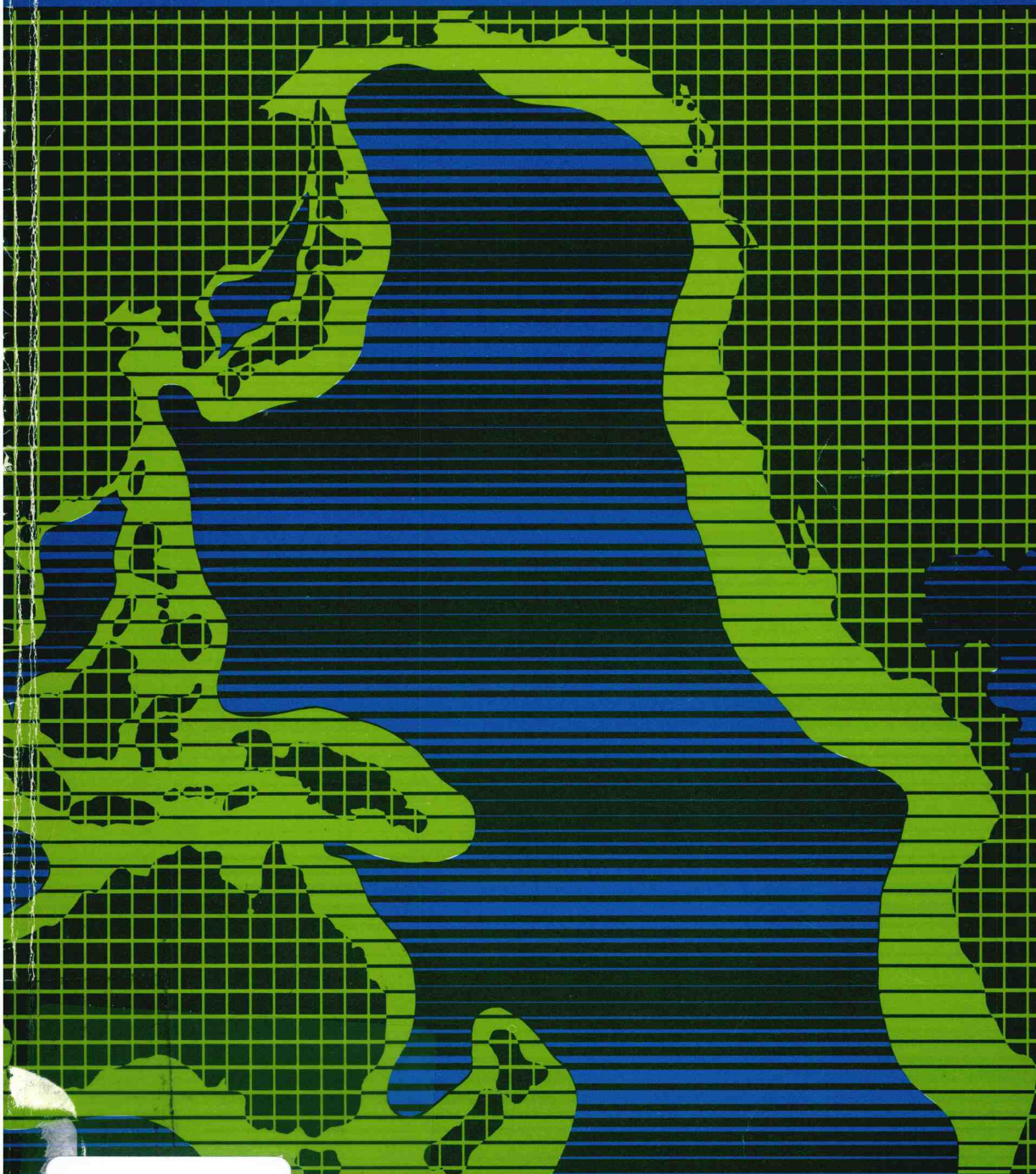


Renewable Resources in the Pacific

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Proceedings of the 12th Pacific Trade and Development
Conference, held in Vancouver, Canada, 7-11 September 1981

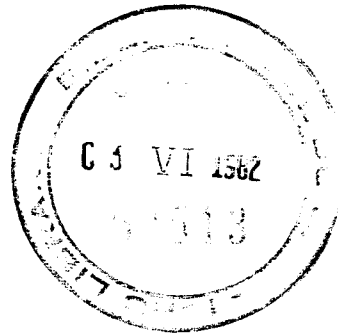


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Renewable Resources in the Pacific

**Proceedings of the 12th Pacific Trade and
Development Conference, held in Vancouver, Canada,
7-11 September 1981**

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Tree Crops in Malaysia

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This paper examines the experience of Malaysia in tree-crop cultivation before and after the formation of the Federation of Malaysia in 1963. It focuses on four major issues: the short-term export instability of tree crops; the long-term resource immobility of tree crops; the ecological and environmental impact of tree crops on the tropical rain forests; and the position of smallholders in tree-crop cultivation compared with that of the large estates. The analysis leads to four conclusions. First, tree-crop dominance in Malaysia has declined significantly in many respects except in percentage of agricultural land use and agricultural employment. Second, the long-term prospects of the major tree crops range from hopeful for oil palm and cocoa to bright for natural rubber. Third, tree crops are, relative to nontree crops, more profitable and less detrimental to the ecological balance in tropical rain-forest environments, although the competition between tree crops and forestry in land use may have reached a critical point. Fourth, the competitiveness of smallholders in tree crops, as significant new techniques in production and processing become available, will be reduced, and, therefore, they may require outside assistance, especially from the state.

