

# Coconut development in Thailand and its stimulation by cocoa (1)

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**Summary.** — Coconut plantations in Thailand are low yielding, often failing to meet national requirements for coconut products. The typical Thai Tall coconut has few, large fruits, shows extreme yield heterogeneity and is not precocious. Lack of soil selection and climatic stress limit yields and cause annual and seasonal fluctuations. It is hoped to increase yields by replanting using precocious, homogeneous and high-yielding hybrid varieties, and through rehabilitation. Cocoa is a recent introduction to Thailand and it is thought that the use of cocoa as a perennial intercrop can be used to stimulate coconut replanting and, in particular, rehabilitation projects, allowing for crop diversity and increased land unit returns. This is illustrated both in theory and practice. The importance of rigorous varietal selection is indicated. Two strategies for coconut development are required. That for replanting using modern, high input, agricultural techniques, while appropriate, low input technology is better suited to rehabilitation, in anticipation of lower returns.

## INTRODUCTION

Of the estimated 417 600 hectares planted with coconuts in Thailand, the average farm size of 2.4 hectares indicates the predominance of smallholdings. Yields are low, being estimated at 22.1 nuts per palm per year [Office of Agricultural Economics, 1982] although this figure ignores on-farm consumption. The traditional planting of coconuts is in a small house plot, often admixed with fruit trees. A large proportion of coconuts are thus grown for domestic consumption and few farm families are dependent on the crop. Little soil selection is carried out and inputs are low. Despite the large nut, weighing 1.45 kg [Harries, Thirakul & Rattanaprak, 1982], national coconut production is often insufficient to meet internal demand, and imports of coconut products are necessary. In 1982, the Ministry of Commerce estimated that US \$ 6 923 096 of coconut products were imported, although imports were greatly curtailed in subsequent years.

The function of the Coconut Development Project is to increase both national coconut production and coconut farmer incomes. This is being done by varietal improvement and promotion of correct cultural practices. Intercropping is considered to be an essential element in the successful implementation of the project. Cocoa is one of the most promising intercrops of coconut, although it is speculative whether symbiotic interactions cause the superior economic performance of the combination [Etherington & Karunanayake, 1981] or that cocoa does not adversely affect coconut yields [Shepherd, Gilbert & Cowling, 1977]. Coconut and cocoa in combination have been shown to be preferable to oil palm or rubber [Lim & Chai, 1978]. The combined coconut/cocoa system is receiving particular attention as a tool for stimulating increased coconut production in Thailand.

## COCONUTS IN THAILAND

### Varieties.

The coconut genetic resources of Thailand have been reported [Harries *et al.*, 1982]. In summary, the typical Thai Tall (THT), locally known as Maphrao Yai, carries relatively few, large fruit, typically rounded in shape, and is not precocious. Exceptionally large-fruited (ka-loke) and, especially, medium-fruited (Klang) varieties are extremes of the Maphrao Yai population. In addition, Pak Chok, with smaller, elongated fruit, Thalai Roi, with up to one hundred small nuts on a single bunch, and five indigenous dwarf varieties are recognised. Maphrao Yai is the predominant form in cultivation, but is heterogeneous, with a high proportion of low yielding palms (Table I). This, combined with lack of precocity compared with hybrid varieties (Table II), makes it unsuited to rapidly increasing coconut production. Of the hybrid varieties being tested for local suitability, Malayan Yellow Dwarf (MYD) × West African Tall (WAT), and THT × WAT, which combines a large, traditionally acceptable fruit with both precocity and high yield, have the greatest potential.

### Environment.

80 per cent of coconuts in Thailand are grown in the central and southern Provinces. There is minimal soil selection and no « typical » environment. Chumphon Horticultural Research Centre (CHRC), responsible for coconut research in Thailand, is situated in Chumphon, the northern most Province of peninsular Thailand (Fig. 1). It can be used to give an « average » meteorological profile for coconut growing areas in Thailand (Fig. 2). Moderately severe dry weather may occur in some years. Conditions associated with the dry season cause pronounced seasonality of yield. Minimum temperatures and percentage of rainy days are positively correlated with yield 12 months later, while sunshine hours show a negative correlation [Dootson, 1983]. Absolute rainfall did not affect seasonal yield trends, but the lowest two consecutive months rainfall was strongly correlated with total yields in the following year [Dootson, 1983 ;

