REPORT ON A MISSION TO THE PHILIPPINES TO INVESTIGATE THE SOCIO-ECONOMIC ASPECTS OF COPRA QUALITY IMPROVEMENTS

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BY

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MARKET RESEARCH AND SYSTEMS

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GLOSSARY OF TERMS AND ABBREVIATIONS

Aflatoxin	Carcinogen produced by the mould *Aspergillus flavus*
Barrio	Market
Bolos	Machete
Carabao	Water buffalo
Corriente	A measure of quality meaning `middling'
D'vapour	Traditional copra dryer using the heat from burning copra husk and/or shell which is burned at a short distance from the copra, the drying effect being semi-direct
Dryage	Loss of weight during the drying process
FFA	Free fatty acid
Goma	Immature copra
ICPS	Improved Copra Production Systems
Nipa	Asian variety of palm tree with leaves used in building and construction
NRI	Natural Resources Institute
NSCB	National Statistics Coordination Board
Pasa	Copra pricing system where-by copra is literally passed as having a fixed moisture deduction regardless of actual moisture content
PCA	Philippines Coconut Authority
PCOPA	Philippine Coconut Oil Producing Association
Resecada	A measure of quality meaning `dry'
SCFO	Small Coconut Farming Organisations
Tapahan	Traditional copra dryer using the heat from burning coconut husk and/or shell passing vertically up through a grate on which the copra is placed and passing directly through the copra
UCAP	United Coconut Association of the Philippines
UK/RP	United Kingdom/Republic of the Philippines

SUMMARY

Introduction

i. In recent years the Philippine coconut industry has been seriously afflicted by declining real prices for its main product, coconut oil. This has been caused by increased competition from palm oil, the near collapse of the United States market following adverse publicity, and the general overstocking of oilseeds in key Western markets. Moreover, domestic supply has stagnated due to a low return on investment and ageing plant stock.

ii. In addition to these problems the Philippine coconut industry now faces the imminent prospect of loosing its entire European Community market for copra cake and meal, due to unacceptably high levels of aflatoxin. These are low value by-products of copra milling, which are nevertheless an important source of foreign exchange. Annual exports to the European Community vary between 400,000 and 800,000 tonnes, with an FOB value between $50 and $100 million.

iii. The purpose of this report is to appraise alternative strategies for solving the aflatoxin problem.

iv. The strategy hitherto pursued in the Philippines has been to organize farmers into Small Coconut Farmer Organisations (SCFO's), and to finance the acquisition by each organization of a *kukum*, indirect heat dryer. However, there are certain alternatives to the kukum dryer. These are as follows:

a. The use of *tapahan* direct fired dryers, whereby the dryers themselves and the operating procedures are modified to get a more fully dried product. Of the different types of tapahan existing, the more sophisticated d'vapour version has the advantage of involving less fire risk.

b. Improvements in sun drying. This may or may not include the use of mould inhibitors, the utility of which has still to be evaluated.

v. It is necessary to define firstly which of the technical solutions is preferable in the Philippines at the moment, and secondly how this can be made to work within the existing farming and marketing system.

Appraisal of Technical Solutions

vi. The costs and benefits of using improved drying technology are estimated, assuming all conceivable benefits from reduced aflatoxin and reduced free fatty acid (FFA) are passed down the supply chain to the farmer.

	Centavos per kg of copra	
	Kukum	Tapahan
Benefits		
Aflatoxin premium (1)	10	10
Reduced FFA (assuming 1.5%) (2)	16	16
Total benefits	26	26
Costs		
Dryer		
- Capital costs (3)	40	-
- Operating costs (3)		
Labour	8	8
Additional fuel	-	2
Total costs	48	10
Net contribution to profit (loss)	-22	16

Notes:

(1) see 6.1.2
(2) see Table 6
(3) see 6.1.3

Assumes that the tapahan already exists, therefore no additional costs. Nominal cost of additional fuel (husk) used by tapahan to produce high quality copra = P0.02 per kg

vii. On commercial grounds, it is unlikely that farmers will have sufficient incentive to adopt the kukum dryers. Capital cost has been assumed to be 12%, a very conservative figure in the light of the capital scarcity in rural areas. If a rate were selected more in line with informal rural capital markets, kukum dryers would be even more unattractive than indicated by the above figures.

viii. Using existing tapahan dryers is an attractive option because they are cheap. They require no additional investment and minimal maintenance, and should be acceptable, providing they fit into existing farming and marketing systems.

Operational considerations

ix. Adoption of these low cost options at farm level will depend on the prospective financial benefits from improved quality being passed back to the farmer. Because of a "chicken and egg" situation, it is unlikely that farmers will initially be paid a premium for reduced aflatoxin. Millers will not receive any premium from their European buyers until they can demonstrate convincingly that they can supply improved quality copra and guarantee shipments against rejection by end-users. To do this they must already have an assured supply of superior quality copra.

x. After eliminating the aflatoxin premium, millers only pay improved prices based on reduced FFA content, but even if the full premium is paid at the farm gate, it is unlikely that the marketing system will transmit to the farmers sufficient benefit to prompt adoption of the new technologies within the time-frame demanded by the present crisis.

xi. Any strategy for improving copra quality should make full use of the existing network of intermediaries who buy copra from farmers and supply the mills. Whether or not the system works equitably, it is the only viable route by which the farmer can quickly be given an incentive to improve his quality. Due to strong patron-client links between traders and farmers, and problems of access to communal dryers, the SCFO is not a viable option in its present form.

Recommendations

xii. Given the situation described above, there appears to be only one possible solution to this crisis. There should be a mandatory system of inspection for aflatoxin of all copra and copra meal/cake exported from the Philippines, and a limit should be set in parts per billion of aflatoxin beyond which shipments may not be exported. 50 ppb is suggested initially. This will increase the pressure for quality improvement of copra arriving at the factory gate.

xiii. While stressing that this is the only feasible strategy, there are certain difficulties in implementation which should be foreseen and planned for, ie.

Some initial unpopularity with farmers and traders. Millers will press traders and wholesalers to supply better quality copra. This may result in lower farm gate prices and in the short run prove a little unpopular. However, provided farmers are taught to make better quality copra it is expected that the problem will be short-lived. The possible consequence of not acting is much more serious ie, the loss of the entire European market.

Difficulties with enforcement. This type of regulation is obviously difficult to enforce, and opens up opportunities for malpractices. The consultants are recommending this course of action because the danger of loss of markets is imminent, and other strategies are unlikely to work within the necessary time horizon. Much planning and
forethought will be needed in order to design a foolproof and acceptable inspection system.

Aflatoxin in the domestic food chain. Rejection of poor quality, high aflatoxin copra at the mill will mean increased aflatoxin in the domestic food chain. This will result in economic losses to domestic animal producers in terms of reduced production and increased animal mortality, as well as the possible effects on public health. Monitoring of aflatoxin levels in domestic animal feed will be an important element of any copra improvement strategy based upon mandatory sampling of exports.

xiv. In recognition of the problems of implementing the strategy, a two stage intermediate phase is proposed. Initially, trial shipments of copra meal will be undertaken to test sampling methods and build up trade confidence. Subsequently, a system of voluntary certification will be introduced to allow benefits to accrue to those producers with a higher quality product. It is stressed that for this strategy to succeed, ultimately a system of mandatory sampling and certification will be required.

xiv. In support of this strategy, it will be necessary to disseminate improved drying practices, including the improvement of existing systems, the development of new and appropriate grading standards, and the use of mould inhibitors (if they work and are financially viable). Mould inhibitors should be tested for their technical and operational feasibility. Extension should be carried out through existing market intermediaries, and avoid creating parallel structures. Section 7 lists some further recommendations in support of this strategy.

1. INTRODUCTION

Copra is the Philippines' most important agricultural commodity, produced in almost every available region. It is characterised by small-scale production (averaging about 2.5 ha) and traditional post-harvest processing methods. Over 50% of the rural population engage in coconut production in one way or another.

Processing methods are varied, reflecting the diverse nature of the political, ethnic and physical geography of the Philippines. Typically, farmers harvest their crops every 90 days, either by climbing, or using a pole with a scythe attached. They split and dry the coconut flesh immediately, using a constructed dryer or the sun, and market to a copra trader at about 18% moisture content on average. There are strong patron/client links between copra buyers and farmers as well as between farmers and tenants/labourers. These are based around credit arrangements and play an essential role in the `coping' and poverty avoidance mechanism adopted by the poorest sectors of the community (see Appendix VI, Description and Characterisation of Copra Localities).

The marketing of copra is undertaken by a widespread network of copra traders and wholesalers, who `bulk-up' copra from the dispersed regions of the Philippines and provide a steady supply of dry (6% moisture content) copra for oil millers. This market chain is made up of a number of layers and involves prolonged storage of high moisture content copra with subsequent deterioration and mould contamination (see Section 2, Marketing and Production Systems for copra).

The authorities have little real influence over the quality and commercial practices in this extensive and complex marketing system. A number of price standards have been attempted in order to encourage the production of higher quality copra. These have, until recently, been based upon moisture content (see Section 3, Copra Quality and Price Standards).

A number of drying practices are investigated including direct and indirect firing as well as sun drying. Consideration is given to efficiency, cost and socio-economic practices. The reasons for the non-adoption of the kukum dryer are reviewed (see Section 4, Drying Practices).

Storage practices are considered including location, duration and possible losses (see Section 5, Storage Practices).

In the light of the above, a number of strategies are considered for improvement and an attempt made to value the costs and benefits of such strategies to various sections of the copra production and processing chain. It is emphasised that this is an iterative, flexible process, responsive to changing circumstances in world and domestic markets.

2. MARKETING AND PRODUCTION SYSTEMS FOR COPRA

2.1 Introduction

The purpose of this section is to show the complexity and diverse nature of the marketing system for copra in the Philippines, highlighting the inefficiencies of the system and the problems of supplying adequate copra inputs into large-scale oilseed crushing facilities. Results are summarised here and further details given at Appendix III.

2.2 Marketing

2.2.1 Market Distribution

The trading system for copra is complex and diverse, consisting of a number of different channels and institutional sub-systems. A flow diagram representing the main marketing channels for copra is presented at Figure 1. For clarity, five operators in the market have been defined. Rough figures showing the magnitude of these transactions are given in brackets (Manuel and Maunahan, 1982).

- Producer: coconut farmer or tenant[i/] - sells to traders (30%), wholesalers (12%) or trader wholesalers (58%);

- Trader: Barrio (market) agent - buys only direct from the producer and sells mainly to Wholesalers (46%) and Processors (42%);

- Trader/Wholesaler: Buys copra mainly directly from the Producer (81%) but will also buy from traders (17%). Sells copra mainly directly to Processors (67%) but also sell on a proportion to Wholesalers (22%);

- Wholesaler: Buy mainly from the Producer (38%) and Trader (44%) but will also buy from the Trader/wholesaler (18%). Sell entirely under contract to the Processor/exporter[ii/].

2.2.2 Marketing and production costs

The copra marketing system is characterised by the dispersion of the producers, involvement of a number of separate layers of traders and poor infrastructure. Marketing margins (the difference between the selling price of a product and its buying price) vary

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i/ For simplicity the plantation producer has been excluded. Plantations often have special arrangements directly with processors or wholesalers.

ii/ Note that figures do not always add up exactly to 100% because of intergroup transactions ie, Trader/wholesalers selling to other Trader/wholesalers.

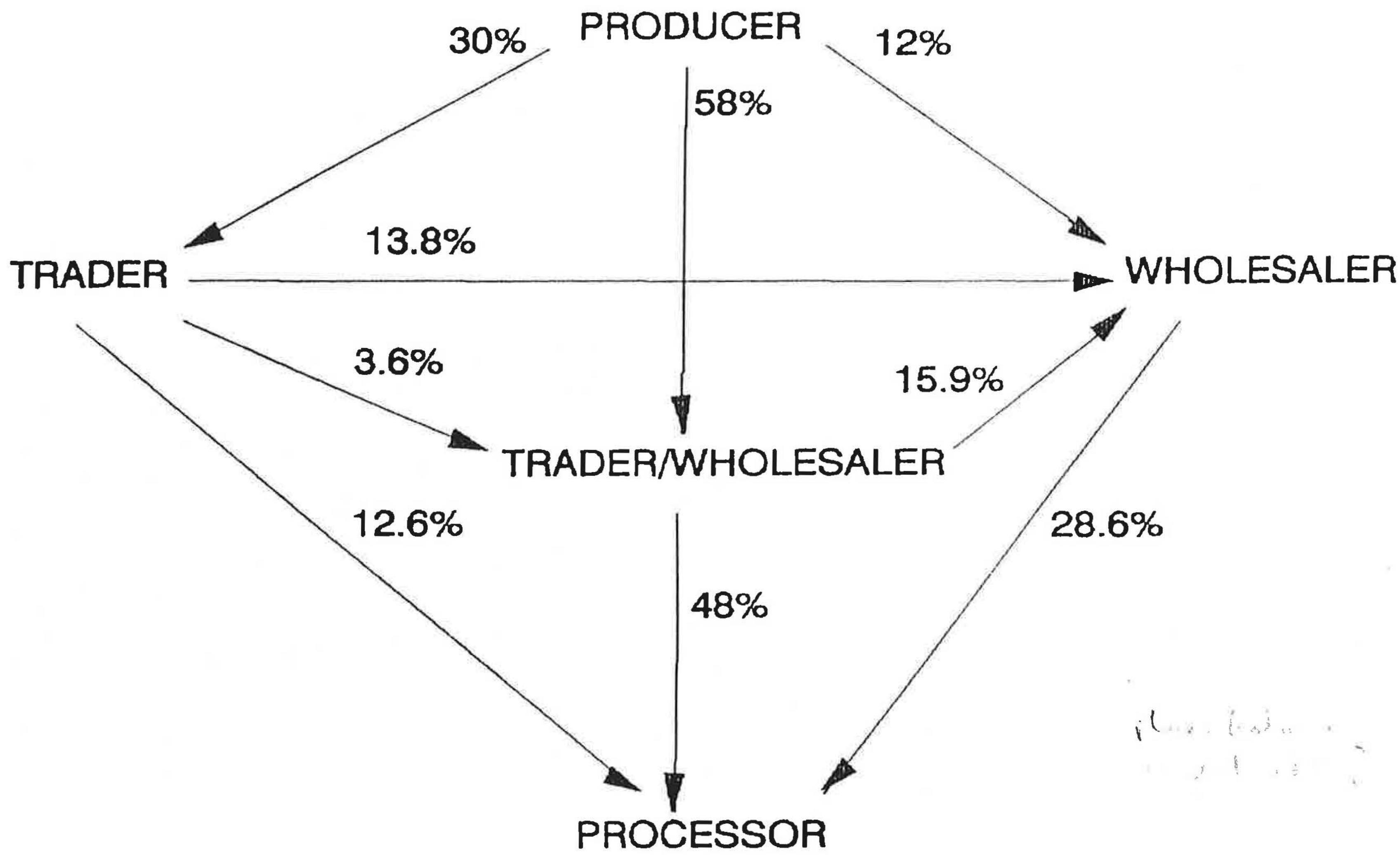

Figure 1: Schematic Diagram of Copra Marketing

proportionately with marketing costs. Information on these costs is scanty. Much of what follows is based upon a survey conducted in 1981 (Manuel and Maunahan, 1982) of seven Filippino Provinces. This has been combined with information gathered during the current mission (May-June 1990). An indication of the capital investment by farmers is given at Table 1.

