Mango *(Mangifera indica)* | 1,434 |
| *Sugars* | | Rambai *(Baccaurea spp.)* | 336 |
| Cone *(Saccharum officinale)* | 27,782 | Cempedak *(Artocarpus champeden)* | 1,952 |
| Palm *(Arenga pinnata)* | 34 | Other fruits | 3,229 |
| *Oil seeds and pulses* | | *Spices and stimulants* | |
| Groundnut *(Arachis hypogaea)* | 5,408 | Areca *(Areca catechu)* | 1,629 |
| Soya *(Clycine max)* | 53 | Betel *(Piper betel)* | 227 |
| Pulses | 107 | Chilli *(Capsicum spp.)* | 846 |
| | | Ginger *(Zingiber officinale)* | 555 |
| | | Pepper *(Piper nigrum)* | 943 |
| | | Tumeric *(Curcuma domestica)* | 102 |
| | | Nutmeg *(Myristica fragrans)* | 376 |
| | | Cloves *(Eugenia caryophyllus)* | 520 |
| | | Tobacco *(Nicotiana tabacum)* | 11,118 |
| | | *Others* | |
| | | Vegetables | 9,595 |
| | | Nipah *(Nipa frutescens)* | 4,005 |
| | | Gambier *(Uncaria gambir)* | 51 |
| | | Kapok *(Ceiba pentandra)* | 116 |

*Source:* Malaysia, Ministry of Agriculture and Rural Development, 1978, p. 10.

*Table 13*

Miscellaneous agricultural statistics for East Malaysia

| Area | Crop | Year | |
|---|---|---|---|
| *Sabah* | | | |
| | Cocoa | 1976 | 11,753 ha |
| | Coffee | 1971 | 1,255 ha |
| | Manioc | 1971 | 9,724 ha |
| | Maize | 1971 | 4,605 ha |
| | Vegetables | 1971 | 905 ha |
| | Pepper | 1971 | 130 tons exported |
| *Sarawak* | | | |
| | Pepper | 1979 | 36,123 tons exported |
| | Sago | 1979 | 27,418 tons exported |

*Note:* Compiled from various sources.

these areas, most notably in western Johor. However, the canning industry (and often labour as well) is largely in the hands of Chinese entrepreneurs who early worked from canneries in Singapore as well as nearby Johor, and though Malaysian government interests have now entered the industry it remains largely based in Johor and in Selangor where fruit is grown for canning. These two states account for 90 per cent of the total Peninsular area, Johor alone contributing 86 per cent to this. Elsewhere, production for the fresh fruit market predominates and this accounts for about 15 per cent of the total area. Production for canning purposes is on both small-holder and plantation lines.

*Coffee* is grown mainly as a small-holder crop in the coastal districts of southern Selangor and in parts of the Interior and West Coast Residencies of Sabah. *Robusta* coffee is the usual variety on the inland hill soils while in coastal areas the *liberica* varieties perform quite well on organic clays and mucks (Histosols) where these have been properly drained. Although monoculture is practised, coffee is often grown in the light shade of coconuts.

*Tea*, like coffee, is grown in two distinct habitats, though unlike coffee, production is entirely under estate management. Peninsular Malaysia produces virtually all the country's tea, either in the Cameron Highlands area of Pahang (87 per cent) or on the lowlands of Selangor and Perak. In the former area the crop is grown on very steep granitic soils at elevations of between 1,000 and 1,300 m, whilst lowland teas are grown on a wide range of soils derived from sedimentary rocks and on soils formed on marine clays.

*Cocoa* areas have been expanding rapidly over the last decade under the stimulus of rising prices for beans. In the Peninsula, the initial plantings were sponsored by government on the well-suited Jerangau soil in southern Terengganu. In 1966 these totalled only 450 ha and the state contained over 95 per cent of the plantings in the Peninsula. Plantings now, however, are more widespread, especially in Sabah which in 1971 had 4,520 ha under the crop, and by 1978/79 had reached 47,325 ha in the country as a whole. Cocoa is grown both on estates, as on the Bal Estate, Tawau district, on land-development schemes and on small-holdings. By nature a shade-loving plant, *Theobroma cacao* is invariably grown under deliberately planted shade trees where it is not grown under other tree-crops, especially coconut.

*Starch crops* are grown both as food and for commercial starch production. Taro, sweet potatoes and yams are cultivated on mixed crop small-holdings solely for food, but sago and manioc are grown for both purposes.

In the Peninsula, Johor is the main producing state where sago is grown mainly for local consumption, whereas in Sarawak and to a very limited degree in Sabah, it enters the export trade. Sago in Sarawak is particularly associated with the Melanau peoples who live in certain of the fresh-water swamps in the Second and Third Divisions. Although sago was the state's major export in the nineteenth century, since 1953 the industry has been in a state of decline and in the 1960s it was claimed that though the sago gardens are still owned by the Melanaus, their role has been reduced by the mechanization of processing (formerly a cottage industry) to tending the palms, felling them and transporting them to the factories (JACKSON 1968, p. 108). The economic consequences of factory mechanization have been particularly serious.

Manioc is grown for processing into flour, chips and tapioca. It is also used as a raw material in the production of monosodium glutamate (MSG), a flavour-enhancing substance. In the Peninsula the main centre of production is in Perak which accounts for 53 per cent of the total area. Growing is almost wholly in the hands of Chinese small-holders. In some areas, the crop has been grown with fair success on the extremely impoverished soils that develop on the tailings of alluvial tin mining, but yields are much higher on sedentary soils. On these manioc is grown, often illegally, by a form of shifting cultivation under which the land is cleared of forest or scrub (often using heavy machinery) following which two crops are taken and the land then abandoned. Manioc also finds a place in the mixed crop assemblages of both sedentary farmers and tribal shifting cultivators.

*Maize* is of very limited importance in Malaysia, particularly when compared with the Philippines where it is, next to rice, a basic staple. Although maize finds a place in kitchen gardens, it is also grown on its own as a dry-season crop following wet rice, particularly in Pahang and Terengganu which accounted for some 40 per cent of the Peninsular total in 1971.

*Sugar-cane* is grown for domestic and local consumption in practically every part of the Malaysian region, but it is only in Perak, Perlis, Negeri Sembilan and to a lesser degree in Johor that it is of particular significance, these states accounting for virtually the whole Peninsular total. In the late nineteenth century, sugar was a major crop in southern Sebarang Prai (then Province Wellesley) and in the Krian district of northern Perak, but by 1914 the industry was moribund not being revived in the Peninsular until the late 1960s and 1970s when mills were established with government encouragement. Production is partly on plantation lines and partly by small-holders.

*Palm sugar* or jaggery, usually derived from the sap of *Arenga pinnata* and other palms by tapping and boiling, was once a major source of sugar in every village, but since the advent of refined cane sugar in the late nineteenth century, its importance has been much reduced. It is now used mainly in the making of sweets and desserts.

*Oilseeds* are much less commonly grown than might be expected in an equatorial region where there is no significant environmental hazard. The explanation lies, perhaps, in the fact that demand for vegetable oil in cooking was (and substantially still is) traditionally met from coconut. This notion is reinforced by the fact that the processing of groundnuts is very much in Chinese hands as it is growing particularly in Perak, where 10 per cent of the groundnut area is to be found. However, in Kelantan and Terengganu the first- and second-ranking states which together have 60 per cent of the Peninsular area total, respectively, production is in the hands of the Malays. They grow the crop either in rice fields after the rice harvest, or on high alluvial land having soils too light or too poorly irrigated for the satisfactory cultivation of rice.

*Fruits* are so widely cultivated and in such a profusion of varieties that no detailed comment is required. Production is almost entirely in the hands of small-holders, with the notable exception of pineapples which have been discussed earlier. On the whole, areas under the various fruits are evenly distributed amongst the various states and this is reflected in the fact that the index of specialization for the crops is mostly below 0·2. (An index of 0·1 would indicate that all production comes from one state.) This evenness of spread markedly contrasts with the pattern of most of the minor crops discussed thus far, which tend to be strongly concentrated in particular areas. Even spread is to be attributed to three main factors. First is the general preference of all small-holders to grow a variety fruits for their own use, and second is the fact that fruit trees will grow practically anywhere, except on peat soils. Finally, while some fruits keep reasonably well, e.g. citrus fruits, many do not and moreover are both difficult to transport long distances (even if marketing arrangements permitted this) and also involve much waste since a good deal of the outer covering is discarded by the consumer. As yet very little is done to preserve fruits, except by drying, e.g. of bananas, partly because of technological problems of canning and freezing and partly because of the unpredictability of consumer demand.

Fruits occupy on the average 2·3 per cent of the agricultural land of Peninsular states, though Melaka and Negeri Sembilan fall much below this (0·90 and 0·60 per cent, respectively) and Trengganu and Johor (4·20 and 3·82 per cent, respectively) are well above the average. Though supporting data are lacking, casual observation would suggest that on individual small-holdings roughly 5 to 10 per cent of the land is generally given over to fruit trees.

Although there is a fairly limited range of variation among the various states and the degree of specialization has become much less since the early 1970s. Thus, of the Peninsular states, Pahang is a major producer of bananas, containing 30 per cent of the total, but now only one-tenth. Perak and Kelantan account for some 40 per cent of the durians, but more recently the three leading Peninsular States account for little over 10 per cent each. Terengganu had two-thirds of the cashew in 1971, reflecting a generally successful local attempt to find a satisfactory crop for the very free-dairing coastal sand-ridge *(beris)* soils of that state, but this has fallen to 24 per cent of the Peninsular total by 1978, reflecting spread from the "core area".

*Spices and stimulants* mostly show a higher degree of spatial localization than fruits, although the distribution of some of the more common and widely used stimulants such as areca and betel *(sireh)* used as a masticatory, and kitchen spices such as chilli, ginger and tumeric is reasonably even, each of these having an index value below 0·15.

Pepper, nutmeg and cloves on the other hand are very strongly localized, the first in Johor (HILL 1969) which accounts for 95 per cent of the Peninsular total, and, especially in Sarawak.

In Johor, pepper-growing is largely in the hands of the Hakka Chinese, and the same is true of the industry in the Kuching and Serian areas of Sarawak. Another centre of pepper cultivation is in the Sarikei–Binatang area of Sarawak's Third Division, where Foochow and Cantonese Chinese farmers predominate. The area under pepper in Sarawak is now about 8,000 ha. As with other minor crops, this strong spatial localization is to be partly explained by historical factors, since any good-quality soil will give satisfactory yields. Chinese settlers were given land near Bau (First Division) in the 1890s, while the Sarikei–Binatang area represents an extension in the 1910s and 1930s of an original core area near Sibu first developed in the 1900s, in which rubber subsequently predominated. More recently, Iban farmers have begun to grow the crop (JACKSON 1968, pp. 98 – 104).

Nutmegs and cloves are strongly localized on Pinang Island, perhaps as survivals from the late 18th and early 19th centuries when European and later Chinese planters paid much attention to these crops. Around 95 per cent of the Peninsular area is found there. Unlike pepper, these crops are unknown in East Malaysia.

*Tobacco*-growing is also strongly localized in the Peninsula where Virginia tobaccos are grown for incorporation into machine-made cigarettes. Kelantan dominates with 84 per cent of the Peninsular area. There, tobacco has been successfully intercalated into the wet rice cycle of cultivation, but although production is by peasant farmers, a major tobacco company (a local off-shoot of the British–American Tobacco Company) provides close agronomic supervision and curing facilities. There has also been some success with Virginia tobaccos near Sibu, Sarawak.

Rough "native" tobacco is widely grown, sometimes by shifting cultivators. Only in Sabah is cigar-quality leaf grown and then only on a very small scale by small-holders as a remnant of the extensive and prosperous plantation-based industry which in the early years of this century rivalled the famed producers of Sumatra's "Oostkust".

Of the remaining crops, market-gardening is to be found near all large towns and accounts for the whole of the area under vegetables. *Nipah*, used for the manufacture of palm thatch, occurs at least as much wild as planted, though many rural villages try to set aside an area of fresh- or brackish-water swamp in which to grow the palm. The main commercial nipah areas in the Peninsula are in the swamps of Lower Perak, though there are large naturally occurring areas in Sarawak, which remain unexploited by reason of high transportation crops relative to the value of the product. This factor accounts for the even spread of the "crop". Gutta percha and gambier, however, are to be found only in one state, the former in Pahang and the latter in Terengganu.

CHAPTER 5

# TYPOLOGY OF AGRICULTURE

Most writers on the agriculture of the Malaysian region have adopted one of two basic approaches (and sometimes both) in organizing material. One approach is to employ a simple two-sector model of the economy, distinguishing between a peasant (sometimes mistakenly termed "subsistence") sector on the one hand, and a commercial (sometimes, more narrowly, plantation) sector on the other. Alternatively, the approach is a simple crop-by-crop analysis, which, although satisfactory for simple description and where there is some form of mono-cultivation, fails as an analytical framework where these conditions are not met.

Here, a rather more refined analysis is attempted, based upon an application of the International Geographical Union World Typology of Agriculture (KOSTROWICKI 1974, 1976, 1978). The range of types presented in the region is great, extending from "integral" shifting cultivation in which swiddening is a basic part of the economic, social, psychological and spiritual fabric, to plantation (estate) agriculture which represents a highly-specialized outgrowth of international capitalism. This means that any analysis based upon national or even regional aggregate data (where they are available) is meaningless. The alternative has been to define five major types, while recognizing that the peasant types, especially, grade into others. These types are follows: shifting cultivation, semi-commercial (peasant) rice cultivation, perennial-crop (peasant) small-holding agriculture and lastly intensive market-gardening and livestock-rearing.

In the remainder of this section, these types are compared, using the World Typology as an analytical framework and drawing largely upon R. D. HILL (1980) for estimates of the various classes and numerical values involved.

## MALAYSIAN TYPES AND WORLD TYPOLOGY MODELS

In this section, the five Malaysian types are compared with their nearest model equivalents after KOSTROWICKI (1978).

*Shifting cultivation* in Malaysia is denoted by the code:[10]

| *Social* | *Operational* | *Production* | *Structural* |
|---|---|---|---|
| 1 2 3 4 5 6 7 | 8 9 10 11 12 13 14 | 15 16 17 18 19 20 21 | 22 23 24 25 26 27 |
| 5111221 — | 3111111 — | 1111115 — | 115111 |

The nearest model type from the World Typology is Type Efb:

| | | | |
|---|---|---|---|
| 4221221 — | 1111121 — | 2211111 — | 215111 |

The Malaysian type diverges from the model at three points for social characteristics which are somewhat more like those of Type Efs, "shifting (forest fallow) cultivation". There are also minor divergencies in respect of operational and structural features, but the production characteristics are so markedly divergent as to require some explanation.

It is a common misconception that the productivity of the land is low in systems of shifting cultivation. Naturally, much depends upon the return period, that is, the period of time which elapses before the regenerating forest or scrub is again cleared for cultivation. Were only the land currently under cultivation to be considered, productivity is likely to be up to 40 grain equivalents per hectare[11] *(Table 14)*, roughly two-thirds to half the yield of wet rice. (This value does not include the important supplementary role of tubers.) But in forest- or bush-following systems, this is obviously an unreal figure since the return period may be anything from 6 to 30 years. Except among some Iban groups in remote areas of inland Sarawak where virgin forest is still felled, most clearings are again cultivated after 10 to 15 years of fallow, giving an annual productivity estimate of from 10 to 40 g.e./ha of dry rice depending upon season, without taking into account supplementation by tubers.

A second misconception about rice-based shifting cultivation is that labour productivity is low. Firm data are scanty, but Freeman's detailed, though now dated study shows conclusively that labour input is low, 168—205 man-days per hectare per year for the cultivation of virgin forest areas and 154—193 man-days for secondary forest. Labour productivity is fairly high if "the farm" is taken to be the currently cropped area, though not otherwise. The remarkable persistence of shifting cultivation thus has a sound economic base.

[10] The names and numerical values of the variables 1—27 are given in *Table 14*.
[11] A hundred kg of rough padi is equivalent to 0·8 grain equivalents.

*Table 14*

The characteristics of major types of agri-

| Number / Variable name | Unit for numerical value | Shifting cultivation | |
|---|---|---|---|
| | | Scale value | Numerical value |
| *Social attributes* | | | |
| 1 Proportion of agricultural land under customary tenure | Per cent | 5 | >99 |
| 2 Proportion of agricultural land under labour or share-crop tenancy | Per cent | 1 | 0 |
| 3 Proportion of agricultural land held as private property | Per cent | 1 | 1 |
| 4 Proportion of agricultural land operated as planned collectives or state farms | Per cent | 1 | 0 |
| 5 Size of holdings as number of employed persons per holding | Persons | 2 | 3–4 |
| 6 Size of holdings as total agricultural land, including fallow | Hectares | 2 | 18[2] |
| 7 Size of holdings as gross output per farm | G. E./farm | 2 | 2·8 |
| *Operational attributes* | | | |
| 8 Inputs of labour as number of people employed per 100 ha agricultural land | Persons | 3 | 17–22 |
| 9 Inputs of animal power as horse power per 100 ha of agricultural land | H.P. | 1 | 0 |
| 10 Inputs of mechanical power as horse power per 100 ha agricultural land | H. P. | 1 | 0 |
| 11 Inputs of chemical fertilizer per ha of cultivated land | kg/ha | 1 | 0 |
| 12 Irrigation, proportion of irrigated to total cultivated land | Per cent | 1 | 1 |
| 13 Intensity of cropland use, ratio of harvested to total land | Per cent | 1 | 5–10 |
| 14 Intensity of livestock breeding, number of livestock units per 100 ha | L.U. | 1 | <1 |
| *Production attributes* | | | |
| 15 Land productivity as gross output per ha | G.E./ha | 1 | 1·54 |
| 16 Productivity of cultivated land | G.E./ha | 1 | 1·54 |
| 17 Labour productivity, gross output per person employed | G.E./person | 1 | 8·25 |
| 18 Commercial labour productivity, commercial production per person employed | G.E./person | 1 | <0·20 |

[1] All the numerical values are estimates, but some are more soundly based than others.

culture (according to the world typology)[1]

| Semi-commercial (peasant) rice cultivation | | Perennial-crop (peasant) small-holding | | Plantation (estate) | | Intensive market-gardening, etc. | |
|---|---|---|---|---|---|---|---|
| Scale value | Numerical value | Scale value | Numerical value | Scale value | Numerical value | Scale value | Numerical value |
| 1 | 5 | 1 | <5 | 1 | 0 | 1 | <1 |
| 2 | 25 | 2 | 35—40 | 1 | <5 | 1 | 0 |
| 5 | 95 | 5 | 85—90 | 5 | 100 | 5 | >99 |
| 1 | 0 | 1 | 8 | 1 | <5 | 1 | 0 |
| 2 | 3·3 | 1 | 1·6 | 4 | 113 | 1 | 1·9 |
| 1 | 1·02 | 1 | 2·5 | 4 | 415 | 1 | 0·75 |
| 1 | 31 | 1 | 78 | 4 | 170 | 2 | 508 |
| 5 | 324 | 3 | 39 | 3 | 30 | 5 | 250 |
| 5 | 34 | 1 | <2 | 1 | 0 | 1 | <0·1 |
| 1 | 1 | 1 | 0 | 1 | 2 | 1 | <6? |
| 4 | 100 | 1 | 0 | 3 | 59 | 5 | >60 |
| 5 | 95 | 1 | 0 | 1 | 0 | 4 | 50—70 |
| 5 | 129 | 1 | <10 | 4 | 75 | 5 | 100—600 |
| 4 | 102 | 1 | <1 | 1 | <1 | 5 | 3,052 |
| 3 | 30 | 3 | 30 | 3 | 41 | 5 | 676 |
| 3 | 30 | 3 | 30 | 3 | 41 | 5 | 676 |
| 1 | 10·2 | 2 | 49 | 3 | 180·6 | 4 | >269 |
| 1 | 3·75 | 1 | 49 | 4 | 180·6 | 4 | 269 |

[1] Assuming a 10-year return period.

*Table 14*

| Number / Variable name | Unit for numerical value | Shifting cultivation | |
|---|---|---|---|
| | | Scale value | Numerical value |
| *Production attributes* | | | |
| 19 Degree of commercialization, as proportion of commercial to gross production | Per cent | 1 | ? |
| 20 Commercial production, as amount of commercial production | G.E./ha | 1 | ? |
| 21 Degree of specialization | Per cent | 5 | >90 |
| *Structural attributes* | | | |
| 22 Land under perennial crops, as proportion of all agricultural land | Per cent | 1 | ? |
| 23 Permanent grasslands and grazed fallow, as proportion of all agricultural land | Per cent | 1 | 0 |
| 24 Land under primary food crops as proportion of all agricultural land | Per cent | 5 | >90 |
| 25 Production orientation as proportion of animal products to total output | Per cent | 1 | < 1 |
| 26 Commercial production orientation as proportion of marketed animal products to total | Per cent | 1 | 0 |
| 27 Industrial crop orientation as proportion of industrial crops to total production | Per cent | 1 | ? |

*Semi-commercial (peasant) rice-growing* is denoted by the code:

| *Social* | | *Operational* | | *Production* | | *Structural* |
|---|---|---|---|---|---|---|
| 1 2 3 4 5 6 7 | | 8 9 10 11 12 13 14 | | 15 16 17 18 19 20 21 | | 22 23 24 25 26 27 |
| 1251211 | — | 5514554 | — | 3311335 | — | 115111 |

The nearest model types of the World Typology are:

Type Tij

| | | | | | | |
|---|---|---|---|---|---|---|
| 1151212 | — | 5323452 | — | 5522332 | — | 114111 |

Mii

| | | | | | | |
|---|---|---|---|---|---|---|
| 1151211 | — | 4234551 | — | 5533443 | — | 114111 |

The Malaysian type thus substantially conforms to the model Tij (highly intensive, irrigated, highly productive, semi-commercial agriculture) in respect

(cont.)

| Semi-commercial peasant rice cultivation | | Perennial crop (peasant) small-holding | | Plantation (state) | | Intensive market-gardening, etc. | |
|---|---|---|---|---|---|---|---|
| Scale value | Numerical value | Scale value | Numerical value | Scale value | Numerical value | Scale value | Numerical value |
| 3 | 57 – 59 | 5 | >95 | 5 | >99·9 | 5 | >95 |
| 3 | 12 | 5 | 30 | 4 | 41 | 5 | >95 |
| 5 | >90 | 5 | >90 | 5 | 90 | 4 | ? |
| 1 | 5 – 10 | 5 | >95 | 5 | >99 | 1 | 6 – 7 |
| 1 | <2? | 1 | <0·1 | 1 | <1 | 1 | 0 |
| 5 | >80 | 1 | <5 | 1 | <0·1 | 5 | 90 |
| 1 | <5 | 1 | <1 | 1 | <0·1 | 5 | 91 |
| 1 | <1 | 1 | <0·1 | 1 | <0·1 | 5 | 90 |
| 1 | <20 | 5 | >95 | 5 | >99·9 | 1 | 0 |

of social and structural attributes, but diverges from it in its operational characteristics which are more akin to those of model type Mii – very intensive, small-scale, irrigated, highly productive agriculture with food-crop growing prevalent.

No distinct sub-types are recognized, though there is a continuum from farms which concentrate entirely upon the production of rice with only "kitchen garden" production of fruits and vegetables to those which include a substantial area of rubber land. In a few parts, especially in the remoter valleys of the northeast of the Peninsula, wet rice may be supplemented by shifting cultivation, a combination of activities much more common in the nineteenth and early twentieth centuries.

*Perennial crop small-holder agriculture* includes three distinct sub-types which have in common small-scale operation usually by a family and dependence upon a perennial crop, everywhere supplemented by "kitchen garden" crops and by some wet-rice growing in areas of suitable terrain. The first and most widespread sub-type is rubber-growing, usually in inland locations on sedentary soils. The second sub-type is coconut-growing, in the Peninsula usually on marine alluvium soils in coastal locations. The third sub-type is a "catch-all" category which includes small-holdings of mixed fruit trees often with separate plots of rubber, and small-holdings growing coffee, cocoa, sago, peppers and pineapples (though not really a perennial) and in a few areas, oil palm.

In Malaysia, the code for this type is:

| *Social* | | *Operational* | | *Production* | | *Structural* |
|---|---|---|---|---|---|---|
| 1 2 3 4 5 6 7 | | 8 9 10 11 12 13 14 | | 15 16 17 18 19 20 21 | | 22 23 24 25 26 27 |
| 1251113 | — | 3113111 | — | 3322545 | — | 511115 |

The nearest model types of the World Typology are:

Type Mss

| | | | | | | |
|---|---|---|---|---|---|---|
| 1151212 | — | 3123341 | — | 4433434 | — | 411114 |

Mxp

| | | | | | | |
|---|---|---|---|---|---|---|
| 1151455 | — | 3133241 | — | 4434545 | — | 411115 |

The Malaysian type conforms reasonably closely to the model Mss, for which Malaysia is given as an actual example (KOSTROWICKI 1978, p. 28), though in respect of production characteristics it is slightly closer to Type Mxp (modern plantations) whilst its operational attributes are roughly equidistant from both the Mss and Mxp models. The social attributes exactly coincide with those of semi-commercial rice-growing.

*Plantations* (estates) are legally defined as holdings of over 40 ha, which means that very small estates that necessarily employ wage labour are enumerated as small-holdings in official statistics. The code for the Malaysian type is:

| *Social* | | *Operational* | | *Production* | | *Structural* |
|---|---|---|---|---|---|---|
| 1 2 3 4 5 6 7 | | 8 9 10 11 12 13 14 | | 15 16 17 18 19 20 21 | | 22 23 24 25 26 27 |
| 1151112 | — | 3113141 | — | 3334545 | — | 511115 |

The nearest model type from the World Typology is:

Type Mxp

| | | | | | | |
|---|---|---|---|---|---|---|
| 1151445 | — | 3133241 | — | 4434545 | — | 411115 |

The Malaysian type conforms closely to the World Typology model (KOSTROWICKI 1978, p. 27).

Three sub-types may be recognized differing mainly in predominant, or more usually exclusive, crop. The first two comprise rubber and oil palm estates while the third is a "catch-all" including estates growing coconut, tea and other minor crops.

*Intensive market-gardening and livestock-rearing* are generally combined on the same farm and only rarely involve pasture. The growing of fruits and the rearing of fresh-water pond fish are also often adjuncts. There is thus a wide range of activities from specialized pig, poultry or vegetable farms to less specialized but still highly intensive sub-types.

The code for the Malaysian type is:

| *Social* | *Operational* | *Production* | *Structural* |
|---|---|---|---|
| 1 2 3 4 5 6 7 | 8 9 10 11 12 13 14 | 15 16 17 18 19 20 21 | 22 23 24 25 26 27 |
| 1151112 — | 5115455 — | 5544554 — | 115551 |

There are no model types from the World Typology which are close to this type. In terms of production and structural characteristics it resembles Type Ln (highly industrialized livestock-breeding) for which the relevant code is 5055555 — 151551, though differing markedly in respect of grasslands and land under primary food crops. Overall, the Malaysian type lies between Type Mi, market-oriented small-scale intensive crop agriculture and Type Ln of the World Typology. Social and production attributes are similar to those of semi-commercial rice-growing.

## COMPARISON OF MALAYSIAN TYPES

Although there are thus striking divergencies between the Malaysian types and the models derived from the World Typology, there are also a number of striking similarities, a few of which are common to all types. Expectably, the proportion of agricultural land operated as planned collectives or state farms is low, though for perennial tree-crop agriculture the numerical value is higher than might be expected in a capitalist context. The reason is that land development schemes owned and operated by the Federal Land Development Authority (FeLDA) and other similar statutory government bodies do not fall easily into either the "small-holder" or the "plantation" categories. (Nor do official statistics fare better, as in Sabah development scheme lands fall into the plantation category whereas in the Peninsula they are included with small-holdings or stated separately). On the whole, development schemes based on rubber are operated more like small-holdings, whereas oil palm schemes are operated more like plantations, which helps to explain the apparent contradictions in the numerical values given in *Table 15*. However, since the objective is ultimately to give small-holders title to these lands, it could be argued that all should be considered small-holdings.

A further common attribute of Malaysian agriculture is the low input of mechanical power since the crops grown do not readily lend themselves to mechanization of actual production — hill rice, rubber, oil palm and perennial crops generally — or mechanization has been recently introduced, for instance amongst wet rice growers and market-gardeners.

*Table 15*

Malaysian types compared

| Type | Code | | | |
|---|---|---|---|---|
| | *Social* | *Operational* | *Production* | *Structural* |
| | 1 2 3 4 5 6 7 | 8 9 10 11 12 13 14 | 15 16 17 18 19 20 21 | 22 23 24 25 26 27 |
| Shifting cultivation | 5111222 | 3111111 | 1111115 | 115111 |
| Semi-commercial rice cultivation | 1251211 | 5514554 | 3311335 | 115111 |
| Perennial-crop small-holding | 1251111 | 3111111 | 3322555 | 511115 |
| Plantation | 1151444 | 3113141 | 3334545 | 511115 |
| Intensive market-gardening, etc. | 1151112 | 5115455 | 5544554 | 115551 |

*Note:* Compiled from *Table 14.*

Amongst the operational characteristics, three stand out as common to all five agricultural types — land productivity (as gross output), productivity of cultivated land and labour productivity. Nevertheless, there is a substantial range in actual values amongst the types. Shifting cultivation is clearly the least productive (assuming a 10-year return period), though in terms of labour productivity it is not significantly below wet rice cultivation. Productivity of the land is very similar for both semi-commercial rice cultivation and perennial crop small-holdings while that of plantation production is not strikingly higher. However, labour productivity values are very different and confirm the common notion that growing wet rice is a great deal of hard work for relatively small return. Given the very small areas of market-gardens and the production of livestock using purchased feedstuffs, the extremely high productivity values are not surprising.

The final characteristic shared by all types is, not unexpectedly, the proportion of agricultural land under permanent pasture or grazed fallow (23). In reality, much of the wet rice land is used as dry season stubble-grazing for cattle and buffaloes, and since this remains uncropped for three to five months every year, the numerical value arguably should be 45 per cent (the area of land cropped once a year) with a corresponding scale value of 3.[12]

In addition to those characteristics which are shared by all five Malaysian types, there are several other groups of shared attributes worthy of comment. Land ownership and tenancy (numbers 1—3 in *Table 9*) are very similar for all types, except shifting cultivation, though the two peasant types have a sufficiently high incidence of tenancy and share-cropping to diverge from the others. The two peasant types, in fact, are identical in all their social attributes.

The similarities of productivity have been noted already, but this seems to extend to all the production characteristics of commercially-oriented farming, perennial-crop small-holders, plantations and market-gardening alike, with the last type only slightly diverging in respect of production specialization (21). These similarities extend to the structural attributes of the perennial-crop small-holder and plantation types, deriving from basically identical crops and production objectives.

Certain similarities, which might not otherwise have been suspected, exist between otherwise rather different types. Thus inputs of labour (8) and of animal power (9) are similar for shifting cultivation, perennial-crop small-holdings and plantations, being moderate for the former and very low or non-existent for the latter. In respect of the proportion of land under perennial crops (22) and land under primary food crops (24), shifting cultivation, peasant rice cultivation and market-gardening are obviously very similar.

One of the more striking features is that the operational attributes of shifting cultivation and of perennial crop small-holdings are identical so far as scalar values are concerned, though for labour inputs (8) in particular, numerical values are somewhat different. It is tempting to conclude that each type may represent optimal operational adjustments to the peculiar constraints of an upland environment, although each functions in a very different socio-economic context.

[12] Kostrowicki's discussions do not include a definition of "fallow" which by implication would seem to mean "fallow for at least one year" (KOSTROWICKI 1974, 1976, 1978).

CHAPTER 6

# SHIFTING CULTIVATION

The model of shifting agriculture discussed earlier is represented by that practised amongst aboriginal groups for whom shifting cultivation is an integral part of their culture and their lives. This integration and interdependence of economics, social organization and ritual in religion is aptly put by the Iban phrase "*adat kami bumai*", which E. JENSEN (1974, p. 5) has translated rather freely as meaning "we farm (hill rice) and live according to the order revealed by the spirits". This involves not just a system of cropping, but a whole manner of life. Or, to use Conklin's typology, "integral" shifting cultivation stems from a "more traditional, year-round, community wide, largely self-contained and ritually sanctioned way of life" (CONKLIN in WATTERS 1960, pp. 66–67).

The degree to which shifting cultivation is "integral" to culture is difficult to judge. Of the Iban of Sarawak, for example, JENSEN (1974, p. 5) uses the phrase "rice cult" – such is the importance of the crop. Amongst the Dayaks, ritual "... is founded on the simple conception of the rice as animated by a soul like that which these people attribute to mankind ..." (FRAZER in FREEMAN 1970, pp. 153–154). Yet Malays share with tribal peoples a belief in the "rice soul": they rarely depend solely upon shifting cultivation, though this may be an important supplement to lowland wet-rice cultivation. Equally, the last two decades have seen the significant development of both wet-rice cultivation and rubber-growing amongst many of the less remote Iban, Dayak and related groups in Sarawak. The Melako of the First Division are a case in point (SCHNEIDER 1977, p. 85). Amongst the Kadazan (Dusun) groups of Sabah, wet rice is of variable consequence, yet rice rituals remain of considerable importance, acting in a socially integrative way for both families and village groups (WILLIAMS 1965, pp. 72–73). The limited evidence available for Malaysia suggests that it is rice ritual, not shifting cultivation *per se* which is "integral" to the tribal cultivators of Sabah and Sarawak. Since no group in that part of Malaysia has yet been denied access to land for shifting cultivation, any question of abandoning beliefs and practices which appears to be integral to the societies concerned is premature.

Broadly, the peoples for whom shifting cultivation might be considered "integral" include the two dominant aboriginal groups of Sarawak, the Iban (Sea Dayaks) and the Dayaks (Land Dayaks) together with related groups, as well as the numerically much less important aboriginal groups in the Peninsula. These include the Jakun (Proto-Malays) of central and eastern Johor and southeast Pahang, and the Temiar and Semai of the central ranges from inland Perak to the Kelantan.[13] In addition to their fewer numbers, the Peninsular aborigines also differ from those of Borneo in that rice is a recent introduction being adopted from the Malays (HILL 1977, pp. 165–168), though the various beliefs and rites associated with the crop are no less rigorously observed (COLE 1959, pp. 205–207).

The total number of people involved in shifting cultivation is hard to estimate since some tribespeople are largely hunters and gatherers, for instance the Negritoes of the Peninsula or the Punan of Borneo, while a further and larger proportion may not be shifting cultivators at all or may be sedentary cultivators for whom shifting cultivation is supplementary. In the latter category may be numbered the Temuan, a tribe of about 7,000 people in the southwest of the Peninsula, most of the Bajau, a group of about 95,000 living mainly in the Kota Belud district of Sabah, and many of the Kadazans of Sabah numbering about 218,000. Perhaps 80 per cent of the 55,000 or so *orang asli* in the Peninsula are shifting cultivators, while in Sabah and Sarawak a somewhat lesser proportion of the Iban, Land Dayak and related groups numbering about 700,000 would fall into this category.[14]

Spencer's estimates (undated, but presumably early 1960s) suggest that some 175,000 families were engaged in shifting cultivation of one kind or another at that time, with about 300,000 ha of land being cleared annually and a total of about 2·2 million hectares either cropped or in fallow (SPENCER 1966, p. 174).[15] Spencer's data, together with official statistics, permit an estimate of the current situation. The proportion of harvested land to total land used for shifting cultivation is roughly 10 per cent (Spencer's data give 10·9 per cent). Using one-tenth as the proportion under crop at any time and accepting present estimates of the area under hill rice (see *Table 8*), the area currently affected by shifting cultivation would only be around 1·1 million hectares. Though it is known that significant areas of abandoned clearings have been planted with rubber, especially in Sarawak, this has not been on a scale anything like sufficient to reconcile the two estimates given here.[16]

[13] These groups are related and are sometimes collectively termed "Senoi", see COLE 1959, p. 191.

[14] CAREY (1976) discusses in some detail the distribution of *orang asli* in the Peninsula, while for the Iban both FREEMAN (1970, p. 130 ff.) and JENSEN (1974, pp. 18–22) have some discussion of population numbers, distribution and migration.

[15] SPENCER's estimate may be slightly on the low side, since the Agricultural Statistics of Sarawak has a figure of 2·3 million hectares for crop land ("wet padi and hill padi") for 1966 in Sarawak alone.

[16] The area under rubber in Sarawak rose from about 145,000 ha in 1960 to 193,000 ha in 1972. See Agricultural Statistics of Sarawak, 1973, 1.7. Were a twenty-year cycle of

Conklin has suggested that there are two sub-types of "integral" shifting cultivation; the "pioneer" sub-type, where significant areas of mature forest are cleared annually, and the "established" sub-type, where practically no mature forest is cleared and where tree crops are common (Conklin in Watters 1960, p. 67). At the time of Freeman's major study of the Baleh district of Sarawak Second Division (late 1949 to mid-1951), it could be claimed that the agricultural practices he described were generally typical of at least fifty to sixty per cent of the Iban population of Sarawak (Freeman 1970, p. 153). Iban agriculture then fell largely into the "pioneer" sub-type of Conklin. But even by the early 1960s, conditions had changed (Jensen 1974, p. 4) so that it is doubtful if any significant areas of pioneer shifting cultivation now remain, except perhaps in the few very remote areas along the Indonesian border free from terrorist activities.

These recent changes, as yet all too inadequately documented, point to the important fact that the crops and methods of shifting cultivation are by no means static in the region. During the nineteenth century, aboriginal shifting cultivators occupied discontinuous areas of the Peninsula from sea level to around 600 m above sea level. Coast-dwellers obtained protein mainly from fishing and sea shore collecting while the greatest objects of their agricultural interest were the banana and cocoyam *(Colocasia* spp.*)*, with padi in some areas only. In the hilly areas, the lower limit of cultivation was around 100 to 150 metres and extended up to about 600 metres above sea level, a good 300 metres below the modern upper limit. Travellers crossing the Peninsula from Perak to Kelantan in the last quarter of the century reported that although rice was grown in the more accessible areas fronting the coastal plain of Perak, the crop was absent inland. There, the main crops included sugarcane, bananas, gourds of various descriptions and millet, probably *Coix* rather than *Setaria*. Manioc and maize, and in southeast Perak and northeast Johor sweet potatoes, pineapples and tobacco, were other important crops, these being of ultimately "American" origin and probably of fairly recent introduction. Rice, certainly, was a newcomer (Hill 1977, pp. 165—168). The effects of the coming of these new crops can only be surmised. Certainly it seems reasonable to suspect that individual clearings needed to be enlarged where rice was adopted, since area-for-area tubers produce more carbohydrate than rice.

Rice does not seem to have been quite such a recent introduction amongst the shifting cultivators of Sabah and Sarawak, though scholars have paid little attention to the matter. Harrisson, for instance, has suggested that the crop

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cultivation to be assumed, the totals could be reconciled. There are, however, no firm data with which to effect such a reconciliation.

is a relatively recent introduction in Borneo, certainly in the interior (HARRISSON in HILL 1977, p. 12).

Little better documented are the changes in the recent past, mainly the addition of cash crops, especially rubber, to the economy, though in some areas wet rice has been also incorporated. Amongst the Selako Dayaks of the First Division of Sarawak, for example, many individuals have grown rubber and pepper for several decades and in recent years many have begun growing rice in irrigated fields, prompted partly by governmental interest and assistance and perhaps also by the fact that in the First Division virgin forest land is no longer available for shifting cultivation (SCHNEIDER 1977, p. 85). Dixon has remarked of the Land Dayaks generally that "Pepper and rubber are grown with techniques unashamedly borrowed from their Chinese neighbours, ... the vegetables they grow for their own use are often cultivated on raised beds in the Chinese style ... a number of them have constructed fish ponds." (DIXON 1972, p. 194), although this process of enculturation has not yet led to the disintegration of Dayak agricultural technology. Cash crops can continue to be incorporated so long as the equilibrium amongst land availability, soils, manpower and Dayak objectives is not disrupted. So long as sufficient hill land is available where soils have been "rested" sufficiently long to restore soil fertility and where *Imperata* infestation has not occurred, no breakdown of shifting cultivation need exist. Since the imperatives of shifting cultivation do not require year-round attention, rubber-growing fits easily into the economy, production actually benefitting from the cessation of tapping during periods of peak labour demand on forest clearings. Pepper, which demands year-round intensive care, is less easily intercalated especially as the pepper harvest coincides with the period of planting rice. Ultimately, it seems likely that as increasing proportions of the Dayak population are drawn into the production of cash crops, shifting cultivation will wither away. But although this process of change is well under way, especially in the First Division, for most, shifting cultivation is still a major focus of interest. For the moment, the model remains valid.

## LANDSCAPE ELEMENTS

The landscape of shifting cultivation in the Malaysian region is not significantly different from that in similar humid equatorial regions, though the particular crop assemblages, the floristic composition of the regenerating clearings and, in particular, the existence of the longhouse as a characteristic settlement feature of such landscapes in Sabah and Sarawak are points of difference (see *Fig. 14* for a macro-view of a landscape of shifting cultivation).

The basic landscape elements are four in number: a clearing (Malay—*ladang*) for the current season's cropping, a small settlement, a patchwork of partly

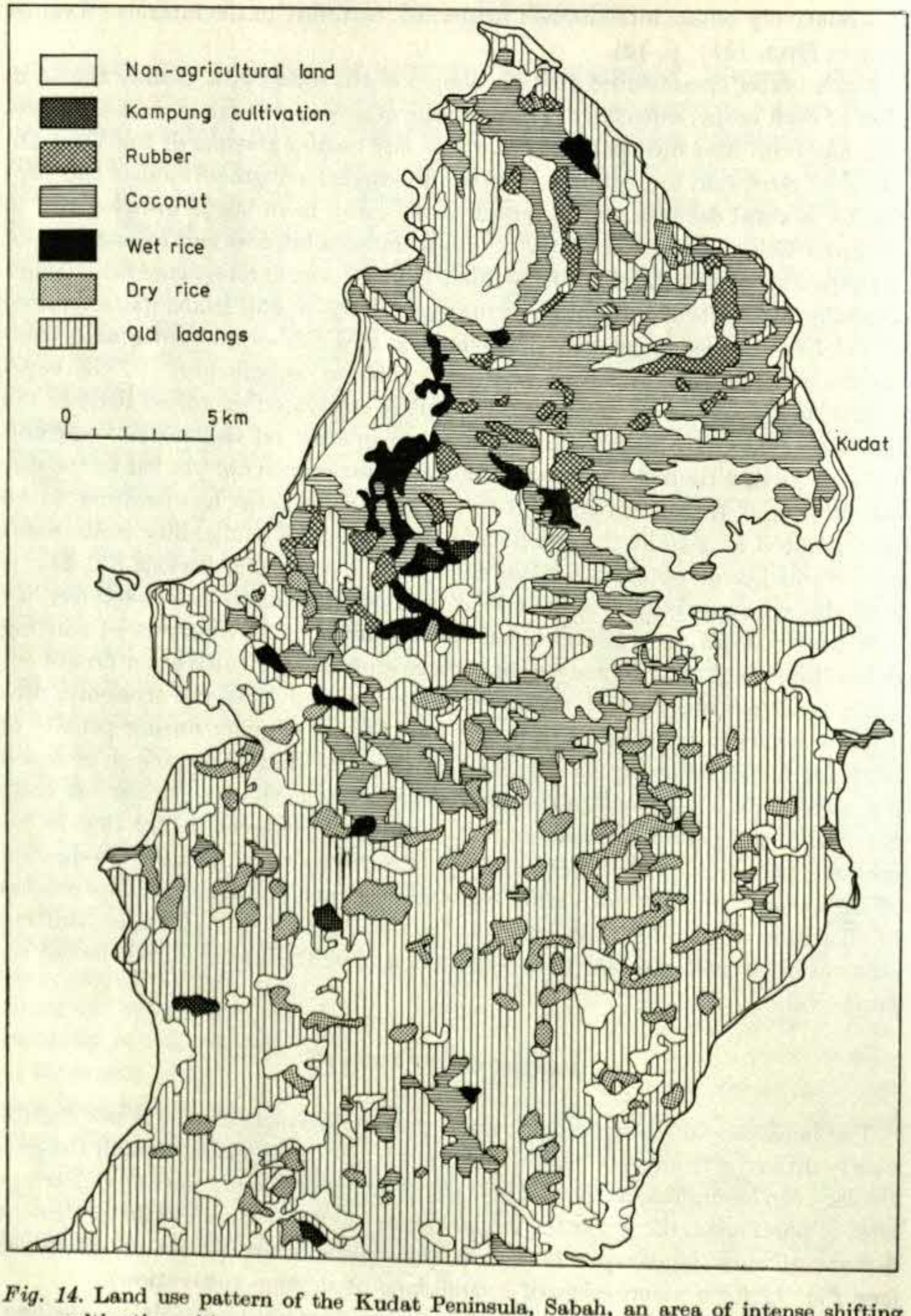


*Fig. 14.* Land use pattern of the Kudat Peninsula, Sabah, an area of intense shifting cultivation with some permanent agriculture (from Sabah Land Use Survey)

or wholly abandoned ladangs in various stages of regeneration, and a river or stream with, less commonly, the sea.

The clearings currently in cultivation range in size from about 0·5 ha to 2·5 ha. D. FREEMAN (1970, p. 248) reporting on an Iban community at Rumah Nyala, in the Third Division of Sarawak, gave a range of cleared areas from 0·6 ha to 2·7 ha, with 70 per cent falling within the range 1·2 ha to 2·2 ha. These figures refer to *bilek*, that is farms belonging to individual families living in a longhouse. Not infrequently though, families clear adjoining areas so that the actual ladang may be up to about 10 ha in size. Generally, the actual planted area is rather less than the cleared area for two main reasons. On the edges of the clearing, the standing forest casts too dense a shade to make the edges worth planting and secondly, there are generally parts of the clearing which cannot be planted because fire has not sufficiently consumed the felled trees and undergrowth to make it possible to plant the seed. In total about 20 to 25 per cent of the ladang usually cannot be planted. Should there be valuable trees within the cleared area these are left standing and very large trees which are difficult to fell may also be left. In secondary forests, however, clearing is usually total.

The crop assemblages vary widely from area to area, both as to the number of crops planted and their proportions. Nowadays, few groups fail to plant at least some rice, though the impression is that cultivators in the Peninsular and perhaps in Sabah, pay rather less attention to this crop than to tubers, whereas in Sarawak, rice is very much the objective even though tubers may provide a substantial portion of the carbohydrate intake in the diet. Maize which matures more rapidly than rice is often sown with the rice and provides a cereal "stop-gap" during the sometimes "hungry months" between planting and harvest. Millet *(Coix lachryma-jobi)* is generally planted separately. Although it may be consumed directly as food (in the form of a porridge) its main use, especially amongst the Land Dayaks is for making an alcoholic beverage for which purpose rice is also used. Manioc *(Manihot esculenta)* is grown for two reasons. First, it is commonly planted on the margins of a clearing as a "fence", not so much as a physical barrier, but as a tactic which diverts the attention of wild pigs from the major crop. Second, though it is far from being a favourite dietary element, it is also a useful supplement and reserve should rice yields be low, particularly as yields (averaging 20—30 t/ha) are high and little labour is required. Other crops, also sown with rice, include various Cucurbitaceae, cucumbers, pumpkins, melons and mustard *(? Brassica juncea)*. Tobacco, lemon grass *(Cymbopogon citratus)* chilli and various leafy vegetables may also be grown in the clearing, but more generally have a place in the kitchen garden adjacent to the village, where those ancient Asian cultigens *Dioscorea* (yam) and *Colocasia* (taro) may also be planted in damp hollows.

Although the longhouse is popularly regarded as an essential component of the landscape of shifting cultivation in the region, it is in fact not so, and is largely absent from the Peninsula, except amongst some of the Kelantan Temiar. There, the usual pattern is of a small cluster of huts set upon stilts. There is no particular orientation to the huts although the verandah which most, but not all, possess usually faces downslope. A piedmont location at a point close to running water is preferred both as a source of drinking water and for sanitary reasons. The number of family huts varies widely, from two up to 40, though rarely more.

Although the longhouse is a social as well as a settlement unit, its corporateness derives from ritual concepts rather than from collective ownership of land or property which, on the contrary, belong to individuals or the family.[17] As a settlement unit, it may be the sole component of the village or the village may include single-family dwellings just as the longhouse itself is divided into single-family compartments *(bilek)*. The size of the longhouse is generally denoted by the number of compartment doors *(pintu)*. The mix of longhouses and single family dwellings varies. Dixon has suggested that among the Land Dayaks the usual pattern is that each village comprises three or four longhouses and a number of single-family dwellings. Of the 267 Dayak villages he surveyed, only 10 did not have single-family dwellings. On average, each village contained 3·2 longhouses, averaging 4·8 doors each, and 21·6 single-family dwellings. Longhouses ranged from two to 27 doors and the average village held 40 families.

By contrast, his survey of 112 Iban villages indicated that 24 had no single-family dwellings. Longhouses were fewer in number (average 1·5 per village) but larger (average 8·8 doors), while single-family dwellings were fewer – an average of 7·4 per village. Longhouses ranged in size from two to 46 doors with an average of 21 households per village. Amongst the Sebuyan and Selako, less than a fifth of the households lived in longhouses (DIXON 1977, p. 87 *et seq.*, p. 108).

Where the cycle of cultivation has led to the clearing of lands, at some distance from the main village a field-hut of some kind is usually constructed. This may be simply a framework of sticks roughly thatched with leaves and constructed solely for shelter during the ripening of the grain harvest when birds and rats must continually be scared away. Where land in permanent cultivation is also owned, families may have a second, more substantial dwelling in which some of the members may live most of the time. This is the case amongst the Dayaks, for example (DIXON 1972, p. 21).

The third major element of the landscape of shifting cultivation is the abandoned clearings. Abandonment is usually progressive, though in Peninsular

[17] Amongst the Selako of the First Division, however, the longhouse is a descent group rather than a bilateral kin group on the usual Dayak model. (See SCHNEIDER 1977, p. 85.)

Malaysia groups of Temiar, for example, have been known to abruptly abandon not only their hamlet but also their clearings, should there be several successive deaths in the group. The usual pattern of abandonment is for a second rice crop to be taken from only part of a clearing, while tubers and bananas may remain from the first planting or be planted again. So long as it is possible to harvest these two crops without difficulty, a ladang will be visited, but after about four years even this is difficult and abandonment becomes complete.