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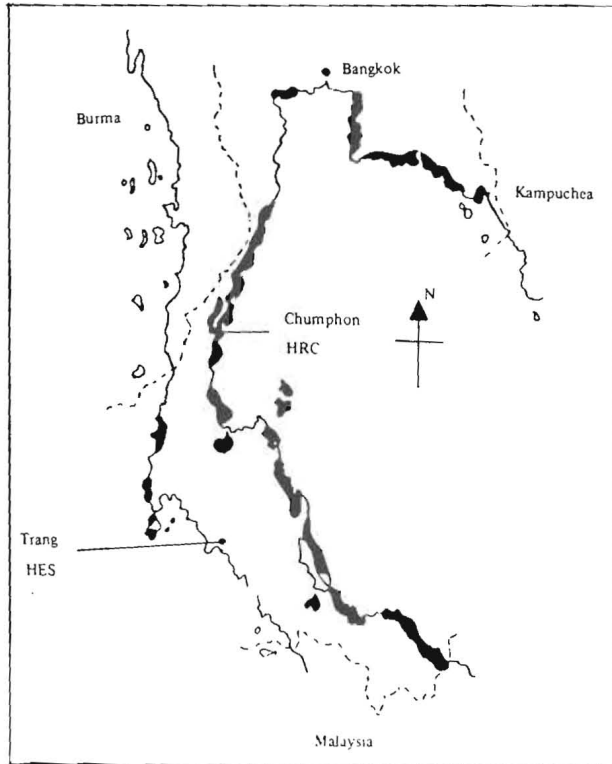


FIG. 1. — Southern Thailand showing main coconut growing areas (Thaïlande du sud, principales régions de culture du cocotier)

FIG. 2. — Meteorological profile for CHRC for 8 years (Profil météorologique sur 8 ans pour le CHRC).

a) Pluviométrie (mm/mois) ;

b) % jours de pluie/mois ;

c) évaporation journalière (mm) (bac d'évaporation) ;

d) températures moyennes (minima et maxima) ;

e) insolation journalière (heures) ;

f) % hygrométrie moyenne ;

g) direction principale du vent.

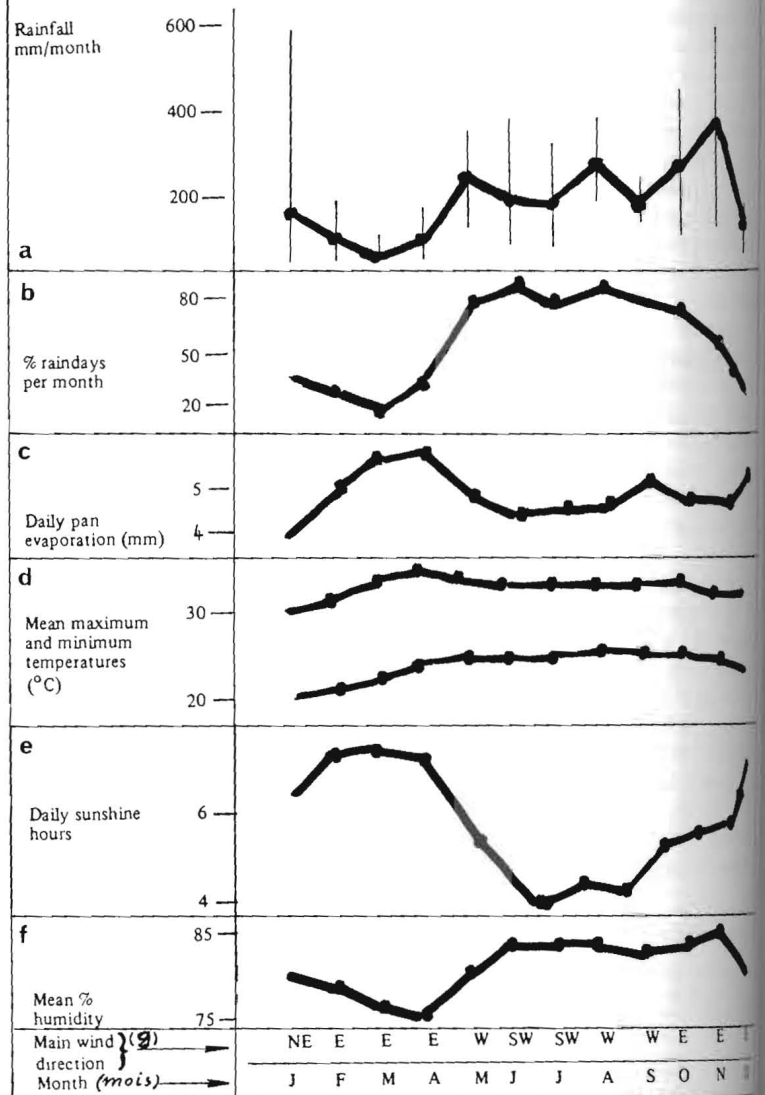


TABLE I. — Percentage of palms from two populations of unfertilised 20-year old Thai Tall coconuts in each of five nut count ranges

100 d'arbres de 2 populations de cocotiers Grands thaïlandais, âgés de 20 ans sans engrais pour 5 catégories de noix)

	Nuts/palm (Noix/arbre) ( $\geq 10$ cm)					Mean/palm (Moyenne/arbre)
	0-19	20-39	40-59	60-79	80-99	
Population 1	53.9	37.5	6.3	1.6	0.8	18.83
Population 2	22.7	37.5	28.9	9.4	1.6	35.27
Mean (Moyenne)	38.4	37.5	17.6	5.5	1.2	27.05