Ce document expose les expériences d'agrosylviculture que la Malaisie a réalisées avant et après la constitution de la Fédération en 1963. Quatre points majeurs ont été traités : l'instabilité à court terme de l'exportation des récoltes forestières; à long terme, les ressources immobilisées dans ces plantations; l'impact écologique et environnemental de ces plantations sur les forêts tropicales humides; et l'étude comparée de la situation des petites et des grandes plantations. Cette analyse débouche sur quatre conclusions. Premièrement, l'importance de l'agrosylviculture en Malaisie a considérablement diminué à plusieurs égards, sauf en ce qui concerne le pourcentage des terres consacrées à l'agriculture et des emplois agricoles. Deuxièmement, les perspectives à long terme des quatre principales espèces d'arbres cultivés sont encourageantes pour le palmier à huile et le cacaoyer et remarquables pour l'arbre à caoutchouc. Troisièmement, les plantations forestières sont plus profitables et moins nuisibles à l'équilibre écologique des forêts tropicales humides que les autres cultures bien que la concurrence entre les deux semble avoir atteint un point critique. Quatrièmement, la compétitivité des petits agrosylviculteurs ne pouvant que souffrir de l'accès à de nouvelles techniques de traitement et de production, il leur faudra peut-être recourir à l'aide de l'État.

More than 77% of Malaysia is forested, and, of the 12% devoted to agriculture, about 80% is under tree crops — mainly rubber (52%), oil palm (19%), and coconut (8%) (Table 1). In Peninsular Malaysia, the total forested area (9.44 Mha) includes 4.66 Mha of virgin forest. Of the total forested areas (6.16 Mha and 9.72 Mha) in Sabah and Sarawak, virgin forest accounts for 4.66 Mha and 8.51 Mha respectively (Malaysia 1976). Recent trends in land development show that the proportion under tree crops is likely to rise as increasing numbers of farms incorporate tree

crops such as oil palm and cocoa, especially in Sabah and Sarawak.

Most of the tree crops are grown for the export market — less than 5% of raw natural rubber and less than 4% of palm oil were for domestic consumption in 1964–73 (Khera 1976).

As tree crops are notoriously price inelastic in supply as well as in demand, violent price fluctuations have often occurred, resulting in corresponding fluctuations in export earnings. Thus, extreme dependence on tree-crop export is clearly dangerous — a fact that was pointed out

Table 1. Agricultural land (Mha) use in Malaysia, 1976.

Land	Peninsular Malaysia	Sabah	Sarawak
Agriculture	3.14	0.38 ^a	0.35 ^b
Rubber	1.70	0.11	0.20
Oil palm	0.64	0.07	0.02
Coconut	0.24	0.05	0.04
Cocoa	0.02	0.01	—
Rice	0.36	0.05	0.04
Others	0.18	0.09 ^c	0.05 ^d
Suitable for agriculture	6.32	2.15	5.31

^aArea alienated for agriculture in 1975.

^bThis value would be 3.2 Mha if the area under shifting cultivation were included.

^cThis figure was estimated as residual.

^dThis value would be 2.9 Mha if area under shifting cultivation were included.

early in the 1960s by Clifton Wharton (1963a, b) for Southeast Asian countries in general and for Malaya (present day Peninsular Malaysia) in particular.

In 1960, rubber occupied 68% of total planted area, provided about 50% of employment in agriculture, and accounted for 63% of total Malayan export value and 18% of federal government revenue, as well as generating 26% of gross domestic product (GDP). This high degree of dependence on rubber posed two dangers: short-term economic instability transmitted from export instability and long-term resource immobility, which was especially ominous because of the emergent threat from synthetic rubber.

Many theoretical and empirical studies on the links between export instability and economic development have since been generated. The issues are obviously interesting and relevant to many developing countries.

Cultivation

Several features in tree-crop cultivation could give rise to problems. First is the long period (3–8 years) before most tree crops in Malaysia begin to produce (Wickizer 1951; Seftleben 1978). The loss on the investment during this period can be offset at times if the seedlings are intercropped with some short-term cash crops.

The long period of negative returns increases the cost of production and makes financing a problem, especially for smallholders. The Malaysian government has recognized this financial constraint, providing grants, initially for replanting but subsequently also for new planting of tree

crops. The amount was originally fixed at M\$988/ha to be paid over a 5-year period for rubber. The grant was calculated to help defray the costs incurred in felling and destruction (usually by burning) of old tree trunks, and for planting material, fertilizers, and other services. The grant has been increased several times and is M\$3705/ha for holdings equal to or less than 4.1 ha.