The vegetational structure and species composition of regenerating clearings is not well known, the bulk of the limited data available coming from the Peninsula rather than Borneo. Where cleared areas are large and soil nutrient levels are low, whether inherently or by reason of excessively short fallow, infestation by *Imperata* (lallang), a persistent rhizomous grass, can lead to very slow regeneration, so that clearings take the appearance of savanna with scattered scrubs and trees and pockets of scrub in damper parts. But generally, farmers are well-aware of the dangers of *Imperata* infestation and the grass, if it comes in at all, is an ephemeral component in the seral vegetation leading back to secondary forest.

In recently-abandoned clearings herbaceous plants form a major component of the vegetation. Grasses and herbs such as *Imperata* spp., *Paspalum conjugatum*, *Eupatorium odoratum*, *Mikania scandens* are common, along with ferns such as the brackens, *resam (Gleichenia* spp. and the less common *Pteridium esculentum)*, the very common *paku (Pteris vittata)* and the tree-fern *Cyathea* spp. Mixed with these are other heliophytes such as the woody *Trema* and *Mallotus* species and *Macaranga* spp., the last, especially *M. triloba*, developing into fair-sized trees which may persist for 30 years or so if permitted to do so. Trees such as *M. triloba* and especially *Adinandra dumosa* will have reached at least two metres in height by the time a clearing is completely abandoned and, after about four years, the herbaceous component of the vegetation becomes increasingly shaded out by young trees. Wyatt-Smith's study of an abandoned agricultural clearing at Sungai Kroh, Perak, over a period of six and a half years is particularly revealing. Within the first year after abandonment the sampled vegetation was dominated by *Nephrolepsis biserrata* and other ferns, *Mikania scandens*, *Imperata* and *Trema* spp. In the second year, the frequency of these plants in the sampled quadrats had begun to fall quite sharply with some rise of *Macaranga* species other than *M. gigantea*, and other woody species. By the beginning of the third year *Imperata*, *Eupatorium odoratum* and *Trema* had become quite unimportant, with a corresponding sharp rise in the frequency of *Macaranga gigantea* and slower falls in the frequency of *Mikania* and ferns (WYATT-SMITH 1955, p. 47).

This sequence in former lowland forest in the Peninsula could be paralleled elsewhere. In the relatively few areas of swamp forest cleared by shifting cultivators, the trees *Melaleuca* or *Macaranga maingayi* may form almost pure stands. On coastal sands, a form of scrub savanna, which compositionally becomes fairly stable where cattle have access, may be formed, perhaps after only a single "round" of shifting cultivation, so "fragile" is the forest.

In economic terms, the regenerating clearings are by no means negative, and plants from the clearings may be used as food, the young fronds of several ferns being used for this purpose, or as light construction material, bedding or for medicinal purposes. Bamboo is perhaps the most widely used material of secondary forests, being widely used for house walls and floors when split, as well as for making traps, water and food containers and blowpipes. Furthermore, the herbaceous phase is particularly attractive to game – wild pig, deer (Cervidae), the mouse-deer (Tragulidae), civet cat *(Viverra* spp.*)* – all of which are hunted or trapped. Where access to markets is available, hunting, both in regenerating clearings and in high forest may take on a commercial aspect, as amongst the Temuan, a proto-Malay group of Negeri Sembilan and Selangor, who supply exotic meats such as turtle, crocodile, monkey, ape and frog (GALL 1977, p. 107). This group, however, is not exclusively dependent upon shifting cultivation.

The resources of rivers, and less commonly the sea, are the final element of the landscape and the economy of tribal shifting cultivators. Rivers are important not solely as a source of drinking water and a place to bathe, but major ones also function as transport links. Access to water deep enough to take a canoe has important consequences for the stability of settlement, since the enhanced speed and carrying capacity of water transport allow a larger activity field, not only for cultivation, but for hunting and also for the collection of jungle produce such as rattans, which may form an important element of the total tribal economy.[18] Fishing by trap, spear or handline is also of some importance (see *Table 17*).

In addition to these major landscape elements, but beyond the direct ambit of shifting agriculture lies the forest. In areas of long settlement this may have been affected by shifting cultivation at some time in the past and hence is part of the reserve stock of land to which claim may be laid should the occasion arise. Forests more than about 30 years old bear few traces of former cultivation except to the eye of the expert who may discern evidence of this in the species composition. This land, together with the little remaining "virgin" forest, forms the overall matrix within which the discontinuous patches of shifting cultivation and regenerating clearings are set (see ***Fig. 14***). But increasingly, even the forests of this matrix have been logged for commercial purposes and, especially in the Peninsula, groups of shifting cultivators are becoming increasingly circumscribed.

[18] This dependence is widely variable from group to group. The Orang Kanak of north-east Johor, for example, are no longer agriculturalists and depend entirely upon collecting jungle produce (CAREY 1976, p. 237).

The documentation of the flows of energy in one form or another — of goods, nutrients and people — is not easy for lack of adequate data especially at the farm level. An "energy budget", in which energy becomes a standardized surrogate for all manner of lows, must necessarily rest on somewhat unsure foundations. Nor is it yet possible to reduce all components to a common denominator. *Figure 15* thus presents a schema from which certain elements are missing. Nevertheless, it does indicate aspects of the various sub-systems present in shifting agriculture. Since certain of these interlock in relatively constant ways in each of the major agroecosystems, only the salient points are indicated.

As with systems of shifting cultivation elsewhere, those in Malaysia are highly generalized. This means that, unlike wet rice cultivation, for instance, the energy cycled within the system is distributed amongst a relatively large number of plant and animal species, each of which is represented by relatively few individuals. There is thus a hig hdiversity index, especially if the forest and regenerating clearings are included.

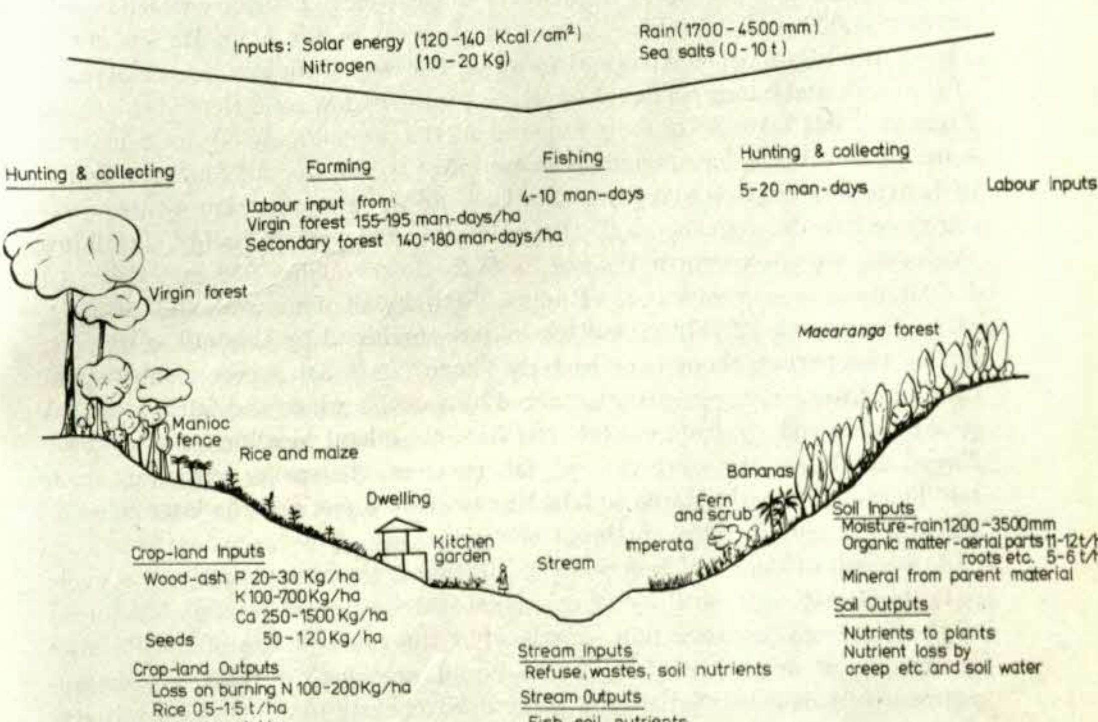


*Fig. 15.* Landscape elements and the agroecosystem of shifting cultivation

Like other agricultural systems, shifting cultivation can be approached from the point of view of nutrient cycling (NYE and GREENLAND 1960, p. 34). From the atmosphere the only nutrients input to the system are those derived from nitrogen formed in small quantities especially during thunderstorms, various elements derived from the sea and carried inland by the prevailing winds, and fine ash from forest fires. Given the usually fairly calm sea conditions and the inland location of shifting cultivation, it is likely that inputs from marine sources fall towards the lower end of the range quoted. The quantum of additions from aeolian ash, like those from marine particulates, are entirely unknown for the region, though they may not be insignificant considering that smoke from clearings may be sufficient to darken the sun for days and sometimes weeks on end (CHIA 1970, p. 22).

Other atmospheric inputs include solar energy, for which estimates are given in *Figure 15*, and rainfall. The seasonal distribution of the former is not known, but the total input is everywhere sufficient for rapid plant growth in the presence of moisture. The seasonal distribution of precipitation is rather better known though necessarily based largely upon observations at lowland stations. Broadly, the region is open to the warm, moist airstreams of the north or northeast monsoon prevailing from late October to early February which brings between 1,000 and 2,500 mm of rain to all areas of the Main Ranges of the Peninsula and to most of Sabah and Sarawak. The west of the Peninsula and parts of the south and interior of Sabah experience rain-shadow conditions at this time. From May until August or early September, the prevailing winds are from the south or southwest, but though these are moist to the west of Sumatra, south of Java and the islands to its east, they lose variable amounts of moisture crossing these islands, with the result that rainfall in the western half of the Malay Peninsula, except north of Penang, is fairly low, roughly 250 mm rising to 1500 mm at the very most in the Ranges. Virtually all of Sarawak and certainly all the main areas of shifting cultivation are shadowed by the bulk of Borneo during this period, though the easterly "horn" of Sabah receives substantial rain. The intervening periods are marked by variable winds and fairly localized precipitation mainly from convection. In some inland locations, for example Negeri Sembilan, there are two rainfall maxima, the earlier extending from late February or early March to late May or early June, and the later coinciding with the period of the northeast monsoon.

As a result of these differences, the inititation of the annual cultivation cycle is fairly closely controlled by the seasonal distribution of rainfall. The onset of the northeast monsoon falls shortly after the constellation of the Pleiades can be seen at its zenith before daybreak and, amongst the Iban, it is the appearance of this constellation above the horizon early in June which initiates the annual cycle of clearing (JENSEN 1974, p. 156).

The annual cycle of cultivation is discussed in greater detail later, but it has obvious effects upon energy cycling and the subsystems involved. The operations of clearing and burning have obvious effects. In the first place, there is a sudden and drastic drop in the total biomass. The mass of mature forest is around 600 tons/ha, with well-grown secondary forest being about half this amount, which on clearance and burning is reduced to perhaps 10—15 per cent of the former total, the residue being represented by unburnt or partly burnt logs, stumps and roots. Of the balance, the bulk is lost to the atmosphere as gas and light ash with only a small portion added to the soil as nutrients. The loss of nitrogen from the soil would seem to be very small (SANCHEZ 1976, p. 368), while additions of P, K, Ca are likely to be of the order given in ***Figure 15*** (estimates based in part upon NYE and GREENLAND 1960, pp. 68—69). Losses from the vegetation are likely to be roughly two orders of magnitude greater.

Burning also has significant effects upon the animal component of the total biomass. Though little is known as to what proportion of the total this constitutes, larger, mobile animals normally escape while the remainder perish. Microbial populations initially fall but quickly recover and rise to higher levels than before in response to increased nutrient supply, though the composition is changed; Corbet observed the effects of burning on a highly acid Oxysol in Peninsular Malaysia and found that the micro-organism population rose from one million per gram to 11 million (NYE and GREENLAND 1960, p. 72). At the same time, most of the seeds present in the soil are either killed or have their germination retarded, though stumps sucker freely and require considerable inputs of labour for weeding, a task usually carried out by women and involving a labour input of 30—50 man-days per hectare.

The main environmental effects of burning are substantially to increase the diurnal range of soil temperatures and, perhaps surprisingly to increase soil moisture perhaps by as much as 15 per cent by reducing interception and evaporation from vegetation surfaces. Soil structure will certainly be changed by heat, but whether these changes are adverse or not in terms of plant growth depends very much upon soil type (SANCHEZ 1976, pp. 359—362).

The only remaining inputs to the soil involve planting — the seeds themselves and associated labour, the latter involving only the making of a hole for the seed, a male task, and inserting the seed, a female task. This labour input is around 22 man-days per hectare (FREEMAN 1970, p. 245).

Under the stimulus of solar energy and moisture these inputs are transformed by photosynthesis into crops. The moisture input probably ranges from 550 to 1,650 mm with all but 200—700 mm being used in evapotranspiration and incorporation into plant tissues. A rice field has a total biomass of around 10—12 tons per hectare, of which between one and three tons of plant material is taken from the field at harvest in the form of the panicles of the plants. Of this, about half is clean grain. Other crops may have a greater mass, manioc for example yielding between 20 and 40 tons of wet root per hectare.

The changes to the soil and to soil processes have not been studied in detail in the region, but there is no reason to suppose that these are substantially different from similar areas elsewhere. In the cleared area, pH generally rises along with total exchangeable cations. While a portion of these is taken up into the growing crops, the bulk is either leached out or moves downslope both by overland flow bearing the soluble elements with it, and by physical movement of ash and topsoil. How much of the latter actually finds its way into watercourses is arguable. NYE and GREENLAND (1960, p. 116) suggest that in the case of a forest soil cropped for three years (longer than the usual Malaysian practice) the loss of topsoil is not likely to exceed 50 tons per hectare, but by no means all of this finds its way into streams. Field observations suggest that on the whole, little more actually reaches the streams than might be expected under fully vegetated conditions, most being deposited as "colluvium" in the piedmont zone where a deposit of mixed ash and topsoil some 0·3 m thick may result from a single clearing. There truly phenomenal crop yields are obtained, 2·5 tons of padi per hectare being by no means unusual, much higher than the rest of the clearing.

Following abandonment, the total organic matter in and on the clearing may actually fall slightly as the residue of burning decays, and especially if *Imperata* takes hold. But usually regeneration is rapid, especially if the burning has been incomplete. The uptake of nutrients is rapid, especially in the first five years, the average uptake of N, for example, probably being in the vicinity of 50–100 kg/ha/yr (NYE and GREENLAND 1960, p. 36). The annual turnover of nutrients is also likely to be rapid. As regeneration proceeds, nutrient uptake and cycling slow down, soil organic matter reaching a level roughly three-quarters that of mature forest after 8–10 years. At the same time, nitrogen is restored to the soil in step with the organic matter increment, at an average annual rate of 30–40 kg/ha for a ten-year fallow. The sources of this nitrogen are from rainfall, though this is insignificant, and from leguminous trees, though the degree to which this is true is still a matter of conjecture since a major N-fixer, *Azotobacter* spp., does not necessarily occur only in symbiosis with legumes.

## THE SOCIO-ECONOMIC FRAMEWORK

Without delving into the definitional and conceptual problems implied by its use, the term "tribal" can be applied to the socio-economic context in which integral and some partial (or supplementary) forms of shifting agriculture may be fitted. In the Peninsula, tribal peoples are readily identifiable by the Malay term *orang asli* which is applied to them whether they are shifting cultivators or not. In particular amongst the indigenous population,[19] tribal groups are

[19] In Malaysia, the term "indigenous people" *(bumiputera)* has constitutional and legal

identified by home language (not Malay), by religion ("animist", though significant numbers of Iban, Dayaks and Kadazans in Sabah and Sarawak are Christians), and by a peripheral position, spatially, economically and politically, though again in Sabah and Sarawak this is much less true than in the Peninsula.

So far as economic activities are concerned, the basic unit is the household which is intimately related by ties of kinship and affinity. Amongst the Iban, FREEMAN (1970, p. 9) identifies the *bilek* family as a basic unit occupying a separate house or a compartment in a longhouse, sharing the same domestic arrangements, owning land and property in its own right, growing its own crops, and forming a ritual group. As FREEMAN (1970, p. 9) has remarked "The *bilek*-family has two dominant characteristics: it is a small group numerically and a simple one genealogically". The extended family, as amongst the Temiar, may be the basic economic unit cultivating collectively, but amongst the Iban, agricultural work is not collective in the strict sense, though an informal but well-defined system of mutual assistance operates especially for major tasks such as clearing the land. Assistance thus given is expected to be repaid by work of a similar kind on another occasion. Co-operation within a whole village or several villages is uncommon, though a fish-drive, in which a watery extract of *tuba (Derris* spp.*)* is used to stupefy the fish, may involve large numbers, though even here families and individuals will keep what they catch while giving away surplus. Truly co-operative labour is thus uncommon, DIXON (1972, p. 28), for example, remarks that "In most Dayak communities there is a great reluctance to work at any job which would contribute to the common weal".

The social basis of production is thus the household and this too is the basis of appropriation. In years of good harvests, surplus rice, in addition to being turned into rice-wine *(tapai)*,[20] may also be turned into cash, since hill rice commands a premium on local markets, or more traditionally into gongs or jars, these of Chinese provenance. The state may also have a role in appropriation and in Sarawak a "door-tax" is levied; but in terms of appropriation, the essential feature which distinguishes this form of agricultural economy from the peasant type is that with the limited exception just noted, the producers appropriate their own surplus.

Land tenure is also very much unlike that of peasant communities, basically because there is no concept of land as property in the legal sense. Rights to

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significance. It includes the Malays and all tribal peoples, but excludes Chinese, Indian and others of imputedly recent immigrant stock.

[20] Aboriginal groups in the Peninsula, except the Semelai, a group of some 2,500 people living in Negeri Sembilan and Pahang, are generally ignorant of brewing methods, a lack not shared by most groups in Sabah and Sarawak.

land are thus rights of use and of the fruits of the land. Amongst the Iban, for example, the ultimate owner is a spirit, one named Pulang Gana from whom the people obtain permission to clear and farm the land through sacrificial offerings and ritual observances. (The notion of God as the ultimate "owner" is not foreign to the Malays amongst whom abandoned land was formerly said to have "gone back to God" — see HILL 1977, p. 45.)

Within this broad rubric, two forms of tenure would seem to exist, one less individualistic and the other more individualistic. The former is represented by the Temiar of Peninsular Malaysia. Of this group CAREY (1976, p. 142) remarks: "... the community ... lays claim to a well-defined tract of jungle, whose boundaries consist of natural features ... the longhouse group normally lays claim to the jungle territory on both sides of a small river and its tributaries, so that the boundaries are formed by the watersheds. The jungle thus claimed is not cultivated all at the same time, but it is looked upon as agricultural potential, an economicunit which marks the boundaries within which actual fields may be selected for cultivation. Moreover, the *saka*, as this economic unit is called, also defines the territorial extent of the fishing, hunting and collecting rights enjoyed by the longhouse group. The elder does not himself own the *saka*, but he may be regarded as a manager or a trustee of the community over which he presides. The territorial extent of each community varies widely, but is generally between about 15 and 40 square kilometers. Rights to land are initially acquired by the clearance of virgin jungle".

The more individualistic forms of tenure of the Iban, Dayaks and related groups also share the last characteristic but in practice, as in most parts of the Peninsula, virtually no virgin forest land now remains outside forest reserves (which are barred to cultivators). Felling and farming for one season confer the right upon the *bilek*-family and its heirs to use a piece of land (for rice-growing) in perpetuity. Like other property, land belongs to the *bilek*-family, not the longhouse community. Whatever else customary land rights may be, they are not communal. The Selako, for example, establish exclusive rights in land by clearing virgin forest for farms. "The first clearer retains the rights during his lifetime and passes these on to his heirs. Ordinarily, a man's estate is divided at or before his death into separate shares for each heir ... (though) a group of heirs will not divide the land but will instead hold it in common, sharing its use among the group" (SCHNEIDER 1977, p. 97). This can lead to control over considerable areas, one prominent chief amongst the Selako controlling over 40 ha, though most families have less than a tenth of this acreage and must borrow land frequently (SCHNEIDER 1977, p. 99). Nevertheless, some land "belongs" to the village community and this includes the longhouse or village site, lands with sacred associations and lands to which cultivation rights have lapsed (DIXON 1977, p. 53). But land is not individual property and, at least amongst the Dayaks, persons leaving the village lose their rights in land by failing to validate them through cultivation. Individuals are not usually able to sell land, since it is "held" by the descendants of the original clearer, though it may be loaned or even rented, usually for one year (DIXON 1977, p. 53).

## PRODUCTION AND MARKETING

Agricultural production follows an annual sequence which varies only slightly from year to year and displays only minor differences from group to group. The process has been described in some detail, for the Iban by FREEMAN (1970, pp. 152—218) and JENSEN (1974, pp. 157—194), for the Temiar by COLE (1959) and more generally, for all the *orang asli* of the Peninsula, by CAREY (1976, esp. pp. 177—196). Every step of the rice production process is marked by rites, even though other crops such as manioc, may provide as much as two-thirds of the basic diet — as amongst the Temiar (COLE 1959, p. 196).

Selection of the clearings is the first step in production. This may be the sole responsibility of the group headman, as amongst the Temiar, or may involve all the elders, the shaman or other persons skilled in taking auguries and all family heads, especially those who have a reputation as skilled farmers, as amongst the Iban (COLE 1959 p. 196; JENSEN 1974, p. 158 ff.). The meeting of the elders has first to decide which area to farm during the coming season. The Temiar base their choice largely upon the interpretation of dreams, whereas amongst the Iban the community elders, led by the *tuai burong*, the elder skilled in hearing and interpreting bird omens, goes to a likely area to observe the birds and their calls. Where the search is for land for a rice farm, the area chosen should bear trees "as thick as a man's arm" or better, i.e. 20 cm in diameter at waist height. For manioc farms, where these are separate, as amongst the Temiar, less attention is paid to the indicators of soil quality, since the crop will grow reasonably well on practically any sort of soil.[21] "Indicator plants" are of some importance in assessing site suitability, the Temiar holding that the wild silk-cotton tree *Bombax larutense*, the palm *Eugeissona triste* and wild mangoes (*Mangifera* spp.) point to soils suitable for all crops, while bamboos (*Bambusa* and *Gigantochloa* spp.) suggest particular suitability for rice (COLE 1959, p. 199). However, should the bird or dream omens be unfavorable, the search proceeds to another locality.

There are further factors in the choice of areas for clearance. COLE has noted that amongst the Temiar, following the acquisition of manioc and subsequently rice, houses became more substantial and their builders more reluctant to move.

[21] It should be noted, however, that the Temiar practice of planting manioc on fallows only three or four years old frequently leads to *Imperata* infestation.

"This desire to preserve the village for as long as possible is very strong and plays a decisive part in the choosing of new farm sites. Even the important Temiar custom of moving the village when the death of a member occurs is taking second place to the desire to preserve the existing village ..." (COLE 1959, p. 197). A further factor in site choice is transport. Not only does the acquisition of a range of personal possessions purchased from the proceeds of the sale of jungle produce, rubber or wage labour increase the reluctance to move the village, but the sheer difficulty of moving to and from a distant clearing, of guarding the crops and of returning with the harvest also influence the choice of site. Where travel by canoe is possible, the clearing may be several miles from the village, for preference upstream.

The second stage, actual clearing, may be preceded by a festival or various rites. Work may begin ceremonially over several days as amongst the Iban or the group may simply set to without further ado. Light undergrowth and brush is first cleared often by women, girls and boys using a bush knife *(parang)*, following which the men take up the work of felling the larger trees using either the traditional flexible-handled adze *(beliong)* or an axe *(kapak)*. Some groups prefer partly to cut all the large trees lower on the slope, completing the job most spectacularly by felling a large tree onto them from upslope, bringing the whole lot down like a house of cards. A period of waiting for the debris to dry out then follows, during which farm shelters are constructed by the respective families and other preparations for planting are made. Should drying not proceed satisfactorily, special "drying" rites may be performed.

The third stage, burning, is crucial to the whole production process, since a good, hot burn will consume the whole of the cleared area leaving only stumps and the largest logs unconsumed and sterilizing the soil. In a "heavy burn", soil temperatures range from about 500 °C at the surface to 100° at 3 cm, whereas in a "moderate" burn the surface temperature may rise little above 200° with a temperature of 100° at 2 cm (SANCHEZ 1976, p. 360). The actual firing is decided by household heads, with mutual consultation where clearings adjoin. Bark torches are employed to light the fires and this too is accompanied by suitable prayers.[22] Where burning has been unsatisfactory, re-burning. for which debris may be dragged into heaps, must be resorted to and it is not uncommon that as much as a quarter of the felled area will require reburning and even this may have to be abandoned should wet weather supervene.

Within a week of a satisfactory burn sowing begins. Amongst the Iban, this is usually a co-operative task undertaken by three or four closely related *bilek* families working together (JENSEN 1974, p. 177). The Temiar usually work in households, each household beginning by planting a "hedge" or fence of manioc

[22] These are of striking imagery; see those quoted FREEMAN (1970, p. 181) and JENSEN (1974, pp. 175—176).

cuttings to mark the boundaries of the plot. Maize and vegetables are planted in patches on an easily accessible perimeter of the plot and planting of maize and cucurbits may be continued out into the area destined to receive rice, a practice which does the rice little harm since these crops mature well before the rice begins to flower. The seed rice is planted after a further series of propitiatory rites, the "sacred rice" (*padi pun* in Iban) being planted first. Teams of two, a man and a woman, plant the seed, the former making a hole for the seed with a dibble, the latter following and dribbling from five to thirty seeds into each hole, a task calling for considerable manual dexterity and accuracy of aim. The holes are covered with a quick movement of the foot. The average sowing rate is about 30—60 kg/ha. The overall pattern of planting is far from haphazard and the various varieties of rice are carefully sown so that they mature, chronologically and areally, to conform with a pre-arranged plan.

As the rice grows, various rites may be performed to encourage its progress, especially if the weather is less than ideal. Until the flowering stage, the crop suffers little from an overabundance of rain, though this may be serious later as it delays ripening and, if accompanied by heavy winds, may cause the crop to lodge which adversely affects the harvest. Drought is much more serious, especially after flowering, since the grains do not fill out properly and there may be a high proportion of empty glumes at harvest. Until the growing crop forms a closed canopy and effectively suppresses much of the weed growth by reducing the light intensity at the soil surface, weeding is a never-ending task, or should be if yields are to be maximized. Weeding is almost entirely a female task, though some groups, for example the Temiar, are said to so detest it that little is done, banana and manioc patches in particular, never being weeded (COLE 1959, p. 201).

As the rice harvest approaches, crop protection becomes important and field huts are occupied overnight. Bird-scaring devices include clappers, gongs, rattles, scare-crows and, amongst the Kadazans of Sabah, ingeniously constructed clacking windmills become part of the agricultural landscape. But the harvesting of other crops long precedes this, maize and vegetables maturing about three months after planting, while manioc roots can be lifted after eight months though they can be left in the ground for at least another year without damage. Bananas are ready between eight and twelve months after planting. The maturation period of rice is 140—160 days.

The rice harvest is the high point of the agricultural year, even if in dietary terms rice is not the most important foodstuff. Preceded by propitiatory rites, the grain is harvested panicle-by-panicle, using a small annular knife, a practice which avoids disturbing the "rice soul" *(semangat padi)*. The men then carry backbaskets of the *padi* back to the settlement where it is normally threshed, though if the field is distant, threshing may be done then and there and only the grain carried back. Treshing is done by laying out the grain on mats and trampling it underfoot, a task which takes only a day or so, in contrast to reaping which may occupy anything between one and three weeks. Various ceremonies appropriate to the "harvest home" are then performed. Rice is invariably stored in the husk (i.e. as *padi*), though practice varies from group to group as to whether the panicles or the threshed grain is stored. Husking of the rice is a daily chore and amongst most tribal peoples performed by women using a wooden pestle and mortar, a practice which retains the nutritive value of the endosperm of the grain while leaving it slightly off-white in colour as compared with the less-nutritious machine-polished rice.

The cycle of production thus takes most of the year as is illustrated in *Table 16*.

*Table 16*

The annual cycle of cultivation at Rumah Ancheh, Lemanak District, Sarawak, 1962/63

| Activity | Date |
|---|---|
| *Manggol* rites | 7 June |
| Clearing begins | 14 June |
| Clearing and felling completed | 14 June |
| Firing | 31 August |
| Planting catch-crops | 2 September |
| Dibbling and sowing begin | 7 September |
| Dibbling and sowing complete | 7 September |
| Planting rites | 27 September |
| Weeding begins | 14 October |
| Growth-promoting rites | 16/17 October |
| Weeding completed | 16 January |
| Harvest inauguration rites | 27 February |
| Carrying home rice begins | 26 April |
| Carrying home rice ends | 13 May |
| *Gawai* festival | 5 June |

*Source:* JENSEN 1974, p. 159.

This annual round not only occupies most of the year, it also occupies most of the time of the able-bodied, though where shifting cultivation is "partial" or supplementary rather than integral, the patterns are rather different. The manner in which these interlock is described in detail for the Kadazans of Sensuron (Interior Residency, Sabah) by WILLIAMS (1965, pp. 68—77), though amongst this group, shifting cultivation accounts for only about 15 per cent of total rice production. A further illustration is to be found in *Figure 16* which

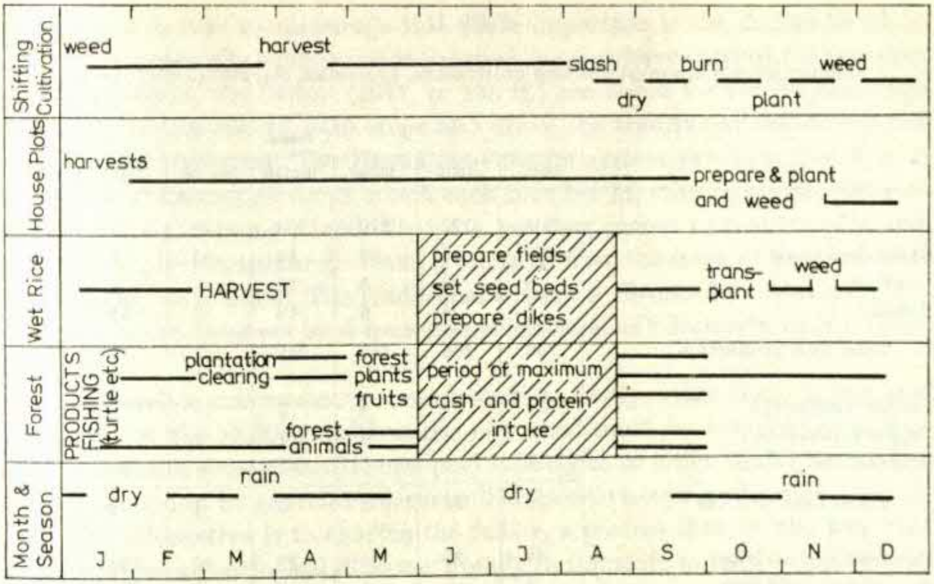


*Fig. 16.* **Seasonal cycle of economic activities amongst the Temuan of Southwest Peninsular Malaysia (after GALL 1977)**

gives details of Temuan agricultural cycles in an area of two annual rainfall maxima where there is a rather more even annual labour commitment which rises to a maximum during the mid-year dry season.

## SHIFTING CULTIVATION IN THE ECONOMY

Although shifting cultivation is obviously of fundamental interest in the economy of shifting cultivators, it is not the only activity of importance. ***Figure 15*** has already indicated the importance of other ecological zones and production systems and even amongst peoples whose primary interest is in shifting agriculture, the pattern of labour commitment indicates a wide variety of activities which also vary according to the age and sex of members of the community. This is illustrated for an Iban group at Lemanak *(Table 17)*.

While the data for Karin are atypical by reason of injury, the remainder show very strikingly the heavy concentration upon food-getting amongst able-bodied adults, with a compensating concentration on domestic activities by the elderly. Despite the great variety of religious observances, mostly associated with the cultivation cycle, the number of unproductive days on this account is remarkably small and the total unproductive time is probably less than amongst workers in the West. The proportion of time spent in obtaining sources of cash income is strikingly low for this group, but in other areas this is

*Table 17*

Labour inputs amongst shifting cultivators, Lemanak, Sarawak (man-days)

| | Person | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sawai | Karin | Burai | Rentap | Mangai | Ungkir | Banun |
| Hill rice | 205 | 127 | 210 | 208 | 192 | 12 | 11 |
| Other food crops | 39 | 15 | 40 | 13 | 60 | 2 | 13 |
| Hunting | 8 | 18 | 5 | 18 | 6 | 1 | — |
| Fishing | 4 | 6 | 4 | 10 | 7 | 42 | — |
| Total food production | *256* | *166* | *259* | *249* | *265* | *57* | *24* |
| Rubber production | 20 | 29 | 5 | 7 | — | — | 13 |
| Pepper production | — | — | — | 1 | 1 | — | — |
| Wage labour | 1 | 8 | — | — | — | — | — |
| Total 'Cash' sources | *20* | *37* | *5* | *8* | *1* | *0* | *13* |
| House-related activites | 43 | 36 | 40 | 38 | 40 | 125 | 120 |
| Animal and child care | 4 | — | 1 | — | 2 | 154 | 15 |
| Total domestic activities | *47* | *36* | *41* | *38* | *42* | *279* | *135* |
| Religious observances | 28 | 36 | 35 | 40 | 36 | 21 | 22 |
| Sickness, rest | 14 | 90 | 25 | 30 | 22 | 8 | 171 |
| Total non-productive days | *42* | *126* | *60* | *70* | *58* | *29* | *193* |

*Note:* Sawai — F aged 19 unmarried; Karin — M aged 20 unmarried; Burai — F aged 22 married, no children; Rentap — M, aged 49, married, children; Mangai — 45, Rentap's wife; Ungkir — M, aged 64; Banun — F, aged 63.

*Source:* JENSEN 1974, p. 45.

much higher. Also striking is the absence of time spent in marketing produce. While this may be an omission by the researcher (Jensen), it may also reflect the fact that traders penetrate most areas to buy up jungle produce, such as fruits, rattans, resins, and where close to easy transportation, bamboos, and sometimes, surplus rice. Rubber and pepper may also be purchased by these itinerant merchants who are usually Chinese. The degree of commercialization of the tribal economy is thus highly variable, but for the most part, actual shifting cultivation is little affected.

## PROBLEMS AND PROSPECTS

Though shifting cultivation may be but little affected by commercialization in a direct way, its indirect influence may be considerable though varying from area to area according to the availability of flat land for wet rice farming and government moves to encourage this. More important is the degree to which cash crops, especially rubber and in Sarawak, pepper have entered the economy of tribal peoples. As DIXON (1977, p. 195 ff.) has noted for the Dayak, aside from the obvious effects, cash crops also affect the traditional Dayak agricultural system indirectly. The Dayak land tenure system provides that land is owned by a descent group of which each member inherits rights to cultivate some part of the group's land. Should a member choose to plant a perennial crop instead of rice, this area of land is removed from the stock of land available to the group as a whole. The traditional system is ill-suited to cope with this situation which removes land from rice cultivation as effectively as if it were sold.

Three possible consequences stem from this: firstly, since there is less land available for the shifting cultivation, new land must be acquired, but here difficulties arise since potential new land is likely to be either under the control of another group or government-controlled forest reserve and hence unavailable. The alternative is to shorten the fallow, a process that, in the long run, is likely to be an ecological disaster. Finally, a full shift to cash cropping may ensue though this is yet to take place on any significant scale. Coupled with this would necessarily be the abandonment of shifting cultivation and the emergence of property rights in land. So far, the introduction of perennial crops has not led to this change and as long as sufficient hill land remains on which soils have had a chance to regenerate properly, these crops can be successfully integrated into the economy. Rubber, which benefits rather than suffers from periodical neglect, is more appropriate a crop than pepper in maintaining an equilibrium amongst land availability, soil resources, man-power and the goals of the people. But overall, there can be little doubt that the days of shifting cultivation are numbered and in many areas the next 50 years will probably see a marked swing towards perennial tree-crops and a cash economy.

CHAPTER 7

# SEMI-COMMERCIAL (PEASANT) RICE-GROWING

The concepts "tribal" and "peasant" both subsume the sorts of societal groups which engage in agriculture basically because the family (and the tribe or village community) must provide a substantial proportion of its basic needs for food and shelter directly from its own resources. The fundamental objective of the practice of agriculture and related subsidiary activities such as fishing, hunting and collecting is the maintenance of the family, present and future, and to a varying degree, the maintenance of the local community as well. The main economic differences between tribal agriculture based upon shifting cultivation and peasant agriculture based mainly upon sedentary cultivation is that the latter involves the sale (either directly or indirectly) of a significant portion of production, contributing notably to the national economy. The major social difference is that tribespeople are members of small-scale social units while peasants are members of larger units. In location, tribal agriculture is peripheral and upland, while peasant agriculture is central and lowland.

The general pattern of location of lowland rice-growing has been indicated earlier (see Chapter 5), and some of the reasons for its lowland concentration have also been mentioned. The total number of people involved in and dependent upon lowland rice cultivation is not easy to estimate. Attempts to enumerate the number of padi farmers in the labour force have not been particularly successful, mainly because of definitional problems during surveys. The 1947 census of population, for example, indicated that there were some 470,000 padi farmers in Peninsular Malaysia, comprising a quarter of the employed population, but an employment survey in 1962 showed that there were only about 300,000 making up 13 per cent of the workforce, though this survey clearly indicated a further 126,000 padi farmers "outside the labour force" (PURCAL 1965, p. 49 and 51). In 1973, the Malaysia Official Year Book estimated that about 20 per cent of all economically active persons were rice farmers. It is unlikely that this proportion has changed significantly and on this basis perhaps 800,000 people, 40 per cent of the work-force in the primary sector of the economy may be considered to be employed in rice-growing of one sort or another. This includes shifting cultivators, however, and a rough estimate of 700,000 peasant farmers engaged in growing wet rice, with or without supplementary shifting cultivation or perennial crops would be of the correct order.

Perhaps the most striking feature of wet-rice cultivation is that in the Peninsula, growers belong to one ethnic group — the Malays. Temiar shifting cultivators regarded rice in general and wet rice in particular as a Malay crop (HILL 1977, p. 168), a view that would seem to be shared by all the other groups in the region. With only minor exceptions, such as the Temuan, the growers of wet rice are Malay. In Sabah and Sarawak, where Malays are in a minority and traditionally were traders rather than peasants, the growing of wet rice is a basic trait of lowland tribal peoples, whether they are coastal groups such as the Tuaran Dusun (Kadazan) of Sabah's west coast, peoples of the interior basins such as those of Sensuron described by T. R. WILLIAMS (1965) or those of the far interior such as the Kelabits of Sarawak (HARRISSON in HILL 1977, p. 12). But amongst these, as amongst the Malays of the narrow valleys of the interior of the Peninsula, shifting cultivation is, or was, an important supplementary activity.

## HISTORICAL BACKGROUND[23]

The practice of growing rice in the carefully-prepared and maintained environment of artificial swamps (termed *sawah* or *bendang* in most of the region) is probably a fairly late introduction to the area, though the crop itself, *Oryza sativa*, would seem to have been introduced in pre-historical times, having reached East Malaysia by about 500 A.D. Cultivation in bunded fields may have been introduced to the Peninsula as late as the fourteenth century, while irrigation techniques, in the sense of applying water to the land in controlled amounts, is a later nineteenth century introduction, still being confined to the Minangkabau peoples of Negeri Sembilan, parts of Perak and inland Pahang. Large-scale irrigation, involving thousands of hectares from a single source is even more recent, all the major schemes, except that in the Krian district of Perak, having been constructed since the 1950s.

In the Peninsula, the strong dominance of the northern states has already been noted, but this deserves some explanation which necessarily involves the historical evolution of rice agriculture in the region, as well as features of the physical environment.

In part, the reasons are *meteorological*: three or four wet months are followed by at least two or three dry months in which clear skies prevail to promote satisfactory growth and ripening of the crop. In part the reasons are *topographical*: there are extensive plains of alluvial origin in the north of the Peninsula which are reasonably fertile, fairly easily drained and not peaty. In the south, by contrast, as in much of coastal Sarawak, the plains of the major rivers, the

[23] A fuller discussion of these matters is to be found in HILL 1977, Chapters 1–3.

Perak, Bernam, Selangor, Langat and Pahang, with those of Johor, are either limited in extent, or contain extensive areas of peat and muck soils (Histosols), or have gradients so low as to make drainage difficult.

But these are only partial explanations and other reasons for the dominance of the northern areas in the Peninsula lie deeply embedded in history, much of which defies anything beyond imprecise formulations. It is possible, though on existing evidence unlikely, that rice-growing, though not in wet fields, dates back two millenia to the Hoabinhian culture. Evidently, early populations grew slowly both by natural increase and as a result of a centuries-long southward drift of people from continental Southeast Asia, some of whom ultimately introduced the bunded field technique and others of whom introduced the plough. The economic significance of the bunded field – this artificial swamp – is that yields are raised and their reliability is improved by providing a controlled environment, but at the cost of an increased labour input. The extent of bunded fields would seem to have grown slowly and to have been accompanied by a steady growth in dependence upon rice, since, unlike the hill slopes, the wet-field environment is one which is largely unsuited to the simultaneous cultivation of rice and other crops.

The spread of the plough is also a puzzle, though its absence from East Malaysia, parts of Pahang, Johor and coastal Perak until recent historical times is firmly based. Archaeological evidence, though less than fully satisfactory, and linguistic evidence both point to its early existence in Kedah. It may be presumed that the plough displaced the practice of *melanyak* tillage which involved turning buffaloes onto the flooded fields to churn the soil with their hooves to a requisite consistency before planting the rice. *Melanyak* tillage survives to the present day in Sabah. The economic significance of the plough is twofold: *first*, it may be symptomatic of a reduction in the numbers of buffalo consequential upon a decline in the amount of fallow and other waste land available as rough grazing, due to the spread of annual cropping of wet rice; *second*, the adoption of the plough would have necessitated a greater labour input for no increase of crop yield, and may even have entailed a fall in yield since no longer would there have been an input of dung from the animals.

What is clear is that from the foundation of the British settlement at Pinang late in the eighteenth century, a process of commercialization of production began, especially in Kedah and Perlis just across the water. This, together with increases in the Malay population[24], led to a swing away from cultivation involving short-term (1–3 year) fallows under grass, which would seem to have been usual in a number of areas including Kedah, Perlis and Kelantan, towards

[24] The total population of Peninsular Malaysia in 1834 was about 425,000 and by the date of the first satisfactory census in 1911, had reached 2·6 million, of which the Malay, largely rice-growing, component was 1·4 million (Hill 1977, p. 177).

annual rain-fed cultivation. Moreover, as British political control began to take hold in Perak, Selangor, Negri Sembilan and Pahang from the 1870s on, the legal prohibition of shifting cultivation, increasingly enforced, led to the sudden adoption of intensive methods where these had not previously existed. However, such was the pace of Malay immigration from other parts of the Archipelago, that in Province Wellesley (now Sebarang Prai) and in the Krian district of Perak, south of the northern core area, intensive commercialized production, virtual rice monoculture, was the rule from the beginning of large-scale settlement – in the Province from the 1820s and in Krian from the mid-1870s. Throughout this region, the basis of production remained the peasant family, but the basis of appropriation was commercialized though retaining traditional elements, especially the entrepreneurial role of some of the traditional aristocracy.

In colonial times then, a von Thünen-like pattern of land use zonation emerged, in which permanent (or short-fallow) rice agriculture played a major role. The clearest example is that of Pinang where an inner zone of intensive fruit- and vegetable-growing in which wet rice had some place lay in the immediate environs of Georgetown. A second zone of commercialized rice production (with annual cropping and minor production of fruit, vegetables and livestock) was formed by the accessible areas of western Pinang island, the Kedah/Perlis plain, the northern districts of Province Wellesley and Krian. Beyond this lay a third zone of extensive agriculture, in which rice-growing was combined with livestock rearing, rice cultivation occupying one year in two or three and stock, mainly buffaloes, being grazed upon the grass fallows and used for *melanyak* tillage. Here, the rice was for subsistence and the livestock were sold. This zone comprised the northern and eastern margins of the Kedah/Perlis plain, inland Province Wellesley and the Perak valley. Beyond this yet again lay a zone of shifting cultivation.

In social terms, a further important change occurred during the colonial period. Where once the peasant who accumulated property and wealth was likely to invite their confiscation by the arbitrarily exercised powers of local despots, under the imperial power this was not possible, so that whoever by skill and energy carved out a substantial property was able to retain it. The fact that in the context of pioneer settlement some peasants were able to obtain land suitable for development into holdings capable of producing far more than was needful for simple subsistence was a potent factor in the emergence of a new "rich peasant" class. A necessary concomitant of the emergence of the rich peasant class and increasing competition for land was the emergence of a class of tenants, though these tenants were not necessarily landless. At the same time, the abolition of slavery and bonded labour added to the numbers of rice-growing peasantry. Paralleling these changes in social organization was a change in attitudes towards land. Where once land was "owned by Allah", and controlled by the local raja as "God's trustee", under the colonial regime land became real property and by 1910 a market in rice land had developed in most parts of the Peninsula. Rice land, even with tenants on it, was bought and sold and the tenant became a source of income, not only for the traditional aristocracy many of whose bondsmen became tenants, but also for the rich peasants.

In the twentieth century, these essential lineaments have remained. The social and technical bases, especially the former, are different only in respect of the virtual disappearance of extensive (grass-fallow) cultivation, improved water supply, the recent introduction of double-cropping (i.e. two annual rice crops), the use of improved seed, artificial fertilizer and a modicum of mechanization.

The dominance of the northern states in the Peninsula has been maintained since 1911/1912 when they accounted for 83 per cent of the Peninsular total of 257,210 ha, though the proportion of that total accounted for by the northwestern states fell from 60 per cent in 1911/1912 to 56 per cent in 1971/1972 with a compensatory rise in the northeast (Kelantan and Terengganu) from 23 per cent to 27 per cent. The increase in total area has been small, only 40·6 per cent over the sixty years, representing a simple average of only 0·68 per cent per annuum. Were production data also available, they would doubtless show a faster rise partly as a consequence of the disappearance of grass-fallow cultivation, except from parts of the interior alluvial basins of Kelantan and Terengganu.[25]

Apart from a brief period in the 1890s when British officials took some interest, large-scale irrigation received little real attention until the 1950s. The Krian Irrigation Scheme was expected to create a "granary of Perak", but this expectation was not realized as substantial portions of the irrigated area were planted to sugar. Generally, the official attitude was that while large-scale irrigation was desirable (and in some areas essential to land development and settlement), government investment in such works would have to pay its way and this simply was not possible. Matters became critical in 1919–1921 and again during the world-wide economic depression of the 1930s when those in government who held that the domestic supply of food was of vital importance to the country finally won out over those who held that rice cultivation was of comparatively small importance, since with a satisfactory market price for export crops, the country could buy its rice requirements from abroad. The latter view had prevailed earlier because then, as now, the profits arising to farmers from rice were lower than from rubber (ANONYMOUS 1931, p. 27). The result, especially in the Federated Malay States of Perak, Selangor, Negeri Sembilan and Pahang, was the planning of large-scale irrigation works. However, war and the terrorist "Emergency" of the 1950s intervened, and little

[25] These survivals are discussed in detail by HILL (1964).

was done until after the independence of Malaya, now Peninsular Malaysia, in 1957. Though efforts to provide the physical infrastructure bore little fruit, one major advance during the 1930s was the institution of a guaranteed price system which has continued since then, together with hidden subsidies on water supply has resulted in high-cost production relative to the Southeast Asian norm.

Where in the 1930s Malaya imported 70 per cent of its rice requirements, by 1967 this had fallen to about 36 per cent and to 15–20 per cent by the late 1970s, though the obstensible policy objective of complete self-sufficiency by 1980 was quietly dropped. This dramatic change has involved very large capital expenditure, especially for irrigation works. The Muda Project, which involved the supply of water to irrigate 18,700 ha in Kedah and Perlis sufficient for two rice crops yearly instead of one as hitherto required an expenditure of almost US$5,000/ha for irrigation and ancilliary works, plus a further US$1,200/ha for loans to provide tractors, harvesters, fertilizers and insecticides (Bean 1969).

The basic objective of these and similar developments is to make the growing of rice fully commercial and, from the farmers' point of view, a viable alternative to the growing of rubber and other cash crops. The achievement of this objective has involved a technical transformation of production, especially the introduction of two rice crops annually in place of one to the extent that by about 1971 some 44 per cent of Malaysia's wet rice land was double-cropped, while the off-season crop represented 51 per cent of the main season crop in terms of production.

Government visions of two rice crops a year go back at least to 1897 when the engineer in charge of the Krian Irrigation Scheme envisaged one crop of a slow maturing heavy-yielding variety and another of a fast maturing lighter-yielding variety. Double-cropping was attempted in Negeri Sembilan in 1899 while in the Langat district of Selangor, Javanese farmers had succeeded in producing two crops in a year in 1889 (Hill 1977, p. 114, 132 and 156). But these were ephemeral activities and it was not until the 1930s that further attempts were made in the then Province Wellesley. During the Japanese Occupation some success was achieved using short-term "Taiwan" types and by 1962/1963 the total area double-cropped in Peninsular Malaysia had reached 18,700 ha, although this still represented only five per cent of the total rice area. The early growth of double-cropping in Province Wellesley may be attributed to two factors: firstly, the initial test area was one of long-standing, with a dependable supply of irrigation water and double rainfall maxima; secondly, local farmers were regarded as "progressive" and had long contact with Western influences and ideas. Moreover, Pinang is a small state, short of land to feed a burgeoning population whose needs could be further met only by intensification (Rutherford 1966, pp. 248–251). The incidence of tenancy was (and remains) high in the area and since tenants paid rent only on main crop land, the entire profits of the off-season crop went to the cultivator.[26]

Although year-round controlled water-supply was one technical key to double-cropping, there were others, notably the use of short-term varieties (120—140 days from transplanting to maturation) and, especially, mechanical soil preparation for the off-season crops. This has been essential not only because the time-slot into which this process must be fitted is very short, but also because the widespread practice of double-cropping involves a fall in the numbers of buffalo due to the severe reduction in the time when stubble-grazing is possible from several months to a few weeks or even days. Mechanized soil preparation takes about five hours per hectare compared with two to two-and-a-half weeks by hoe or buffalo-drawn plough (RUTHERFORD 1966, p. 253). These recent changes have not been without problems, often because the new system is not entirely adequate to cope with local conditions or because the cost of change outweighs its advantages. These matters are discussed later, since they belong as much to the future as to the past.