TABLE II. — Number of 7-year old palms from three varieties of fertilised coconuts in each of four yield ranges

(Nombre d'arbres âgés de 7 ans de 3 variétés de cocotiers avec engrais dans chacune des 4 catégories de production)

Variety (Variété)	Yield (nuts/palm) (Production - noix/arbre)				Mean (Moyenne)	% palms bearing (% arbres en (kg coprah/ production)	kg copra/ nut (kg coprah/ noix)	kg copra/ha (kg coprah/ ha)
	0	1-40	41-80	81 +				
WAT (GTH)	44	35	1	0	7	45	0.344	385
WAT × WAT (GTH × GOA)	17	36	26	1	28	79	0.285	1,276
WAT × WAT (NJM × GOA)	1	24	35	20	57	99	0.221	2,014

TABLE III. — Annual yields, in kg copra/ha, of MYD × WAT coconuts under different fertiliser regimes

(Rendements annuels en kg de coprah/ha des hybrides NJM × GOA selon des barèmes différents de fumure)

Nutrient level (Doses d'engrais)	kg copra (coprah)/ha				Total cost of fertiliser <sup>d</sup> (Coût total des fumures)	Return at (Revenus à) 7 Baht/kg
	Year (Année) 4	Year (Année) 5	Year (Année) 6	Year (Année) 7		
kg/ha/year(/an)						
Nil (Nul)	0	41	35	142	0	1,526
Nitrogen <sup>a</sup> (Azote)						
0	0	129y	417	2,047	20,890	18,151
32	7	826x	317	2,248	22,648	23,786
64	0	747xy	239	1,937	24,409	20,461
96	43	832x	294	1,812	26,167	20,867
Potassium <sup>b</sup>						
0	0	13y	56	454y	12,084	3,661
115	14	691x	236	1,898x	18,248	19,873
230	0	747x	239	1,937x	24,409	20,461
345	47	1,012x	222	1,989x	30,572	22,890
Magnesium <sup>c</sup>						
0	0	716	201	1,565	19,151	17,374
22	21	753	295	1,762	21,782	19,817
43	0	747	239	1,937	24,409	20,461
65	63	1,169	423	2,275	27,040	27,510
p	ns	**	*	***		

<sup>a</sup> — Nitrogen as nutrient N supplied as ammonium sulphate, always with 45 kg triple superphosphate, 230 kg muriate of potash and 43 kg kieserite (all to nearest kg) (Azote, N, apporté sous forme de sulfate d'ammoniaque, avec toujours 45 kg de superphosphate triple (SPT), 230 kg de chlorure de potasse et 43 kg de kiesérite - arrondis au kg).

<sup>b</sup> — Potassium as nutrient K<sub>2</sub>O supplied as muriate of potash, always with 64 kg ammonium sulphate, 45 kg triple superphosphate and 43 kg kieserite (all to nearest kg) (Potassium, K<sub>2</sub>O, apporté sous forme de chlorure de potasse, avec toujours 64 kg de sulfate d'ammoniaque, 45 kg de SPT et 43 kg de kiesérite - arrondis au kg).

<sup>c</sup> — Magnesium as nutrient MgO supplied as kieserite, always with 64 kg ammonium sulphate, 45 kg triple superphosphate and 230 kg muriate of potash (all to nearest kg) (Magnésium, MgO, apporté sous forme de kiesérite, avec toujours 64 kg de sulfate d'ammoniaque, 45 kg de SPT et 230 kg de chlorure de potasse - arrondis au kg).

<sup>d</sup> — Total cost of fertiliser since planting. In years 1 to 4, 12.5, 25, 50 and 75 p. 100 of the final rates are applied (Coût total des fumures depuis la plantation. De l'année 1 à l'année 4, respectivement 12,5 p. 100, 25 p. 100, 50 p. 100 et 75 p. 100 des doses définitives sont appliquées).

Lower case letters x and y indicate where treatments within a comparison are significantly different at the 5 p. 100 level using Duncan's Multiple Range Test (Les lettres x et y en minuscules indiquent les traitements qui, dans une comparaison, sont significativement différents à 5 p. 100 d'après le nouveau test de Duncan de gammes multiples).

p — This indicates the probability of a real effect-occurring as indicated by analysis of variance (ns = not significant. \*, \*\* and \*\*\* represent 5, 1 and 0.1 p. 100 probabilities). This notation is also used in Tables IV and VII. (p indique la probabilité de l'existence d'un effet réel mis en évidence par l'analyse de la variance (ns = non significatif, \*, \*\* et \*\*\* représentent respectivement une probabilité de 5, 1 et 0,1 p. 100. Ces symboles sont également utilisés dans les tableaux IV et VII).

