PRODUCTION RESPONSE TO PRICES IN THE COCONUT INDUSTRY OF PAPUA NEW GUINEA

N. T M. H. De Silva, L. J Kiele a n d A. F. Lagap*

1. INTRODUCTION

Coconut is one of the first plantation crops of Papua New Guinea. In 1922-23 coconut made up 90 percent of exports and in 1950 it contributed 69 percent of the export earnings (Sackett and Williamson, 1977). Area under the crop is about 265,000 hectares or 0.6 percent of the total land area in the country (Charles, 1980, Turner, 1985). Relatively lower copra prices which prevailed especially in 1970s, the escalating cost of production coupled with Government policies aimed towards the diversification of country's export base have primarily resulted in copra becoming the 3rd(l) export earner of PNG. These changes nevertheless have not given rise to any marked decline in the copra production. What seems to have occurred is that the value of exports from other tree crop industries have exceeded the export value of copra.

Although coconut is cultivated in all the coastal provinces of the country, much of the commercial production is confined to the New Guinea island provinces of East New Britain, North Solomons, New Ireland and Madang. It is cultivated both as a smallholder and a plantation crop. Coconut is increasingly becoming a part of a mixed cropping system involving cocoa. Apart from the apparent change in the mode of cultivation there have hardly been any significant events leading to marked changes in production pattern of coconut. Although hybrid coconut has been introduced in the early 1970s (Wheeler, Sackett and Densley, 1977), its industry wide impact appears to have been fairly marginal even now.

I.I. Production Response and Price Stabilization

Price stabilization is the main Government intervention measure affecting the copra industry of PNG. The stabilization scheme is meant to regulate producer prices either by imposing a levy or by payment of a bounty(2) depending on whether the prevailing F.O.B. price is high or low. Tee scheme came to effect in late 1940s. Because of the remunerative producer prices which prevailed, the need for utilization of the stabilization fund did not arise at least during the first twenty years of its existence. Nevertheless the potential benefits of the scheme became obvious in the early 1970s with the declining copra prices (Wheeler and Wyatt, 1978). As discussed in detail elsewhere in this paper the effectiveness and success of such measures rest largely with the price responsiveness of farmers. While the scheme has so far operated on the premise that the growers in general are price responsive, no empirical evidence is available in support of it. In his recent review of agriculture in PNG economy, Shaw (l 985: p 150) notes that ..... Without research on the supply response of growers, it is not possible to say whether the stabilisation policy has meant higher supply in times of low prices and lower supply in times of high prices."

---

*Senior Commodity Economist, Principal Economist and Economist respectively of the Department of Primary Industry, Konedobu, Papua New Guinea.

Keeping the production at a higher level by supporting prices when world prices for the commodity is low may appear economically irrational. However it is important to realise that economic considerations alone are not sufficient to make any final decisions on price stabilisation policies. Loss in employment opportunities and abrupt disruption in the social well-being stemming from a sudden decline in the industry should. also be considered. Instances of price support schemes becoming a burden for the Government when the stabilization funds dwindle are not rare. The situation currently (August 1986) experienced by PNG in which the Copra Stabilization Fund is on the verge of exhaustion and the consequent efforts by the Government to provide a budgetary allocation for payment of bounties to growers, can be cited as an example. As to the amount of funds needed and the level of bounty required to keep the industry and the interest of the growers alive can be ascertained with the aid of studies on the price responsiveness of producers. The main purpose of this paper is to study the price responsiveness of growers in PNG using aggregate time series data for the past 25 years. The study would also shed some light on the nature of short term and long term price responsiveness of growers.

The analytical method used for gauging the responsiveness of growers to price changes is presented in Section 3 after a discussion of some of the main issues on productivity response to prices in the next Section. Results of the analysis and a discussion are in Section 4. Policy implications arising from the analytical results and some concluding comments are in the 5th Section.

2. PRODUCTION RESPONSE TO PRICES

Producers of perennial crops may respond to changes in prices in many different ways. In the short run they may vary production by modifying the rate of adoption of agronomic practices. For instance the quantity of fertilizer used and/or the frequency of use of fertilizer can be varied in most perennial crops to impart marked changes in production levels. The variation in the intensity of application of other cultural practices such as weed control, soil and moisture conservation may also bring about similar results. Field data on the length of response lag and the magnitude of yield improvement in coconut are not available for PNG. Nevertheless, results from other tropical countries with similar agro-climatic conditions would provide a meaningful insight in this regard.

