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Southeast Asian Agriculture : Stasis and Change, an Ecological Overview

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Résumé
L'évolution de l'agriculture en Asie du Sud-Est au cours des trois dernières décennies est revisitée du double point de vue du changement structurel de l'économie régionale et de l'incidence sur l'environnement biophysique. Suivant le schéma de la typologie agricole, l'auteur discute la question du degré avec lequel les systèmes agricoles, en relation avec l'environnement, sont demeurés statiques. Cependant, l'essentiel de l'article est consacré à l'analyse de divers changements dans les systèmes agricoles (extensification, intensification, désintensification) et conclut que, tant que le changement structurel de l'économie à l'échelle macro reste le processus fondamental de l'évolution de l'agriculture, il demeure d'importants problèmes tels le développement durable, la pauvreté et la distribution des bénéfices du changement.

Summary
Agricultural change in Southeast Asia over the last three decades is reviewed in the dual contexts of structural change of the region's economies and of impacts upon the biophysical environment. Following a sketch of agricultural typology, the author discusses the question of the degree to which agricultural systems, in relation to environment, have remained static. The bulk of the paper, however, considers the varions kinds and degrees of change amongst the systems - extensification, intensification and disintensification - concluding that while macro-level structural change of the economy is the basic process driving changes in agriculture, there remain important issues of long-term sustainability, poverty and distribution of benefits of change.

Mots-clés : agriculture, Asie du Sud-Est, écologie

Key-words : *agriculture, Southeast Asia, ecology*

The stereotypical view of Southeast Asian agriculture is that it occupies most people most of the time, that it is practised on tiny fields by farm proprietors or in huge "factories-in-the field", that it is highly dependent on the particular characteristics of the biophysical environment and is associated with idyllic landscapes of sky-reflecting rice-fields, waving coconut patins, thatch-roofed houses or dully-monotonous expanses of rubber trees or oil-palms. The romantics may rest assured that the idyllic landscapes still exist but may now bide modest wealth, evidenced by a motor-cycle in the front yard and a television aerial on a roof now more likely to be of tile or corrugated steel than thatch. Or they may hide grinding poverty that in part may derive from the very processes of rural transformation that have given others a degree of comfort. For the speed of transformation has been truly astonishing, encompassing, in some areas, little more than the three and a half decades of this writer's professional life.

Agriculture and other primary-sector activities, in the Tate 90's are only relatively minor contributors to production, having fallen from substantially higher levels in the 60's, Burma (now : Myanmar) clone being exceptional by reason of the long-continued stagnation of its economy (Table 1).

Table 1 : Southeast Asia : Primary Sector Contribution to Production ("Total Industries") (at current prices) %

	1992	1990	1980	1970	1960
Brunei	2.9	2.3	0.6	n.a.	n.a.
Cambodia	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	20.5	23.1	25.7	51.6	50.0
Laos	n.a.	n.a.	n.a.	n.a.	n.a.
Malaysia [1]	18.1	20.6	26.4	34.3	45.8
Myanmar	61.6	59.6	48.9	41.3	25.0[3]
Philippines	23.3	23.8	26.5	29.5	33.7
Singapore	0.2	0.3	1.3	2.5	n.a.
Thailand	13.3[2]	13.3	24.4	29.6	41.7
Vietnam	41.2[2]	39.01	n.a.	n.a.	n.a.

Notes : [1] Constant prices [2] 1991 [3] 1962

Source : *U.N. Yearbooks of National Accounts Statistics 1970,1980,1992*

At the same time the former overwhelming dependence of international exports upon agricultural commodities has much diminished in the face of substantial structural change in most of the economies of the region (Table 2). This structural change is, contrary to widespread impressions, not reflected in a widespread reduction of workers in agriculture but merely by a reduction in the proportion of the work-force in the sector (Hill, in press).

Table 2 : Southeast Asia: Contribution of Agricultural Commodities[1] to International Exports %

	1994	1990	1980	1970	1960
Brunei	n.a.	0.4	nil	0.5[3]	2.2
Cambodia	n.a.	n.a.	n.a.	88.8[3]	93.9
Indonesia	15.8	14.4	12.6	43.7	65.8
Laos	n.a.	n.a.	n.a.	9.74	n.a.
Malaysia	11.7	15.3	31.1	53.8	64.5
Myanmar	n.a.	36.7	n.a.	68.9	85.4
Philippines	13.8	18.4	35.6	45.6	61.6[5]
Singapore	5.0	6.6	15.8	41.1	n.a.
Thailand	24.6	32.5	55.8	71.8	85.1
Vietnam	n.a.	10.00[2]	n.a.	84.7[4]	94.0[4]

Notes : [1] CTCI commodity classes 0, 1, 22, 23, 2634, 2927 [2] Class 03, fish only [3] 1969 data [4] S. Vietnam only
[5] 1961. The substantial rise in Vietnamese rice exports, now the world's third highest, is not yet reflected in the data source

Source : *U.N. Yearbooks of International Trade 1960, 1973-74, 1995*

It has to be admitted though, that official statistics do not necessarily "capture" the reality of illegal immigrant workers - Malaysia is a case in point - and certainly fail to reflect the fact that large numbers of "agriculturalists" actually derive significant proportions of their income from off-farm, non-farm employment (Hill, 1995). In the region, since circa 1960 the numbers in agriculture have grown very substantially, yet in each country the proportion of agriculturalists in the work-force has declined (Table 3), though the ratio of workers to the total population has remained at about 42 percent

Agriculture has thus lost its pre-eminent role in production and external trade though if anything, its role in employment and in society has increased in step with the numbers of agriculturalists who in many instances represent a relatively-deprived segment of the social order, one that is producing much less than its share and in consequence, is in general relatively poor (Hill, in press). At the same time, perhaps because of the widespread notion that overall economic growth is resulting in an amelioration of the position of farmers and that growth is being accompanied by massive, nd rapid structural

Table 3 : Number and Proportion of Economically-active Persons in Agriculture, 1994 and 1960, Growth in Agricultural Work-force, 1960-1994

	1994 No. (mill.)	Prop'n (%)	**1960** No. (mill.)	Prop'n (%)	**Growth** 1960-94(%)
Brunei	8.6	45	7.2	68	19
Cambodia	2.6	69	1.9	82	34
Indonesia	35.4	45	24.7	75	43
E. Timor	0.2	71	0.1	71	57
Laos	1.5	70	1.1	83	39
Malaysia	2.2	29	1.7	63	30
Philippines	10.8	45	7.8	74	39
Thailand	19.4	62	11.3	84	71
Vietnam	20.6	58	14.3	82	44
Total	101.3	Av. 50	70.1	Av. 76	Av. 44

Compiled from *FAO Production Yearbooks*

change in most countries, the attention being given to agriculture, certainly in terms of published works, appears to the declining. The literature upon which to base this overview is rather patchy for Burma, Laos, Cambodia and Vietnam especially. What is clear is that continued, though slowing population growth coupled with significant structural change, including a "piling up" of people in the agricultural sector, is accompanied and underlain by a number of interrelated processes. Stasis may appear to be represented by the biophysical environnent though even here there is change, especially in the complex relationships of trop plants to it. Change is pervasive and ramifying. Its processes are related in complex ways, not ail of which will be described here. Change, however, has affected agricultural systems in different ways, partly because of their inherent nature, partly because of the varying degrees to which they have been drawn into the emerging global economy and partly because of differing agricultural research and implementation priorities.

L TYPES OF AGRICULTURAL SYSTEMS

While it is true that the region's agricultural systems may be divided into two groups on the oasis of topography (Tanabe 1994), this is far too simplistic for useful analysis, quite apart from the obvions fact that terraced wet-rice agriculture represent the deliberate creation of "miniature lowlands", veritable swamps, in the uplands. However, no one has yet attempted a classification of Southeast Asian agriculture using a formally-established international system with agreed criteria and standardized weights applied to them. Hill (1966, 1970), Hill and Ühlig (1964), Ühlig (1983) showed the great diversity of systems of rice agriculture in Malaysia and in the region generally while Hill later (1982, 1983) expanded this to encompass the International Geographical Union world typology, developed by Kostrowicki and his associates, though applying it only within the Malaysian region. These five types, shifting cultivation; semi-commercial (peasant) rice cultivation, perennial-crop (peasant) small-holding, plantation, intensive market-gardening, while in some cases grading into each other, can be recognised throughout Southeast Asia, although some sub-types, notably coconut, rubber and oil-palm cultivation, both on plantations and small-holdings are less significant in mainland Southeast Asia than in the insular parts of the region.

