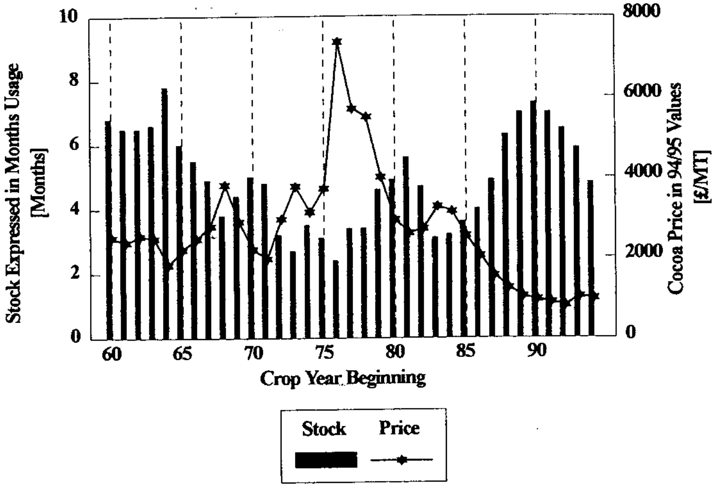
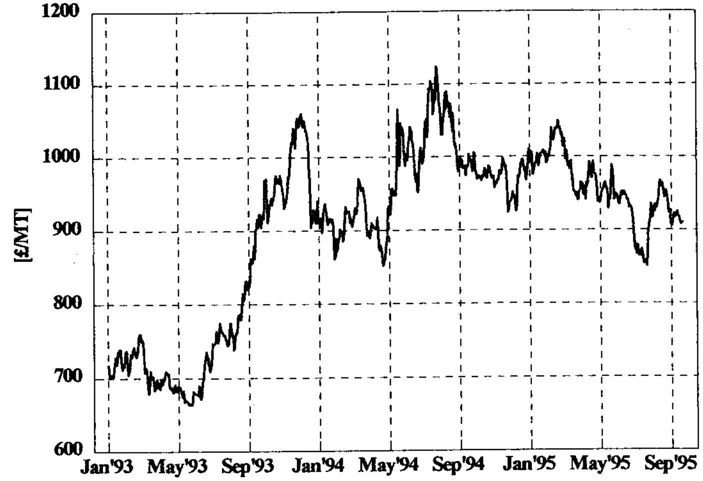
WORLD COCOA STOCKS AND PRICES



Prices adjusted to 1994/95 terms ie. adjusted for inflation and currency movement

COCOA PRICES - LONDON TERMINAL MARKET - 2nd POSITION



Source: E.D. & F.Man Limited, Cocoa Market Report No.353.

COCOA CULTIVATION ON P.T.P.P. LONDON SUMATRA INDONESIA ESTATES IN NORTH SUMATRA PROVINCE, INDONESIA

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BACKGROUND

P.T.P.P. London Sumatra Indonesia (or "Lonsum" as it is popularly known) was, until July 1994, a wholly-owned subsidiary company of Harrisons & Crosfield PLC. The Company is now under Indonesian ownership and operates 19 estates in North Sumatra and on the islands of Java and Sulawesi extending to 46,000 planted hectares of oil palm, rubber, cocoa, coconuts, tea and coffee. In addition, new oil palm and rubber areas are under development in South Sumatra. Cocoa is planted on 6 estates in the Medan area of North Sumatra and, more recently, in East Java. This article deals with the development of the cocoa area in North Sumatra, which on Lonsum estates now stands at 4,200 hectares.

In the early 1970s, when the plantation industry showed renewed interest in planting cocoa in North Sumatra, the strategy of the Harrisons & Crosfield Group at the time was to concentrate on oil palm on its estates in Malaysia (Harrisons Malaysian Plantations Berhad - HMPB) and on rubber in Indonesia, but also to allow some diversification into other crops. It is with this background that cocoa came to be planted on Lonsum estates around Medan. With hindsight, the diversification away from rubber has been of considerable importance in the subsequent development and performance of the Group's plantation business in Indonesia.

CLIMATE AND SOILS

Situated around 4 degrees north of the equator, on the eastern coast of North Sumatra, the region has a typical tropical rainforest climate. Rainfall of 1,500 to 2,500 mm per annum is well distributed through the year, with most months having in excess of 100 mm rain per month. Relative humidity is high, averaging 85% throughout the year, with a diurnal range of 70% to 95%.

Mean temperatures also vary little during the year, averaging 27°C, with daily minimum and maximum temperatures of 22°C and 32°C respectively. Temperature rarely exceeds 35°C. Daily sunshine duration is around 5 hours (1600 to 1800 hours per annum), which is slightly on the low side for cocoa, although the recorded solar radiation is good at 5.9 $GJ/m^2/year$.

Long-term rainfall records for the three main cocoa estates are given in Table 1. Under such conditions, annual water deficits of 100 to 300 mm are not uncommon at Bah Lias and Rambong Sialang estates, which must be considered a limitation to achieving maximum potential yields.