### SUB-TYPES

The terminology of rice cultivation in the Malaysian region is more than a little confused. While the term "wet rice" is clearly equivalent to *padi chedongan* (transplanted rice), grown in standing water regardless of whether this is applied by irrigation or simply by entrapment of rainfall and natural rise of the water-table, the term "dry rice" is ambiguous. In the region, all non-transplanted rice, even if it is grown in flooded conditions, is referred to as "dry". To further compound the confusion, rice cultivated under all but one system is grown during the wet season (HILL 1966, p. 73). The term "permanent rice" cultivation is preferred, though grass fallow rice-growing which involves short-cycle swiddening (cropping one year in two or three) may also be included, since it is practised by people who are more correctly termed peasants than tribespeople and who can be regarded as "semi-permanent" rather than "shifting" cultivators, especially as the fallows are used for pastoral purposes, and cultivation methods approximate those of annual cultivation.

Data do not permit the definition of sub-types of semi-commercial (peasant) rice-growing in terms of the World Typology — only its application at the field-study level could do this —, so that the definition of sub-types must rest largely upon differing techniques, concerning which there is adequate knowl-

[26] RUTHERFORD (1966, p. 252) also points out that this comparatively happy state of affairs did not last and rents (in the form of a share of the crop) came to be charged on both crops — a practice subsequently made illegal.

edge. Social and economic characteristics necessarily receive little attention, though in terms of the degree of commercial orientation, the less intensive and less productive[27] systems (grass fallow and annual cultivation with broadcast sowing) are the least commercially oriented, while the most intensive systems (two annual rice-crops and experimental continuous cultivation) have the greatest degree of commercial orientation.

As *Figure 17* shows, using the factors of topography, season of cultivation, rotation, water supply and control, as well as the various processes of cultivation and harvest, a wide range of sub-types may be recognized. These, and the whole question of rice typologies and terminology have been discussed in detail by Craig (1933), by Hill (1964, 1966, 1970) and by Hill and Uhlig (1969).

The least intensive sub-types are also the least common, though they were once of considerable importance, and all involve lowland cultivation, though without transplanting (types 27 to 31 in *Figure 17*).[28] Short-cycle cultivation, with one year of crop followed by two years of fallow under grass and herbaceous adventive vegetation, is confined to the alluvial terrace country of inland Kelantan and Terengganu. The soil is not actually tilled and clearing is by heavy knife *(parang)* and in the Peninsula by a type of hand-hoe termed *keri* which can do little more than skim the surface. Rice seed is planted by dibble or may be broadcast, and may be intercropped with maize. Where burning is practised, maize and squash (Cucurbitaceae) are planted in the ash heaps. A further variant involves the ploughing up of grass fallows (sub-type 33). Irrigation, combined with grass/scrub fallow, occurs in Sarawak (sub-type 31).

Akin to these one-year-in-three types is the cultivation of *padi tenggala*, once common on the alluvial terrace lands of Pahang. This also involves grass fallowing, but the cycle of both cultivation and fallow are longer, the former being two to three years followed by four to six years of fallow during which the land is used for grazing (sub-type 28).

*Kendinga padi* (sub-type 32) is rather more intensive in that the fallow is lacking, though it shares the common characteristic of promiscuous cultivation in which rice shares space with other crops.

Most types involve at least one rice crop every year and this probably is the practice on at least 98 per cent of the flat land. Nevertheless, it should not be thought that this involves the widespread practices of ploughing and trans-

27 "Productive" in terms of area.

28 Misleadingly, they have been referred to as "dry rice" systems of cultivation in the older literature and statistics, but it is the method of planting, broadcast or dibble rather than transplanting, which particularly distinguishes this group. Recent detailed statistics are not available, but in 1964 "lowland dry rice" occupied about 10,500 ha in the Peninsula and in Sabah, *kendinga padi*, which falls into this same group occupied just under 1,000 ha in 1970/1971. "Lowland dry rice" (i.e. "lowland non-transplanted" rice) comprises sub-types 14, 16, 18, 26—31 in *Figure 17*.

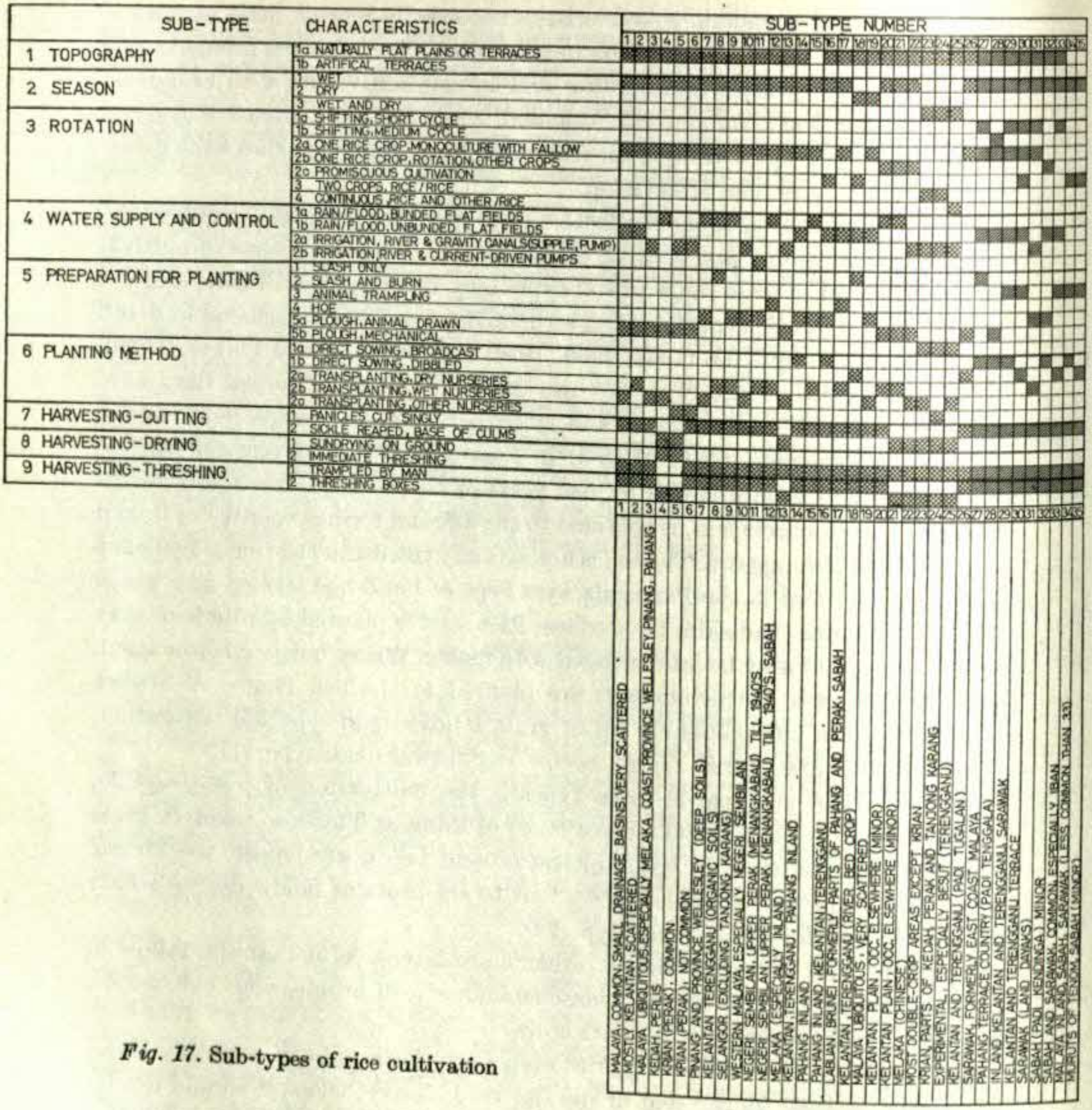


*Fig. 17.* **Sub-types of rice cultivation**

planting. In Terengganu, that veritable museum of rice cultivation practices, annually-cultivated rain-fed rice is sown broadcast, or more commonly, dibbled into bunded fields prepared by ploughing. Hoe tillage may also be substituted and this allows inter-cropping, with citrus for instance. During the dry season river beds may be exposed, and there rice may be intercropped with maize and vegetables on hoed land.

Nevertheless, by far the most common type is rain-fed rice with dry season fallow and this comprises about half the total lowland rice area. Locally, especially in Kelantan and increasingly elsewhere, dry crops such as maize or groundnuts replace the fallow. On the Melaka plain, Chinese rice-growers grow vegetables in the dry season though in recent years rice has tended to be abandoned in favour of growing vegetables the whole year round.

Scattered about the main cultivation areas are low-lying tracts, termed *tanah dalam* in Kelantan, often marking abandoned river channels. These are too deeply flooded during the rainy season to be cultivated and traditionally were cropped during the dry season. Where such lands now lie within irrigation areas, however, they are flooded all the year round and have gone out of production (Bray 1977, pp. 12—13).

Except amongst the Minangkabau peoples, artificial irrigation cannot be regarded as "traditional". In the region some 200,000 ha are now irrigated during both the wet and dry seasons, and two annual rice crops are taken. However, not all irrigated land is occupied by two crops each year for two reasons. Firstly, in some areas farmers simply have not accepted the desirability of cultivating an off-season crop, and secondly, not all irrigation areas have a water supply sufficient to serve the whole area during the dry season. In the 1960s in Peninsular Malaysia, for example, less than half of the irrigated area (48 per cent), then totalling 41,670 ha was actually double-cropped, though this proportion has risen markedly since then (Hill 1966, p. 73). Irrigation is largely by gravity flow from rivers, sometimes with limited storage, as at Krian and Muda, or supplemented by pumping during periods of low water level. Flood irrigation is usual and the distribution systems mostly lack a tertiary canal network to bring water directly to each field and allow "fine control" of amount and timing of water application.

Within the broad grouping of rice (with or without off-season dry crops), there is a wide range of practice as indicated in ***Figure 18***. The use of the animal-drawn plough is by no means universal and in double-crop areas it is disappearing. Hoe tillage is largely confined to inland Melaka and Negeri Sem-

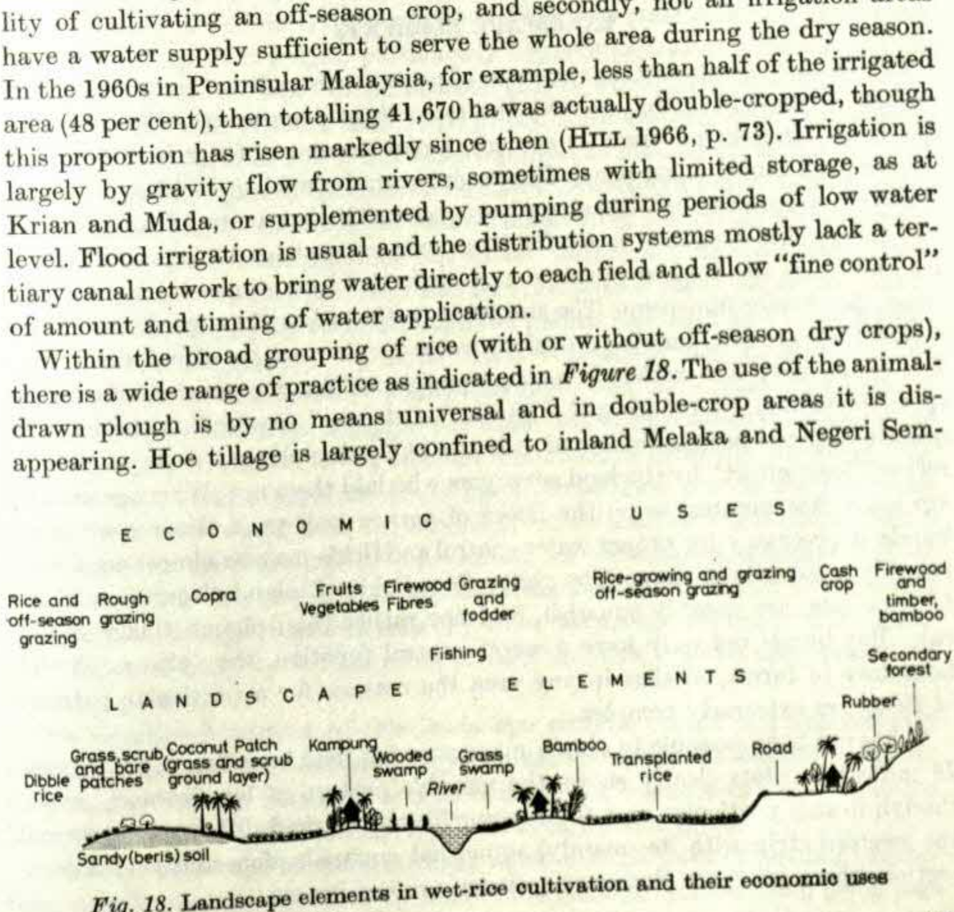


*Fig. 18.* **Landscape elements in wet-rice cultivation and their economic uses**

bilan and to very small holdings elsewhere, while soil preparation by animal trampling *(melanyak)*, once common in the Peninsula, survives only in Sabah. Broadcast and dibble sowing also survive there and in the remoter areas of the northeast of the Peninsula. Reaping by means of the traditional annular knife, identical with that used by shifting cultivators, is also quite widespread, though being steadily supplanted by sickle harvesting. Immediate threshing is usual, though storing of the panicles in bunches is also practised. Where panicle-cutting is practised, threshing is by trampling underfoot or rarely by simultaneous husking and threshing in a mortar. Where the culms have been cut at the base, threshing by hand into threshing boxes is usual. Simple threshing and winnowing machines are no longer entirely lacking, virtually all farmers in the Muda district owning a winnower (Ministry of Agriculture and Co-operatives, 1967, *Table 32)*. The common Indian and Thai practice of threshing by animal trampling is now entirely unknown.

## LANDSCAPE ELEMENTS

The main elements in the landscape of peasant rice cultivation fall into two groups — the field (mainly in rice) and the village *(kampung) (Fig. 18)*. The rice-fields landscape is familiar enough, broad expanses of flat land bounded by low mud bunds being usual. Fences are entirely lacking. Field size (as distinct from farm size) and field shape have received little attention from scholars, but the general tendency is for fields on extensive plains to be about 0·5 to 1·5 ha in size, rectangular in shape and with the long dimension around 10 times the shorter dimension. The size partly reflects low slope gradients, since where they are low, bunds to control water levels may be placed far apart. The shape may also reflect a general preference for elongated fields which speed ploughing by reducing the number of "turns" required. Although the question has not been investigated, it is also likely that elongated shapes simply reflect "least effort" by the land surveyors who laid them out. Where gradients are somewhat greater, as on the floors of narrow valleys, a closer spacing of bunds is necessary for proper water control and fields may be almost square or roughly crescentic in shape. The valley-floor fields of inland Negeri Sembilan, for example, are notably squarish, and hoe rather than plough tillage is the rule. But bunds not only have a water control function, they also mark the boundary of farms, so that in any area the reasons for a particular pattern of fields are extremely complex.

It has not been possible to obtain maps showing field boundaries, but *Figure 19* indicating plots clearly shows the variable pattern of lot size and shape, though in this particular case the reasons for the marked differences between the western strip with its (mainly) somewhat squarish plots and the eastern section where most are elongated in form, are not known.

The bunds occupy a significant proportion of the fields, DOBBY *et al.* (1955, p. 91) reporting that in Batu Hampar *mukim*, Negeri Sembilan, 18 per cent of the rice-field area was so occupied. Bunds are generally colonized by various grasses, in the north of the Peninsula, often by *Eupatorium odoratum*, a "migrant" from Thailand which has spread from the *kampung* area. Only rarely do bunds have other forms of vegetation, though in parts of Perlis, "mengkuang" *(Pandanus* spp.) occurs in small clumps at bund junctions, where they form the "home territory" of marauding rice-field rats.

The rice-fields themselves are occupied by plants other than rice, especially during the fallow and early in the growing stages of the crop, though the total biomass of plants other than rice falls steadily as the latter grows and casts shade. Many of the common rice-field weeds are grasses, including barnyard millet *Echinochloa crus-galli*, *Isachne* and *Paspalum* spp. and the herb *Utricularia flexuosa*. Most die down during the fallow period and are replaced by other grasses with sedges in wetter spots. The fallow of the northern parts of the Peninsula is colonized by the grasses *Paspalum orbiculare* and *Brachiaria distachya*, along with sedges, particularly *Cyperus pilosus* and *Scleria* spp. to form a fairly close carpet of herbaceous plants which may also include the water-fern *Morsilla* (DOBBY *et al.* 1957, p. 49). A further important component is *Eragrostis unioloides* which has been reported as making up to one third of the total herbiage grazed by animals on fallow sawahs (BURKILL 1966, p. 949).

The second major landscape element is composed of the loosely agglomerated groups of houses of wood, bamboo and thatch which make up the village. Each house or group of houses is surrounded by fruit trees such as rambutan, duku, durian, and especially by coconut and betel palms. Rubber may also be a component. "Kitchen gardens" provide fresh vegetables such as spinach, the brinjal *(Solanum melongena* – Malay "terung") and chilli *(Capsicum* spp. – "chabai"). Together these comprise the ubiquitous *kampung* cultivation, to be found not only in rice areas but amongst smallholders generally. In Sabah, the number and variety of fruit trees would seem to be fewer than in the Peninsula and to be located away from the dwellings rather than amongst them. Where a slope adjoins the plain, a piedmont location for the *kampung* element is characteristic, while in more extensive plain areas location on higher terraces and especially on the light textured soils of former beach ridges is usual. A considerable degree of linearity is thus often present and this may be accentuated by the road pattern.

One significant variant of this landscape pattern occurs in areas recently developed for rice cultivation in government-sponsored settlement schemes. At Tanjung Karang, Selangor, and on some minor schemes such as at Sungai Mati, Johor, individual dwellings are located in the rice fields.

A further landscape element in many areas is some form of natural vegetation, usually strongly modified by human interference. Rather than being just a reserve of land for future development, most of such areas have an economic function. In Padang Pauh *mukim*, Perlis, for example, the economic role of a patch of secondary forest, together with road and river side trees such as the sago palm *(Metroxylon sagu)* was reported upon by DOBBY *et al.* (1957, pp. 48–49). Most component species were used as firewood, while *Litsea grandis*, *Pithecellobium confertum*, and two species of *Eugenia* were of particular value in house-construction. Bamboo was also widely used for building purposes, making fish traps and baskets, while the shoots of one species were eaten. The pith of the sago palm provided food for man and poultry whilst the leaves were used for making thatch *(atap)*: the fronds provided a tough flooring material and the inside skin was plaited into food and other covers. The fan palm *Corypha utan*, though now found only in limited stands near dwellings, makes excellent mats and is tapped for palm sugar (jaggery) which is prepared by boiling down the sap.

Grazing grounds which are never cropped form another landscape element of variable size and importance, usually fairly minor, except perhaps in parts of Kedah and Perlis in the northwest of the Peninsula and in the "sand-ridge and swale" terrain of the northeast. The vegetation of such areas is almost entirely adventive, though in the northeast attempts have been made to establish stands of the tropical legume *Stylosanthes gracilis* in an endeavour to raise plant productivity for grazing. This is generally very low with grazing intensities of the order of one beast to 5–10 hectares being usual. Grazing grounds commonly occupy areas of markedly difficult soils; in Perlis, for instance, they are found on sedentary soils where a lateritic pan may exist close to the surface (DOBBY *et al.* 1957, p. 48) and in Kelantan on the very free-draining *beris* soils occupied by scattered shrubs of *Melostoma* spp. and *Rhodomyrtus tomentosa* with a ground cover, often discontinuous, of grasses such as *Panicum repens*, *Imperata* spp., *Ischaemum* spp., sometimes the introduced *Paspalum conjugatum*, though this is more common on roadsides, together with a variety of herbaceous plants. Other areas used for grazing are those under coconuts, where the cover is very similar to that of open grazing grounds, road sides and river banks. The grasses and herbs of the last two, especially the latter, are much more productive than other grazing areas and the vegetation may be cut for fodder and carried back to farms. Common grasses in these habitats include *Coelorrachis glandulosa*, *Eragrostis* spp., *Hymenachne* spp., *Isachne globosa*, several wild relatives of cultivated rice, including *Oryza minuta*, *O. rufipogon*, wild relatives of sugar, *Saccharum arundinaceum* and *S. spontanicum*, as well as *Themeda arguens*, a grass of dry places and its close relative *T. villosa* which is more commonly found along water courses.

These landscape elements combine in different proportions from area to area, as described by DOBBY *et al.* (1955, 1957) who give detailed case studies of seven contrasting areas: Perlis, Kedah, Sebarang Prai (Province Wellesley),

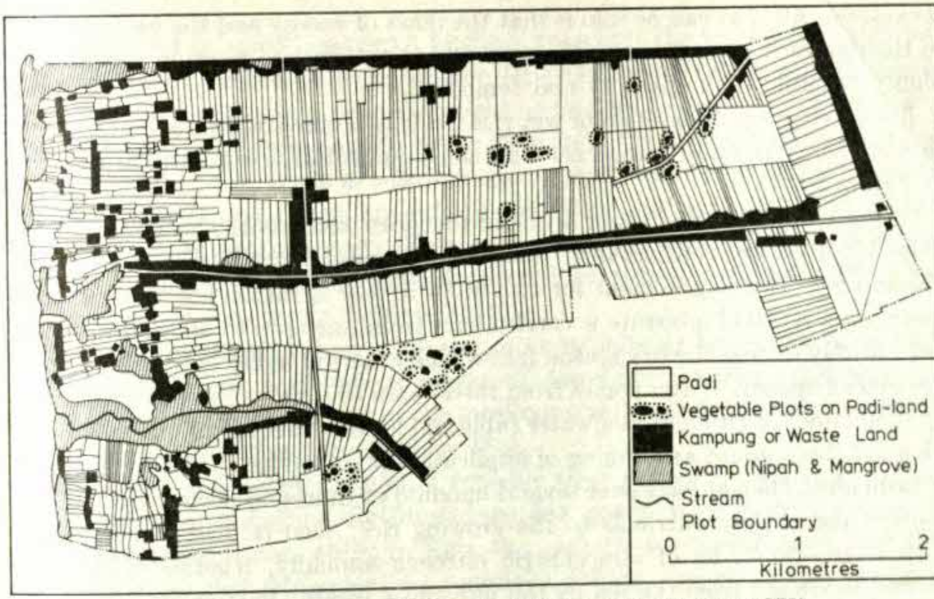


*Fig. 19.* Field patterns in Lowland Kedah (after DOBBY 1951)

the Krian district of Perak in the northwest of the Peninsula, Daerah Tanjung Pauh in the northeast, and Melaka and Negeri Sembilan in the south. Broadly, these studies indicate that in the main production areas the two major elements of the landscape are the rice fields themselves and the *kampungs*. On the Kedah/Perlis plain these are paramount, though a little grazing exists along the banks of rivers, swampy abandoned meanders and road sides. The plain is punctuated by "islands" of tower karst, sparsely vegetated and of economic significance as the source of guano from the bat caves in them. In the northeastern states of Kelantan and Terengganu, the coastal margins of the plains are marked by long sand-ridges *(gong)* and flats paralleling the coast which are the sites of linear villages, coconut patches, and dry rice and grazing grounds between which wet padi is grown. Inland, where valleys become narrow, coconuts are confined to the village sites at the piedmont while the foothills are either used for rubber or are under secondary forest used for firewood or timber, the valley floors being entirely occupied by rice, except in very poorly drained corners and along water courses or roads (see *Figures 18, 19*).

## THE AGROECOSYSTEM OF RICE

*Figure 18* shows schematically the functional relationships among the various elements of rice-growing landscapes, but data do not permit more rigorous analysis of the various flows of energy within the overall rice-growing ecosystem. All that can be said is that the flows of energy and the contribution to the domestic economies by the various habitats of rice-growing regions are highly variable both spatially and temporally.

The specific agroecosystem of wet rice fields is better-studied, and the direction of energy flows in it together with some quantitative estimates are shown in *Figure 20*.

Of the various inputs, water is one of the more important. The actual quantities involved are considerable — the figures given being for a single main-season crop. The requirement for two crops a year is rather less than double these, since residual moisture is carried over from one crop to another and not lost entirely during the dry season fallow when the soil bakes hard and shrinkage cracks appear. Water comes from three main sources — rainfall entrapped by field bunds, a rising groundwater table and in some areas artificial irrigation whereby the amount and timing of application is controlled, if not at the field or farm level, then at least over several hundred or thousand hectares. All these sources also supply nutrients to the growing rice, even rainfall which brings with it 10—20 kg/ha of atmospheric nitrogen annually, together with salts carried landward from the sea by the prevailing winds. (Particulate sea salt is

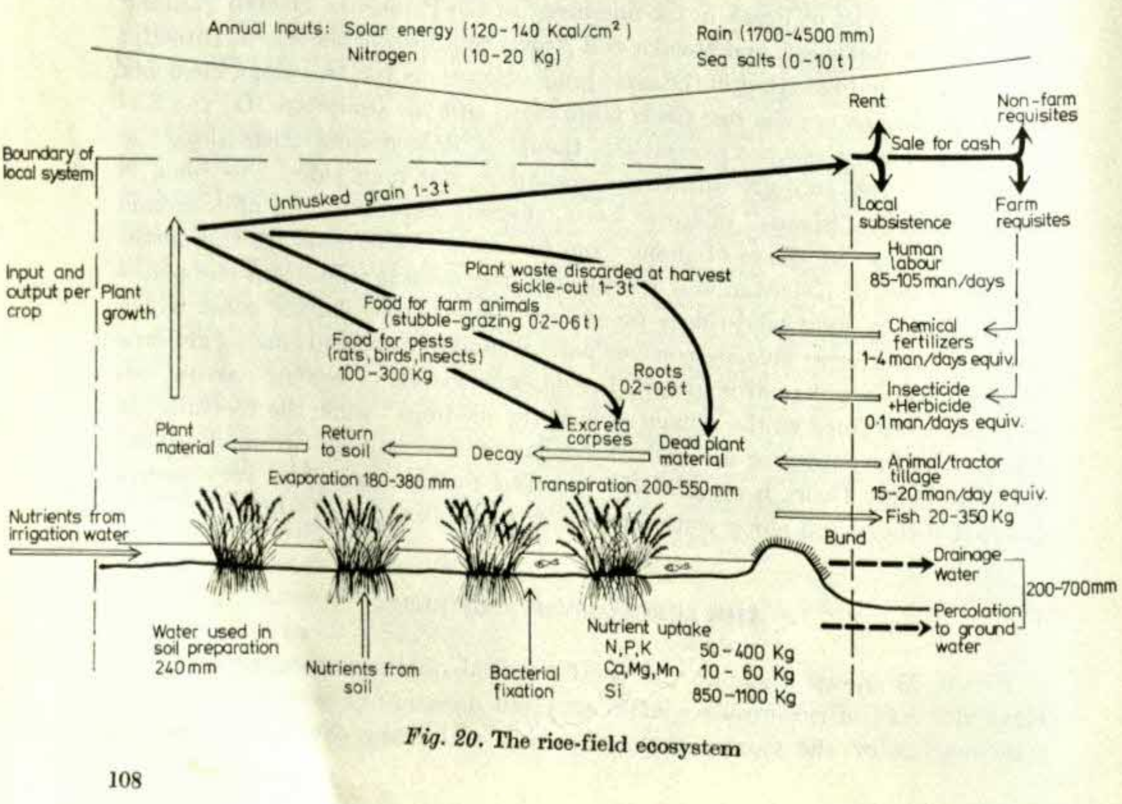


*Fig. 20.* The rice-field ecosystem

also deposited in some quantity.) Little is known of the respective contributions to plant nutrition of ground water, irrigation water (where supplied) and the soil itself, but a rough estimate would be that up to one-third of the nutrients taken up come from outside rather than from the soil by mobilization following flooding. The range of nutrients taken up is very large and the limited data available suggest that on unfertilized fields nutrient uptake in Kedah is on the whole greater than in Kelantan; about 100 kg/ha of N, P, K in the former, i.e. double the latter, whereas grain yields were about 1·06 and 3·2 t/ha, respectively (ANGLADETTE 1965, p. 361).

The input of nitrogen from algae and bacteria, notably blue-green algae such as *Tolypothnix* spp. and various species of *Azotobacter*, is also significant and there have been suggestions that the total non-symbiotic N-fixation may reach 70 kg per hectare (SANCHEZ 1976, p. 185).

The input of fertilizers is highly variable from region to region. In Kedah and Perlis, the traditional fertilizers are bat guano from nearby limestone caves plus burnt bones, whilst in Kelantan, ash from coconut husk and fish waste is employed. Though their beneficial effects are widely appreciated, the quantity used is generally too small to allow application upon much more than the area of seedling nurseries. At one time human faeces formed an input, but with the spread of latrines (for health reasons) this source has tended to diminish. The use of artificial fertilizers is much below the optimum and ranges from none at all to the equivalent of four or five days' labour, worth about M$25, even though a dollar's worth of fertilizer will return between 1·8 and 3·0 times that value of grain (A. HALIM ISMAIL 1972, p. 6). One reason for this is that many traditional rice varieties do not respond to artificial fertilizers and for some, the response is actually negative, that is, fertilizer application may lead to reduced yields under certain conditions.

Labour inputs per crop vary widely from area to area. Studies drawing on the field data of Narkswasdi, Selvadurai, Ani bin Arope and others suggest that actual mean inputs per hectare are very low and that even in double-cropping areas such as those of Selangor, effective under-employment may be around 50 per cent in the absence of off-farm work. Various studies indicate that labour inputs range from about 85 to about 105 man-days per hectare per crop.

On the output side, rough grain (padi), represents a high proportion of the total biomass of each rice crop – roughly a third to two-fifths. The biomass ranges from around 2·5 tons per hectare up to some 7 tons per hectare with the ratio of grain to straw being around 1 : 1·3 to 1·5, and the roots comprising between 10 and 15 per cent of the plant.[29] The destination of the various parts of the plant is also indicated in *Figure 20*. Usual losses to rats, birds, stem-borers and like pests range up to 300 kg/ha, but may be much more in isolated patches

[29] Excluding soil.

subject to predation. These residues, together with those from animals grazing stubble, plant waste discarded at harvest and the roots find their way back to the soil and are recycled though in the areas where it is practised, stubble-burning results in a substantial loss of nutrients to the atmosphere as gas. The practice of cutting the rice stalks near the base, immediately threshing them and discarding the stalk on the spot leads to some reduction in the export of nutrients from the system as compared with the more traditional but still widespread practice of harvesting panicle by panicle. The latter results in the export from the field of the nutrients in the panicles as well as the grain and this loss is not made up by returning panicle waste to the fields since the grain is trampled or otherwise cleaned at home. This is followed by husking, traditionally performed by a wooden pestle and mortar but now almost invariably being done in the village by machine. Husk has a high silica content and is not returned to the fields. Overall, as in most annual cropping systems, the output from the system is a high proportion of the biomass, comprising about 40 per cent of the total (excluding soil). This compares with an "export" (as latex) of under one per cent of the biomass in rubber-growing.

An important, yet often overlooked output from rice areas is fish, which are caught in the rice-field irrigation canals, drains and other water courses. Catches are particularly heavy during rainy weather and following a storm many people can be seen at work with cast nets, lift nets and fishing rods reaping the benefits of fish washed into the water courses. In some areas, Krian for example, "wells" are dug at topographical low points, one for every 2 – 3 ha of land. Into these fish retreat during the dry season and from these fish are bailed out for preservation by salting and drying. Yields are variable from one "well" to another, but HEATH's data (1934, p. 187) for a single harvest indicate an average yield from 10 "wells", each 2 m deep, of 9·4 kg per m$^2$ of surface area of the "well". More generally, yields range from 10 to 300 kg/ha of rice field. The fisheries depend largely upon airbreathing varieties of the families Anabantidae, Ophiacephalidae ("serpent heads") and Siluridae ("catfishes"), especially the introduced "sepat Siam", *Trichopodus leeri* and the larger *Trichogaster pectoralis*.

## THE SOCIO-ECONOMIC FRAMEWORK

Compared with tribal societies, Malaysian peasant society is much more differentiated in terms of class, and linkages with government are much stronger. Surplus production is, in many instances, appropriated by the landlord class, and even where this is not so, the government receives its share, as quit rent (land tax) and rates for water. Rice production is partly commercial and the cash nexus is of considerable, if not always basic, importance. Again compared with tribal societies the whole scale of society is larger, although the family is still the basic operational unit and the *kampung* is the basic unit of settlement.

Traditionally, the social polity of the Peninsula comprised several basic groups, even though the Malay population was ethnically heterogenous and included not only Peninsular Malays but Minangkabau immigrants from Sumatra (whose social structure was unlike that of the bulk of the Malay population), Javanese, Rawas from Sumatra, Banjarese from southern Kalimantan and Bugis traders from Makassar (Sulawesi). Whatever their origins, the common people, the *rakyat* formed the great bulk of the population. This group was largely village-dwellers, the *kampung*, in part reflecting the need for physical, political and psychic protection and in part reflecting the imperatives of terrain and technique in the rice economy. To avoid the risk of the rice crop being wiped out by marauding pigs, rats or birds, simultaneous cultivation was highly desirable and this was more readily accomplished within the framework of authority of the village. Amongst the Minangkabau and others who practised irrigation, this authority (in reality consensus as much as authority) extended to co-operative labour *(gotong-royong)* devoted to the repair and construction of brushwood dams, current-driven water wheels *(kinchir ayer)* and irrigation channels.

Below the *rakyat* in status, though more often found in larger villages and towns, were bondsmen *(hamba)*, not slaves but not wholly free, who were in the service of aristocrats and others to whom they were indebted. Amongst their tasks were field labour and land clearance. This group no longer exists following emancipation towards the end of the nineteenth century.

The supreme local authority was the *raja* or chief, almost always a person of noble birth, while the head of each state (these, with some exceptions, are more or less coterminous with each of the modern states) was a *raja* or *sultan*. The aristocracy, including royalty, played a major part in the rice economy. Firstly, they made up a group, which with their followers *(kawan)* had to be maintained. A substantial portion of the economic surplus, whether rice or other goods, was directed to this end. Secondly, the local and state rulers controlled all trade including the rice trade. Thirdly, the aristocracy often played a major role in directing part of the economic surplus, including the labour of the *rakyat* into productive works, especially land clearance and drainage. Notable in this respect were the activities of the Kedah aristocracy in the latter part of the nineteenth century. Canals were cut and "aristocratic entrepreneurs" sold lands along them to the *rakyat* charging them an annual rent in addition, though the payment of this exempted them from corvée labour (HILL 1977, pp. 56–58).

During the colonial period, the political power of the aristocracy was undermined and this had the consequence that the aristocracy no longer took any significant part in promoting the development of land for rice-growing and, in any case, the growing colonial economy gave the wealthy more profitable avenues for investment. At the same time, the accumulation of capital by members of the *rakyat* was no longer hindered by the prospect of arbitrary confiscation by aristocrats and their followers which had existed in pre-colonial times. This, together with active land development, allowed the emergence of a "rich peasant" stratum which today probably makes up a substantial portion of the landlord class. Equally, so far as is known, a rural proletariat, having neither land nor access to land as tenants, has not emerged in the rice areas.

The question of who are the landlords and how much rice land they own is a "sensitive issue" in Malaysia. Wilson's detailed studies of tenure in the Krian district scarcely broach it, nor do Smith and Goethals (WILSON 1954, 1955, 1958; SMITH and GOETHALS 1964). Hill's consideration of historical data for Province Wellesley in the 1830s links social class with the pattern of farm sizes and ownership, and throws some light on specific cases of European and Malay landowners (HILL 1977, p. 81 and 89). From early colonial times at least, there were numbers of Malays, including royalty and the aristocracy who held tracts far larger than the norm and this group doubtless survives to the present, though SMITH and GOETHALS (1964, p. 19) may be correct in suggesting that so far as rice land is concerned, there are extremely few landlords with holdings of more than 200 ha. They quote a case from Krian district where only three out of 102 holdings were larger than 40 ha, though these three accounted for 56 per cent of the land area. Absentee owners were also stated to be in a minority (SMITH and GOETHALS 1964, p. 19).

Data collated from studies by DOBBY and his associates *(Table 18)* show that only a small proportion of people in the villages owned land and did not work it, but the group did not investigate the question of who owned the land occupied by tenants, who constituted up to 65 per cent of the farmers. In many cases, those who owned land but did not work it were either elderly or widows or divorcees, people physically unable to work their land.

There also exists a class that comprises those who rent out land, while still working their own land. This was the case for rice lands near Kuala Lumpur in 1879 and there is no reason to suppose that matters are different now — given the high incidence of tenancy in many areas.

The 1960 Census of Agriculture showed that 31·4 per cent of main crop padi farms in Peninsular Malaysia, representing about 46,000 farms, were in the hands of tenants, with a further 15 per cent (19,800 farms) being operated by those who owned some land but rented more in addition (HILL 1967, p. 101). In all, an estimated 78,200 tenant or owner–tenant farms grew some padi (SMITH and GOETHALS 1964, p. 13). However, the incidence of tenancy varies substantially from state to state and from village to village (see *Table 18*).

*Table 18*

Land ownership by households in sampled areas of Peninsular Malaysia (per cent)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Households | | | | | | | |
| Owning land and working it | 13 | 32 | 17 | 69 | 50 | 73 | 19 |
| Owning land and not working it | 5 | 4 | 1 | — | 4 | — | 14 |
| Tenants | 52 | 52 | 65 | 1 | 46 | 4 | 20 |
| Owner–tenants | — | 5 | (0·5) | 8 | — | — | 11 |
| Neither owning nor working land | 30 | 7 | 17 | 22 | — | 23 | 36 |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

| | *Households sampled* |
|---|---|
| (1) Mukim Four, Sebarang Prai (P. W.) | 815 |
| (2) Mukim Dulang, Kedah | 882 |
| (3) Bagan Serai Triangle, Perak | 1578 |
| (4) Daerah Tanjung Pauh, Kelantan | 868 |
| (5) Mukim Padang Pauh, Perlis | 531 |
| (6) Mukim Bukit Hampar, Negri Sembilan | 338 |
| (7) Mukim Balai Panjang, Melaka | 560 |

*Note:* Compiled from data in DOBBY *et al.* 1955, 1957.

In Sabah and Sarawak tenancy scarcely exists, but in the Peninsula, 91 per cent of all tenant and owner–tenant farms were located in five states — Kedah, Perlis, Kelantan, Terengganu and P. Pinang —, and these include the largest producers in the region. The limited and now dated information of Wilson quoted in SMITH and GOETHALS (1964, pp. 14—15) suggested that in Perlis and Kedah, a significant trend from ownership towards tenancy occurred between 1949/1950 and 1954/1955, when over 16,000 ha out of a total of 83,000 ha changed status, but it is not known how successful have been legislative measures aimed at controlling this process, as well as excessive rises in the level of rent demanded. DOERING (1973, p. 74) has suggested that maximum rents set by law in 1967 have not acted as an effective ceiling in the Kedah portion of the Muda scheme. Nor has this been successful in Province Wellesley, where SELVADORAI and ANI (1969, p. 57) reported that 40 per cent of the tenant farmers paid more than the maximum prescribed.

The attempts to control rents in 1955 and 1967 were not the first efforts to regulate relationships between landlords and tenants in the rice areas, though early attempts focused on the problem of indebtedness. The government achieved local success in sponsoring the co-operative movement and bodies representing the interest of padi farmers, most notably in Kedah, where a peasants' union was founded in 1946 and by the mid-1950s became a political force to be reckoned with (DOERING 1973, pp. 70–71).

The main problem in controlling landlord–tenant relationships is that under the Malaysian Constitution land and land policy is a state, not a Federal matter, so that while the Federal Government may legislate, as it did in 1955 and again in 1967, states are not obliged to adopt the legislation, the earlier Ordinance, for instance being ratified only in Kedah, Perlis and Perak. Only registered tenancy agreements could be enforced and it was estimated in 1955 that only 15 per cent of all agreements were registered. But to legislate is one thing, to enforce is quite another, especially where landlords are firmly entrenched in the higher ranks of the social order, and only in Kedah has enforcement been reasonably vigorous with the result that tenancies have been registered, though there is little evidence of success in pushing rental levels below the traditional one-third of the crop (DOERING 1973, pp. 72–74, 87–88).

Broadly, there are two major types of rental—rents in cash for a fixed sum, the amount of which may be periodically renegotiated, and rents in kind which may be fixed or a proportion of the crop. The incidence of these types varies from area to area. In the northwest of the Peninsula (Kedah, Perlis, Province Wellesley and Krian), a fixed rent in grain was usual with between 74 and 85 per cent of padi land under this system, but in Kelantan 96 per cent of the tenant-operated padi land was under share rental. According to a survey of the Kemubu area (Kelantan), on lands that are very poor, the landlord takes one-third of the crop, whereas on very good lands he may receive two-thirds of the crop, though the most common level is half (SELVADURAI, ANI and NIK HASSANI 1969, p. 59). In all the remaining Peninsular states, with the exception of Selangor, share-cropping is the rule (Smith and GOETHALS 1964, p. 16). Other studies seem to indicate some variation in this pattern. A survey of the Muda Irrigation Scheme in 1966 indicated that 50 per cent of the farmers rented for cash, 47 per cent paid rents in kind at a fixed rate (averaging 28 per cent of the total yield), while only 3 per cent paid rents as a share, and this represented about 27 per cent of their yield (Ministry of Agriculture and Co-operatives, 1967, *Tables 10–13*). A similar study in Province Wellesley suggested that the bulk of tenants paid in cash. Cash rents were paid in advance and these represented 18 per cent of the total value of production, whereas rents in kind were paid after the harvest and represented 25 per cent of the value of production (SELVADURAI and ANI 1969, p. 52).

Though these are the main types of rental agreements, there is in fact a wide range of practice in arrangements between landlords and tenants. Some landlords require cash deposits, some require payment in dry winnowed padi transported to the landlord's home, while others accept it in the field, sometimes as standing grain with the landlord being responsible for all further operations.

Even where rents are fixed, it is understood in some areas that they will be reduced should these be a poor crop, though in others this is not the case and in addition the increasingly common practice of registering tenancy agreements has tended to lead landlords to insist on full payment. By law, agreements may not be for less than three years, but a fair degree of stability is indicated by SELVADURAI and ANI (1969, p. 58), at least in Province Wellesley where 45 per cent of the tenant farmers were reported as having operated their existing farm for ten years or more. Earlier data, however, showed extreme instability in some areas, especially in Kelantan where there was an almost complete turnover of tenants every two years (SMITH and GOETHALS 1964, p. 17).

Tenancy is widespread amongst rice-growing peasants, while far from absent amongst those who grow perennial crops. It is thus worth summarizing some of its causes and effects. Certainly, so far as padi land is concerned landlord–tenant relationships lie deeply embedded in Malay society. Nineteenth and early twentieth century entrepreneurs obtained grants of land from rulers and state governments and subsequently encouraged the immigration of farmers from Peninsular states and neighbouring areas to settle on their lands as tenants. These entrepreneurs were often minor royalty and *hajis* (returned pilgrims) whose descendants are among present-day landlords. To these must be added those whose social and economic advancement has come other than by traditional means. To what degree land legislation has affected the incidence of tenancy is uncertain, since various enactments reserving land to the Malays have simply resulted in non-Malays being unable to obtain land in Malay reservations, though PUTHUCHEARY (1960, p. 7) suggests that reservation laws have aided the increase of the area owned by the landlord class.

So far as the effects of landlordism are concerned, these are essentially negative, though landlords may take an initiative in the use of fertilizer since this is reflected in crop yield and hence their income. As SMITH and GOETHALS (1964, p. 20) remark, "Apparently in most cases the landlord's participation in management is limited to selecting tenants, evicting ones that do not perform satisfactorily, paying quit rents (government land tax) and water fees and collecting his rent." For the tenant's part, it seems clear that unless the tenant inherits wealth, he can never expect to achieve full ownership. More positively though, there is no evidence that the present tenure system discourages double-cropping or the use of fertilizer. Indeed, the average yield on tenant farms is higher than on other farms, since tenants who must pay one-third to one-half of their crop as rent are under more pressure to obtain high yields simply to maintain a minimum level of subsistence than are owners with farms of a similar size (SMITH and GOETHALS 1964, p. 70).

A further change which took place in the social fabric during the colonial period was the establishment of a modern bureaucratic form of government. Initially this involved the peasantry only at two points — land registration and taxation through a district office or land office and secondly, land settlement which, in the interests of order, good government and the raising a revenue, was controlled by government functionaries. Government also increasingly undertook the provision of production infrastructure — paths, roads, railways, drainage and irrigation and social infrastructure, schools and health centres — many of which tended to increase the opportunities for partly commercial production and productivity generally.

Perhaps the most notable infrastructural provisions have been in drainage and irrigation (SHORT and JACKSON 1971). Until the 1890s, drainage and irrigation were essentially of local importance and carried out by simple methods which were not always successful. Even a large canal built in Kedah by a local entrepreneur, Wan Mat Saman, failed, because the levels were incorrect. Until 1893, works depended upon the initiative of local government might supply equipment and limited funds these were on a small scale, essentially because the return on its funds was considered too low to commit them more fully. Largely as a result of a change in policy brought about by concern over the large outlay on importing rice, work began on a major scheme of irrigation to encompass 70,000 ha at Krian. Construction, begun in 1899, was completed in 1906 by which time the cost was over five times the original estimate. This cost over-run was to hinder effectively the construction of similar works in the British-controlled states for the next 30 years. However, in Kedah and Perlis (then semi-independent) good progress was made after 1913 in linking the disjointed canals built in the 1880s and 1890s into a comprehensive system. Since rice constituted almost the entire economic base, the need for modern large-scale irrigation and drainage was crucial and several important schemes were constructed, resulting in a 35 per cent increase in the rice area of Kedah to reach 79,500 ha by 1930—1932 (SHORT and JACKSON 1971, p. 98).

With the world economic depression of the 1930s, Malaya's vulnerability to falls in the prices of its basic exports, rubber and tin, became obvious and considerable distress ensued, stemming from the basic fact that only a third of its rice requirements were being met locally. The consequence was the setting up of a Rice Cultivation Committee which recommended greater investment in rice agriculture, especially drainage and irrigation and, as a consequence, a Drainage and Irrigation Department was set up for Malaya. However, the "lead time" on all major engineering schemes is long, especially where local expertize is lacking, and works were slow in reaching the construction stage, so that by the time of the Japanese invasion in 1941 only a few had actually been constructed. The first stage of a scheme at Sungai Manik had been completed in 1935 and some 4,850 ha occupied with a second stage in progress, along with work at Tanjung Karang, Selangor (FERGUSON 1954; DOERING 1973, p. 31). Following the defeat of the Japanese, all parts of what became Malaysia suffered critical food shortages and though these gradually eased, continued government concern was reflected in the rush to complete certain of the projects of the 1930s. The result was a considerable increase in the area of irrigated and drained land. In 1940, some 32,300 ha of both newly-opened land and improved land was irrigated under the control of the Drainage and Irrigation Department of the Federated Malay States and the Straits Settlements, with another 20,800 ha under drainage schemes, making a total of 53,100 ha. By 1969, in the whole of Peninsular Malaysia (Malaya), 244,500 ha had been drained or irrigated at a capital of M$222/ha borne almost entirely by the national exchequer. Maintenance was costing nearly M$30 per hectare annually and in most areas only part of this was recovered through a water rate.

Irrigation was only one of various the forms of government technical assistance, albeit a major one, and despite the overwhelming attention given to cash crops, especially rubber by the pre-independence Department of Agriculture, some attention was also given to rice. Seed selection and distribution by government began in the 1920s with some research into mechanization, pest control, manuring and the economics of padi-growing. Several small research stations were set up, especially to test different varieties, and statistical services were improved (DOERING 1973, p. 11, 24 and 33). However, until the 1950s and 1960s this was only small-scale, and the extension of research results and technical assistance to the practising farmer was very limited.

With independence and democracy came the realization that the rice-growing peasantry represented a substantial political power bloc for whom it was both politically and economically desirable to do something. In addition to the extension of irrigation, various fertilizer subsidy schemes were begun in the early 1950s, initially in the two poorest states, Kelantan and Terengganu. The rate of subsidy has varied from around 10 up to 50 per cent of the market price and while growth in consumption by Peninsular padi-growers has been rapid, from 3,800 tons in 1961 to 24,800 tons five years later, the amount of fertilizer used is still low by Japanese standards (DOERING 1973, p. 74 and 260).

Perhaps the least obvious, but nevertheless important feature of the socio-economic framework is the governmental role in pricing and subsidies other than those directly expressed in the landscape as engineering works or fertilizer dumps (see DOERING 1973, p. 12, 24, 34 and 59; BROWN 1975). Rationing and price controls were imposed during World War I and immediately afterwards, and while this involved the setting of a guaranteed price (1919–1924), the fact that the subsidy was applied at the retail level meant that there was little corresponding increase in production. The guaranteed price system was reintroduced in the 1930s. During the post-World War II period, the system was essentially inoperative until 1954, since the market price had only once dipped below the guaranteed price, but in that year it was proposed that the guaranteed price be cut as a result of low international prices. This proposal led to an immediate outcry which ultimately led to the setting up of a government-managed marketing authority and a buffer stock. The stock is so managed that the consumers of local rice, not just the consumers of imported rice, ultimately subsidize the guaranteed price system, a situation the exact opposite of which exists in Thailand, where control of domestic rice prices has the effect of subsidizing the consumer, since domestic prices are not uncommonly set well below world prices.

Farm size reflects the agrarian structure to a considerable degree and as has already been noted in comparing peasant rice farming with other types, farms are notably small.[30] Farm size is also directly related to production, and hence income, the prevalence of off-farm work and overall levels of commercial orientation. The mean size of rice farms in the region is fractionally over one hectare, but this figure hides a fair range of variation not only within each rice-growing area, but also from area to area. Within an area, farm size distribution is usually skewed in the direction of a large number of small farms. This is shown in ***Table 19*** which gives the proportion of farms in various size groups for Peninsular Malaysia and other selected areas. One measure of this is the divergence between the mean and median values which, as the regional studies show, may be considerable – as in the Muda Scheme, for example *(Table 19)*.