A more detailed typology was developed, for Thailand, by O'Reilly and McDonald using the already old-fashioned Weaver crop-combination method. This recognized 13 types, most involving some form of rice production, both for cash and for subsistence, together with other crops including rubber, maize, kenaf *(Hibiscus,* sp.) manioc *(Manihot esculenta),* predominantly for cash or in combination with shifting cultivation, the last-named not necessarily for subsistence. Many more types and sub-types could be recognized for some are clearly static, others are becoming less complex as specialized commercial orientation of production takes hold, while yet others are becoming more complex as farmers diversify their crops to reduce the risks of specialization and also as improved transportation improves market access, and as irrigation and short-term cropping on residual soil moisture - after-cropping - permit intensification of production.

Broadly, however, the typology of Capistrano and Marten encompasses the major types and sub-types of the region's agroecosystems as these reflect crop diversity, the levels of adoption of modern technology, operational scale and locus of production.

Table 4 : Agricultural Typology

Type	Crop Species Diversity	Degree of Modern Technology	Scale of Operation	Topography
Rice-based agriculture				
Irrigated	Rice monoculture, often rotated with other crops	Medium to high	Small to large	Lowlands (alluvial plains), terraced uplands
Rainfed	Rice monoculture, sometimes rotated with other crops	Low to medium	Small to medium	Upland rice in hilly areas, rainfed wet rice in lowlands including swamplands
Shifting cultivation	High	Low	Small	Wet tropical slope lands and upland areas
Permanent field crops (other than rice)	Low to high	Low to medium	Small to medium	Flat to hilly, may cultivable lands not used for rice
Homegardens	High	Low to medium	Small	Slope lands or flat lands
Commercial field crops				
Vegetables	Low	High	Small to medium	Cool uplands
Annual plantation or cash crops	Monoculture	High	Medium to large	Flat lands
Perennial plantations	Low	Low to high	Small to large	Flat to hilly

After *Capistrano and Marten 1986*

II. STASIS? THE BIOPHYSICAL ENVIRONMENT AND AGRICULTURE

While it may be argued that stasis is a myth, for even "static" continents drift, it is clear that over less than geological time-scales, some, a few, agricultural systems have changed little. In the remote areas of Burma, Cambodia and Laos as in parts of West Irian (New Guinea) some shifting cultivators guard the old ways. (See, for example, Condominas, 1974; Matras-Troubetzkoy 1974, Martin 1974). But even there the growth of population may be beginning to force the shortening of fallows while "young bloods" seek to prove their manhood not by cutting heads but by living adventurously in cities, logging camps and mines at least for a period. At quite the other end of the socio-economic spectrum, the plantation sector, especially that portion growing perennial tree-crops, has changed relatively little, apart from its share-holdings and management having became local rather than foreign.

Stasis is also seen, at the broadest level of generalization, in the overwhelming importance of rice in the regional crop assemblages (Table 5). With close to 38.5 million ha in rice, this accounts for nearly two-thirds of all arable land in the region, ranging from 118 percent in Vietnam (by reason of widespread double-cropping), to 48 percent in Thailand and rice is universally grown, even in oil-rich Brunei though not in Singapore, a true city-state. There are several reasons for this preponderance. For most

cultural groups "rice" is literally "food" for the words are the same in the vernaculars. Physically, as Christiansen (1986) has noted, its major advantage is its ability to withstand moderate, or with deep-water (floating) varieties, severe flooding, a major consideration in monsoon climates that range from weakly seasonal in the western equatorial zone to strongly so in most of mainland Southeast Asia. (Description of regional weather and climate may be found in such standard works as Hastenroth, 1985; Nieuwolt, 1977 and Riehl, 1979) Cultivation in stagnant or slowly moving waters means that water-soluble nutrients are more easily retained than in dry fields, volatilization is reduced, water-dwelling organisms, notably *Azolla* with its associated alga *Anabaena,* add nutrients in this case nitrogen, while the water itself may contribute between one third and two thirds of the total nutrient input. Dry-land cultivation, which accounts for only about 13 percent of the rice area, Jacks these advantages. All other types, deep-water (roughly 5 percent), wet or dry season irrigated (roughly 34 percent), rainfed (roughly 48 percent) have the advantages of growth in what are essentially managed swamps (Huke 1982). Only in the Visayas (central Philippines) and parts of Mindanao does maize, grown in dry fields, challenge the pre-eminence of rice as the basic food crop for the indigenes of the region.

Table 5 : Agricultural Land Use, Southeast Asia, 1993

	Mill. ha	Percent
Total agricultural land	103.5	100.0
Permanent pasture	17.6	17.0
Permanent crops (mainly coconut, rubber oil palm)	24.6	23.8
Arable	61.3	59.2
Rice	38.5	37.2
Maize	8.2	7.9
Pulses	2.8	2.7
Soya	2.0	1.9
Groundnuts	1.5	1.4
Cassava	1.9	1.8
Sesame	1.1	1.1
Sweet potatoes	0.8	0.8
Millet	0.2	0.2

Compiled from *FAO Production Yearbook 1994* (figures rounded)

Whether production is for subsistence or for cash however, whether on flat land or sloping the biophysical realities remain dominant in production though the last several decades have seen greater human control, especially of water supply, and possibly also doser adaptations of specific crops and crop rotation to those realities. While soifs and topography place obvions limits upon crop choice, both are capable of significant modification or at least appropriate matching of crops to circumvent their limitations. Amongst the climatic parameters, temperature is a significant limitation at varying altitudes and latitudes. Thus rubber *(Hevea brasiliensis)* shows reduced latex yields above about 300m in the equatorial zone while rice is scarcely to found above 1500m by reason of depressed yields at higher elevations. Rice requires at least 1200 hours of bright sunshine to yield satisfactorily. By contrast, temperate vegetables require temperatures below about 25°C such as are found in scattered production amas around Dalat (Vietnam), the northem hills of Thailand, Malaysia' s Cameron Highlands and Kundasan or the Bogor region of Java. (For an agroclimatological overview of the region see Oldeman and Frère 1982) Whether of temperature, rainfall or for a few crops, *Cacao* is one, humidity, the important limits are in fact economic rather than physiological, for the key issue is the obtaining of a life-supporting or a marketable yield rather than simple crop survival. However, in the region generally these limits have not been well studied with the consequence that it is not all clear whether they are static or are slowly changing as both scientific research and farmers' plant selection allow the improved matching of crops to environment. Subsistence producers have long been regarded as adoptors of risk-minimizing agricultural strategies, though like anyone elle, they are vulnerable to he exceptional, especially to drought, as Brookfield et al. (1995, pp. 160-161) emphasise.

For Malaysia, Nieuwolt's agroclimatic studies bave demonstrated the importance of climatic factors in a rather uniform environment in which rainfall, both its total and its seasonal distribution, is the dominant controlling factor below an elevation of about 500m (Nieuwolt 1982, 1984, 1986). Working on major upland crops - rubber, oil palm, cocoa, coconut, coffee, cashew, mango, citrus, durian, plus herbs such as manioc, pepper, pineapple, banana, papaya - he found a rather complex pattern. The first three listed were confined to regions below 300m elevation with the others ranging up to a maximum of 1800m, for citrus. For some - rubber, oil palm, coconuts - drought beyond one or two months depressed yields. For others - coffee, mango, citrus, sugarcane - two to four months dryness increased yields while the response of cacao was more precise, one month's low rainfall was advantageous but two months was the reverse. In addition, for most crops, saturated soils and strong wind gusts were disadvantageous (Nieuwolt 1986, p. 125).

For Thailand, a much more strongly monsoonal country, with a large latitudinal spread, roughly from 6°-20°N, Kaida and Surarerks (1984) have recognized six rainfall regimes, from which, taken with seven soil classes, were derived 14 actual "agro-ecological zones". However, taken with maps of crop distributions, no particularly clear patterns emerge, except that rubber is found mainly south of Bangkok in regions of no or weak dry season, and that kenaf and manioc are grown north of that latitude where rainfall variability is moderate to high and, especially in the Northeast where sandy entisols, alfisols and ultisols predominate These patterns reflect the history of recent land colonization and commercial opportunities as much as climate and soil.

Rice, as the basic staple, is universally grown on entisols and some histosols despite marginal conditions of highly variable rainfall regimes and of depth of flooding. Maize, sugar-cane, kenaf, manioc and much of the rice, roughly 86 percent, is rain-fed and yield variability is considerable. That of maize varies between 1.2 and 2.4 t ha' while Rasinaditta has shown for 1972, a drought year, a depression of national rice production by about 18 percent and of maize by about 43 percent, compared with 1973, a normal year (Rasinaditta in Kaida and Surarerks 1984, p. 248). Cambodia, too, where less than a tenth of the rice land is irrigated, shows the vulnerability of its crop to weather. In 1954, for example, harvest in the major province of Battambang was reduced to less Chan a quarter of normal because of drought while in 1968-1969 a fifth of the country's production was lost to floods (Quinn-Judge 1982, p. 17).