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TABLE 1: 1968 TO 1991 MEAN MONTHLY RAINFALL ON THREE ESTATES*
(mm per month)

Month	Rambong Sialang	Bah Lias	Gunung Melayu
January	77	100	134
February	71	81	101
March	84	73	141
April	133	111	155
May	151	135	212
June	101	135	179
July	148	111	193
August	147	158	213
September	225	214	176
October	244	242	330
November	166	183	256
December	147	148	223
Annual Total	**1,694**	**1,691**	**2,413**

This pattern of rainfall has led to marked biannual cropping, with peak crops approximately six months apart, typically in March/April and September to November. Agricultural practices are geared to this cropping pattern.

All the Lonsum cocoa estates are located on volcanic soils derived from liparitic tuff arising from the creation of Lake Toba some 75,000 years ago. These young volcanic soils are well drained and have a good friable structure, with pH in the region of 5.0 to 5.5. Availability of potassium (from K-bearing minerals) and magnesium is generally good, but supply of nitrogen and phosphates is low to moderate and must be provided in the fertiliser schedules.

Towards the eastern coast, the terrain is flat to slightly undulating, making it well suited to cultivation of cocoa. Surface run-off and erosion are potential hazards that need to be guarded against, particularly in the early years of plantings. Overall, the conditions can be considered to be very suitable for cocoa cultivation. Low rainfall leading to depleted soil moisture reserves is the main limiting factor.

PLANTING MATERIALS

In the early 1970s, there was very little primary cocoa germplasm in Sumatra. Some material had been assembled by RISPA (the Research Institute of the Sumatran Planters Association, formerly AVROS) and by the state plantation companies PTP II and PTP VI, comprised of a selection of Upper Amazon

* These are centred on Medan, Sumatra, Indonesia.

hybrid material available in South-East Asia. Hybrid seed was imported from HMPB's Bagan Datoh estate in Peninsular Malaysia for the first commercial plantings on Lonsum estates. Amongst these were several popular hybrid crosses including ICS 40 x Pa 7, GS 29 x Na 33 and IMC 60 x Na 32.

From the outset, it was the Company's intention to develop the capacity to produce its own planting material. The initial introduction was augmented subsequently through exchanges of material and new acquisitions from Kew, Jember (East Java), Mayaguez, Miami and Papua New Guinea. The base population has been carefully screened and tested through a programme of field-testing of prospective hybrid crosses to identify improved material that meets several important criteria as follows:-

- acceptable sustained level of production (minimum 1,500 kg dry beans per hectare per annum) and meets minimum requirements of average bean size (>1 gramme), minimum butterfat content (55%) and minimum shell content (<12%);
- acceptable growth habit without excessive vigour;
- good tolerance to important local pests and diseases (VSD, *Phytophthora* pod rot, *Colletotrichum* leaf disease, *Helopeltis* and pod husk-borer).

A number of Parinari, IMC, UF and Pound selections have proven to be good parents, notably Pa 310. Other good parents are Sca 9, UIT 1, Amz 3-2, Na 32 and GC 29 (imported as GS 29 but this clone differs from the CATIE description).

From using open-pollinated seed collected from selected mother trees in the first commercial areas in the late 1970s and early 1980s, the Company has advanced to producing its own hand-pollinated (HP) hybrid crosses and (open-pollinated) biclonal seed. The progression in planting material and the area planted has been as follows:-

		Hectares	%
1973-76 -	F1 UAH hybrid seed ex-Bagan Datoh, Malaysia	277	6.5
1977-87 -	F2 open-pollinated seed from Bah Lias commercial plantings	962	22.8
1981-90 -	F1 HP hybrid seed ex-Bah Lias	1750	41.4
1987-89 -	F1 biclonal and polyclonal seed (mainly Pa x UF, GC 29, Keravat and local BL selections)	607	14.4
1989-to date -	clones	631	14.9

From 1989, selected clones have been planted exclusively. The material includes both recognised international clones and local selections arising from the programme of trials at Bah Lias. The best of these to date are GC 29, UF 11, UF 191, Pa 4, Pa 310, BL 703 and IMC 49.