The second prominent feature is the long economic life of tree crops. It depends on such factors as rate of exploitation, level of upkeep, discount rate, and variety of species. A serious problem in this respect is that research on tree crops takes a long time, and the results may not be applied for many years. For example, in experimental work on breeding and selection of high-yielding planting material for rubber (*Hevea brasiliensis*), at least 25 years are needed from pollination to recommendation for large-scale planting. An additional period would usually be required to test for other desirable plant characteristics. For example, the clone RRIM 501 was originally bred in 1929 and was recommended for large-scale planting in 1947 but was withdrawn in 1959 because of high susceptibility to wind damage (Barlow 1978). Equally, a long time is needed for new planting materials to be widely disseminated. At an economic life of 33 years, a stand of rubber trees evenly spaced in age would be replaced at the rate of 3% a year. Thus it would take 33 years for the whole stand to be replanted unless the period of modernization is shortened, which would raise costs substantially.

The third important feature of tree crops is the short-term, and possibly also long-term, price inelasticity of supply. In the short term, this is expected for four reasons. First, productive capacity, as represented by the existing stand of mature trees, cannot be changed. Second, other inputs, especially labour, are difficult to vary either because of contractual arrangements or because of the absence of alternative employment opportunities. Third, there are physical or botanical limits to plant exploitation. Fourth, the effective variable cost is only a small proportion of the total cost of production. Some of these factors are more likely to be operative under estate conditions than under smallholding production so that estates are expected to be less price responsive. In the long term, price elasticity may still be low because it is costly to replace an existing stand with other crops or to expand productive capacity rapidly unless undeveloped land is easily available. Empirical studies tend to support these expectations (Askari and Cummings 1976).

Recent Developments

When Malaya gained political independence from the British in 1957, rural development was given high priority. The main objectives were to provide rural opportunities, to raise per-person output, protect living standards against the adverse effects of a possible decline in rubber prices, and to diversify the agricultural products from rubber. The three principal programs were replanting overaged rubber trees, improving drainage and irrigation to facilitate double-cropping of rice, and developing new land to create new employment and to relieve the pressure on existing agricultural land.

In the First Malaya Plan, rubber replanting was accorded the top priority followed by drainage and irrigation. In later plans, however, land development became progressively more dominant (Table 2) for several reasons. Rubber replanting is obviously limited by the age structure of the existing rubber area. Equally, the number of projects on drainage and irrigation is limited. In Peninsular Malaysia, few areas are suitable for this purpose, and, in Sabah and Sarawak, the constraint is low-population density and, hence, the low economic feasibility of irrigated rice cultivation.

Land development is the logical solution in Malaysia where substantial areas are still undeveloped. In Peninsular Malaysia, of the total 13.15 Mha, 48% (6.32 Mha) is suitable for agriculture; 60% (3.81 Mha) has been alienated. In Sabah and Sarawak, where the total land areas are 7.19 Mha and 12.45 Mha respectively, 30% (2.15 Mha) and 43% (5.31 Mha) are suitable for agriculture, 18% (0.38 Mha) and 51% (2.72 Mha) already having been alienated. Agricultural development can be used effectively to redress rural poverty, increase

agricultural production, and create rural employment for unskilled labour. Equally, it can provide the opportunity to modernize traditional communities and agricultural practices.

The desire for social transformation, especially the development of modern farm practices, is probably one of the reasons that land development in postindependence Malaysia has been in the form of publicly controlled land-development schemes. In this respect, it represents a dramatic departure from the pre-War colonial practice of leaving land development strictly to the private sector (Wan 1976).

The pace of development is reminiscent of the early days of rubber planting in Malaya. Between 1906 and 1930, the area planted to rubber increased by almost 1.0 Mha to about 1.3 Mha. Total land development in Malaysia between 1961 and 1980 amounted to 1.3 Mha, of which 0.5 Mha was developed by the Federal Land Development Authority (FELDA). The target for FELDA in 1981-85 is 0.15 Mha, whereas the total for the country is 0.54 Mha. The total public expenditure on land development between 1956 and 1980 amounted to M\$4343.3 million or 18% of the total public economic development expenditure, and another 16% has been allocated to land development under the current Fourth Malaysia Plan. Besides FELDA, many other state and federal land development agencies are involved; however, FELDA is clearly the major agency.

Tree crops, especially oil palm and rubber, are strongly preferred in land development projects. Thus, by the end of 1977, FELDA had allocated almost 93% of the 0.4 Mha it developed to oil palm (60.5%), rubber (31.7%), cocoa (0.5%), and coffee (0.2%). Data are not readily available on the choice of crops under the other schemes, but tree crops probably represent 75-80% of the expenditure.

Another important aspect of land-use development has been the massive effort at rubber replanting begun in 1952 and still being vigorously pursued. A total of M\$797 million was spent between 1956 and 1980 to assist mainly the smallholding rubber sector to replant old rubber stands either with high-yield rubber or with one of the approved crops — coconut, oil palm, coffee, cocoa, citrus fruits, and sago, as well as other nontree crops.

By 1975, about 94% of crops selected were also tree crops: rubber (85.4%), coconut (2.4%), oil palm (5.4%), and coffee (0.5%). Thus, when it was possible to replace existing tree crops, the choice made was predominantly another tree crop or the same tree crop (generally rubber).

Table 2. Public-development expenditure allocation, Malaysia, 1956-80.^a

	1956-60	1966-70	1976-80
Total economic expenditure (M\$ million)	759.9	2685.4	13570.8
Agriculture and rural development (M\$ million)	227.5	1114.1	4672.4
Rubber replanting (%)	67	15	4
Drainage and irrigation (%)	17	31	19
Land development (%)	7	33	59

^aExpenditures for 1956-80 are estimated expenditures implemented under plan.