Climate, specifically the length of the dry season, is particularly related to rice production in another way. Little, if any of the region is capable of supporting two rice crops a year under rainfed conditions. At the same time the length of the dry season is quite closely related to the supply of irrigation water necessary for reliable wet-reason production and absolutely essential to dry-reason production. However, it is not the only factor. Large-scale irrigation works such as Phumibol Dam in the central Thailand, make use of still-substantial base-flow and have substantial storage capacity though this reduces with time through siltation. On the other band works on small streams have little or no storage and thus are vulnerable to drought. 11e manner in which wet-rice cultivation is broadly related to dryness is well illustrated in Indonesia which has a marked west-east rainfall gradient from Java to eastern Nusatenggara. In Java, some 4.1 million ha is yearly harvested from 3.0 million ha of wet-rice land a ratio of 1.37. In Sulawesi the ratio is 1.44 but eastwards falls to only 0.97 in Kalimantan and to 0.42 in eastem Nusatenggara (Oldenman, 1984 p. 286), the reason being the long dry season in the east.

One significant question conceming agriculture and the biophysical environnent is the question of how closely crops and cultivation techniques fit the "givens" of die environnent and whether fariner practice aided by science, is better or worse attuned than formerly. The issue is, of course, fundamental to questions of environmental degradation and long-term sustainability. Given die overwhelming importance of rice for subsistence and its cultivation in parts of the region for at least 6000 years, it is not to be wondered that its cultivation systems are extremely diverse or that there exist several tens of thousands of types of *Oryza sativa.* In an area of 60 000 ha, the Chiang Mai valley, for example, die Rerkasems collected 42 distinct varieties, each with specific environmental requirements, lodging resistance, harvesting, threshing, cooking and eating characteristics (Rerkasem and Rerkasem 1984). In that area, modem varieties produced by plant breeders have made little headway, being grown on only 5 percent of the land, far surpassed by a natural mutant variety from the Central Plain But elsewhere in the region modem high-yielding varieties have swept all before them, especially in irrigated areas. Rather Chan fitting the varieties to die environment, the environment, in die foret of more and better-controlled water, inputs of fertilizer, herbicides and pesticides, has been fitted to the varieties, resulting in substantial ecological simplification, both deliberately and "accidentally". The latter is represented, for example, by a severe reduction in botte numbers and quality of rice-field fish, prawns and molluscs which once were collected to form a significant portion of farmers' protein intake.

What may be the situation with respect to other crops is unclear. Rubber, oil patin, manioc, kenaf, and a host of others are comparatively recent introductions with rather few varieties. Some, notably rubber and manioc, ale tolerant of a wide range of conditions, within broad climatically-determined limits. Where environmental adaptation through plant breeding has taken place, this has mainly taken the form of increasing yields, thus reducing labour costs, within or on the margins of existing production zones rather attempting to broaden the environmental capabilities of the crops themselves.

Stability of production is often held to be particularly characterisitc not only of wet rice but also of tree-crop production. Ecologically, the latter is held to mimic, to some degree, the structure of the forest is has replaced. As will be seen in the next section, some forms of tree-crop production, coffee, tea and rubber, are not necessarily particularly conservative. Others are, notably the complex mixtures of herbaceous and free crops termed *kampung* cultivation in Malaysia or *pekarangan,* sometimes *talun-kebun,* in Indonesia. While the prevailing trend in Southeast Asian agriculture is away from relatively static, conservative systems based upon a diversity of crops and towards market-based production taking advantage of commercial opportunities, these farms remain environmentally protective while providing a continuons and varied supply of foods containing essentiel nutrients, some of which are not supplied in significant quantity from rice fields (Abdoellah and Marten 1986, Sumarwoto and Sumarwoto 1984). These authors emphasise the stable nature of production from multi-storey "artificial forests" in which, for example, the ground layer may be occupied by sweet potato *(Ipomoea batatas)* or flavorsome pot-herbs, intermediate layer shrubs or herbs such as chilli, coffee, citrus, guava, papaya and taller patins or trees such as coconut, areca *(Areca catechu),* durian *(Durio zibethinus),* jack-fruit *(Artocarpus integrifolia)* and other "emergents". Even climbers such as *Sechium edule* or the bitter gourd *(Momordica charentia),* are usually present to complete the structural similarity to forest. Field research in central and east Java, for example, has indicated a not insubstantial economic role for these "forests", with household incomes derived from them ranging between 7 and 56 percent of total incomes (Sumarwoto and Sumarwoto 1984, p. 266).

III. CHANGE : IMPACTS UPON THE BIOPHYSICAL ENVIRONMENT

Most authorities agree that wet rice cultivation is essentially environmentally-conservative though its maintenance in upland areas requires substantial inputs of manual labour, which, if withdrawn rapidly results in deterioration and abandonment, processes visible in north-central Luzon and Java. Both perennial-crop cultivation and especially the cultivation of short-term crops in upland areas (especially where tillage is involved) may be seriously damaging and unsustainable In the broader context is the possible impact of land degradation upon regional climate.

Soil degradation may be distinguished from erosion by the fact that it takes place *in situ,* involving loss of good soil structure, of organic malter and nutrients, rather than the physical transportation of the soil downslope. All agricultural systems cause some degree of degradation and erosion compared with tropical or monsoonal forest that once provided the natural land cover. 11e question is thus one of degree on all but the gentlest of slopes. Rates of erosion under perennial crops are roughly two or three times greater than under forest or other dense natural covers. Much of the soil loss, however, takes place during the establishment phase when loss from bare soil can be three or four orders of magnitude higher than under forest, etc. Where good cover is established, either by natural colonization or by planting cover-crops such as *Pueraria, Centrosema* and *Calopogonium,* an equilibrium is established in which sediment production is stable, though greater than tender forest. Daniel and Kulasingam (1974, p. 158), for example, show that mature rubber and oil palm showed soil loss only 1.5-2.8 times greater than that from an undisturbed forest catchment. Unfortunately, especially under mature rubber, where the ground cover may be partly shaded out or even deliberately destroyed in the name of good husbandry, or in clean-weeded tea and coffee plantations, soil loss may be substantial and run-off increased, leading to greater flooding in the lowlands. Data from Cameron Highlands, Malaysia, for example, show losses from tea gardens 20 times higher than from forest (Daniel and Kulasingam 1974, p. 157). But even then there remains the question of what happens to the greater amounts of sediment produced for it is unlikely that all of it finds its way into the hydrological system, or that all which does necessarily soon fends its way to the lowlands.

Much the same considerations apply to shifting cultivation where the primary considerations are the lack of significant soil disturbance by tillage (rice, for instance, is usually dibbled) and, especially, the rapid growth of crops and after abandonment, colonization by grasses, herbaceous and woody plants. The period during which bare soil is exposed to heavy rain is crucial as current research by Hill and Peart in Hong Kong is demonstrating. Soil loss under shifting cultivation may be as little as three times that from forest or as much as

50 times (sec Hill and Peart 1996). But the data are not altogether conclusive since much seems to refer to loss only in the fast year or two of cultivation. With a "return period" of 5-30 years before subsequent cultivation on the same site it is simply wrong to take to account only losses during cultivation and then to ignore the much lower losses during fallow. Attaviroj (in Arbabharama et al. 1988, p. 71), suggests that the effect of taking one crop of rice every ten years by swiddening is to increase soif loss by only 1.5 to 1.7 times compared with typical dry Dipterocarp forest. So long as there are not exposed bare surfaces under fallow, los ses are unlikely to be large.

Much the same is truc for nutrients. It is widely suggested that fallows are crucial to their restoration and it is, of course unquestionable that they lead to increased nutrients and organic malter. But there are, in fact, no published studies for the region of soil nutrient status at all stages in cycles of shifting cultivation and on most soifs it is likely that increased weediness and the diseconomies of removing them lead to abandonment. Where *Imperata* and broadleaf weeds such as *Chromolaena odorata* invade three-year fallows they are incorporated as a green manure (Gillogly et al. 1990, p. 63, p. 78) and thus may be crucial to the long-term maintenance of nutrient levels even under high-intensity, but still shifting cultivation. There may be, in fact, a threshold of use-intensity beyond which farmers apply the additional labour needed for simple conservation measures, not only to minimize deterioration of the upland but to avoid damage to lowland crops (Le Trong Cuc et al. 1990, pp. 90-94).