Studies carried out in Sri Lanka, for instance, reveal that even the indigenous variety of coconut responds appreciably to inputs like fertilizer raising yields by about l 00 percent over a period of 3 to 5 years. To obtain yield levels of this magnitude the initial standard of management or the type of soil appear to be of little relevance (De Silva, 1973). Cook (1932), based on his studies in Sri Lanka, reported that even intercultivation practices can raise productivity of coconut palms by about 40 to 50 nuts per year Migvar, (l 965) based on his studies in Pacific Islands reports that yields can be increased by as much as 30 percent by appropriate thinning of densely planted coconut stands. This evidence from different countries suggests that, in general, raising productivity by as much as 30 percent, or even up to levels as high as 100 percent in the short run, is agronomically feasible if favourable prices prevail. Similar possibilities may exist in PNG as well.

It is not uncommon among perennial crop growers to vary the intensity of harvesting in response to price changes. Rubber growers, for instance, may adopt 'slaughter tapping 'when the prices are favourable despite the strain that it can exert on trees. Coffee growers, on the other hand, may pick green cherries when the prices are good although this may somewhat impair the quality of coffee. Similarly tea growers may increase the supply in the short run by adopting 'coarser plucking'. In PNG, as in the rest of the Pacific, where it is customary to collect the fallen coconuts (Wheeler et al, 1977) rather than to regularly pick the mature bunches every second month, as practiced in India and Sri Lanka, the smallholder growers may simply neglect to collect the fallen nuts when the prices are not favourable. Smallholders can afford to temporarily neglect the collection of nuts, and even neglect attending to cultural practices in coconut stands, because they usually have alternative sources of

income. According to Sackett and Williamson, (1977) only 23 percent of the smallholder growers are entirely dependent on coconut. The others have many alternative sources of income, where, cocoa sales and fish and vegetable sales are the most popular (Sackett and Williamson, 1977). More recent studies clarify the findings of above researchers (Waliji, 1986).

A further reason for the apparent smallholder attitude is the fairly low degree of importance which is attached to coconut in the diet of Papua New Guinean people. The domestic utilization of coconut in PNG is around 20 percent of the total production (Turner, 1985) or about 7 nuts per person per year as compared to about 125 in Sri Lanka. Coconut is not a staple diet of majority of Papua New Guineans(3). Consequently, it is not suprising to find the lack of interest shown, especially by smallholder coconut growers to even gather the fallen nuts when low prices prevail. The large holder on the other hand, cannot afford to adopt a similar attitude of temporarily neglecting the gathering of coconut because of the heavy financial and other commitments that have been incurred initially. These observations suggest that smallholders' price responsiveness could be much higher than that of large-holders' at least in the long run. Thus an analysis of price responsiveness of copra growers in PNG should ideally be carried out separately using time series data for the smallholders as well as large holders.

2.1 Price stabilisation and grower response

Growers may not respond to every change in copra price in the same manner. For instance, the productivity changes they make in response to price changes of different magnitudes may appear in-consistent. In other words there may be price changes which are 'inert' in that they are inadequate to trigger a grower response. Their response will also depend on the magnitude of the price change relative to other factors such as the prevailing factor costs. This, in other words, means that the growers would respond to real price changes only when the price changes are of a certain level. Consequently, even if a certain bounty payment is made as a means of assisting growers during price slumps, the resulting producer price may not reach the required level or the 'critical real price' which spurs the grower response. This bounty payment would, therefore, not prevent the decrease in production which it sought to avoid (see situation 5 in Table l). Other likely situations are summarised in Table l. If conditions 3 and 7 occur as a result of government intervention to price changes, then, there could possibly be welfare losses to the society.