Data are not available for farm size for the whole country, but those for Peninsular Malaysia show that the average size of rice farms in the major "rice bowl" of the northwest (Kedah and Perlis) together with Selangor is substantially above the norm, those in the northeast and the centre range about the mean, whereas average size in the less important states tends to be very much smaller, though Kelantan stands out as a major state with notably small farms. The reasons for this particular distribution are complex and unclear, but probably relate to the particular history of land development in each state. In Kedah and Perlis, for example, where many rice holdings are notably large, the original lots laid out in strips running back from canals dug in the 1880s and 1890s were about 5·75 ha in extent. Similarly, newly cleared rice lots in the Kuala Lumpur district in 1879, while averaging only 1·9 ha, ranged up to 12 ha with 22 per cent being larger than 2 ha (Hill 1977, p. 57 and 147).

Fragmentation is often a feature of Asian peasant agriculture, but in Malaysia operational fragmentation is not particularly common, nor is it necessarily a "bad thing" since in circumstances in which many farmers are underemployed, time spent in moving from one plot to another is of no particular consequence, especially when the various plots may be expected to be somewhat

[30] In economic terms, however, farm size is not a satisfactory measure since "farm size" properly refers to the size of the business. As Narkswasdi and Selvadurai (1967, p. 157) point out, in economic terms, a farmer with 50 pigs on 0·2 ha may have a larger business than a rice farmer with 1·2 ha. While the use of an economic measure such as the "Productive Man-Work Unit" (PWU) is to be preferred, labour inputs have been measured only to a limited degree so that, generally, area must be retained as a measure.

*Table 19*

Size distribution of rice land in Peninsular Malaysia and selected areas (1960s)[1]

| Per cent in each size (class (ha) | Peninsular Malaysia | Muda Scheme | Province Wellesley | Kuala Selangor | Sabak Bernam | Bachang | Kemubu |
|---|---|---|---|---|---|---|---|
| under 0·4 | 10 | 8 | — | — | — | 10 | 9 |
| 0·4 and under 0·8 | 23 | 15 | 39 | 14 | 13 | 17 | 29 |
| 0·8 and under 1·2 | 21 | 18 | 13 | 32 | 10 | 14 | 30 |
| 1·2 and under 1·6 | 14 | 28 | 16 | 8 | 12 | 23 | 18 |
| 1·6 and under 2·0 | 10 | 13 | 12 | 16 | 21 | 14 | 8 |
| 2·0 and under 4·0 | 19 | 12 | 19 | 29 | 39 | 22 | 6 |
| 4·0 and under 6·0 | 3 | 4 | 1 | 1 | 5 | — | — |
| 6·0 and over | — | 2 | — | — | — | — | — |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Mean size (ha) | 1·02 | 1·73 | 1·34 | 1·70 | 2·03 | 1·37 | 0·89 |
| Median size (ha) | 1·13 | 1·34 | 1·15 | 1·41 | 1·91 | 1·36 | 0·96 |
| Farms reported | 132,276 | 2,476 | 370 | 209 | 149 | 58 | 1,157 |

[1] Data for Peninsular Malaysia are from the 1960 Census of Agriculture and refer to "rice farms" not just rice land, and thus include a variable proportion of non-rice land (but by definition less than 25 per cent). A "deflator" about 12 per cent would bring these figures into line with the others which are for padi land only. Sources for the regions are (from left to right) A. HALIM ISMAIL, 1973, p. 12; Ministry of Agriculture and Co-operatives, 1967, Table II; SELVADURAI and ANI, 1969, p. 30; NARKSWASDI and SELVADURAI 1967, p. 56, and p. 159; SELVADURAI, ANI and NIK HASSANI 1969, p. 56.

different environmentally and serve to spread the risk of failure. There are, however, advantages in the farmer having his land is a single unit, for supervision, lower ratio of boundary to area, and especially with regard to mechanization.

There are no comprehensive data on operational fragmentation. In the Muda Scheme area, for example, 31 per cent of the rice farmers reported owning a single parcel of land with a further 24 per cent owning two. The ratio of those owning four parcels or more was just under four per cent. Many of those operating more than one plot are probably owner-tenants seeking to increase their farm area by renting another parcel. For those owning one parcel of rice land, the average distance from home to field was three kilometres compared with seven kilometres for those few with four parcels (Ministry of Agriculture and Co-operatives 1967, Table 4). SELVADURAI and ANI (1969, pp. 26–27) reported a similar pattern with 81 per cent of farmers in Province Wellesley having one or two parcels, which accounted for 69 per cent of the padi area, suggesting that the more land a farmer owned, the more likely it was to be in several plots. In Kelantan, however, the degree of parcellation of padi land was rather more marked, with 60 per cent of farms having one or two parcels. The average "one-parcel" farm contained only 0·65 ha of padi land, whereas the two per cent of farmers who had six or more parcels had 1·70 ha on average (SELVADURAI, ANI and NIK HASSANI 1969, p. 57).

In addition to operational fragmentation, however, there is "fragmentation" of ownership which in Malaysia is probably much more widespread and in the main derives from Islamic inheritance laws. These serve to multiply the number of owners of plots of land rather than reducing the actual size of plots, since actual subdivision involves the payment of transfer and re-survey fees. A Malay landowner may freely dispose of land during his lifetime and transfer of ownership from husband to wife "for love and affection" is by no means uncommon and shows less affinity to partiarchal Muslim law than to the matriarchal features of Malay custom. On the death of a landowner, the property must be distributed according to the unanimous wishes of all the joint-heirs or according to Muslim law which provides a very elaborate system of fractional shares in proportion to the nearness of the claimants' kin relationship to the deceased. Broadly, all sons inherit equally, with all daughters receiving an amount equal to half that of the sons, though the residue of property after a woman without brothers had received her share goes into the Muslim Treasury, the *Bait-ul-mal* (WILSON 1955, pp. 80–81).

In such circumstances fragmentation of ownership is rapid, though by law plots of less than 0·2 ha cannot be subdivided. Wilson's study of the Tanjung Piandang mukim, Perak, where 98 per cent of the land is in padi, showed that in 1900, the average size of plot in this then newly-cleared area was 2·84 ha and the average share was slightly less at 2·77 ha. There were, on average 106 landowners or co-owners for every 100 plots. By 1954 the average lot size had fallen only slightly, to 2·54 ha, but the average share had fallen to only 1·07 ha with 238 owners or co-owners for each 100 plots (WILSON 1954, p. 127).

Just how widespread this sort of situation may be is not known, but one of the more important factors determining the course of development may be the size of the original lot. WILSON (1954, p. 131) suggested that three-quarters of those padi lots which remained in the hands of a single owner were originally under one hectare in size, while only 16 per cent of plots originally at least 2·8 ha in size were still in the hands of one owner half a century later. He concluded that in Krian, the forces which tend towards fragmentation, population pressure and laws of inheritance, have overcome the economic forces which might tend to stabilize holdings at their most efficient size under customary methods of cultivation.

Farm size is also related to tenure in a way which at first sight would suggest that many tenants are better off then those who own their own land. Certainly the 1960 *Census of Agriculture* indicates that for Peninsular Malaysia tenant-farms are, on the average one, third larger than owner-farms, a proportion that happens to coincide with the usual level of rents payable, i.e. one third of the

*Table 20*

Average size of rice farms by tenure status in Peninsular Malaysia (ha)

| | Owner | Tenant | Owner-tenant | All types |
|---|---|---|---|---|
| *Peninsular Malaysia* | 0·87 | 1·13 | 1·30 | 1·02 |
| Johor | 0·60 | — | 0·81 | 0·68 |
| Kedah | 1·29 | 1·41 | 2·02 | 1·42 |
| Kelantan | 0·72 | 0·80 | 0·95 | 0·83 |
| Melaka | 0·52 | 1·09 | 1·07 | 0·60 |
| Negri Sembilan | 0·50 | 0·28 | 0·42 | 0·51 |
| Pahang | 0·72 | 0·41 | 0·53 | 0·68 |
| P. Pinang and S. Prai | 0·96 | 0·87 | 1·25 | 0·98 |
| Perak | 0·83 | 0·89 | 1·15 | 0·90 |
| Perlis | 1·46 | 1·37 | 1·76 | 1·49 |
| Selangor | 1·42 | 0·96 | 1·90 | 1·37 |
| Terengganu | 0·79 | 0·82 | 0·95 | 0·85 |
| *Case Studies* | | | | |
| Kuala Selangor | 1·50 | 1·38 | 2·43 | 1·70 |
| Sabak Bernam | 1·98 | 1·30 | 2·51 | 2·03 |
| Bachang | 0·61 | 1·08 | 1·38 | 0·89 |
| Muda | 2·07 | 2·15 | 3·65 | 2·31 |
| Kemubu | 0·77 | 0·96 | 1·16 | 0·89 |

*Sources: Census of Agriculture*, 1960; NARKSWASDI and SELVADURAI 1967, p. 56, 283; Ministry of Agriculture and Co-operatives, 1967, Table 8; SELVADURAI, ANI and NIK HASSANI 1969, p. 59.

crop or its equivalent *(Table 20)*. In fact the pattern is highly variable from area to area. Where tenant farms are larger, they are larger by about a tenth — not a third, and where tenant farms are smaller, they are in a number of cases strikingly so, particularly as effective size is reduced by the amount of the rent. On the other hand, owner–tenants generally have much more land than either owners or tenants. Only in two states, Negeri Sembilan and Pahang where social disapproval of renting is considerable, do owner–tenants have less land than owners. For the rest, the difference ranges from one-fifth (Terengganu) up to just over one half (Kedah), with Melaka owner–tenants having more than twice as much land as owners, though the average size is still small.

Little information is available concerning the land operated by owner–tenants, though in the Muda Scheme owner–tenants farmed slightly more rented than owned land, averaging 1·70 and 1·94 hectares of each type, respectively (Ministry of Agriculture and Co-operatives, 1967, Table 8).

Similarly, little is known of the relationship of tenure to yields. HILL's conclusion (1967, p. 108) that, taking 1,300 kg of padi as the annual subsistence requirement for a family of five, average yields were below subsistence level in Kelantan, Terengganu, Pahang, Johor, Melaka and Negeri Sembilan, is now out-dated. A further conclusion was that even though some tenant farms are smaller than owner farms, this is offset by higher yields, though landlord's deductions result in a lower average yield after payment of rent on tenant farms than on owner farms. Thus the effective land area available to produce rice is not the same for owners and tenants, since for the latter it is reduced by the amount of the rental. Tenants must, therefore, either produce at levels per hectare higher than owners to reach the same income level, or must seek supplementary sources of income.

Farm size is also very clearly related to yield, though again up-to-date data are lacking. SMITH and GOETHALS (1964, Fig. 1) indicate that in Kedah, Perlis, P. Pinang and S. Prai there is a reasonably constant relationship between farm size and yield, i.e. the yield per hectare does not fall with increasing size of farm. However, they also show that in Kelantan and Perak, yields fall sharply with increasing farm size. PURCAL's detailed study in Province Wellesley (Sebarang Prai) showed that while yields per hectare on the very smallest farms (under 0·3 ha) were 25—50 per cent higher than average, there was no consistent relationship between farm size and yield per hectare — a pattern also found by Ho amongst farms in Pahang (PURCAL 1972, p. 107; Ho 1967b, p. 63). On the other hand, a more recent study (DOERING 1973, p. 197) has suggested that in Muda yields increase with increasing farm size. The reasons for these inconsistent patterns are unknown, though Ho (1967b, p. 63), for example, found that for a very small sample of farmers in Pahang, labour input, cash value of the land and seeding rates were highly correlated with production.

Although peasant rice-growers devote the bulk of their efforts to growing rice, this is by no means the only form of economic activity for the majority, and off-farm employment of one kind or another is often important, especially in providing cash income. This is particularly the case where only one crop of rice is grown annually. The Kemubu (Kelantan) study indicated that farmers worked only 123 days per year on average, of which 39 days were spent on growing rice, 16 days on other farm activities and 68 days in off-farm work. Corresponding figures for other family members, assuming 1·6 workers per farm, indicated a total labour input of 90 man-days with 42, 17 and 31 man-days, respectively for the other activities (SELVADURAI, ANI and NIK HASSANI 1969, p. 91). This study did not report on the incidence of off-farm labour as such, though in Province Wellesley (Sebarang Prai) where double-cropping is the rule, 55 per cent of households reported that off-farm income comprised 23 per cent of average household incomes (SELVADURAI and ANI 1969, p. 95). Coincidentally, this is almost exactly the same proportion of off-farm work as is found among rice-growing households in coastal Selangor (NARKSWASDI and SELVADURAI 1967, p. 79). In the Bachang area, Melaka, where off-farm employment in town as trishaw riders, taxi drivers, in hawking, cottage industry, wood-cutting and the like is available, rice-growing is little more than a part-time activity, farm operators on average working 42 days on padi, 6 days on other farm activities, and 87 days on non-farm employment (NARKSWASDI and SELVADURAI 1967, p. 183).

## PRODUCTION

As with shifting cultivation, the production of wet rice involves an annual cycle which varies only slightly from year to year. The two basic cycles relate to a single or double annual crop, though the initiation of the one-crop cycle is much more variable both in timing and from area to area than the two-crop cycle. While by no means all one-crop areas lack artificial irrigation and hence are not entirely dependent upon rainfall to initiate the cultivation cycle, it is generally true that in one-crop areas, the first major task, ploughing, must be delayed until at least 200—300 mm of rain have fallen and the bunded fields are covered with water to a depth of 50—75 mm. Only then is the soil sufficiently soft for the ox- or more usually buffalo-drawn plough or the hand-wielded *tajak* to be effective. Where mechanical tillage is employed, this constraint is removed and it is not unusual for heavy tractor-mounted rotary hoes to give fields an initial tilling whilst they are still parched and cracked from the dry season. Increasingly, the initiation of the cultivation cycle is becoming independent of rainfall and is set by official proclamation in each district. All two-crop cycles are, in most years, independent of the onset of the rains.

Often rice-growing is independent of rainfall, a situation which seemingly prevailed in some areas of the Peninsula during the nineteenth century, notably in Melaka and Negeri Sembilan where there is a double rainfall peak each year. There it seems to have been customary to begin the cycle directly after the Muslim fasting month. But since the Muslim calendar is 11 days shorter than the solar year, the fast and hence the beginning of rice cultivation would necessarily be out of phase with the seasons in many of the 32·5 years it takes for the Muslim calendar to pass through all the seasons (HILL 1977, p. 39, and 129—130).

The place of religion and magic in the production process is now much less than it once was, though the more traditionally-minded still perform the ceremonies appropriate to the various stages of the production cycle and, like tribal cultivators, retain a belief in the "rice soul" *(semangat padi)*. The decline in such observances has paralleled the increasing commercial orientation of production and the adoption of "new" techniques such as sickle-harvesting replacing panicle-by-panicle harvesting by means of an annular knife of ancient design, and the use of threshing boxes — techniques which were introduced in Melaka, for instance, in the 1890s.

Though the crop cycle varies from area to area within which are many minor variations of practice, the traditional cycle of rain-fed cultivation as practised in Terengganu may be taken as a model with which to compare practices elsewhere *(Fig. 21)*. In that state wet season cultivation is by far the most important and was described in detail by HILL and ANI (1969, pp. 58–60). The planting cycle begins in late July or early August when the low bunds which separate plots are repaired, a task made necessary by the fact that they are damaged during padi-field fishing or trampled by cattle grazing the rice stubble during the dry season. As repairs are carried out, weeds are cut down and left to rot in the fields.

The first, and sometimes only, ploughing is commenced some time between mid-August and the beginning of November, depending upon the timing and intensity of the northeast monsoon rains. Traditionally, this is done with a steel-shod, single-share plough drawn by a single buffalo, but mechanical rotary hoeing is steadily becoming more widespread, and is essential in double-cropping areas. It is also independent of rainfall. After ploughing, the field may be rolled or raked or both to break down soil aggregates. On particularly heavy clay soils where sufficient aeration is a problem, a further ploughing and raking may follow.

At about the same time as the second ploughing, the preparation and planting of seedling nurseries is undertaken. In Terengganu, these are of two types, wet and dry, though in other parts of the Peninsula, especially Krian and coastal Selangor, a third type, the floating nursery or *semaian rakit* is found. Wet nur-

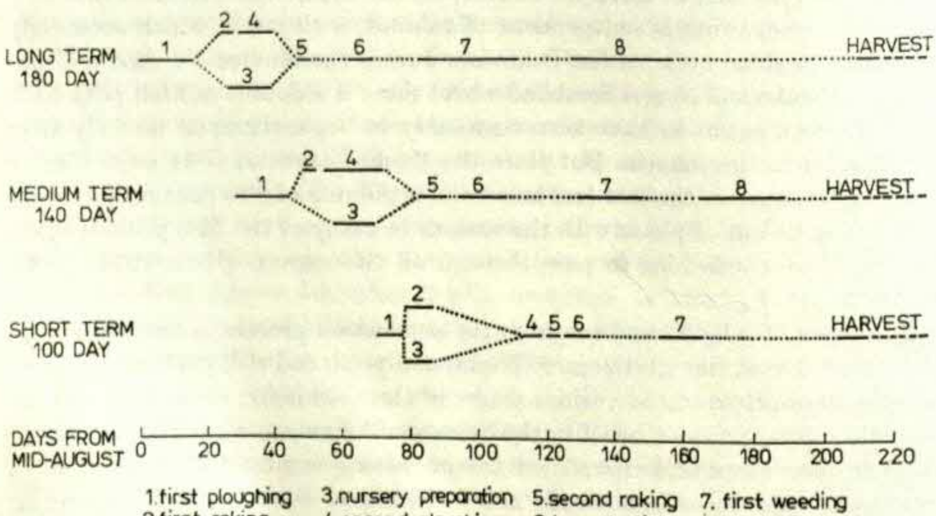


*Fig. 21.* The main-season cycle of rice cultivation in Terengganu (after HILL and ANI 1969)

series are established by individual farmers on land adjacent to fresh-water swamps, in the beds of abandoned river channels, or for preference where water supply is adequate in the centre of the fields into which the seedlings will ultimately be transplanted. The soil is hoed or rotavated[31] to a fine tilth before the pre-germinated seed is sown broadcast sometimes with organic fertilizer, wood ash, bone meal, or artificial fertilizer. The seedlings are ready for transplanting after 40—50 days for the traditional slow-growing but heavy-yielding varieties, 30—35 days for medium-term varieties and about 25 days for short-term varieties. One disadvantage with wet nurseries is that once the seedlings in them are mature, transplanting must take then place, lest the seedlings become "over-aged" and consequently fail to thrive. Where cultivation is entirely rain-fed and non-mechanical tillage is the rule, there is the obvious risk that insufficient rain will have fallen by this time. The farmers' strategy to minimize this risk is to prepare several nurseries successively or to employ dry nurseries on the slopes of river levees, sand ridges or road embankments. Though not popular, since hand-watering may become necessary, dry nurseries have the advantage that seedlings do not become over-aged as readily as in wet nurseries.

The next stage in the cycle is transplanting. Unlike ploughing, raking and nursery preparation, this is a women's task, groups of women from various households working together on an informal basis. The seedlings are uprooted in clumps, assembled at the edge of the nursery, tied into bundles and usually soaked in water or liquid manure before planting out. The leaves may be trimmed to reduce wilting, since some damage to the root system invariably occurs. The seedlings are usually planted out in highly irregular rows roughly 0·3 m apart, four to six seedlings being planted in a single cluster which, seen from a distance, appears to be a single plant. The irregularity of the rows hinders weeding and makes the use of the simplest weeding implement almost impossible. Where artificial fertilzer is applied, this is done at the same time as planting. Where slower-acting organic fertilizers are used, application may follow the first ploughing, but generally there is insufficient supply to permit this, such fertilizers being reserved for the nurseries. A further application of artificial fertilizer may be made during the first weeding which begins a month or so after transplanting.

A second weeding may be carried out during the growing period during which the water level is gradually reduced by evaporation, slow percolation and drainage. About two weeks before the crop flowers, a nitrogenous fertilizer might be applied. Thirty days after flowering the crop is ripe for harvest, and the field is dry or should be.

[31] Tilled with a rotary hoe. For example, in Malaysia the common term for both the machine and what it does is "kubota", after the brandname of a small hand tractor.

Harvesting may take place all at once if ripening in a field is even, but if it is not, panicles will be harvested singly, the whole process taking several weeks. The process begins towards the end of January and continues through the period of drier northeast winds which encourage ripening, ending in March or even April. Threshing usually follows immediately, though where panicle-by-panicle harvesting is the rule, bundles of panicles rather than padi may be stored.

The various stages in the production processes are not universal, the processes of soil preparation, particularly, varying widely from area to area. For example, on the deep muck soils (Histosols) of Krian, coastal Selangor and parts of coastal Melaka, the use of an animal-drawn plough is impracticable, so that traditionally a type of billhook *(tajak)* is employed to slash down weeds. A rake is then employed to collect the weeds into heaps which are then removed to the bunds. Once any remaining weeds have rotted, seedlings are pushed into the untilled soil by means of a ***kuku kambing***, a simple rod with a hook on the end. The heaping of weeds involves a loss of nutrients and also encourages the breeding of rats which damage the crop. The yield under such husbandry is 20–30 per cent lower than that obtained with ploughing, which on these soils must be carried out by machine. Where lands have been recently developed for rice cultivation, ploughing, whether by machine or buffalo, is very difficult because of the stumps, roots and other undecayed debris in the soil, and hand methods may have to be used for up to 30 years because of this.

Regional studies in the Peninsula indicate a wide range of tillage practices both between and within production areas. In the Muda area, prior to the widespread introduction of double-cropping, some 6·5 per cent of farmers used only manual methods, 38 per cent employed only buffalo-drawn ploughs, with 6 per cent using tractors. Of the remainder, 24 per cent used a variety of non-mechanical methods with the balance employing both mechanical and non-mechanical methods (Ministry of Agriculture and Co-operatives 1967, Table 22). In contrast, in the rather poorer areas of the Kemubu Scheme, Kelantan, again before widespread double-cropping, 5 per cent of the farmers used only hand methods, 81 per cent only buffalo tillage, with only 3 per cent depended wholly or partly on mechanical methods (SELVADURAI, ANI and NIK HASSANI 1969, p. 30). In the predominantly double-cropping areas of Province Wellesley, 74 per cent of farmers used mechanical tillage in whole or in part, with all but one per cent of the rest using hand methods (SELVADURAI and ANI 1969, p. 34). One feature that is particularly striking is that farmers with little land use hand methods. In the Muda survey area, for instance, while 6·5 per cent of the farmers used hand methods alone, this involved only 3·8 per cent of the land under rice.

Variation of practice within production areas is also considerable. NARKSWASDI and SELVADURAI (1967, p. 37), for instance, indicate that in the coastal

Selangor area there were six different methods of soil preparation involving the use of small tractors. Of these, the most effective was that largely practised by Chinese farmers who first rotavated the dry land to a depth of about 15 cm, thus cutting weeds and stubble to shreds. Water was then let into the field to hasten the decay of plant debris and when decay was sufficient the soil was again tilled and was then ready to receive the seedlings.

Tillage by the trampling of buffaloes after the off-season growth has been cut down survives in Sabah and was formerly practised in Brunei, Labuan and in Pahang, but in most areas there are now too few buffaloes in relation to area to be tilled to make this practicable.

Wet and dry nurseries have been described already, but in those parts of the west coast of the Peninsula where the water is deep, floating nurseries *(semaian rakit)* are employed. Grass is cut and piled in a long strip, about a metre wide and standing about 3 cm above the water level. On this mud is plastered to make a solid bed and on this more mud, rich in organic matter, is superimposed, on which the pre-germinated seed is sown broadcast. About 10 days after sowing the seedlings are moved to a second nursery for a further 10 days or so, and to a third nursery for yet another 10–20 days, the clumps of seedlings being sub-divided as transfers proceed. There is little evidence of any agronomic advantage in this labour-demanding process, but it does mean that nurseries are not affected by a rise in the water level.

Transplanting from nurseries is not universal and on gently rolling land or on higher terraces, levees or sand-ridges or when the season is too far advanced to go through the process of establishing nurseries and transplanting, seeds may be directly dibbled into the prepared soil, *padi tugalan* or, less commonly because of losses of seed to birds and rats, simply sown broadcast, *padi taboran*. Yields, under such circumstances, are substantially lower than under transplanting, mainly because of competition from weeds during the early stages of growth.

The off-season cultivation of other temporary crops by rice-farmers, whether on land earlier occupied by rice or not, is not well-developed in Malaysia, although the small size of farms and general poverty have led to more widespread off-season cultivation of crops other than rice in Kelantan than elsewhere. This is aided by the wide variation in river flows which during the dry season are so low as to expose islands and river channels for a period sufficient to take a crop – sometimes two – and these are commonly water-melons, groundnuts or maize. Short-term rice (padi *menghulu)* may also be planted, often being intercultivated with maize or cowpeas. Chillies, brinjals, radish and green vegetables are also grown (Mahmood 1958). Elsewhere, padi land is used for an off-season crop of maize, usually sown before the rice is harvested to use the residual soil moisture, while tobacco has also been successfully intercalated into the agricultural cycle particularly on higher terrace lands. Oversight of actual cultivation, which remains in the hands of peasant farmers, is by advisers employed by an off-shoot of the multinational British–American Tobacco Company, which also buys and cures the leaf that is entirely of the Virginia type. Some 5,000 ha are planted annually.

Off-season cultivation has been of some note in Melaka where several hundred hectares were cultivated by Chinese with a main-season rice crop followed by quick maturing crops such as beans, cucumbers, tomatoes, chilli, celery and green vegetables, mainly lettuce and mustard. Buffaloes were used for tillage and pigs not only supplied a cash income but provided abundant manure supplemented by prawn dust, burnt earth and padi straw mulch (Cook 1948). With the larger incomes now to be obtained by concentrating entirely upon market-gardening this system of cultivation has tended to disappear.

From the agronomic point of view, off-season cultivation with crops other than rice is almost entirely beneficial, even if in some areas no fertilizer is used. At Tanjung Karang (coastal Selangor), it was found that off-season cultivation benefitted the subsequent padi crop in most years, while at Bukit Merah, Province Wellesley, no yield reduction was noted (Hartley 1947; Allen 1956). Economically, this form of cropping would appear to offer advantages, both by increasing income and by diversifying its source, but this may not always have been the case since this type of production is necessarily seasonal, and if a constant supply of the crops chosen can be ensured demand inelasticity effectively prevents their wide adoption. The situation with groundnuts and soyabean is rather different and the growing of these crops is to be encouraged where dry season soil moisture is sufficient.

Where two rice crops are taken every year the cycle of cultivation involves a rather different pattern of operations (*Fig. 22*, in which the single- and double-cropping cycles of the Muda area are compared). In the first place, the adoption of double-cropping necessitates a number of simultaneous innovations at

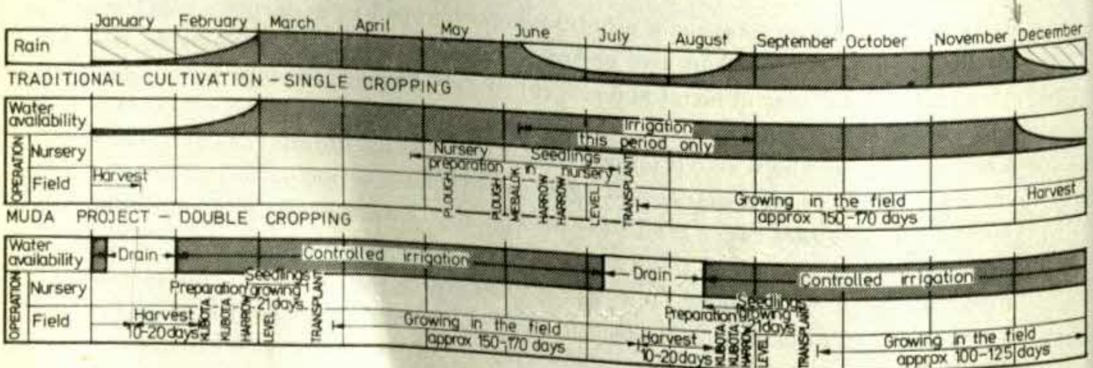


*Fig. 22.* Rice cultivation cycles in the Muda Region, Northeast Peninsular Malaysia (after Bean 1969)

both project and farm level, namely, an assured water supply, a sufficient number of farmers living near each other agreeing to double-crop (so that it is worth supplying water during the dry season and so that pests will be "spread" amongst a number of farms and will not so concentrate their attentions on a few as to destroy the crop), a shift to at least partial mechanization of tillage (since the period between crops is too short for non-mechanical means to be quick enough) and a shift to quick-maturing varieties such as "Malinja" and "Mahsuri" which ripen in 100–120 days from transplanting, compared with more traditional varieties which take up to 180 days to mature. However, these varieties perform to specification only where artificial fertilizer is applied in the same quantity, but through propaganda, demonstrations and subsidies to meet part of the cost, the step towards the use of artificials is not such a large one as it once seemed.

Perhaps the largest step is the virtual doubling of labour input. Under single cropping, labour inputs range from around 90 to 115 man-days per hectare largely according to the amount of mechanical tillage used. By contrast, in a double-cropping area of Province Wellesley a survey showed that the average labour input *per crop* was 87 man-days per hectare, compared with 102 man-days[32] per hectare for a single annual crop in Kemubu, Kelantan (SELVADURAI, ANI and NIK HASSANI 1969, p. 84). The input task-by-task was very different, reflecting greater technical skill, more cash inputs and a much greater commercial orientation in Province Wellesley as compared with Kemubu.

A further survey based upon detailed analysis of 50 households gave rather higher direct labour inputs, 345 man-days/ha, for the two crops in a double-cropping area in Province Wellesley *(Table 21)* compared with 180 man-days/ha for a single rain-fed crop (PURCAL 1972, p. 23 and 73).

The seasonal pattern of labour commitment is also very different as is shown in *Figure 23*. The very seasonal nature of input under a single crop system such as in Melaka is striking where a minor peak at ploughing and transplanting followed by a relative hiatus in the middle of the year is superseded by frantic haste at harvest, with 28 per cent of the total labour input occurring in one month, at which time it is necessary to hire up to 30% of the labour required, though this practice has been confined to areas of semi-commercial production in the Central District of the state (NARKSWASDI and SELVADURAI 1967, p. 292). In contrast, the labour commitment in the double-cropping areas of coastal Selangor is much more even, although in both areas actual labour utilization was much below that available. While in some double-crop areas, especially in Kedah, labour utilization may be sufficiently high to satisfy even agricul-

[32] Malaysian agricultural economists have traditionally taken an "industrial" man-day of 8 hours as the norm, but many Malaysian rice farmers would regard a 5-hour day (0700–1300) as the norm.

*Table 21*

Average labour inputs for rice cultivation in Sebarang Prai (Province Wellesley) and Kemubu (Kelantan)

| Task | Input (% man-days) | | Province Wellesley | |
|---|---|---|---|---|
| | S. Prai | Kemubu | Double crop | Single crop |
| Nursery work | 4 | 4 | 8 | 8 |
| Field preparation | 19 | 27 | 16 | 30 |
| Transplanting | 18 | 35 | 20 | 19 |
| Fertilizer and fungicide application | 3 | 1 | 4 | 3 |
| Weeding | 10 | 2 | 11 | 5 |
| Harvesting and threshing | 43 | 27 | 37 | 32 |
| Transporting padi | 3 | 4 | 4 | 3 |
| | 100 | 100 | 100 | 100 |

*Sources:* SELVADURAI and ANI, 1969, p. 62; SELVADURAI, ANI and NIK HASSANI 1969, p. 86; PURCAL 1972, pp. 19 and 70.

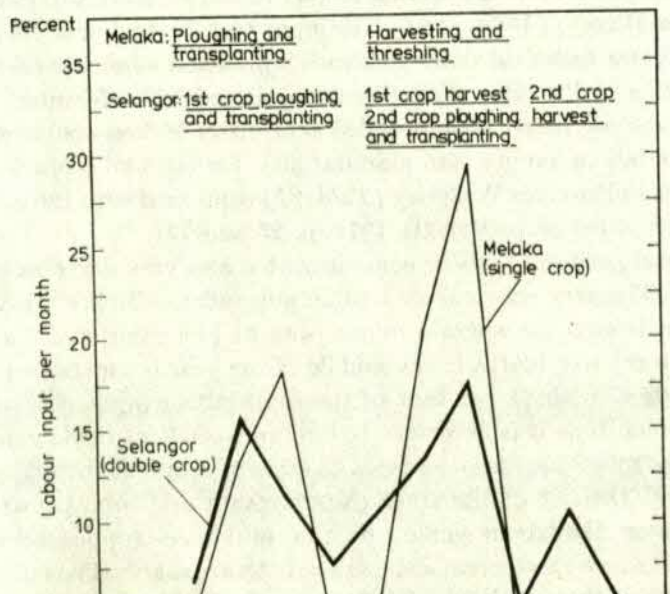


*Fig. 23.* Labour inputs on rice farms in Melaka and coastal Selangor

tural economists (since it certainly satisfies the farmers, some of whom complain about having to work too hard), a high level of utilization is by no means general even in double-crop areas. V. NARKSWASDI and S. SELVADURAI (1967, pp. 69—70) note that in the double-crop areas of coastal Selangor, the average annual labour input per farm was only 289 man-days (258 man-days per family), whereas labour availability, allowing for off-farm work was 842 man-days giving a utilization ratio of around 30 per cent, each farm averaging 3·3 workers, and assuming 300 working days yearly. In the then single-crop area of Kemubu, the farmer and his family were generally under-employed for 486 man-days per year, out of an available 567 man-days, allowing a further 213 man-days work outside padi-growing (SELVADURAI, ANI and NIK HASSANI 1969, p. 90).

The reasons for these variations in the production cycle are complex and not well-studied, making it difficult to proceed beyond appeals to "custom", "conservatism" or "tradition". There can be little doubt that the use of a traditional implement such as the *tajak* was soundly based, considering the technical difficulty of tilling muck soils with an animal-drawn plough. Similarly, traditional irrigation technology, which was perfectly capable of coping with the limited flow of small streams, was unable to handle large flows, to provide storage on any significant scale, to ensure satisfactory control or to meet the problem of entrenched river courses from which water had to be raised. Traditional technology was barely capable of coping with the task of cutting a drain which sloped in the correct direction. (A major late 19th-century scheme in Kedah failed for this reason and around the same time one observer noted that the people of Pahang were ignorant of any method of taking levels.) But equally important was the fact that until the 1960s in the Peninsula, and perhaps still in Sabah and Sarawak, the rice frontier was open, so that there was little felt need to intensify production methods, except in those areas, such as Province Wellesley (Sebarang Prai), where not only had the rice frontier long since closed, but where there were also initiatives by both farmers and government officials. In Malaysia, technical innovation intensifying rice cultivation has tended to come from the top down, i.e. from the government, rather than from the bottom up, i.e. from the peasantry, especially as the landlord class, where it had taken any initiative at all, has been slow to push innovation. There is, however, little evidence that it is the richer farmers who had been the innovators or that they have benefitted to a relatively greater degree than poorer farmers. Since it is a major innovation, irrigation is applied on an area-by-area basis, and such areas contain a range of farm sizes and degrees of wealth. The benefits from this innovation thus depend more on spatial location than anything else. Farms distant from the secondary distribution system or located on slightly higher or slightly lower land than average tend to benefit least. At the same time, the government tends to concentrate its extension and other services

*Table 22*

Average rice farm budgets in Sebarang Prai (Province Wellesley) during the early 1960s (Malaysian dollars/year)

| | Single-crop area | | Double-crop area | |
|---|---|---|---|---|
| *Income* | | | | |
| Cash income from | | | | |
| Rice | 621 | | 1021 | |
| Poultry and eggs | 43 | | 37 | |
| Rubber | 115 | | — | |
| Mats | 35 | | 5 | |
| Other farm sources | 14 | 828 | 14 | 1077 |
| Farm produce retained | | | | |
| Rice | 283 | | 278 | |
| Other (eggs, poultry, fish, bananas, coconuts, vegetables) | 64 | 347 | 53 | 331 |
| Value of farm produce used for payments in kind | | | | |
| Rent in kind | 87 | | 118 | |
| Payment for buffaloes | 38 | | 9 | |
| Seed padi | 7 | | 12 | |
| Religious taxes | 82 | 214 | 145 | 284 |
| Gross farm income | | 1389 | | 1692 |
| Off-farm income from | | | | |
| Wage-work on rice farms | 95 | | 77 | |
| Wage-work on rubber farms | 213 | | 103 | |
| Other employment and profits on trading | 158 | | 227 | |
| Cash gifts | 62 | 528 | 6 | 413 |
| Gross household income | | 1917 | | 2105 |
| *Expenditure* | | | | |
| Cash expenses (rice farming) | | | | |
| Ploughing and harrowing | 35 | | 88 | |
| Transplanting, weeding, harvesting | 85 | | 150 | |
| Fertilizers | 59 | | 94 | |
| Cash rent | 4 | | 111 | |
| Other | 30 | 213 | 62 | 505 |

*Table 22* (cont.)

| | Single crop area | | Double crop area | |
|---|---|---|---|---|
| Expenses in kind (rice farming) | | | | |
| Rent | 87 | | 118 | |
| Payment for workers and buffaloes | 38 | | 9 | |
| Seed rice | 7 | 132 | 12 | 139 |
| Rubber farm expenses | | 42 | | — |
| Total farming expenses | | 387 | | 644 |
| Net Income (own farm) | | 1044 | | 1048 |
| Net Income (other activities) | | 486 | | 413 |
| Total net income | | 1530 | | 1461 |
| Household expenditure | | 1067 | | 1278 |

*Source:* Derived from data in PURCAL 1972.

in the irrigation areas, where they are equally available to all. Nevertheless, tenant farmers are relatively disadvantaged over access to credit which is necessary for the adoption of some modern inputs.

In one of the very few longitudinal studies in the region, MOKTAR and HASHIM (1975, pp. 209—215) showed that the average amounts of fertilizer applied per hectare declined as farms increased in size before and after the introduction of modern varieties. In Kelantan (Meranti), one of their two study areas, there was no pattern in yield increment by tenure class—owner–operator, tenant or owner–tenant. In their other study area, Salor, owner–operators used more fertilizer than did tenants or owner–tenants on farms belonging to the same size group. However, tenants, especially those with large farms, had the lowest rates of fertilizer application since they were dependent upon their landlords and credit from the Farmers' Association to finance this. The net return for main season production for tenants improved between 1966/1967 and 1971/1972 by about one-third, only fractionally less than for owner–operators and more than for some of the owner–tenants. However, the situation of the tenants seems hopeless since, imputing a value for unpaid family labour, tenant–farmers actually received a negative return from growing rice after rent had been paid.

The incomes of rice farmers vary substantially both between and within the production areas, mainly reflecting farm size, technical sophistication and the incidence of tenancy. One common feature is the substantial reliance upon activities other than growing rice for a substantial proportion of the household income. These may include other on-farm activities, such as growing rubber or coconuts, agricultural wage-labour on the rice farms of others or on rubber estates or small-holdings, as well as off-farm activities which may include the hiring out of buffaloes or a hand tractor, petty trading (often by the womenfolk), riding a trishaw for hire, assisting with house construction or general labouring.

The wide range of income sources of those who are considered to be rice-growers is indicated in *Table 22* which presents average budget data based upon a survey of 50 households in single- and double-crop areas of Sebarang Prai (Province Wellesley).

The budgets presented in *Table 22* show what little economic surplus is available after essential needs have been met and it is notable that about 70 per cent of household expenditure is made up of food. In the double-crop areas rice, including that retained, accounts for about a third of food expenditure with a further fifth being allocated to the purchase of fish, fresh or dried. In the single-crop areas, food accounts for about the same proportion of domestic expenditure, but within this, rice accounts for two-fifths of spending (compared with one-third) and fish only one-sixth (rather than one-fifth). One apparent consequence of double-cropping is that families eat better and spend more, but the rate of capital formation is lower. However, this is probably atypical of single-crop farmers in the region because the local co-operative society insisted upon prompt loan repayment and because households owning rubber land received a replanting grant from government which forced the investment of both grant and family labour in replanting. Other studies suggest that savings are low and must be set against substantial indebtedness. On-farm capital formation, whether by the investment of capital or labour, is low to non-existent.

## MARKETING

The portion of the crop that reaches market comes from two sources. Some is padi which has been rendered up to a landlord as rent. After storing what is needed for their own use, landlords sell the balance on the open market but unlike the peasant, who usually has little financial reserve and must sell directly after the harvest, many landlords are able to wait until prices rise to their maximum shortly before the subsequent harvest. The other major source of rice coming onto the market is from sales by peasants to local merchants usually shopkeepers, or to official rice-purchasing agencies. Where peasants are indebted to a shopkeeper who freely provides credit for household necessities, purchase is at a fixed price agreed long before the harvest and almost invariably substantially below the going rate.[33] Other minor sources of rice com-

[33] Shopkeepers (and pawn shops) charge the equivalent of about 25 per cent annual interest on cash loans, but almost all goods supplied on unsecured credit are sold at prices higher than for cash so that effective interest rates may exceed 100 per cent annually

ing onto the market are sales of rice donated to mosques *(zakat* and *fitrah)* and rice smuggled into the Peninsula from Thailand.

Most farmers sell their rice to a middleman, whether a shop-keeper or a peripatetic agent of a private mill, though in some areas, especially in Sabah, government mills or agencies have a local monopoly. In coastal Selangor, for instance, almost 90 per cent of rice sold off-farm goes to co-operatives. Co-operative societies also buy rice and some own mills. The cost of transport to a mill is usually borne by the producer, though in some areas mills provide the transport if a lorry-load can be made up.

The proportion of production coming onto the market is difficult to establish and is complicated by the fact that in some areas, and amongst poorer farmers, rice is sold at or before harvest to be purchased later. In Kelantan, for example, only 15 per cent of farmers were reported as selling rice, and of the 15 per cent, 5 per cent sold an average of 350 kg and purchased 165 kg. In the same area, only 31 per cent of farmers were self-sufficient or had a surplus for sale. At the other end of the scale, farmers in the double-crop area of Sebarang Prai studied by PURCAL (1972, p. 110) sold about two-thirds of their off-season crop to dealers for cash and a slightly lower proportion of their main crop. In Muda, prior to the introduction of double-cropping, 82 per cent of farmers reported selling rice with an average sale of about 2·75 tons (Ministry of Agriculture and Cooperatives 1967, Table 28). This compares with 3·75 tons in Sebarang Prai where 57 per cent of production was sold for cash and where an overall total about 70 per cent of production found its way onto the market by one route or another (SELVADURAI and ANI 1969, p. 84).

The role of government in marketing has been alluded to already and this role is steadily growing, partly for political reasons. Where farmers have an option as to where they sell their rice, the practice has arisen of selling that portion of the crop which is of highest quality to private mills who pay slightly more than government agencies and pay cash on the spot, while selling poorer quality rice to the government agency which is obliged to purchase it at the guaranteed price, even though it will necessarily be re-sold at a low price. Thus government "subsidizes" the producer of poor quality rice while failing to give adequate incentive for good quality, i.e. low moisture content through proper drying, and absence of husk and foreign matter by proper winnowing. In any case, the achievement of good quality is a matter of some difficulty, since the off-season crop, especially, is harvested early in the wet season and even the dry season does not have that scorching dryness which leads to low moisture content and good keeping qualities.

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(NARKAWASDI and SELVADURAI 1967, p. 231). Thus the shopkeeper wins both ways, by charging more for credit sales and paying less for purchases of padi.

Various attempts have been made to analyze production controls in a quantitative manner, though few have been wholly successfully. Ho's study of 125 *paya* rice-growing households in Pahang, for instance, found that of the variables selected as "controlling" yields, only labour input, the number of owners and rates of seeding in the nurseries were statistically significant (Ho 1967b, p. 63). Similarly, DOERING (1972, p. 194 ff.) tried to see if yields in the Muda district were related to tenure status, farm area, the man–land ratio and costs of fertilizers and pesticides, but no consistent, statistically significant relationships were found. In some areas farm size or fertilizer input or both showed weakly positive relationships with yields. HUANG (in DOERING 1972, p. 201) using data from Kemubu, Kelantan, has hypothesized the existence of the backward sloping supply curve in subsistence areas so beloved of Boeke and others several decades ago, but the fact remains that differences in fertilizer and insecticide inputs explained little of the variation in yield amongst Muda farms, though farmers firmly believe that new varieties, plus fertilizers and insecticides had led to increased yields. This conclusion leads to the speculation that the undoubled improvements in yields stem from better farming particles with generally derive from the "how effect", well-known to social scientists. In other words, new procedures work because they are thought to work!

This view is partly confirmed by Francesca Bray whose analysis for a village in the Kemubu area, Kelantan was qualitative rather than quantitative (BRAY 1977). In that area " . . . a completely new system is now the norm: two crops a year of new, high-yielding varieties are grown; the fields are irrigated and are cultivated with tractors; chemical fertilizers are used to promote growth; the rice is no longer harvested with a knife but with a sickle. The local agricultural authority, KADA, runs the irrigation scheme, issues the farmers with strict planting timetables, provides information and training courses through Farmers' Associations, sells seeds, fertilizers and pesticides and hires out tractors . . . no one, it seems, has prejudices against using a tractor or growing new varieties . . . and the locals were well aware of the advantages of modern-style padi cultivation before it became available to them" (BRAY 1977, p. 10).

Yet many of the old ways persist and the new ways have created new problems. Since the area is pump-irrigated, supply may be interrupted at crucial periods. Moreover, the distribution system is not fully effective since the more distant farms do not receive sufficient water on the fields to be able to change it every week as is advisable or even to maintain the 25–30 cm depth of flooding, while some higher areas of sandy soil are now flooded twice a year and this seriously affects the perennial crops traditionally grown there. This has been a problem in parts of the Muda scheme as well. Low lying areas present a different problem. Whereas these were once the most highly favoured because of abundant water and consequent high yields, they are now perpetually water-logged and cannot be used, being left to grow useless reed vegetation. On low fields, yields are reported to be little more than those obtained in the days before fertilizer was used, while it would seem that because the soil is always damp, the response to nitrogen is below expectation. Again, the cultivation timetable is so rigid that should farmers lag by a few days in one season and then a few days more in the next, they ultimately have to forfeit a whole season. Indeed the need for co-operation in timing operations is greatly enhanced, especially since farmers far from roads must machine-till the soil early, otherwise they delay their neighbours across whose fields the tractor must pass. Certainly, the new methods demand much more labour, especially in weeding since not only rice benefits from increased nutrient input, and should the farmer have some reasonably secure alternative employment, labour inputs will be sub-optimal, to the detriment of yields. Indeed it may be questioned whether the official objective of making all rice-growers into full-time farmers can ever be achieved on very small farms, in Kelantan or elsewhere. Equally it may be asked if rice-growers can ever become fully-commercial producers when appropriation by landlords reaches the high levels it does. DOERMING's data from Muda, 1970 are instructive *(Table 23)*.

These figures clearly show the highly exploitative nature of landlordism. It is only by adopting double-cropping which raises yields but does not result in a proportionate increase in rents that the tenant or owner–tenant can avoid a situation in which rents are disproportionately high in relation to production.

*Table 23*

Average estimated production returns[1] to Muda rice farmers

| | Single crop area (ha) | House-hold size | Single crop returns ($) | Single crop rent ($) | Rent as % return | Double crop return ($) | Double crop rent ($) | Rent as % of return |
|---|---|---|---|---|---|---|---|---|
| Large owners | 2·79 | 7 | 1,746 | — | — | 3,552 | — | — |
| Largetenants | 2·82 | 6 | 719 | 1,024 | 142 | 2,301 | 1,164 | 51 |
| Large owner–tenants | 4·29 | 8 | 1,943 | 835 | 43 | 4,655 | 949 | 20 |
| Small owners | 0·95 | 5 | 622 | — | — | 1,267 | — | — |
| Small tenants | 1·07 | 5 | 334 | 379 | 113 | 996 | 431 | 43 |
| Small owner–tenants | 1·81 | 6 | 708 | 333 | 47 | 1,728 | 379 | 22 |

*Source:* DOERMING 1972, p. 169.

[1] After deduction of rent, if any.

Though income data are scarce, there can be little doubt that compared with the growers of perennial crops and with workers in industry and commerce, many rice-growing peasants are worse off, although this is true only in strict monetary terms, since it is equally clear that peasants do not view the growing of rice simply as a business. If they had done so, many would have given it up long ago. This is strikingly illustrated by Ho's analysis of rice-and-rubber farms in central Pahang (though there the rice-growing component of the farm enterprise was technically and economically low-grade in which it was estimated that the cash value of rubber produced was 12·6 times that of rice (Ho 1967b, p. 62). Analyzing the relationship between the average cash value of production and farmers' estimates of what they thought their land was worth, he showed that the value of rubber land was only 1·17 times the annual value of the rubber produced, but that for rice the same ratio was 13·8. Obviously the valuation of rubber land was grossly understated by informants, or that of rice wildly exaggerated, yet this wide disparity points clearly to the attachment peasant farmers have for rice, an attachment which represents more a way of life than an economic occupation. As Y. Huang (1975, p. 95) notes, double-cropping may not make economic sense in the more subsistence-oriented areas where farms are small, irrigation poor and yields low. A solution might be to shift the padi farmer into other crops, and these may very well be perennials.

# PERENNIAL CROP SMALL-HOLDER AGRICULTURE

It is usually a matter of little difficulty to determine what a perennial crop is in the Malaysian context, since the most important perennial crop is rubber to the extent that JACKSON (1964, p. 273) has suggested that this form of agriculture is almost monocultural. Though technically any crop with a growth period longer than a year is a perennial, all but a few such crops in Malaysia have growth periods in excess of five years and are trees or palms, with the exception of pepper which is a vine. Most are physiologically capable of producing crops for very extended periods, in excess of 50 years for coconuts, rubber, oil palm, tea and most fruit trees. These may be termed "long-term" perennials and their production gradually falls with increasing age, normally terminated for economic rather than physiological reasons. "Medium-term" perennials have a shorter production period, usually 3 to 15 years, and include pepper, citrus and coffee. "Short-term" perennials have maturation periods of more than a year but less than three years and include manioc, bananas and pineapples. In contrast with other types, "short-term" perennials may involve field tillage. Fields often remain in one of these crops, though individual plants may be slashed down as soon as the produce is harvested. Bananas, for example, propagate naturally, from basal shoots, while pineapples form "suckers" which are torn from the parent whom the fruit is taken and these are immediately planted and the parent slashed down.