By contrast, erosion and soil degradation are much more significant where the soil is actually tilled. The data assembled by Hill and Peart (1996) and by Daniel and Kulasingam (1974) show a wide range of erosion losses, especially on unterraced land, one study from Java showing soif loss from crops of potatoes grown upslope that were 600 times those from a dense grass cover nearby. Interestingly, growing the same crop on the contour reduced losses to only 215 times those from grass cover. Losses less than 20 times those from good cover in otherwise similar environments seem to be quite exceptional though on relatively gently-sloping lands, mainly with rather sandy soils, in the Ping and Nan catchments of northeast Thailand, Cepomchon and Panichapong (in Arbabhirama et al. 1988, p. 71) suggest that if land use changes from forest to row crop cultivation (such as manioc and kenaf), without conservation measures, soif loss increases about six to ten limes. The spatial scale of erosion in the country as a whole is rather large, with 34 percent of the cultivated area, about 51.3 mill. ha, losing more than 6.3 t/ha yearly and 12 percent losing more than 625 t/ha a year (Arbabhirama 1988, p. 70).

Degradation of soil, in situ, resulting from cultivation in Thailand is also serious. Norman (1984, in Arbabhirama, 1988 p. 69, p. 71) showed that the infiltration capacity of soils in older development areas had fallen by 62 percent compared with forest, while organic carbon dropped by 18 percent. Contents of calcium, magnesium and potassium also tended to be lower though the source does not state what their significance to agricultural production might be other than noting declines in the yields of both mare and upland rice when comparing newly-cleared and other development areas. Just how widespread similar changes might be in other parts of the region is not all clear, particularly as forest clearance for agriculture, i.e. extensification, has been more marked there than in most other countries of the region. What might be the broader implications are also unclear though Sirinanda (1984) Houghton (1991, 1995) and others have raised the question of a possible impact upon climate (Salati and Nobre, 1991; Prance, 1986; Brookfield et al 1995).

IV. EXTENSIFICATION

Extension of the cultivated area continues in much of the region though most alluvial lowland areas have long been occupied, except in Borneo, mainly by rice-growers (Adas 1974, Hill 1977, Ishii, 1978). To a limited degree this is counterbalanced by the abandonment of land, especially in periurban locations as the spatial growth of cities continues. Statistics on these processes are imprecise and difficult to obtain. In Malaysia, for example, rubber smallholdings are still counted as such even if not actually producing and, the sanie may be true for rice land. Estimates of "deforestation" may include logging as well as clearance for agriculture leading to marked discrepancies (Aikin and Leigh 1992, p.9-11). These extend to estimates of rates of deforestation. Ooi (1987, p. 8) for example, suggests that logging of productive forest in the region was much the same in the 1976-1980 period, 1.016 mill ha a year, as in 1981-85, 1.078 mill. ha a year. Aikin and Leigh (1992, p. 11) give a substantially higher 1.477 mill. ha annual cut for the latter period with a rise to 8.170 mill. ha in 1989. Myers (1991, p. 6) gives "current rates" as 3.85 mill. ha annually while Berger (1990, p. 2) suggests that moist forests have regressed by 38 percent from the estimated 3.02 million km^2 of "climax" in the region. Country-by-country details are given by Myers (1980) though his judgements as to clearance for agriculture are not to be relied upon.

What the proportion of the land deforested for agriculture might be is basically anyone's guess though Myers (1991, p. 23) suggests that "shifted cultivators" account for "well over half of ail deforestation" globally. Contrary to general impressions, it seems unlikely that significant areas of virgin forest are converted for agricultural purposes. A common pattern is for landless and near-landless rural people to penetrate logged-over land via timber extraction ronds and drag-paths to clear fell and plant crops. Typically it is the uplands which see such conversions for the acid, peaty soils of freshwater swamp forest are difficult to farm, as are coastal mangroves where conversion has generally involved prawn fisheries rather than agriculture for which a substantial period of flushing of the soil with fresh water is required before use. Where conversion for agriculture is undertaken within the framework of a formai land settlement scheme, commercial logging now invariably precedes clearance though several decades ago this was not necessarily the case. However, rather patchy data on clearance for farming do exist. Kummer (1991, p. 86) suggests that in the Philippines, by 1980 some 14.4 million people lived in (once-forested) uplands, of which number 77 percent were on lands officially designated as public forest. Another estimate he quotes gives 18 million by 1988 of which 10 million migrated since 1948. At the same time some 74 percent of Indonesia's land area has been designated as state forest (Coppenberger 1990, p. 7) and this contains several tens of millions of people at the very least. Thailand has received considerable attention, not least because of rapid deforestation. From 57 percent of the nation's land in forest in 1961, by 1978 only 25 percent remained that way, Ühlig (1988, pp. 13-14) suggests that since about 1960 roughly 4-5 million hectares of land had been cleared by about 1 million families of spontaneous settlers. These figures compare with around 0.7 million ha cleared for state-directed agricultural settlement occupied by roughly 230 000 families. These are impressive compared with the 0.65 million ha cleared for government schemes in Peninsula, Malaysia (to 1984) and 1.3 million ha cleared for official transmigration schemes in Indonesia, to 1980.

Studies by Ühlig (1988), Scholz (1988) and Riethmüller (1988) identify several kinds of extensification and show that the initial phases of colonization may be followed by consolidation and intensification. Village lands may be extended into adjoining forested uplands but remain farmed (for maize and cassava mainly) from the original settlements. "Agro-seasonal commutera" retain their houses and rice lands in their native villages but move annually to and from distant maize and cassava fields. Others are true pioneers settling permanently on newly-cleared lands while yet others, with good road access from high-altitude areas grow temperate fruits and vegetables at high intensities. Field research by Scholz (1988) shows that insecurity of land tenure, coupled with the need for start-up credit play major roles in commercially-oriented maize monoculture. As he observes, "The fear of one day being driven from their land makes the farmers exploit the natural resources as rigorously as they can". Measures to conserve or improve the soil, for example terracing of clopes, crop rotations, the use of fallows, the cultivation of perennial bush and free crops, and the use of fertilizers, are only taken in exceptional cases. Much of the growth of upland cash cropping in Thailand took place in the impoverished and environmentally-difficult Northeast. Between 1950 and 1984 the proportion of cultivated land under rice in the region fell from 96 percent to 76 percent, the total number of faim holdings increased by over 36 percent and the total area increased by 53 percent as kenaf *(Hibscus sabdiffera)* cassava and maize expanded onto hitherto little-used but not necessarily forested uplands. This expansion was driven basically by prices on the export market though some have suggested that the long-standing and now-abolished "rice premium", in fact a tax on rice production, turned farmers' terms of trade towards these crops and away from rice (Hafner 1990, p. 79). At the same time numerous loopholes in legal codes, the political difficulty of enforcing their provisions and inadequacies in survey and land registration have permitted continued expansion in the country (Hafner and Apichatvullop 1990).

Spontaneous settlement in truly montane regions has also been of some significance. The more accessible parts of the Grand Cordillera of north-central Luzon has seen a steady expansion of the intensive cultivation of temperate vegetables, especially cabbages, north-eastwards from Baguio along the highway (Reyes-Boguiren 1989, Sajise and Omegan 1990). This process has seen the replacement of montane forest by high-input/high-output vegetable gardens in response to growth in the Manila market roughly a day's journey away. On a much smaller scale are similar developments at Kundasan on the flank of Gunung Kinabalu, supplying Kota Kinabalu and at Tam Dao, supplying Hanoi. Less-intensive production, mainly of coffee, has been the objective of recent colonization of southem parts of Sumatra's Barisan mountains Many of the spontaneous migrants started out as seasonal wage labourers in the coffee, pepper and clove gardens of local Sumatran smallholders or as state-sponsored "transmigrants" in the lowlands. With nothing to sell but their labour, such pioneer colonists characteristically start out by clearing (sometimes virgin) forest for fast-growing annuals such as dry rice, cassava, maize and peanuts as precursors to coffee (Scholz 1988b).