Abeywardena, 1968]. Recent findings indicate that the highest yielding palms within a population may be proportionately more stressed by drought.

### Cultivation.

Traditionally, coconuts receive low levels of inputs, and consequently grow best along the coast or on deep, fertile soils with reliable ground water. Traditional preference was to use superior inland soils for indigenous fruit trees, but modern diversification has led to use of these soils for rubber and oil palm. Ribbon development has frequently led to unhealthy stands of coconuts on inferior soils, especially susceptible to environmental stress.

Fertiliser is rarely applied, although domestic waste and organic manures may be used, particularly close to houses. Weed control is minimal and largely confined to bearing stands. Mulching is rarely practiced and weed spoil and fallen coconut fronds are usually burned. Some inland farmers may apply unrefined sea salt, and there is local evidence to suggest that this is beneficial.

Harvesting is irregular, either using a curved knife lashed to a long bamboo pole or with the assistance of trained pig-tailed macaques, these monkeys being common in the forests of southern Thailand. Large fruits are preferred in internal trade, while small fruits are rejected on-farm, and converted into copra by sun-drying or over a smoky fire of coconut husks. Seasonal surpluses are converted to copra on a semi-industrial scale. The viviparous nature of Thai Tall coconuts allows farmers to respond to falling prices by delaying harvesting.

### Replanting.

Replanting, using precocious, prolific hybrid varieties, is an integral part of the strategy of the Coconut Development Project. The technology for replanting is imported, necessitating local assessment and adaptation. The costly inputs involved make it essential that soil identification and selection are carried out. Current fertiliser recommendations are annual application of 4 kg of a 13 : 13 : 21 NPK compound and 2 kg of dolomitic limestone at maturity. These recommendations are undergoing urgent redefinition. Leguminous covercropping is promoted, where no intercrop is grown.

Early results from MYD × WAT grown on Chumphon series soil, an unfertile and highly erodible red-yellow podzolic type, indicate enhanced precocity through fertiliser use (Table III). Ammonium sulphate application induced marked precocity but this effect rapidly declined in the presence of a leguminous cover-crop. The effects of potassium chloride application are predominant, but with no indication of luxury requirement. The benefit from early yield must be balanced against the high cost of application of inorganic nutrients. Ultimately it will be seen whether the cost of enhanced precocity was justified.

Experimentation is currently being carried out to determine the optimum spacing for monocropping MYD × WAT, and the implications of spacing on fertiliser policy. The current spacing recommendation of 8.5 m triangular may prove to be a compromise between the anticipated optimum for monoculture and the lower density appropriate for intercropping.

### Rehabilitation.

Proposals for rehabilitation through fertiliser use have recommended the same rates of nutrient application as

those for replanting with uniform, precocious and high yielding coconuts. As Table I shows, variability of genetic yield potential within the Thai Tall population even under good management can be expected to constrain the response to fertiliser. Table IV shows that the yield response of Thai Tall coconuts to fertiliser applications is variable. At one site, a real yield response is insufficient to justify the cost of fertiliser used, while at another site, and economic response in one year could not be statistically verified. Annual fluctuations and limited responses to applied fertiliser justify extreme caution in recommending rehabilitation through fertiliser use. Where coconuts have been planted on inferior soils, juvenile neglect leads to reduced girth, which in turn will reduce the ability of the palm to translocate applied nutrients and thus diminish the potential for rehabilitation.

More emphasis needs to be placed on low input rehabilitation using intercropping and improved management. This would include mulching and recycling nutrients, weed control, soil and water management and optimal fertiliser use. Intercrop establishment under existing stands of coconut is constrained by the great variability of observed spacings. Random coconut planting prevents systematic intercrop planting, while close spacing necessitates palm thinning and wide spacing may require secondary shade establishment.

## COCOA IN THAILAND

Varieties of cocoa in Thailand are few and largely untested. No large plantings exist although many small farmers are experimenting with the crop. Most bearing material is of unselected, open pollinated, modern Upper Amazon type. Recent acquisitions at CHRC include clones and identified F1 hybrids from Malaysia, and clonal budwood from Kew and Miami. Early results indicate that some named F1 hybrids are more vigorous and precocious than open pollinated modern Upper Amazon material, but not exclusively so (Table V). This concurs with the contention that modern Upper Amazon hybrids may develop vegetatively at the expense of crop under certain environmental conditions [Lockwood, 1985]. Long term yield trends must be determined on the inferior soils planted with coconut before any, specific hybrid can be recommended. On the basis of promising early yields, and success elsewhere, Pa 7 × Na 32 and UIT 1 × Na 32 can be considered suitable. Unselected open pollinated cocoa performs well on inferior soils given good management. Yields given in Table VI are from plants of modern Upper Amazon type on Visai series soil at CHRC under local tall coconuts at 9 metres square planting. Returns are good and certain individuals give 2.5 times the average yield of the population, indicating good prospects for clonal selection. Visai series is a less erodible and more fertile form of Chumphon series previously mentioned. The first hybrid seed gardens have been planted at CHRC and a Trang Horticultural Experiment Station some 400 kilometres further south. These seed gardens are guarded biconal types producing the following hybrid crosses and their reciprocals.