Table 1: Capital investment and costs

	------Typical Investment-----
	Pesos per farm
Dryer[iii/]	
Tapahan	.60
D'vapour	800
Kukum	10,000
Poles	1
Sickles	21
Husk remover	35
Meat remover	35
Bolos (machete)	85
Sacks	14
Sled	150
Carabao (Water Buffalo)	1,750
Total tapahan	2,351
de vapour	2,891
kukum	12,091

Note: Where 1990 prices are unavailable costs have been inflated from 1981 using the Consumer Price Index for all income households in Southern Mindanao (NSCB, 1989).

In order to approximate the capital costs of copra production to the farmer a number of assumptions were made.

- an average farm size of 4.89ha (Davao Region);
- copra output of approximately 5,840kg per annum on a 90 day cropping cycle;
- a 10 year life span for the project;
- a discount rate of 12%.

Using the appropriate annuity factor (5.65), the capital cost of copra production per kg is calculated at approximately 7 centavos per kg for the tapahan method, 9 centavos for the de vapour and 37 centavos for the kukum dryer (see Section 4.2 for descriptions for dryers).

It has been shown that the average price received by farmers is 12.5% below the resecada price to account for moisture content (Manuel and Maunahan, 1982). In other words, average moisture content at marketing is 18.5%.

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iii/ In each case the minimum technology is considered. Based upon discussion with farmers, May - June 1990.

With a typical density of trees of 126 per ha (UCAP, 1987) and an annual average yield of 30 coconuts per tree (assuming a 90 day cycle of harvesting), 1 ha produces 3,780 nuts per year. Each nut yields 0.19kg of non-resecada copra (ie, with an average marketable moisture content of say 18.5%), therefore 1 ha produces 721kg of copra. At May-July 1990 prices, a farmer could sell this for between P1,703 and P1,893 at provincial buying stations. A farmer with 2.5ha of coconut would earn a gross annual income of at least P4,257 from the sale of copra. Although this is significantly below the national per capita income for the lowest decile group of P6000 per annum[iv/], most coconut farmers have additional income from crops planted on other land or from inter-cropping between coconuts. Although increasingly popular, intercropping remains the exception rather than the rule on coconut land. It is most intensively practised in Laguna (40% reported in 1978) but elsewhere only a small percentage is seen. Farmers interviewed in Northern Mindanao did not practise intercropping for the following reasons:

- insufficient labour to till the land area
- inadequate capital to purchase seed and tools
- insecurity of tenure - there is some evidence that farm owners are discouraging tenants from tilling land under coconut in order to protect their traditional claims to that land

The valuation of labour time in copra preparation is extremely difficult. Much of the labour used is household or under a reciprocal agreement with neighbours. Recurrent activities requiring farm labour inputs include clearing and planting sites, planting/replanting of trees, weeding, harvesting, copra processing and marketing. These variable labour costs have been estimated to average P3528 per annum per hectare over a 15 year period based 1987 prices (PCA, 1990). This suggests an approximate variable cost for labour of P4.90 per kg of copra produced, which is higher than the 1990 trader offer price!

A high proportion of coconut land is farmed by tenants under a number of different arrangements usually based upon a sharecropping system. These include sharing the copra crop with the owner, sharing both the copra crop and the intercrop with the owner and working on the owners land to make copra. Interestingly, the intercrop is most commonly seen as the property of the tenant.

Transport costs for marketing copra are either borne by the farmer or the trader. Larger traders have their own trucks, smaller traders rely on the copra brought to them by farmers and then send a message for a truck to come from the wholesaler when their warehouses are full. In June 1990 a typical farmgate price was P2.7 per kg. Traders and agents were buying at P2.80 to P2.90 with delivery by the farmers to their stores. Wholesalers prices at this time were in the region of P3 per kg (Davao and Puerto Princessa) whilst the mill gate price in Manila was P4.80 for small millers and P5.15 at best. Thus gross margins[v/] for traders were in the region of 3.7-7.4% whilst for wholesalers delivering directly to the major Manila oil millers, gross margins were in the region of 60-72%. This disguises the very heavy transport costs and storage costs incurred by wholesalers supplying distant markets.

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iv/ NSCB, (1990).

v/ Equal to the difference between the price the buyer pays for a good or service and price that it is sold at.

Table 2: Wholesaler marketing costs

Item	-----Typical cost----- (Pesos/kg copra)
Shipping cost to Manila	0.25
Truck to harbour	0.15
Loading/unloading (handling charge including, sack replacement and stitching)	0.40
Storage (1)	0.05
Dryage @ 2% (2)	0.06
Port duties, Manila	0.22
Miscellaneous @ 10% (3)	0.12
Total	1.33

Notes:

(1) Storage cost: Near-market warehouse costs P40 per m3 per month, distant warehouse costs P25, therefore average cost = P32.5 per m3 per month. One m3 holds 667kg of copra, therefore, P32.5/667kg = P0.05 per kg. Average storage time at bodega = approx 1 month.

(2) "Dryage" = loss of weight during the drying process whilst in store. This loss is mainly moisture but losses can also occur through attack by moulds and insects

(3) Includes taxes, licenses, maintenance, insurance and sundries.

Source: Discussions with copra traders and dealers in seven copra growing regions.

Marketing margins for a typical wholesale trader are in the region of P0.82 per kg or approximately 17% of sales.

The study by Manuel and Maunahan (1982) indicated that wholesalers had the highest net profit (67%) before administration, selling and financial costs. This may be explained by the economies of scale experienced by wholesalers. Traders, with their relatively low overheads received profits of 50% of margins and trader/wholesalers received profits of 43%. On average, intermediaries in the marketing chain received 53% profit as a percentage of their marketing margins. For copra trading from areas distant from the mills and passing through a number of trading levels, this represents a considerable proportion of overall marketable value.

2.2.3 "Bulking-up" for oil production

The location of copra oil-milling facilities is dependent on a number of factors including economies of scale, supply constraints, and power availability. The majority of Philippine oil mills use imported continuous expellers for crushing copra. Only three mills currently use solvent extraction.

High capitalisation is required for large scale production, therefore these mills must run at a high capacity in order to recover costs. Location of mills is also dependent on both copra and power supply. An idea of the number of typical copra producing farms required in order to meet the daily needs of each of four categories of mill size is given at Table 3.

Table 3: Number of farms required to supply typical oil mills

Mill size (tonnes of copra per day)	Number of 2.5 ha farms per annum (1)	Number of 4.5 ha farms per annum
8	1,268	704
20	3,803	2,113
50	9,509	5,283
100	19,017	10,565

Notes:

(1) Annual production of resecada (6% moisture) copra assumed to be 631kg per hectare based on figures supplied by the PCA.

This presents a considerable logistical problem as far as copra quality improvement is concerned, since any farm based improvement programme must seek the cooperation of large numbers of farmers. For marketing, this "bulking-up problem" means that millers rely on the marketing system to provide suitable quantities of copra at the right moisture content and at the right time. It also means that oil millers keep high inventories of copra in order to maintain economic production levels. This bulking up requirement goes some way to explaining the complex stratification of trading/marketing systems and the sub-systems that have developed in the Philippines.

In mid-1986 there were 43 commercial coconut oil milling operations in the Philippines of which 16 were in Southern Tagalog, 13 in Mindanao, 8 in Metro Manila, 4 in the Visayas and 2 in Bicol. In 1987 this represented a total crushing capacity of 4.67 million tonnes of copra per year which is the equivalent of 2.92 million tonnes of crude oil. The great majority of Philippine oil mills are large scale mills and have a crushing capacity between 7,500 to 300,000 tonnes per year. In recent years copra production has been at a level less than 50% of production capacity and capacity utilisation has averaged at 60% between 1970 and 1985. Due to the problems of supply, small-scale mills have tended to operate at higher utilisation rates. They are particularly desirable for operation in remote areas and islands where farmers have difficulty in marketing their coconuts. In these areas consumers generally pay higher prices for coconut oil and soap due to greater transport costs and the prodigious number of intermediaries involved in distribution, this increases costs to the retailer and he might also purchase less of the product. However, production costs may be lower for small oil mills as labour and land costs are less. However, it should be remembered that for many mills capital investment in processing plant is a sunk cost, the principal on loans having often been repaid years ago. Therefore, in these circumstances, under-utilisation may not be the financial burden that it appears to be.

3. COPRA QUALITY AND PRICE STANDARDS

3.1 Introduction

The domestic price of copra in the Philippines is largely dependent upon the price of coconut oil in the World market. Traders operating at the higher levels in the marketing, distribution and processing of copra will usually have access to the latest World market prices for coconut oil. It was noted that even traders in apparently isolated situations had access to prices either through the telephone or telegraph system. The difference between the copra price at the farm and that at the crushing mill ranges between about P0.40 and P2.40 (PCA, 1990). These price differences depend on the following factors:

a. the distance from the trader to the nearest oil mill or major copra trading station;

b. the declared mill price (ie, the higher the mill price the greater the difference ie the higher the margins);

c. the commercial integrity of the traders . (There is considerable scope for traders to cheat sellers).

There are a number of different copra quality/pricing classification systems in use (or proposed). These are designed to induce higher measurable quality standards upon the production and marketing of copra. These are investigated below. Note that for calculation of copra price an average farm-gate value of P3 per kg is assumed (the lowest at the time of the mission).

3.2 Quality Standards

A number of attempts have been made to introduce pricing structures that reflect quality. Examples are The Moisture Meter Law, The Indophil Recommended Moisture Table, the PCOPA recommended moisture table, and more recently, the New Copra Classification Standards of November 1990. Details of these systems are given at Appendix IV.

Traditionally, two classification systems have dominated the market. The `Pasa' system, whereby traders literally pass the copra as acceptable or unacceptable giving a standard deduction down to 6% moisture content regardless of actual moisture content. Typical deductions are in the range of 20-25%. Larger traders tend to use the `Resecada' system, which gives a price deduction based on the traders judgement of the moisture content of the copra down to 6%. Copra arriving at the trader at 20% moisture content under this system will receive a discount of 14% by weight. Additional discounts are incurred under each system for dust (usually an arbitrary 1%) and quantity of copra `Goma'.

3.3 Alternative quality criteria

A number of ways around this problem are considered. Copra quality standards must be affordable, easily administered and regulated or policed. Copra standards based solely on moisture content do not meet these criteria. Dr Lozada of the University of the Philippines, Los Banos identified a number of factors which might form the basis of a more comprehensive quality standard for the avoidance of mould growth and therefore aflatoxin secretion (Lozada, 1988). These are, by and large, based upon visual and tactile criteria, as these are the most practical methods of measurement in the absence of laboratory facilities or affordable testing technology at farmer and trader level.

3.3.1 *Moisture content*

Lozada (1988) recommends that moisture content should be based on a 5% standard as at this level mould and insect attack is minimal. Traditionally, traders and dealers in copra have tested the moisture content of incoming material by breaking it in the hand. The feel of the copra tells the buyer both the moisture content and the age of the copra at harvest (early harvest copra or copra "Goma" is rubbery). The appearance of the outer surface of the copra also reveals information about age at harvest with very young or very old (over-mature) copra being more inclined to wrinkles. Moisture content is judged by the "crack!" the copra makes as it breaks and the cleanliness of the break. Dry copra makes a loud "crack" and breaks in a clean, straight line. At this point traders check for other criteria, inspecting the cross section of the copra to determine mould attack and colour. Low moisture copra results in low free fatty acid levels in the resultant oil which lowers refining costs considerably.

This commonly used informal method of measuring moisture requires validation. A study should be undertaken to see how accurate the method is in practice and what improvements can be made.

3.3.2 *Oil content*

Lozada (1988) bases his standard on oil content rather than moisture content. At 6% moisture content copra contains 61.5% oil, compared to 70% for a completely mature and fully dried copra, and as low as 43% for poor quality copra which has been subject to attack by insects, fungus, or bacteria (Hyman, 1990). The advantage of this is that oil content can be easily calculated using a standard weight and a conversion table and is a more accurate measurement of the true value of the copra. Additionally, measures of oil content would mitigate against the common practice of early harvest, which produces a low oil content, rubbery copra "Goma". This can only be used at the oil mill or at a large traders premises because basic laboratory equipment is necessary.