But it is rubber, par excellence, which is the most important perennial crop grown on small-holdings. In the Peninsula the area under rubber small-holdings rose from around 654,500 ha in 1952 to about 1,104,600 ha in 1973, an increase of 69 per cent. Over the same period, the number of rubber small-holdings rose by only 8 per cent from an estimated 393,166 to 424,846, indicating a substantial increase in average size from 1·66 ha in 1952 to 2·60 ha in 1973 (JABKSON 1964, p. 249; BARLOW 1978, p. 951).[34] More recent data (for

[34] The data in the 1960 *Census of Agriculture* do not match those of JACKSON and BARLOW who drew upon other official sources. The *Census* reports 303,380 small-holdings other than those with 75% or more of their area in rice. As GREENWOOD (1964, p. 84) has shown, the 1952 small-holding total is probably an over-estimate, since each rubber lot was taken to be a farm. The 1960 *Census* shows that 53% of rubber farms comprised more than one lot. GREENWOOD (1964, p. 86) concluded that in 1961, approximately 820,000 ha

1977) indicate a total of 1,164,000 ha under rubber small-holdings, but this includes 736,000 ha under the control of the Federal Land Development Authority and other government agencies. Coconut small-holdings are reported to cover 226,000 ha. The total number of small-holdings in the Peninsula in which perennial crops other than rubber predominate has not been officially reported, but is probably in the range of 80,000 to 100,000. Since small-holdings are virtually always family farms (1·3 workers per farm on average), the total number of tree-crop small-holders is probably somewhere around 670,000 in the Peninsula, supporting about 2·75 million people.

Data for Sabah and Sarawak are even less reliable and what follows are mostly crude estimates by the author. The 1960 census of agriculture in Sarawak reported that 41,356 persons were engaged in rubber production, 90 per cent of whom would have been small-holders, with a further 2,216 in coconut production — all small-holders, the two groups comprising 18 per cent of the work-force in the primary sector of the economy (Sarawak, Dept. of Agriculture 1970). In 1975/76, the rubber area was 193,000 ha, but the number of small-holdings is unavailable. However, taking the average Peninsular Malaysian size of 2·6 ha would indicate that there were about 74,000 rubber small-holders[35] (though this assumes that rubber was the major crop on these small-holdings). To this may be added perhaps 8,000 coconut small-holders and possibly 3,000 pepper-growers to give a total close to 80,000. For Sabah, estimates of the numbers of small-holdings other than those growing rubber are equally imprecise — a figure of 7,000 coconut small-holdings possibly being of the correct order in c. 1976, when the area under coconut small-holdings was approximately 53,600 ha. The estimated area in rubber small-holdings in 1976 was 70,300 ha and again using 2·6 ha as an average, this would give around 27,000 rubber holdings with perennial-crop small-holdings totalling aroun 135,000.

For Malaysia as a whole the total number of perennial-crop small-holdings (and small-holder proprietors) is thus in the vicinity of 785,000. A substantial proportion of the small-holders are of non-indigenous origin, mainly persons of Chinese descent with some Indians, especially on sub-divided estates. In Peninsular Malaysia, for instance, 49 per cent of the 838,800 ha in rubber small-holdings in 1972 was owned by Chinese, a proportion 9 per cent higher than in 1953, a rise partly accounted for by the strong predominance of Chinese on small-holdings subdivided from estates, a category which totalled 157,000 ha by 1972. Over the same period, the proportion owned by Malays fell from

were under small-holder rubber, comprising 284,565 holdings, to give an average size of 2·88 ha.

[35] This is probably a very conservative estimate since JACKSON (1958, p. 90) has recorded nearly 97,000 rubber small-holdings as early as 1941. However, the average holding is now substantially larger than at that time.

47 to 40 per cent, despite a substantial increase in the Malay-owned rubber area as development projects sponsored by the Federal Land Development Authority (FeLDA) came to maturity and were given over to the settlers, mainly Malays. The proportion of land owned by others, mainly Indians, has remained relatively constant.

The proportions of owners in the three ethnic groups is quite different, though unequivocal data have not been found. On average, each Chinese small-holder owned 4·2 ha in 1957/1958 compared with an average size of 1·7 ha for each Malay small-holder (BARLOW 1978, p. 231). Though there is a wide distribution around these means and though they are probably skewed towards large numbers of small farms,[36] it can be very crudely estimated that there are about 105,000 Chinese rubber small-holders and about 265,000 Malays, the balance being made up mainly of Indians.

Chinese are also dominant in the cultivation of other crops. In Sarawak, they dominate pepper-growing, though their predominant position as growers of rubber is much less marked now than formerly. In Sabah, Hakka Chinese especially tend to dominate both rubber and coconut areas. The small-holder sector of commercial pineapple-growing[37] in Johor, where there are some 3,000 individual growers, was Chinese-dominated until recently and pepper-growing still is, this activity accounting for several hundred growers (TAN 1969; HILL 1969).

## LOCATION AND EVOLUTION

The most striking feature of perennial crop small-holdings is their upland location. This is largely to be explained by the fact that most perennial crops were found to thrive on the soils of the upland areas, which under humid equatorial conditions are generally deep clay loams or sandy clay loams with adequate moisture-retaining properties. Since the annual nutrient uptake for most crops is not large, such upland areas, mostly below an elevation of 500 m, are peculiarly suitable. Rubber, for example, generally does poorly on undrained Entisols since the high groundwater level interferes with proper root development. The same is true of plantings of rubber on Histosols, on which there is the further problem of adequate mechanical support for the trees. As VOON (1976, p. 16) has noted, one of the early misconceptions about *Hevea* was that it preferred swampy conditions, and it was only when this notion was cast aside

[36] The 1960 Census of Agriculture, which covered 175,284 rubber small-holdings encompassing 369,431 ha indicated that 41 per cent were under 1·2 ha in size (BARLOW 1978, p. 228).

[37] Small-holders account for about 65 per cent of the production of pineapples in the state (TAN 1969, p. 11).

late in the nineteenth century that the ecological basis for the planting of hill slopes was laid. In the Peninsula the marked lowland concentration of coconuts on coastal Psamments and of pineapples on Histosols is to be explained by the fact that few other crops are viable on such soils.

Nevertheless, before the introduction of rubber, the utilization of upland soils (except by shifting cultivators) was very limited, though the cultivation of certain perennial crops, notably pepper, has a long history. Early perennial crop small-holders were generally Malays and there are seventeenth-century reports of these folk growing pepper (and rice) on the Langkawi Islands, off Perlis, where this crop was of such importance that the group formerly bore the name "Pualau-pulau Lada" or "Pepper Islands". Johor was also producing pepper at about the same time (HILL 1969, p. 32, 1977, p. 35). Pepper-growing by Chinese was first reported from Kelantan in 1782–1795, where Fukienese were engaged both in cultivation and trade. Early in the nineteenth century pepper-growing began again, this time in Singapore, from which Chinese cultivators fanned out into nearby Johor. These operations were temporary, however, and the organization of production was much more capitalistic and exploitative in nature (JACKSON 1968, pp. 9–51).

During the period from the foundation of Penang (1786) to the beginnings of British control in Perak, Selangor, Negeri Sembilan and Pahang in the 1870s, little is known of the status of perennial crop cultivation by small-holders, but with the establishment of British control there was a boom in small-holder cultivation, though initially this expansion was associated with the concurrent growth of largely foreign-owned plantations. Two strands in the process may be discerned. One involved settlement and the opening up of new lands by indigenous Malays and their ethnic relatives from the Archipelago. In the 1880s and 1890s, for example, substantial areas of alluvial soil in Lower Perak and the Dindings were cleared and drained for coconuts by Banjarese and Javanese settlers, rice initially being grown as an inter-crop. At the same time, in the Kuala Selangor district, the cultivation of perennial crops such as sago, areca and coconut was combined with poultry-rearing and the growing of short-term crops including sugarcane, yams, plantains, maize and rice (HILL 1977, p. 117 and pp. 155–156). Pioneering of the alluvial lowlands of western Johor dates from around the 1870s, when Malays and subsequently Javanese in rather superior numbers cleared jungle land for agriculture, the main crops being bananas, yams, manioc and fruits for both subsistence and sale, as well as coconuts and arecanut which were exported to Singapore. Towards the turn of the century indentured labourers from Java were brought in by sheiks and many of these remained to become small-holders on the expiry of their contracts (HUSIN ALI 1964, pp. 29–31).

Many of these initial settlements were coastal and lowland in location, partly because of a cultural preference for this type of land by the settlers, and partly because access to the interior was difficult. Tin-mining provided both a means and an opportunity for developing overland transportation networks, which steadily expanded inland and parallel with the Main Ranges from small coastal and riverine ports. These not only brought "foreign Malays" into the interior, but Chinese as well, and the latter represent the second strand in the development of perennial-crop small-holdings. This is particularly well illustrated by studies of Selangor state (VOON 1967) and, more particularly of Ulu Selangor district (FRYER and JACKSON 1966).

In this district, tin-mining at the initiative of Loke Yew in the 1880s and again after 1893 gave the initial impetus to settlement and the development of communications in an area hitherto sparsely settled by aboriginal shifting cultivators and collectors. Soon afterwards, European planters began to open up estates for the cultivation of coffee and at the same time Malays, many of them recent immigrants from Sumatra, carved out small-holdings along the new road and railway. However, the coffee boom was short-lived and by the end of the 1890s both estates and small-holders had been in difficulties. The first rubber in this district was planted on an estate, but within ten years small-holders, again mainly Malays, had begun planting the crop. Between 1905 and 1920, the total area of rubber rose from around 300 ha to 27,700 ha, of which some 8,600 ha was in small-holdings. Malays owned much of this area, their rights being protected by Malay Reservations with the consequence that no great area was available for Chinese. Members of the latter community had originally been attracted by the working of tin deposits, but some began to acquire land outside the Reservation and planted rubber. Of the present Chinese small-holder families in the district, two-fifths have been in the area since before 1933 and two-thirds since before 1942, the balance having moved in between 1949 and 1954. A significant proportion of present holdings is owned and worked by urban residents and this pattern seems to be quite widespread, since the mode of production does not necessarily require residence on the farm, since newly made sheet rubber can readily be transported.

More generally, the evolution of rubber small-holdings in the Peninsula as a whole has been fully documented by DRABBLE (1973, p. 66 ff.). The period 1906–1910 saw a flood of applications for land on which to plant rubber, not only from Chinese and Indians but also from Malays. The two former groups tended to apply for large areas, though still mostly below 40 ha (and hence by definition small-holdings), because limited funds prevented them from applying for more. Many already had other business interests, suggesting that the areas were small plantations rather than small-holdings. Nevertheless, though some holdings were sold to company interests, others were sub-divided and sold to genuine small-holders with yet others being let out. Malays, lacking both substantial financial resources and access to them, necessarily applied for much smaller areas. The median size of area applied for in Selangor and Negeri

Sembilan by Malays in 1909—1910 was only 2 ha compared with 9 ha for those applied for by Chinese and Indians. While some purchases by Malays were also speculative, the basis was nevertheless laid for substantial Malay participation.

In the Federated Malay States, government policy towards small-holders was equivocal. Attempts were made to keep them away from areas along newly constructed roads which were to be reserved for "scientific planting", an euphemism for large-scale plantation interests, and to control speculation, especially by Malays, whose agriculture they nevertheless desired to foster. Often the result was a mosaic of small-holdings and plantations, the former not infrequently coming under "attack" by expansionist estate interests. During the 1914—1918 War, small-holdings expanded substantially at a time when European-managed estates were not able to do so and by 1930 just on 48 per cent of the 452,000 tons of rubber produced in Peninsular Malaysia (then Malaya) came from small-holdings. In Sabah there were few restrictions on the alienation of land to non-indigenous peoples, especially under the administration of the British North Borneo Company which owned the whole state until 1942. Chinese rubber small-holders are numerous in all districts of the west coast, though in the north (Kudat district) rubber takes second place to coconuts. A further area of Chinese small-holdings is around Sandakan town in the east where rubber and fruit orchards combine with market-gardening and subsistence crops, while coconuts are found in parts of the lowlands (Y. L. Lee 1965, pp. 77—79).

In Sarawak, marked expansion of small-holder rubber production by both indigenous groups and Chinese took place in the 1910s and from around 1923. In the southwest of the state it involved Malays; along the coast it began to compete with sago amongst the Melanau, while in the Sibu and Sarikei areas Foochow Chinese also adopted the crop. By the mid-1920s, about 40,000 ha had been planted, entirely with unselected seedlings, though most of this was still immature since exports in 1924 were only about 6,700 tons. With substantial price rises, planting spread rapidly, especially amongst the Chinese, not only around the established areas of Sibu and Sarikei, but also at Binatang, Kapit, Sebauh and in the Baram valley. Ibans also began planting at this time and by the early 1930s the planted area was close to 90,000 ha with exports of around 10,500 tons. By 1941, the total area had risen to 97,000 ha of which 92 per cent lay on nearly 97,000 small-holdings. As in the Peninsula, the holdings of the Chinese were much larger than those of the indigenous people, averaging just under two-and-a-half hectares as compared with around 0·6 ha (Jackson 1968, pp. 90—91).

During the 1920s and 1930s, a perennial problem of the rubber industry in general and its small-holder sector in particular was its vulnerability to both economic and political pressures. Observers early in the century were not entirely incorrect in labelling the crop as "speculative" and sharp price fluctuations early characterized the commodity, beginning with a sharp drop in 1920/1921. The response was to initiate a scheme to restrict production in the hope of driving up the price, an expectation which was generally realized, but only at the cost of severe disruption and distress. In 1928 a British politician spoke of "the menace of native rubber" for such it was to the (largely British) share holders in the plantation sector (McHale 1967, p. 50). In its implementation, the Stevenson Restriction Scheme and subsequently the International Rubber Regulation Agreement discriminated against small-holders who generally constituted the most vigorous and productive sector of the industry (Barlow, 1978, p. 68). The result was that small-holders, whose share of the total mature area in the period 1923–1940 ranged from 30 to 41 per cent, were allocated a less than proportionate output quota, so that their contribution to production, which in the first five years of the 1930s had ranged between 42 and 48 per cent of the total, subsequently fell to between 32 and 37 per cent. C. Barlow (1978, p. 70) has argued that mean yields were higher on small-holdings than on estates, thus exacerbating a situation in which small-holders were being penalized for the benefit of plantation interests domiciled largely in Britain, who otherwise would have been forced to cut costs and rationalize production rather more than they did. As Barlow (1978, p. 72) has remarked, "The virtual freezing of the small-holding sector for so many years prevented what might have been a great expansion of labour-intensive production, the return from which would have benefitted wide sections of the rural population . . ." However, nothing else was to be expected from a colonialist government which saw the enterprises of British-domiciled companies as the lynchpin of the rubber industry.

Following the Japanese War, the small-holders in Malaya, Sarawak and Sabah quickly responded to high prices and in the Peninsula small-holder production rose to exceed half the total for the first time. Though this achievement was not repeated until 1969 and again in 1973, never again did the share fall below 40 per cent. In the Peninsula, during the period of insurgency of the 1950s, small-holdings suffered less severely than estates, but by this time small-holdings were beginning to feel the effects of the low inherent production capacity of the unselected rubber varieties that had generally been planted, which were also beginning to show the inevitable production decline of advancing age. In Sarawak (which was not affected by insurgency), for instance, at least four-fifths of the rubber on small-holdings was unselected and was nearing or even past the stage when tapping was economic, except when prices were exceptionally high (see Jackson 1968, pp. 91–98). Technically, production standards were low as was the quality of the product. Replanting with higher-yielding clones was hindered by the very small size of most small-holdings, under two hectares in size, which meant that owners were unwilling to forego income from their existing plantings.

Government intervention began in 1959 and since that time substantial aid has been given to small-holders to replant, to open up new areas and also to improve standards of production by giving instruction on proper tapping and processing methods. Group processing centres, which include a smoke-house to preserve and up-grade the quality of the sheet rubber, have also been established at nodal points. While the early phases of planned assistance concentrated upon new planting with high-yielding clones, later phases have attempted to up-grade existing farms by replanting. The result has been that two processes — intensification, represented by replanting, and extensification, represented by new planting — have proceeded in parallel. Whereas in 1960, only 16 per cent of the 145,000 ha under rubber in the State (90 per cent of it in small-holdings) was planted in high-yielding clones, by 1972, when the Rubber Planting Scheme had been terminated, 43 per cent of the 193,000 ha under rubber was in high- yielding varieties.

In the Peninsula, a similar situation existed in the immediate post-war decade. Average yields had fallen by 10 per cent between 1949 and 1952, and in 1954 only 5 per cent of the 659,000 ha under small-holder rubber had either been replanted or represented new planting, and almost two-thirds of the area had been established for over 30 years. Unlike Sarawak, where new planting expanded rapidly from the mid-1950s, replanting in the Peninsula initially accounted for a much larger area than new planting, but in the first five years of the 1960s new planting quickly caught up *(Table 24)*. Although the area replanted annually has not fallen below 15,000 ha since 1954, the areas of new planting have been much more variable, ranging from 1,300 ha in 1954 (and more recently only 4,200 in 1968), up to 40,600 ha in 1963. These general fluctuations have since continued with a recent up-turn in the late 1970s. Virtually all of the small-holder rubber replanted since 1946 has been of selected clones, and by 1973 the replanted area comprised 67 per cent of the original 1946 area

*Table 24*

**Small-holder rubber areas, new plantings, replantings and total area in Peninsular Malaysia, 1954—1973 (1000 ha)**

| Period | New plantings | | Replantings | | Mature area | |
|---|---|---|---|---|---|---|
| | area | cumulative total | area | cumulative total | date | areas |
| 1953—1958 | 18·9 | | 82·5 | | 1958 | 275·9 |
| 1959—1963 | 120·0 | 138·9 | 141·1 | 223·6 | 1963 | 299·5 |
| 1964—1968 | 62·4 | 201·3 | 137·4 | 361·4 | 1969 | 479·4 |
| 1969—1973 | 51·8 | 253·1 | 111·9 | 472·9 | 1973 | 791·7 |

*Source:* BARLOW 1978, p. 445.

(including estates later subdivided). Nevertheless, a substantial area of the 1946 stock remained to be replanted in 1973, comprising 274,200 hectares or 35 per cent of the small-holder rubber area (Barlow 1978, p. 87).

The varying rates of new planting and replanting have led to marked variations in the productivity of rubber small-holdings — though this productivity can be measured only by relating production to total mature area, some of which may not have been tapped. In every year from 1929 to 1934, small-holdings were actually more productive than the plantations, by as much as one-third in two instances. Contrarily, in every year after 1934,[38] small-holdings were less productive than the plantations which were more readily able to mobilize financial resources with which to replant or undertake new planting. In the 1960s and 1970s, rubber small-holdings have been less productive by around 30 per cent (Barlow 1978, pp. 445—446). One factor in addition to a relative lag in the use of more productive planting material by small-holders is that when prices fall, small-holders tend to reduce tapping frequency, some areas not being tapped at all. Thus in 1935 the average small-holder yield fell to 287 kg/ha compared with 443 kg/ha the year before. This was followed by a sharp rise in 1940. Similar, though less pronounced trends occurred during the early 1970s, average production rising sharply from about 750 kg/ha to almost 950 kg/ha in 1973.

The recent evolution of perennial-crop small-holder agriculture other than that based wholly or partly upon rubber is difficult to document. There is little material available for the thriving mixed perennial small-holdings of coastal Selangor, for example, where coconuts, coffee, fruit trees of many varieties, pineapples and vegetables, together with patches of rubber make for a much more varied crop pattern than is usual. Data are available, however, concerning pineapple small-holdings (Neville 1963, 1964) and pepper small-holdings both in Sarawak (Jackson 1968, pp. 98—104) and in Johor (Hill 1969), as well as coconut small-holdings in Peninsular Malaysia (Fernando and Grimwood 1973, 11/1, pp. 89—114) and in Sarawak (Jackson 1968, pp. 108—112). Burkill (1966) has useful summaries of the history of all the common, and many of the uncommon small-holder crops.

Pineapple small-holdings producing for export were established in Singapore during the 1880s when at least one cannery was constructed, but it was not until the first decade of this century that the industry firmly established itself (Wee 1970). Until the Japanese War, the supply of fruit to canneries was entirely from small-holdings, mainly in Johor, where from 1921 the pineapple was a catch-crop associated with the extension of the rubber area. With the marked fall in the price of rubber during the world economic depression of the 1930s, new plantings of rubber fell drastically threatening in turn the supply

[38] There are no data for the years 1941—1945.

of pineapples for which prices were maintained. In 1939 Malaya accounted for 27 per cent of the world production of canned pineapple and 80 per cent of world exports: by this time, pineapple production had become a special entreprise, though it largely remained on a small-holder basis with growers under contract to the canneries. In the Pontian district of Johor and the Klang district of Selangor, however, plantations had been established on flat peaty land, where the problems of soil exhaustion that had characterized small-holder production on sloping land had not become apparent. As with rubber, it was plantation interests which tested the ecological suitability of the crop, though in this case the environmental requirement for continuous cropping was a lowland peat rather than hill soils. With rehabilitation of the industry in the late 1940s, production became concentrated on peats as a result of official policy, and there it has remained. The area under pineapple has been roughly equally shared between small-holders and plantations since the 1950s, though recent policy has been to increase the proportion of small-holders so that they now account for two-thirds of the area.

Pepper-growing is a major activity in Sarawak and pepper has ranked as the second most important agricultural export for much of the post-war period, Sarawak ranking as a major world producer alongside Indonesia (mainly southern Sumatra) and India. The industry seems to have no connection with early activities in the Peninsula, its basis in Sarawak being laid by offers of free passage to Chinese planters from Singapore in 1876. In addition to liberal concessions of land by government (then the personal rule of Rajah Brooke — an Englishman), the Borneo Company financed Chinese small-holders to grow both pepper and gambier, mainly near Bau. Another centre emerged near Kuching and by 1906 just over 5,000 tons were exported only to fall to 1,000 tons by 1920, largely as a result of disease and falling prices. By the late 1930s, Sarawak was producing around 2,700 tons a year from well-established centres in the Kuching–Serian area where Hakkas predominated, and in the Sarikei–Binatang area, where Foochow and Cantonese farmers predominated. This pattern has persisted, with fairly steady increases in production, even though the crop is somewhat speculative and capital costs at M$25,000—30,000 per hectare high, a fact which tends to favour the Chinese farmer since he tends to have most ready access to urban money-markets. In Johor, pepper-growing is also in the hands of Chinese small-holders, mainly Hakkas. Present production is not linked with the phase that began in Singapore and Johor in the nineteenth century, as this had ended by the 1920s. Rather, planting materials were brought from Sarawak in the 1950s and from a core area at Kelapa Sawit (a "New Village" set up by the military authorities to house "bandit sympathizers"), pepper-growing spread to several nearby villages though remaining largely in the hands of Chinese. There can be little doubt that Chinese pepper-growers are amongst the wealthiest small-holders in the region, Hill's study of

1967 indicating that 23 per cent of the 136 Johor farmers interviewed had household incomes over M$450 per month, roughly four times the national norm (HILL 1969, p. 39).

Although coconuts have been a "kitchen-garden" crop for centuries, their cultivation as a commercial crop probably dates from the nineteenth century when they were cultivated in plantations in Pinang and Melaka, especially (in Pinang) following the collapse of the nutmeg industry in the 1840s (OOI 1976, p. 277). Unlike pineapple-growing and the later phases of pepper-growing, Chinese small-holder interest has been minimal, except in Sabah. In the Federated Malay States, 61 per cent of the 11,000 ha under coconuts in 1917 was in small-holdings of less than 40 ha in extent. In Peninsular Malaysia as a whole, the area in coconut small-holdings reached 178,500 ha by 1961, and subsequently increased slowly to reach 191,000 ha by 1972 (OOI 1976, pp. 277–278). The main reason for this relatively slow growth has been competition from oil palm — and hence continued low prices, although even on established holdings production has tended to fall through ageing and, especially in Lower Perak and western Johor, through major problems with drainage. A government scheme of rehabilitation and replanting has helped to stem this decline, though average annual yields, which range from 0·6 to 0·75 tons of copra per hectare, remain low. The rehabilitation process has been partly conditional upon inter-cropping with other perennials, mainly short-term crops such as pineapple, banana, coffee, and on fertile alluvial clay soils, cocoa (FERNANDO and GREENWOOD 1973, II/1, pp. 92–93 and 106). The commercial production of coconuts is also recent in Sarawak, where it is concentrated on the coastal and riverine flatlands of the First and Second Divisions which account for 80 per cent of the crop area (JACKSON 1968b, p. 109). Similarly, in Sabah, commercial plantings, many of which should be regarded as small estates in terms of organization if not size, are associated with late nineteenth and early twentieth century settlement by the Hakka Chinese of the Kudat Peninsula as well as with indigenes of the West Coast.

While pineapple, pepper and coconut small-holdings obviously represent sub-types of perennial crop small-holder agriculture, there is insufficient detailed information available to define adequately and to discuss other sub-types which, in comparison with rubber small-holdings, are of relatively minor importance. An exception to this is obviously the sub-type combining rubber and rice which characterizes many of the inland areas of the Peninsula, both where narrow valleys used for rice-growing are flanked by steep hills planted to rubber, as in Negeri Sembilan, and on river-terrace terrain, such as that of inland Pahang. Parts of these areas have been studied by HO (1967a, b), though in both studies the rice and rubber sectors of the economy were treated almost entirely separately.

The landscape of rubber small-holdings is one of exceeding monotony, surpassed only by that of rubber estates, the difference lying only in the greater frequency of settlements in small-holder areas. The usual pattern is of irregular linear settlement along the highways, from which minor roads and laterite-surfaced tracks lead off, along which dwellings are also set *(Fig. 24)*. Near towns and villages, dwellings may be absent from small-holdings, though on most, a simple thatch-roofed processing shed is likely to be found, as on farms which also contain a dwelling. But the landscape ensemble is dominated by endless *Hevea* trees trunks, gray-green foliage, dark green turning non-uniformly to autumnal tints during "wintering", or bright green during refoliation. Below the trees is a ground layer of various plants, dense where the canopy

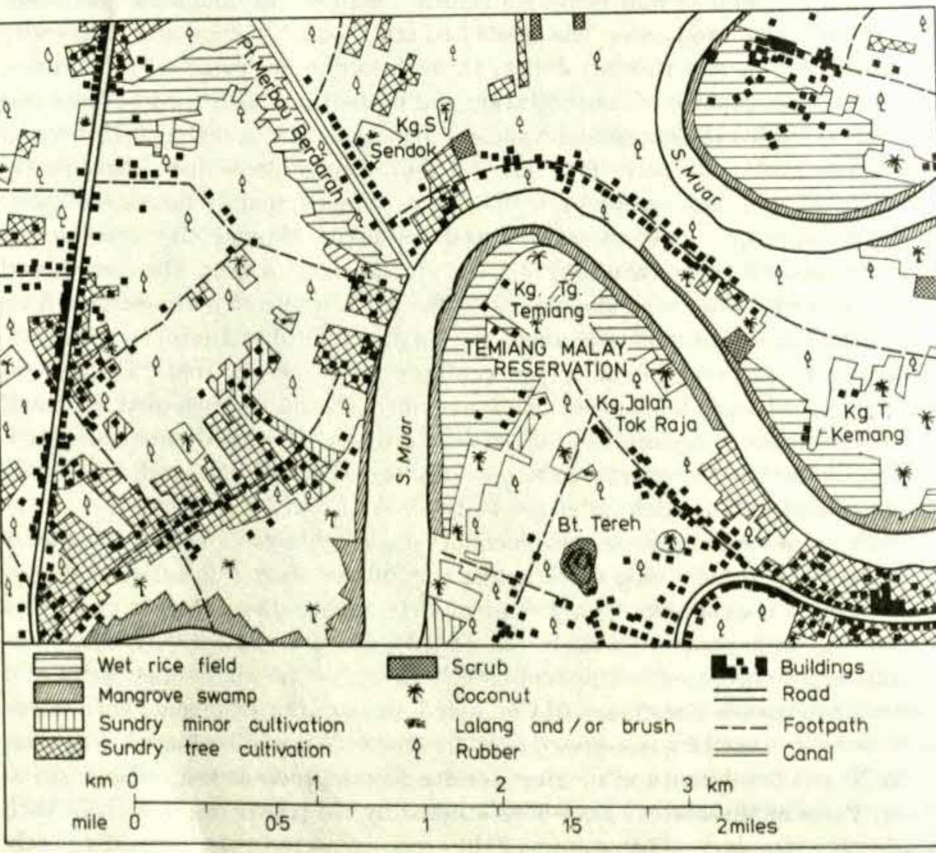


*Fig. 24.* **Perennial crop small-holder cultivation, Muar, Johor, Peninsular Malaysia (map extract)**

is broken, scattered where the over-arching branches produce a cathedral-like gloom so intense as to prevent the growth of all but a few ombrophytes.

*Hevea* is the first major landscape element. Botanically it belongs to the family Euphorbiaceae, but unlike some of its kins (e.g. *Croton* and *Euphorbia* spp.), it cannot be said to be a particularly handsome tree, though not without some attractiveness even during wintering and refoliation. On most small-holdings, the stands are even-aged, though on better managed ones there is a scattering of trees younger than the majority which represent "supplies" planted to replace those damaged or destroyed by wind or lightning. Where replanting has taken place on a farm, this is evidenced by the existence of several plots, each of which is even-aged, though with some "supplies". The total above-ground mass of mature and old trees has been reported by WYCHERLEY (1968, p. 27) as ranging from 44 to 132 tons/ha, with a mean of 77 tons/ha (oven-dry weight). A minor component associated with all *Hevea* is epiphytes, mainly lichens, as well as occasional epiphytic ferns, *Asplenium nidus* being the most common. The incidence of all epiphytes increases with increasing age of the stand.

The second major landscape element comprises the ground layer. In recently established small-holdings under skilful husbandry this usually comprises a vigorous growth of leguminous creepers which are established by deliberate sowing at about the same time as the young rubber, with the objectives of suppressing weed growth, reducing soil temperatures and with this losses by oxidation, lowering the loss of topsoil by rain wash and other forms of erosion and incidentally supplying same nitrogen and other nutrients from decaying leaf matter to the growing trees. A common cover-crop on well-managed farms is a mixture of legumes — ***Pueraria phaseoloides***, an indigenous species, ***Centrosema pubescens*** and ***Calopogonium mucunoides***, both introductions from tropical America. Other covers include ***Mikania cordata*** (Compositae), another American introduction, various grasses, such as ***Axonopus compressus*** and ***Paspalum conjugatum***, again American species which have the advantage of being able to be grazed. However, since cover-crops cost money, though their cost is recovered by enhanced production, adventive shrubs, herbs and grasses form the cover on many small-holdings and are kept from smothering the rubber trees only by active clearing, an activity also required of planted covers. The dry weight (in tons per hectare) of various types of cover about two years old have been reported as follows: leguminous creepers: 5·2; ***Mikania cordata:*** 3·7; grasses (mixed ***Axonopus compressus*** and ***Paspalum conjugatum****):* 2·7; and naturally occurring adventives: 6·4 (ANONYMOUS 1972, p. 75). In the normal course of events, ground cover begins to decline as the crowns of the rubber trees grow together and on small-holdings where there may be up to 450 trees per hectare, the shade is so intense that only a few grasses and herbs survive. However, even this cover may still be controlled by slashing, especially near the trees. Where the canopy is opened out by wind-throw and the gaps are not filled, a rapid growth of heliophytic shrubs, herbs and grasses ensues. On poorly managed and abandoned holdings, the usual neat rows disappear to be replaced by what can best be described as *Hevea*-dominant secondary forest in which the originally planted *Hevea* form a somewhat patchy "upper storey", with a dense tangle of rubber seedlings below, some of which may be tapped if large enough, and various shrubs such as ***Melastoma malabathricum***, herbs such as ***Mikania scandens*** and a host of others. The whole is intersected by narrow pathways leading to each tree.

The third landscape element in rubber small-holder areas is an open shed, located at a nodal point of the farm, usually near a road or path. To this is brought daily liquid latex for coagulation and pressing into sheet rubber. The building, usually open-sided, is constructed very simply, usually with a roof of *atap* thatch, a simple workbench on one end of which stand two hand-powered mangles, one with smooth rollers used to express water from the coagulum and the other with ribs. The floor may be of beaten earth or increasingly of concrete. Sometimes the processing shed is a simple lean-to constructed against the dwelling, or amongst Malays who customarily build their houses on stilts about two metres high, the space beneath the dwelling may be used for processing the latex into sheet rubber. Somewhat over half of all rubber small-holders have their own processing shed, the others using a neighbour's or, less commonly, the facilities of a group-processing centre where these have been up by the government. Where farmers live in town, the processing shed may be the only building on the farm.

Much less common than processing sheds in a rubber small-holder landscape are smoke houses, only about one farmer in a hundred having his own. These are small windowless buildings, three to four metres square and built of timber, though asbestos building board is now preferred as it reduces the risk of fire. In small-holder areas, smoke-houses are hand-fired using old rubber wood as fuel, so that stacks of this may be found nearby. Smoke-houses, especially if they are privately owned by shopkeepers who double as rubber merchants, may also be located on the fringes of small towns where the characteristic pungence of smoke and drying rubber indicates their presence.

Dwellings are to be found on all farms except some near to towns, a major architectural difference being that they are usually rather more substantially constructed than those in rice areas, a fair proportion of mill-sawn timber being employed in their construction. This simply reflects the fact that rubber small-holders not uncommonly have household incomes between three and ten times those of rice farmers. A further remarkable architectural difference is that the dwellings of the Chinese are almost always built flush to the ground, nowadays often with a concrete floor, whereas Malay homes are on stilts.

In areas where small-holders combine the growing of rubber with the growing of rice, the landscape elements remain those appropriate to the growing of each crop. The common pattern is of rice on the alluvial lowland and rubber on terraces and hill slopes. This pattern should not be termed "mixed", since spatial differentiation is complete.

The term "mixed" can be applied quite properly where various perennial crops, together with kitchen garden crops, are combined on a single farm. Here the crops are not arranged singly in discrete plots, but are planted so that they quite unconsciously mimic the structure of the tropical rainforest which they have replaced. The "upper storey" generally consists of coconut palms with some areca, and their feathery fronds, while reducing raindrop impact substantially, do not reduce light intensity sufficiently to hinder the growth of other crops below. Some of the upper-storey trees do have dense crowns. Examples are fruit-trees such as the durian *(Durio zibethinus)*, jack-fruit *(Artocarpus integra)*, mangosteen *(Garcinia mangostana)*, rambutan and mata kucing *(Nephelium* spp.*)* and rose-apple *(Eugenia aquea)*, all of which grow to 10–15 m, and cast such dense shade that little can grow beneath them. The intermediate storey rising to about 3 m may consist of a variety of medium- or short-term perennials such as citrus, coffee, cocoa, papaya, bananas and manioc, and these may form a more-or-less continuous cover. Where light intensities are high enough, a "ground layer" is planted. This may comprise leafy vegetables, especially brassicas, various kitchen herbs, chilli and pineapples, the last for consumption either ripe as a fruit or unripe as a vegetable. The area near the dwelling may also be used for growing flowers (orchids are popular) and as a "scratch area" for domestic chickens.

The landscape of coconut small-holdings is also distinct, there being two sub-types associated with monoculture and with mixed cultivation. The former is now largely confined to areas of coastal Psamments where the upper storey of coconuts is combined with a ground layer of coarse grasses, tough herbs and shrubs which may form rough grazing for cattle. The structure of the latter sub-type is somewhat like that just described for mixed perennial crop small-holdings, but only one crop, usually cocoa, is grown beneath the coconuts. An important element is the copra-drying shed, a structure rectangular in plan, usually about 5 m wide and up to three times that in length, constructed of corrugated iron on a wooden frame and with a wooden floor upon which the coconut flesh is placed to sun-dry. The hipped roof is hinged at floor level and designed to be quickly closed, should rain threaten. Alternatively, drying may be carried out on a drying ground of beaten earth over which palm fronds or some other form of protection from rain can be dragged.

The agroecosystems of perennial tree-crop cultivation have not been widely studied as a whole, though the agronomy of individual crops is well-advanced, this being particularly true of rubber (BARLOW 1978, Chap. 4). Systems of mixed perennial tree-crops are obviously highly generalized, so that not only is energy cycling complex, but the energy flows interlock and interact in ways that have yet to be studied. The ecosystem of rubber, however, is relatively simple, basically involving only *Hevea* together with any cover-crops. Structurally, the mature stand is thus remarkably uniform, with a single storey of even-aged *Hevea* and a variable ground layer composed of cover-crops and/or various adventives. Energy being cycled within the system is thus distributed amongst a comparatively limited number of plant species, each of which is represented by a large number of individuals *(Fig. 25)*.

The structure of immature stands of rubber on small-holdings is rather more complex, since small-holders may inter-crop rubber with short-term crops such as tobacco, melons, pineapples, chilli, groundnuts, sweet potatoes, manioc, yams and maize in order to gain subsistence and some income during the establishment phase. Where inter-cropping is absent, there is usually a cover-crop pres-

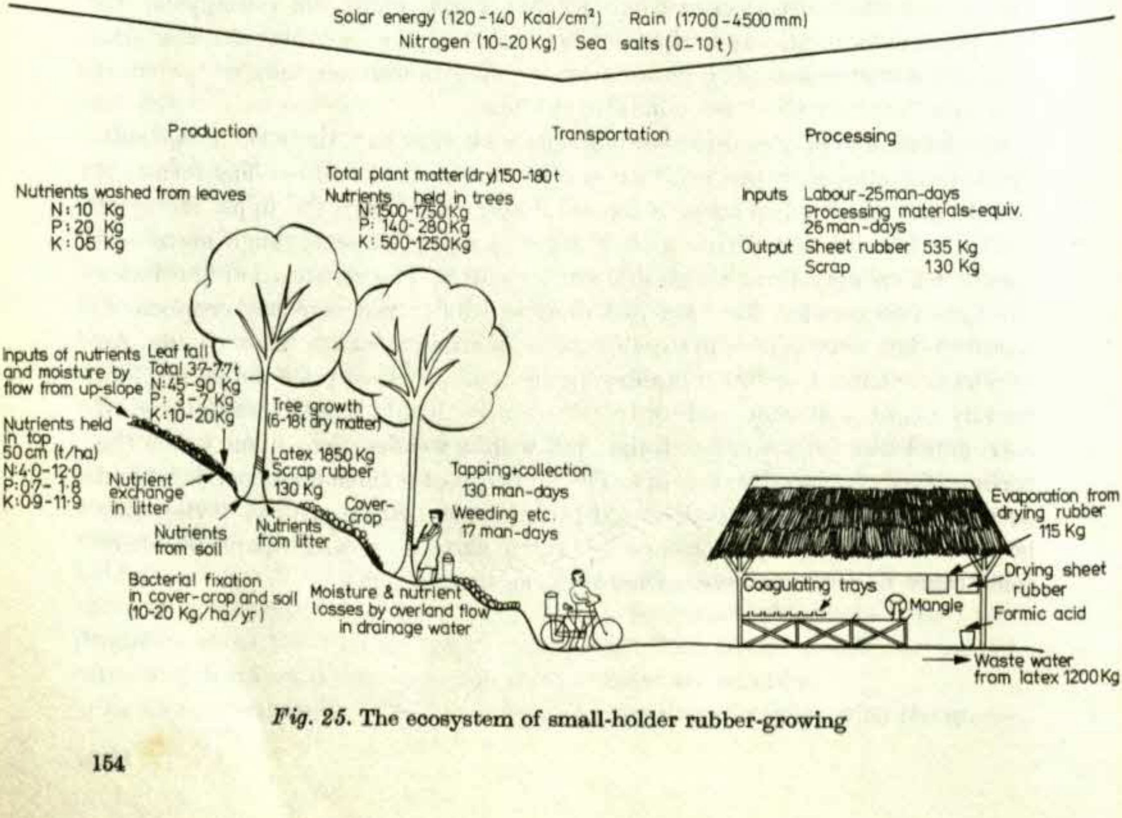


*Fig. 25.* The ecosystem of small-holder rubber-growing

ent, so that nutrient-cycling becomes increasingly simple as the stand matures. By contrast, on rubber plantations inter-cropping is rare (mainly because of higher labour costs and because inter-cropping tends to extend the time needed for the rubber trees to reach tappable girth). A further point of difference is that the planting density of *Hevea* tends to be higher on small-holdings than on plantations, with densities of 400–600 trees per hectare being common on the former compared with 300–400 on the latter. Consequently the total plant mass may be slightly higher on small-holdings, though it is possible that the actual difference may be small, since at high planting densities the weight of each individual may be less than where densities are lower. However, these differences apart, the ecosystems of small-holder and plantation rubber are the same.

Inputs to the rubber ecosystem from the sun and the atmosphere are obviously more or less the same as the inputs to shifting cultivation and rice-growing, though it is likely that solar energy levels, especially light levels, are substantially lower at the soil surface under mature rubber than below an intercrop under immature rubber or rice.

The nutrient cycle is best described in terms of its two phases, the soil phase and the plant phase (ANONYMOUS 1972). Generally, soils on which rubber is grown are highly leached and contain rather low though variable levels of nutrients. Nitrogen levels in the top 50 cm of five typical rubber-growing soils in Peninsular Malaysia have been reported as ranging from 4·6 to 11·6 t/ha. Levels of phosphorus, potassium and magnesium are even more variable, the ranges quoted being 0·76–5·7, 0·8–11·9 and 0·5–14·7 t/ha, respectively (as determined by acid extraction). Much of these nutrients are not necessarily available to plants. The actual uptake by trees is only a small fraction of the total nutrient content and this increases as the rubber trees mature. For example, one-year-old trees will have immobilized only 12 kg of nitrogen per hectare, compared with a cumulative total of 350 kg and 1,529 kg at four and ten years respectively (ANONYMOUS 1972, p. 76). In young trees the nutrients are stored largely in the unbranched trunk, leaves and roots while in older trees a higher proportion is contained in the branches. The quantity of nutrients held in young trees may be rather smaller than in the ground layer. For example, at two years old, the total content of N, P, K and Mg in rubber has been reported at 134 kg/ha, compared with 245 kg/ha for leguminous cover-crops and 256 kg/ha for mixed natural cover. However, as the canopy closes, the ground layer is shaded out, dies and the accumulated nutrients become available to the rubber trees.

At the same time, nutrients are continuously returned to the soil both from the rubber and the ground layer. At the immature stage, the dry weight of the ground layer, which ranges from 2·7 to 6·4 t/ha after about two years is roughly equalled or slightly exceeded by the weight of the litter. Over the whole period of immaturity, which on the best small-holdings is about 5 years, the return of nitrogen to the soil from the ground layer ranges from 24–65 kg/ha for grasses up to 226–353 kg/ha for leguminous cover-crops. During those early years, the trees return only an insignificant amount to the soil, but by maturity, the quantities returned are substantial, the amount of plant material per year ranging from 3·7 to 7·7 t/ha (dry weight) for leaves alone. The total annual contribution of nutrients, N, P, K, Mg, ranges from 67 to 135 kg/ha (ANONYMOUS 1972, p. 78). On small-holdings, normally the only inputs of nutrients to the soil come from the decay of the parent material and from the trees and ground layer, but on plantations a further input is from the application of artificial fertilizers, a total input of N, P, K and Mg of around 250 kg/ha being recommended. The leaf fall is equivalent to a fertilizer input of 0·5 to 1·0 t/ha (SHORROCKS 1965, p. 49). Further inputs of unknown quantity to the soil come from seeds, branches and dying roots of living trees and from dead trees of which there are about 5 per ha every year. About 1·6–2·4 t/ha (dry weight) are added from the latter source yearly.

Nutrients are added to the cycle from a number of other sources (SHORROCKS 1965, p. 50). Nitrogen may be introduced by symbiotic fixation in root nodules and non-symbiotically by soil bacteria. There is considerable disagreement as to the quantities so added, some estimates ranging up to 40 kg/ha, though around 6 kg/ha seems a better estimate. With an annual rainfall of 2,500 mm, an input of roughly 20 kg N, 12 kg K, 3 Kg Mg and 38 kg Ca per ha has been estimated as being derived from the rain itself. At the same rainfall level, the following quantities of nutrients have been reported as having been washed out of leaves and added to the soil: 10 kg N, 20 kg K, 0·5 kg P and 1·5 kg Mg (ANONYMOUS 1972, p. 78).

The nutrients in the soil, whatever their origin, follow one of three paths. They may be absorbed by the roots and transferred to the plants, they may be taken up into insoluble compounds unavailable to the plant or may be lost from the nutrient cycle by various means. Of the last, loss through leaching, especially N, K and Mg are likely to be significant in light-textured sandy soils, while on steep land with sporadic surface cover losses also occur through erosion. Additionally, nitrogen is lost by bacterial denitrification and volatilization. There is also a major loss of nutrients and water through the latex. With an overall output of rubber (dry weight) of 1,400 kg/yr, about 20 kg of N, P, K and Mg are required. In reality, what is taken from the tree falls into two components – latex, which is 28–30 per cent actual rubber and the balance, which is mainly water, together with scrap and cup rubber which are solid rather then liquid. Average values for these components are given in *Figure 25*.

Rubber is only a small part of the dry matter produced, representing around 0·4–0·6 per cent of total production. Unlike rice, where a total plant mass of perhaps 5 or 6 t/ha is reached within 3–6 months of transplanting, rubber takes much longer (TEMPLETON 1968). In the early stages of growth, the relative rate is high, just over 3·5 per cent per week for one-year-old trees, though the plant mass is low: a 15-month budding weighs only about 5 kg. Growth rates slow with increasing age, though leafiness increases up to about the fifth year when it levels off, at which point the total area of leaves is about 5·6 times that of the ground area covered by the tree. However, total plant mass increases more or less exponentially, a five-year-old tree weighing about 200 kg (TEMPLETON 1968). Dry matter produced annually from selected modern clonal rubber rises rapidly from about 3 t/ha nine months after budding to a peak of around 35 t/ha after 39 to 63 months, slowing thereafter. This is in line with dry matter production for tropical rainforest trees. More correctly, however, mature rubber should be compared with mature forest and here production for rubber has been estimated as not exceeding 15 t/ha/yr (TEMPLETON and IYER 1969, p. 262). In rainforests, annual production may commonly be 4–9 t/ha, ranging up to a maximum of 16 t/ha. A similar comparison can be made for total plant mass. Using the data of BARLOW (1978, p. 129) and SHORROCKS *et al.* (1965), the plant mass at usual small-holder densities of around 400 trees per hectare may be estimated as 150–180 t/ha compared with 600–650 t/ha for rainforest. Thus it is not really correct to suggest that rubber "forest" simulates the rain forest which it has replaced either structurally or ecologically, though obviously it does this to a much greater degree than the "artificial swamp" of the wet rice field. Rubber, however, is a relatively efficient converter of solar energy and about 2·8 per cent of incoming energy has been reported by TEMPLETON (1969, 259) to end up as part of the plant.

The remaining inputs to the production system are those relating to cultivation. On small-holdings the only other major input is labour – for weeding, and for tapping and collecting latex and scrap rubber from each tree. Daily tapping is usual, and continues throughout most of the year, interrupted only by morning rain, though during the annual period of wintering and refoliation the frequency of tapping may be reduced. Some small-holders also apply stimulants to the trees to increase the flow of latex, though this is more usually a plantation practice. Similarly, various herbicides, whether arsenicals or hormonal, are more commonly used on plantations than on small-holdings. There is thus no real annual cycle of activity, only a daily one, unless of course the small-holder combines rubber with rice-growing, in which case labour inputs on the rubber side of operations fall away at peak periods of the rice-growing cycle.

The farm system has two further aspects, transportation and processing. Of the former, little need be said beyond the fact that it involves carrying liquid latex, every day or alternate days, from the trees to the processing centre. Scrap is collected every week or so and, since it is not processed further on the farm, it is simply stored until the time when it is sold to a dealer. Latex must first be coagulated and this is done by adding acid, usually formic acid, and leaving the mixture in small tins of galvanized iron, each holding about 4·5 litres of the fluid. The coagulum is then passed through rollers, first smooth, then ribbed and hung on a line to dry like so much washing. The inputs are thus labour, around 25 man-days per year, and processing materials worth the equivalent of around 26 days' work. Outputs from the processing system are sheet rubber (together with collected scrap) and waste water. The values for inputs and outputs given in ***Figure 25*** are somewhat conservative and on the better small-holdings they are at least double.

## THE SOCIO-ECONOMIC FRAMEWORK

The social framework in which perennial-crop small-holders operate has received rather less attention from scholars than has that of rice-growers, perhaps because their social and economic problems are seen as rather less pressing. As a result, there are no comprehensive studies, though the 1960 Agricultural Census provides some data. Even case-studies are few and like the Census are confined to Peninsular Malaysia.

According to the 1960 Census, 80 per cent of the rubber farms and 87 per cent of the coconut farms in the Peninsula were worked by the owner or family members, with a similar proportion of "fruit-kampung" farms falling into the same category. The bulk of remaining farms were held in some form of mixed tenure, but tenancy was reported as being very low, existing mainly in the northern states and then only as ownership combined with tenancy (HILL 1967, pp. 101–102). Strictly speaking, the view presented by the Census is correct, since share-tapping of rubber, which is widely prevalent, is a form of share-cropping rather than a form of tenancy, since the share-tapper obtains only the use of the trees and not the actual use and control of the land. On coconut small-holdings in the Kudat district of Sabah, for example, share-workers are paid an agreed rate for the copra produced and are often provided with a house and grounds which may be used for kitchen garden crops. The distinction between a share-cropper who merely has the use of the trees and a tenant who actually rents land, for instance to grow rubber, is in practice a fine one. In any case, it would be highly unlikely for a landlord to give a tenant the freedom to choose whatever crop he wanted, since on perennial tree-crop farms the trees are probably worth more than the land and are regarded as a more or less permanent productive asset. FRYER and JACKSON (1966, p. 207) have argued that since share-tappers make the decisions as to when and how to tap and where to process the latex, it is they who are the farm operators and, in effect, tenants. "Tenancy" arrangements are usually little more than informal verbal agreements. Rent is usually paid monthly, usually in kind; in Ulu Selangor the rent is generally half the produce, sometimes 40 per cent, and less commonly 60 per cent (FRYER and JACKSON 1966, p. 209). Though these writers do not mention it, share-tappers often retain all the scrap rubber produced, a practice which may encourage careless tapping since this increases the proportion of scrap.