Govemment-sponsored land seulement schemes, especially in Indonesia, have received a great deal of attention, despite accounting for a relatively small proportion of land cleared and families settled. (See, for example, Hardjono 1977, Burbridge 1981, Charras 1982, World Bank 1988, Fassbender and Erbe 1990). In Peninsular Malaysia it seems unlikely that in the period 1957-1975, when about 59,000 families were settled, resettlement accounted for more than a few percent of the total increase in the rural population, and although between 1975 and mid-1984, the Federal Land Development Authority had successfully developed 367 schemes, covering 654 000 ha and resettling some 84,265 familles on 227 schemes, some 140 schemes were without settlers (Shamsul 1988, p. 188). In Thailand, some 241 000 settler families had been placed on about 700 000 ha under varions kinds of govemment scheme. Indonesia's plans have been extremely ambitions with annual targets for migration ranging up to 2.5 million. Achievement has been very modest by comparison, the years 1951-1979 seeing just over a million being resettled, mainly from Java and Bali, and again those moved to new regions made up only a couple of percent of the total population increase in the source islands (Shamsul 1988, pp. 186-187) Similarly, though migration and land development, mainly in Mindanao, Philippines, has been substantial, active government-sponsored colonization has involved only a few thousand families - only 9-415 for 1955-63, according to Shamsul (1988, p. 187). (It should be noted, in this context that few, if any, data are available on families leaving schemes).

Land development has proceeded rather differently in varions countries. In Malaysia, virtually all schemes have concentrated upon perennial free-crops, mainly rubber and oil-palm with cocoa, sometimes planted under coconut, being of less significance. As Aikin and Leigh (1992, pp. 65-66) note, within three decades, the FeLDA alone has transformed some 850 000 ha of former forest into "serried rows of plantation crops that now march endlessly across the landscape". They conclude that "...land development and resettlement schemes have boosted the production of export crops, and contributed to higher living standards in rural arecs..." but note that their very success may have contributed to the abandonment of agricultural land elsewhere and that the amount of idle land in already established agricultural areas probably now exceeds the amount of land that FeLDA has brought into production (Aikin and Leigh 1992, pp. 67-68).

By contrast, the cropping patterns elsewhere in the region have been more diverse, a common objective being to provide the means for settlers to produce their own rice for consumption while also producing other crops for cash. Some schemes have involved rice production alone, especially in Indonesia, though this has often involved using terrain and soils that are difficult to develop, both technically, as on rolling land or peat swamp in Lampung province, southern Sumatra, and economically, for other crops, such as maize and cassava, give higher returns and do not require the massive inputs of labour and capital (roughly U.S. $20,000 ha) needed for successful rice production. Abdoellah's case-study of a tidal irrigation scheme on peat land in southern Kalimantan is instructive (Abdoellah 1996). While initial production of rice was high (2.0-2.7 t/ha), by the early 80's yields had fallen catastrophically to only 70-700 kg ha as a result of acidification of the soil and by that time 53 percent of the original households had left with the rest living a hand-to-mouth existence supported in part by migratory labour *(merantau).*

The forces driving extensification are varied. Though structural transformation has been remarkably rapid, in the face of equally rapid, though now slowing, population increase, it has not been fast enough to avoid the piling up of a mass of poor rural people, many lacking adequate access to land. Even though with such land, growers of rain-fed rice especially, have not necessarily benefited from the intensification of production, and lacking skills other than in farming, have sought new land for themselves and their children. Political motives have clearly driven government settlement schemes, the need to be seen to be doing something for the rural poor who might otherwise be led into civil disorder, the need to colonize national territory, a move often seen by ethnie minorities whose traditionally-held lands are colonized, as "cultural imperialism" by the dominant groups in society, Javanese in Indonesia, Christians from the north and centre of the Philippines, Kinh in Vietnam, lowland Thai in Thailand.

But the strongest force of all is economics, influencing not merely extensification *per se* but choices of crop systems in the new lands. The market, now basically a global one, reigns. This is well illustrated by Ooi's (1993, pp. 97-107) analysis using conventional cost-benefit analysis applied to rubber, to oil-palm and to intercropped cocoa and coconut. He concludes that purely on fmancial grounds, forestry under "natural management" is not an economic proposition and is not a viable form of land use, except at unrealistic discount rates, when compared with cash-crop agriculture based on these perennials (Ooi 1993, p. 98). Such activities also employ far more people and their number is even higher

where the growing of short-term crops such as sugar, kenaf and other fibres, maize and cassava is possible on a sustainable basis. While the validity of such forms of analysis may be challenged, for instance on the undervaluation of forest products other than timber, of conservation functions, such challenges are unlikely to concern the rural poor. Certainly, it can be agreed with Kummer and Turner (1994, p. 326) that deforestation, for agriculture or otherwise, is not necessarily related to increases in local or national increases in per person gross consumption.

V. INTENSIFICATION AND DISINTENSIFICATION

The conversion of forest for agriculture is striking and, in principle, relatively easy to measure, especially using remote-sensing techniques though cost often prevents their systematic employment. Not so the more subtle processes of intensification, marked perhaps, by changes in the seasonal aspect of agrarian landscapes as irrigation allows the double cropping of rice or by cocoa plante(' under no-longer economic coconut, or by hand-tractors and pumps in the fields. Disintensification may marked by scrubby underbrush in rubber and coconut plantations, possibly being grazed by cattle which may also occupy newly-abandoned rice-fields.

In principle there are two basic types of intensification, labour and capital. Some would argue that energy is another kind but this is really only a manifestation of capital, as, for example, a petrol-driven pump substitutes for hand lifting of water using a scoop. The region generally has seen a significant substitution of capital for labour in the region, not that labour inputs have necessarily been reduced but that increases in productivity can be substantially attributed to increases in capital intensity. This process is, from a different perspective, one of the results of commercialization which has become so pervasive that no local economy is entirely free from its effects though there are clearly still such economies whose agricultural component is not yet commercialized Thus, for example, there are minority peoples practising shifting cultivation in the hills of northern Thailand who are also temporarily itinerant petty traders or labourers on the farms of others or in an urban context. Much the same is true of majority peoples in rice-producing lowlands, for, except amongst wage-labourers on plantations, off-farm work has widely become a significant contributor to the income of rural households. Here the two related processes are considered separately.

Intensification has affected different agricultural systems in quite varied ways and to different degrees. As measured by scholarly concem it would appear that wet-rice systems, whether irrigated or rainfed, have undergone the highest degree of intensification though this might partly be an artifact of governmental and scholarly interest. But the production of annual dry-crops, even of shifting cultivation and livestock production have also seen changes. Perennial tree-cropping, however, because of its inherent nature has seen only minor intensification. In principle, four kinds of intensification or disintensification situations can be envisioned, though in specific cases it is not always clear which exists. They are:

1) Both labour and capital intensities increases or decrease.
2) Only labour intensity increases or decreases - labour is substituted for capital.
3) Only capital intensity increases or decreases - capital is substituted for labour.
4) No change.

Surprisingly, there seem to be rather few macro-level studies of these basic processes in the region, though there is a considerable literature on the detail of intensification, especially of rice-based systems. Mya Than (1988, 1989), has shown that for Burma, both labour and capital intensities have increased substantially from the mid-70's to the mid-80's. While the index of cultivated land rose from 100 to 101, the index for the agricultural labour-force rose to 120, though this index does not necessarily measure actual labour inputs, while the index for total fixed capital rose to 148. (Note that the labour-force index rose approximately in step with population). For the other countries in the region it seems likely that a similar situation exists, given that the number of agricultural workers, though not their proportion in the total work-force, continues to rise. One exception may be Peninsular Malaysia where, in the rice sector, broadcast rowing and machine harvesting are now widespread, raising labour productivity and increasing capital intensity. (In this context it is pertinent to note that official labour-force statistics are not wholly reliable for they ignore the existence of illegal, mainly agricultural, workers whose numbers are variously estimated to be between half and one million).

Few systems are stable, not even subsistence shifting cultivation, for that, at a minimum, has generally undergone labour intensification as populations have increased and as production has become partly commercial. The various aspects of intensification are linked, of course, dry-season irrigation requiring the adoption of tractor tillage to fit two rice-crops into a year, high-yielding varieties requiring improved water-

control as well as the application of fertilizers and insecticides.

VI. RICE

No other sector has received as much attention as this though that attention has been confined largely to those who have land, or as tenants, access to it, the often-substantial rural proletariat in this sector, perhaps half of the rural population in parts of Java, roughly two-fifths in the Philippines, being substantially ignored. While purely subsistence rice producers still exist, these are mainly people who are part-time cultivators with cash incomes derived variously from the cultivation of rice-land for other crops, growing animais or perennials in upland areas, or from part-time off-farm rural or urban employment. Ganjanpan (1982, pp. 392-393) has drawn a useful distinction between farmers with subsistence-dominated strategies and those with fully commercial status, noting that they occupy different kinds of land and adopt different tactics in meeting their economic objectives. Thus, in northem Thailand, the former have insufficient land for glutinous rice, the subsistence crop, but grow soyabeans, peanuts or chillies on residual moisture after rice or on uplands, exchanging these for cash or rice. Such farmers intensify to ensure basic food needs. Others do so more to increase cash income, though it is by no means clear that the move up to high-input/high-output necessarily results in large increases in farmer incomes as Purcal (1971) and Ishak Shari and Sundram (1982) have demonstrated. The degree to which production remains at subsistence level is highly variable. In Vietnam it has been estimated that only 30-40 percent of faim households produce a marketable surplus (Duong and Cho 1994, p. 4).