Sources: Various development plans of Malaya and Malaysia.

Table 3. Main crop areas (Mha) in Peninsular Malaysia, 1950-76.^a

Crops	1950	1960	1965	1976
Rubber	1.42 (67.0)	1.58 (65.9)	1.75 (66.3)	1.70 (54.2)
Oil palm	0.04 (1.8)	0.04 (1.9)	0.10 (3.7)	0.64 (20.3)
Coconut	0.20 (9.3)	0.21 (8.8)	0.21 (8.1)	0.24 (7.5)
Rice	0.31 (14.8)	0.38 (15.7)	0.38 (14.6)	0.36 (11.4)
Miscellaneous	0.15 (7.1)	0.18 (7.7)	0.19 (7.3)	0.20 (6.5)

^aFigures in parentheses are percent of total agricultural land.

Source: Selvadurai (1979) and government statistics published in Area of Miscellaneous Crops, 1978 and the Statistical Digest, 1976.

In other words, the commitment to tree crops in Malaysia has actually increased. Between 1960 and 1976, the share in total planted area of just three tree crops (rubber, oil palm, and coconut) increased from 77% to 82% in Peninsular Malaysia (Table 3). The actual share today is probably higher, as cocoa is beginning to find popularity throughout Malaysia, especially as an intercrop with coconut. Trends in Sabah and Sarawak have been similar (Table 4).

If, for Peninsular Malaysia, all potential agricultural land were planted according to the soil-capability classification scheme, perennial tree crops would occupy about 79% of all agricultural land compared with the 77% in 1970. However, land devoted to agriculture would constitute almost 49% of total land area compared with about 22% in 1970 (Selvadurai 1979: 10-11).

Export Instability and Economic Development

Export instability will affect economic development adversely if an economy depends heavily on the export commodities in such important aspects as employment, export earnings, contribution to GDP, and government revenue. Rubber was vitally important in Malaya in these respects in the early 1960s. Today, the position of rubber in these respects is not as critical. For example, the planted area of rubber has dropped from 68% to 52% but that of tree crops has probably increased throughout Malaysia due to the expansion of oil-palm cultivation.

About half the population of Peninsular Malaysia is employed in agriculture, and that statistic has remained fairly constant. However, the share of the labour force involved in production of rubber has fallen consistently from 1962 to 1976, whereas it has been an insignificant item in Sabah and Sarawak.

The most important change is in the share of tree crops in total export earnings in Peninsular Malaysia from a high of 63% for rubber alone to only 31% for both rubber and oil palm in 1976-80. The shares of oil palm and rubber in GDP and federal-government revenue have also dropped, and for all Malaysia the shares would be even smaller because rubber and oil palm are much less important in the economy of Sabah and Sarawak.

Thus, over two decades, the Malaysian economy has become much less dependent on tree crops in some important aspects. It has achieved a substantial degree of diversification both within the agricultural sector (away from rubber) and sectorally (toward manufacturing, commerce, and services as well as toward the exploitation of other natural resources such as forest products and petroleum).

These various trends toward a more diversified economy are basically healthy. Some are responses to changing marginal comparative advantage; for example, the estate sector responded to the challenge of synthetic rubber by replacing old rubber areas with oil palm when the latter was more suitable and profitable. Although total estate area remained almost constant, the

Table 4. Main crop areas (Mha) in Sabah and Sarawak, 1965-76.

Crop	1965		1970		1976	
	Sabah	Sarawak	Sabah	Sarawak	Sabah	Sarawak
Rubber	0.10	0.17	0.11	0.19	0.11	0.19
Oil palm	0.01	-	0.04	<0.01	0.07	0.02
Coconut	0.04	0.03	0.06	0.04	0.05	-
Padi	0.04	0.11	0.04	0.13	0.05	0.13

Sources: Various issues of the annual bulletins of statistics for Sabah and for Sarawak.

share of rubber dropped from 87% to 66% and that of oil palm increased from 8% to almost 31%. Equally, oil palm constituted about 61% compared with 32% for rubber in FELDA schemes up to 1977.

The increasing importance of the manufacturing sector is another example of the economy's responding to market forces. This can be seen in the increasing share in exports of manufactured products, which rose from an insignificant amount to about 15% of total exports between 1971 and 1975 and to 21% in 1980. In fact, it was second only to petroleum (25%) in 1980. Thus, the desirable degree of diversification has come about without sacrifice of economic gain or efficiency.

On this basis, the Malaysian economy has apparently overcome export instability, at least in the form of overdependence on rubber and tin. Export instability will continue to be a threat, however, not because of overdependence on a few export commodities but because the Malaysian economy is still, like that of most developing countries, highly susceptible to changes in the developed countries. The increased economic interdependence of the world and the emergent synchronization of business cycles pose serious problems to small open economies such as Malaysia, almost regardless of what they do. This becomes increasingly clear when the developed countries seem unable to control inflation and unemployment. However, in the absence of severe worldwide depression, the Malaysian economy will be increasingly less concerned with the problem of general export instability, much less to export instability from export proceeds of tree crops.