3.3.3 *Colour*

Dark copra (as a result of the direct drying process which allows smoke to circulate around the copra) results in discoloured oil. Additional expenditure is required in the refining process in order to clarify this oil to marketable quality. Dr Lozada proposes a colour standard distributed throughout the copra trade. A possible disadvantage of this might be that it would encourage sun-drying which produces light coloured copra. Though sun-drying can produce copra of a high standard, the risk of mould attack are heightened by rainfall and high ambient humidity.

Additional to Dr Lozada's list are:

3.3.4 *Mould coverage and colour*

Since the avoidance of aflatoxin requires the avoidance of mould growth, copra with high mould coverage, or suffering obviously from the results of mould attack (pitting of the inside surface) should be rejected. The measurement of the quantity of mould or mould attack would be largely subjective and very hard to regulate, the current PCOPA criteria of rejection over 10% mould coverage being a case in point. It was observed that copra contaminated with *Aspergillus flavus*, an orange mould, is easily identified even in a large pile of copra. These "hot-spots" of dangerous mould may be the cause of serious overall contamination in copra cake and meal after processing. Therefore, a programme of rejection of consignments containing orange moulds might reduce the chance of contamination.

3.3.5 *Smell*

Copra that has been stored for long periods has a tendency to rancidity or increased odour.

It can be seen that a large number of locally appropriate quality criteria are already in use by farmers and traders. Following validation, their adoption could produce a multi-level appropriate and acceptable copra standard which would encourage high oil content, low moisture levels, light colouration, low mould and insect attraction, whilst discouraging early or late harvest and inappropriate drying or storage methods.

3.4 <u>Impact of quality standards on farmers</u>

Table 4 below shows the relationship between price and quality for copra using three purchasing standards. Clearly, the Meter law provides a wider range of acceptable moisture levels allowing traders to accept copra of all standards. The Meter law pays a proportionately greater premium for copra below 5% moisture content than it deducts for moisture above 5%.

The crucial point about this quality standard is that it only pays farmers for water removed, and not for the work involved in doing it. Therefore, the farmer has no incentive to dry.

The Indophil standard, on the other hand pays a considerable premium for copra between 10% and 5% but does not encourage over-drying. The PCOPA standard mirrors the Meter law but pays a slight premium over and above it.

Disincentives to farmer drying: In monetary terms the results of these differing standards to the farmer are represented below at Table 4.

Table 4: Effect of Standard systems on Farmer Incomes (Pesos)

Moisture content at marketing (%)	Meter Law	PCOPA Standard	Indophil Standard Increment per annum
15	5256	Reject	-5256
12	5431	5840	409
10	5548	5957	409
7.5	5694	6103	409
5	5846	6132	286

Notes:

Assuming a trader price of P3 for Resecada copra.

Source: Farmer incomes from PCA Yearbook, 1988.

The moisture Meter law gives no incentive to dry copra to beyond the point at which the miller will accept it. The PCOPA system gives an incentive to dry down to 12% but no further.

Under the old moisture meter system a farmer marketing 100kg of copra at P3 per kg would receive P234 at 25% moisture content. If he dries off the moisture until it is only 5% the farmer should receive greater than 20% of the value of his crop again in compensation for labour, inputs and loss of overall weight. In actuality, the farmer receives P300 which represents only a 17% increase in returns. Thus, there is an inherent disincentive to dry copra built into the Meter law.

The PCOPA standard largely circumvents this problem by rejecting all copra with greater than 14% moisture content. It also ensures that compensation for copra supplied within the limits of the scheme's moisture requirements is valued both for moisture levels and reduced weight. The difference between high and low acceptable moisture levels is 7%, whilst the monetary value difference at these rates is 10% (ie, valuing farmer effort and capital at 3% or 9 centavos per kilogram). The disadvantage is that it only provides an incentive for copra drying to 12% at which the moulds that cause aflatoxin still develop.

4. DRYING PRACTICES

4.1 Introduction

A number of drying practices were observed over a wide area of the Philippines. These are analysed below and a comparison is drawn between these and alternative farm level drying practices currently proposed. Finally, a number of alternative drying options are considered such as trader drying.

Drying methods are divided into four categories, sundrying, `direct', `indirect' and `semi-direct'. This refers to the contact that the copra has with the combustion gases. In a direct dryer, the combustion gases pass straight through the drying copra. In an semi-direct dryer, there is some distance between combustion and drying surface, therefore, the gases are more diffuse. An indirect dryer uses fresh air heated by combustion gases through a heat exchanger to dry the copra. In the latter, no combustion gasses come into contact with the copra (further details and construction costs are given in Appendix V.)

There is no one post-harvest system practiced in the Philippines that could be referred to as typical. The drying systems in existence produce copra of differential qualities, oil and water contents. The requirement of copra drying is to reduce the moisture content of wet, fresh coconut meat from about 50% to the ideal level of 6% at which it is ready for oil processing. In the Philippines, the current average moisture level in copra at marketing is about 18%, thus farmers are drying off about 32% of the moisture whilst traders and millers are drying the remaining 12% in their warehouses.

It has been long known that the keeping qualities of copra depend on its moisture content. Copra dried to between 6/7% of moisture and stored in a well-ventilated dry go-down at an even temperature, will not seriously deteriorate. More importantly, it will not be attacked by mould.

4.2 Drying Methods

4.2.1 Sun drying

When conditions are right and the operation is well organised, sun drying can produce good quality copra. Unfortunately, optimum rainfall conditions for the successful sun drying of copra, 1,500mm falling on not more than 140 days a year, do not coincide with the optimum conditions for coconut growing (Childs, 1974). Problems with sun drying are as follows:

- drying during period of insufficient unbroken sunshine,
- leaving split nuts uncovered at night or during rainfall,
- drying on the ground so that the copra becomes contaminated with sand, soil etc.

For sun drying, copra is usually scooped out of the shell and laid out with the inside facing the sun. After a period the copra is turned and broken, both to speed the drying process and to reduce the sacking requirement for the finished copra. More elaborate sun-drying mechanisms were observed involving trays either moving the copra into shelter or moving a roof over the copra. Neither of these approaches has been widely adopted since normal sun dried copra sells at the same price as improved sun dried copra.

It is the practice in some areas to dry copra in the husk. The advantage of this approach is that it reduces labour time required as scooping is made much easier since the copra dries away from the shell. The disadvantage is that the husk and shell remain joined, so this method is used in areas where the coconut shell has little value.

Case study 1 - Small copra miller, Mindoro Occidental

Milling 10 tonnes per 24 hour working day and marketing the oil locally. Buying copra directly from farmers and from traders and drying using a number of different dryers including the "Lozada Dryer[vi/] ", and a "Samoa Dryer[vii/]", but mostly sun drying. Copra purchased directly from the farmer at 25% moisture content is spread out over a large concrete platform (capacity 6 tonnes). The copra is usually dried for four days and then mixed with damp copra to get a mean moisture content of about 7%. In total the operation took 12 person hours per day, including spreading, turning, piling, covering and bagging, with a cost of P0.03 per kg (assuming casual labour costs P60 per day).

The chief advantage of sun-drying is cost. If a suitable open area is available, then the only costs involved are those for labour in spreading, turning and breaking the copra. These jobs are often done by women and children.

Incidence of mould attack in sun-dried copra are likely to be higher than other methods due to the ease with which moisture can be re-introduced to the coconut flesh during the prolonged process by rainfall or dew formation. Other methods involving dryers reduce the time that copra is exposed to the elements and the overall time between harvest and storage in the trader's warehouse.

4.2.2 Direct drying

Incidence

A recent survey of Philippine coconut post-harvest practices (Bawalan, 1990) showed that of the existing dryers, 98.4% are variations on the direct/semi-direct firing type. The majority (76%) had capacities ranging between 1,000 and 5,000 nuts per loading and were constructed of nipa roofs (78%), with bamboo flooring (88%) and bamboo walling (53%).

Construction

The "Tapahan" Dryer is the most common variety of man-made dryer to be found in the Philippines. It consists of a platform, commonly made of split strips of bamboo, suspended above a fire which can either be in a pit or laid on the ground. This type of dryer is referred to as a direct type because the fumes from the fire come into direct contact with the copra and often result in some discolouration of the finished product. Typical costings of large and small Tapahans are given at Appendix V.

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vi/ A direct drying system using coconut shell as fuel designed by Professor Lozada of the University of the Philippines, Los Banos

vii/ An indirect continuous drying system imported from the Islands of Samoa.

Advanced Tapahan

This is a sizable structure consisting of a roofed drying platform over a single or double trench and fired using available biomass including fronds, timber, coconut husk and coconut shell.

Farmers have considerable outlays on material to consider when building a tapahan. A typical large (5000 nut capacity) tapahan in Palawan cost P4,585 to construct (see Appendix V).

Items such as bamboo lengths are becoming increasingly valuable as pressure on the marginal farm land where they are normally found increases. Rural, and increasingly, urban demand for building materials means that the opportunity cost of using home grown coconut timbers and bamboo is high. In most cases observed, a surprisingly high proportion of the timbers used in the main superstructure were marketable and could be valued accurately. All farmers interviewed purchased Nipa fronds for roofing ready plaited as this is a time consuming activity.

Basic Tapahan

In its most basic form the [illegible]sts of shallow pit, often dug into a sloping hillside, cover[illegible]nework of bamboo and wood. Such a construction can cost as little as P250 including 4 person days labour. This type of tapahan has a capacity of between 1-2000 nuts and is not expected to last more than 2 coconut harvests before the pit needs re-digging and the framework must be replaced. Thus, farmers using this type of tapahan will expect to replace it at least once a year.

Between these two types of tapahan lies a plethora of intermediate constructions incorporating various levels of sophistication and local adaptation. Tapahans commonly have roofs to prevent rain damage to the drying copra as well as to reduce subsidence into the pit. Sometimes these roofs include areas for wet weather dehusking and dry places for shells to be stored. They are commonly constructed some distance from the family compound to avoid the risk of fire and are usually sited at a point where access for carabao sled (a timber frame dragged behind water buffalo and used for transporting whole coconuts from the field) is easy.

Tapahan drying results in the discolouration of the copra and may result in a build-up of polyaromatic hydrocarbons which are toxic. Darker colouration of the resultant oil also increases costs incurred during the refining process.

Operation

Direct dryers are fuelled with a combination of coconut husks and shells. Traditionally, the fire is started with coconut shell which has good combustion qualities, and is maintained with coconut husk. There are two main drying practices.

(a) De-husking the shell, splitting, drying, scooping, breaking and further drying.

(b) De-husking the shell, scooping, drying, turning and breaking.

The nuts are either de-husked by the tree and only the appropriate amount for firing hauled to the dryer, or the whole nut is hauled to the dryer and the husk removed there. The former method is traditionally practiced in hill areas where the extra effort involved in moving the considerable biomass of the husk is great.

The amount of husk/shell used in drying depends upon the efficiency of the dryer and the length of drying. Anecdotal evidence suggests that the great majority of farmers have husk left-over after firing their dryers and that this residue has no value and is burnt to reduce the risk of fire. Some farmers said that they always had at least one third of their husks left over after firing. This becomes important when dryer efficiency is considered because this extra husk could provide the additional fuel required by improved traditional dryers to dry copra to a more acceptable moisture level on-farm.

Case study 2 - Tapahan operation, Surigao, Mindanao

Basic tapahan dryer constructed on a hill-side in the centre of the farmers land and some distance from both the homestead and the road. The dryer had a very deep pit which the farmer claimed was to prevent fire damage. The capacity was 800 nuts which represents about 1/3rd of his usual crop. This crop was harvested and dried over a period of 5 days using four labourers as follows:

	Pesos
. climber @ P60 per day (without a meal) x 4 days	240
. Scooper @ P30 per day (without a meal) x 2 days	60
. husking @-P7 per 100 nuts	56
. hauling @ P60 man animal days x 1.5 days	90
Total labour costs	446

Notes:

Crop (kg) = 620

Therefore, total labour cost per kg = P0.72

This farmer was sharing his crop 50:50 with his landlord.

4.2.3 Semi-Direct

D'vapour dryers

The d'vapour dryer consists of a pit dug into the ground or hill-side connected to another pit by a tunnel or tube. Over the main pit, a tapahan is constructed. The fuel is burnt in the lesser pit and the heat drawn through the tunnel and up past the copra. In some instances (see case study 3) the whole contraption is above ground, but the same principles apply. The operation of these dryers is exactly the same as the tapahan, though more fuel may be required. The major advantage of this approach is security as there is a much reduced chance of the dryer setting alight. This means that the farmer does not have to watch the dryer throughout the firing process, but can charge it and then go about other work. Additionally, the d'vapour reduces the contact of the copra with the fumes from burning husk, resulting in copra of a lighter colour.

> Case study 3 - D'vapour operation, Cotcot, Liloan, Cebu
>
> Using a raised d'vapour dryer with an extended concrete flue to maintain the distance between the fire and the copra. The dryer capacity is 1000 nuts and is fuelled with both husk and shell together. Total time taken from harvesting to marketing is 4 days including picking, hauling, splitting, drying and packing. For drying the farmer was firing continuously for 24 hours. The farmer considered this design of dryer to be both the most economical and the safest. During the rainy season the farmer rented out his dryer to neighbours for P3 per 100 nuts.