Irrigation is the major method of intensifying production and has generally brought in its train both further labour and more capital inputs. In the region generally, except where two rice crops a year were usual, as in much of Vietnam, or where five rice crops in 24 months are common, as in parts of Java, the usual move has been from one, previously rainfed rice crop up to two irrigated crops. Irrigation has two effects. During the rainy season it improves the reliability of yields for it allows greater precision in water control by allowing control of application as well as drainage, previously the only, partial, method of controlling levels under rain-fed conditions. In addition it allows dry-season cultivation when generally clear skies and higher isolation result in yields that are usually higher than those of the wet season. However, only locally is there sufficient water to irrigate all potentially-irrigable land during the dry season. Consequently rice-land cropping indexes at national level mostly range from around 100 to about 120, Malaysia being exceptional at 156, though locally die index may reach 200, as in parts of Java (Fryer 1990, p. 174). For the region generally, about two-fifths of die rice land is irrigated.

Almost universally, the expansion of irrigation and in the Chao Phraya Delta, drainage which began in the mid-60s, has been accompanied by the now-familiar package of double-cropping, high yielding varieties (HYV's), mechanization of tillage (and, in Malaysia, of harvesting), the use of fertilizers, insecticides and other pesticides (Laine 1974, Daniel and Cheong 1976). In turn this has required some increase in labour input though mostly less than a doubling (Barker 1982, p. 153). The comparative study of northwestem Peninsular Malaysia and Aceh, northem Sumatera, by Gibbons et al. (1980), shows that while intensification was well under way in the former area by 1965, with a five-year lag in Aceh, by 1975 the percentage of adopters of die new techniques mostly exceeded 80 percent. The major exception was tractorization which in Aceh had scarcely begun. In Peninsular Malaysia's Muda Project, the adoption of combine harvesting on the 60 percent of the rice land suited to its use was also rapid, the first combines appearing in 1974 yet harvesting 35 percent of the crop within four years and causing severe loss of income amongst daily-paid labourers in die rice sectors (Bell et al 1982, pp. 262-263). This shift reflects the fact that multiple-cropping severely reduces the time available for soil preparation, which by using tractors can be accomplished while soils are still comparatively hard and dry (Abdul Mutalib b. Ahmad and Ong Kheng Hoi 1975, p. 338).

In die Philippines intensification of rice agriculture was also rapid. Under the stimulus of cheap government-supported credit, by 1980 over 85 percent of the irrigated area and 70 percent of the rain-fed land were under modem varieties with fertilizer use expanding 5.5 times between 1960 and 1979 (Fegan 1989). As elsewhere, the shift has been botte to two crops of rice a year or to one main-season rice crop with maize, vegetables, sweet potatoes and pulses either as "fore-crops" or as "after-crops" on residual soil moisture. Nishimura (1992), for example, describes contact production of cucumbers and tomatoes in Nueva Ecija.

By contrast, the Indonesian pattern has been radier different, especially in Java where it was the four decades from 1920 which saw substantial increases in rice-cropping intensity along with some expansion of the crop area. But even Java saw very substantial production increases from the late 60's to the mid-80's when about

three-quarters of the growth derived from increases in crop yields with the remaining quarter coming from stepped up crop ratios (i.e. increased crop frequency), the area of wet rice-fields, *sawah,* growing not at ail (Booth 1988, p. 38). Outside Java yields' growth accounted for over half of the total increase in production, except in Sumatra where increased yields and area expansion have been about equally important. The main rice areas of Kalimantan, Sulawesi and Nusatenggara appear to have missed the 1920-1960 period of intensification and have moved directly from extensification to a stage in which growth in yields rather than increased crop frequency accounts for much of the growth in production (Booth 1988, p. 40). These broad conclusions are supported by detailed case studies such as by Maurer (1986) and Hüsken(1989) for central Java, and by Cederroth and Gerdin (1986) for the eastem island of Lombok.

Documenting intensification in mainland Southeast Asia is more difficult than for the insular region since apart from broad-scale statistics little information is available Cambodia has seen the restoration of war-ravaged rice land to production, a process much hindered by the continued existence of uncharted minefields. In Vietnam restoration of the southern rice lands proceeded rapidly as former refugees and other urban residents, mainly close supporters of the defeated regime, were quickly decanted into so-called New Economic Zones, most of which were located in areas long abandoned because of the civil war. So effective has this been that the south has become a major source of rice exports. These are expected to grow as essential inputs, especially fuel, fertilizer, tractor spares and insecticides, become more available Of Burma and Laos little can be said beyond the fact that the Green Revolution has scarcely begun. Though both the rawaddi and the Mekong would appear to offer great scope for the development of irrigation any such will be highly capital intensive and it is doubtful that rice agriculture alone could provide an economic rate of retum on such investment.

The Thai case is rather different. While supplementary wet-season irrigation and drainage have been implemented on a large scale since 1960, this served mainly to stablize and to reverse a trend of falling yields under a single-crop regime until the mid-70's (Fukui 1978, 258). Since then, especially in the Chao Phrya Delta, a two-crop pattern has become more common, notably on the western side of the Delta, though the second crop is not necessarily rice since vegetables, legumes, peanuts, even fruit-trees may give higher returns. According to Takaya (1987, p. 248) 49 percent of the Delta area was to have been dry-season cropped by 1990, 15 percent each in rice, legumes, peanuts and the rest in vegetables and fruit-trees. The dissemination of HYV's in Thailand has been relatively slow for several reasons. Since the Kingdom is an exporter of premium rice grades, the early HYV's simply did not meet market requirements though later varieties, mostly specially bred by the Rice Department have met them. The use of such varieties is quite uneven being confined mainly to the Central Plain though even there their distribution is very uneven partly because two essential conditions for their use must be met: deep flooding must not occur until alter the end of August, late in the rainy season, and irrigation water must be available over the four-month growing period up to that Lime (Fukui 1978, p. 259). Locally, even more intensive rice production systems have developed. Anan Ganjanapan (1988, pp. 126-127), for example describes Ban San Pong village, near Chiang Mai, where triple cropping had begun, on an experimental basis, in 1968 and by the 1980-1981 season two-fifths of the land was triple cropped in a glutinous rice (main season) - rice or vegetables - non-glutinous rice rotation made possible not only by reliable water supplies, partly from tubewells, but also by the use of non-photoperiod sensitive HYV' s for the second and third crops, together with heavy fertilizer use, raising main-crop yields to a remarkable 5.5t/ha. Mechanization, mainly of tillage and pumping water, are now widespread and buffalo-raising has been relegated to single-crop areas, partly for lack of space for grazing Harvesting is now done largely by daily-paid labour rather than mutual help (Tomosugi, 1980) but it is probably only a matter of time before the rising cost of labour leads to broadcast sowing rather than labour-intensive transplanting and to combine harvesting. The effects of these processes of intensification upon local and regional environments are not well-studied but they clearly include eutrophication of freshwaters by excess nutrient derived from fertilizer, Laguna de Bay, South of Manila being just one case in point. The period in which rice-field fish such as *Channa striata* (snakehead), *Clarias macrocephalus* (catfish) and *Trichogaster pectoralis* (gouramy) can develop is substantially shortened under double cropping, resulting in undersized fish. The widespread use of pesticides, and in some areas, herbicides, also contributes to depressed production of fish, molluscs and crustacea from fields, drains and canals (Ahyaudin 1990). What is abundantly clear is that many rice production systems are now heavily energy-dependent, requiring substantial subsidies to obtain high yields. Jiragom, for example, has estimated that modem systems have deanased the energy output/input ratio to less than one. He notes, for Thailand, that for broadcast-seeded systems, industrially-based inputs account for 69 percent of ail inputs though accounting for only 23 percent under transplanting systems (Jiragom 1995, p. 173).

VII. INTENSIFICATION OF RAIN-FED CROPPING SYSTEMS

Although this topic has received much less attention than intensification by irrigation it is clear that they too have become more intensive not only by increasing the number of crops obtained from the same fields but also by increasing the yields of single-crop systems. Improved varieties of rice for rainfed conditions are beginning to spread though the major thrust of breeders, notably the International Rice Research Institute at Los Baños, Laguna, has been to get farmers to adapt the environment to the needs of the plant rather than the other way round. Such varieties respond to fertilizer with better panicle growth - and grain yield - whereas most traditional varieties do not. The adoption of wet direct seeding of rice, rather than time-consuming transplanting has led to double-cropping in favourable areas of the Phillipines (Fujisaka et al. 1993, p. 115) but few rainfed areas in the region have sufficient and sufficiently well-distributed rainfall to permit this.