Although export instability adversely affected economic development in Malaysia, policy options that reduce the share of exports based on tree crops are likely to generate much lower, though possibly more stable, average return to investment in agriculture. In any case, the Malaysian economy seems to have experienced several episodes of severe export instability without apparent ill effects on overall economic development. The comprehensive study by Ariff (1972) found that built-in mechanisms in the economy helped to insulate it against the worst effects of export instability. Such built-in mechanisms are still in place and should cushion the impact of future export instability.

Resource Immobility

A more fundamental issue than export instability of tree crops is the potential danger of

resource immobility associated with tree crops. Diversification becomes urgent when the long-term prospects of tree crops are clouded and uncertain, as were those of natural rubber from the late 1950s.

The issue of diversification in Malaya has been raised on several occasions such as during the Great Depression and immediately after World War II. In both instances, the solution adopted was to encourage the largely subsistent Malay peasantry to be self-sufficient in rice while the government maintained a stockpile of rice equivalent to a 4-month supply for the so-called "ration population" (i.e., population minus the self-sufficient padi planters).

Even up to the early 1950s, many remained persuaded that natural rubber was still the crop for Malaya. They were supported in their belief by the rubber boom brought on by the Korean War and by the expectation that once the synthetic rubber plants set up by the U.S. government during the War were transferred to private hands, and hence ceased to receive government subsidy, the competitive strength of natural rubber would be evident. As it turned out, the synthetic industry under private enterprise after 1956 continued to make rapid progress and came up with several improved special types, some with technical superiority to natural rubber (Allen 1972). Only then did diversification become a serious issue.

The answer to the question of what crops should replace rubber is, however, not evident. For one thing, it is not clear that natural rubber has completely lost its comparative advantage in Peninsular Malaysia because of the substantial cost reduction through replanting with superior high-yield varieties that began to appear from the research effort of the Rubber Research Institute of Malaya. The increase in yield per unit of tapped area can be estimated from the ratio of average yield of high-yielding rubber to that of unselected rubber in the estate sector. The ratio increased from about 2.2:1 in 1953 to 3.6:1 in 1976. The ratio continues to increase as higher yielding lines are made available to producers.

The increase of output with little additional increase in cost through the use of these high-yield varieties keeps natural rubber cost-competitive against what Allen (1972) called the large-tonnage synthetic rubbers such as Styrene/butadiene copolymer (SBR) and polybutadiene rubber (BR). Synthetics managed to encroach on the share of natural rubber in world consumption, nonetheless, because the demand for all rubbers has increased much faster than natural

rubber producers have been able to expand their output. Thus, synthetics, which require 2–3 years to expand capacity compared with the 6–7 years for natural rubber, were able to fill the gap and thus increased their share of the world market. For example, the average rate of growth between 1951–76 for natural rubber was 3% compared with 13% for the synthetics (Chan 1978).

Second, the alternatives to rubber in Peninsular Malaysia were not easy to identify in the late 1950s or even now. The other tree crops were not doing well in international markets and might not suit the conditions in Peninsular Malaysia. The nontree crops seemed to be even less likely candidates because of marketing problems and considerations of suitability to soil and climate.

Even the experts invited to examine the problem of diversification agreed that the intention of the Malayan government to press ahead with rubber replanting with high-yield material was generally wise. For example, the Ford Foundation Survey Team (1963:43) recommended:

Continue but modify the rubber replanting scheme. The diversification team is convinced that the government's rubber replanting scheme is a wise one. The only safe economic strategy to meet the challenge of synthetic rubber is to increase efficiency and thereby reduce unit cost in the production of natural rubber.

Elsewhere, the team also observed:

... with the high rainfall, tropical climate, and rolling terrain of much of Malaya, potential crops for diversification have for the most part been perennial crops. Although perennial crops take time to become established and have high initial costs, they in effect replace the original jungle with alternative tree crops and thus continue to retard erosion, protect the notoriously volatile humus content of tropical soils and shade out weeds and bush.

Evidence of the continuing competitiveness of natural rubber is that all natural rubber produced has been taken up and usually sold at a substantial price premium over comparable synthetic rubber for most of the post-War years. For example, the price ratio of RSS3 (rubber smoked-sheet grade 3) to its comparable substitute (SBR) has been greater than one in most years since 1950.

Furthermore, many significant advances in natural rubber production and presentation have yet to be widely spread, especially to the small-holding producers and to producers outside Peninsular Malaysia. On the global level, small-holding rubber accounts for some 63% of total

world natural rubber and about 75% of all planted rubber area. Thus a huge technological gap waits to be filled. This is true even in Peninsular Malaysia where, in spite of huge government efforts and assistance, only 63% of planted area was high-yielding material in 1971 compared with 92% for the estates (Chan 1978).

More recently, the competitiveness of natural rubber compared with the synthetics received a most important boost when crude oil prices quadrupled in 1973 and continued to rise. In addition, a recent World Bank study came up with some findings that are "sweet music" to rubber producers. In examining the effect of the oil crisis on the competitive relation between natural and synthetic rubbers, the study concluded: "... the relative market position of natural rubber (NR) has improved substantially in the short term, but has improved even more in the longer term" (Grilli et al. 1980:55).