Costs

A number of d'vapour dryers were costed. On the whole, the d'vapour costs much the same to build as the tapahan except for the need for an additional pit and tunnel. However, replacement of burn parts such as bamboo slats is much reduced using this process. The more elaborate d'vapours found on the island of Cebu are an expensive local adaptation which saw its hay-day of construction 10 years ago. No recently constructed Cebu d'vapours were found. A typical basic d'vapour of 2000 nut capacity, costs about P800 to construct (see Appendix V).

4.2.4 Indirect

Kukum dryers

Originally developed by the Department of Agriculture of the Solomon Islands, this dryer consists essentially of a closed heating chamber, through which passes a flue 60cm in diameter, constructed of welded oil drums (usually 4 required). A drying platform of split bamboo is placed about 1.5 to 1.8m above the flue.

Case Study 4 - Kukum operation, Davao Del Sur

This farmer had 2 kukum dryers which cost him P4,000 each to construct in 1987. His dryers have a capacity of 1000 nuts each and take 2 days to dry the copra to a marketable moisture content. He sell his copra for about a 4% discount, therefore, the moisture content at farm gate is near 10%. He employs men to husk, shell and scoop his copra which costs about P220 per day. He noted that the traders preferred his "white" copra but were not paying any premium above the resecada basis.

Costs

A breakdown of typical Kukum dryer costs is given at Appendix V. Establishment costs are shown below at Table 5. Both capital and recurrent expenditure is high on the kukum relative to traditional methods of drying. This is because of the high level of purchased inputs required such as timber for the frame and oil-drums for the burning chamber. The latter are of particular importance, since oil-drums become increasingly scarce (and therefore valuable) in proportion to the cost of importation of petroleum products. This component alone increased in price by almost 20% during the course of this mission.

Consideration should be given to improving the life span of oil-drums by improving the design of the fire-box to reduce wear and tear during firing. Replacement of drums is the significant recurrent cost.

4.3 Reasons for non-adoption of Kukum dryers

The Kukum dryer is now in distribution in the Philippines. However, there are a number of difficulties which will, under present circumstances, discourage up-take.

4.3.1 Lack of price incentive

As yet no price incentive is paid anywhere in the Philippines for copra dried to a moisture content that will prevent mould attack (6-8%). Since the kukum dryer represents a considerable expenditure both in terms of extra capital and labour plus increased recurrent costs over current drying practices (see above), and considering that centralised drying is the exception rather than the norm in most coconut areas, up-take of this technology is not expected under current conditions.

4.3.2 High cost to farmers

The construction costs of the 2,000 nut capacity Kukum have proved consistently higher than the grant provided by the PCA for this purpose (P6,500). The major capital component is oil drums, and these are imported items which have risen in value consistently in recent years in line with rising oil prices. Replacement of these drums represents a considerable financial burden on the farmer. A high proportion of tenants and farmers already have traditional dryers or have access to such dryers. This represents a massive sunk cost both for the farmers and for the Philippines as a whole which could be in the region of P750 Million (calculated on the basis of about 1.5 million farmers, 70% of whom have dryers (Bawalan, 1990) and assuming a standard value of P500 each.

4.3.3 Socio-economic factors

The practice of centralised drying was only found in certain areas of Northern Mindanao and Cebu. In other areas (ie, the majority of the Philippines), farmers were found to prefer individual dryers placed in close proximity to the homestead. For small farmers, the additional expense of hauling nuts from harvest site to dryer should not be underestimated. Current land tenure arrangements mean that for the majority of tenanted farmers, copra production is a comparatively minor proportion of their income. When choosing dryers farmers often consider the labour requirements and safety aspects as high priority. When siting dryers, farmers show most concern with proximity to the homestead and to the coconut trees because of the fire risk. The value to the farm family of the additional time required in order to dry their copra to a safe moisture level has not been adequately addressed.

4.3.4 Credit arrangements

An indeterminate but substantial number of farmers use copra as collateral against loans from copra buyers and have thus often spent the value of the crop long before it is harvested. Under such circumstances, additional expense incurred in drying and not covered by quality premia could result in increasing the indebtedness of the farmer. The role of copra traders as lenders of the first and last resort in isolated and poor areas should not be underestimated. Any copra quality improvement scheme which either by-passes this process or fails to provide an acceptable alternative will meet difficulties in attracting cooperation from small tenant farmers.

4.4 Results of incomplete drying

During storage and transportation, the inadequate drying of copra results initially in bacterial attack (at around 20% moisture) then a number of different fungi depending on moisture content, and finally insect attack. The losses take the form of decomposition as a result of mould attack, then consumption of material by insects. The result is a build up of copra `dust' or extraneous disintegrated material.

Financial losses resulting from deteriorated copra take the form of reduced overall weight, increased fatty acid levels (and therefore increased refining expenses) and poor quality pressed cake. Severely attacked copra may have higher concentrations of oil as a result of the removal of the lower oil bearing outer layers. Overall weight loss as a result of storage attack is yet to be determined though Childs (1974) showed that a sample containing 12% moisture stored under reasonable conditions for five months showed a loss of 10% of its weight, and the oil had a FFA content of 1.5% (lauric).

4.5 Drying cost summary

4.5.1 Capital costs

Table 5 shows the capital cost of various different drying methods/technologies per kg of copra throughput. As might be expected, sun-drying has no capital costs since no financial outlay is required. There may be a recurrent opportunity cost in terms of the land use, though many farmers use roads and communal areas. The d'vapour dryer is the least costly of the other alternatives, reflecting its durability and low cost of construction. The Kukum dryer is twice as costly as any of the alternatives.

Table 5: Comparison of capital cost of drying

	Total establishment cost (Pesos)	Total Throu-put (kg/yr)	Cost per kg copra	
Discount Factor			12%	25%
Method				
Sun-drying (1)	0	n/a	0	0
Small tapahan (2)	260	760	0.38	0.42
Large tapahan (3)	4,585	3,800	0.21	0.34
D'vapour (4)	785	1,520	0.14	0.19
Kukum (5)	10,440	3,040	0.61	0.96

Source: See Appendix V

Notes:
(1) Assumes suitable flat open area available
(2) Capacity 1 000 nuts, replaced once a year
(3) Capacity 5,000 nuts, life of about 10 years
(4) Capacity 2,000 nuts, life of about 5 years
(5) Capacity 2,000 nuts, life of about 10 years

All cases assume a 90 day cropping cycle and are calculated on an average of 0.19kg of non-resecada (18.5% moisture) copra per nut. Also assumes that owner does not hire out dryer. Discount rates of 12% and 25% have been used to express a range of possible values for the opportunity cost of available rural capital.

In some areas of the Philippines, notably Mindanao, farmers only use their dryers during the rainy season when sun-drying is impossible. In terms of kilos of copra dried on the farmers dryer, this means a considerable increase in capital cost. Risk aversion (ie, in this case the avoidance of wet weather damage and the need to market the copra quickly after harvest) is, therefore, a key issue for the farmer.

4.5.2 Recurrent costs, the importance of risk aversion

Most farmers interviewed considered it essential to provide a constant watch on drying copra. Farmers wish to avoid risks associated with the copra making process. Key examples of risks are listed below.

- delays in marketing result in financial hardship and possible loss of credit.
- loss through rain damage of copra or the re-wetting of copra already dried.
- loss through pilferage of unguarded copra.
- burning of copra either during the drying process or during storage.

The latter is of prime importance to farmers since the accidental conflagration of dryer and crop is potentially disastrous especially if the crop had already been the result of a financial advance to the farmer by a trader. Farmers are very keen to avoid conflagration and therefore often build dryers with very deep pits or high drying platforms thus reducing the dryer efficiency. As noted above, the major advantage of the d'vapour type dryer is that it avoids the risk of conflagration.

The fire risk has another effect on farmers methods of drying. Vigilance is considered very important during the drying purpose, so often the farmer will stop all other work to watch the dryer, or pay someone to watch the dryer for him.

4.6 Conclusions

The following factors should be taken into consideration in choosing dryer technology:

(i) Cost
(ii) The avoidance of risk
(iii) Traditional practices
(iv) Availability of materials
(v) Convenience
(vi) Land-holding arrangements
(vii) Efficiency of dryer
(viii) Speed of drying
(ix) Sunk costs

Traditional drying systems have considerable advantages in all these areas. Therefore, it is suggested that improvements to traditional methods will be both financially and economically cost effective as well as having a much greater likelihood of adoption. The development of methods to improve sun-drying or to encourage sun-dryers to adopt alternative technology should be considered a priority.

5. STORAGE PRACTICES

5.1 Introduction

The problem of development of moulds during storage of copra is currently being addressed by the UK/RP Copra Quality Project. Copra is stored in the Philippines for a number of reasons including: to increase value, to dry, and as collateral. This section will briefly discuss these issues and contend that, in all likelihood, mould growth in store is a major contributory factor to the overall high levels of aflatoxin in Philippine copra.

5.2 Points of storage

Copra is stored on-farm after processing, in the marketing chain and at the oil mill. During this process it has been shown (see Section 4 above) that on average it falls from an average of about 18% moisture to 6% moisture. The majority of this fall in moisture occurs in the stores.

5.2.1 On-farm storage

A recent survey (Bawalan, 1990) revealed that, of a sample of 4214 farmers, 92% of farmers sold their copra immediately after drying. A major reason for not drying copra to lower level is that farmers need to release the capital locked up in that copra. Anecdotal evidence suggests that pressures on farm family income often provide the farmer with the motivation to harvest copra. Commonly these pressures are in the form of tri-annual school fees which represent a regular and growing burden to hard pressed family budgets. Less predictable expenditure includes family deaths and marriages which require suitable celebrations, marriages and natural disasters which result in harvest failure or physical damage to property.

5.2.2 Trader and wholesaler storage

The great majority of traders have warehouses with capacities which vary between 5 and 20 tonnes. Most claim to store their copra for a maximum of one month (92%) and only 4% store copra for 3 months or more. Few traders or wholesalers re-dry the copra that they store since there is no incentive to do so. They will, however, usually sun-dry the occasional bag of copra which is obviously so wet that it will contaminate the store contents. In all the warehouses visited no evidence was discovered of separation of copra of differing qualities or moisture contents. Generally, when it arrives copra is taken out of the sack to facilitate drying and piled up loosely on top of copra already in store. Once it has dried to an acceptable level and a buyer has been found, it is put back into bags by teams of men and loaded into lorries for transhipment either to wholesalers or directly to the oil mills. There are a number of advantages to the trader in this in-store drying process:

(i) Storage allows the trader/wholesaler to enter period contracts (usually 30 days) with wholesalers and millers and thus he can buy cheap copra when it is available and avoid purchase of copra when prices are rising.

(ii) Moisture premium: Traders tend to exaggerate moisture deductions in their transactions with farmers in order to increase their profit margins (see Case Studies 5 & 6).

Case Study 5 - Trader, Matnog, Southern Tagalog

This trader buys 90% of his copra directly from farmers, 65% of whom have credit arrangements with him. His total warehouse capacity is 40 tonnes and the majority of his copra is delivered directly to the San Miguel plant at Bulan on 15 day fixed contracts. On average he stores for 2 weeks. He was paying P3.60 per kilo, at resecada, which, with a 10c per kilo labour cost, gave him a profit of 30c per kilo (not including warehouse rental and overheads) when selling copra at P4.00.

Case Study 6 - Trader/wholesaler, Leyte

Buying directly from the farm gate using his own truck with a typical moisture deduction of 20-25%. After deducting 1% for "dust" this trader then dried in a large d'vapour dryer to resecada. This method allowed him to buy from [illegible] gate at P2.70 per kilo, dry and sell for P4.00 delivered to the [illegible]er. No other traders in the town had taken up the idea of drying instead of storing.

(iii) Flexibility: In-store drying allows traders to respond quickly to changes in the market, buying in copra wet when prices fall and selling it dry when prices rise again. Similarly, if prices rise, stored dry copra can be mixed with bought in material to provide an acceptable overall moisture content. This is one method which mitigates against the successful implementation of a moisture standard to combat in-store mould growth since traders can and will practice mixing of good and bad copra in order to meet the trade requirements. Criteria additional to moisture content are essential in order to prevent in-store drying.

5.2.3 Oil miller

All oil millers keep significant stores of copra in order to ensure a steady supply of inputs into the production process. To the oil miller this represents a high proportion of working capital costs. The great majority of millers (95%) store their copra for one month or less before it is used. Since copra is purchased at low moisture levels (10% and below), storage damage and losses at this stage are minimal. Storage practices at the miller level are usually better than those seen at the trader level, with regular cleaning and adequate ventilation being more common. After milling, Crude and Refined oils are stored in tanks, whilst copra cakes and meals are either bagged and sold immediately, or stored in bulk (often in pellet form) for transhipment or export. Moisture contents in these materials is low and mould attack would not be expected unless re-wetting occurred.

5.3 Storage Losses

At present little is known about the losses incurred by storing wet copra over time. Stored copra is attacked by bacteria, mould and insects and this results in the production of "dust" or broken down copra. Another affect of this process is the concentration of oil in the copra, which may increase overall FFA concentrations. The value of these losses to those that store and to the Philippines as a whole will be addressed during the course of the UK/RP Copra Quality Project.

5.4 Conclusion

Copra produced in the Philippines is stored for financial gain. This is either inter-temporal, through increased prices, or by increased value due to reduced moisture content. The great majority of copra storage occurs in the marketing chain and is a factor of the small-scale of production characteristic of the Philippines and the traditional complexity of the marketing system (see Section 2). Damage to the copra during this storage through bacterial, mould and insect attack, though not currently of concern to traders, is an economic loss to the Philippines as a whole in terms of foreign currency earnings foregone which represent the opportunity cost of inadequate drying and quality control methods. It is hoped that the investigation of storage losses currently being conducted in the Philippines will quantify these losses and provide an incentive to improve quality. Similarly, work on aflatoxin presence in stored copra will provide evidence of the effects of in-store drying of high moisture content copra.