Rather the approach has been to add a less moisture-demanding crop to the main rice crop. In northeast Thailand, for example, where rice occupies the land from August to December, crops such as sesame, peanuts, cassava, tobacco and vegetables have been successfully intercalated with rice (Anan and Marten 1986). A rather different situation exists in Vietnam where rice-rice rotations, because of high material and labour inputs, give lower net returns than rice-vegetable (eggplant, cowpea, squash) rotations. Cowpeas or peanuts have also been added to rice-rice rainfed rotations (Duong and Cho 1994, pp. 4-5). Another development has emerged in the Thai "maize belt" which stretches from Phitsanulok in the north to Nakhon Ratchasima in the south. Here land was rapidly developed for (export) maize monoculture in the 70's. In most of the older areas this seriously-amaging monoculture is no longer profitable even with the application of minerai fertilizer. This system is now being replaced by a four-year vegetables-maize-fallow-fallow system made possible by year-round irrigation of vegetables, cabbage, broccoli, canots, onions, peas, along streams. Alternatively, maize and vegetables are alternated without fallow, Riethmüller (1988, p. 85) concluding that areas with access to water will see increased intensification with less intensive use of the upper slopes lacking irrigation sources.

The intensification of production from perennial crops has received rather little attention in the literature and little more can be done than to draw attention to it. Most notable has been the underplanting of established coconut plantations with cocoa. Interestingly, this results in enhanced yields of both crops, coconuts probably by improved nutrition from fertilizer applications and by better soil moisture status through shading At the same tune, the light shade provided by mature coconuts results in higher yields of cocoa beans than if grown in the open. Much Malaysian cocoa is now grown in this way, including new plantings, though the Philippines, where coconut is much more extensively grown, has been slow to intensify production in this manner. The production of oil palm and rubber is inherently difficult to intensify. It is not economic to plant palms and trees closer together for to do so depresses yields per plant. Gathering oil-palm fruits is difficult to mechanize beyond using lorry-mounted cranes to load fruit. Tapping rubber has so far resisted mechanization though the use of latex stimulants has permitted a reduction in tapping and collection frequency without depressing yields. The main form of intensification of production has come from continued "genetic engineering" aimed at producing more per plant and lowering unit colts.

Fruit production in the region continues to expand despite some degree of competition in urban markets from temperate-country imports, while the prospects for tropical fruit exports, notably pineapples from the Philippines and durians from southern Thailand continue to expand, as also do the region's own urban markets. Genetic improvement has scarcely begun, that of durian, for example, aiming at increasing the proportion of edible pulp in the fruit. In mainland Southeast Asia there is considerable scope for increasing production of fruit by irrigation. Blanadet (1974), for example, describes its application to the production of rambutans and durians. Given that perennial free-crops have extended periods of immaturity before production can Begin - 3-4 years for rubber, up to 10 years for durian - this type of crop reflects a considerable increase in capital intensity as compared to the growing of short-term crops such as manioc or maize. (See, for example, Koentjaraningrat 1974, Ch'ng et al. 1976).

VIII. INTENSIFICATION OF SHIFTING CULTIVATION

Under the combined pressures of the need for cash and of population growth, it is doubtful that any system of shifting cultivation in the region has not intensified over the last several decades. Such intensification is marked not only by reduced fallows, in some areas to the extent that cultivation is now semi-permanent, but also by commercialization, the introduction of new crops and even monoculture. In some cases, more intensive production has been grafted onto existing shifting cultivation as with wet rice amongst the Temuan of

Peninsular Malaysia (Gall 1977) or pepper and rubber amongst the Kantu' of central Kalimantan (Dove 1985).

Just how much shifting cultivation has intensified is hard to establish. Certainly it is doubtful that much virgin forest is destroyed for this form. For the Philippines, Kummer has argued that if shifting cultivation be defined as characterized by short periods of cultivation followed by long periods of scrub and secondary forest fallow, then "...shifting cultivation is not as widespread as commonly assumed." (Kummer 1991, p. 88). He notes that on Cebu, for example, what had originally been a system of migratory maize cultivation was, by the 60's, basically sedentary, and notes many other examples of increased stability, some involving substantial increases in labour inputs, mainly to control weeds in very short (1-2 year) fallow systems, or a shift to high-input/high-output temperate vegetable production, as in north-central Luzon (Kummer 1991, p. 89). The cultivation of opium may be regarded as another form of intensification, in terms of financial return if little else, for it is easy to grow and readily bears the cost of transportation of the crude latex from inaccessible locations which are now mainly in Northeast Burma and parts of Laos rather than in Thailand where its former cultivation has largely been suppressed (see Gutelman 1974, for example). Effort to promote such substitutes as potatoes and cut flowers have been largely unavailing except where easy access to transportation is available.

Changes in crop assemblages have also been part of the process of intensification. In north-central Luzon, for example, where shifting cultivation is a common supplement to terraced wet rice, swidden rice is no longer to be found rince sweet potatoes provide a higher yield of carbohydrate, area for area. In northem Thailand Keen (1972, p. 30) reported that *Solanum* potatoes, both for subsistence and for cash had become common, likewise chili, with yams, taro and cassava mainly for the former. Amongst the Karen and Lua, swidden-grown cotton for hand-weaving and the crafting of clothing, both to wear and for sale to tourists, bas expanded (Keen 1972, p. 31). But shortened fallows remain the major means of intensification as Katin Srimongkol and Marten's study (1986) of Lahu and Yunanese in the Kae Noi highland, NW of Chiang Mai illustrates. There the land is cropped, with rice and maize for food, sesame and opium for cash, for one or two years followed by fallows of about the same duration.

One further form of shifting cultivation that is intensifying is *taungya,* a system devised in Burma by colonial foresters who intercalated teak *(Tectona grandis)* into swidden systems in which teak seedlings were planted in clearings along with rice, maize and other short-term crops, silvicultural activities being maintained by villages under official supervision. From Burma the system was spread elsewhere, in the region to northem Thailand and to Java notably. It is in Java that successful efforts have been made to improve taungya by using HYV's, better land preparation, fertilizers and improved timing of their application as well as enhanced control of pests and diseases, thus moving to a high input regime. The yields of short-term crops have increased markedly and the enhanced labour demand, now 230 person-days per hectare, has helped to provide employment. Since a government subsidy for some inputs is now withdrawn the long-term benefit is not clear especially as the teak, valuable though it is, grows on an 80-year rotation (Simon and Wiersum 1992).

One basic question remains however. Is increased intensity of use sustainable in even the medium term, let alone the long run? So far as soils derived from basic volcanic materials are concemed - the "terres rouges" of Vietnam and Cambodia, much of Java, Bali - the answer is probably yes. In Indonesia, the annual cultivation of *"padi gogo"* on moderate slopes, with the occasional fallow and limited soil conservation, has existed, on the same land, for many decades. But most upland soils are rather poor in nutrients. It is doubtful that swiddens are necessarily abandoned because crop yields fall in step with lowered nutrient status - the matter has never been widely investigated in the region - and it seems likely that abandonment is caused by the reluctance or inability of cultivators to apply sufficient labour in the face of burgeoning regrowth and weed infestation (Hinton 1978). Where such labour is applied the system becomes semi-permanent though at risk of low yields and of long-term damage through levels of soil erosion three or four orders of magnitude greater than under long-cycle shifting cultivation where soi loss is quickly reduced by crop growth and forest regeneration. (See Hill and Peart 1996, for a review).

Possible strategies for the development of swidden areas have been outlined by Kunstadter (1978) and by Chapman (1978). Given present crop assemblages, one of the few viable alternatives seems to be to promote after-crops that use residual soil moisture or longer-term annuals such as cotton, peppers, tobacco. Another is planting trees. Teak is problematic because of its long rotation. But other species, Eucalypts, Acacia, reach merchantable size in 20-25 years. However, annual crops cannot be grown under trees for more than a couple of years, so how is subsistence to be gained? In equatorial regions, Sarawak is one, planting rubber in swiddens bas transfonned many swiddeners into perennial-crop

smallholders (Jensen 1966) and there is obvions scope for this transformation provided the necessary technical back-up and access to markets are available. Irrigation potential is limited by high capital cost, small catchments and consequential vulnerability to drought. Improvement of crop varieties holds considerable promise but until now little has been done, not even to identify the mechanisms by which existing plant materials are exchanged amongst individuals and communities. Changes in crops towards those of higher value are technically quite simple but economically problematic by reason of market access. Opium, because of its high value, does not suffer from this and is an ideal crop economically and environmentally. But virtually all produced is destined for illicit markets and production for the legal, pharmaceutical market would be almost impossible to police adequately.