In the short term, even allowing for the appreciation of the Malaysian currency against the U.S. dollar by more than 25% between 1971 and 1974, Grilli et al. (1980) found "... the operating costs on estates and smallholdings apparently increased by about 65% between 1971 and 1974" compared with a 70–80% increase in the average direct cost of producing SBR-1500 over the same period. Thus the market share of natural rubber increased in the world market (excluding the centrally planned economies).

In the longer term in which changes in existing facilities are allowed, the analysis, based on the estimation of "full supply price" of natural rubber and SBR-1500, indicates that, at a real rate of return of 10%, investing in SBR-1500 would only be feasible if future expected real prices were at least U.S.\$0.88/kg (\$0.44/lb.). In contrast, "... investment in NR in Malaysia, at the same real rate of return of 10 percent, would ... have been possible in 1977 if a future real price of U.S.\$0.79/kg (\$0.36/lb.) (cif) in Europe had been expected" (Grilli et al. 1980:73).

The authors of the report went on to point out that this conclusion probably understates the competitive position of natural rubber because some assumptions used in the calculation tended to overstate the supply price of natural rubber and to understate that of SBR-1500. Furthermore, with each increase in the real price of petroleum, the competitive position of natural rubber is further enhanced.

Although the future prospects for natural rubber thus seem much less uncertain than they were in 1973, prospects for other tree crops in

Malaysia are harder to predict. For oil palm, Malaysia may have a strong competitive advantage over other oil-palm producers because production is predominantly organized in large-scale plantations that encourage central processing of the output and are in a good position to innovate and improve productivity. Thus, between 1952 and 1972, output per employee increased from about 3 t to 13 t, whereas the average area increased from about 3 ha to 7.5 ha (Khera 1976). Furthermore, most reported studies on the relative profitability of oil palm placed oil-palm cultivation above rubber and certainly over padi (Ng 1971; Wafa 1972; Khera 1976).

The main advantage of cocoa in Malaysia seems to be that it is ideal for intercropping with other crops such as coconut. Some evidence for this comes from the areas reported under "sole," "main," and "mixed" cropping of cocoa between 1958 and 1966. The area under "sole" crop stagnated at about 510 ha, the area under "main" crop dropped from 11 ha to insignificance, but the area under "mixed" crop increased from 106 ha to 627 ha. Thus, cocoa may have a place in Malaysia's future.

Tree Crops and the Humid Tropics

The land capability classification scheme prepared during the First Malaysia Plan specifically gives priority of land use to mining over agriculture and to agriculture over forestry. This order is justified on the basis of higher value-added by each use (Lee and Panton 1971). The use of value-added as the basis is, however, not an absolute recommendation because development decisions on the land use for a specific area presumably are taken only after careful evaluation of the economic, social, and ecological factors (Arshad 1979). The use of this basis in the case of mining versus other uses is not likely to lead to any serious consequences because the total area likely to be involved is only about 0.6% of total land. Past mining land has also been steadily reabsorbed by urban zones for housing, industrial, and recreational purposes or for market gardening, livestock farming, and fish farming (Lee and Panton 1971).

The application of the same principle to allocations of land to agriculture and forestry is more doubtful especially in Peninsular Malaysia where the past rate of land development is beginning to reduce the supply of land suitable for agriculture. There is now the fear that the forest is disappearing too fast and that rapid land development has led to wasteful use of forest resources. As revenue

from forestry is an important source for the state governments and land is a state matter under the federal constitution, excessive conversion of forestry to agricultural use is clearly a danger. According to the estimate of the Environment Assistance Mission, provided by the IBRD at the request of Malaysia in December 1974, the nation's lowland forest area would be consumed in the next 30 years at the current rate of forest conversion (IBRD 1975).

The issue of the proper and balanced use of the nation's land and forest resources was considered explicitly under the Third Malaysia Plan, which has just ended. At the urging of the IBRD mission, a National Environmental Policy has been developed and was incorporated into the Third Malaysia Plan. Among other things, that policy accounts for "... the critical importance of maintaining the quality of the environment relative to the needs of the population, particularly in regard to the productive capacity of the country's land resources in agriculture, forestry, fisheries and water" (Malaysia 1976:219).

Such a broad vision of land use in Malaysia is clearly needed as a replacement for both the federal development-oriented view and the state revenue-oriented view. It is to be hoped that it has not come too late for the forest resources of Peninsular Malaysia.

On the issue of the relative compatibility of tree and nontree crops to the humid tropical climate of Malaysia, I focus on Peninsular Malaysia, although the remarks are often relevant to Sabah and Sarawak.

The climate of Peninsular Malaysia results from the state's being in an equatorial region, but it is modified by the effects of the northeast and southwest monsoons. Annual rainfall is high (203–305 cm), as are humidity (85%) and temperature (26–28°C). Lying between 1° and 7°N with no point more than 170 km from the sea, and three quarters of the area below 304 m, the state never experiences excessively high temperatures, and the heavy cloud cover reduces the average sunshine to fewer than 7 hours/day. The maximal difference between the longest and the shortest day is only 37 minutes. The absence of seasonal variation in temperature is so marked that the daily temperature range is greater than the annual range. The main climatic difference results from seasonal rainfall distribution, with the northeast monsoons bringing rain to the eastern and northeastern coastal area and the weaker southwest monsoons bringing less rain to the western and southwestern plains (Ooi 1959, 1976; IBRD 1955).