The limited material on tenure is summarized by HILL (1967, pp. 102–103) who suggests that the incidence of share-cropping varies widely from area to area and also by size of farm. E. K. FISK reported that in three Malay villages in Ulu Selangor only 5·7 per cent of rubber farms were operated by their owners, no fewer than 80 per cent being operated on a tenant or share-cropping basis, the balance being worked by owners' relatives. Again, C. P. BROWN's study of an area in Muar district, Johor, indicated that 36 per cent of rubber farms were either entirely or partly share-cropped. R. Ho's study of rubber farms in central Pahang indicated that only 3·6 per cent were worked by owners and their immediate families, with another 10 per cent worked by relatives outside the nuclear family, so that 54 per cent were worked by tenants (Ho 1967b, p. 69). Even more striking are the data from Syed Husin Ali's study of a village in Johor *(Table 25)* where most of the land was in rubber, with the balance in coconuts or areca.

*Table 25*

Land ownership in Kg. Bagan, Johor (in per cent)

| Class | Proportion of persons | Proportion of land owned |
|---|---|---|
| Landlord | 16 | 67 |
| Landlord cum owner-operator | 3 | 5 |
| Owner-operator | 28 | 16 |
| Owner-operator cum tenant | 24 | 8 |
| Tenant (and owner-tenant) | 29 | 4 |
| | 100 | 100 |

*Source:* S. Husin Ali in HILL 1967, p. 103.

The extent to which share-cropping arrangements cut across ethnic lines is little known. FRYER and JACKSON (1966, p. 209) reported that in the Rasa area of Ulu Selangor most Chinese share-croppers rented holdings from other Chinese, renting from Malays being much less common and mostly involved land in Malay Reservations. In the Kudat district of Sabah, significant numbers of coconut small-holdings are Chinese-owned and are let out to Kadazans on a share-crop basis.

The evidence of the *Census* notwithstanding, it would seem that in some areas the incidence of landlordism and tenancy, broadly defined, is comparable to their occurrence amongst rice-growers, and that some perennial-crop farmers may have similar difficulties.

The incidence of share-cropping also varies according to farm size. T. B. Wilson's 1960 data (in BARLOW 1978, p. 230) indicate that in the Peninsula share-cropping increases in step with farm size. On farms of less than 1·2 ha only 20 per cent were share-cropped, while on those of over 4·0 ha 40 per cent were share-cropped. Though this is an expectable pattern, Fryer's and Jackson's data indicate the contrary, namely that the larger a Chinese small-holding, the more likely it is to be family-operated, the majority of those working less than 2 ha doing so as share-croppers.

Farm size itself is an important parameter, but its measurement has been a matter of some difficulty, the 1960 Census in particular falling short in covering less than half the rubber small-holding area. On the basis of this incomplete data the average size for Peninsular Malaysia was given as 2·1 ha, but two more recent surveys give estimates of 2·3 and 2·8 ha (BARLOW 1978, p. 227). These mean values, however, hide a wide range, as is shown in *Table 26*, which indi-

*Table 26*

**Size distribution (%) of rubber small-holdings in Peninsular Malaysia (1960) and in Bentong District (1962—1968)**

| | Size group (ha) | | | |
|---|---|---|---|---|
| *Peninsular Malaysia* | *below 1·2* | *1·2—2·0* | *2·0—4·0* | *over 4·0* |
| Number | 41 | 23 | 23 | 13 |
| Area | 13 | 16 | 30 | 41 |
| *Bentong District* (all races) | *below 0·8* | *0·8—2·4* | *2·4—4·0* | *over 4·0* |
| Number | 2·1 | 44·7 | 23·2 | 30·0 |
| Area | 0·4 | 19·5 | 19·7 | 60·4 |
| *Bentong District* (Chinese) | | | | |
| Number | 1·4 | 41·7 | 24·0 | 32·8 |
| Area | 0·2 | 17·4 | 19·0 | 63·4 |
| *Bentong District* (Malays) | | | | |
| Number | 5·3 | 60·3 | 20·1 | 14·3 |
| Area | 1·4 | 37·1 | 26·9 | 34·6 |

*Sources:* BARLOW 1978, p. 228; VOON 1972, p. 69.

cates that while there are many small-holdings, these account for a comparatively small area whether at the regional or local level. Farmers recognize this situation and BARLOW (1978, p. 227) has indicated the existence of political pressures towards some rectification.

It may be surmised that political pressure arising from such an uneven size distribution may be exacerbated by significant differences amongst the major ethnic groups. Not only do the Chinese own more perennial tree-crop land, especially rubber than any other group (49 per cent in Peninsular Malaysia, 1972), but the average size of their farms is also larger. BARLOW's review of the question (1978, p. 231) indicated that on the mainly new or replanted farms surveyed, the mean size of Chinese rubber small-holdings in the Peninsula was around 4·1 ha compared with 1·7 ha for Malay farms. VOON's data for Bentong district (1972, p. 70) indicate a mean farm size among the Chinese of 4·0 ha; amongst the Malays of 2·4 ha; for the Indians of 3·1 ha, and markedly different size distributors for the two major communities (see *Table 26*).

There is also evidence of considerable transfers of rubber small-holdings from Malays and Indians to Chinese, other than those in Malay Reservations which cannot be sold to non-Malays (BARLOW 1978, p. 230). The Chinese have also benefitted from the subdivision of former estates, BARLOW (1978, p. 231) estimating that they own 90 per cent of such subdivided lands, though overall, this trend is counterbalanced by the overwhelming predominance of Malays and other indigenous peoples on land-settlement schemes.

Fragmentation of holdings is often held to be "unhealthy" (see VOON 1972, p. 74, for example), but its effects have not been examined in any rigorous way. GREENWOOD (1964, p. 89) has suggested that though the 1960 Census indicated that only 47 per cent of rubber small-holdings in the Peninsula comprised one lot with 13 per cent being composed of more than three parcels, this was not a serious matter economically. It is not difficult to operate two or more parcels as a single unit, since hand tools, a minimum of chemicals and fertilizers are all that is required. Cultivation, tapping and latex collection are tree-by-tree tasks and latex collected from several sources can easily be processed at a central point. Physical fragmentation is not a serious drawback, unless the parcels are far apart or provide in aggregate less than a full day's work for the operator.

As with rice land and for similar reasons, the physical subdivision of perennial tree-crop land is rather less than might be expected in a situation where both custom *(adat)* and Islamic law inexorably lead to fragmentation of ownership, notwithstanding the provision of the National Land Code that 0·4 ha is the lower limit of legal subdivision. Overall it seems that rubber land has suffered from the subdivision process much less than rice land, perhaps, as HO (1970, p. 89) suggests, because of its relative recency as a crop, because of its greater worth as a source of cash income which discourages sale, and because government assistance is available for replanting. Even so, most rubber small-holdings consist of more than one lot, the 1960 Census average being just over two. These lots may be exceedingly small, Ho (1967a, p. 191), for example, reporting a mean lot size of only 0·89 ha for the Terachi valley, Negeri Sembilan, where 87 per cent of the 687 lots surveyed were less than 1·62 ha in extent.

There are also definite ethnic differences in patterns of land ownership in terms of single ownership, co-ownership (two owners) and joint ownership (more than two owners) as Voon (1972, p. 73) has shown for Bentong, Pahang. Substantially fewer Malays were sole owners, 76 per cent as against 87 per cent for the Chinese, with 15 per cent of Malay holdings having two owners and the rest three or more. The difficulties of practical decision-making in a situation where several people have claims to a plot of land is probably reflected in the relatively low rate of replanting on Malay small-holdings (Voon 1972, p. 73), though small size is probably at least that important.

In economic terms, perennial tree-crop small-holder agriculture is something of a hybrid, as is obvious from the typology presented earlier (see Chapter 6). In one sense, this is a peasant type, yet it is also capitalist in terms of the objectives of production, in most cases, for export. This concentration is particularly marked in the case of rubber, of which 98 per cent is exported. Small-holders, especially in the rubber industry, compete directly with estates and the fact that they do so successfully suggests that "peasant" characteristics, such as the small scale of operations, the head of household management and the use of family labour are no impediment. There are a number of technical and economic reasons for the strength of the small-holders vis-à-vis both rice-growers and the estates and these need to be considered, especially in relation to rubber.

One of the most important is the sheer ease of rubber-growing, the main phases of which involve relatively simple techniques constantly repeated. A major input is the labour for tapping and this can neither be avoided, nor simplified or mechanized. A further major input is latex (and scrap) collection though here there is a prospect that estates may for a time reduce labour inputs by replacing the latex cups now employed with "polybags" of large capacity which will be emptied perhaps once a week. The use of unpaid family labour keeps costs low in circumstances of very limited alternative employment, so that the "opportunity cost" may also properly be regarded as low. Labour input is regular, giving a steady income and avoiding the need to have recourse to money-lenders for operating capital while periodical neglect of tapping should alternatives arise is beneficial to the crop rather than deleterious. Cash inputs, apart from acid for processing latex, are low and neither plough nor draught animal is required. Indeed, in terms of actual work, it was once suggested (of semi-commercial coconut-growing in Kelantan) that tree-crops should be officially discouraged as leading to indolence (Kelantan Annual Report, 1903–1904 in Hill 1977, p. 66). But the basic point is that area-for-area growing rubber (though not coconuts) is more profitable than growing rice. Although there are problems when comparing annual crops with perennials because of the differing capital requirements and long lead times, it is clear that the net return from a hectare of rubber is roughly three to four times that from a hectare of rice which in turn has a return about double that of coconuts (McHALE 1967, p. 94).

Structurally, small-holdings are very distinct from estates (see P. P. COURTENAY 1979, p. 116). The small-holding is usually family-owned, managed by the family head and worked by family labour, whereas the plantation is frequently owned by a company, often professionally-managed. The clearance, planting and maintenance of large areas, the provision of roads, paths, and accommodation, health and educational facilities for a labour-force require capital and skills beyond those of the small-holder, for whom many of these services are available, being provided free or at low direct cost by government. Thus the small-holder is a "low overhead" producer and he is able to maintain his competitiveness for this reason and because government assists him, mainly in the provision of new techniques, especially in processing and marketing. Though these inputs from government may appear to be a form of hidden subsidy, in reality, small-holders ultimately meet many of these costs themselves through an export tax on rubber (BARLOW 1978, Chap. 9).

## PRODUCTION – RUBBER

The most obvious fact relating to production on perennial tree-crop small-holdings is that there is no annual cycle, although the daily routines may be slightly modified by the progress of the seasons and the response of the trees to this. For example, with rubber tapping frequency is generally reduced during wintering and refoliation since not to do so can reduce overall yields. The period of the wet monsoon also affects tapping, since morning rain will dilute the latex and fill the cups. Similarly, copra production is reduced by rainy weather which slows drying, whereas during the dry season, all efforts are made to harvest ripe nuts. But for most perennials there is no particular urgency in harvesting; coconuts, for instance, can still be made into copra even though the nuts are so old that they fall from the palm. These facts mean that there are no "critical periods" when certain operations must be carried out to ensure a crop. Other activities, such as growing rice, off-farm wagel abour, petty trading or recreational activities can be intercalated with farm work without significant loss; a little extra effort can easily make good any small losses thus occasioned. The routines of the various crops vary somewhat and these are discussed separately.

Amongst small-holders the establishment phase is one of difficulty and uncertainty, since not only is there the large cost of clearing the original vegetation, establishing a cover-crop, planting seedlings (for rubber often subsequently grafted) and maintaining these until production can begin six to eight years later, but there is also the crucial business of maintaining the household until that happy event. One partial solution during immaturity is inter-cropping, though this strategy is not as popular now as it once was and in the 1970s only about a fifth to a quarter of immature small-holder rubber was inter-cropped. The most widely-grown catch crops are bananas and pineapples which begin to fruit a year to 18 months after planting, and continue to produce until shaded out. Other, shorter-term crops include chilli, groundnuts, soya, maize and sorghum. Manioc, maturing in 10—14 months, is another. There are certain difficulties in inter-cropping, especially as this can adversely affect the growing rubber not only by competing for the available soil nutrients, but also because tillage tends to interfere with the proper development of the root systems of the perennials. However, young perennials do not require daily attention so that the maintenance of a rubber or coconut plot can be a part-time activity until production begins. This means that plots can be established at a considerable distance from the place of residence so that extension of the cultivated area need not, initially at least, involve an extension of settlement.

Once a perennial comes into full production, residence on or within a few kilometres of the farm is essential. Then begins the daily round. Rubber trees are usually opened for tapping when 50—70 per cent of the trees in a plot have a girth at chest height of at least 50 cm. Tapping is done using a special knife, cutting across the latex vessels located underneath the outer bark. Since the hydrostatic pressure within these vessels is greatest during the night and early morning and because a greater pressure expels more latex, tapping is invariably done in the morning. The latex flows out of and along the wound, across a spout and into a cup, usually of earthenware, supported in place by a wire hanger. About four or five hours later, the tapper makes a further visit to each tree to take the latex. Any remaining flow coagulates in the cup and this, together with the fine "lace" of coagulated rubber along the wound, are removed just before the next cut is made. "Cup lump" and "scrap" together comprise about 10—20 per cent of the total yield. The bark regenerates after excision, taking 6 to 9 years before it can be tapped again. The usual small-holder pattern of tapping is "daily half spiral" though where two lots are operated, alternate daily half spiral is common. Where trees are old and are to be replaced, daily full spiral may be practised to extract as much latex as possible, though this kills the tree in the process. Stimulants, in which the active principle is ethylene, may by applied periodically to increase latex flow. Because of rain, a usual regime involves 20—25 tapping days per month. Tapping frequency is related to size of holdings, small holdings being worked more intensively than large ones (Ho 1967b, p. 74).

The factors influencing output are extremely complex and may include age, area, planting density, slope, the genetic characteristics of the trees, tapping practice, stimulation and fertilizer use. While these have been investigated in considerable depth on estates and experimental plantings, rather less is known about actual small-holder conditions in the field, although Ho (1967a, b) has attempted a partial analysis for areas in Negeri Sembilan (Terachi) and Pahang (four *mukims* in the Temerloh district). His analysis in the Terachi valley in terms of age of trees, area of plots, density of planting and slope, suggested that yields were not correlated with slope but were positively correlated with the other parameters, $r$ values being +0·55, +0·99 and +0·88, respectively. (However, his conclusion that economic performance is related to size of small-holding is not confirmed by BARLOW and CHIA, 1969, in BARLOW 1978, p. 277, who suggest that there is no such relationship). Tapping frequency was also found to be strongly correlated with yield, though tapping intensity (roughly the amount of bark consumed at a tapping) was not (Ho 1967a, pp. 193–196). Similar results were obtained from the Pahang study, which added the further parameters of cash value of the rubber land with which yield was strongly and predictably correlated, and number of owners with which it was not.

Regression analysis of the relationship between yields and age of trees showed an initial rise in production from around 45 kg/ha/month at 6 years of age, to about 60 kg/ha/month at 18 years. (Ho 1967b, p. 77ff.). From this level, production slowly declined, until around the thirtieth year, when yields fell sharply to stabilize at around 40 kg/ha/month after the fortieth year. The relationship between yield and size of lot was rather different. As with rice, the yield per hectare decreased fairly uniformly from around 65 kg/ha/month for plots of 0·6 ha to about 40 kg/ha/month for plots of 2·0 ha and yet lower to 30 kg/ha/month for lots of 3·5 ha. The last size was probably larger than could be readily worked with family labour, since given the usual tapping norm of 500 trees (or 1·6 ha at usual planting densities), more than two workers would have been required. Ho concludes that 2·6 ha is thus an optimal size for a rubber farm, though where combined with rice a rubber area of 1·2–1·6 ha is probably optimal from the farmers' viewpoint.

The daily round-of-work in rubber-growing continues year in and year out until the small-holder decides that the relationship between yield and price in relation to the perceived costs of production (in which "own labour" is rarely included) fall to the extent that replanting is necessary. Decision-making is based upon factors other than these of course, many imperfectly understood, but a major burden is the direct cost of replanting. BARLOW (1978, p. 454) has estimated the cost per hectare over the first six years as M$2.350 excluding the cost of family maintenance (at least another $8,500), though some of this expenditure can be offset by inter-cropping. Fortunately, government replanting grants are readily available, though in practice there is some reluctance to give them for very small plots. However, the old trees are by no means a complete loss, since the nutrients they contain are worth around $2,000/ha and rather more as feedstock for charcoal manufacture if the farm is in the "catchment" of the Perai blastfurnace which uses charcoal in steel manufacture (WYCHERLEY 1968). Whatever the situation in detail, there can be little doubt that replanting is highly profitable in the long run, BARLOW (1978, p. 285), for instance, indicating a private internal rate of return of almost 34 per cent where intercropping is practised.

Even without replanting, earnings per worker on rubber small-holdings compare very favorably with those from rice-growing and at $1074 per year (early 1970s) compare reasonably well with average returns from wage labour in both the plantation ($1,560) and manufacturing sectors ($2,263) (BARLOW, p. 282). The same author has made detailed estimates of net household incomes under various conditions and these range from $4,666 per annum for a FeLDA smallholding of 3·7 ha employing 9·1 persons with some supplementary earnings to $729 for a household of 6 with one hectare of low-yielding rubber and the profits

*Table 27*

Estimated annual budgets of low- and high-yielding rubber small-holdings

| | Low | | High | |
|---|---|---|---|---|
| Production (kg/ha) | 564 | | 1,193 | |
| Gross revenue ($/ha) | 469 | | 1,005 | |
| Costs | ($/ha) | (%) | ($/ha) | (%) |
| Tapping | 263 | 60·7 | 342 | 50·0 |
| Processing labour | 26 | 5·9 | 76 | 11·1 |
| Maintenance labour | 23 | 5·3 | 50 | 7·3 |
| Processing charges | 32 | 7·5 | 77 | 11·3 |
| Transport | 4 | 1·0 | 2 | 0·3 |
| Maintenance materials | 38 | 8·7 | 80 | 11·7 |
| Minor equipment | 16 | 3·8 | 24 | 3·5 |
| Major equipment depreciation | 8 | 1·8 | 18 | 2·6 |
| Land taxes | 12 | 2·7 | 12 | 1·8 |
| Rent | 8 | 1·9 | — | — |
| Replanting provision | 3 | 0·7 | 3 | 0·4 |
| Total | 433 | 100·0 | 684 | 100·0 |
| Family return ($) | 348 | | 789 | |
| Profit ($) | 36 | | 321 | |

*Source:* BARLOW 1978, p. 273 (values rounded).

from share-cropping. The annual budgets of two rubber small-holdings are set out in *Table 27* and these may be compared with the budgets for rice-growing presented in *Table 22*. The large cost of tapping and collection is noteworthy for both types of rubber farm. But more striking is the fact that while costs on a farm with high-yielding trees are 58 per cent higher than on a farm with low-yielding trees, the family return and profit are higher by 1·3 times and 7·8 times, respectively, a situation very much more favorable than that of double-cropping of rice vis-à-vis single-cropping.

The much higher profitability of high-yielding rubber varieties comes about largely because the costs of producing a kilogram of rubber fall dramatically with increases in yield. The family return (at standard prices for the mid-1960s) where yields were below 639 kg/ha rose dramatically from \$280/ha to \$1,543 where yields were over 1,893 kg/ha (BARLOW 1978, p. 269). But the transition from low- to high-yielding material is not easy, and by 1973 BARLOW (1978, p. 233) had reported that only 67 per cent of the rubber small-holders in Peninsular Malaysia had made the transition. Of the impeding factors, the most important is probably the size of farm. Whereas large plots can be replanted in sections so as to minimize loss of income, the small-holder with only 1—2 hectares faces a very large loss of income and for the farmer with only a hectare the choice lies between replanting the whole area or not at all. Clearance can cost \$1,250—\$1,500 per acre, though this cost may be avoided if the farm is on a road and the wood is sold. Until the land is cleared, nothing is received by way of replanting loan. Further impediments to replanting are disagreement among joint owners, lack of a clear title to the land and bureaucratic delays. Only 39 per cent of the area of Malay-owned rubber small-holdings in Peninsular Malaysia had been replanted by 1971 compared with 59 per cent of Chinese-owned farms, probably reflecting the much smaller average size of the former, though a high value placed upon leisure by Malay owners may help to explain the difference.

## PRODUCTION — COCONUTS

Though production methods and rounds-of-work in coconut-growing are similar to those for rubber, there are some differences. Firstly, the fact that the establishment phase takes about one to two years longer than for rubber makes inter-cropping even more essential, much the same crops being grown where the soils are suitable. The more open nature of the crowns of the palms as compared with rubber means that shade is much less dense. This has two consequences. Firstly weed growth is more vigorous and longer, more continued than under rubber, which means greater labour costs for weeding, especially as cover crops are virtually never grown on small-holdings. Secondly, hight intensities are still high enough for either grass or another crop to be grown below the mature palms. With the former, the absence of latex cups which might be damaged by animals grazing under rubber, together with quite fair grass growth makes animal husbandry possible and this is sometimes to be found on Malay-owned coconut small-holdings, often on those owned by Indians, never on Chinese-owned farms where, however, under-planting with cocoa is coming in vogue.

Unlike rubber, coconuts need not be harvested frequently. The usual practice is to harvest the small-holding on a regular block pattern as the nuts become ripe. On most farms ripe nuts are cut from the palms using a simple knife attached to a tall bamboo, a task requiring considerable skill and effort when palms may be as tall as 25 m. Less commonly, a monkey, *Macacus nemestrina*, trained to distinguish ripe from unripe nuts, may be employed in the Peninsula. The next stage is to transport the nuts to the drying ground or shed and this is commonly done using a buffalo-drawn sledge or cart, though in areas of drained alluvium such as Lower Perak, the nuts may be strung together and floated along the drains. At the drying ground the nuts are split using an axe or heavy knife and laid out flesh uppermost to dry in the sun. A skilled man can split up to 10,000 nuts in a day. Since there is no market for coir in Malaysia, the nuts are not husked. After two days the flesh of the coconut begins to come away from the shell and at this point the partly-dried flesh is removed to the drying shed or laid out on a drying ground of concrete or beaten earth during the day. At night the copra is heaped up and covered and the drying shed roofs are closed. In Malaysia, hot-air drying is rare so that discarded husk and shell need not be used for this purpose, though it is still generally burnt and the ashes employed as fertilizer. Otherwise, the empty half-coconuts should be turned "cup" downwards to prevent the accumulation of water in which malarial mosquitoes breed. Once the copra is thoroughly dry, it is packed into gunny sacks for sale and transportation to the warehouse of a local merchant for subsequent sale either as bagged copra for export or to commercial oil mills for pressing and refining. All these operations require considerable inputs – of solar energy for drying, and of labour for harvesting, collecting, splitting and packing – but little is yet known in detail. Generally, coconut farm operations require perhaps a quarter of the labour input per hectare of rubber, reflecting not only a lesser labour requirement per tree, but also the much lower planting density of coconut, namely about 125 palms to the hectare (CHILD 1964, p. 70), compared with 300–350 trees per hectare for rubber.

Although the pepper vine *(Piper nigrum)* is a perennial, it is unlike rubber and coconut in that the harvest is confined to a limited period each year – in Sarawak June to August. The development phase is also rather shorter, the first harvest being taken two and a half to three years following planting. Like rubber, pepper is planted on well-drained sloping land, usually on contour terraces or in pits. Whereas in Indonesia shade-trees, usually *Erythrina* spp., up which the vines are subsequently trained, are first planted, in Malaysia the vines are trained up hardwood posts. This practice reduces the establishment time though at considerable cost estimated at around \$15,000/ha in the mid-1960s, hardwood posts at about 1,500 to the hectare comprising a quarter of this (HILL 1969, p. 36).

Pepper requires constant weeding (clean weeding is the rule), spraying against pests and diseases and pruning to maximize the fruiting area, while fertilizers, both prawn dust and artificials, are applied regularly. Though harvesting begins at about the age of three, maximum production occurs when the vines are five or six years old, falling off thereafter to between the tenth and fifteenth year of production or whenever production becomes uneconomic. The berries are stripped from the stems of the vine by hand. For black pepper, they may then be sun-dried, though some operators boil them first, but for white pepper they are soaked in water to loosen the outer skin of the berry which is then rubbed off and the inner white seed is dried in the sun. Since black pepper is easier and cheaper to produce and does not require fully-formed berries, white pepper must command a sufficient price premium over black to be worth producing (JACKSON 1968, pp. 100–101).

When the vines have reached the end of their economic life, the area may be abandoned or planted with other crops, rubber being favoured. A second cycle of pepper-planting on the same land is not initiated, since the soil is regarded as being infected by disease which would seriously affect young plants.

Yields have not risen since the seventeenth century, despite the use of modern farming techniques and remain at about 3·3 tons/ha annually. Nevertheless, prices, though variable, are generally high and yields of this order give considerable profits despite the high levels of capital inputs required. Since families growing pepper also keep themselves in fruit, vegetables and poultry, and may also raise pigs or market-garden crops where quick access to urban markets permits, income levels are high. Of 99 families reporting their cash income in a survey conducted in the mid-1960s in Johor, over half had a monthly income in excess of \$300, an amount at least three times that of the mean of rubber smallholders or plantation workers (HILL 1969, p. 39).

Most marketing channels for the production of perennial-crop small-holders share one characteristic, namely at one level or another the goods pass through the hands of Chinese. It has been estimated, for example, that three-quarters of all rubber, whether estate-produced or small-holder, is handled by Chinese processors and dealers. This situation broadly applies to all export crops and to many of the others as well. Coffee and tea are examples of non-export crops for which Chinese provide marketing services and it is only in the marketing of fruits such as durian or rambutan that indigenous people play a significant part, though in the marketing of rubber, individual Malays are first-level dealers.

Because of its overwhelming importance, the case of rubber marketing has received the most attention (see especially Barlow 1978, pp. 316–330 and Wharton 1962). The stages of marketing, together with off-farm processing are given in ***Figure 26***, which shows the differences between small-holdings and estates. For small-holders, the stages are carried out by government-licenced private dealers, who handle over 90 per cent of the produce, and by government-sponsored group processing centres or by central factories owned by a government corporation.

Amongst private dealers, especially at the "first-dealer" level in the countryside, there is generally imperfect competition and a considerable degree of oligopsony – the situation in which a few buyers confront many sellers. The buyers perform a number of functions. Some, such as collecting sheet rubber and scrap

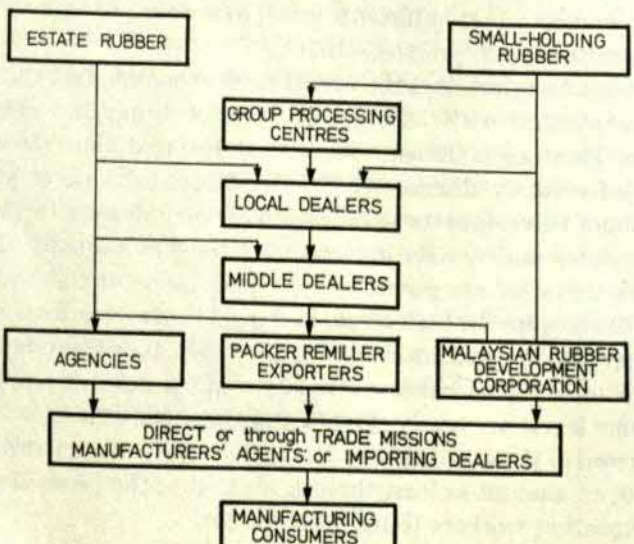


*Fig. 26.* **Marketing from rubber estates and small-holdings**

from the small-holdings, weighing and grading, the smoking of unsmoked sheets to preserve them, storage and transportation, relate directly to production and marketing. Dealers are always prepared to buy rubber for cash on the spot and most small-holders sell their produce at least once a week so as to obtain ready money.

It is also often believed that dealers obtain a hold over farmers by granting them cash loans and credit which the farmers are subsequently unable to pay back. Aziz (in Wharton 1962, p. 1) has suggested that farmers " . . . have to pay unscrupulous moneylenders exorbitant rates of interest on debts that never seem to get settled. The unfavourable terms of trade are made doubly so by the margins that are charged by monopsonistic and monopolistic traders who buy their produce and often sell them their requirements." How far this may be true is difficult to establish. Lim (in Barlow 1978, p. 320) has found that, contrary to Aziz's view, dealers who sold daily requisites on credit in kind and made small cash loans not only did not charge interest but charged less than other dealers who did not provide these facilities. Nevertheless, oligopsony undoubtedly exists and for several reasons. Firstly, the small-holder's response to price changes is limited since the nature of production makes it difficult to increase the amount, should prices rise. Should prices fall, a possible response is to stop tapping or at least reduce its frequency, but this is a feasible strategy only for those who have alternative sources of income. Secondly, since most small-holders do not have facilities for smoking rubber, they must sell at whatever price they can obtain, since physical deterioration of the product is rapid. Thirdly, rubber-buying is a government-licenced business and in practice this operates against new applicants so as to ensure that each dealer gets his customary share of the market. Since dealers' margins are inversely related to their volume of business, this may not altogether be a bad thing, though it is hardly conducive to perfect competition. Lastly, there can be little doubt that the symbiotic relationship between the small-holder and the dealer who performs multiple functions is often seen by the small-holder to be to his own advantage. If the small-holder were to shift his patronage to another dealer, the latter would likely make higher deductions for the water content of unsmoked sheet, apply grading criteria more stringently and be less willing to give credit for daily necessities purchased from the dealer's shop. Other factors placing dealers in a powerful position include physical isolation leading to insulation of the local market, poor price information (though daily radio broadcasts assist here) and perhaps most important, cultural factors generating collusive behavior among buyers or among sellers and leading to selling on a particularistic or traditional basis rather than on price. There can be little doubt that for rubber small-holders, and probably for most perennial crop small-holders, competition in the marketplace is less than perfect and this leads to their receiving rather less than might otherwise be the case.

In an attempt to counterbalance the power of the dealers, the Malaysian government has set up over 800 group processing centres, but although often benefitting participants through higher prices because of the higher quality of the final product and from economics of scale, a number of problems have arisen. Most notable of these is low throughput, reflecting under-utilization and lack of leadership and adequate advisory services for what are in effect co-operatives. A further development has been the setting up of central processing factories owned by a government corporation and by 1975 these were handling three per cent of small-holder production in the Peninsula. But these too have encountered major difficulties, mainly managerial and technical. A particular problem has been with field purchasing agents some of whom deliberately undergraded and short-weighed rubber so that the balance accrued to them. The result has also been under-utilization of capacity. The benefit to the small-holder is very small, BARLOW (1978, p. 328) estimates just over 2c/kg, while the overall cost to the public exchequer is several tens of millions of dollars annually. For the moment, the verdict must be that government-sponsored marketing has yet to show that it is really a viable alternative to private channels.

## GOVERNMENT LAND DEVELOPMENT AND SMALL-HOLDER AGRICULTURE

Since, in Malaysia, virtually all government-sponsored land developments involve perennial crops and most have the objective of creating a prosperous small-holder class, the whole topic may be conveniently considered at this point. Perhaps because of the obvious and dramatic nature of transforming wild nature into orderly rubber and oil palm landscapes, numerous scholars have studied this process. It should be remembered, however, that in no year since the formation in 1956 of the Federal Land Development Authority (FeLDA), the major agency responsible, has the total number of people settled on government sponsored land development schemes exceeded one-tenth of the annual rural population increase. Approaches to rural development have been eclectic and have been reviewed by HUSSAIN WAFA (1972—1973) and RUDNER (1975b). Strategies and organizational forms range from those in which governmental involvement is little more than the setting aside of land and general oversight, for example fringe alienation schemes and the early schemes promoted by the Kelantan state government, to recent schemes which are virtually state plantations. Amongst the many studies of FeLDA in the Peninsula are those by WIKKRAMATILEKE (1962a, b; 1964, 1965, 1972). Other types of scheme, fringe alienation schemes and youth schemes have been studied by SENFTLEBEN (1978) and SHAMSUL (1969), respectively. In Sabah and Sarawak, Federal government involvement in land development is minimal.

In Sabah, a State Land Development Board, the SLDB, performs very much in the same manner as the FeLDA in the Peninsula. Y. L. LEE (1965) and more recently SUTTON (1977) have examined aspects of development in that state. Sarawak, too, has adopted its own pattern of land development, though this has yet to receive adequate academic attention, though Y. L. LEE (1969) has briefly summarized the position.

There can be little doubt that the formation of FeLDA and the whole thrust of land development is basically a political act. On the one hand, indigenous economists such as AZIZ (1964) argued persuasively, if from rather inadequate data, that rural poverty was rampant and that land development was one answer to this. On the other hand, power in the then Malaya had, by 1957, passed into the hands of a political grouping (the Alliance) formed from ethnic Malay, Chinese and Indian parties, in which the Malay party (UMNO) was dominant – and the bulk of the rural poor was Malay. Nevertheless, land development has never been a political football and since 1960 the FeLDA has had both the funds and specialist expertize to push ahead with its task in the Peninsula. By 1977, 124,000 ha had been planted with rubber and 236,450 ha with oil palm. Other crops included sugar cane, cocoa and coffee. The total number of schemes (all in the Peninsula) was 211 on which 46,000 families were settled. Oil palm schemes are a much later development and while on some of the earliest planted rubber schemes the settlers have met their obligation to the Authority and have or shortly will receive individual title to their allocated farms, this has yet to happen on oil palm schemes where managerial control is still tight. The pattern of change is given in *Table 28* which clearly shows the relative swing away from rubber towards oil palm. This was especially marked in the late 1960s when the annual planting of rubber was only a few thousand hectares, compared with over 10,000 ha of oil palm.

*Table 28*

FeLDA schemes and areas to 1977

| | Rubber | | Oil palm | |
|---|---|---|---|---|
| | number | area (ha) | number | area (ha) |
| to 1963 | 43 | 28,790 | 5 | 3,853 |
| 1964–1968 | 8 | 23,005 | 18 | 32,888 |
| 1969–1973 | 16 | 37,030 | 39 | 87,825 |
| Total | 67 | 88,825 | 62 | 124,566 |
| To 1977 | | 124,000 | | 236,450 |

*Source:* Partly from KHERA 1976, p. 145.

Under FeLDA control, procedures in land development are now fairly standard. Most of the land selected is either commercial forest or, if it is virgin terrain, the commercially-valuable trees are first removed before full clearance is undertaken by contractors. Before this stage is reached, however, all potential land for settlement will have been surveyed at least at reconnaisance scale to determine its suitability. Land-suitability mapping involves topographical survey, mainly from aerial photography, geological survey again partly from aerial photography and partly from ground checks, and a similarly-based soil survey (ALEXANDER 1962). More detailed surveys are undertaken, once the decision to develop had been made and on the basis of these, the preliminary planning of village sites, roads and drainage begins and the decision as to which crop to plant is made. Nurseries and workers' quarters are set up once there is sufficient cleared land for this to be done. At this point the land is still in the hands of contractors, though on some of the early schemes the settlers themselves were involved. Meanwhile, the settlers are selected, preference being given to those with a rural background, who are physically fit, under 40 years of age and married. However, the settlers do not move in until their houses had been built and the seedlings planted, again carried out by contractors who are often Chinese. During the first few years while the crops mature, settlers work as labourers under scheme management and at fairly low wages. On rubber schemes, as the trees approach the productive stage, standard farms of 3·7 to 4·0 ha each are balloted for and the settler can then care for his own trees, but still under supervision. Approved methods of tapping have to be followed and the produce must be delivered to central collection centres. This is not only to ensure a good standard of processing, but is a means of ensuring that repayment is made for the costs of clearing and planting the land, of maintenance until maturity, and of interest. The current requirement is that about four-fifths of these costs are met by the settlers, the balance, together with the whole of the cost of management and of infrastructure being met from the federal exchequer.

This is thus a capital intensive rather than a labour-intensive form of development and, though settlers are generally capable of meeting it, there is a high level of indebtedness as harvesting begins, averaging M$22,000 for each block of 3·7 ha during the early 1970s. KHERA (1976, p. 153) has suggested that for 4 ha oil-palm small-holding on a FeLDA scheme the investment in the first years is around M$22,300 of which management costs comprise 33 per cent. Though this cost falls with time, it is still substantial and even in the twenty-fifth year when the farmer finally pays off his debt (and when yields may well have begun to decline), the cost of management still accounts for 13 per cent of gross farm income, while loan repayment comprises 30 per cent. Thus though farmers on schemes may have incomes much higher than otherwise, they also have a much higher burden of debt, basically because of high development and running costs on both the farm and the scheme as a whole.

The major reasons why costs are high include the extended use of contract labour, the provision of houses (not just the materials), the lack of inter-cropping because settlers do not have their own land until the rubber or oil palm is mature (and hence it cannot be inter-cropped) and the high cost of management. In terms of an average of 6·8 people supported per $10,000 of public money invested, FeLDA schemes are far more expensive than fringe schemes, for example (BARLOW 1978, p. 267).

Fringe schemes (most of which involve rubber) are much smaller in scale than FeLDA schemes, are designed to supplement existing farms and are thus located on the fringes of existing cultivated areas. Government involvement is substantially less than on FeLDA and state schemes and farmer participation is consequently greater. Standards of husbandry are generally lower and so are rubber yields averaging 1,720 kg and 1,191 kg per hectare, per year, respectively (BARLOW 1978, p. 266). Nevertheless, C. BARLOW (1978, p. 266 ff.) has suggested that in terms of doing the greatest good for the greatest number at the lowest cost, fringe schemes may be a better proposition. For one thing, their internal rate of return is almost identical, while many of those on schemes of land development have substantially higher incomes than those who are not, as is shown by a comparison of *Table 29* with *Table 27* and, for this reason, form an elite group within the peasantry.

The importance of small-holdings on land development schemes is thus considerable. As an example, scheme small-holdings in the Peninsula make up 23

*Table 29*

Estimated annual budgets for rubber small-holdings on land development schemes (early 1970s)

| | FeLDA | | Fringe | |
|---|---|---|---|---|
| Production (kg/ha) | 1,720 | | 1,191 | |
| Gross revenue ($/mature ha) | 1,517 | | 919 | |
| Costs | ($) | (%) | ($) | (%) |
| Family labour | 465 | 53·9 | 411 | 67·5 |
| Loan repayment | 278 | 32·2 | 48 | 7·9 |
| Materials | 108 | 12·5 | 135 | 22·2 |
| Land tax (quit rent) | 12 | 1·4 | 15 | 2·4 |
| | 863 | 100·0 | 609 | 100·0 |
| Family return | 1,119 | | 721 | |
| Profit | 654 | | 311 | |

*Source:* LIM in BARLOW (1978 ,p. 265).

per cent of the area in rubber small-holdings, and 27 per cent of the number. Since they have a larger proportion of high-yielding rubber trees than the average private small-holding, it is likely that production will increasingly outstrip that from private small-holdings as the proportion of immature rubber, currently around 40 per cent, falls *(Table 30)*.

*Table 30*

**A comparison of private and development scheme rubber small-holdings in Peninsular Malaysia**

| Type of farm | Planted area (1000 ha) | Planted area % | Av. area per farm (ha) | Proportion H.Y.V. (%) | Number of farms (1000) | Number of farms (%) |
|---|---|---|---|---|---|---|
| Private | 838·8 | 76·8 | 2·8 | 63 | 299·6 | 72·6 |
| Schemes | | | | | | |
| FeLDA | 76·2 | 7·0 | 3·7 | 100 | 20·6 | 5·0 |
| Unsubsidized | 53·3 | 4·9 | 2·4 | 88 | 22·2 | 5·4 |
| Fringe | 52·1 | 4·8 | 2·2 | 95 | 23·7 | 5·7 |
| State | 14·6 | 1·3 | 1·8 | 73 | 8·1 | 2·0 |
| FeLCRA | 9·6 | 0·9 | 2·2 | 100 | 4·4 | 1·1 |
| Other subsidized | 47·3 | 4·3 | 1·4 | 95 | 33·8 | 8·2 |
| Total | 1,092·0 | 100·0 | 2·6 | 70 | 412·4 | 100·0 |

*Source:* LIM in BARLOW (1978, p. 223).

Land development schemes are also important since they frequently represent something of a deviation from the usual pattern of settlement in perennial crop areas. In particular, the settlement pattern is frequently like that on estates in that dwellings are located in a central, planned village, though the actual houseplots of around 0·1 ha in size are larger than those on plantations and are thus used for the cultivation of a range of kitchen garden crops and fruit-trees. Sabah may be taken as an example (SUTTON 1977).

Land development is in the hands of the Sabah Land Development Board which is closely modelled on the FeLDA in Peninsular Malaysia, though its involvement in the provision of infrastructure, especially in processing and marketing is, if anything, rather greater. Unlike its Peninsular counterpart which operates in a context of strong demand for land, Sabah has experienced a deficit of labour for much of the decade that the Board has existed — with consequential problems of attracting suitable settlers. Most of the Board's schemes are planted with oil palm, 86 per cent of the planted area in 1976, though on some of the smaller schemes there is a mixture of crops, oil palm, cocoa and coconut in various combinations, or rubber. In 1976 there were 29 schemes which, by 1980, were planned to provide land for 10,119 families and to cover 57,565 ha (SUTTON 1977, p. 82). In 1976 SLDB schemes accounted for 29 per cent of the State's oil palm area.

Though some schemes incorporate established communities within their boundaries most people come from elsewhere. The population structure is unusual — few, if any are over 40 years, but within a few years there is an abundance of children, since couples are encouraged. Initially, a dispersed pattern of settlement was tried, but this was found to be unsatisfactory, because of uneven development and high costs. As in Sarawak, this pattern was heartily disliked by traditional Iban longhouse dwellers and the longhouse has now been accepted as an alternative to the nucleated village, should the settlers wish it. These are provided with the basic social amenities, a school, community centre, clinic, and in the larger ones a police station and shops. Larger villages may also have an industrial component in the form of a palm oil mill.

While land development schemes must be regarded as a considerable success, especially in agronomic terms and even in economic terms despite doubts as to "cost-effectiveness", some problems remain, particularly at the social level These are, perhaps, most severe in Sabah and Sarawak where settlement has involved the abandonment of shifting cultivation and the adoption of a sedentary way of life with consequent culture-shocks. More broadly, it has been argued that the high degree of specialization, though apparently profitable for the foreseeable future, does leave schemes vulnerable to world economic forces. As PALMER (in SUTTON 1977, p. 90) has remarked: "In place of biotic and social diversity, the settlement scheme has uniformity of product and uniformity of producer with the instability to be expected from a system of low diversity and high rate of productivity to biomass." The replacement of natural ecosystems by agroecosystems of one sort or another has consequences which are as yet little studied. LEIGH (1974) has pointed out the possible consequences of this transformation in terms of soil erosion and silting in the lower courses of rivers and his data suggest that losses of soil to streams may be three orders of magnitude higher than under forest. Of the ecological consequences of land development, our ignorance is profound.

## PROBLEMS AND PROSPECTS

Even though many perennial crop small-holders, especially those growing rubber, have at times suffered considerable economic hardship because of world economic conditions, the simple fact remains that on the whole they have been substantially better off than their rice-growing fellows who have remained locked into a self-perpetuating semi-subsistence syndrome of poverty. Though growing perennials may be more risky than growing rice, the rewards more than compensate for the risks. Moreover, on slopes the cultivation of perennials makes sounder ecological sense than growing annuals. With the removal of the threat posed to natural rubber by synthetics based upon petroleum as a feedstock, the long-term prospect is rosy. Equally favourable are the long-term prospects for oil palm which will begin to become a small-holder crop as various FeLDA and other land development schemes are given over to their settlers.

The favorable outlook does not, however, mean that there are no significant problems — quality of product, low productivity and low incomes, share-cropping, inequitable taxation, and diversification. For rubber, many of these have been analyzed in detail by BARLOW (1978, especially Chapter 9).

Low quality is typical of small-holder production of many tropical commodities and basically derives from the low technical standards of the farmers compared with the plantation sector. It may reflect a lack of adequate produce grading facilities and also the fact that buyers may not pay a premium price for a good quality product. This is the case amongst copra buyers in Sabah, for instance. Amongst rubber small-holders quality is affected by lack of clean water and poor equipment but above all, by lack of smoking facilities which by enabling the production smoked sheet, helps the producer to avoid problems of "unjust" deductions and lower than justifiable grading. As mentioned earlier, government assistance has not yet provided a solution.

The problem of low productivity and consequently low incomes derives from the basic fact that many production and household costs are more or less fixed, regardless of the inherent productivity of the rubber and coconut trees. The problem also stems from the small size of many of the holdings. Though the concept of an "economic holding" must necessarily be a questionable one for if, as Barlow has argued, an "economic holding" of high-yielding rubber is taken as 3 ha, most Malay-owned and many Chinese-owned farms must be "sub-economic". The existence of a substantial proportion of farms, especially Malay-owned farms yet to be replanted exacerbates this. Operators of very small farms are faced with an "all-or-nothing" decision, but this is not all for on low-yielding rubber small-holdings worked on the *bagi dua* system of share-tapping by which the owner of the trees takes half the latex and the share-tapper the remainder plus all the scrap rubber, the profits of the owner form a much higher proportion of direct costs than an owner–operator's profits. Though the absolute profits of the *bagi dua* owner are superior, they appear to be more so on low- than on high-yielding small-holdings (BARLOW 1978, p. 369). These features may thus explain the popularity of share-tapping on low-yielding holdings and why some owners are reluctant to replant.

At first sight the notion of peasant farmers paying tax may seem odd, but in fact their tax burden, on rubber-growers at least, is considerable and, according to BARLOW (1978, p. 369 ff.), inequitable. Not only are there taxes ranging from 10—25 per cent on manufactured inputs and from \$3·50—\$15.00 per hectare of land annually, but also duties upon the product when exported. Though these also apply to estate produce, they bear more heavily upon the small-holder, especially the small-holder with one hectare or less, who is unable to take advantage of research, extension and replanting which, ironically, are precisely the purposes for which the duties are levied. The effective rate of export tax for an owner–operator not taking advantage of grants and services in the early 1970s was 21 per cent and for an owner–operator who took full advantage of these facilities thus offsetting the tax, six per cent. At these rates, wage earners (most of whom would be in the tertiary sector in town) would have an annual net income of \$40,000 and \$7,500 respectively, incomes far above those of small-holders. Nevertheless, it cannot be said that the revenue from small-holders is to any major degree "subsidizing" urban development as is the case in many developing countries, since increasingly this revenue has been returned to small-holders in services and grants to peasant agriculture generally and in investments in rural infrastructure and social services.

Diversification is a problem that appears at all levels, national, regional, and individual farm, and there can be little doubt, a high degree of specialization renders the economy vulnerable to the vagaries of international trade. The degree of diversification among perennial tree-crop small-holdings is impossible to establish, though the 1960 *Agricultural* Census of Peninsular Malaysia indicated that 30 per cent of all farms (not estates) enumerated were "mixed" to the extent that less than three-quarters of their area was under any one crop. Mixed cropping, in the sense of a diversity of crops on one farm, is probably fairly prevalent, rice/rubber, rice/coconut, coconut/cocoa and pepper/rubber combinations together with the promiscuous cultivation of assorted perennials have already been mentioned. But it is on rubber (and in future oil palm) small-holdings that diversification is most desirable, though technically problematical, since for maximum production, constant work is required. This makes it difficult to intercalate other crops into the pattern of labour commitment. Inter-cropping is feasible on rubber and oil plam holdings only at an early stage in their development, though much more could be done in this respect. A multiplicity of small plots, each with a different crop may also be difficult, since with rubber, for example, quite dense shade is cast along the margins, while perimeter trees are particularly vulnerable to wind-throw. There is also no particular reason of crop health for breaking up the spatial pattern since both rubber and oil palm are remarkably free from disease, though wide expanses of coconut may be rather more vulnerable.

On-farm diversification may also involve cultural values. While many Chinese-operated market-gardens in the Peninsula and Chinese and indigenous farms in Sarawah can properly be regarded as diversified, Chinese (and Indian) rubber small-holdings are almost always entirely given over to that one crop, whereas Malay small-holdings tend to be diversified. There is no reason to believe that non-Malay small-holders, and the many Malay small-holders who have specialized holdings, see any real need for diversification. In a number of areas alluvial land suitable for the growing of rice is regarded as a "strategic reserve" to be cleared and planted only should this be necessary. This has been observed amongst coconut small-holders in Sabah, where both "permanent" and shifting cultivation of rice have this "stand-by" function, amongst Chinese pepper-growers in Johor, and amongst Malay rubber-growers in the same state.

The question of diversification at the regional level has not received any attention from economic planners, though it can be claimed that in regions of virtual tree-crop monoculture such as inland Melaka, Negeri Sembilan, inland Kedah (rubber) and the Kudat district of Sabah (coconuts) down-turns in prices have had considerable ripple effects through the regional economy. The nature and magnitude of these are unknown, but on general grounds it would seem desirable that there should be a degree of diversification in the economy at the regional level since "stop-and-go" development may well be more costly than even progress, especially if actual disinvestment occurs.

Much the same is true at the national level, though here Malaysia has made considerable steps away from heavy dependence upon rubber as its major agricultural export. This is shown by the marked fall in the value of rubber as a proportion of the country's exports — from 51—52 per cent in the period 1936—1965 (reckoned quinquennially) to 28 per cent in the quinquennium to 1975 and only 17 per cent by 1978. The main factor pushing this proportion down has been the substantial rise in the area under oil palm. Amongst tree-crops, oil palm gives outstanding returns, area-for-area earning just over twice as much as rubber, though its superiority in terms of gross value added is less marked, because of the higher labour requirement or rubber. Rubber is much superior to both coconuts and cocoa. The superiority of oil palm may ultimately be reflected in a swing to that crop by small-holders. But for the moment it is less favoured, since it requires a relatively sophisticated co-ordination of operations from harvesting to quality control and, as a result there are very few small-holders growing the crop outside the highly supervised milieu of land development schemes. Moreover, though the costs of establishing all tree-crops from jungle (early 1970s) are around $2,500 to 3,500 a hectare (excluding infrastructural costs), the capital investment per worker is much lower for rubber than for oil palm, coconut or cocoa. In addition, the minimum size of oil palm and coconut oil factories, to take advantage of economies of scale, is comparatively large, an annual capacity of several thousand tons being required. Rubber thus scores on these grounds (BARLOW 1978, p. 396 ff).