6. COPRA QUALITY IMPROVEMENT STRATEGIES

6.1 The benefits to millers of better quality copra

6.1.1 Reduced refining losses

Refining losses result from free fatty acid formation which must be removed to produce an edible, marketable finished oil. The formation of free fatty acid is a function of the production system and depends upon harvesting, drying and storage practices. Provision of low (oleic) free fatty acid, filtered and moisture free oil from the extraction process is particularly important to manufacturers which integrate oil extraction and refining (as is commonly the case in the Philippines).

The largest single cause of financial loss is through reduced recovery of oil during the refining process. Oil losses in neutralising are adjudged to be 1.4 times the FFA content (Flynn, 1973). Additionally, there is a loss through filtering and splashing of about 2% of the post neutralising weight of oil.

Caustic soda required during the neutralising process is also dependent upon the quality of processed copra and economies are available from reduced FFA levels. For every kg of FFA in oil, 0.142 kg of caustic soda is required for neutralisation plus an excess of 0.15 per cent of the weight of the oil being neutralised (Flynn, 1973).

Bleaching follows neutralisation and is usually done with fullers earth which has a high absorbent capacity. The quantity required depends on FFA levels plus the colour of the extracted oil. Oil produced from smoked copra required higher levels of bleaching earth. It is assumed that 0.77 kgs of bleaching earth are required to refine one tonne of poor quality extracted oil at 3% FFA, 0.575 kgs are required for oil at 2% FFA and 0.383 kgs for oil at 1% FFA.

Table 6 shows the results of these losses and additional costs for a range of FFA levels. It can be seen that the additional value per 100 kg of copra input of a 1% reduction in FFA is in the region of P11.

Table 6: Value of Refining Losses due to Free Fatty Acid Content (FFA)

Per 100 kg of oil	Percentage of FFA 1%	2%	3%
Refining losses (kg)			
Neutralising (1)	1.4	2.80	4.20
Filtering and splashing (2)	1.97	1.94	1.92
Sub total	3.37	4.74	6.12
Cost of lost oil at P11.5 per kg (3)	38.76	54.56	70.38
Refining costs (Pesos per 100kg of oil)			
Caustic Soda (kg) (4)	.274	.40	.52
Cost at P19.50 (P) (5)	5.343	7.76	10.18
Bleaching earth (kg)	.04	.06	.08
Cost at P13.50 (P) (5)	.54	.81	1.08
Total Value of losses per 100 kg of oil (4+6+8)	44.64	63.13	81.64
Total costs per 100 kg of copra input (6)	26.34	37.24	48.17

Notes:

(1) Losses 1.4 times FFA levels
(2) Filtering losses about 2% of weight after neutralising, approximately 0.5% of weight after splashing
(3) Average of Manila factory gate oil price for three oil mills May-July, 1990
(4) Every kg of FFA in oil requires 0.124kg of caustic soda to neutralise it, plus about 0.15% of weight of the oil being neutralised
(5) Prevailing market price, May 1990
(6) Assuming factory gate price for copra of P3 and a ratio of oil to copra input of 0.59:1

Source:

Flynn (1973), plus field observations

Many millers already take advantage of these benefits by mixing good and bad quality copra inputs to reduce overall FFA levels. A great many of the millers visited were already achieving relatively low FFA levels (between 1 and 2 per cent and sometimes less). Therefore, the full premium would only be available to millers who currently have consistently high levels of FFA in their oil before refining.

Lozada, of (1988) (Lozada, 1988) calculates total saved by reducing FFA levels in unrefined oil to be from 3% to 1% of P56.77 per 100 kg of copra input. The difference between this and the figure stated above of P.11 (or

P0.22 for FFA reduced from 3% to 1%) is accounted for by the inclusion in Lozada's calculation of the value of eliminating from the market chain of immature "goma" copra. Lozada also includes reduced refining losses of 2.2% which represents a saving of 3.3kg per 100 kg of copra. Additionally, Lozada values reduced caustic soda requirements for neutralising at 0.142 kg per 1% of FFA in the crude oil. Lozada identifies, but does not quantify, savings in bleaching costs, though a figure of P1.78 per 100 kg of copra is included for other savings. These include reduced maintenance of plant, reduced steam consumption in deodorising the oil, reduced storage costs at the mill due to diminished losses, and lower transport costs due to lower moisture levels.

6.1.2 Premiums for aflatoxin free copra cake and meal

There is some evidence to suggest that copra cake and meal with consistently low levels of aflatoxins which have been tested in Europe, receive a premium over and above those copra by-products arriving from countries which have a poor record with aflatoxin levels. Purchases of copra meal from Indonesia are considered to be good quality ie low levels aflatoxins, and, therefore have been trading at up to $20 above the Philippine price per tonne. During the period February 1989 and April 1990, Indonesia copra meal (cif Rotterdam) was, on average, $12 more expensive than Philippine copra. This is despite the fact that Inodesian copra has consistently lower residual oil levels in solvent extracted meal than Philippine copra meal due to more efficient extraction techniques.

Approximately 34.7 kgs of meal (with 2% oil content) might be left after the processing of 1 tonne of raw copra, based on a recovery rate of 59% of oil from the extraction process, less 1% moisture loss during processing, and a further recovery of 6kg of oil during solvent extraction. Thus 1 tonne of finished copra meal represents 2.88 tonnes of copra input. This shows that a premium of $4.17 per tonne of copra input is available for guaranteed, aflatoxin free copra meal. This is equivalent to 10 centavos per kg of copra input.

Therefore,

(1) Premium/copra input = premium per tonne

(2) $12/2.88 = $4.17

Therefore, Pesos value ($1=P25.08) per kg

(3) $\frac{4.17 \times 25.08}{1000}$ = P0.10

A premium is available to manufacturers of copra meal and cake and would be in addition to the benefits of lower FFA content in copra[viii/].

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viii/ Personal communication with the Royal Dutch Association of Grain Handlers, Rotterdam

6.1.3 The costs of improved quality copra

To guarantee no mould growth it is necessary to dry it on-farm to about 6% moisture content. This prevents any further deterioration due to bacterial and fungal attack and discourages insect attack.

Assuming the farmer dries copra for twice as long as was the previous practice (in order to reduce moisture content from an average of 18% to 6%), the incremental cost to the farmer is the extra labour involved in watching the drying copra plus the additional value of fuel used. This latter cost is minimal in the case of husk which when splitting is done by the drier. When splitting is done under the tree, the increased labour and hauling costs should be considered. On top of this is the increased wear and tear on the family drier from increased firing. In the case of sun drying, the cost would be labour plus the additional risk of rain damage affecting crop value.

In terms of discounted capital costs, the incremental value of using a kukum drier over a typical tapahan is approximately P0.40 (see Table 7). This assumes an opportunity cost of capital of 12% only. In addition, increased labour costs (applicable to all types of drying) are in the region of P60 per man day assuming that the opportunity cost of farm family labour is the marginal value product of hired labour and assuming that rural labour is in fairly full employment. For a kukum this represents about P0.08 per kg, making a total, including capital costs of P0.48 per kg.

In return for the drier copra we assume that the farmer receives the full resecada value for copra which, under the PCOPA system, means an additional 10%. With a copra price of P3 per kg this is P0.09 per kg. If the costs of the process are deducted, an incremental loss of P0.39 per kg remains. This is a rough estimate of the minimum premium required by farmers to invest in kukum driers and adopt better drying practices.

Even if the additional benefits to millers of reduced FFA (P0.11 per kg of copra for each % point of FFA) are passed on to the farmer, this is not enough incentive for the Kukum to be adopted. Costs and benefits are shown in Table 7.

Table 7: Benefits and costs of adopting the Kukum dryer the optimistic scenario

	Centavos per kg of copra	
	Kukum	Tapahan
Benefits		
Aflatoxin premium (1)	10	10
Reduced FFA (assuming 1.5%) (2)	16	16
Total benefits	26	26
Costs		
Dryer		
- Capital costs (3)	40	-
- Operating costs (3)		
- Labour	8	8
- Additional fuel	-	2
Total costs	48	10
Net Gain/Loss	-22	16

Notes:

(1) see 6.1.2
(2) see Table 6
(3) see 6.1.3

Assumes that the tapahan already exists, therefore no additional costs. Nominal cost of additional fuel (husk) used by tapahan to produce high quality copra = P0.02 per kg

If tapahan driers are assumed to be a sunk capital cost or if disadvantages of sun drying are considered, the financial returns from improved copra available to the farmer are better (see Table 7). The reduced capital cost per kg gives more scope for the successful implementation of a premium for improved quality copra that is commensurate with the benefits to oil refiners from the reduced FFA.

In practice, the passing-on of these incentives/benefits from the oil refiner to the farmer is beyond the current incentive structure (see Sections 2 and 3). The ability of the market alone to regulate copra quality by passing on incentives to farmers is doubtful.

6.2 The opportunity cost of increased quality

It has been estimated that the average farmer with a land holding of about 2.5 ha's, spends about 4 days per crop working on copra production. This includes harvesting (climbing and piling), hauling to the dryer by carabao sled, de-husking, splitting, drying, scooping, final drying, breaking, sacking and marketing. The majority of farmers spend little time weeding or fertilising their crop. With a typical cropping period of 90 days it can be seen that copra production and marketing is a marginal activity for farmers.

Discussions with farmers about time allocation show that, on the whole, they are usually fully employed. Therefore, other economic activities take up a great proportion of their time. These are dependent on land-holding. Farmer/owners tend to have a variety of other cash crops that require more regular attention than coconut. For example, in Southern Mindanao maize production is over 1 million tonnes per annum or about 3.5 tonnes per farm per annum. Similarly, rice production (Palay or rough rice) in Central Luzon was 5,253 tonnes in 1986 or about 23 kilos per farm. Other significant products include root-crops (cassava and sweet potato), fruit and nuts, bananas, coffee, sugar-cane, abaca, livestock and poultry.

Tenants and landless labourers sell their labour to neighbouring farms for cash or crop-shares. There are strong patron-client relationships present which form an important part of the `coping' methods adopted by the Philippine rural poor against disaster such as crop failure.

Case Study 7 - Copra harvesting and marketing, Surigao

This tenant farmer has 2.5 ha's of which 50% is covered by coconut. This means 150 trees and a harvest of 2000 nuts every 90 days. To harvest takes 4-5 days using 4 different labourers (six man days) as follows:

	Pesos
Climber:	
@ P60 per day (without meal) x 4 days	240
Scooping:	
@ P30 per day (without meal) x 2 days	60
De-husking:	
@ P7 per 100	140
Hauling:	
@ P60 per man/animal day x 1.5 days	90
Firing:	
done by tenant x 2 days	120
Total	650

Thus, the tenant invests about 25% of the gross value of his/her crop in hired labour and uses only 2 days a month in copra making. The profit from this activity is shared 50:50 with the owner. This tenants chief form of income was rice production.

This is important in terms of incentives to dry for longer periods, because it allows assessment and valuation of the opportunity cost of increased drying time. It also shows the benefits of dryers which require less constant attention (such as the d'vapour dryer).

The opportunity cost of extra drying could be defined as the valuation of extra time spent drying, plus the incremental cost of improved dryer technology and reduced life expectancy of dryer.

6.3 Small Coconut Farmers Organisations (SCFO's)

In an attempt to improve the power of the typical Philippine coconut farmers characterised by small-scale production, tenancies and an inability to raise capital, the PCA has begun encouraging farmers to collect together to form SCFO's which can then become the focus of targeted development programmes to improve productivity, assist in marketing and to enable weaker sectors of the coconut community to benefit from development programmes such as extension and credit. These SCFO's are made up of small-farmers, tenants and farm labourers. The membership is predominantly male and to judge by the three groups contacted during the mission, control is in the hands of the more substantial local landowners. On average the ration of farmers to tenants/workers is about 1:2.5.

These organisations are an essential step in the process of identifying farmer needs, and targeting coconut development programmes. However, they have suffered from problems typical of those experienced world wide in co-operative development. Motives for forming and joining SCFO's are mixed. Most wish to benefit from promised subsidised input programmes, whilst other join at the behest of their patron. However, the speed of formation and ability to maintain momentum of those SCFO's currently formed is in doubt especially if they are to function as businesses. If the aim of SCFO's is to by-pass the marketing chain and sell more directly to enhance price, one of the keys to success will be credit. At present the constitution of the PCA forbids it to enter credit agreements with farmers. Similarly, the current PCA ability to respond to the needs of SCFO's with extension expertise and inputs is limited. Should only 10% of farmers join SCFO's, and each one limit its membership to 30 farmers/tenants/workers, then 3,000 SCFO's would be formed. At a ratio of 1 extension officer to 10 SCFO's, 300 officers would be required.

6.4 Improved Copra Production Systems (ICPS)

These proposed systems are designed to produce economically viable quantities of high quality copra. The intention is that end-users such as oil mills, copra exporters, feed mills, and chemical plants, which place a financial value on higher quality copra, should be identified. Then the financial advantage of using high quality copra would be quantified by assessing the savings available from eliminating losses currently incurred in primary and secondary processing and losses in the marketing chain as well as determining any added value of the products. This would give a figure for gross margins available for purchasing good quality copra. A proportion of this "profit" might then be passed on to traders, processors and farmers as an incentive to produce and buy better copra. This higher price for good copra over poor copra should be sufficient to pay for any increased processing/marketing (principally drying) costs.

Some of the difficulties with quantifying these incentives are outlined above. Based upon this information I would argue that an ICPS should be an incentive or deduction scheme based upon providing farmers with the motive to improve the quality of their copra and assisting them with financially acceptable technology to meet this aim.