Pa 7 × Na 32, UIT 1 × Na 32, UIT 1 × Na 32

The guard areas will produce mixed seed of Na 32 with Pa 7 and UIT 1, and UIT 1 with Na 32 and Na 33. The choice of clonal parents was based on early results from hybrid variety trials already mentioned (Table V).

TABLE IV. — Annual yields of 2-year old Thai Tall coconuts in response to fertiliser application at two sites.  
(Rendements annuels de cocotiers Grands thaïlandais âgés de 2 ans en réponse à une fertilisation sur 2 sites).

Kg 13 : 13 : 21 NPK compound/palm/year engrais complet kg/arbre/an	Yield (nuts/palm/year) (Rendement - noix/arbre/an)					
	Site 1			Site 2		
	Year (Année) 1 <sup>a</sup>	Year (Année) 2	Year (Année) 3	Year (Année) 1	Year (Année) 2	Year (Année) 3
0	11.5	27.8	47.3	14.6	15.5	10 y
1	11	31.4	62.1	20.6	18.8	12.6y
2	13.9	26.8	58.6	15.9	25.3	9.9y
3	16.1	31.6	65.4	19.4	23.1	21.3x
4	11.5	28.6	57.4	21.7	27.6	24.6x
5	12.1	35.5	63.4	19.9	21.9	21.2x
p	ns	ns	ns	ns	ns	***

<sup>a</sup> — 3 months data only (données s/3 mois seulement).

Lower case letters represent statistically similar groups at 5 p. 100 using Duncan's New Multiple Range Test (Les lettres en minuscules représentent les groupes statistiquement semblables à 5 p. 100 avec le nouveau test de Duncan à gammes multiples).

TABLE V. — First 4-years yields of some named F1 cocoa hybrids compared with modern Upper Amazon open pollinated material  
(Rendements des 4 premières années de quelques cacaoyers hybrides F1, comparés au matériel de Haute Amazone moderne issu de fécondation libre)

Variety (Variété)	Beans/100 grams (Fèves/100 g)	Kg dry beans/ha (4 years) (Kg fèves sèches/ha - 4 ans)
Pa 7 × Na 32	108	1,895
UIT 1 × Na 32	80	1,258
Na 33 × ICS 60	113	1,163
Upper Amazon (Hte Amazone)	100	1,118
UIT 1 × Sca 6	84	678
UIT 1 × Na 33	81	648
Pa 35 × Na 32	96	339

— Planted at 606 points/ha under 20 year old Thai Tall coconuts at 156 points/ha (Plantation à la densité de 606 arbres/ha sous cocotiers Grands thaïlandais de 20 ans, plantés à 156 arbres/ha).

TABLE VI. — Yield of unselected open pollinated Upper Amazon cocoa under coconuts  
(Rendements du matériel de Haute Amazone non sélectionné, issu de fécondation libre, sous cocotiers)

Years from planting (Années après plantation)	Kg dry beans/ha (Kg fèves sèches/ha)	Ha equivalent yield of best individual (kg dry beans) (Rendement/ha du meilleur individu — kg fèves sèches —)
2	246	1,064
3	759	2,149
4	937	2,450
5	594	1,580
6	1,017	3,128

— Planted at 988 points/ha under 15 year old Thai Tall coconuts at 123 points/ha (Plantation à la densité de 988 arbres/ha sous cocotiers Grands thaïlandais âgés de 15 ans plantés à 123 arbres/ha).

## COCOA UNDER COCONUTS

A study carried out at CHRC demonstrates the performance of modern Upper Amazon cocoa planted under coconuts, and illustrates the increase of economic return once the cocoa comes into bearing. Table VII shows that there is no significant change in yields of coconut

TABLE VII. — The effect of underplanting cocoa on 15-year old Thai Tall coconuts, and the yields and returns from the system

(Effet de la plantation de cacaoyers sous cocotiers Grands thaïlandais âgés de 15 ans, et rendements et revenus qui résultent de cette association)

Year (Année)	Kg copra/ha (Kg coprah/ha)	Baht/ha	Kg dry beans/ha (Kg fèves sèches/ha)	Baht/ha	Gross return (Revenus bruts) (Baht)	Net return (Revenus nets) (Baht) <sup>a</sup>
1	2,175	13,594	0	0	13,594	6,328
2	1,281	8,969	0	0	8,969	1,703
3	2,069	14,481	106	3,188	17,669	10,403
4	2,344	16,406	328	9,831	26,237	18,971
5	1,863	13,038	185	5,544	18,582	11,316
6	1,550	10,850	242	7,247	18,097	10,831
7	1,681	11,769	621	18,626	30,395	23,129
8	1,514 <sup>b</sup>	10,598 <sup>b</sup>	1,008	30,238	40,836 <sup>b</sup>	33,570 <sup>b</sup>
9	1,435 <sup>b</sup>	10,045 <sup>b</sup>	708	21,253	31,298 <sup>b</sup>	24,032 <sup>b</sup>
10	1,183	8,281	1,608	48,236	56,517	49,251
r	-0.54					*0.90
p	ns					***