Table 1.
Relationship between the 'critical real price' and grower response

Price Stabilisation	Resultant Price	Remarks
1. Real price	= C.R.P.	Production normal
2. Real price – levy	= C.R.P.	Production normal
3. Real price – levy	< C.R.P.	Production decreases
4. Real price – levy	> C.R.P.	Production increases
5. Real price + bounty	< C.R.P.	Production decreases
6. Real price + bounty	= C.R.P.	Production normal
7. Real price + bounty	> C.R.P.	Production increases

2.2 Price stabilisation and benefit transmission

Owing to the inability for all coconut growers to have a copra drier (copra is made by drying the kernel of coconut) of their own (majority of growers fall into this category) or dry copra by other methods, most smallholders have to sell their coconut to a copra producer in the village. Since the prices are stabilised at the copra producer level, it is likely that the bounty paid on copra at times of

low prices may not reach the growers(4) who sell fresh nuts. I is the opinion of those who know the industry well, that, growers have imperfect knowledge about price movements. Nevertheless in this study it is assumed that such misappropriations do not occur. In other words, it is assumed here that production response is a true reflection of the stabilised prices which are passed on by the copra producer to village coconut growers with minimal or no distortion.

2.3 Prices and response lag in the short run

In Papua New Guinea, response by coconut growers to price changes may vary from a few months to a number of years. Obviously the yield response in a shorter period, such as a few months, can only be very marginal because of the physical and physiological inability of a perennial crop such as coconut to rapidly show any marked yield changes. As mentioned earlier such a response within a matter of a few months can arise only as a result of the grower's decision to devote more time out of his other commitments to collect fallen nuts. In this regard the observed positive response is not actually a yield response but merely a market supply response. Furthermore, such coconut supply responses in a fairly short period are more commonly observed among the smallholder producers. According to Bae (l 986), the earliest response, from smallholder producers is observed in about 3 months. This, obviously, is the time period which is required in total for the slow diffusion of price information to coconut growers and for the consequent effective increase in the quantity of copra collected at PNG's copra depots.

The shortest time period during which it is agronomically (physical as well as physiological) feasible to obtain any appreciable yield response in coconut is about 12 months (Smith 1969; De Silva 1973).

2.4 Prices and response lag in the long run

In the long run, the perennial crop growers would usually respond to positive and stable past price trends by varying the area planted or replanted(5). In situations where agroclimatically suitable land for the expansion of coconut cultivation is limiting, the response to stable and favourable prices may be prevented from taking the form of increases in the area newly planted. In such instances the response to prices, both in the short and the long run, could essentially be in the form of increased production per unit area. Instead of an area response, therefore, there would be a replanting response centred upon upgrading unproductive stands of perennial crops. On the other hand, if the prices are extremely low and the future outlook appears to be grim then the growers may decide to diversify or grow intercrops with their perennial crops in a more systematic manner. Therefore, in the long run, changes in the area planted or replanted may seem more appropriate as a measure of long-run response to prices. The measurement of productive response on the basis of area planted has not been possible in this study due to the paucity of data on the annual changes in area planted. Therefore, the aggregate annual production of coconut is used as a measure of price responsiveness in this study. Researchers have widely adopted the use of aggregate yield as a suitable indicator of long term response in perennial crops (Maitha, 1972; Akiyama and Duncan, 1982a and 1982b). Maitha (1972:50) in his study of Kenyan coffee concluded that 'productivity (yield) should be used to estimate the farmer response in the case of perennial crops'.

The relationship between the long and short run responses and the prices are illustrated in Figure 1. As illustrated there, continued neglect of the short term practices could give rise to permanent decline in yield. When palms are neglected during the early phases of growth and development by not providing even the minimum short term cultivation practices, these often show permanent set back in their growth and productive capacity (von Uexkull, 1975). Such palms may also take much longer to respond to inputs such as fertilizer.