However, it has been shown (see section 6.1.3 and Table 7) that, without a system of mandatory inspection with an upward limit on the level of aflatoxin permissible in export shipments, there is insufficient incentive for improved farmer drying.

6.5 Trader drying

The final method for improving copra quality which perhaps has not received enough attention in the past is the possibility of the trader buying copra exactly as he/she does at present, but then drying immediately to resecada levels.

The benefits to the trader of doing this would lie in reduced storage costs, reduced storage losses due to bacterial, mould and insect attack and faster turnover. These would have to outweigh both the additional costs of drying plus all the benefits the trader received from storage, such as the ability to benefit from price fluctuations.

There is some evidence that this is commonly practiced in other countries that produce copra, such as Indonesia, though there is little information of how the system works.

6.6 Alternative Methods of Combating Aflatoxin

Any financial and economic solution to the aflatoxin/quality problem in the Philippines should consider in addition to improvements in drying, alternative ways of approaching the problem.

- (i) Wet processing of copra
- (ii) Mould inhibitors - propionic acid
- (iii) Ammoniation
- (iv) On-farm or village level processing

6.6.1 Wet processing of copra

This process involves the low pressure extraction of coconut oil using fresh coconut, dried and pressed. This could be done at the farmer or village level and would address the aflatoxin problem by processing coconut before the mould has a chance to grow. Further socio-economic appraisal of such methods is required.

6.6.2 Mould inhibitors

The proposed introduction onto the Philippine market of chemical solution which, when sprayed onto drying copra form a layer which prevents mould growth, is an interesting one. The major advantage of this would be in the application of inhibitor to sun drying copra. Additional work is necessary in order to quantify the costs and benefits of this approach as well as the affects of the chemicals on the nutrient value of the copra cake and meal.

6.6.3 Ammoniation

This process involves the mixing of contaminated copra meal and cake with ammonia and steam under pressure. The capital costs for such a process are high and it is not expected to be economically viable for a low value commodity such as copra.

6.6.4 On-farm or village level processing

The use of small-scale oil extraction plant at the village level to process freshly dried copra into oil and cake for local marketing would require high quality copra in order to produce an acceptable, un-refined oil. There are a number of attractive aspects to this approach which revolve around the addition of value to copra at the farm/village level. However, consumer acceptability of the product and the demand for coconut oil will be crucial to the success of any such scheme.

6.7 Conclusion

As a result of the foregoing, the following copra improvement strategy is suggested. There should be a mandatory system of inspection for aflatoxin of all copra and copra meal exported from the Philippines, and a limit should be set in parts per billion of aflatoxin B1 beyond which shipments may not be exported. This will force exporters to implement the necessary changes in their buying practices to ensure the quality of copra arriving at their factory gate is increased.

Problems expected implementing such a strategy include:

Extracting the full international premium from the European buyers. This will be overcome in time by certificating the shipments of copra leaving Philippine ports as below a specified level of aflatoxin contamination (50ppb is suggested initially) and thus guaranteeing quality.

Passing the millers premium for better quality down to the farmer. Millers will press traders and wholesalers to supply better quality copra. This may result in lower farm gate prices and in the short run prove a little unpopular. However, providing farmers are taught to make better quality copra it is expected that the problem will be short-lived. The possible consequence of not acting is much more serious ie, the loss of the entire European market.

Aflatoxin in the domestic food chain. Rejection of poor quality, high aflatoxin copra at the mill will mean increased aflatoxin in the domestic food chain. This will result in economic losses to domestic animal producers in terms of reduced production and increased animal mortality. Monitoring of aflatoxin levels in domestic animal feed will be an important element of any copra improvement strategy based upon mandatory sampling of exports.

Demand for better drying practices. A sudden increase in the requirement for better quality copra will mean a call for better on farm drying. The most cost effective way of achieving this has been shown to be via improvement to existing drying systems (see Section 4) and mould inhibitors if they work. It is recommended that mould inhibitors are tested for technical and financial feasibility.

Difficulties with enforcement. This type of regulation is obviously difficult to enforce, and opens up opportunities for malpractices. The consultants are recommending this course of action because the danger of loss of markets is imminent, and other strategies are unlikely to work within the necessary time horizon. Much planning and forethought will be needed in order to design a foolproof and acceptable inspection system.

7. FURTHER RECOMMENDATIONS

7.1 Introduction

Further to the key recommendation and findings to be found at the front of this study are a number of specific recommendations which lie outside the specific terms of reference of this study.

7.2 Validation of non-formal quality criteria

It was observed that a number of non-formal quality criteria, such as breaking copra to determine moisture content, were already practiced by farmers and copra traders (see Section 3, Copra Quality and Price Standards).

The objectiveness of these methods, along with other suggested quality criteria, should be tested to determine their utility, accuracy and acceptability within current marketing structures and practices.

7.3 Improvements to traditional dryers

A number of technical improvements to traditional direct and semi-direct dryers have been identified as a result of work being carried out by the NRI Officers currently stationed in the Philippines. Improvements to existing drying technology have the great advantage of reducing the requirement for capital investment by the farmers, whilst making maximum use of current assets.

Among the suggested improvements are the better spacing of bamboo slats in the drying surface to facilitate greater air flow past the copra, increased use of semi-direct type dryers to reduce discolouration from smoke and reduce the risk of conflagration, and the burning of a greater proportion of the coconut husk to produce drier copra.

All these approaches require both technical and economic evaluation with respect to their incremental net benefit stream as well as their physical and financial acceptability.

7.4 Sun Drying

Methods of improving current sun drying practices should be considered, specifically, the technical feasibility of using mould inhibitors. The economic and financial net benefit of this should be compared with alternative approaches of preventing mould growth in sun dried copra (such as drying for longer or using dryers such as those describes in Section 4).

7.5 Small Coconut Farmer Organisations

It is recommended that copra quality improvement be pursued by using the existing network of intermediaries, and not through producer cooperation, for the reasons given in Section 6.4. The existing copra marketing system may not be highly efficient, but the time and resources required to reform it are completely beyond the scope of this project of which the main objective is to address the impending danger that the Philippines will lose the European market for its copra

7.6 Copra Grading Systems

The recently introduced copra grading system of PCOPA based on no deduction no premium at 12% moisture does not provide sufficient incentive to persuade farmers to improve quality (see Appendix IV).

If aflatoxin is to be attacked at the farm level they will need to devise grading system that pays sufficient premium to farmers to adequately cover any additional cost incurred in producing quality copra.

7.7 Investigation of Indonesian Copra Production

It has been shown that Indonesian copra cake and meal trades at a premium on the world market (see Section 6.1.2). A study of the Indonesian copra post-harvest practices to investigate reasons for this improved quality and to identify lessons applicable in the Philippines would be extremely beneficial.

7.8 Investigation of FFA levels at Philippine oil mills

Given the importance of current FFA levels to the premium available for better quality copra, it is suggested that a study be undertaken to demonstrate over a period of time exactly what levels of FFA are experienced by millers who refine their oil.

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APPENDIX I:

The European Market for Copra Products

Introduction

The purpose of this brief mission was to identify and contact the main operators in the European trade for copra products and to initiate discussions which will assist the UK/Philippine copra quality project.

The mission was undertaken from 16-22 May 1990 and consisted of a number of meetings with traders, dealers, animal feed compounders and trade associations in West Germany and the Netherlands.

Summary and Conclusions

For all practical purposes, the German feed compounders are now working to a maximum level of 2ppb aflatoxin in finished animal feed, whilst the Dutch compounders are working to 3ppb in finished feed.

Despite the bad experiences with Philippine copra cake and meal, it is still regarded to be a high quality ingredient which, if the aflatoxin problem can be overcome, would be used in cattle diets of both German and Dutch compounders.

The current price differential between Indonesian and Philippine copra meal and cake leaves considerable scope for a price premium for guaranteed low aflatoxin content exported copra meal/cake provided that a consistently low level of contamination can be maintained. The European trade showed interest in alfatoxin free guarantees but is not yet prepared to commit itself on price claiming that aflatoxin free ingredients should be the norm and that a discount system should operate for those that do not meet this level.

Overview of the Trade in Copra Products

Background

Around 80% of the total European trade in copra meal and cake is carried through the port of Rotterdam. Of this, almost all is traded through the three main German trading houses (Peter Cremer, Khrone & co and Topfe) based in Hamburg, or their agents based in Rotterdam.

Until recently, feed compounders wanting to buy copra meal/cake would purchase it via a dealer or trader at a fixed cif price in Rotterdam and include an element for transport and insurance to the factory gate. More recently, some of the larger German integrated feed compounding and dairy producing cooperatives have attempted to circumvent this process by purchasing copra meal/cake directly from the Philippines. The size of this trade is not known.

In Germany the copra meal and cake is used almost exclusively for dairy diets where its effect on butterfat quality has traditionally been valued. In the Netherlands copra meal and cake has been used in pig diets at a maximum of 4% inclusion, but at current prices none is being used in this manner. Higher inclusions result in over-production of fat and reduced tenderness. An unspecified amount of copra meal/cake is being used in pet food diets.

There are three methods of purchasing copra meal/cake in Europe; through a trader, most of whom are based in Hamburg, through a broker who in turn either buys direct or from a trader, and the final option, which is to buy copra meal and cake directly from the Philippines.

Most traders have representatives in the Philippines. Some buy cif transit an EC port (ie, Krohn & co) whilst others prefer to trade regularly with the same oil millers and buy fob at a Philippine port (such as Peter Cremer). Shipments are rarely below a minimum of 2-3000 tonnes purchased fob Manila and transported by the buyer.

Volume of Trade

The total EC importation of copra meal and cake has declined by more than 20% since its peak in 1986. The bulk of this decline has been born by the Philippines (see Table 2 below) though Table 1 shows that in Germany, Indonesian copra cake and meal has been hit as well. What is surprising is that despite the stringent rules introduced by the German dairy industry, the market for copra meal and cake from all sources has remained relatively firm after the large falls between 1987 and 1988. Early figures for the first three months of 1990 show that, initially at least, European demand for copra products is back to 1987 levels.

Table 1: Imports of Copra By-products, 1985-89 (1000mt)

	1987	1988	1989	Change in % 88-89
West Germany				
Philippine	405792	247056	228331	-7.6
Indonesia	188420	235276	161299	-45.8
Africa	11561	15807	11369	-39.0
Other	11919	6830	16805	146.0
Total	617692	504969	417804	-17.3
Netherlands				
Philippine	328298	300103	137060	-54.3
Indonesia	42286	45349	57943	27.8
Other	46080	32468	22759	-29.0
Total	416664	377920	217762	-42.4

source: MarktInformatie Veevoedergrondstoffen

The Philippine share of the Netherlands market for copra products has declined from almost 80% in 1988 (300,000mt) to 63% in 1989 (137,000mt). Total usage in the Netherlands has declined and it is specifically Filippino copra products that are being excluded.

It is the general opinion of the trade that the growth in the Northern European market for compound animal feeds is weakening. This is born out by the statistics, which show most countries in diminishing or declining growth. The French and Italian compound industries grew by 13% between 1985 and 1989, whilst Germany and the Netherlands saw a decline of 1.2% and 1.3% respectively. Pressure on grain prices means that the comparative advantage in the industry is shifting away from the North of Europe, towards the Southern countries including Spain, France, Italy and Portugal who have indigenously produced grain by-products in surplus. Recent food scares and long term changes in eating patterns will mean that Europe as a whole will be consuming less meat and dairy products.

Table 2: Source of EEC Copra By-product Imports (1000mt)

Country of origin	1984	1985	1986	1987	1988
Phil'	397	401	764	769	600
Indo'	154	343	356	341	397
Sri Lanka	2	18	49	11	5
Other	51	63	68	80	60
Total	604	825	1237	1201	1062

Source: Statistische Informatie Veevoedergrondstoffen

Aflatoxin

European buyers and users of copra meal and cake expressed a preference for Indonesian products as being less risky for aflatoxin contamination because of the better drying and handling methods used. It was universally considered that the Indonesians dry their copra to a lower moisture content. However, Indonesian copra has two main disadvantages which, until the recent aflatoxin scare, meant that Philippine copra by-products were preferred by the trade. Firstly, Indonesian copra cake has a higher oil content (upto 11%) than Filippino (up to 7%). Secondly, Indonesian solvent extracted meal is very low in oil which means that oil has to be added to the diet. Philippine solvent extracted meal has a higher oil content and, in the absence of aflatoxin contamination, would be preferred.

Informal Agreements

There are two informal or "gentlemen's" agreements currently in operation in Germany and Holland. Both of these agreements have resulted from pressure from the dairy industry to keep aflatoxin levels in milk at acceptable levels

In Northern Germany, the milk producing associations have agreed with the compounders that the maximum aflatoxin level in finished feed should be 2ppb (ie, 20ppb in copra meal included at 10%). State wise the current situation vis the milk associations in Germany is as follows:

	Maximum
Schleswig Holstein	= 1ppt[1/] in milk
Neider Zachen/Bremen	= 3ppt in milk
Bavaria	= 5ppb in compound feed

1/ parts per trillion

In Holland the Productschap Voor Veevoeder (Board for Feedstuffs), a non-trading organisation which represents all aspects of the feedstuffs industry (address supplied at Annex C), collates weekly statistics on aflatoxin levels in tested feed ingredients and distributes them to all members in a weekly news letter. It should be stressed that this information is confidential as the Philippines trade appears unaware of the existence of such data.

The Dutch have a gentlemen's agreement or "Covenant" which limits producers to 5ppb in finished feed. This gives a level in milk of 0.05ppb. For straights (feed ingredients sold directly to the farmer) the covenant regulation is 5ppb. This has been instigated to safeguard the considerable Dutch milk exporting industry.