Cocoa planted at 469 points/ha under coconuts at 156 points/ha (Cacaoyers plantés à 469 arbres/ha sous cocotiers plantés à 156 arbres/ha).

a. Net return calculated at 7 Baht/kg for copra and 30 Baht/kg for dry cocoa beans, less a calculated cost of 7,266 Baht/ha/year for all inputs (1 US \$ = 25.5 Baht) (Revenus nets calculés à 7 Baht/kg pour le coprah et à 30 Baht/kg pour les fèves de cacao, moins un coût calculé de 7 266 Baht/ha/an pour l'ensemble des intrants — 1 \$ US = 25,5 Baht).

b. Calculated values in the absence of accurate coconut yield data (Faute de données précises pour le rendement des cocotiers, ces valeurs sont des estimations).

r = Correlation coefficient of the linear regression  $Y = a + bx$ , where  $x$  = year and  $y$  = kg copra/ha, or net return in Baht/ha (Coefficient de corrélation de la régression linéaire, avec  $Y = a + bx$ ,  $x$  = l'année et  $y$  = kg coprah/ha ou revenus nets en Baht/ha).

after planting cocoa. This agrees with Shepherd *et al.* [1977], but does not disprove synergism, as the coconuts were previously fertilised. Shade effectively reduces potential cocoa yields [Cunningham, 1963] and therefore coconut and cocoa in combination are an amenalistic polyculture [Hart, 1974]. There is no observable effect on the coconut and a negative effect on the cocoa. This is probably not true if coconuts are previously unfertilised on unfertile soils.

Using the data already given, a theoretical model can usefully be constructed to predict the economic performance of cocoa planted under mature coconut. The simplistic comparative models and their associated assumptions are shown (Table VIII). These illustrate that although rehabilitation through fertiliser use can successfully increase farm revenue, planting cocoa as an intercrop offers three times the benefit, with negative cash flow only in the first year.

## DISCUSSION AND CONCLUSIONS

Much is to be gained through increasing coconut production in Thailand. The strategy for this must be clearly defined and, through peculiarities of local conditions, cannot be imported as an exotic technology package. Replanting using MYD × WAT appears the most attractive option for increased national coconut yields, but suffers several soluble constraints.

Many Thai Tall coconuts are on inferior soils where reduced responses to high levels of inputs are likely because of limitations other than infertility. Soil selection is necessary in any replanting programme. New plantings on superior soils should also be considered. Traditional coconut cultivation will oppose success of MYD × WAT if it is considered an alternative to local Tall. Despite

good culinary qualities, small fruit size will act against MYD × WAT being adopted by the local fresh fruit trade. As traditional practice is to convert small fruits to copra for this reason, emphasis needs to be placed on the aspect of growing this variety as an oil crop. If it is treated by local farmers as a traditional coconut, they will be disinterested because of the small fruit, and the low input cropping practised will prevent MYD × WAT from realising full yield potential.

Replanting initially offers limited opportunity for promoting cocoa as an intercrop, because of the delay between planting the palms and the formation of a coconut canopy to provide shade for cocoa establishment. On superior soils, F1 cocoa hybrids can be introduced in anticipation of high returns. Intercropping may be seen as necessary to supplement coconut revenue as increased national coconut production will probably depress prices. A recommendation for a compromise spacing restricts the full potential of coconut replanting. A rational decision should be taken whether to attempt high density monocropping or to adopt wider spacing to accommodate cocoa intercropping at maturity. More specific fertiliser recommendations are necessary and, as severe dry seasons are expected, inhibiting expression of potential of high yielding coconut varieties, irrigation should be investigated. To stimulate smallholder participation in coconut replanting, stem utilisation is useful, generating income. Emphasis is placed on timber processing and charcoal production.

The technology used for replanting would be inappropriate in a programme of rehabilitation. The problems of successful rehabilitation of existing coconut plantations preclude realisation of the long-term benefits of replanting. Appropriate methods are available for removal of these constraints to benefit the small coconut farmer without disrupting farm income.