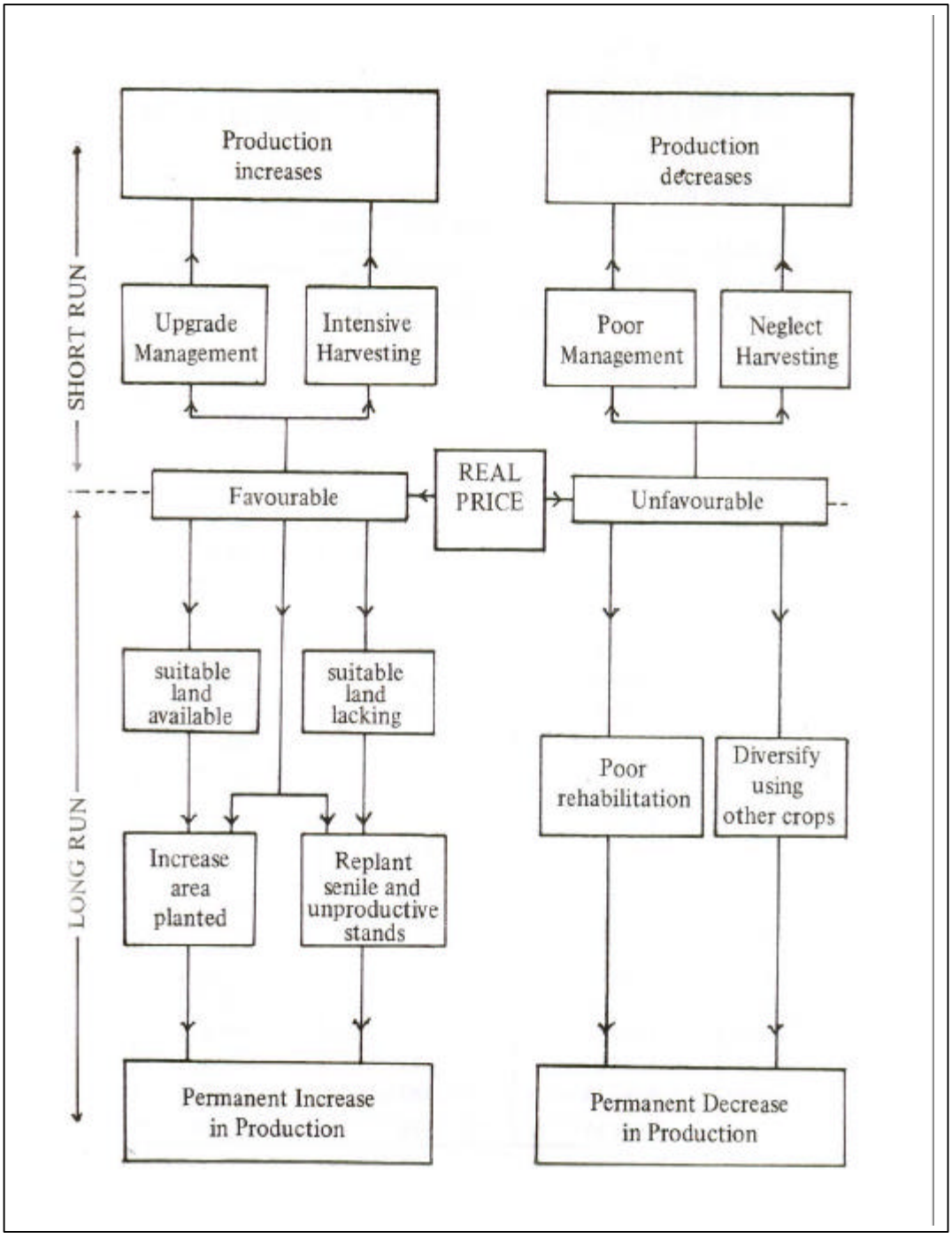

Figure 1. Short and long run responses to producer prices

3. DATA AND METHOD OF ANALYSIS

Aggregate production and price data for the 25 year period from 1960 to 1985, inclusive, have been used in this study (See Table 2).

Table 2.
Annual Production of Copra, Copra Prices and Consumer Price Index for Papua New Guinea

Year	Copra production (tones)	Producer Prices (Kina/tones)	Consumer Price Index*
1960	106533	149	80.26
1961	108911	119	84.04
1962	110639	118	82.19
1963	106696	134	83.62
1964	114339	144	86.31
1965	122340	171	90.85
1966	114209	137	93.87
1967	115211	148	95.81
1968	136556	171	95.64
1969	128444	146	96.23
1970	128947	163	99.59
1971	137827	142	99.83
1972	131736	113	76.17
1973	125438	197	82.82
1974	137236	368	103.90
1975	139369	165	112.48
1976	123252	174	120.77
1977	134004	237	127.20
1978	145927	252	62.27
1979	160136	344	67.12
1980	148373	249	75.00
1981	146867	223	79.17
1982	138128	172	84.65
1983	137527	240	91.83
1984	158224	387	95.83
1985	175833	310	100.00

*Producer prices given in column 3 were deflated by Consumer Price Index taking 1985 as the base year.
Sources : Rural Statistics Section, Department of Primary Industry and National Statistical Office, Papua New Guinea.