CHAPTER 9

# PLANTATION AGRICULTURE

In tropical regions generally, the plantation is the epitome of capitalism in agriculture to the extent that P. P. COURTENAY (1965, p. 52) has suggested that a plantation bears more resemblance to a factory than to a farm. The plantation in the Malaysian region is no exception, though the exploitative elements which may have existed in the early days have long since disappeared under the surveillance and control of independent governments eager to protect the interests of their own nationals in the face of perceived threats from foreign entrepreneurs and under the steady attack of plantation workers' unions. One result is that earnings by plantation workers are substantially higher than those of most small-holders and approach those of some industrial workers. BARLOW (1978, p. 282) gives M$1,560 per year as an average income for estate rubber tappers, compared with $1,074 for rubber small-holders or $1,500—$1,600 in textile and plywood manufacture. These figures suggest that labour on plantations is not "cheap" and because it is relatively expensive, particularly by comparison with land as a production factor, and because estates must bear much of the cost of social infrastructure, the ideal crops are those which require infrequent planting (since planting requires much labour but only for a short time) or do not demand a further input of labour at harvest.

In Malaysia, the perennial tree-crops, rubber, oil palm, tea, as well as pineapples meet these requirements. Though transportation and processing are mechanized, actual production in the field cannot be, so that labour costs form the bulk of total costs — often as much as 60 per cent. It is thus no coincidence that the relatively empty lands of the Malay Peninsula and Sabah (then North Borneo) were attractive to foreign capital on both economic environmental grounds, an attractiveness greatly enhanced in the 1870s by the imposition of British control. Against these factors were the limited development of infrastructure, especially in the case of Sabah where the state was owned in its entirety by a chartered company which had then to provide all of its own infrastructure, economic, social and political. Thus an important locational factor in addition to the availability of vacant land within regions well-suited to plantation crops was the existence of communications, initially often by river, and of port facilities (P. P. COURTENAY 1965, p. 47 ff., 1979, p. 123 ff.).

The present distribution pattern of plantation agriculture, therefore, owes a great deal to historical factors which are considered in more detail in a later section. This distribution has not been studied in detail, so that *Figure 27*, compiled from state land use maps of varying dates supplemented by large-scale topographical maps must be regarded as indicative rather than authoritative, particularly as only the location and not the extent of estates is shown. Nevertheless, the western distribution of estates in the Peninsula is clear, the most striking feature being a broad belt from central Selangor south to Melaka.

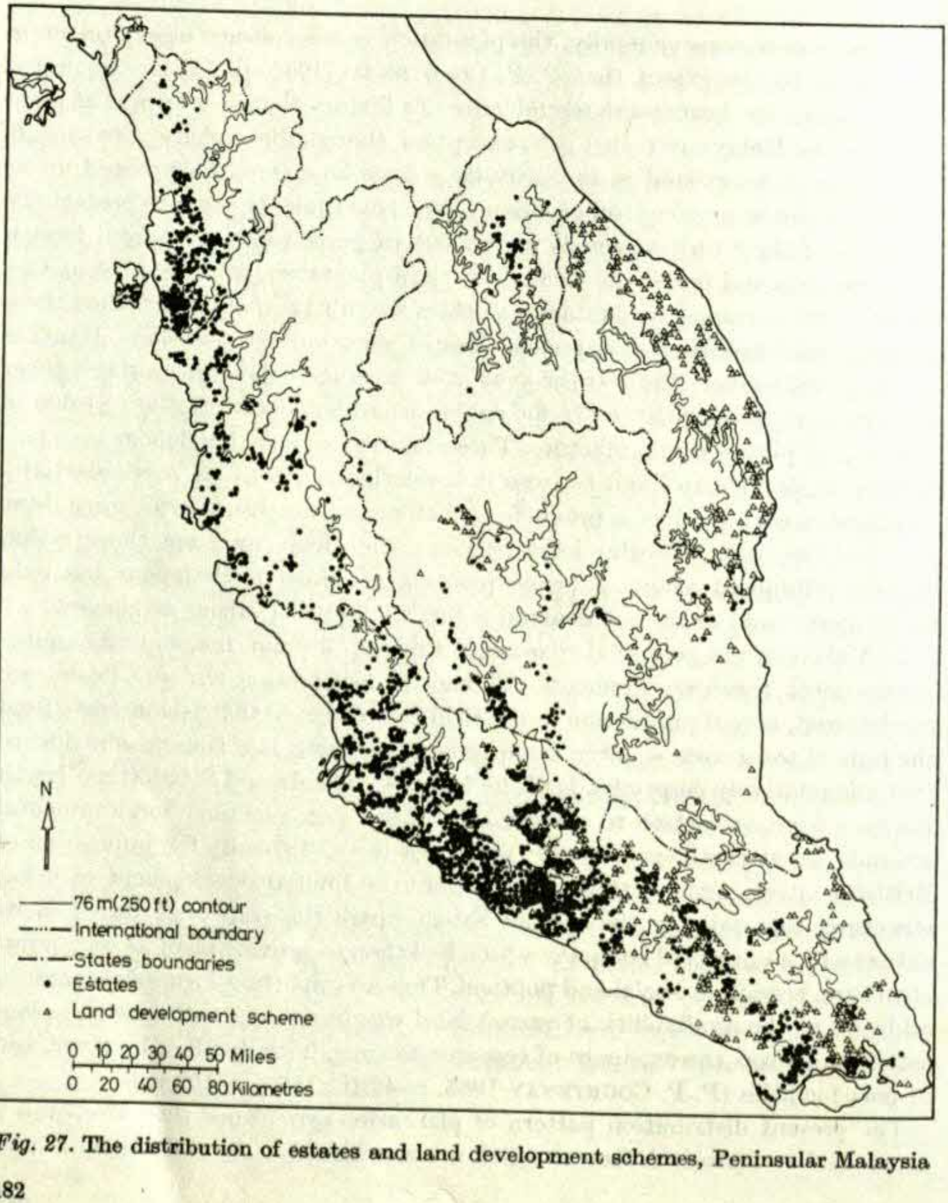


*Fig. 27.* **The distribution of estates and land development schemes, Peninsular Malaysia**

While some of the estates in this belt are large, most, especially rubber estates, are rather small, perhaps reflecting the long period over which the plantation industry has been established there. In the north a similar belt of estates extends southwards from the hill country of southern Kedah and inland Seberang Prai, formerly Province Wellesley, though there the Uniroyal rubber plantation of 4,159 ha is an exception to the usual moderate size. Elsewhere in the western states (except on Pinang Island) plantations are fewer in number, but many are notably large and grow more than one crop, especially those bordering the lower Perak, Bernam, Selangor and Langat rivers, many of which were established before 1900, but have not been significantly subdivided since. A further zone of large estates lies along the railway in Johor where some exceed 8,000 ha, two of the largest being the Labis Estate (8,221 ha) owned by a subsidiary of the Socfin company and the Ulu Remis estate owned by Oil Palms of Malaya Ltd. Sabah contains the largest unit in the region, the Bal Estate (9,498 ha of rubber, oil palm and cocoa) situated near Tawau. Areas which notably lack estates are northern Kedah and Perlis, which are mainly rice-growing plains, Kelantan, though there are a few small estates in Ulu Kelantan, Trengganu where virtually the whole state is Malay reservation (though there are two cocoa plantations near Jerangau), eastern Johor, Singapore where rubber estates have largely been subdivided for suburban housing, Brunei and Sarawak.

The relationship of the main plantation crops to the physical environment has been discussed already (Chapter 4), but the general location of estates below the 76 m (250 ft) contour is striking *(Fig. 27)*.

The extent of land under plantations is considerable. The total area under rubber, oil palm, and coconuts in 1973 was estimated to be 919,000 ha, but to this may be added the 35,000 ha of estate oil palm in Sabah not identified as such in the available statistics, so that estates account for about 27 per cent of all agriculturally-used land in Malaysia. The areas in Brunei with about 1,000 ha of estate rubber and Singapore where estates are largely inactive are insignificant.

To establish the number of estates in the region is a matter of some difficulty, since although they should be registered, there is no formal definition of a "rubber" or "oil palm" estate. Statistics are invariably presented by type of estate, so that there must be a considerable degree of double-counting, since an estate growing both rubber and oil palm is counted once in each category. Official statistics indicate that there were 2,040 rubber estates and 631 oil palm estates in Malaysia in 1973, of which 1,908 rubber estates and 506 oil palm estates were in the Peninsula. However, an analysis of 492 estates listed in the *Straits Times Directory* showed that 121 one-quarter of those appearing were mixed estates, mainly growing both rubber and oil palm, while some were very large, with 20 over 3,000 ha in extent. Recent data (1978) indicate that in Peninsular Malaysia 240 "oil palm sole crop" estates covered 199,000 ha, 236 "oil palm principal crop" covered 137,000 ha and 301 estates mainly in rubber and other crops possessed 67,000 ha of oil palm.[39]

The number of workers and persons supported by estate employment may be estimated with rather more certainty, since there is no great variation in the number of workers per unit area under a particular crop from estate to estate. On rubber estates, the average area per worker is 3·1 ha (BARLOW 1978, p. 217), compared with around 4·9 ha for oil palm (KHERA 1976, p. 34) and an estimated 6·2 ha for coconut. Rubber estates thus support about 200,000 workers, oil palm estates around 49,000 workers and coconut estates, roughly 5,000 which, with a further 5,000 on tea and pineapple estates, gives a total in the vicinity of 260,000 out of a total labour-force of slightly over three million. Allowing an average of two dependants per worker, since in most families or estates there is more than one worker, plantation agriculture probably directly supports slightly more than three-quarters of a million people in Malaysia. Elsewhere, employment on estates is miniscule, totalling around 600 in Brunei.

The contribution of plantation agriculture to the export economy is also significant, though its share of total exports is falling. In 1973, for example, it contributed 23 per cent of Malaysia's total exports, but by 1979 both non-agricultural exports and agricultural exports of small-holder origin increased their share. The respective shares of major plantation crops is shown in *Table 31*.

There is also a further contribution to the national economy through both employment and downstream processing. Some 15 per cent of oil palm products (palm oil and palm kernel oil) are used locally, though for rubber (both estate

*Table 31*

Estimated contribution of plantation agriculture to exports in Malaysia, 1979

| | Million US$ | Per cent |
|---|---|---|
| Rubber | 654·4 | 65·8 |
| Oil palm | 293·3 | 29·6 |
| Coconut | 4·4 | 0·4 |
| Cocoa | 41·8 | 4·2 |
| | 993·9 | 100·0 |

*Note:* Compiled from trade and production statistics.

[39] Since the sample in the *Directory* is self-selecting and many small estates (? mainly rubber) have obviously been omitted, firm conclusions cannot be drawn.

and small-holder) the proportion is only 1·7 per cent (KHERA 1976, p. 42; BARLOW 1978, p. 246). To this may be added the contribution of transportation and related services, though since the marketing chains for estate produce tend to be shorter than for small-holder produce, particularly for palm oil which may go direct from the estate factory to bulk installations at the ports and because of economies of scale, this contribution is probably less than is the case for small-holder produce.

## EVOLUTION

Studies of the evolution of plantation agriculture in the region, such as those of DRABBLE (1973) and BARLOW (1978) dealing with rubber, KHOO (1964) and KHERA (1976) with oil-palm, COURTENAY (1947) and NEVILLE (1964) with pineapple, and GRIST (1937, 1940) with tea, largely fail to make the point that the "planting industry" is very largely a single industry. Such has been the degree of crop specialization over the years that the evolution of the various branches of plantation agriculture have been considered largely in isolation. But during its early beginnings and increasingly over the last 15 years, specialization has not been extreme as at other times.

Early in the nineteenth century, there were two distinct strands to a planting enterprise in the region as JACKSON (1968a) has described. On the one hand, Chinese capitalists took up land for the cultivation of medium-term perennial crops such as pepper and gambier *(Uncaria gambir)*, and later manioc, while British entrepreneurs were engaged in the planting of spices, including pepper, nutmegs and cloves, and from about 1820, sugar. The core areas for both types of enterprise were the British Straits Settlements, initially Penang, then Singapore and later Melaka.

On Singapore island and then in Johor, Chinese entrepreneurs leased land for the speculative cultivation of pepper and gambier and by the mid-nineteenth century some 10,900 ha in Singapore were under these crops, which though complementary both economically and agronomically, were grown in separate blocks on each plantation. Since the crops exhausted soil fertility and because of a continuing influx of Chinese, a shortage of suitable virgin forest land forced a shift to neighbouring Johor by the 1840 and 1850s. By the early 1860s there were some 1,200 plantations employing about 15,000 workers – all Chinese (JACKSON 1968a, pp. 14–15). Subsequently, lands in Melaka state and adjoining Negeri Sembilan also came under the onslaught of what was in essence a form of commercial shifting cultivation which left in its wake a devastated landscape of *Imperata* and scrub.

From the 1850s, but especially during the 1870s and 1880s, another crop was added to this form of robber economy – manioc. By 1887, some 36,000 ha in Negeri Sembilan were held by manioc planters and the industry had spread to Selangor, Perak, and Province Wellesley by the last decade of the century and to Kedah by the second decade of the twentieth century. The decline of both types of shifting cultivation owed a good deal to changing fortunes on the world market, but much also to governments which had belatedly recognized their essentially short-term and exploitative nature and were no longer prepared to lease land for these crops, especially as European-managed "scientific planting" was beginning to demand land for cultivation in perpetuity. Even so, the effects of the exploitative system were not wholly bad. Roads and cart-tracks were constructed, "useless" forest was cleared and the country was surveyed and mapped, features that were of undoubted benefit to European planting activities, which by the later years of the nineteenth century were on the verge of rapid growth.

The early history of European planting is very much one of raised expectations and dashed hopes. The breaking of the Dutch spice monopoly – nutmegs, cloves, and pepper – was an early objective of the English East India Company after the foundation of Penang in 1786. In this it at first enjoyed little success, but by about 1825, under the stimulus of high prices, private entrepreneurs, both at Penang and at Singapore, began to plant nutmeg on a considerable scale to the extent that a Singapore newspaper spoke of "nutmeg mania". But for most, this was a bad dream and no permanent industry arose.

More successful was the growing of sugar, mainly on the alluvial lowlands of Province Wellesley to which attention had been given with some success in the 1820s, and by the 1870s, sugar-growing had begun to develop into a highly capitalized business. Modern processing plants, driven by steam and producing fine "centrifugal" sugar, were set up as the planting industry began to apply truly industrial methods in a context which had hitherto relied upon simple hand methods and abundant labour. The Province was particularly suited to growing cane. Not only was there a more marked dry season than in more southerly parts of the Peninsula, and available flat land through which canals could readily be cut for drainage, irrigation and the transportation of cane, but nearby was the town and port of Penang with its financial and commercial links as well as with its transportation facilities. But again, though the enterprise lasted much longer than the "nutmeg mania", it proved ephemeral in the face of disease in the cane, shortages of fuel and labour, and falling world prices. By 1914 all the mills had closed and the land was taken for rice or rubber (P. P. Courtenay 1979, p. 113).

At the other side of what was ultimately to become Malaysia, planting operations were to begin much later than in the Peninsula. The British established control in Sabah only in the 1880s but by the end of that decade some 25 companies, British, Dutch and German, had purchased nearly 200,000 ha, mainly with the intention of growing tobacco and the region was seen as having a potential rivalling that of Sumatra's *Oostkust*. During the 1890s trial plantings of sugar, coffee and Manila hemp (*Musa textilis* — used for making marine cordage) were made, but tobacco was the only crop of importance and by 1903 estate-grown tobacco had accounted for 55 per cent of the exports from the territory of the British North Borneo Company (*British North Borneo Herald*). However, by 1908, tobacco exports had begun to fall before any compensation was realized by the beginnings of rubber-planting, often on the same tobaccoestates.

The historical continuity had been paralleled in the Peninsula a decade earlier where the first commercial planting of *Hevea* rubber (as well as soon to be abandoned *Ficus* and *"Ceara"*, i.e. *Manihot glaziovii*, rubbers) was on established estates about 1895. These had been preceded by a decade of experimental plantings mainly in government gardens. The rubber industry was thus the first in the region to reap the benefits of scientific experimentation both in acclimatization and, especially, in developing appropriate methods of extracting the latex, benefits, too, that stemmed from the foresight of H. N. Ridley, the government botanist, and those few pioneer planters whom he managed to persuade to undertake initial commercial planting (DRABBLE 1973, p. 19 ff.).

Expansion from these tentative beginnings was spectacular under the stimulus of assured markets and high prices as the demand for rubber rose, mainly for tyres and for use in the electrical industry. From 2,400 ha in 1900, the rubber area reached 218,900 ha ten years later and in rubber governments had at last found a "permanent" crop and with it an important source of revenue. Thus investment in railways and roads was expanded and land was made available on very easy terms to individual entrepreneurs, Chinese and European, and to the various companies, many of which were floated (mainly in London) specifically to plant rubber. At the same time what were later termed "agencies" became important in channelling capital to the Malay States and in providing a wide range of services to the estates. These "instruments of international capitalism" which began mainly as British merchant firms in Singapore still survive and control a major portion of the rubber plantation sector (BARLOW 1978, pp. 30—31). Of the 425,000 ha of rubber controlled by agencies with more than 800 ha each, 57 per cent were controlled by only five agencies in 1972, all but one of which was substantially European-owned (BARLOW 1978, pp. 446—447).

The evolution of rubber plantations is typified by the "Pal Melayu" estate described by JAIN (1970, pp. 189—235), though it is somewhat unusual in being located on an artificially-drained alluvial lowland. The identity of the initial entrepreneur is not known, but in the 1890s surveyed lands along a road were obtained in perpetual leasehold at very small rents. Coffee was interplanted with coconuts, a fortunate circumstance since a depression of coffee prices coincided with the estate's first crop. The enterprise seems to have come close to foundering and though an initial planting of rubber was made in 1904, it was only under new management two years later, taking advantage of a government loan (this under a system of not so *laissez-faire* capitalism), that progress was made. Javanese and Chinese contract labour was employed to fell the rainforest and to dig drains. By 1907 the estate was about 480 ha in extent with a resident labour force of Tamils originally imported from southern India, and two European managerial staff.

Clean-weeding was practised until about 1925, though this had much less serious consequences in the form of soil erosion on this flat terrain than on estates in hilly country. Another consequence was the rather more intensive employment of labour than is now usual – 2 ha per worker rather than 3 per worker at present.

Though many estates employed indentured labour, this was not the practice on Pal Melayu, since this form of labour was costly and many of the workers were unused to field tasks. Thus the "kangany" system was used, by which a government-licenced recruiter-foreman arranged to bring in workers from India and supervised their work. With expansion of the estate in 1910, the need arose to employ intermediate staff – "conductors" (supervisors), clerks, factory foremen, a "dresser" (medical attendant) and most of these, though Indian, were not Tamil – again a pattern which has persisted.

The fortunes of the estate, having wildly fluctuated in step with world markets, had reached a nadir by the early 1930s. Yet, as on most estates except those that went bankrupt, labour was not dismissed, though all, from managers down, were forced to take substantial cuts in remuneration. Other costs were cut to the bone by employing as few workers as possible to carry out essential tasks and through increased labour efficiency by the adoption of new methods, such as full-spiral tapping (i.e. a cut right around the tree) every fourth day which substantially reduced tapping and supervision costs without lowering yields and the abandonment of clean-weeding in favour of cover-crops and selective weeding.

(Similar technical changes have since continued and one result may have been to reduce potential employment, relative to the growth of the plantation industry as a whole, if not absolutely. This situation does not seem to have been recognized by the National Union of Plantation Workers, since its members benefit financially from productivity-linked payments. Another major concern of the Union is subdivision of estates which effectively destroys the livelihood of wage labourers and the Union is now slowly emerging as an estate-owner in its own right in an endeavour to protect its members. In 1972 it owned 16 estates totalling almost 9,000 ha.)

Pal Melayu had not yet, at the time of R. K. Jain's study (late 1960s) undertaken the cultivation of oil palm in addition to that of rubber. Indeed, this recent change has been entirely undocumented in either of the two recent major studies, of rubber by Barlow (1978) and of oil palm by Khera (1976). The recent very large increase in areas under oil palm is to be attributed not only to deliberate government policy, based upon the view of the World Bank in 1955 that agricultural diversification was an urgent necessity, but also to the opinion of directors, management and share-holders of some of the larger rubber-planting companies that the long-term future of rubber was jeopardized by competition from petroleum-based synthetics and rising costs of production. Growing oil palm seemed to have every prospect of success and profitability as the world demand for fats continued to outpace population growth.

But in fact, the growing of oil palm had long been established in the Peninsula. Unlike rubber, the early phase of oil palm cultivation seems to have owed nothing to established plantation enterprise (BUNTING, EATON and GEORGI 1927; KHOO 1964, pp. 2–5; KHERA 1976, pp. 21–27). The first commercial plantation was sited in the Kuala Selangor district in 1917 using planting material from Sumatra where the first estate had been established in 1911.[40] But early development was slow and by 1923 there were only 410 ha under the crop. Some advance came in 1924 with the setting up of Oil Palms of Malaya Limited by a major rubber estate agency. Several other companies, including the Belgian Socfin group, entered the industry and by 1926, some 18,400 ha had been alienated for the crop, of which 5,000 ha were planted. In addition to the original core in the Kuala Selangor district, a secondary centre began to develop around Labis along the main north–south highway and railway in north–central Johor. The downturn in the fortunes of the rubber industry in the 1930s may have stimulated interest in oil palm (though this has not been documented) and the planted area had expand to 31,500 ha by 1940. As *Figure 2* indicates, the growth of production and area have kept well ahead of population since 1949, the planted area doubling between 1952 and 1964, doubling again by 1968 and yet again by 1972 (KHERA 1976, p. 31). The growth in production has been equally spectacular. Thus, it took 12 years, from 1948 to 1960, for production to double, but since then it has doubled four times at an average interval of just under four years.

Malaysia now produces about 47 per cent of the world's oil palm from a total planted area of about 788,000 ha, of which estates account for about half, most of the balance being on government land development schemes. The latter represent a new development and although the objective is eventually to allocate land on these schemes to individual small-holders, to all intents they are operated as estates though owned by FeLDA, the Sabah Land Development Board or by state governments. FeLDA began the cultivation of oil palm in 1961 and by 1978 had developed almost 283,000 ha, while a further 66,000 ha had been developed by state government schemes. In the long term it seems

[40] The manager of this estate was Henri Fauconnier whose novel, *Soul of Malaya*, besides having considerable literary merit, contains excellent descriptions of plantation life.

likely that the relative share of estates will decrease, though their area will continue to expand in absolute terms.

Estate cultivation of coconuts began early in the Straits Settlements, but it was not until about 1850 that copra was first exported (OOI 1963, p. 248). The failure of the nutmeg industry led to some increase in Pinang and later in Province Wellesley, while towards the end of the century lands in the Lower Perak district were developed for the crop. This district has remained a major centre of estate production, several exceeding 2,000 ha in size, though some are now interplanted with oil palm, as part of a change over to that crop, and others with cocoa. The former considerable extent (about 9,000 ha in 1961) in Selangor, mainly Kuala Selangor district, has now entirely disappeared. Thus the area of coconuts on estates in Peninsular Malaysia fell by almost 15,000 ha from 1961 to a total of 17,000 ha in 1977 and estates now account for 7 per cent of the total area compared with 15 per cent in 1961 (FERNANDO and GRIMWOOD 1973, p. 91). Estates remaining in coconut after the ravages of the Japanese occupation began intercropping their land with cocoa, a process accelerated during the 1960s. As a result, economic returns were roughly doubled from the same land, giving even better returns than oil palm. One reason for this is that on the heavy clay soils of Lower Perak, the roots of the cocoa break up the soil to the benefit of the coconut (FERNANDO and GRIMWOOD, 1973, p. 91), in addition to the obvious advantage of income from both. Cocoa estates are thus of recent evolution in the Region, Perak and Selangor accounting for three-quarters of the Peninsular total of 19,300 ha (1978). Estates make up 56 per cent of the 34,300 ha under cocoa in the Peninsula.

Estates account for a third of the total area under pineapples, but whereas coconut planting on estates can be placed in the mainstream of plantation enterprise in Malaysia, pineapples cannot. During the initial stages of the development of the canning industry, one very largely in the hands of Chinese entrepreneurs, supplies of fruit came from small-holders, but by 1940 pineapple lands had seriously deteriorated to the extent that the canneries were in difficulties. The consequence was the purchase of land in Johor and Selangor with the objective of engaging in estate production. This was achieved after World War II and in 1966 canners' areas accounted for about 4,860 ha, virtually all of it in Johor where they still remain (C. E. COURTENAY 1947; WEE, 1970, pp. 72–73). Estate cultivation has been described in detail by NEVILLE (1964), but historically it is somewhat unusual in that it represents an attempt by locally based manufacturing to obtain assured supplies of raw materials, though in essence it is similar to the operations by such international rubber-manufacturing groups as Dunlop and Uniroyal.

Tea estates were never developed by international combines, possibly because these were already well-established in India and Ceylon when British control was extended to the Malay States. While tea will grow satisfactorily on lowland sites, in the 1920s Chinese small-holders in Selangor were growing it. It was only in the 1930s that lands become available at an elevation of around 1,500 m on which teas of high quality could be grown with the opening of a road to the Cameron Highlands. This was fostered by government experimental plantations and taken up partly by Chinese capitalists (MILSUM 1929; ANONYMOUS 1931; GRIST 1937, 1940). Estates are confined to the Peninsula where 19 of them comprise 71 per cent of the area planted with tea.

## LANDSCAPES

The landscapes of plantation agriculture share a number of basic similarities, even though the crops may be different in the various areas. Thus, except on tea estates which are clean-weeded in strips and on pineapple estates where the plants grow closely packed together, cover-crops are invariably employed. But rather than consisting of various adventives such as are common on small-holdings, the covers are planted. Moreover, where required, artificial drainage is similar for the various crops, as is the spacing and layout of settlements and their location with respect to main roads.

The primary element is the tree-crop itself, rubber, oil palm, coconut, cocoa, tea or pineapple, usually grown without an inter-crop. However, where coconuts are giving way to oil palm, the latter may first be planted under the coconuts which are poisoned and die as the palms mature. Coconuts and cocoa are the only crops interplanted on a permanent basis, though on the extensive Bal Estate, near Tawau, Sabah, cocoa is grown on the African pattern under leguminous shade trees.

The usual spatial layout is in rows, the pattern for rubber varying from rectangular systems with 9 – 11 m separating the rows to square systems spaced at 6 – 8 m. Some older plantings dating from the 1930s and immediate post-war years were in "hedges", 20 – 25 m apart, with the trees being one metre or even less apart. This system has since been abandoned because of lowered production and enhanced susceptibility to wind-throw (BARLOW 1978, 130 f.). The pattern for oil palm is similar, the rows being about 8·5 m apart, though the palms are planted in a triangular pattern (see P. E. COURTENAY 1979, Fig. 6.9). In the case of oil palms there is often an abundant epiphytic flora, mainly ferns, on the trunks in which soil may accumulate in tiny pockets.

The second important landscape element is the cover-crop which, except on small estates, is invariably planted, since this procures higher profits, despite the cost. Whereas under rubber, cover-crops are ultimately partially or entirely shaded out, under oil palm they remain, though a circle with a radius of a metre of so from the stem of each palm is clean-weeded to reduce competition for nutrients and to prevent the creepers from climbing into the palms.

The third landscape element is the settlement. On small estates this may be simply the manager's or proprietor's house, together with a shed for coagulating latex and a smokehouse on rubber estates, or a drying shed on coconut estates, but on larger estates which employ their own labour, the settlement has many of the characteristics of a small town (see *Fig. 28*). An early, "basic" pattern has been described by JAIN (1970, pp. 236–237). This consisted of the man-

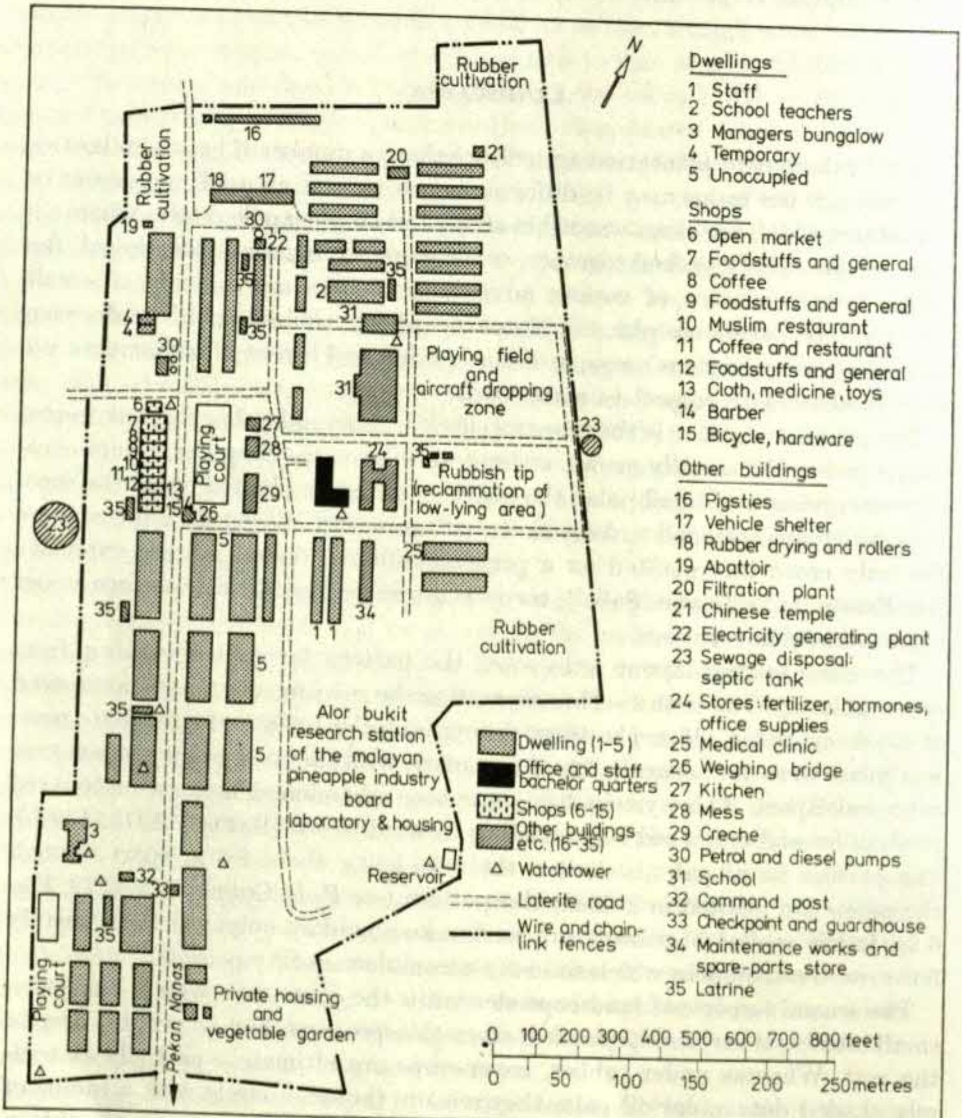


*Fig. 28.* Plan of a pineapple estate settlement, Johor

ager's bungalow, the field supervisor's house, eight sets of coolie "lines", a store and an Indian temple. Each set of coolie lines consisted of 20 rooms, each of 9 $m^2$, built back-to-back, but with a common verandah sheltering the outer face of each row of rooms. Here the cooking was done, and the verandah functioned in much the manner as the Iban longhouse which, except in type of construction material, the lines resemble. The kangany occupied the room nearest to the main entrance of the estate from which vantage point he was able to keep watch upon the off-duty activities of his labour-gang. Such semi-communal housing still survives on a few estates, which today contain the manager's house, usually a large bungalow set in ornamental grounds and often on a hill, and labourers' quarters, usually one or two-roomed dwellings, often semi-detached and all built to a standard architectural design. With these are buildings for processing — on rubber estates an open-sided building for coagulating latex in tanks and rolling the sheets, a smoke-house, a store and a workshop. Larger rubber estates have more buildings — detached houses, in a style rather less grand than that of the manager for the teachers, dresser, and administrative and supervisory staff. There is also a school and a clinic and on the production side a bulk latex installation if liquid latex rather than sheet is produced, together with a plant to produce "crumb" rubber, or plant and workroom to produce crepe.

On small oil palm estates which sell fruit to a factory, the buildings, other than those used for residential purposes, are few, perhaps only a garage and workshop for lorries, tractors and trailers. On the larger estates a factory for processing the fruit into oil will be found, a minimum area of about 2,000 ha of palms being required to support what in Malaysia is regarded as a factory of economic size. On coconut estates, especially the smaller ones, processing beyond the copra stage is generally carried out at a central oil-pressing plant located off-farm, and the same is true for pineapple estates, since canneries draw supplies of fruit from both small-holders and estates. Nevertheless, the number and variety of buildings in the central settlement may be considerable as shown in *Figure 28*. On a few estates, a further component may be a research facility owned by a producer board or by a major group of estates. The Chemara Research Station, near Seremban, Johor, owned by the Guthrie group is an example.

The spatial pattern of these major elements is somewhat variable from region to region. Where small estates are the rule, in the Kudat Peninsula for example, the landscape ensemble is very much like that of small-holder areas except that the farms are larger and there is thus a greater distance between the dispersed farmsteads. Each estate may have a number of blocks of even-aged trees, each block being only a few hectares in extent. At the other extreme, blocks may be several hundred hectares in size and the central settlements ten kilometres or more apart. The location of the settlements with respect to main roads also

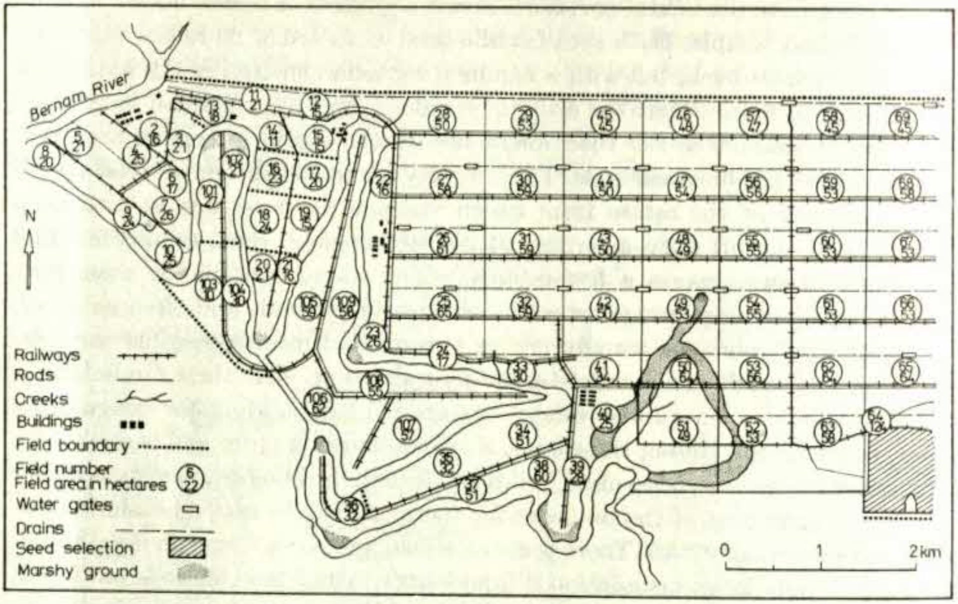


*Fig. 29.* **Plan of an oil palm estate, Northwest Selangor**

varies. On small estates the settlement is usually within 100 m of a national road, but on larger estates, it is generally some distance from a main road and is located centrally with respect to the "fields". From the central settlement a network of laterite-surfaced roads provide access to the main collection points. On rubber estates there is a further subsidiary network of foot tracks and bicycle paths centring upon latex collection points which are simple open-sided rain-shelters. However, on oil palm estates the network of roads is denser, since the total quantity of produce to be carried is much greater, up to 30 tons of fresh fruit bunches per hectare per year compared with a maximum of two tons of latex. Many oil palm estates construct roads at intervals of about 325 m so that the maximum distance fruit has to be carried by hand is half this figure. Between every other row of palms is a path leading to a road or railway. The large quantities to be moved also make narrow-gauge railways feasible and on flat terrain they are preferred, since costs are about 30 per cent of those by lorry (KHERA 1976, p. 101). Thus, so far as rubber is concerned, the individual landscape elements of perennial-crop small-holder agriculture and of plantations are quite similar. The major differences lie in scale. The overall layout of an oil palm plantation is shown in *Figure 29*.

The ecological aspects of rubber-growing have already been considered in some detail, with reference to small-holders, in Chapter 9, the only significant difference lying in planting density — usually close to 300 trees per hectare for estates compared with up to as many as 600 trees per hectare on some small-holdings. This does not mean that the total biomass is very much lower, however, since at lower densities the trees grow larger and become tappable sooner.

Further differences are the general use of leguminous cover-crops, so that nitrogen input from this source falls towards the higher end of the range and the fact that estates commonly use fertilizers, especially during the establishment phase and where stimulation is practised. Thus on fairly typical rubber soils such as the Rengam series, the amount of N returned to the soil-cover the first five years following planting ranges from 225—350 kg/ha for legume covers compared with only 10—115 kg/ha for natural covers. Inputs of K and P are also two to three times higher under legumes (Barlow 1978, p. 152).

Since most oil palms are on estates it is appropriate that the agroecosystem of oil palm be considered in detail at this point. No other system can be discussed for lack of adequate data. As with rubber, the ecosystem is relatively simple — basically the palms themselves, together with the epiphytic community (if any) and the arboreal soil in which the epiphytes are rooted, plus the ground cover. Similarly, energy cycling is through a limited number of species, though many individuals. The structure of immature stands is also simple, unlike small-holder rubber where inter-cropping adds complexity.

Inputs from the sun and the atmosphere to the ecosystem of the oil palm are obviously more or less the same as for other crops, though the general inland location of estates is probably reflected in the fact that sea-salt inputs are towards the lower end of the range indicated in *Figure 30*. Except directly beneath the fronds of the palms, light values are undoubtedly higher than under rubber and this is reflected in a continuous and often very vigorous ground-cover. Light intensity below the canopy also varies during the lifetime of the palms. For the first three years, the canopy is open, but with increasing age and as the stems elongate, the canopy closes at least partially; in old age, the crowns become rather more open, the number of leaves tending to fall after the 20th year (Hartley 1967, p. 153).

On the whole, soils such as those derived from the rather limited basic volcanic area of the Segamat and Kuantan series, from the less acid granites and granodiorites of the Rengam and Jerangau series, and from the artificially drained alluvium of the Briah and Selangor series are superior to those developed on sedimentary rocks, especially older alluvium or light-textured soils generally. The physical and chemical properties of typical oil palm soils are summarized in Hartley (1967 pp. 116—118). Most are texturally clays, clay

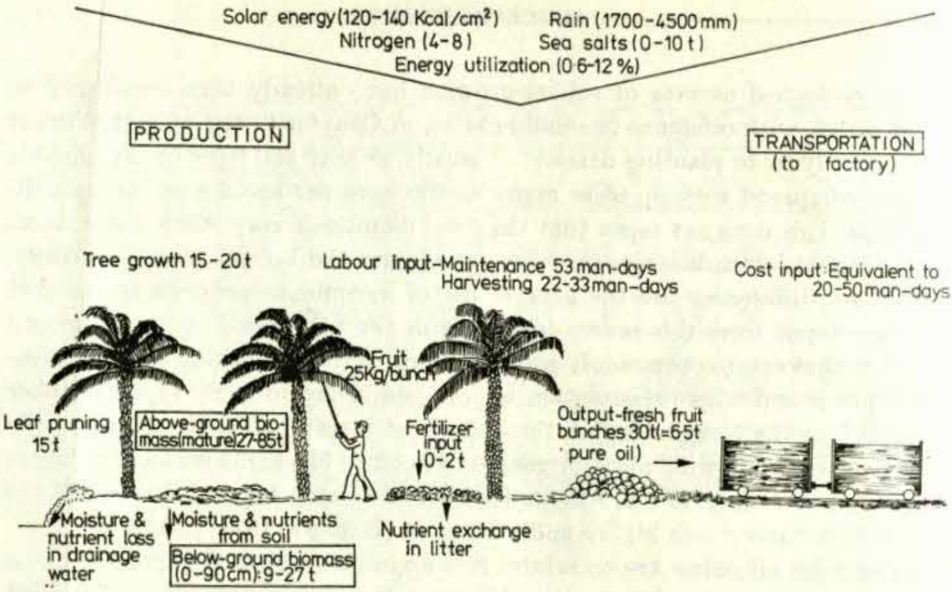


*Fig. 30.* The oil palm ecosystem

loams and sandy clay loams with good water retention properties. The soil phase of nutrient cycling is very much like that of rubber, though the range of soils upon which oil palm is grown is rather less. This is reflected in rather higher nutrient levels. Nitrogen in the top 50 cm of a typical oil palm soil is generally in the range of 7 to 14 t/ha, the levels of phosphorus, potassium and magnesium being in the ranges 3–6 t/ha, 6–12 t/ha and 8–15 t/ha, respectively.

Not all of these nutrients are available to the plants and the actual uptake is but a fraction of the total. The quantities involved rise linearly to about the palms' 20th year, thereafter falling. Data for Malaysia suggest that one hectare of mature palms will have immobilized in their trunks about 370 kg of nitrogen with a further 127 kg in the fronds. Values of potassium are slightly higher at 604 kg and 142 kg, respectively. The total above-ground plant mass of mature oil palm is about 85 tons ranging down to about 27 tons on poor sites and of this total, about 10–12 per cent is fronds and the remainder trunk. In young palms, the trunk is scarcely formed but by about seven years of age the weight of crown and trunk are about equal. The rate at which plant matter increases is rapid and from the 5th to the 20th year an annual increment of 15–20 tons/ha is common. Planted leguminous covers have a mass of about 5–7 tons/ha and these values are reached 8 to 15 months after planting.

Unfortunately, little has yet been published indicating the rates at which these nutrients are cycled. In addition to an output of about 30 tons/ha of fresh fruit annually, the palms also lose nutrients to the soil by pruning which usually involves the removal of both dead leaves and some of the older functional ones as well, thereby producing somewhat higher yields as more female inflorescences are formed. The input to the soil is about 15 tons (dry weight) yearly. It is likely that the addition of nutrients to the soil from cover-crops is of the same order as under rubber, since the covers are the same, with the difference that these inputs probably persist rather longer as the palms mature. Additions from tree-fall are probably negligible since palms are much less susceptible to wind-throw than rubber, to the extent that large bulldozers are required to clear the old trees.

Thus compared with rubber some salient differences may be summarized. The total above-ground plant mass, at around 90 tons/ha (of which the cover may be 5 tons) is only about half that of rubber. The peak annual dry matter production at 45–50 tons/ha compares with around 35 tons/ha for rubber between 3 and 5 years old. However, the actual produce (the fruit) forms from half to two-thirds of total dry matter, whereas latex comprises five per-cent of the total annual production at the very most. Rubber, compared with oil palm, is thus energy-conserving, even in the field. The fact that a high proportion of the dry matter of the oil palm leaves the field has important consequences at both the transportation and processing stages and these are considered in a later section.

## THE SOCIO-ECONOMIC FRAMEWORK

If in any form of capitalist agriculture it were necessary to identify capitalists, bourgeoisie and proletariat, in plantation enterprise these are present with a vengeance. Three "classical" groups may be identified: *capital*, often foreign but probably decreasingly so, usually represented by the company, though on small estates by individuals; *management*, usually the paid employees of capital though on some small estates the owner and the manager are one and the same person; *labour*, mostly employed on a daily-rated or piece-work cash basis.

On individual estates, especially those owned by Europeans and centrally managed, the local "king pin" was and still is the estate manager who might be a petty despot, though such have been rather firmly put in their place since independence, bu[illegible] would nevertheless have a paternalistic relationship with his workers, a status which accords well with their cultural values. The hierarchy of control is well-defined and reflected spatially. Surveying all is the manager's bungalow, set in orderly and spacious grounds, often looking down upon the less pretentious but still comfortable homes of the clerks, school-teachers and dresser. The bulk of the inhabitants, by contrast, live in labour

*Table 32*

Employment structure

| | Rubber | | Oil palm | | Coconut | |
|---|---|---|---|---|---|---|
| | 1000 persons | % | 1000 persons | % | 1000 persons | % |
| Executives, supervisors | 5·09 | 1·8 | 0·14 | 1·1 | 0·11 | 2·0 |
| Tappers, harvesters | 182·48 | 66·2 | 3·05 | 22·8 | 1·48 | 27·0 |
| Field workers | 69·93 | 25·4 | 8·07 | 60·4 | 2·45 | 44·6 |
| Factory workers | 11·06 | 4·0 | 1·08 | 8·1 | 0·62 | 11·3 |
| Other daily-rated | 7·24 | 2·6 | 1·02 | 7·6 | 0·83 | 15·1 |
| | 275·80 | 100·0 | 13·36 | 100·0 | 5·49 | 100·0 |

*Source:* CHENG 1970, p. 46.

lines with their restricted living space and still, in some cases, communal toilet and washing facilities (see *Fig. 28*). Associated with these material differences are many others, both social and psychological, as JAIN (1970) has described. While this model applies to those estates on which Tamil labour is found, it applies with less validity to those where Chinese are employed, since they are more likely to be contract employees and to live outside the estate in nearby towns and villages. In Peninsular Malaysia a quarter of the 46,000 Chinese workers on rubber estates were on contract in 1973 (BARLOW 1978, p. 210). Malays and other indigenous peoples are even less likely to live on estates, though contrary to general opinion they actually form a significant portion of the estate workforce — 64,000 on Peninsular Malaysian rubber estates in 1973 (BARLOW 1978, p. 210).

On medium-sized estates, the management style and social structure is similar except that the system of visiting managers controlled by the central agency is lacking. Small estates are generally owned by private individuals or, more commonly, by partnerships, the owners often being small businessmen owning stores and coffee-shops or professional people, many having a sharper eye for the prospects of capital gain by virtue of the ownership of land than for optimal efficiency in farming. From the workers' viewpoint, such estates are the poorest, offering the fewest fringe benefits and, according to a report of the National Union of Plantation Workers (quoted in BARLOW 1978, p. 212), the management is more authoritarian than on the large ones.

The class divisions on estates are paralleled by an employment structure strongly weighted towards semi-skilled workers, such as tappers on rubber estates and harvesters and pluckers on oil palm, tea and pineapple estates, together with factory workers, and unskilled field workers, weeders and sprayby type of estate, 1960

| Tea | | Pineapple | | Mixed | | Total[1] | |
|---|---|---|---|---|---|---|---|
| 1000 persons | % | 1000 persons | % | 1000 persons | % | 1000 persons | % |
| 0·03 | 1·1 | 0·04 | 1·9 | 0·23 | 1·4 | 5·65 | 1·8 |
| 1·34 | 51·0 | 1·42 | 68·6 | 7·60 | 45·1 | 197·41 | 62·3 |
| 0·76 | 28·9 | 0·48 | 23·2 | 7·00 | 41·5 | 88·92 | 28·1 |
| 0·27 | 10·3 | 0·00 | — | 0·98 | 5·8 | 14·04 | 4·4 |
| 0·23 | 8·7 | 0·13 | 6·3 | 1·04 | 6·2 | 10·62 | 3·4 |
| 2·63 | 100·0 | 2·07 | 100·0 | 16·85 | 100·0 | 316·64 | 100·0 |

[1] Including "other" not shown here.

ers. This structure is shown by Cheng's data for 1960 which are taken from a census known to be incomplete and which may account for differences as compared with Khera's figures given in *Table 32*.

The number of workers in the estate sector has been estimated by KHERA (1976, 30) and by CHENG (1970), the latter also estimating the number of workers indirectly employed, i.e. through contractors. The estate sector as a whole is unlike most other agricultural sectors in that employment is falling, not only relative to the overall increase in the national workforce but also absolutely. The notable exception to this pattern of decline is on oil palm estates where employment rose from just over 12,000 in 1952 to 47,500 20 years later. The overall pattern of change by type of estate is given in *Table 33*.

The fall in the number of employees, except in the oil palm sector, has not been paralleled by a fall in area, so that worker productivity has risen both

*Table 33*

Estimated numbers (000s) and proportion (%) of employees in the estate sector by type of estate, selected years

| Year | Rubber | | Oil palm | | Coconut | | Tea | | Pineapple | | Total persons |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | persons | % | persons | % | persons | % | persons | % | persons | % | |
| 1951 | 260·0 | 90·7 | 12·2 | 4·2 | 11·2 | 3·9 | 3·4 | 1·2 | n.a. | — | 287·4 |
| 1960 | 285·3 | 90·6 | 15·6 | 5·0 | 7·5 | 2·4 | 4·3 | 1·4 | 1·8 | 0·6 | 314·9 |
| 1968 | 206·7 | 81·7 | 34·5 | 13·6 | 4·4 | 1·7 | 5·0 | 2·0 | 2·5 | 1·0 | 253·1 |
| 1972 | 196·3 | 77·9 | 47·5 | 18·8 | 3·3 | 1·3 | 3·5 | 1·4 | 1·4 | 0·6 | 252·0 |

*Source:* KHERA 1976, p. 30.

in the rubber sector and, especially, in the oil palm sector. For example, the average area per worker on large rubber estates (over 810 ha in size) rose from 3·0 ha in 1960 to 3·4 ha in 1973, though small rubber estates (under 202 ha) absorbed relatively more labour over the period (BARLOW 1978, p. 214). On oil palm estates, the average area and production per worker rose from 3·0 ha and 3·3 tons, respectively, in 1952, to 7·6 ha and 13·6 tons, respectively, 20 years later (KHERA 1976, p. 31). Increased productivity had the consequence of displacing workers in the sense that had productivity remained unchanged, more workers would have been employed — in the oil palm sector a further 72,500 workers.

This situation has been partly offset by worker ownership of estates. In the rubber sector, the National Land Finance Co-operative Society controlled 16 estates covering around 9,000 ha in 1973, the necessary finance coming partly from the workers themselves, mainly in the form of retirement gratuities, and partly as loans from government. On these estates, the use of labour is more intensive than on typical commercial estates, though organizationally, worker ownership has not yet led to significant worker participation in management (BARLOW 1978, pp. 217—218).

Any consideration of the relationship between ownership, type of crop grown and the size is made difficult by the fact that a substantial proportion of estates fall into the "mixed crop" category (mainly rubber and oil palm, though some are mixed coconut and cocoa, while a few estates grow all three). Thus out of the total planted area of estates (627,500 ha) listed in the Straits Times Directory (1971), no less than 35 per cent was on "mixed" estates. The proportion could be higher than this, however, since H. S. KHERA (1976, p. 133) reported that only 109 estates out of 453 (24 per cent) grew oil palm alone, while 122 had this as the principal crop with a further 2·5 per cent growing mainly rubber but with some oil palm.