The high annual temperature and precipitation have great significance in the problem of maintaining the fertility of the soil, for the choice of crops, and the technique of cultivation, as was noted by the Ford Foundation Survey Team (1980).

The high frequency of precipitation in the form of thunderstorms encourages rapid runoff and soil erosion of inadequately covered land. Heavy downpours within a short period increase the force of the impact on the ground, and the volume of accumulated water exceeds the absorptive capacity of the soil. The maximum absorptive rate of an average open soil in Peninsular Malaysia has been calculated to be 7.5 cm of water per hour. However, slightly more than 25% of showers in Kuala Lumpur were of a higher intensity — hence, the erosive force of tropical downpours (Ooi 1959).

An example of the serious consequence of the failure to account for this was reported by Bauer (1948) concerning the practice of clean weeding that European-owned rubber estates in Malaya used until 1930: the practice not only was expensive but also led to soil erosion and the loss of soil fertility. Because the high annual temperature works in conjunction with the high annual precipitation, leaching of uncovered soil, giving rise to low soil productivity, is greatly enhanced. The combination greatly speeds chemical reactions and weathering processes in the soils throughout the year. The high precipitation, in excess of the soil absorptive rate, leads to a continuous leaching from the surface of the soil downward. Organic matter and plant nutrients are washed out and are not replaced by compensating upward capillary action.

The high temperature has another significance. The higher the temperature, the more difficult it is for nitrogen to accumulate (Ooi 1959). In the natural equatorial forest, this destructive process of the climate is retarded by the heavy canopy of leaves that reduces the ground temperature to a level at which humus formation exceeds or keeps pace with the rate of destruction. It also counterbalances the rapid rotting of leaves, twigs, flowers, branches, and so on that fall on the ground and are quickly reabsorbed by the living plants. "A closed cycle is thus set up, in which the plant food is circulated from the top soil, taken up by the vegetation and then returned to the soil again to start the process anew" (Ooi 1959: 80). Because of the rapid turnover of the nutrient "capital," the tropical forests appear lush and luxuriant, and the appearance often gives rise to a false notion of the fertility of tropical soils.

The precarious equilibrium is maintained as long as the soil temperature is no higher than 25°C. Soil temperature under tropical forest fluctuates slightly because of the heavy shade and the high humidity of the air. However, if the heavy shade is removed, the equilibrium is upset and the cycle is broken. The tropical sun then raises the soil temperature, causing the rate of humus formation to slow and the rate of breakdown to accelerate. At the same time, "reinvestment" of the nutrient "capital" in the form of vegetative wastes is removed. The removal of the natural cover also facilitates the weathering process of the heavy downpours. Unless heavy applications of fertilizer are used, the result is the conversion of an arable land into one infested with obnoxious weeds and bushes.

Thus, tree crops clearly have several clear advantages over nontree crops because the tree crops better simulate the natural forest. In some situations, the higher value of some annual crops, such as vegetables cultivated close to urban centres, may be sufficient to pay for the fertilizers needed to maintain soil fertility. In general, nontree crops stand at a disadvantage relative to tree crops in terms of both protecting or preserving land quality and soil fertility and return to investment.

Smallholders

The stake of the smallholders in Malaysia varies widely among the three major tree crops (Table 5). Smallholders are distinguished from the estate sector in which holdings are more than 40 ha. Coconut is practically all on smallholdings, whereas oil palm is practically all on estates. Only in rubber is the distribution more balanced between estates and traditional smallholdings.

For rubber smallholders, the Rubber Industries Smallholder Development Authority (RISDA) schemes of replanting and the Federal Land Consolidation and Rehabilitation Authority (FELCRA) account for 65% of production. The FELCRA area consists mainly of rubber schemes that had originally been developed by state fringe alienation schemes and failed but were within commuting distance of existing settlements and were subsequently redeveloped under FELCRA.

The relative performance of the estates and smallholdings can be compared with some indicators. Between 1957 and 1971, the share of smallholdings (plus FELDA) devoted to rubber increased from 46% to 63%. In 1971, the average size of a farm under smallholding was 2.6 ha

Table 5. Distribution (%) of area in selected tree crops by type of organization, Malaysia, 1976.

	Peninsular Malaysia	Sabah	Sarawak	Malaysia
Rubber				
Estates	32	16	4 ^a	29
FELDA	7	—	—	6
Others	61	84	96	65
Total area ^b	1.70	0.11	0.19	2.00
Oil palm				
Estates	59	49	27	58
FELDA	34	51 ^c	69 ^a	36
Others	7	—	4	6
Total area ^b	0.64	0.07	0.02	0.72
Coconut				
Estates	7	6	—	6
FELDA	—	5 ^c	—	1
Others	93	89	100	93
Total area ^b	0.24	0.05	0.04	0.33

^aIncludes area under land-settlement schemes.^bAreas in Mha.^cMainly under Sabah land-development schemes.

Sources: Government statistics from Rubber Statistics Handbook, 1976; Oil Palm, Coconut, and Tea Statistics, 1976; and annual bulletins of statistics for Sabah and for Sarawak.

compared with 313.7 ha for estates. Between 1957 and 1971, the area under high-yield planting material increased from 15% to 63% for smallholdings compared with 48% rising to 92% for estates. The percentage of area replanted or newly planted was only 15% in 1957 for smallholdings compared with 33% for estates; this figure improved to 63% and 83% respectively. Smallholders were responsible for 42% of total production in 1957 and 48% in 1971. The yield of mature plantations was 456 kg/ha in 1957 on smallholdings compared with 578 kg/ha on estates, and these yields increased to 702 kg and 1239 kg, respectively.