Dutch compounders are now working to a limit of 3ppb in finished feed.

In Denmark, where copra meal/cake is reported to be used in pig diets, the only known agreement is called "Da Kopra Aflatoxine Clause" which limits aflatoxin to 50ppb in raw materials (ie, 2ppb in feed incorporating 4% copra cake/meal).

Prices

There are two factors pertaining to copra meal and cake prices which are of interest. Firstly, the falling price of competitive ingredients, such as palm expeller meal, makes copra meal/cake less attractive to compounders. Secondly, the difference in price between Philippine and Indonesian copra expeller. This is shown below in Table 3.

At its worst, the price differential between Indonesian and Filippino copra meal and cake has been $20. This is accounted for by generally better post harvest handling in Indonesia and is backed-up by aflatoxin analyses carried out over some time by the Dutch.

Table 3: Copra Meal Prices (cif Rotterdam, US$ per tonne)[2/]

Date	Philippines	Indonesia	Price Difference
Feb 1989	173	175.5	2.5
Aug 1989	136.5	151	14.5
Mar 1990	135.5	151	15.5
Apr 1990	135	151	16

source: Discussions with Krohn & Co BV

This shows that there is a market for copra by-products of known better quality. However, at the current premium for Indonesian copra meal/cake, it is a matter of time before someone trades Philippine copra meal/cake through an Indonesian port. Traders suggest that this is already the case and there is a history of trade in copra to Indonesian crushers[3/].

At current prices copra meal/cake is not being chosen for pig diets. However, at lower prices it is chosen. Until now this has only occurred two or three times a year. If current price trends continue down, Dutch compounders will be tempted to buy copra meal/cake for pig diets in larger quantities. In Germany, copra meal and cake in pig diets is less competitive against indigenously produced barley and wheat when transport and insurance costs ex-Rotterdam are considered.

Of the alternatives, Palm expeller cake is the most popular due to its comparative price advantage. However, it too has aflatoxin problems (particularly West African palm) as well as a high fibre content. Inclusion of palm expeller cake is limited by fat content and its effect on pellet consistency. Current maximum inclusions are less than 20%.

Copra expeller cake trades at a premium in Europe, currently $22, over copra meal. This suggests that the additional fat available in the cake is highly valued; possibly because it allows the inclusion of some other low fat ingredient. Currently, coconut oil is trading at $367.50 in Hamburg. There is no price difference between Indonesian and Philippine oil and prices are based upon free fatty acid content. Those contacted did not know of a price premium or discount based on polycyclic aromatic hydrocarbon content.

Sampling

This is conducted in Rotterdam on arrival of the consignment as per GAFTA regulations. In practice, this means a bucket full of copra meal/cake being taken by the barge owner during discharge from the main vessel into the barge. This is then sent for testing at any of a number of Rotterdam based analysis concerns. The speed of the result is important as the trader bears the cost of the barge whilst it is standing idle. When the

2/ copra expeller cake
3/ see <u>Vegetable Oils and Oil Seeds, A Traders Guide: Volume 1</u>, International Trade Centre, Geneva, 1990, pp147-8.

results are received, a telex is sent to the barge to proceed directly to the feed compounder. If the consignment proves to be over 50ppb, the trader must register it under Dutch Government regulations and then sells it where he can at a indeterminate discount. If the consignment is over 200ppb, the trader will have great difficulty in selling it and can expect a heavy loss.

Most samples are of 2kg and samples vary between one per barge (about 1000mt) or one per 500 mt. In the Netherlands, results are collated by the "Produktschap voor veevoeder" and published weekly.

Taking samples is an additional cost burden to the trade. In the Netherlands, where most of the incoming samples are taken, each test costs f300 (Guilders) or £10 (Sterling).

Traders and direct purchasers of copra by-products from the Philippines usually request their commission agents to take samples in the port of loading. This is normally a 2kg average. This sample is sent to Europe for testing.

Alternatives

Alternative methods of combating the aflatoxin problem were discussed. All parties had heard of the Ammoniation process being used by the French. CEBECO in the Netherlands have even used ammoniated feed in times of difficulty. Mr Markoyt at Khron claimed that in the late eighties he had almost completed a joint venture deal with a British company to build an ammoniation plant in Liverpool but that it had fallen through.

During the visit several parties in the Netherlands drew my attention to the work currently being carried out by TNO and CIVO in Holland using *Rhizopus oryzae* in a wet environment to destroy aflatoxin. This work is being carried out in Zeist and a pilot plant has been set-up with a 300l capacity in cooperation with an unspecified feed compounder (universally rumoured to be CEBECO). Initial trials are said to have successfully detoxified from 800ppb to 80ppb.

APPENDIX II

TERMS OF REFERENCE

1. Describe and categorize copra localities: farming system, size, tenancy, post-harvest handling, drying and storage practices.

2. Review the introduction of the Kukum dryer: reasons for adoption/non-adoption, financial incentives and costs.

3. Identify firms wanting superior copra and possible areas of supply including financial gains to buyers and quality premia to be agreed.

4. Post-harvest handling and copra marketing: financial costs and benefits at all levels of the marketing chain.

5. Assess the quality improvement strategies: quantify the incremental costs and benefits to participants in the chain.

APPENDIX III

COPRA MARKETING AND PRODUCTION SYSTEMS

Background

Coconuts form an important source of farm income in over half of the Provinces in the Philippines. There were 3,222 hectares under coconut in 1988 (UCAP, 1988) representing 1,633,916 coconut farms (PCA, 1988). These are divided between owner-operated, tenant operated and plantation. Average farm size is 2.3 ha and over 70% of farms are of less than 5 ha (Hyman, 1990).

Evidence from a recent nationwide survey of post harvest practices (Bawalan, 1990) suggests that the great majority of farmers harvest their nuts by either climbing the tree or by using a pole with a knife attached (PCA, 1990). With the exception of the Luzon Region most farmers harvest their coconut every 90 days. In Luzon the practice is to harvest every 45 days. Most farmers dehusk, scoop and dry their own coconuts before selling it as copra almost immediately. Very few farmers store copra for any time before selling it.

Credit arrangements

Anecdotal evidence suggests that a substantial proportion of farmers are involved in credit marketing tie-ups. Under these arrangements dealers and traders advance cash to farmers interest free on the condition that farmers should sell their product to those dealers. In regions where credit facilities for farmers are unavailable this forms an important lubricant in the farm economy especially during periods of financial stress such as when school fees are due, at times of marriages or deaths and following natural disasters (earthquakes and severe tropical storms are common in the Philippines and effect crop yield). Traders interviewed observed the potential benefits of this credit tie-up to them as securing regular supplies at predetermined prices. Additionally, traders often sell other farm inputs which farmers purchase with the cash received for their copra. Farmers receiving credit are more likely to buy from the trader who holds that credit line.

This is important for traders supplying oil-mills since they often agree to supply a quantity of copra under a 30 day contract with fixed price and need to be able to guarantee delivery. Traders often encourage the dependent relationship by supplying bags for copra carriage free of charge after each sale making the farmer duty bound to return the bags to that trader. In rural areas traders often provide a source of agricultural inputs such as seed and fertilizer and will give credit in kind in return for guaranteed copra deliveries. For dealers this provides a source of non-price competition which is particularly important in areas where there are many competing buyers (see Case Study 1).

Case Study 8 - Trader/wholesaler, Brookes Point, Palawan

This trader/wholesaler had a total turnover of copra of about 450 tonnes per month, 80% of which was gathered from a catchment area less than 12km from the trader's warehouse, the remainder coming from up to 30km away. A small proportion of the traders copra throughput arrived by out-riggers from neighbouring islands. Practically all the traders copra was purchased directly either from farmers delivering to the bodega or from traders collecting from farmers in the hinterland. A typical farmer delivered 1.5 to 2 tonnes per harvest (representing about 3-4 hectares of copra). The trader was deducting 10 centavos per kilo for collection from the farm and was buying copra for about P1.80 per kg less than the Manila buying price. On average, the traders expenses (storage, dryage, transport, stevedoring, sacking etc) were P1.20-1.40 depending on moisture content. The trader therefore calculated his/her profit after expenses (but not including overheads, traders imputed wage etc) to be in the region of 30 centavos per kg of copra.

The trader entered into credit arrangements with his clients, lending up to twice the money value of the copra harvest. Usually the loan would be judged against total farm production including copra, corn and rice. Rice and seed would be advanced against future copra harvests.

It has been found that farmers not involved in tie-ups regularly receive a better price for their copra which can sell for as much as 12% higher (Manuel and Maunahan, 1982).

APPENDIX IV

COPRA CLASSIFICATION SYSTEMS

The Moisture Meter Law

Defined under RA1365 of the Philippines Government and in use until mid 1990, this basis all prices on a "resecada" (ie, dried) standard of 5% moisture content by weight. A series of deductions and premiums is provided for depending on moisture content and copra prices are adjusted accordingly. Copra grades and corresponding moisture grades are defined as follows:

As the name suggests, this pricing standard is dependent upon the adoption of regular moisture testing by traders, trader/wholesalers and wholesalers. The law requires all copra buyers to use moisture meters in all their domestic copra purchases. In reality this law has been inoperable and none of the traders interviewed regularly scientifically tested their copra for moisture. Levels of moisture in incoming copra (and therefore the price deduction over Resecada) is determined by trader observation. This subjective measurement is almost always accepted by the farmer whose need for cash is often paramount. Relationships with traders are long-term in nature, with farmers returning to the same trader in return for credit during time of need (see Section 2 and Appendix III for a better description of this process).

Grades	% Moisture content	Deduction %	Copra Price P/kg
Corriente	25	22	2.34
Corriente Mejorado	20	16	2.52
Buen Corriente	15	10	2.70
Buen Corriente Mejorado	12.5	7.5	2.77
Semi-resecada	10	5	2.85
Resecada	5	0	3.00
Resecada bodega	3	+2	3.06

Notes: Farmgate price assumed to be P3. Roughly translated "Corriente" = "Middling", "Corriente Mejorado" = "Improved Middling", "Buen Corriente" = "Good Middling", "Resecada" = "Dry" and "Bodega" = "Warehouse".

Although promoted by the Philippine Coconut Authority, this pricing scheme was not universally adopted. In July 1990, the resecada basis in use by most traders (ie, no deduction, no premium) was 6% moisture content.

Indophil recommended moisture table

This is recommended for use by the official buyers for Indophil in Cagayan de Oro, Mindanao and is based upon a Resecada (no deductions, no premium) between 10-12%.

Moisture Reading	Discount/premium factor (Pesos)	Copra price P/kg
7.9 & below	1.0	4
8	1.0	4
8.5	0.75	3.75
9.5	0.50	3.5
9.5	0.25	3.25
10	0	3
11	0	3
12	0	3
12.5	1.20	1.8
13	2.45	0.55
13.5	3.70	Reject
14	5	Reject
14.1 & above	Reject	Reject

Source: Traders near Iligan city.

The idea of this system is to heavily penalise farmers marketing copra above 12% moisture content. Current prices show that at the higher levels (above 13.2% moisture) all copra would be rejected.

There was no evidence to suggest that this system was actually in use. No other oil mills were using it. However, it does bear some resemblance to the Philippine Coconut Oil Producers Association (PCOPA) system as used by San Miguel and adopted nationwide in November 1990.

PCOPA recommended moisture table

Adopted by San Miguel, this table uses as its basis a 12% no deductions, no premium moisture content, with all copra above 14% moisture content being rejected. Additionally, it imposes an arbitrary maximum on mould coverage of not greater than 10% of surface area. There are some practical difficulties with using an arbitrary measure such as mould coverage to assess quality. Not all moulds are bad and research at NRI has shown that the colour of *Aspergillus flavus* changes with time. Aflatoxin may be secreted at an early stage in the marketing process and remain in the copra whilst the mould itself degrades and is unrecognisable.

Moisture Reading	Discount/Premium factor (%)	Copra Price P/kg
7.0 & below	+5.0	3.15
7.5	4.5	3.14
8.0	4.0	3.12
8.5	3.5	3.11
9.0	3.0	3.09
9.5	2.5	3.08
10.0	2.0	3.06
10.5	1.5	3.05
11.0	1.0	3.03
11.5	0.5	3.02
12.0	0	3
12.5	-1.0	2.97
13.0	2.0	2.94
13.5	3.5	2.90
14.0	5.0	2.85

As with other systems, this moisture table penalised copra above the nominal "Resecada" or dry level more heavily than it rewards copra with moisture contents below the norm.

<u>The KAWBRO Corporation - Albay agreement</u>

An informal agreement in the form of a proposed memorandum between KAWBROS, a milling company who intend to set up a plant in Albay Province, and the local Small Coconut Farmers Organisations (SCFO's). This agreement is based upon the supply of high quality "white" copra to the KAWBROS factory collected from the farms and delivered directly to the plant. Under this arrangement the base or resecada price is assumed to be no discount or premium at 6% moisture content. At this level a standard price premium of 5% is payable over the normal resecada price for "white" copra defined as:

"a. oil content - 65% minimum at resecada
b. moisture content - 12% maximum
c. Relatively free from moulds, soot, dirt and other foreign matter
d. Free of rancid or undesirable odour"

In return for the premium, farmers are expected to use indirect "kukum" dryer to produce their copra and to prepare their product at set times for collection by the companies trucks.

KAWBROS wish to tap the confectionery market for copra, for which high quality, white copra is essential

There are, however, a number of problems with quality standard criteria based upon moisture content. Firstly, the mechanics of testing for moisture at trader level using current technology means that very few farmers have their copra sampled for moisture content other than by sight and feel. Though most oil millers have the capability to complete large numbers of tests, often the aflatoxin contamination has already occurred. This is because traders are encouraged to buy copra from farmers at high moisture levels (and inflated deductions) and then store that copra in their warehouse until either the price becomes more favourable or the moisture content is at resecada allowing them to gain the full price for their copra. It is likely that during this storage process mould attack will occur.