In the rubber sector, ownership is strongly dominated by Malaysian and British interests. Of the 589,000 ha in Peninsular Malaysia in 1973, 48 per cent were owned by Malaysian interests, with 37 per cent in British hands, the only other significant group being Singapore ownership with 8 per cent (BARLOW 1978, p. 202). In the oil palm sector the pattern is quite similar, with 48 per cent owned by British interests, 18 per cent by other foreign owners, mainly Belgian, Danish, French and Singaporean, with the balance owned by Malaysians (KHERA 1976, p. 130). This, however, is not the total picture since a substantial proportion of the estates is owned by public companies, whose shareholders may be of any nationality. Indeed it has been a deliberate objective of the Malaysian government to "buy back the farm" and mechanisms have been created to this end.

There is also a significant relationship between ownership and size of estate, in general the Malaysian-owned estates being smaller than the foreign-owned,

*Table 34*

**Estate ownership by size groups in Peninsular Malaysia, 1972/73 (per cent of planted area)**

| Planted area (ha) | Rubber | | Oil palm | |
|---|---|---|---|---|
| | Malaysian | non-Malaysian | Malaysian | non-Malaysian |
| Below 202 | 86 | 14 | 75 | 25 |
| 202—404 | 68 | 32 | 63 | 37 |
| 405—809 | 51 | 49 | 49 | 51 |
| 810—1,214 | 34 | 66 | 23 | 77 |
| 1,215—2,023 | 24 | 76 | 39 | 61 |
| 2,024 and over | 33 | 67 | 15 | 85 |
| Total | 48 | 52 | 34 | 66 |

*Sources:* BARLOW 1976, p. 201; KHERA 1976, p. 130.

as is shown in *Table 34*. The differences are striking. In the oil palm sector, for example, 48 per cent of the British-owned estates exceeded 809 ha in 1972 whereas over 90 per cent of the Malaysian-owned holdings were under that size, 64 per cent being under 202 ha (KHERA 1976, p. 131).

More generally, the size distribution of estates shows a dominance of small estates in terms of size, but a predominance of medium to large units with relation to area. The structure of the rubber and oil palm sectors is indicated in *Table 35*, in which there is probably some double-counting. Nevertheless, it is clear that, on the whole, oil palm estates are larger than rubber estates, this

*Table 35*

**Sizes of rubber and oil palm estates in Peninsular Malaysia, 1972/73**

| Size group (ha) | Rubber | | | | Oil palm | | | |
|---|---|---|---|---|---|---|---|---|
| | number | % | area 1000 ha | % | number | % | area 1000 ha | % |
| Below 202 | 1,261 | 66 | 96·3 | 16 | 223 | 50 | 16·6 | 7 |
| 202—404 | 233 | 12 | 69·1 | 12 | 62 | 14 | 18·2 | 7 |
| 405—809 | 213 | 11 | 121·3 | 21 | 60 | 13 | 34·1 | 14 |
| 810—1,214 | 86 | 5 | 83·9 | 14 | 40 | 9 | 39·3 | 16 |
| 1,215—2,023 | 78 | 4 | 121·8 | 21 | 36 | 8 | 57·0 | 23 |
| 2,024 and over | 37 | 2 | 97·0 | 16 | 25 | 6 | 81·4 | 33 |
| | 1,908 | 100 | 589·4 | 100 | 446 | 100 | 246·6 | 100 |

*Sources:* BARLOW 1978, p. 195; KHERA 1976, p. 130.

being especially the case at the larger end of the size range. It is likely that these large oil palm estates form single, integrated units, complete with a factory, whereas the smaller ones necessarily sell their crop to a factory nearby. This contrasts with rubber estates where a small estate may well have a factory though some concerns sell latex for processing by others.

The subdivision of rubber estates has already been alluded to as an issue leading to the beginnings of rubber estate ownership by workers, but the subdivision process has involved much more than the few thousand hectares of which workers' organizations have gained possession. It has been estimated that from the early 1950s to 1972, some 145—155,000 ha of estate rubber were split into much smaller parcels, usually of less than five hectares (BARLOW 1978, pp. 91—92). Although an unknown number of the subdivisions were merely legal fictions designed to avail owners of government replanting grants, others were not. The subsequent displacement of estate labour, mainly Tamils, and their replacement by small-holders, mainly Chinese, led to inter-ethnic tensions, though because there are no significant economies of scale in rubber production except in processing, the overall economic consequences were minimal. Indeed, it could be argued that at the national level, subdivision is beneficial not only in putting land into the hands of local people, but also in providing more employment since labour inputs are generally higher on small-holdings than on estates.

## PRODUCTION, PROCESSING AND MARKETING — RUBBER

The methods of production, manner of processing and channels of marketing for each of the major plantation crops are so different that they need to be considered separately, though there are obvious similarities particularly in the cycle of cultivation. For rubber, the cycle has already been described in Chapter 9 and the main differences on estates, compared with small-holdings, are that trees come into production rather earlier, perhaps by as much as a year and that they may also be taken out of production somewhat earlier. On estates, fertilizers are applied to the young trees and planting densities are lower, leading to the trunks reaching tappable girth (50 cm) more quickly, especially when compared with small-holdings that have adopted inter-cropping. At the other end of the planting cycle, the financial resources of the larger estates are sufficiently adequate to enable them to decide to replace trees with an improved variety or another crop on purely economic grounds. Whereas the small-holder may be forced to persevere with old trees of poor inherent quality because he has no alternative income, the estate operator can replant block-by-block or even subdivide and sell off the land and invest the proceeds elsewhere, an option not always open to the small-holder.

The daily cycle of operations, while broadly similar to that of the small-holder is rather more rigid and regimented especially where labour is directly employed. Every day at about 5·30 a.m. there is a morning muster which all labourers must attend. Tapping begins at 6·00 a.m. and continues until about 10·00 a.m. at which time the tappers begin to collect the latex from those trees earliest tapped. From the small earthenware cup attached to each tree latex is transferred to 25 litre buckets and then carried to the nearest weighing station presided over by a "weighing-kangany". The latex is then weighed and a small sample taken for hydrometer testing to determine rubber content (and to discover if the tapper has watered down the produce). A lorry then collects the latex from the stations and takes it to the factory for processing. Cup lump and scrap are also brought to the weighing station.

The subsequent processing of these two products, latex and field coagulum, follows slightly different paths as is shown in *Figure 31*. Treated with an anti-coagulant, strained and concentrated in centrifuges, latex concentrate is a major product on some of the largest estates, though small ones tend to sell the latex for processing into concentrate. This is used largely in rubber-based adhesives, paints and in moulded goods such as gloves and condoms. Smoked sheet was one of the earliest developed products and is still a mainstay of plantations, forming (with small-holder sheet rubber) more than half of the rubber exported. However, this pre-eminence is being increasingly challenged by block rubbers which, like sheet, are processed to standard grades. While

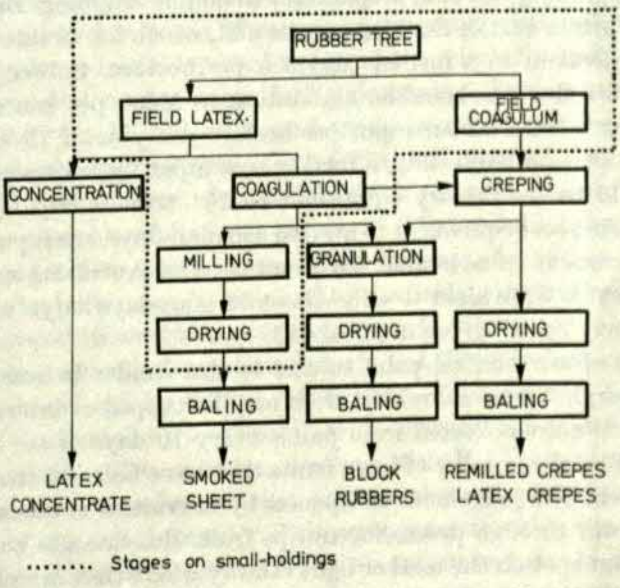


*Fig. 31.* **Processing on rubber small-holdings and estates**

small-holders produce smoked sheet, estates produce concentrate, crepe and block rubbers, largely because of the fairly sophisticated technologies and the great economies of scale involved, though recently-established government factories are now producing block rubbers from small-holders' produce and estates occasionally buy latex from small-holders for concentration (JAIN 1970, p. 13).

The marketing channels of estates and small-holdings are also rather different as is shown in *Figure 26*. The output from most estates is sufficiently large to avoid the need for involvement with the elaborate network of dealers whose function is agglomeration. Estates are thus able to take advantage of considerable economies of scale in marketing.

## PRODUCTION, PROCESSING AND MARKETING – OIL PALM

The cycle of cultivation of oil palm is quite similar to that of rubber. The initial stages of establishment are virtually identical except that the period of immaturity, three to four years, is rather shorter than for rubber, whilst the productive period, roughly 22 years, is also rather shorter, at the end of which the palms, unlike rubber, have no economic value beyond that of the nutrients they contain.

The costs of establishing oil palm are considerable. In 1972 it was estimated to be M$5,000 per hectare for a 2,000 ha estate, although substantially below the cost of upgrading rice land preparatory to double-cropping. But in addition there is the further cost of establishing the mill, which for an estate of this size would be equivalent to a further M$1,300 per hectare. Subsequent costs of production are also considerable, amounting to M$60 per ton of fresh fruit bunches. Thus with a labour input per hectare per year of 75–83 man-days for maintenance and harvesting, a further cost input for transporting the fruit from the field to the factory equivalent to 20–50 man-days (see *Fig. 30*), plus a processing cost equivalent to around 380 man-days, the input of "energy" in various forms is considerable. By contrast, the processing cost of rubber (smoked sheet) is equivalent to only about 38 man-days/ha/yr which may be added to other "costs" given in *Figure 25*.

The round-of-work on oil palm estates is also similar in some respects to that of rubber, but whereas rubber trees may be tapped at intervals of one to four days, fruits are collected from palms every 10 days or so, their ripeness being judged by the number of loose fruits that have fallen to the ground from the ripe bunch. The judgement of ripeness by harvesters is crucial, since large losses will occur through processing unripe fruit. Bunches are hand-carried to any convenient spot on the road or light railway where they are piled for transport, a process formerly done by hand but now more usually by crane.

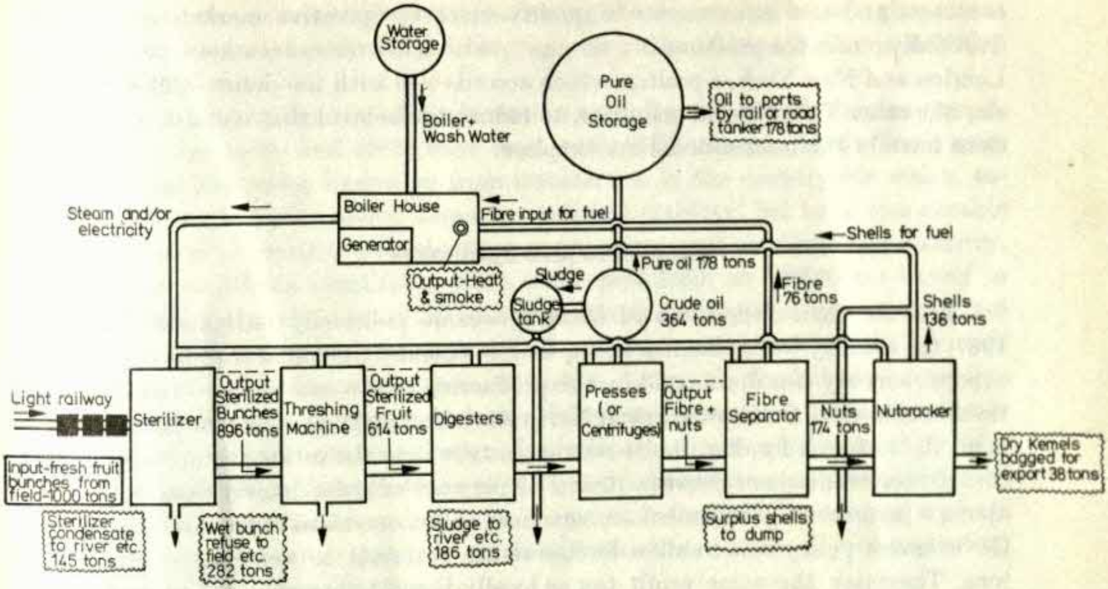


*Fig. 32.* The palm oil factory as a system

Rapid processing of the fruit is essential, since delay leads to fermentation and the formation of free fatty acids, which reduce the value of the final product. The various stages of processing are indicated in *Figure 32*. While the mill is self-supporting in terms of energy inputs, waste material being used as the source, the large initial input of fruit and the relatively small final output result in substantial energy losses during processing. These wastes are in several forms, both liquid and solid, and some, especially sterilizer condensate and sludge, are strongly polluting. GILL (1978) has reported that oil palm factories contribute 80 per cent of all pollutants to rivers in Peninsular Malaysia, 42 of which are considered "grossly polluted". The total discharge in 1975 was more than three million tons and was expected to rise to 6·4 million tons by 1980. Bunch refuse, however, may be returned to the fields, though the surplus shells are simply dumped or used to surface estate roads.

The marketing system for palm products (oil, kernels and kernel oil) has been described in detail by KHERA (1976, Chap. 8) and is very unlike that of rubber being dominated by two "pool" arrangements, one each for Peninsular and East Malaysia. All companies, together with FeLDA and other government producers, are members so that any member shipping produce can use the facilities of any other member. This arrangement avoids the necessity for an individual producer to seek a market for his output and also leads to economies of scale in storage, co-ordination of transportation by tanker, long-term contracts and the maintenance of quality. Such co-operative marketing undoubtedly places the producer in a stronger position in overseas markets, mainly London and New York, a position which accords well with the desire of Malaysia, like other Third World countries, to reduce the control that consumer nations have in the international marketplace.

## PROSPECTS AND PROBLEMS

When the then Federation of Malaya became politically independent in 1957, the country was a classical example of a dependent, colonial economy. The export economy was dominated by the production of raw materials – rubber, tin and timber – for European and North American markets. The new government did not seek for doctrinaire reasons to take over the estate sector, which contributed somewhere between 10 and 12 per cent of gross domestic product, about 9 per cent of government revenue, and about one-third of total exports. Government policy was to allow foreign-estate interests to continue operations. They pay the same profit tax as locally-based companies (40 per cent); they receive the same benefits from export duties, a portion of which is returned in the form of grants for replanting rubber which, in 1974, was made compulsory for estates yielding less than 800 kg/ha (BARLOW 1978, p. 86). BARLOW (1978, p. 85) has argued that in the rubber industry, estate interests have been favoured relative to small-holders. Nevertheless, area-for-area the overall economic contribution of the rubber estate sector, is probably higher than the small-holder sector. Thus RADHAKRISHNAN (1974, pp. 123–124) has indicated that in 1968 the average gross export proceeds from small-holder rubber were M$822/ha with a gross national value added of M$758/ha, whereas the corresponding figures for foreign-owned rubber estates were M$1,427/ha and M$1,312 and for Malaysian-owned estates, M$1,205/ha and M$1,102. The gross national value added of foreign-owned estates includes repatriated profits of M$183/ha, but even so, on an areal basis these estates were worth slightly more to the economy than Malaysian-owned ones.

While estates have maintained and improved their overall position absolutely, their relative share of production and area has fallen. In the rubber industry, estates accounted for 62 per cent of the area in 1938, but twenty years later this had fallen to 53 per cent and to only 35 per cent in 1973. The planted area has also fallen from 820,000 ha to 589,000 ha over the same period (BARLOW 1978, p. 444). This fall has been compensated by the rise in the area under oil palm of which more than two-thirds is owned by estates. It is clearly government policy to encourage the continuation of the estate sector but to work towards placing the domicile of plantation companies in Malaysia and towards increasing the share-holdings of local interests. One method of doing this has been to set up share-holder trusts and to require the reservation of a proportion of new share issues for local interests in an endeavour to build up a Malay capitalist class.

The basic problems faced by plantation agriculture, especially foreign-owned, during the 1950s and 1960s have been resolved (RATCHAGA 1956). These were physical insecurity stemming from insurrection in the countryside which, together with doubts about long-term political stability, led to a considerable reluctance to invest in new plantings or to replant and, in the rubber industry, competition from synthetics. With crude petroleum at US$20 per barrel in 1979, however, the use of fossil hydrocarbons to produce synthetic rubber makes little sense when, for virtually all purposes, natural rubber can be used. Competition from synthetics was not only a matter of price but also of quality and specification, matters which the Malaysian government has taken firmly in hand, though there is still room for improvement, especially on the smallholder side. With these problems virtually solved, the future of the rubber plantation sector seems assured, though low prices in the past discouraged replanting to some extent so that the "productive stock" is ageing. Recent replanting has not kept pace with this.

The prospects for the oil palm sector of plantation agriculture also seem fair. The crop has no major pests, and although processers face substantial rises in costs as they are forced to clean up the pollution they are causing, palm products will still remain competitive in world markets. A basic problem, however, is falling prices, partly resulting from rapidly increasing production, but for the moment these are offset by continued expansion in demand. A further problem is that vegetable oils are interchangeable for many purposes, and palm products therefore come into competition with these other oils, the production of some of which may come to be protected or subsidized. Malaysia has been very concerned that the United States, as a major soy and groundnut producer, would impose restrictions on palm oil. This leads on to the final point, which is that although Malaysia's agriculture has diversified over the last quarter century, the consumer countries still "call the tune" in the market place, so that while Malaysia's "muscle" has increased, it is still puny in the face of international capitalism. Nevertheless, it would be a very brave person who would argue that capitalism, in the form of plantation agriculture, has not brought substantial benefits.

CHAPTER 10

# INTENSIVE MARKET-GARDENING AND LIVESTOCK-REARING

If the cultivation of oil palm represents the least intensive form of permanent agriculture in the region, the growing of vegetables and the raising of livestock, mainly pigs and poultry, represents the most intensive form. On a number of farms, the growing of table fruits – durian, rambutan, star fruit (carambola), papaya, citrus and many others – is a less intensive subsidiary activity, though orchards may also be independent from market-gardening and pig-rearing. While Malay-owned orchards, as distinct from the array of fruit-trees found around village houses do exist, many orchards are in the hands of Chinese as is market-gardening, while pig-rearing is entirely so. The rearing of other livestock, mainly buffaloes and milch cows, is carried on to a minor degree by Indians and local dairy companies, and this usually involves stall-feeding of feedstuffs brought in. This occupational separation is well-illustrated in Singapore, where Malays make up only 0·2 per cent of the agricultural work-force (though comprising 15 per cent of the population) with Chinese accounting for 99 per cent, the rest are Indians (Y. K. WONG 1975, p. 57).

The location of lowland market-gardening and intensive livestock-rearing follows the classical model of von Thünen in being located on the urban fringe The existence of accessible cool uplands has led to the development of areas specializing in the production of temperate vegetables, mainly Brassicas, as at Cameron Highlands, in Pahang which is accessible to Perak and within reasonable distance of the major urban centres of the western Peninsula, and in the Kundasang area of Sabah's Kinabalu massif, supplying mainly the state capital at Kota Kinabalu. Favoured sites are those with an adequate water supply at all seasons – a prime requirement – and non-flooding alluvial land. However, the latter is not a key requirement, and gardens can be found on practically every soil type, even on the initially almost sterile sands left exposed by tin-mining. A basic objective in farm operations is the deliberate creation of optimal soil conditions, and this is achieved by large inputs of organic matter and labour. A further basic characteristic is that production is generally unspecialized. In Singapore, for example, only 17 per cent of farms undertake the raising of a single product, all the rest are mixed. The various combinations are exemplified in *Table 36*.

The reasons for some of the crop or crop/livestock combinations are quite obvious. The waste produced by the livestock, for example chicken manure,

*Table 36*

Types, number, estimated area and average size of intensive farms in Singapore, 1973

| | Number | % | Area (ha) | % | Av. size (ha) |
|---|---|---|---|---|---|
| Horticulture | 1,733 | 11·0 | 1,194·0 | 10·1 | 0·69 |
| Poultry | 300 | 1·9 | 145·8 | 1·2 | 0·49 |
| Livestock | 512 | 3·2 | 168·5 | 1·4 | 0·33 |
| Fishery | 132 | 0·8 | 82·5 | 0·7 | 0·62 |
| Horticulture and poultry | 3,062 | 19·5 | 2,224·9 | 18·8 | 0·73 |
| Horticulture and livestock | 1,508 | 9·6 | 1,035·0 | 8·8 | 0·69 |
| Horticulture and fishery | 288 | 1·8 | 282·4 | 2·4 | 0·98 |
| Poultry and livestock | 598 | 3·8 | 242·8 | 2·1 | 0·41 |
| Poultry and fishery | 24 | 0·2 | 17·4 | 0·2 | 0·72 |
| Livestock and fishery | 36 | 0·2 | 28·5 | 0·3 | 0·79 |
| Horticulture, poultry and livestock | 5,913 | 37·6 | 4,419·1 | 37·3 | 0·75 |
| Horticulture, poultry and fishery | 419 | 2·7 | 449·2 | 3·8 | 1·07 |
| Horticulture, livestock and fishery | 235 | 1·5 | 277·1 | 2·3 | 1·18 |
| Poultry, livestock and fishery | 34 | 0·2 | 29·1 | 0·2 | 0·82 |
| Horticulture, poultry, livestock and fishery | 952 | 6·0 | 1,236·4 | 10·4 | 1·30 |
| | 15,741 | 100·0 | 11,832·7 | 100·0 | Av. 0·75 |

*Source:* Y. K. Wong, 1975, p. 21.

is used either wholly or partly to fertilize the soil to raise vegetables, fruit trees and ornamental plants or is even incorporated into mixtures to feed other animals. The few poultry/crocodile farms in Singapore (total crocodiles – 6,900 in 1973) are particularly energy-conserving in that dead chickens are fed to the crocodiles and crocodiles slaughtered for their skins are fed to the survivors. Further somewhat unusual intensive agricultural units in Singapore include 1,087 aquarium fish 'famus', 392 farms growing ornamental foliage and flowers, together with 2,064 orchid farms, the last averaging only 0·01 ha in size, but producing orchids worth S$2·3 million in 1973 (Y. K. Wong 1975, Singapore, Primary Production Dept., 1974).

The area under market-gardening is not known in detail for lack of adequate statistics, especially for Sarawak. A summary is given in *Table 37*.

Similarly, the number of people involved is not known, though the total number cannot be large, even allowing for the fact that a fair proportion of the workers is part-time. In Singapore, for example, 58 per cent of the 45,655 workers worked less than 40 hours per week (Y. K. Wong 1975, p. 37). It can

*Table 37*

Intensive agriculture: area, production, pigs and poultry, 1970/73

| | Peninsular Malaysia | Sabah | Singapore |
|---|---|---|---|
| Vegetables, area (ha) | 8,650 | 905 | 11,833 |
| production (tons) | 42,806 | n.a. | 73,710 |
| Pigs (1,000) | 733 | 107 | 1,186 |
| Poultry (million) | n.a. | 1·3 | 6·5 |

*Note:* Compiled from various sources.

be estimated that about 33,400 workers are engaged in intensive agriculture in Peninsular Malaysia, with perhaps a further 3,500 in Sabah, to give a total of possibly 87,000 workers, full-time and part-time, in the region as a whole.

Estimates of the contribution to the national economies are difficult to make for lack of data upon which to base them, but in Singapore, agriculture, including ornamental fish and aquatic plants and orchids was worth S$605 million in 1980, representing almost S$290 per person. The nation is self-sufficient in pork and eggs and 78 per cent self-sufficient in poultry.

## EVOLUTION

Since the traditional diets in the region consisted largely of rice, fish and coconut (in curries) with a periodical contribution from house-yard chicken, or pig or wild game amongst non-Muslims, it is clear that intensive agriculture in the region dates back no further than the earliest Chinese settlers for whom fresh vegetables were a daily necessity. Though published information is entirely lacking, it is reasonable to suppose that wherever Chinese settled, they grew vegetables and raised pigs. This was certainly the case in the Kudat district of Sabah, for example, where early this century settlers sold produce to local townsfolk and supplied both Jesselton (now Kota Kinabalu) and Sandakan, as well as planting some coconuts and coffee. As a contemporary newspaper reported of market-gardening, "This form of agriculture is practically monopolised by the poorer class of Chinese, mainly Hakkas, who produce wonderful results from their five or ten acres of land (2—4 ha) . . . and the gardeners almost invariably combine the occupation of gardening with that of pig-farming." (*British North Borneo Gazette*, 2 May, 1910.)

Though specialized pig-rearing must date back to at least the nineteenth century (at which time the "farming" of the right to sell pork by local rulers was an important contribution to state revenues), specialized poultry-rearing is probably of recent origin, since a report of 1935 noted that Malaya imported substantial quantities of live poultry from Thailand, and eggs from Indochina and China (MANN 1935, p. 263). The region generally is now self-sufficient in pork, poultry and eggs though, as with vegetables, there is considerable intra-regional trade.

## LANDSCAPES

As is obvious from the small average size of various types of farm given in *Table 34*, the landscapes of intensive agriculture are small in scale. The major elements are indicated in *Figure 33*. At the scale of the small region, the landscape is not unlike that of rice areas, though the subdivision of fields is finer and the raised vegetable beds contrast markedly with the flat, bunded fields (see *Fig. 18*). At the farm level, the spatial pattern of landscape elements also varies, though the association of house-site and orchard on higher ground is almost invariable. Wherever possible, the pigsties or poultry sheds are located some distance from the dwelling, while the water supply must necessarily be located within the limits imposed by the drainage pattern and the groundwater table. An important feature of many farms, especially those raising animals in any number, is the fact that a fair proportion of the farm site is covered with buildings — pigsties, poultry sheds, storage and feed preparation space —, mostly of simple construction with a timber frame clad with corrugated iron and a floor of concrete or beaten earth. Since heating is not required and strong

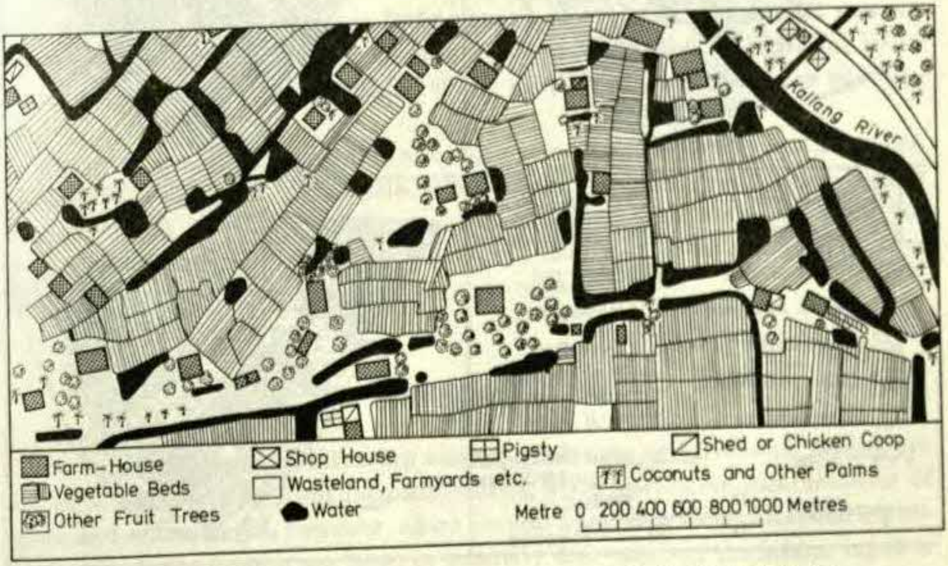


*Fig. 33.* The landscape of intensive vegetable and livestock farming

winds accompanied by rain are rare, the upper part of the wall may be left open for lighting and ventilation.

The plant assemblages to be found on intensive farms are quite varied. The orchard usually resembles that of the ubiquitous *kampung* cultivation containing fruit trees of many kinds – durian, rambutan, duku, jackfruit, star fruit (carambola), bananas and papaya –, all of which may be sold or consumed. Coconuts are also grown, but in rather less profusion than on Malay farms, since they do not enter into the diet to the same degree. All these perennials, with the exception of heliophytes such as papaya and coconut, are grown in mixed stands. In the vegetable gardens, however, each plot is planted with only one crop, though such is the speed of the rotation, from five to ten crops a year, that the same piece of ground may have in it at least five different crops during the course of a year. The spatial pattern of the farm thus consists of permanent elements – the buildings, ponds, drains and orchard – and temporary elements which are endlessly rotated. This is shown in *Figure 34*.

The range of short-term crop plants is very large, though leafy vegetables, especially Brassicas predominate. A partial list is given in *Table 38*. To these

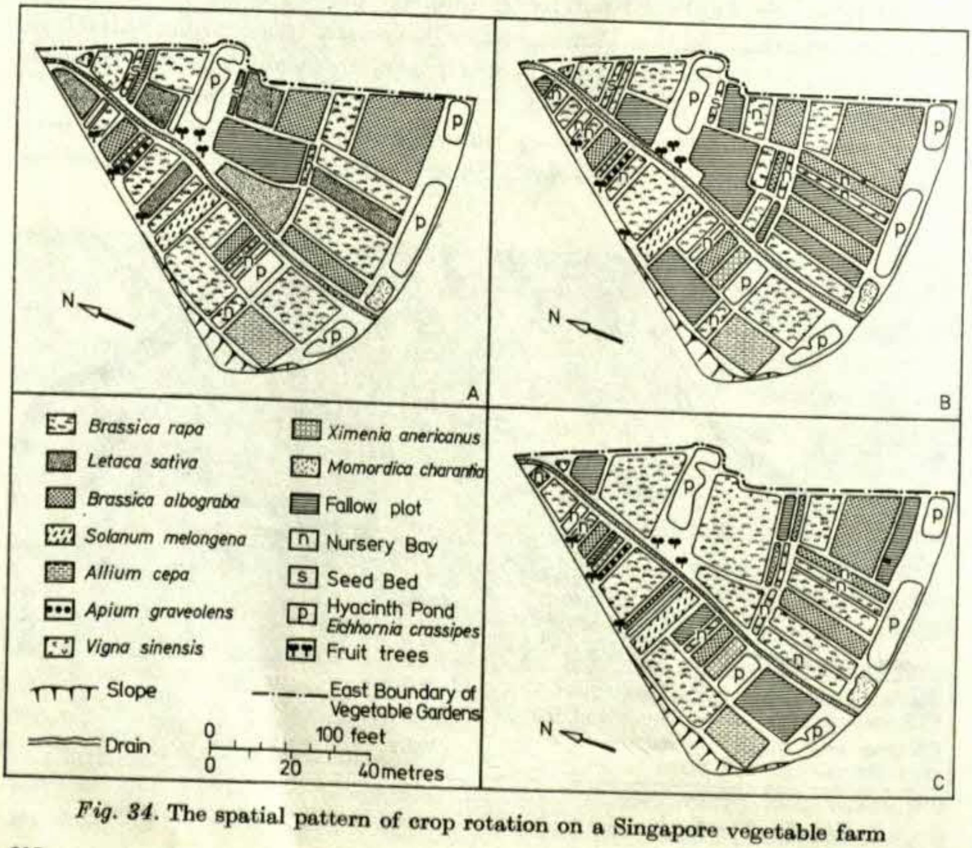


*Fig. 34.* The spatial pattern of crop rotation on a Singapore vegetable farm

*Table 38*

Some common short-term crop-plants on intensive farms

| Botanical name | English name | Remarks |
| --- | --- | --- |
| *Allium ascalonicum* | Shallot | Confined largely to drier areas |
| *A. cepa* | Onion | Marketed as "spring onion" |
| *A. sativum* | Garlic | Grown in drier areas |
| *Apium graveolens* | Chinese celery | A "green" variety |
| *Brassica albograba* | Chinese Kale | |
| *B. chinensis* | Chinese cabbage | Probably commonest leafy type |
| *B. oleracea* | Cabbage, cauliflower, brussels sprouts | A polymorphous species confined to cool uplands |
| *Capsicum annuum* | Chilli | |
| *C. frutescens* | Bird pepper | |
| *Coriandrum sativum* | Coriander | Young leaves as flavouring |
| *Cucumis sativus* | Cucumber | Eaten both cooked and as salad |
| *Ipomoea batatas* | Sweet potato | Probably commonest root type |
| *Latuca sativa* | Lettuce | Does not "head" |
| *Momordica charantia* | Bitter gourd | |
| *Nasturtium aquaticum* | Chinese cress | |
| *Saccharum officinarum* | Sugar-cane | Sold for juice or chewing |
| *Solanum melongena* | Eggplant | |
| *Vigna sinensis* | "Bean-sprout" | |

*Note:* Compiled from various sources.

may be added semi-permanent leafy aquatic plants such as *Ipomoea reptans*, the water Convolvulus, and *Eichhornia crassipes*, the water hyacinth, the latter being grown solely as pig-food, for which purpose banana stems are also employed.

Where land is not of high value and cultivation is consequently less intensive, the case in many parts of Malaysia, fallow under *Imperata* grass forms a further element which, though generally regarded as a pernicious weed, functions not only as a vegetative cover during fallow, but may also be cut to shade nursery beds. It is subsequently dug in to provide organic matter.

## AGROECOSYSTEMS

The agroecosystems of intensive market-gardening and livestock raising are complex and variable from farm depending upon particular combinations of crops and animals. All, however, share several basic characteristics; the inputs from outside the system are large in quantity and number; the labour input is high: the output is considerable; but despite these features, the system is energy-conserving. Moreover, the system involves environmental transformation to a much greater degree than any other system of agriculture in the region, day-length being possibly the only significant uncontrolled factor.

The atmospheric inputs are the same as for other systems, except that in cool highland areas, the input of solar energy is lower because of greater cloudiness, while temperatures are mainly in the range 18 – 25 °C. In such areas too, the input of salts of marine origin is probably very small, since they are located far from the sea, while rainfall may exceed the upper value given in *Figure 35*. Large though the water input from rain may be, in lowland areas water loss from leafy vegetables by transpiration is high and watering by hand or by pump is essential if milting and plant damage are to be avoided. BLAUT (1953, p. 43) has estimated that the additional water supplied is equivalent to an annual rainfall of 900 mm. The effectiveness of water application is enhanced in a number of ways. In nursery beds, shade is provided to reduce evapotranspiration and to lower near-ground and upper soil temperatures. Without such shade and water supply, bare soil temperatures at 2 mm depth would probably rise to around 50 °C during the afternoon heat-peak, and temperatures at 3 cm up to 40 °C (HILL 1979, p. 33). Timing of water application is also crucial to avoid wilting during the daily heat-peak.

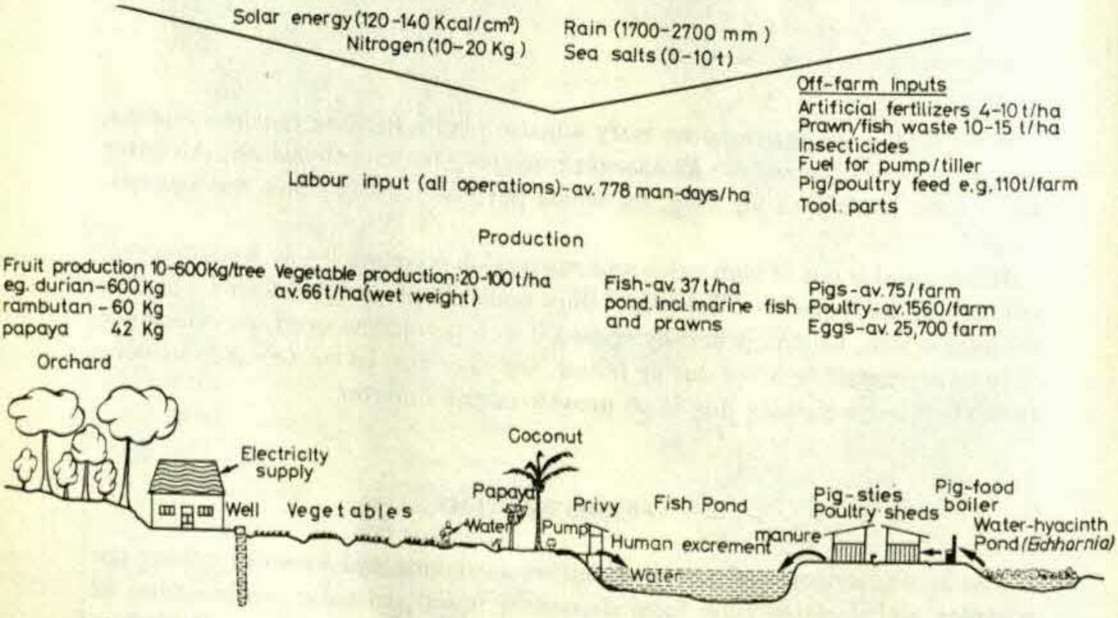


*Fig. 35.* Landscape elements and ecosystem of an intensive vegetable and livestock farm

Soil texture is modified by adding organic matter to light soils and by tillage and raised beds on clay soils, the object being to maintain good aeration and oxidizing conditions in the top 40—50 cm, while aiming for a good sandy clay loam texture.

A further input to soils is fertilizer, both organic, mainly prawn and fish refuse, and inorganics. BLAUT (1953, p. 45) has estimated an annual organic fertilizer input of about 100 tons per hectare for the Singapore farm studied by him, this being roughly equivalent to 11·8 t/ha of nitrogen, 8·6 t/ha of phosphorus and 1·6 t/ha of potassium. Since that time, the use of organic fertilizers has probably fallen as the popularity of artificials has risen. Further inputs to the soil are the roots of the vegetables and discarded leaves which may amount to 20—30 per cent over the weight of cleaned vegetables produced.

In pig and poultry rearing, the bulk of inputs are purchased from outside the farm. The items include broken rice, rolled oats, maize, bran and copra cake for pigs, while for poultry, dried lucerne, meat and fish meal, powdered milk or proprietory mixtures prepared by importers may be added to these. Again the quantities are considerable. Data from NG, TAN and WIKKRAMATILEKE (1966, p. 189 and 192) indicate a total of about 300 kg per pig annually. Since the conversion ratio of feed to meat is about three to one, this represents an annual growth increment of about 100 kg for every 300 kg fed to the animals. As with vegetables, there is a continual turnover. On a farm studied by NG *et al.* (1966 p. 191) in the beginning there were 239 pigs (including breeding stock) which by the and of a period of 3½ months had risen to 277, while 116 had been sold off the farm. Over the same period from an initial stock of 400 poultry, 366 were sold, leaving a final stock of 384.

Nutrient-cycling in the system is thus particularly rapid. It is also conservative in that wastes from the animals, if not used on the fields or applied to the orchard are employed to fertilize ponds which are used as a source of irrigation water or for growing water-hyacinth used as pig food. Fish, mainly species of carp, may be raised in the fresh-water ponds, both for sale and occasional home-consumption, while in estuarine areas ducks may be reared. Where ponds are brackish or salty they cannot, of course, be used for irrigation but marine fish and prawns are raised instead.

An essential feature of the whole system is the large input of labour, though in the last 15 years this has been increasingly supplemented by small engines especially in the arduous task of watering and also in tillage. Unfortunately, detailed data concerning the pattern of labour input are not available, though Y. K. WONG (1975, p. 37) indicated that in Singapore the bulk of farm work (67 per cent) is done by full-time labourers each working an average of 325 days a year. Since these comprise 42 per cent of the agricultural workforce, the remaining workers are part-timers, working on average, about 114 days a year. The average annual input of labour is 778 man-days per hectare. At the farm level, however, it is likely that available labour is determined by family size, though wage labour may be employed to some degree. Moreover, labour supply strongly influences the pattern of activities and, in some areas, actual farm size as well. The latter situation is more typical of Malaysia, where unused land was once generally available which squatters converted into market-gardeners (CLARKSON 1968, p. 94 ff.).

## SOCIO-ECONOMIC FRAMEWORK

The social aspects of intensive market-gardening and livestock rearing have been examined in some detail by DE KONINCK (1972) for Singapore and by CLARKSON (1968). The basic operational unit is the Chinese family, usually nuclear, but sometimes extended, and has been studied by NG *et al* (1966). To this extent the social framework has similarities with peasant and tribal agriculture, but the highly commercial nature of production and marketing set it off as distinctive. As is obvious from the high incidence of part-time workers, many families operate a dual economy, with some members obtaining income from off-farm employment. Thus DE KONINCK (1972, p. 252) reported that only 40 per cent of livestock-rearing households in Singapore depended entirely upon farming, though crop-growing and mixed farming households had a higher proportion of dependence.

One feature is that the farmers of a given area frequently form a distinctive dialect group. Thus in Sabah, Sarawak and many parts of Peninsular Malaysia, the farmers are Hakka. Even in Singapore, where more diversity exists, there is still a considerable degree of differentiation by dialect group both spatially and in terms of types of farming. DE KONINCK (1972, pp. 247–249), for instance, has shown that the Teochew are concentrated in the northeast of the island where they comprise the great majority of farmers and concentrate almost exclusively on livestock, while the Hokkien are the predominant group numerically and are the most scattered. Like the Teochew, they mostly concentrate on livestock rearing, but often combine this with crops. Hakka and Cantonese farmers are predominantly crop growers and they, too, are spatially concentrated, though in smaller areas.

Land tenure is highly variable from area to area. Until recently, many in Malaysia were illegal squatters, occupying mining land, forest reserves and land under vaguely-defined forms of indigenous ownership. As a result, cultivation in many places was often much less stable than now. With ample land, but inadequate capital and consequent inability to purchase fertilizers, farmers would roughly clear a plot of a hectare or so and grow up to three crops a year. As soil fertility dropped, the farmer would gradually concentrate his efforts and available fertilizer on a smaller and smaller area as his ability to purchase fertilizer rose with each successful crop. Eventually, the farm would consist of a small plot, perhaps 0·3 ha in size, surrounded by a larger area of formerly cultivated land that had reverted to scrub (CLARKSON 1968, p. 95).

However, this pioneering phase is now over in most areas, though it persists to some degree at Kundasang, Sabah, and farmers now have some security of tenure as owners or as tenants of private individuals or government. Though the question seems not to have received attention, it is unlikely that rents are a significant outgoing for most such cultivators and conditions are, therefore, conducive to stability.

Stability would also seem to characterize the pattern of holdings perhaps because most are already tiny (see *Table 35*). Nowhere has either functional or tenurial fragmentation been reported. However, in some places, most notably the urban fringe areas of Singapore, continued urban growth, compulsory acquisition of land by the government for public housing and subsequent resettlement with inadequate compensation in areas distant from the urban core have created some uncertainty. Resettlement has also taken place at the Cameron Highlands as a result of the construction of hydroelectric works. Because six or seven years are required to re-create the microenvironment of market-gardening, resettlement is a serious economic set-back to those displaced.

## PRODUCTION AND MARKETING

On many gardens in Malaysia, the first step in production is the clearance of land under scrub or grass fallow. The soil is then turned over to a depth of about 40 cm using a heavy hoe and allowed to rest. This process may be repeated several times and any roots are removed by hand. After a further hoeing, the soil is formed into raised beds about 0·7 m wide and up to about 10 m long. Lime, which acts as a fungicide and, by accelerating nitrification, indirectly as a fertilizer is then added together with a dressing of prawn dust, followed by a dressing of liquid pig or poultry manure. On more intensively worked farms, the first stage is hoeing and forming the beds, these being so oriented that their long axes lie exactly where the gap between the beds of the previous crop lay. The time interval between the previous harvest and the formation of new beds is rarely more than a day or two. Both nursery beds, which are used for many vegetable crops, and the main production beds are prepared in a similar manner, though nurseries are often shaded by palm leaves during the day.

From the nurseries, seedlings are transplanted into the main beds, the work usually taking place in the late afternoon. While the seedlings are young, water must be applied four times daily when the sun is hot and less so if it is not, but as maturity approaches, once daily applications suffice. As the crops grow, regular applications of liquid manure are made and weeding using a push-hoe or by hand is required. Daily or more frequent watering, either by hand buckets on a carrying-pole or by pump, is continued until harvest. The leafy crops take varying periods to mature, 38 days from seeding to harvest for *Brassica chinensis* and 60 days for *Latuca sativa*. The combination of crops chosen is influenced by seasonal variation in rainfall, variation in market demand and farmers' choice, those farmers who market their own produce tending to produce a wider variety. The period of Chinese New Year (usually February) sees a change in customer preference as well as increased demand, especially for lettuce, which, because of its longer maturity time and higher price than most other "greens", is grown in small quantities at other times of the year (see SIMPSON and LAU 1934; NG and others, 1966).

The production of pigs is very much like that under intensive conditions in other parts of the world. Near urban centres, waste food from restaurants, hotels, private homes and institutions is commonly used and an elaborate system of collection, usually involving an exceedingly battered lorry or motorcycle sidecar combination channels the swill to farms. Elsewhere, prepared feedstuffs including home-grown banana stems, chopped and cooked with water-hyacinth, are the basis of nutrition. The most important tasks are cleaning the sties and bathing the pigs, the latter being necessary in the warm, moist climate with its fast-breeding pathogens. A major recent advance in pig-rearing has been the adoption of European breeds, mainly the Large White, which has led to more rapid fattening and higher productivity.

Foreign breeds of poultry are also common, the main types being White Leghorn and Rhode Island Red, the latter often cross-bred with a local Canton type. Poultry-rearing is practically independent of locally-grown feedstuffs, the various mixes being formulated by local feed merchants using imported raw materials. As overseas, the "battery" form of production is usual.

The marketing chains are generally short. Gardeners near the small towns often market their produce themselves (or their wives do), selling direct to the consumer at stalls in the municipal market, or sometimes by hawking from door-to-door. Elsewhere, stall-holders may buy direct from farmers but more usually a wholesaler will purchase from farmers either at farm-gate or in the market, for distribution and sale to stallholders. The involvement of large organizations in local marketing is rare, though produce from the Cameron Highlands is handled by a few transport and marketing companies (privately owned) which has rendered producers vulnerable to economic pressure. Companies are involved in "international" trade, however.

The carriage of market-garden produce and pigs and poultry over long distances is by no means of recent origin and Peninsular Malaysia and Singapore function as a single marketing region with others operating in Sabah and Sarawak. Thus in 1973 Singapore produced around 56,000 tons of fresh vegetables, imported 138,000 tons from Peninsular Malaysia while exporting a further 41,000 tons to Malaysia (Singapore Primary Production Dept., 1974, Table 4).

## PROBLEMS AND PROSPECTS

For market gardeners on the fringes of large cities and, in effect, all market-gardeners in Singapore, the most serious long-term problem is competition for land. Much suburban development in Singapore and Malaysia has been at low densities such as might be found in most cities in the West and this has tended to push farmers further from the city cores. At the same time, given the present lack of refrigeration, customer demand for produce of the utmost freshness and present marketing arrangements, the setting up of specialized production areas at some distance from the consuming centres is not feasible. This is further emphasized by the use of the city as a source of feedstuffs and especially, as a source of employment for some household members.

To the pressure upon gardeners to move to the periphery may be added pressures to modify "traditional" practices. The use of human excrement is forbidden by law on hygienic grounds, though it continues to some degree. More serious is pressure to control the discharge of pig manure into the waterways of Singapore, many of which have been incorporated into catchment areas for public water supply as a result of the Singapore government's efforts to secure a supply independent of Peninsular Malaysia.

CHAPTER 11

# CONCLUSION

The range of agricultural types in Malaysia is extremely wide, from the simple forest cultivations without tillage of tribal peoples, to the sophisticated "factories in the field" of international capitalism. The existence of such a wide range in a region of quite uniform environmental characteristics reflects the differing degrees of penetration of outside elements, whether they be crops or cultures, and it is for this reason that considerable attention has been given to the historical evolution of agriculture. This process has not stopped and, with massive government intervention in the agricultural sphere, may even be accelerating. Notable is the beginning of the stabilization of shifting agriculture which began in parts of the Peninsula amongst the Iban and the Kadazan in Borneo up to 80 years ago. For some, such as the Kadazans of the Ranau and Tamparuli districts of Sabah, the shift was from full shifting cultivation complete with longhouse settlement to permanent wet rice with nucleated villages of individual huts or more recently separate dispersed dwellings. For others, like the Iban of Simmangang, the shift has been to pepper or rubber cultivation and the custom of building longhouses has survived (UHLIG 1969, p. 16 ff).

To lowland rice-growing has been added rubber-growing and, during the last 15 years, a second rice-crop. Some people have moved entirely away from rice-growing to become small-holders growing rubber or settlers on government land schemes concentrating on the oil palm. But the extent to which structural change has taken place is debateable. Certainly, Malaysia, with only two-thirds of its workforce in agriculture is unlike most other countries of Southeast Asia, where the proportion is nearer four-fifths. Still, a substantial proportion of those who are agriculturalists of one sort or another must be considered poor by Malaysian standards and some are poor by any standards. Amongst the relatively wealthy are those who work on estates, market-gardens or have moderately large perennial-crop small-holdings, especially those on land development schemes nearing full maturity, where income levels are undoubtedly comparable to those in manufacturing industry. Many of the rest lead simple, but moderately comfortable lives. Most possess a bicycle, some a motorcycle. Many, especially in the Peninsula, live in villages with basic services, a secure water supply, electric lighting, a clinic and a school. Many are content with these, though many are not but seek to move to cities where the prospect of upward social mobility, especially for those without a hectare or two of land, is undoubtedly greater. By the standards of Java, there is little real land hunger and people do not seriously suffer from either a lack of land or lack of access to land, except in the northeast of the Peninsula. Nevertheless population growth, though slowing down, continues at rates in excess of two per cent annually, exacerbating the problem of rural underemployment. Where urban centres lie within commuting distance, the answer for some is part-time farming combined with urban employment, but where this is lacking, the answer, if such it be, is more or less enforced idleness for extended periods accompanied by uncomfortable though not dire poverty.

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A New Zealander by birth, Dr R. D. Hill has lived in Asia since 1962 and now continues his studies of the agricultural geography of Southeast Asia from the Department of Geography and Geology, University of Hong Kong. His recent books include *Rice in Malaysia*, *South-East Asia — a Systematic Geograpyhy*, *Geography and the Environment in Southeast Asia* (with Jennifer M. Bray), and *Tropical Agriculture*. His numerous articles and reviews have been published in geographical and agricultural journals as well as those of Asian studies. He is also a Permanent Member of the International Geographical Union, Commission on Rural Development.

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