PLATE 1: HIGH YIELDING CLONAL COCOA TREE AT P.T.P.P. LONDON SUMATRA INDONESIA

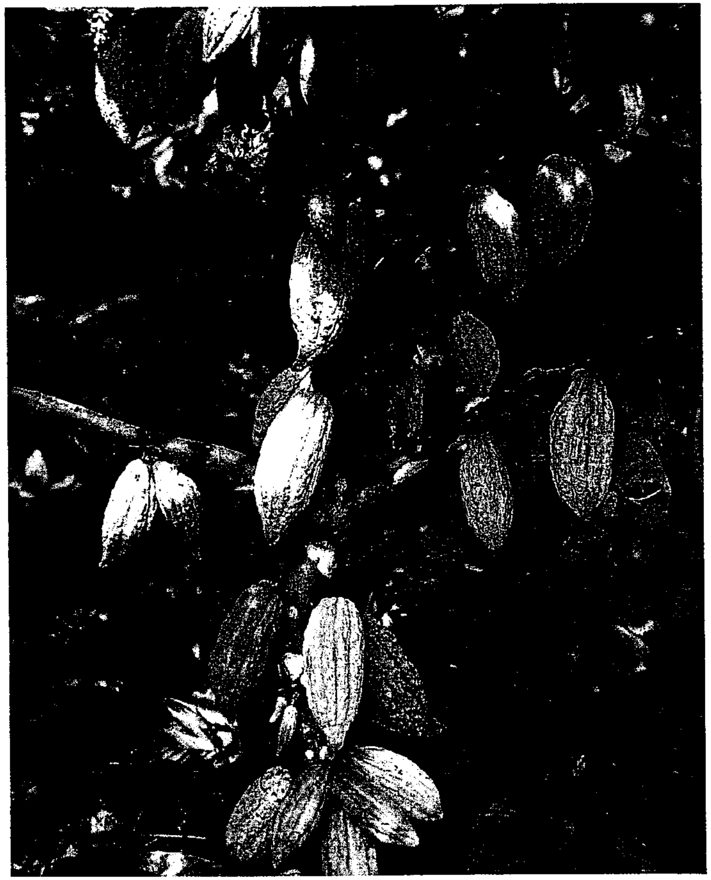
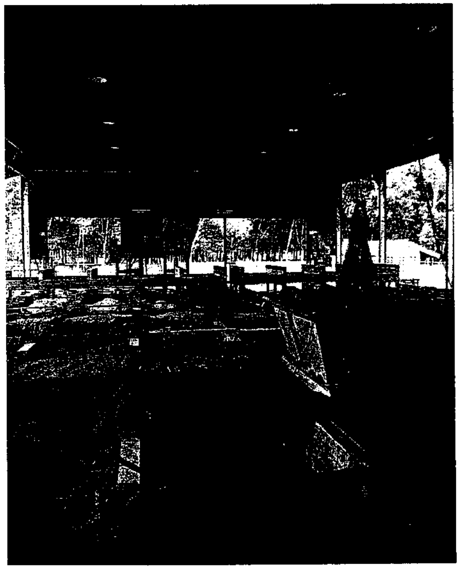


PLATE 2: NURSERY AT P.T.P.P. LONDON SUMATRA INDONESIA

PLATE 3: FERMENTATION BOXES BEING FILLED AT P.T.P.P. LONDON SUMATRA INDONESIA



Besides producing its own planting material requirements, Lonsum has established a reputation for supplying seed to the plantation industry in Indonesia. It is now one of the major suppliers of planting material in the country, capable of producing in excess of 12 million high quality HP and Biclonal seed per annum for the Indonesian market. This germplasm is continually upgraded through new acquisitions and selections from the breeding programme.

CULTURAL PRACTICES

Nurseries

Until 1989, the Company had planted only hybrid seedlings, raised in standard polybag nurseries under palm frond or bamboo-strip shade. Using 30 x 20 cm layflat bags, seedlings are ready for planting out at 4 to 5 months. Intensive culling is practised, removing some 25% to 35% of the plants, to ensure that only well-grown healthy material, of good uniformity, is established in the field.

A good deal of attention is paid to filling of the polybags. Only good quality top-soil with pH not less than 4.5 is used. It was previously common practice to incorporate one part well-rotted manure to three parts soil, but this has now changed in favour of adding triple super-phosphate (TSP) or NPK compound fertiliser to the polybag soil. This has given good results at several sites, with few micro-nutrient problems (especially iron chlorosis).

A manuring programme based on two-weekly rounds of NPK Mg 15.15.6.4 from 8 weeks after planting the seed is administered. Additional nitrogen or micro-nutrients are applied as foliar sprays, as necessary.

For the production of budgrafted plants, larger 35 x 23 cm layflat bags are used, for a nursery period of 5 to 6 months. Conventional grafting is carried out on 2 to 3 month old seedlings, though there is a tendency now to bud onto more juvenile rootstocks. The seedling is cut back in two steps to half its height once the graft has taken and the stock retained as a support for the developing scion.

Field Establishment

In the early years, cocoa was established on land formerly under rubber cultivation. After completion of the felling and clearing operations both *Flemingia congesta* and *Gliricidia maculata* were established as temporary shade. However, this led to a prolonged non-productive period, frequently more than 4 years between felling the previous crop and bringing the cocoa into production. It also tended to exacerbate pest and disease problems in the establishment period, notably root disease (*Rigidoporus lignosus*) incidence and polyphagous leaf-eating insects. Where cocoa is planted after rubber, considerable attention is given to removing the old stumps and primary roots in order to minimise the incidence of *Rigidoporus lignosus*.

The unproductive period has now been reduced to about two and a half years by establishing a full stand of *Gliricidia* as early as possible after felling. This is achieved by planting 1.2 metre stakes of 2 to 3 year old *Gliricidia* wood just prior to wet periods at the same density as the cocoa points. Four

well-spaced shoots are retained to produce temporary overhead shade under which the cocoa can be planted. Regular pruning, weeding and manuring of the stakes is required to effect quick establishment. Failed points are checked and re-supplied on a fortnightly basis. In favourable circumstances, cocoa can be planted 12 months after planting the *Gliricidia*. *Flemingia* is only used now to supplement the *Gliricidia* in less fertile situations, on exposed sites and slopes, and as a source of mulch.

In the last few years, several hundred hectares of cocoa have been very successfully established under oil palms at Gunung Melayu estate. The oil palms are thinned to about 40 to 50 per ha by poisoning soon after planting the cocoa. Any under-shaded patches are supplied with *Gliricidia*, and the area interplanted with coconuts (for the permanent shade). Initial establishment and growth of cocoa is good and uniform. Harvesting of the oil palm bunches can continue up to 18 months after planting the cocoa and the loose fruit collected until the palms are eventually poisoned out as the coconut and *Gliricidia* shade takes over. Minor losses and damage to the cocoa from falling debris and from mammalian pests is considered to be acceptable in view of the very quick establishment and the continued income from the palm fruit. Rhinoceros beetle (*Oryctes*) can, however, be a serious problem to the coconuts in these conditions. This is hard to control.