The aggregate annual production of copra is determined by a number of factors. The most important determinants arc the factor product prices, influence of technological changes, changes in mode of production, influence of diffusion of technological know-how (resulting in gain in production efficiency) and weather factors factor product prices capture a number of other influences such as the decisions on input usage, variation of effective area under the crop and many others as given in Figure 1. Assuming that weather pattern in normal, the major determinants of annual copra production in PNG can be algebraically presented as follows:

$$Y = f(P, T, A) \quad (1) \qquad (1)$$

Where, Y is the aggregate annual production of copra in tonnes, P is the price in 1985 constant Kina per tonne of copra, T is the time trend and is included as a proxy for increased diffusion of technological know-how among copra producers, and of the increase in production efficiency, etc, which usually take place during the development process.

The equation does not account for the influence of technological changes. As mentioned earlier, there have been no significant technological changes affecting the industry from 1960 up to now (see also Jarrett 1985). The mode of production of copra has shown a distinct change from large holder to smallholder dominance from about 1977 to the present (Goldthrope, 1985 and Charles, 1980). It is hypothesised that this structural reorganisation of the industry may have altered the aggregate responsiveness to prices. Considering the markedly different manner in which the smallholders and the large holders respond to price changes, this assumption is realistic and will be tested empirically in this paper. For this purpose a binary dummy variable (A) is included to allow for the change in the mode of production from a predominantly large-holder type of operation which existed prior to 1977 to a more smallholder orientated production situation as it exists now. This production reorientation can be viewed partly as a consequence of the establishment of over 75,000 hectares of smallholders and village coconuts during the 1955-1965 period forming 2 8 percent of the total land area currently under coconut (Wheeler, Sackett and Densely, 1978). As coconut usually comes into bearing after a period of about 7-15 years, these replantings would seem to be the major explanation for the recent production domination of the smallholder subsector, though low reinvestment levels by plantations, particularly around the time of de-colonisation, must also have contributed. The dummy variable has been included in the analysis as follows :

$$A = \begin{cases} 1 \text{ for the period 1960-1976,} \\ 0 \text{ for the period 1977-1985.} \end{cases} \qquad (2)$$

Prices used in the analysis are producer prices for copra expressed in Kina equivalents for the years 1960 to 1975 and in Kina thereafter. The prices have been deflated using the Consumer Price Index (see Table 1).

4. RESULTS AND DISCUSSION

Regression equations are presented in Table 3. The equations show that copra. production in the current year is influenced by price of copra in the current year as well as price of copra lagged by one to ten years. Apart from price influence, the first set of equations also shows the influence of T on production. The second set shows the influence of prices, T and A on copra production.

Preliminary analysis was carried out using copra price as the only independent variable. Results of the preliminary analysis revealed that the copra prices which prevailed in the current year and one, seven and eight years prior to the current year were positively and significantly correlated on the output of copra in the current year. The inclusion of the time trend improved the explanatory power of all the equations (as measured by the value of the coefficient of determination or RI) by over 50 percent as compared to the equations fitted for preliminary tests. Nevertheless, the inclusion of T altered the level of significance and/or the nature, of correlation between output and the price in some equations. For example, it lowered the level of statistical significance of the coefficient for copra price in the current year, and the price lagged by five years. It improved the statistical significance of the price variable in all the other equations. Signs of the coefficients for prices lagged by three, four and eight years were negative and statistically significant, whereas signs of coefficients for prices lagged by two and nine years were negative but not statistically significant (see Table 3).

The negative correlation between production and copra prices as observed here does not accord with the a priori expectations and can be regarded as showing no note-worthy correlation

between the production of copra and its price. Explaining the negative price responsiveness, Labys, (1973:p 211) suggests that such" …… negative sign could imply that producers increase output when prices fall so as to maintain their income……..". Such an explanation is not implied in this study largely because the price coefficient for majority of the price lags are positive. Moreover producer behaviour of the type suggested by Labys (l 973) can be expected only in the immediate short run, such as in the current year or the year which immediately preceeds. Under most long term situations such an explanation may not be relevant.