The two sectors differ significantly (Table 6), even though the differences decreased consider-

ably from 1957 to 1971. Along with differences in area planted, the smallholdings have higher proportions of overaged trees and larger areas that are replanted with unimproved material than do the estates. They also use fewer modern techniques and produce lower grades of rubber than do the estates. A great deal of improvement in the smallholding sector came as a result of the vigorous state and federal schemes to encourage planting with high-yield material. In the smallholdings, the average rates of expansion (newly planted areas) were 0.5% between 1937 and 1952 and 1.2% from 1953 to 1972 and those of replacement (replanted areas) were 0.3% and 2.5% respectively. The corresponding figures for estates were 0.9% and 0.4% for expansion and

Table 6. Some aspects of smallholding and estate rubber-holding, Peninsular Malaysia, 1957 and 1971.

	Smallholding		Estate	
	1957	1971	1957	1971
Total planted rubber (1000 ha)	692.3	1086.9	818	631.8
Percentage of total area	46	63	64	37
Average size of farm (ha)	—	2.6	341.4	313.7
Percentage planted with high-yield material	15	63	48	92
Percentage replanted or newly planted since 1946	15	63	33	83
Average yield for mature area (kg/ha)	456	702	578	1239

Source: Department of Statistics, Malaysia, Rubber Statistics Handbook, Kuala Lumpur, Malaysia, various issues.

2.0% and 2.3% for replacement (Chan 1978). The government schemes for planting contributed substantially to the improvement and modernization of the smallholdings, being responsible for almost 100% of the replanted areas and 67% of the newly planted areas (Chan 1978).

Given the important and wide disparities between smallholdings and estates, it is relevant to examine the relative efficiency of the smallholders.

Historically, that is before World War II, it is probably true, as Bauer (1948) maintained, that the smallholders could compete successfully against the estates. Three factors seem to have worked in the smallholders' favour: the negligible cost of establishing a smallholding of rubber; the practical absence of technological breakthroughs in production in the rubber industry; and the lack of an effective substitute for natural rubber. However, with the release of high-yielding varieties and the development of synthetic rubber during and after the War, the picture changed drastically, and the poor quality of output of the smallholders became a severe disadvantage. In the meantime, the estate sector had adopted many of the improved methods that were developed by research institutions or by some of the big estate groups.

Under the changed conditions, the smallholders could not compete unless given some outside assistance. This came from the state and federal governments with incentives to help the smallholders to plant with improved high-yield planting varieties. In other functions, assistance has come from agencies that carry out specific roles for the benefit of the smallholders.

For example, the Rubber Research Institute of Malaya, since independence, has become more active in providing advisory services to the various schemes at project level. The Rubber Industry (Replanting) Board gave assistance in kind and cash for replanting. The Malaysian Rubber Development Corporation has been basically involved in the purchase of latex from the smallholders for the production of processed Standard Malaysian Rubber (SMR) to prescribed specifications for export. In 1972, RISDA was formed to centralize, coordinate, and integrate the various activities directed at the smallholding sector so as to help accelerate the development of the smallholders.

The key lesson from the Malaysian experience is that when technological changes, such as improved planting material and improved methods of processing, become available in tree

crops, cultivation in traditional smallholdings may not be efficient enough to compete with the estate-type organization unless supported by a strong institutional infrastructure. Support is needed especially to offset the estate sector's quicker access to and adoption of new techniques and innovations (Chan et al. 1973).

One should ask, however, whether the state and federal governments have been wise to have taken such active steps to encourage smallholders in tree-crop cultivation. The political gains are obvious, but there is a danger that the state then feels bound to intervene when the industry experiences, for example, a steep drop in commodity prices. This danger has proved to be real, for the decline in rubber price has led to an appeal by smallholders for the government to take steps to check the decline (Business Times 1981).

Similarly, the Malaysian government's active interest in pushing for an international-commodity agreement for natural rubber seems to be motivated by the desire to protect the interest and welfare of the rubber smallholders. As an efficient rubber producer, Malaysia may stand to gain little from such an attempt unless it is one aimed purely at price stabilization. Any attempt to maintain price upward would not be in the long-term interest of Malaysia or of the smallholders, especially when synthetics are readily available.

Conclusions

In conclusion, three points from the Malaysian experience may be stressed. First, of the twin problems of short-term export instability and long-term resource immobility, the latter poses a greater threat to the economic development and welfare of a country with a high degree of "perennial monocultural dominance" (Wharton's phrase).

Second, there is a strong tendency to prefer agriculture to forestry in land-use policies because of the emphasis on value-added or employment creation. This approach fails to give proper weight to the noneconomic, but equally fundamental, roles of the tropical forests. These roles often complement agriculture. Such neglect should be corrected and a more balanced approach adopted in land-use planning.

Third, and finally, the special problems of the smallholders in tree-crop cultivation, especially when new techniques for improved yield and processing of output become available, may require some form of state assistance, as the market solution to these problems is likely to be less than optimal.