Planting Patterns

Various planting patterns have been used by the Company at different times:-

1973-75	3.5	x	3.5	m	offset	square	816	trees/ha
1976-85	3.5	x	2.5	m	"	"	1143	"
1986-89	3.6	x	2.0	m	"	"	1388	"
1990-92	3.6	x	3.0	m	"	"	926	"

Attempts at high initial densities, with a view to getting high yields for the first 3 to 4 years, followed by thinning, have largely been unsuccessful. The data in Table 2 from a density trial reflects this.

TABLE 2: YIELD OF FOUR YEAR OLD COCOA SEEDLINGS AT FIVE PLANTING DENSITIES

Number of Trees/Ha	Dry Bean Yield (kg/tree/annum)	Dry Bean Yield (kg/ha/annum)
816	1.78	1,449
952	1.62	1,537
1,144	1.37	1,570
1,428	1.10	1,569
1,633	0.94	1,532

Both trial data and commercial experience have led to the conclusion that an initial and fixed mature stand of around 900 to 1,000 trees per hectare is optimum for currently available hybrid seedling material under local conditions in North Sumatra. Consequently, the fields with stands over 1,000 points per ha have now been reduced to 850 to 950 by gradual removal of poor performers, diseased and damaged points, and other unproductive trees. A planting density of 926 per ha (3.6 x 3.0 m) is preferred for budgrafted plants.

Shade

Budgrafted plants of seedless *Leucaena* clones L2 and L19 were planted as the permanent shade in the early 1970s, but from 1975 coconuts have been used exclusively as permanent shade trees on Lonsum estates. Both tall cultivars and tall x dwarf hybrids have been used.

Despite their longer unproductive period, talls are preferred as they grow clear of the cocoa canopy much sooner, allowing the temporary shade points (*Gliricidia* and remaining *Flemingia*) to be removed at an early stage.

Coconut seedlings grown in polybags or nursery beds are planted out at the same time as the *Gliricidia*, approximately one year before planting the cocoa. The palms provide adequate shade for the cocoa after 4 to 5 years.

Up to 100 coconuts per ha were planted initially (10.5 x 10.5 m offset square), but this has been found to cause excessive shading in the longer term. Such stands have now been systematically thinned through 60-70 to about 45 points per ha. Cocoa yields have increased as a result. Present policy is to plant just 37 palms per ha (18 x 15 m offset square) at establishment. Covariance analysis of data from a fertiliser trial at our Bah Lias Research Station quantifies the effect of coconut shade on cocoa yields:-

Number of Coconuts/Ha	Dry Beans Yield (kg/ha/annum)
35	2,037
70	1,776
105	1,515

In addition to its function as a shade plant, it is considered that coconuts are also helpful in creating a stable environment for beneficial insects, in particular black ants, *Dolichoderus thoracicus*, which are antagonistic to *Helopeltis*, the main pest problem in North Sumatra.

Further benefits from coconuts - apart from the obvious one of providing an income from the sale of nuts or copra - are that the shade is more constant through the year than with dicotyledonous species (which are liable to defoliate in very dry periods) and, also, the shade level can easily be manipulated by pruning fronds.

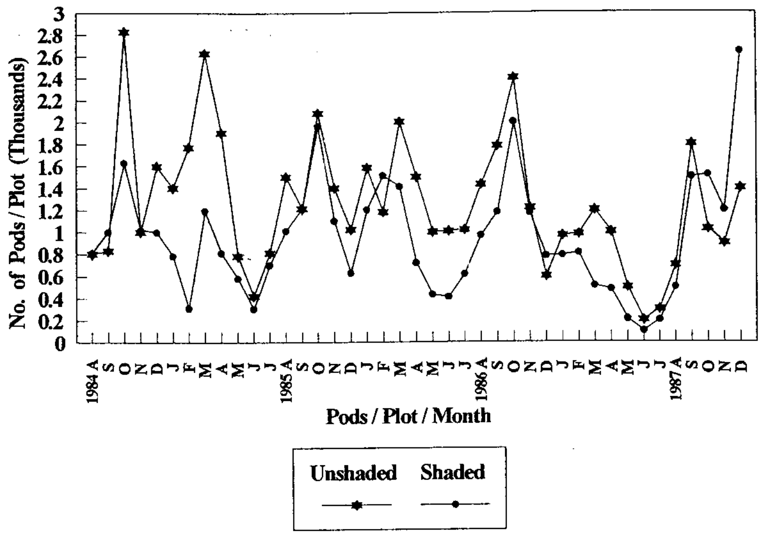
Maintenance

Maintenance of cocoa is aimed at producing a uniform, healthy, balanced stand capable of giving a sustained yield of 1,500 to 2,000 kg dry beans per ha per annum. From the outset, attention is given to all cultural practices. Key aspects are:-