The dummy variable which is included to capture the change in production trend due to the transition from large holder dominance to smallholder dominance has improved the explanatory power of the equations marginally. The coefficient of the variable is not statistically significant. The sign of the coefficient of the dummy variable is not positive in all the eleven equations. Nevertheless, in all equations where the coefficient for price variable is positive, the sign of the dummy variable is also positive. The results suggest that the transition from largeholder to smallholder dominance has had no significant influence on copra production. Therefore, further tests to examine whether the above transition has given rise to markedly different price responsiveness among the two groups of growers have been abandoned.

As expected, the variable for time trend is positive and significant in all equations. This is suggestive of a significant positive impact of a progressively improving supportive infrastructure and improving technical know-how among growers resulting in increased production of copra.

4.1 Price elasticities

For the purpose of estimating short run price elasticity, the second equation (column 2 Table 3) was selected. The 6th equation (column 7 Table 3) was selected for the estimation of medium term price elasticity and equation 12 (column 13) was selected for the estimation of long term price elasticity. The selected equation and the corresponding price elasticities are presented be low. The selected equation to estimate short run price elasticity:

$$\text{Log } Y = 5.0141 + .012942 \log P_{t-l} + - 000l\ T \qquad (3)$$

Short run price elasticity (6) is .012942.

The selected equation to estimate medium term price elasticity

$$\text{Log } Y = 5.0082 + .00011 \log P_{t-7} + .00632\ T \qquad (4)$$

Medium term price elasticity is .00011.

The selected equation to estimate long term price elasticity

$$\text{Log } Y = 5.0225 + .00017 \log P_{t=11} + .0064\ T \qquad (5)$$

Long term price elasticity is .000 17.

The estimates show, that the short run elasticity is much higher than the medium or the long run elasticities. While long run elasticity is usually much higher than the short run elasticity, the reverse order(7) of elasticities observed in this particular situation could perhaps be due to the reluctance by coconut producers to commit major investments on either rehabilitation or replanting of coconut. Any sizable response to either a major rehabilitation effort or replanting takes over 5 to 7 years.

Table 3
Regression results using different price lags, time trend and dummy raviabli

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Constant variables	5.0123	5.0141	5.0419	5.0513	5.0467	5.0234	5.0082	5.0174	5.0758	5.0613	5.0273	5.0225	5.0074	5.0543	5.0597
Pt	.000137 (2.18)*														
Pt-1		.012942 (1.74)*													
Pt-2			.000096 (1.62)												
Pt-3				.000015 (3.01)**											
Pt-4					.00012 (2.26)*										
Pt-5						.00002 (0.43)									
Pt-6							.00011 (1.95)*								
Pt-7								.00005 (0.65)							
Pt-8									.000207 (2.24)*						
Pt-9										.00014 (1.48)					
Pt-10											.000001 (0.0118)				
Pt-11												.000178 (1.7432)*			
Pt-12													.000221 (1.4324)		
Pt-13														.000031 (0.1687)	
Pt-14															.000011 (0.0624)
Pt-15															
T	.00546 (6.50)**	.0001 (7.58)**	.00721 (9.57)**	.00741 (11.23)**	.00727 (10.29)**	.00651 (8.61)**	.00632 (9.32)**	.00664 (9.32)**	.00607 (8.78)**	.00624 (8.58)**	.00662 (8.95)**	.00643 (6.90)**	.00711 (6.02)**	.00623 (4.45)**	.00611 (4.89)**
R^2	.8251	.8136	.8106	.8485	.8274	.7905	.819	.7927	.8269	.8074	.7889	.7152	.7152	.6701	.6697
D-W	1.4863	1.3937	1.5336	2.0713	1.5413	1.4734	1.4908	1.4757	1.676	1.6942	1.4847	1.7184	1.7184	1.5315	1.5305

Note: Values in parenthesis are t-statistics
** significant at 1 percent level
* significant at 5 percent level

The short run elasticity shows that a 10 percent increase in copra prices increases the production by 0.l percent within the 2 year period which immediately follows. Accordingly, if the producer price dropped to K200 per tonne of copra as compared to the average price for 1985 which is K310 per tonne, the production would decline by about 0.45 percent. The very low price elasticity observed here can be attributed largely to the absolutely minimal usage of purchased inputs, particularly fertilizer, by the majority of coconut growers. Response to fertilizer use is generally exhibited in one to two years. The price decline considered here is about 35 percent from a fairly high initial price of K310 per tonne. It can be inferred from the estimated supply function that the producer behaviour to price changes would be markedly different if a price decline of the same magnitude take place from a much lower initial price level of about K 150 per tonne.