TABLE VIII. — Theoretical revenue flow model of a 1 ha coconut plantation rehabilitated through fertiliser use with and without cocoa  
(Modèle de revenus théoriques d'un ha de plantation de cocotiers, réhabilité par l'emploi d'engrais, avec ou sans cacaoyers)

Year (Année)	Baht/hectare					
	Unimproved farm (Plantation non améliorée)		Fertiliser applied (Engrais appliqué)		Fertiliser + cocoa (Engrais + cacaoyers)	
	Annual (annuel)	Cumulative (cumulé)	Annual (annuel)	Cumulative (cumulé)	Annual (annuel)	Cumulative (cumulé)
1	4,763	4,763	2,835	2,835	-6,821	-6,821
2	4,763	9,526	2,835	5,670	5,648	-1,173
3	4,763	14,289	5,573	11,243	15,116	13,943
4	4,763	19,052	8,348	19,591	30,866	44,809
5	4,763	23,818	8,348	27,939	30,866	75,675
10	4,763	47,630	8,348	69,679	30,866	230,005

Assuming (Dans le cas de) :

1. Coconuts 20 years old at 156/ha, yielding 20 nuts/palm/year, sold as fresh fruit at 2 Baht/fruit. Yield doubles by year 4 through rehabilitation. 4 p. 100 annual mortality, replanted with local talls at 2 Baht lost income/replants (Cocotiers âgés de 20 ans plantés à 156/ha produisant 20 noix/arbre/an — noix vendues sous forme de fruits frais à 2 Baht/fruit. Grâce à la réhabilitation, les rendements sont doublés au cours de l'année 4. Taux de mortalité annuelle = 4 p. 100. Replantations avec Grands locaux — 2 Baht de revenus perdus/arbre)
2. Cocoa as open pollinated seedlings at 5 Baht each, planted at 938 points/ha. Yields assumed to be 1 kg dry beans/tree at year 4, sold at 30 Baht/kg (Cacaoyers sous forme de jeunes plants issus d'une fécondation libre à 5 Baht/plant, plantés à une densité de 938 arbres/ha ; rendements estimés à 1 kg de fèves sèches/arbre en année 4 vendues à 30 Baht/kg).
3. Fertiliser at 5.8 Baht/kg. 2 kg/palm and 0.5 kg/cocoa plant/year (Fumure à 5,8 Baht/kg, 2 kg/cocotier/an et 0,5 kg/cacaoyer/an).
4. 1 man day costs 60 Baht. 8.13/year for coconut harvesting rising to 16.26/year after 4 years of rehabilitation. 12.5/year for weeding, falling to 3.13/year after 4 years if cocoa is planted. 3.13/year for coconut fertiliser application, and 12.5/year for cocoa fertiliser application. Cocoa planting takes 31.25 man days and harvesting and processing the cocoa takes 37.5 man days/year from year 4 (1 jour/homme = 60 Baht ; 8,13/an pour la récolte des noix augmentant jusqu'à 16,26/an après 4 années de réhabilitation ; 12,5/an pour désherbage et tombant jusqu'à 3,13/an après 4 ans si les cacaoyers ont été plantés ; 3,13/an pour la fumure apportée aux cocotiers et 12,5/an pour la fumure apportée aux cacaoyers ; 31,25/an pour la plantation de cacaoyers et 37,5/an pour la récolte et le traitement du cacao à partir de l'année 4).

Poor soils, frequently associated with coconuts in Thailand, have limitations to their agricultural use. High levels of inputs, with delayed returns, are therefore hard to justify. Emphasis should be placed on improving soil and water management techniques ; on reducing weed competition without increasing erosion hazard ; on retention of vegetative wastes ; on pH adjustment particularly liming acid swamp soils and acidifying cordline beach sands ; and on application of optimal amounts of fertiliser. Heterogeneity of the local Tall population ensures that some trees cannot respond economically to applied nutrients. This suggests that selective fertiliser application may be appropriate. Genetically restricted palms should be felled, converted to timber or charcoal, and replanted with selected local Talls or improved varieties.

Soil variability means that some areas are unsuited to cocoa growth. Other intercropping options should therefore be considered. Cocoa can be planted once shade adjustment has been undertaken by palm thinning or secondary shade establishment although shading will severely limit cocoa yields when grown under coconuts at 8.5 m triangular spacing. Areas surrounding coconut infills could be used for small scale vegetable cultivation for example. Cocoa can be expected to aid coconut rehabilitation by encouraging fertiliser use, effecting weed control by shading and through mulching by leaf fall. Crop diversity and increased economic production will also stimulate the coconut smallholder sector. Cocoa yields may be depressed on inferior soils and unselected F1 hybrids may not be suitable under these conditions. Reasonable yields can be obtained, however, with unselected open pollinated modern Upper Amazon material. Cocoa

breeding and selection should identify and produce suitable F1 hybrids for use only on better soils. Initial planting of modern Upper Amazon cocoa would allow for future improvement by budding with locally selected clonal material.