- regular weeding rounds, either manual or using broad-spectrum herbicides (glyphosate, glufosinate, paraquat) to maintain weed-free conditions;
- thinning out and adjusting the shade trees over time to provide just the right amount of shade; a final stand of about 40 coconuts per hectare, evenly spaced, is considered optimal for North Sumatra conditions. Trials have shown that yields can be doubled in the short term by drastic reduction of shade, but it cannot be sustained even with additional fertiliser inputs (Figure 1);
- obtain a regular jourquetting height in seedlings through corrective pruning;
- maintain a full stand of productive plants by supplying any vacancies, replacing unproductive points and overbudding low-yielders with high-yielding clones;
- regular (monthly) removal of chupons;
- routine pruning to achieve a balanced canopy with good access and height control (3.5 metres); experience has shown that this can be achieved by two major pruning rounds annually after the peak crops, and regular "light" pruning rounds every 6 to 8 weeks to remove drooping branches, diseased wood and chupons in order to provide good access and ventilation;
- strict control of harvesting intervals of 7 to 10 days during peak seasons and no more than 14 days in low crop periods;
- regular and routine monitoring of all major pests and diseases in order to detect outbreaks at an early stage so that remedial action can be taken;
- correct timing and placement of recommended fertilisers is considered to be especially important;
- regular maintenance of access paths and collection roads, construction of bunds on sloping land to prevent run-off and keeping land-drains and water-courses clean.

Attention to these agricultural practices is important and is effected through close supervision and monitoring of activities at all levels of the management structure. This is seen as a pre-requisite for the successful and profitable management of plantation cocoa. Particular attention is now being given to progressively upgrading the lower-yielding seedling areas by overbudding with proven high-yielding clones.

FIGURE 1: YIELD OF UNSHADED VERSUS SHADED COCOA



(Shade Removed in August 1984)

Fertiliser Policy

The Company's Research Station at Bah Lias has done considerable work on nutrition for the local volcanic soils. The main requirements are for nitrogen and phosphate. Responses to applications of urea and of triple super-phosphate (or TSP) or rock phosphate is very marked in young cocoa, but the response diminishes with time, as has been demonstrated elsewhere. Potash can be shown to be important in the early years through interactions with both N and P. Responses to magnesium fertilisers have not been seen. The most important trials' results are shown in Table 3.

Quadratic response models are fitted to the observed trial data and yield contour maps for different rates of N and P fertilisers calculated from the response equation. In Figure 2, the path of least cost is superimposed assuming urea and TSP prices of Rp. 220 and 280 per kg respectively. In this case, the optimum fertiliser combination, if crop value is Rp. 1800 per kg, has been calculated to be 196 g urea plus 247 g TSP per tree per year, which is very close to the fertiliser rates giving maximum yield.

In view of these findings and considerations from the economic analysis, the present policy is to give judicious N, P and K dressings during immaturity and early maturity up to the point of canopy closure and the formation of a good layer of leaf litter. Rates are then reduced, recommendations being drawn up annually taking into account the physical condition of the cocoa canopy, the stand per hectare, the degree of overhead shade and the current yield level, in addition to soil analysis data. Typical rates

commonly applied are 200 g urea in 3 applications, 200 g TSP in 2 applications and a single round of 50 g muriate of potash per tree per annum.

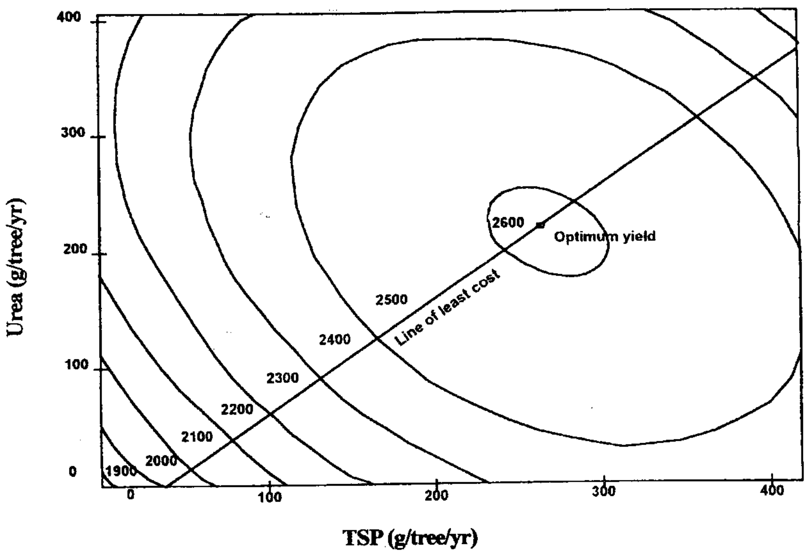
TABLE 3: YIELD RESPONSES IN 3 FERTILISER TRIALS ON VOLCANIC SOILS ON LONSUM ESTATES IN NORTH SUMATRA

Fertiliser Rate (g/tr/annum)		Trial 312 Dry Bean Yield (kg/ha/annum)	Trial 320 Dry Bean Yield (kg/ha/annum)	Trial 325 Dry Bean Yield (kg/ha/annum)
Urea	0	1,160	2,112	2,176
	100	–	2,048	–
	200	1,222	2,081	2,394
	300	–	2,137	–
	400	1,256	–	2,539
TSP	0	991	1,958	2,067
	100	–	1,943	–
	175	1,259	–	2,394
	200	–	2,288	–
	300	–	2,189	–
	350	1,380	–	2,374
Potash	0	1,255	–	2,379
(Muriate)	300	1,178	–	2,414

Correct placement of the fertiliser is considered to be most important to obtaining maximum economic benefits. Up to 5 years of age, all N, P and K fertilisers are applied as an increasingly widening circle to a maximum of 150 cm radius from the trunk. In older plantings, these fertilisers are spread in strips 1.5 metres broad along the rows. Where urea is used (it is the cheapest form of nitrogen in Indonesia), the leaf litter is disturbed by the workers to incorporate it into the surface layer. Where this is not done, considerable losses of N by volatilisation can be expected.