It was pointed out in sub-section 2.2, that, if the prices received by growers are inadequate or do not fall. within a certain. Critical range, then, the adjusted (or stabilised) producer price may not bring about the required change in production. According to the price elasticities estimated here, it appears that, the prices received by growers after the appropriate adjustments have been made, either by paying a bounty or charging a levy may not have had any marked unfavourable (or favourable) consequences.

5. CONCLUDING COMMENTS

Within the range of prices studied here, the productivity response to changes in copra prices is very low. The observed low price responsiveness is a reflection of a fairly high dependence by copra producers (the majority of them are smallholders) on various other activities (both agricultural and non agricultural) as main avenues of earning income. The fact that the coconut palm continues to produce under poorer husbandry practices than any other perennial crop or annual cash crop has enabled growers to shift their emphasis towards other crops.

Coconut growers cultivate various other crops either as inter-crops or in separate plots of land. Cocoa is the most widely cultivated intercrop in coconut holdings(8). Despite the relatively high availability of cultivable land in agroclimatic zones suitable for coconut cultivation, it can be seen that a major proportion of the coconut holdings in the country carry intercrops in some form or another. In such holdings coconut often seem to serve the function of a shade crop cum a supplementary source of income. These reasons perhaps explain why the price elasticity of copra is relatively low, at least compared to cocoa the crop which coconut growers use most widely for interplanting (9).

The findings of this study have implications for policies on research and development for the coconut sub-sector. For instance the findings strongly suggest that the promotion of coconut cultivation would be successful only if coconut is promoted as a component of a mixed farming system, for example with cocoa. Agronomic and agro-economic research into spacing of coconut in crop mixtures, reducing competition among crops for moisture and soil nutrients when grown in mixed culture, alternative forms of intercrops and systems of planting seem necessary.

The palm responds appreciably to fertilizer in one to two years. Most coconut producers do not seem to exploit this potential which exists in the palm to respond in the short run. A plausible explanation for this perhaps could be the lack of awareness by growers of both the magnitude of yield response to fertilizer and the fertilizer response lag. Perhaps promotion of fertilizer usage and other short term yield improving measures may improve short run productivity response.

The mode of production of copra which is widely prevalent among most smallholders may also be contributory towards the low price elasticity observed here. In coastal areas of PNG, where the land is invariably communally owned, proceeds from sale of surplus produce, especially from perennial crops, are shared. The growers usually share these proceeds each time the produce is sold. This

sharing may take the form of income rotation (or what is termed amongst some wage earners in PNG "the Sunday System"). The latter method is practiced to fulfill lump sum cash needs (10). In such instances one share holder, the one who is obviously in need, would receive shares from all the other member-owners of the land. This procedure is repeated so that every member of the communally-owned land would benefit depending on how urgent the individual needs are.

From a resource allocation point of view the low price responsiveness can be interpreted as a likely cause of inefficiencies in resource use. Such inefficiencies become quite apparent especially at times of higher prices when growers would be able to gain higher marginal returns on the use of additional units of labour or other inputs such as fertilizer. Profit maximisation does not appear to be the objective of the majority of coconut growers.

ACKNOWLEDGMENT

With the usual caveate the authors gratefully acknowledge the valuable comments of Sir John Guise (Chairman, Copra Marketing Board), Joe Bae (General Manager, Copra Marketing Board), Paul Barker, Peter Boone and Vaia Vaii of the Department of Primary Industry, Konedobu, Papua New Guinea.

REFERENCES

Akiyama, A. and Duncan, R.C. (l982a). *Analysis of World Cocoa Market,* World Bank Staff Commodity Working Papers, Number 8, The World Bank, Washington, D.C.

Akiyama, A. and Duncan, R.C. (1982b). *Analysis of World Coffee Market,* World Bank staff Commodity Working Papers, Number 7, The World Bank, Washington, D.C.

Bae, J. (l986). Personal communications, Port Moresby.

Charles, A.E. (1980). *Constraints on the use of High Yielding Varieties by Small Coconut Farmers - Pacific Islands Section,* Department of Primary Industry, Konedobu.