Two separate approaches are needed to increase coconut and cocoa production in Thailand. These systems are divergent, one is a semi-industrialised agro-technology and the other a smallholder-targeted development system. Both will fulfill the function of increasing national coconut production, and increasing Thailand's share of world cocoa trade. It is not possible to change the climatically induced seasonality of yield of either crop. This is of great significance when considering coconut which plays an important role in the Thai diet. It is necessary to decide if the development strategy should achieve self-sufficiency year round, with large production surpluses for six months, or to accept that oil production will completely stop or at best run at low levels for half the year. This decision will also dictate the potential for cocoa development under coconuts. Use of cocoa, amongst other intercrops, may greatly influence the level of participation by the smallholder sector in increased national coconut production. Cocoa may therefore, be considered stimulatory to future coconut development in Thailand.

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## RÉSUMÉ

**Développement du cocotier en Thaïlande et sa stimulation par le cacaoyer.**

J. DOOTSON, MALIWAN RATTANAPRUK et WIT SUWANNAWUTH, *Oléagineux*, 1987, **42**, N° 6, p. 233-243.

La production des cocoteraies en Thaïlande est faible et ne satisfait pas les besoins nationaux en produits du cocotier. Le Grand thaïlandais local produit un petit nombre de gros fruits, à un rendement extrêmement hétérogène et n'est pas précoce. Un manque de sélection dans le choix des sols, et les conditions climatiques, limitent les rendements et provoquent des variations annuelles et saisonnières de production. On pense pouvoir augmenter la production par l'utilisation en replantation de variétés hybrides précoces homogènes et à haut rendement, et par la réhabilitation des cocoteraies existantes. Quoique le cacaoyer soit d'introduction récente en Thaïlande on pense que son utilisation comme culture pérenne intercalaire pourrait servir à stimuler le cocotier dans le cadre des projets de replantation ou de réhabilitation, permettant ainsi une diversification des cultures et une augmentation des revenus par unité de terrain. Ceci est décrit à la fois de façon théorique et pratique; l'importance d'une sélection variétale rigoureuse est également indiquée. Deux stratégies du développement du cocotier sont nécessaires: l'une qui concerne la replantation, utilisant des techniques culturales modernes, l'autre qui concerne la réhabilitation, dont des recettes moins importantes sont attendues, impliquant des moyens plus limités.

## RESUMEN

**Fomento del cocotero en Tailandia y estímulo a este cultivo por el cacao.**

J. DOOTSON, MALIWAN RATTANAPRUK y WIT SUWANNAWUTH, *Oléagineux*, 1987, **42**, N° 6, p. 233-243.

La producción de los cocoteros en Tailandia está reducida, y no permite atender a las necesidades de este país. El Grande de Tailandia local produce un pequeño número de frutos gruesos, tiene un rendimiento muy heterogéneo y no es precoz. Una elección de los suelos mal hecha y el clima poco propicio limitan los rendimientos, dando variaciones anuales y estacionales de la producción. Se piensa estar en condiciones de aumentar la producción usando en renovaciones variedades híbridas precoces homogéneas y de alto rendimiento, y rehabilitando los cocotales existentes. A pesar de haberse introducido recientemente el cacao en Tailandia, se piensa que su uso como cultivo perenne intercalado podría estimular el cocotero dentro de proyectos de renovación o de rehabilitación, lo cual permitiría diversificar los cultivos y aumentar los ingresos por unidad de terreno. Eso se describe de modo teórico y práctico. Asimismo se indica la importancia de realizar una mejora varietal rigurosa. Para fomentar el cocotero se necesitan seguir dos estrategias: la una se refiere a la renovación, y recurre a técnicas modernas de cultivo, la otra se refiere a la rehabilitación, que proporciona ingresos menos importantes y que utiliza medios más limitados.

## Développement du cocotier en Thaïlande et sa stimulation par le cacaoyer (1)

J. DOOTSON (2), MALIWAN RATTANAPRUK (3) et WIT SUWANNAWUTH (4)

## INTRODUCTION

Sur environ 417 600 hectares de cocoteraies en Thaïlande, la taille moyenne d'une plantation est de 2,4 hectares, ce qui montre la prédominance des petites propriétés dans ce pays. Les rendements sont faibles, estimés à 22,1 noix/arbre/an [Office of Agricultural Economics, 1982], sans tenir compte de la consommation du planteur et de sa famille. Traditionnellement, le cocotier est planté en association avec des arbres fruitiers sur de petites parcel-

les familiales. Un grand nombre de noix sont ainsi destinées à la consommation familiale et rares sont les planteurs dont le revenu dépend uniquement de cette culture. Il y a un manque de sélection dans le choix des sols et les moyens mis en œuvre sont limités. Malgré la grosseur des noix qui pèsent jusqu'à 1,45 kg [HARRIES, Thirakul et Rattanaprak, 1982], la production nationale est souvent insuffisante pour satisfaire la demande du pays et il est nécessaire d'importer des produits dérivés du cocotier.

En 1982, le Ministère du Commerce a estimé que la valeur des produits dérivés du cocotier importés était de 6 923 096 \$ US; en

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