Limestone dust (LSD) or Dolomite is applied depending on the soil pH - 1,000 kg/ha for pH 5.0 to 5.5 and 2,000 kg/ha where pH is less than 5. As with the straight fertilisers, it is spread in circles up to 5 years of age and thereafter in broad strips, but always spread beyond the area of NPK application. Recent investigations have shown that soil pH is often higher in the avenues than down the cocoa tree rows, due to previous manuring practices; in these cases, emphasis is given to overall rather than strip application of lime.

FIGURE 2: YIELD CONTOUR MAP FOR DIFFERENT RATES ON N AND P FERTILISER [COCOA DRY BEAN YIELD (KG/HA/ANNUM)]



Very few problems have been encountered with micro-nutrients, the most important being occasional iron deficiency in nurseries - in particular in budgrafted plants. Ferrous sulphate sprays are given where the symptoms are acute, but there has not been any need to apply corrective measures in the field.

PESTS AND DISEASES

There are a number of important pests and diseases of cocoa in North Sumatra, which can cause serious losses if not detected and controlled effectively. However, with good supervision and management, incidence can be kept at acceptable levels. The strategy adopted by the Company has been to minimise pesticide usage and to use practical biological control measures whenever possible. It is a good example of effective Integrated Pest Management (IPM) on a plantation scale.

Fortunately, two serious pest and disease problems of cocoa elsewhere in South East Asia - cocoa pod borer (CPB) and Vascular streak dieback (VSD) - do not yet present major problems on the Lonsum properties. An outbreak of CPB was eradicated in the early 1970s (Parnata and Pardede, 1979), but it is present in other parts of Indonesia and has recently been recorded again in North Sumatra. VSD can be found in wetter areas of North Sumatra (Turner and Keane, 1985), but does not appear to be particularly virulent locally. Nevertheless, concern over potential problems from CPB and VSD is one reason mitigating against further expansion of the cocoa area in North Sumatra.

In the crucial two years after planting, leaf-eating insects and sap-feeders can seriously damage young cocoa, resulting in slow, irregular early development, and poor tree shape. Notable pests are the scarabaeoid beetles *Adoretus* and *Apogonia* spp, grasshoppers, bagworms (esp. *Cryptothelea* sp.) and the sucking insects *Helopeltis* sp, aphids, jassids, leafhoppers and *Lawana candida*. Where the incidence of these pests is high, it is often necessary to control them by applying regular (4 to 5 days) alternate rounds of contact and systemic insecticides. Experience has shown that spot-spraying of just the shoot-tips of affected points is better than blanket-spraying every plant, as this allows beneficial insects to thrive. Heavy ground vegetation and thick *Flemingia* side-shade tends to encourage pest species and should therefore be kept in check.

In mature cocoa, by far the most significant pests are *Helopeltis antonii* and mammalian pests (rats and squirrels), requiring constant attention. Stem-borers (*Zeuzera* sp.) and the "cocoa pod husk-borer" (the yellow peach moth, *Dichocrocis punctiferalis*) are common pests at low incidence, which can become important locally if not contained, especially where the cocoa becomes stressed through lack of shade or poor maintenance. Other incipient pests are a variety of leaf-eaters: the pagoda bagworm (*Pagodiella hekmeyeri*), other bagworms, limacodid caterpillars (*Thosea* spp, *Darna trima, Ploneta diducta), Orgyia* spp, etc.

Lonsum has gradually evolved effective control measures against *Helopeltis* through biological rather than chemical means (Bakri et al, 1986). Experience in Java in the early part of the century (Van der Goot, 1917) showed that the presence of large numbers of the black ant, *Dolichoderus thoracicus* reduced damage caused by *Helopeltis* feeding on the shoots and young pods of cocoa. The ants are clearly antagonistic to *Helopeltis*. Once the cocoa canopy is closed, populations of black ants can be built up through a variety of measures:-

- providing nesting sites made of bundles of cocoa or coconut leaves;
- introducing their mealybug host (*Planococcus lilacinus*) from which they collect honeydew;
- placing coconut fronds between trees to facilitate movement within the field;
- constructing "bridges" of bundles of coconut fronds between areas of high and low populations, across roads, etc;
- destroying antagonistic ant species (*Technomyrmex albipes* (Smith)) and *Anoplolepis* sp);
- interplanting coconuts in the cocoa.

These measures, coupled with minimal use of insecticides, allows the black ants to proliferate. The result is a stable, balanced environment with acceptably low incidence of *Helopeltis* feeding-damage. The situation needs to be continually monitored, and can be re-dressed by spot spraying of contact insecticides (synthetic pyrethrins mainly) to control "hotspots" followed by rapid introduction of black ants and mealybugs. By such means, *Helopeltis* can be kept in check in mature cocoa for a cost of just Rp. 20 to 30,000 (US $ 10 to 15) per ha per annum.