The New Copra Classification System - November 1990

Based on a `no premium, no discount' norm of 12% moisture content, this system seeks to prevent trading of copra with greater than 10% survase mould coverage as tested by visual inspection.

Moisture content	Premium/discount factor (%)	Copra price P/kg
7.0 and below	+5.5	3.16
8.0	4.5	3.13
9.0	3.5	3.10
10.0	2.5	3.07
11.0	1.5	3.04
12	0.0	3.00
12.5	-1.0	2.97
13.0	2.0	2.94
13.5	3.0	2.91
14.0	4.0	2.88
Above 14%	Reject	

Source: PCA Administrative Order No1., 1990

This system compensates for moisture loss but not for additional time spent processing copra down to a lower moisture content. There is also the danger that traders will adopt 12% as a `Resecada' or dry standard. At this moisture content, the mould that produces aflatoxin still develops.

APPENDIX V:

DRYER COSTS AND FURTHER DRYER INFORMATION

Dryer efficiency

According to Childs (1974), the efficiency of the dryer depends upon the temperature, humidity and movement of air within the dryer. He observed that in direct dryers typical of those commonly found in the Philippines, control of the temperature is limited to the arrangement of the burning fuel and the height of the drying platform above the fire. Additionally, the arrangement of the copra on the dryer might be considered a factor affecting dryer efficiency. Crucially, Childs noted that the commonest error in such kilns is inadequate ventilation.

CONSTRUCTION COSTS OF D'VAPOUR DRYER, SORSOGON

Description:

Road side indirect dryer of basic construction with partial roofing
Pit unlined and dug into slope. About 2000 nut capacity.

1. Material	P
a. Frame	
large supporting struts at two person days	80
Bamboo slats x 50 @ C25 each	12.5
b. Sundries	
Blocks to line firing pit x 10 @ P3.20 each (1)	32
GI sheet to line tunnel x 1 @ P300 each (1)	300
Total material costs	424.5

2. labour	
Pit digging at 8 person days (2)	320
Main frame construction at 1 person day	40
Total labour costs	360
Total costs	784.5

Notes:

(1) Optional
(2) Rural wage rate for area assumed to be 40 per day,based upon discussions with farmers

NB: Frame requires replacement every 2 years

KUKUM DRYER NO.1: SORSOGON

Description:

Recently constructed dryer made of ply wood lined with tin sheets. Both ends made of concrete. Drums mounted on hollow blocks.

Cost of construction:

1. Materials	Quantity	Cost (P)
Hardboard	6 sheets (4'x8') @ P200 each	1200
Drums (1)	4 @ P250	1000
Concrete	10 bags @ P100 each	1000
Tin sheet		
Chimney construction	2 sheets (4'x8') @ P300 each	600
Oven lining	6 sheets (4'x8') @ P300 each	1800
Steel grill	3 x 20' lengths (3/8") @ P170 each	510
Concrete reinforcing steel	2 x 20" lengths (3/4") @ P200	400
Concrete blocks	50 @ P3.20 each	160
Hinges	20 @ P5 each	100
Superstructure wood beams		1310
Nails	4kg @ P20 per kg	80
Coco leaf shingles (2)	250 @ P0.80 each	200
Coco lumber supports	23 @ P8.70 each (average cost)	200
Large posts	6 @ P50 each	300
Plastic string (3)	1 ball @ P20	20
Bamboo slats		40
Transport of materials (4)		
blocks		200
Other materials		200
sub total		9320
2. Labour		
Dryer construction	20 man days @ P60 per day	1200
Shed construction	6 man days @ P60 per day	360
Welding		150
Sub total		1710
3. Land		
Land value (5)	35mx35m	80
Total costs		11110

Notes:

(1) Replaced every 12 months.
(2) Replaced every 3 years.
(3) Used for binding shingles to bamboo roof supports
(4) Hire of one Jeepney for 30 kilometres.
(5) Opportunity cost of land valued at area time two annual crops of groundnuts.

KUKUM DRYER NO 2: PCA ESTIMATE

Description:

Estimate for construction of a 2000 nut capacity drier double walling.

Cost of construction:

1. Materials	Quantity	Cost (P)
Drums	4 x 2' dia @ P250 each	1000
Concrete hollow blocks	40 x 4" @ P5	200
Cement	7 bags at P77	539
Round steel bars	5 x 5/8" dia. @100	500
Round steel bars	5 x 8mm dia @ P12	60
Plain GI sheet	10 x ga 26 @P177	1770
Lawanit	6 x (4'x 8') @ P150	900
Hinges	10 pairs @ P8/pair	80
Assorted CW nails	5 kgs @ P16/kg	80
Tie wire	1/2kg, ga 16 @ P20/kg	10
Welding rod	1.5kg @ P20/kg	30
Sand	1 m3 @ P150/m3	150
Gravel	0.5 m3 @ P150/m3	75
Bamboo splits		100
sub total		5494

Lumber	Board feet
4, 4"x4"x8'	42.66
10, 2"x3"x8'	40
27, 2"x3"x12'	162
9, 2"x2"x10'	30
18, 1"x2X12'	72
Total	346.66

Cost of lumber @P7 per board foot	2426.62
sub total	7920.62
Labour at 40% of material cost	3168.25
Grand Total	11088.9

CONSTRUCTION COSTS OF LARGE TAPAHAN IN PALAWAN

Description:

Abnormally large (5000 nut capacity) tapahan constructed of locally available materials and raised about 3' off the ground above two large trenches.

1. Materials	**P**
a. Main frame (hardwood)	
Cross struts x 13 @ P15 each	195
Vertical struts x 8 @ P40 each	320
Horitontal struts x 3 @ P40 each	120
Y-supports x 15 @ P16 each	240
b. Superstructure	
Coconut cross timbers x 24 @ P30 each	720
Bamboo lengths x 44 @ P25 each	1100
c. Roof (of Nipa)	
Nipa x 500 @ P150 for 100	750
d. Sudries	
Nails x 2kg at P20 per Kilo	40
Total Material Costs	3485
2. Labour (1)	
Trench digging at 5 person days	250
Main Frame construction at 3 person days	150
Roof construction at 5 person days	250
Bamboo spliting at 4 person days	200
Finishing off at 5 person days	250
Total Labour Costs	1100
Total Costs	4585

Notes:

(1) Rural wage rate for casual labour in Palawan assumed to be P50 per day, based upon discussions with traders and farmers.

CONSTRUCTION COSTS OF SMALL TAPAHAN NEAR IROSIN

Description:

Absolutely basic form of tapahan consisting of a pit covered by a framework of bamboo and wood construction. Capacity is between 1000 and 2000 nuts.

1. Material	P
a. Frame	
Struts x 3 @ P20 each	60
Bamboo slats x 64 @ P5 for 8 (1)	40
Total material costs	100

2. labour	
Pit digging at 2 person days (2)	80
Main frame construction at 2 person days	80
Total labour costs	160
Total costs	260

Notes:

(1) Frame not expected to last more than two harvests (6 months).
(2) Rural wage rate for area assumed to be 40 per day,based upon discussions with farmers.

APPENDIX VI:

DESCRIPTION AND CHARACTERISATION OF COPRA LOCALITIES

Background

Available statistics show that in 1984 there were approximately 1.5 million coconut farmers in the Philippines of which 71% were owner occupiers. About 33% of the 3.4 million hectares planted to coconut in 1984 was owned by 91% of farmers whose average land-holding size was just 1.4 hectares/ Altogether, an estimated total of 18 million people are supported by the coconut industry of which only about 6,000 individuals are involved in the trading, manufacturing processing and export.

Coconut Regions

Roughly speaking, the coconut regions are defined as follows (it should be noted that the Coconut Regions are distinct from the Political Regions of the Philippines, of which there are 12):

Region I: Ilocos, Cagayan Valley, Central Luzon and some of Tagalog

Region II: Southern Tagalog

Region III: Bicol

Region IV: Western Visayas

Region V: Central and Eastern Visayas

Region VI: Western Mindanao

Region VII: Northern, Southern and some of Central Mindanao

Region VIII: Southern Mindanao and parts of Central Mindanao

Table 1 shows the distribution of coconut production and activity amongst these Regions. It can be seen that Southern Mindanao is both the most productive and the largest of the 8 Regions with a nut productivity per tree of 64. This is reflected in the average farm size and the number of people engaged in the growing of coconuts, which can be accounted for by the large number of plantations in the area. Further characteristics of the coconut growing Regions are outlined in Table 2. Combined together, these tables allow some generalisations to be made about the coconut Regions in the Philippines.

Table 1: Basic Coconut Statistics by Region

Region (PCA)	(1) Area Under Coconut (000 ha's)	(2) Coconut i/ trees (000's)	(3) Coconuts gathered (million)	(4) Nut productivity per tree	(5) Land Area (000 ha,s)	(6) Coconut Farms	(7) Av farm size (ha's)	(8) No. of coconut farmers ii/ (000's)	(9) Rural Pop' (000's)	(10) % of rural pop engaged in coconut production
Total Philippines	3222	400930	14978	49	25419	1633916	1.97	1529799	30154	55
I	23	3508	134	42	5921	95485	.24	77518	7365	11
II	550	83234	2801	45	2966	255506	2.15	225532	3861	63
III	370	39823	859	40	1731	186084	1.99	177751	2731	70
IV	475	68291	1810	39	3550	343636	1.38	395305	3243	100 iv/
V	116	14538	328	40	1908	288551	.4	265236	4765	60
VI	463	45164	1865	44	2108	135963	3.41	138390	2097	71
VII	373	41115	1201	41	2662	132897	1.93	155017	2026	83
VIII	852	105257	5980	64	4574	135794	6.27	95050	4066	25

Notes:

i/ Includes non-nut bearing trees.
ii/ Government statistics gathered from different Regions to those used by PCA, therefore some discrepencies may occur.
iii/ Assuming an average family size of 10.8 and that each coconut farmer counted was a house hold head.
iv/ Some discrepancy in the figures found between population statistics available from the NSCB and the number of coconut farmers provided by the PCA suggests that the number of coconut farmers in this Region have been over-estimated.

Source:

Columns (1)-(5) taken from UCAP (1989). Original source was the Bureaux of Statistics. Data refers to 1988.
Columns (6)-(8) from PCA (1987)
Columns (9) and (10) from NSCB (1989)

Table 2: Broad Characterisation of Regions by Post-harvest Practices

Region (PCA)	(1) Intercrop (% of coconut area)	(2) Typical harvesting cycle (days)	(3) Most common Copra making method i/	(4) Typical harvesting method	(5) Typical drier capacity (no of nuts)
I	Unknown	90	Tapahan	Pole Climbing	>1000
II	20%	45	Tapahan	Climbing	1000
III	<5%	45	Tapahan	Pole	1000
IV	Unknown	90	Sun D'vapour	Climbing	<1000
V	5%	90	Tapahan	Climbing	<2000
VI	5%	90	Tapahan Sun	Pole Climbing	>1000
VII	20%	45	Sun Tapahan D'vapour	Pole Climbing	>1000
VIII	>20%	90	Sun Tapahan D'vapour	Pole Climbing	>1000

Notes:

i/ Stated in order of expressed preference.

Source:

Balawan (1990) plus observation.

Traditional copra dryers are divided into two classifications for the purpose of definition. `Direct' or `Tapahan' dryers are distinguished by the heat source being directly beneath the copra. `Semi-direct' or `D'vapour' dryers, have the heat source physically distanced from the copra, usually by a tunnel (see Section 4 for further information on dryers).

Region I: Very low percentage of the rural population involved in coconut farming, which is a secondary activity in this area. This is reflected in low productivity and small average farm size. No figures are available for intercropping.

Region II: Coconut farming is a major activity with above national average farm size and high productivity. Tapahans are the main method of drying and these are characteristically small. Evidence suggests that there is a sizable area under intercrops.

Region III: Coconut production is the predominant rural activity using small tapahans and 45 day harvesting. Productivity below average, possibly as a result of adverse weather conditions and an ageing tree population. The traditional method of harvesting is with a pole. Very few intercrops are grown.

Region IV: Small land-holding and poor productivity characterise this under-developed island Region. The majority of farm families are involved in coconut production using sun-drying for copra making or small d'vapour dryers.

Region V: Minor coconut producing region with low productivity reflecting the very small average land-holding and poor prevailing weather conditions. Tapahan drying traditional due to poor weather. Little intercroping although the majority of farms are involved in coconut production.

Region VI: Intensive coconut growing area with large average farm holdings and high productivity. Cropping is still only every 90 days. Tapahan drying is usual although there are sun drying practices during periods of favourable weather.

The Region VII: majority of farmers are involved in coconut production and considerable evidence of intercropping seen. Various different drying methods in use with centralised drying popular in some areas. Typically, d'vapour dryers over 2000 nut capacity and tapahans below this. Farms on average small and coastal.

Region VIII: Characterised by large holding and coconut estates which are highly productive, often using hybrid trees. Coconut farming a minority activity amongst rural householders, other crops include maize, rice and bananas. Wide variety of drying devices in use, these being typically large on estates and small on farms. The majority of small-holders sun drying during favourable periods of weather.

In conclusion, coconut production is characteristically carried out by small-holders and tenants on coastal strips using a 90 day harvesting pattern. Almost all farmers make copra and, typically, they do this by drying with a small tapahan, though they take advantage of the sun where possible. Few farmers intercrop and those that do, are not doing so intensively. The greater part of the rural population of the Philippines grows and harvests coconut in one form or another.