Cooke, F.C. (1932). *Investigations on Coconut and Coconut Products Ceylon,* Department of Agriculture, Ceylon, Series 8.

De Silva, M.A.T. (1972). Fertilizer Experiments and Coconut Yield, *Ceylon Coconut Planters' Review,* 7, 92-94.

Goldthrope, C.C. (1985). *Plantation Agriculture in Papua New Guinea,* Institute of National Affairs, Port Moresby.

Labys, W.C. (1973). *Dynamic Commodity Models, Specification, Estimation and Simulation,* D.C. Heath, Lexington, Mass.

Maitha, J.K. (1972). Productivity Response to Prices: A Case Study of Kenyan Coffee, *East Africa Economic Review,* 4(l), 40-51.

Sackett, M.A. and Williamson, P.G. (l977). *The Copra Industry in Papua New Guinea,* Department of Primary Industry, Konedobu.

Shaw, B. (l985). *Agriculture in the Papua New Guinea Economy,* Institute of National Affairs, Port Moresby.

Smith, R.W. (l969). Fertilizer Response by Coconut (Cocos Nucifera) on Two Contrasting Jamaican Soils, *Experimental Agriculture*, 5(3), 133-145.

Stewart, M.B. and Wallis, K.F. (l981). *Introductory Econometrics* (2nd Edition), John Wiley and Sons, New York.

Turner, P.D. (1985). *Coconut Research: Requirements and Priorities*, Copra Marketing Board of Papua New Guinea, Port Moresby.

von Uexkull, H.R. (1975). The Coconut: Has it a Future as 'the Lazy Man's Crop'?, *The Planter*, 51(592), 289-297.

Waliji, Z. (1986). Personal communication, Port Moresby.

Wheeler, M.A., Sacket, M.A. and Densley, D.R.J. (1977). *Agriculture in the Economy: Coconuts*, Department of Primary Industry, Konedobu.

Wheeler, M.A. and Wyatt, S.L. (1978). *Agricultural Stabilization Funds in Papua New Guinea - the case of coffee and cocoa*, Department of Primary Industry, Konedobu.

NOTES

1. Copra ranked 3rd largest export earner over the last 10 years.

2. The level of the bounty and levy are calculated using the following formula :
   Bounty = (Base Price - Buffer Zone x Base Price) - Market Price)/2
   Levy = (market Price - (Base price + Buffer Zone x Base Price)/2

   Where, base price or the threshold price is the 7 year moving average, buffer zone is the price range bounded by a 10 percent higher price than the threshold price and a 10 percent lower price than the threshold price within which growers are not entitled for a bounty or required to pay a levy.

3. Note however that the importance of coconut in the diet of Papua New Guineans vary considerably from one region to the other. For instance coconut constitute a major part of the diet of people in remote islands such as Lockland and Budibudi islands of PNG. In the highlands where the majority of people live, the importance of coconut in the diet is fairly minimal.

4. There are 16 copra depots owned by the Copra Marketing Board. Most coconut growers seem to make an effort to transport their produce and sell at these depots. This has been possible because of the improved transport facilities which are now available in most of the rural areas. Growers still seem to get remunerable prices despite the cost of transport. Where transport facilities are lacking or the copra depots are not conveniently located, the villagers have no, alternative but to sell the produce to traders. From the past experience there is no guarantee that the villagers who sell their produce to dealers receive the prices paid by the depots. In Gulf and Western provinces the growers have little option but to sell to copra traders.

5. Note that even if agroclimatically suitable land is available for expansion of coconut cultivation, it may not be economically feasible.

6. The first order derivative of Equation (3) is $(.012942\ Y)/P_{t-1}$
Short run price elasticity is $(.012942\ Y)/P_{t-1} \times (P_{t-1}/Y)$.

7. Instances of smaller long term elasticities than short term elasticities are rare. See for Akiyama and Duncan (1982) for an instance similar to what has been noted in this paper.

8. Nearly 80 to 90 percent of coconut lands are interplanted with cocoa other than in areas such as Manus and New Ireland provinces where, the soil is of the coral terrace type and hence unsuitable for cocoa. Here the large holder growers raise cattle in coconut lands.

9. Price elasticity for PNG cocoa is .103 (see Akiyama and Duncan 1982a).

10. Lump sums of cash are usually needed for purposes such as payment of bride price, school fees, payment of compensation etc.