Of the mammalian pests, it is difficult to distinguish clearly the feeding marks of rats and squirrels. Generally both are present. Rats can be easily controlled by regular baiting with brodifacoum wax blocks. Squirrels (*Callosciurus* sp) are too bait-shy to be poisoned, and are controlled through air rifle shooting, trapping and destroying nests. Locally, civet cats (musang) and monkeys can do a lot of damage. Without control, mammalian pests can cause yield losses as high as 50%.

Diseases are generally not a major problem in North Sumatra. Losses due to root disease (*Rigidoporus lignosus*) of young cocoa trees can be high in patches when planted after rubber when the old stumps and roots have not been removed. Treatment by drenching with systemic fungicides (triadimefon, triadimenol, benomyl) is only partially effective and is expensive. Good sanitation at the time of land preparation and intensive supplying of diseased points are the best means of obtaining a full mature stand. *Ganoderma* sp. have also been implicated in these early losses.

Recently, leaf-spotting due to *Colletotrichum* sp. has become more prevalent, particularly in budgraft plantings, indicating that screening clones for susceptibility to this disease is important locally. This is carried out by our Bah Lias Research Station.

Surprisingly, perhaps, *Phytophthora* pod rot (and other *Phytophthora* symptoms) has not become an important problem in North Sumatra. Affected pods can be seen, especially when peak crops coincide with wet periods, but are usually at a low incidence (a few percent). The worst outbreak to date in North Sumatra was seen in late 1992 on a number of estates. Losses in some fields in nearby estates were as high as 30% to 40%. The reasons for this outbreak are not understood, and clearly there is a risk of it becoming more prevalent locally. Apart from collection and removal of diseased pods, other measures to contain *Phytophthora* pod rot are not usually carried out.

Pest damage to shade trees has been important on occasions. Outbreak of negro bugs on *Gliricidia* proved difficult to contain until a natural fungal pathogen was found. A more serious problem has been *Oryctes* (Rhinoceros Beetle) damage to coconut shade. On one estate, in particular, new coconut plantings incurred 100% failures and a large number of mature palms have been killed. The problem has only been brought under control by intensive sanitation, prophylactic treatment of damaged palms and destruction of breeding sites.

PRODUCTION

Average yields have gradually increased through improvement of the planting material and the adoption of better management practices, and particularly through reduction of shade levels in the last few years. The most recent plantings have been very precocious, giving several hundred kilos of dry beans per hectare in the third year after planting. The company average in 1992 was 1,320 kg dry bean/ha. The progression in yield of the various planting materials on Bah Lias estate is shown in Table 4.

The poorer performance of open-pollinated F2 seedlings is evident, where as much as 30% of the stand are very low yielding trees. Such areas are being upgraded by supplying and overbudding low-yielders with high-yielding clones.

TABLE 4: YIELD OF DIFFERENT TYPES OF PLANTING MATERIAL ON BAH LIAS ESTATE (KG DRY BEAN/HA/ANNUM)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
F1 UAH	–	96	357	716	1092	1466	1489	1385	1359	1207	1619	1582	1487	1437	1458	1372	1204	1286	1694	1053	1549
F2 OP	–	80	594	780	919	1045	1153	1211	1154	1211	1154	1279	1304	1347	1387	1300	1368	1133	1014		
F1 HP	–	108	532	935	1091	1149	1291	1403	1350	1649											
Clones	–	110	907	1060	981																

The performance of the hand-pollinated material and, latterly, the clonal plantings has been very satisfactory, with many blocks yielding in excess of 2,000 kg per annum.

The most important factor regarding cultivation of cocoa in Indonesia is the relatively low cost of labour, which is reflected in the production costs. Table 5 gives details, including the average selling price realised since 1977.

TABLE 5: AVERAGE COST OF PRODUCTION AND SELLING PRICE FOR LONSUM COCOA 1977 TO 1994

Year	Cost of Production (Rp/kg Dry Beans)	Average Sale Price (Rp/kg Dry Beans)
1977	1,255	1,698
1978	340	1,258
1979	349	1,680
1980	329	1,321
1981	330	1,033
1982	390	962
1983	593	1,426
1984	546	2,066
1985	656	2,237
1986	556	2,182
1987	770	2,579
1988	1,075	2,177
1989	930	1,837
1990	679	2,080
1991	1,026	1,924
1992	1,316	2,039
1993	1,511	1,963
1994	1,396	2,750

Note: The Indonesian Rupiah was devalued by 50% and 45% in 1978 and 1986 respectively. At the time of writing, the exchange rate was approximately US$ 1.00 = Rp. 2,200.

Although prices have not recovered from the high of 1987, there is still an acceptable margin over cost of production. Presently the net income per hectare is comparable with that from rubber, but considerably less than is being obtained from oil palm on similar land.

A breakdown of production costs (Table 6) over this period shows little change in the proportionate cost of the various components, despite an increase in labour costs in real terms. The proportion accountable to general overheads has increased over the period. The most noticeable change is the reduction in fertiliser costs in 1992, reflecting the much lower rates of urea and TSP now being applied as a result of the findings from field trials.