Out-migration and population control are other processes likely to have their impact on agriculture. Already upland people, in Thailand especially, are partly integrated into the wider economy and society by way of temporary migration, especially to urban jobs in the dry season. This integration is likely to increase, possibly reducing the rates at which traditional upland agriculture is being intensified. The problem is, of course, most acute in the more monsoonal parts of the region, the mainland and Nusatenggara, where perennial free-crops such as rubber, oil palm, coconut and cocoa cannot thrive.

IX. DISINTENSIFICATION

Although intensification has been a dominant process over the last several decades and although the agricultural work-force continues to grow, it is clear that the opposite process has begun, or at least a plateau of stability has been reached in some areas. The latter does not imply active withdrawal of labour from agriculture but rather the addition of off-farm, non-agricultural work to the repetoire for subsistence. This has involved some shifting cultivators but many more lowlanders, especially in rain-fed crop areas where the annual labour commitment may be no more than around 150 days per hectare.

Disintensification has thus far received little attention though in some areas, notably Peninsular Malaysia, the results - buffaloes grazing former rice fields - are there for ail to see. Parnwell's study of northeastern Thai villages showed that migrants were absent, on average, nearly a year. He notes that "...agriculture in particular has been adversely affected by the periodic departure of large numbers of villagers to work in town: fields had been left fallow or cash crops not cultivated, sometimes for several years, because family labour had been insufficient during peak farming periods and because households could not afford to hire labour or machinery to compensate; fields, drainage ditches and irrigation canais had been neglected because migration had interfered with the farmer' s ability to undertake routine field maintenance, or the ability of the village headman to muster sufficient support for community projects, both of which are traditionally undertaken during the dry season, which is when the majority of migrants are away from the village." (Parnwell 1986, p. 110).

The incidence of disintensification seems to be highly variable both with respect to crop and location. In Peninsular Malaysia, for example, it is mostly rice land that has been abandoned to the buffaloes though rubber has also been abandoned, especially in periurban locations on uneconomically small holdings and where the trees are old or of poor quality. Rubber trees do not suffer from abandonment and can readily be put back into production if circumstances warrant. Not so rice. Here abandonment has been substantially in one, relatively poor state, Kelantan, which accounted for 51 percent of idle paddy land in the mid-80s. There a high proportion of the land capable of being double-cropped was actually cropped only once. In states without extensive irrigation - Negri Sembilan, Melaka, Johor and Pahang, rather little rice land is now cultivated. In aggregate more than half of the rice land, by the mid-80's had been left idle for more than three years or during the dry season (Sivalingam 1993, pp. 45-47). Sivalingam (1993, p. 45) summarizes the reasons as out-migration of youths, large households with small farms and out-migration of tenants unable to rent sufficient land on reasonable, secure terms. Unquestionable, too, is the fact that once irrigation and crop areas fall below a threshold, difficulties of maintenance and losses because of weeds and birds rise.

But a basic reason is the rise in the cost of labour vis-a-vis urban employment for just over half of the country's population now lives in town. Despite govemment support, now being restructured and in part withdrawn, rice production especially, simply cannot compete in increasingly deregulated markets, except by increasing labour productivity, greater capital input and, ultimately farm consolidation to take advantages of economies of scale (Sivalingam 1993, pp. 9-10). Malaysian government projections for 1990-2010 foresee an annual decline in agricultural employment of 1.6 percent a year, a rate not substantially below natural rates of population growth. At the policy level a World Bank study shows that preparing rural youths of non-agricultural employment is more effective in raising incomes than increasing the productivity of small farms. Support for

the remaining peasantry is thus likely to follow the European welfare-based path while a minority becomes fully commercialized. And where Malaysia leads, others will follow.

X. CONCLUSION

The discussion thus returns to the outset. Massive structural change is likely to continue though its pace will vary not only in response to macro-economics - slowing when times are bad, speeding up when they are good - but also in response to government policies aimed at cushioning the social and economic effects upon farmers of that change. It seems likely that intensification will continue for a period, where it has not already reached a plateau. For one thing populations continue to grow and must be fed. But they are also becoming wealthier over all even if the spread between rich and poor generally seems to be increasing. This is already resulting in changes in food habits - less rice, more fruits vegetables, fish, meat and even dairy products as Tasker (1997) notes for Thailand, and these changes will feed back to agricultural systems. At the same time, agri-business is increasingly moving into crops other than the perennials with which it has long been associated, either directly or indirectly via contract farming (Cordova n.d., Glover and Lim 1992).

Macro-level structural change, however, remains the basic "driver" of changes in agriculture and the rural sector generally. So far as benefits and costs of change are concerned an important issue remains that of poverty.

The consensus seems to be that few rural people are absolutely poorer, at least in quantitative terms than by qualitative measures though exceptions clearly exist. Bovis and Haddad (1990, p. 188) point to the fact that pre-school children of maize and sugar producers in Bukidnon, Philippines, were receiving only 75 percent of "adequate food". Rola (1991) and Lumanta (1991, pp. 234-235), also point to nutritional inadequacies in the Philippines during the period 1982-1987 though by 1989 the proportion of malnourished children had dropped to 14 percent. Certainly in food intake terms great strides have been made sine the 60's (Table 6) though aggregates may hide considerable ranges.

Nevertheless estimates suggest by the year 2000 Burina will still have 29 million poor people, up from 20 million in 1975, and Indonesia 30 million, clown from 76 million in that year (Krishna 1985, p. 23), most of them likely to be rural. Poor rural people are also likely to be around for some decades in the former Indochina where the substitution of production contracts and

Table 6 : Average Calorific Intake (per day), 1965, 1989

	1965	1989
Burma	1917	2440
Cambodia	2276	2166
Indonesia	1800	2750
Laos	1956	2630
Malaysia	2247	2774
Philippines	1924	2375
Thailand	2101	2316
Vietnam	n.a.	2233

Sources: *World development report* 1989, 1992

substantially free markets for collectives (less common in Laos) and closed markets has been the major foret of structural change. In Vietnam the trial introduction of contracts in Vinh Phu province at the end of the 60's failed, for ideological reasons, and it was not until a decade later that it was implemented, partly because of the severe difficulties in collectivizing agriculture in the South where the peasant response was to revert substantially to subsistence production thus partly starving the urban sector. Since 1989, when collectivization was formally abandoned as policy, farmers have been required to sell only a small fraction of their trop to the state at prices below those of the market. In the rice sector the response was dramatic and Vietnam now exports 1.0 to 1.5 million tons a year and ranks as the world's third largest exporter (Ljunggren 1993). This development seems to have little effect upon the structure of the peasantry in the South where, in 1981, a quarter of the households had no or insufficient land (Ngo Vinh Long 1988, p. 140).

That proportion is low compared with the Philippines where at least two-fifths of so-called peasants (really the rural proletariat) have neither land nor access to it as tenants. Indeed, in the region generally it seems likely that both rural day labourera and tenants foret a significant proportion of permanent rural-urban migrants. Others make ends meet by circular migration and the receipt of remittances from family members in towns. Reduced travel costs not only increase the participation of rural familier in off-farm employment in towns or other agricultural areas (World Bank 1983, p. 3) but increasingly allow the emergence of true large-region and national markets for produce and encourage specialized production despite market risks. It is worth noting, however, that significant numbers of farmers seek to spread risk by ensuring their own food supply. With time, however, it seems likely that the opportunity costs of so doing will rise, as clearly they have for perennial

ree-crop producers. At aggregate levels, however, national agriculture has clearly become more diversified. Malaysia has added significant areas of oil palm, cocos, vegetable and fruits to what in the 50's were virtual moncultures, rice in the lowlands, rubber on the hills Thailand has added manioc, maize and kenaf by developing, sometimes ill-advisedly, its less-steep uplands. The Philippines has brought hybrid maize, peanuts, soyabeans, pineapples, manioc, oil palm and vegetables to significant levels of production where once rice and sugar were the mainstays (Gonzales 1984). Three things seem clear. Structural change will continue. Markets are becoming freer and market signais stronger (Praipol Koomsup 1979). Govern ments are intervening less and, proportionately, spending less on an agricultural sector that is steadily becoming relatively less important as a producer of goods and prospectively will become less significant as an employer of people.

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