TABLE 6: BREAKDOWN OF PRODUCTION COSTS FOR 1978, 1985 AND 1992 (RP/KG DRY BEANS)

Item	1978	(%)	1985	(%)	1992	(%)
Upkeep and Cultivation	64	(18.9)	106	(16.1)	212	(21.7)
Fertiliser	102	(30.0)	153	(23.3)	115	(11.8)
Harvesting Transport	49	(14.3)	111	(16.9)	148	(15.2)
Processing	39	(11.6)	80	(12.3)	147	(15.0)
General Overheads	86	(25.3)	194	(29.5)	355	(36.3)
Others	–		12	(1.9)	–	
Total	**340**	**(100)**	**656**	**(100)**	**977**	**(100)**

Very encouraging results have been obtained from studies by the Company's agronomists on methods of forecasting yields from commercial areas. This is based on cherelle counts on representative tree samples from the main commercial areas and predictions of survival rates to maturity. Early attempts were unreliable but the procedure has been refined to incorporate rainfall data, so that quite accurate forecasts of the crop anticipated 3 to 4 months ahead can now be made. This has already proven to be of significant commercial benefit.

PROCESSING

Before the construction of automated plants in 1989, Lonsum's cocoa was processed using traditional methods of tiers of wooden fermentation boxes, and either dried in the sun or on wood-burning Samoan driers. Whilst this process was satisfactory for small volumes of beans, it was labour intensive and drying of the beans could take as long as 2 to 3 days in wet weather. The quality of the beans met export specifications, but nib pH was invariably below 5 and with associated astringency and acid off-flavours.

It is now recognised that the problem of low pH, acid beans in South East Asia reflects both field and factory procedures. Our two factories, which have a total capacity of 36 tonnes (dry beans) per day, that now handle the bulk of Lonsum's crop, were designed to tackle quality aspects associated with processing. On receipt from the field, the wet beans are pressed in 750 kg capacity metal cages, reducing their volume by 15%, and retained under pressure overnight. Much of the acid juices arising from the mucilage, which are partly responsible for nib acidity, are expelled. The beans are then fermented for 6 days in 2 x 2 x 0.5 m wooden boxes, lined with nets for lifting by overhead gantry cranes. The beans are turned daily during the fermentation period. Drying is a two-stage process: initial drying for 8 hours at 60°C in a circular drier and finished in a rotary drier for 8 to 12 hours at 60°C to 70°C. Kerosene is used to fuel the burners.

Compared with the traditional fermentary and Samoan driers, beans processed in the new factories have a pH above 5, with less noticeable acid off-flavours and have better chocolate flavour. A typical sample would have the following characteristics:-

No. beans per 100g	-	95
Moisture Content (%)	-	6.9
Nib pH	-	5.2
Shell (%)	-	14.0
Butterfat content (%)	-	55.4
Admixture (%)	-	4.3

A concerted effort was made in 1991/92 to implement the Cadbury-Sime process on a field scale; viz. 10 days pod storage after harvesting, shorter fermentation period in shallow boxes, longer two-stage drying with the final stage using forced air at ambient temperature. Bean quality and flavour was clearly improved, but in the event it was decided to discontinue the method because the premium attracted by the beans did not cover the cost of the extra work involved nor the unavoidable losses through spoilage and germination during pod storage.

MARKETING STRATEGY

Formerly, beans were sold mainly to European processors, and the price was based on the futures market (a discount to West African Beans). The South East Asian process market was relatively new and its capacity relatively small until the late 1980s. Recently more and more of Lonsum's production has been targeted towards quality processors in the Far East, or those buyers willing to pay for beans of consistent quality.

A better understanding of the cropping patterns in North Sumatra and an improved forecasting method has allowed crop to be sold forward, taking advantage of price movements. In view of the still general problem of poor flavour of South East Asian cocoa relative to West African beans, and the large discounted prices (circa £100 per tonne) on the European markets, the present Company strategy is to produce a maximum yield of acceptable quality beans with a high butterfat content, which can be sold to local processors.

Consideration towards further flavour improvement are secondary at the present time, and this is unlikely to change unless there is a clear financial incentive to producing beans with improved flavour.

CURRENT AND FUTURE PROSPECTS

Net income from cocoa presently in Indonesia is around US$300 per hectare per annum (after depreciation). This compares with US$350/ha for rubber (at 1,500 kg DR/ha) and US$1,250 for oil palm (at 6.8 tonnes palm products/ha). Under the present economic climate of a long-term decline in commodity prices and a fairly rapid increase in labour costs in Indonesia, it is clear that profits will only be maintained through careful control of costs, through improvements in productivity and by increasing yields per unit area. In the shorter term, there is perhaps more scope for improving the economic performance of cocoa than of rubber or oil palm, by rapidly introducing improved planting material and improving labour productivity.

Presently, it is difficult to present a good economic argument for planting anything other than oil palm, where it can be suitably grown. However, the Company has decided upon a crop mixture that should help to cushion the vagaries of commodity price fluctuations: 55% oil palm, 30% rubber, 10% cocoa and 5% other crops (tea, coffee, coconuts). In the shorter term, we feel the Company is well placed to take advantage of the expected upturn in cocoa prices as a result of falling production in West Africa and Malaysia. Cocoa should continue to have a good future in Indonesia, provided that labour rates do not rise too rapidly, but it is likely that plantation cocoa will have to be intensified through upgrading, higher planting densities and higher inputs (fertilisers, crop protection measures) in order to maintain profitability.

In support of these aims, Lonsum continues to fund research on cocoa agronomy, nutrition and crop protection, and is committed to a breeding programme to produce improved hybrid and clonal material.

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