PRODUCTION PERFORMANCE: AN ECONOMIC ANALYSIS OF SMALLHOLDER COFFEE PRODUCERS

Peter A. Manus[1]

ABSTRACT

Smallholder farms produce 70 percent of total national production. This study, which was undertaken in Nipa, Southern Highlands Province by a survey, aimed to examine the level of farm investment and factors affecting production. It was found that the sampled farms made, on an average, a net income of K129.86 with a net return of K2.54 per manday of labour. The production function fitted indicated diminishing returns to scale. Farm size and capital were significant at 1 percent and 10 percent levels of probability respectively. However, farm size, family labour and capital inputs were all used excessively due to high plant density, infrequent weeding and poor management of gardens.

Keywords: Samllholder, coffee production, input valuation, farm investment, farm returns .

INTRODUCTION

Coffee is one of the most important agricultural industries in Papua New Guinea (PNG). Two types of coffee are grown: Arabica and Robusta. Arabica coffee, which is grown in the cooler Highlands Region, contributes about 85 percent of annual national production. Robusta and some Arabica coffee are grown on the lowlands. ·

Coffee is a monocultural cash crop grown mainly for export income. During the 1986 to 1992 period, coffee accounted for an average of 53 percent of total agricultural export income.

Earnings of this magnitude are made possible by a large number of smallholder producers who account for 70 percent of total annual production. The remaining balance is produced by the plantations and the blockholders. Smallholders see their high level of participation in the cash economy as necessary to improve their quality of living in the rural villages. In this regard, provision of physical and institutional infrastructure (such as roads, etc. and marketing information, etc.) is crucial in the development of agriculture (Longmire 1994).

Finney (1969), Arthur (1975) and Anderson (1976) studied the smallholder costs of production, levels of labour input use, and income. These studies found that small scale coffee farming was a remunerative farm activity. However, the studies showed that smallholders incurred very minimal cash cost inputs. Overfield (1994) found that smallholder production levels were positively related to labour input, implying that labour use may increrase and/or decrease in proportion to changes in producer price.

The farmer's production level for a given unit area can be high or low depending upon the influences of (i) local environmental factors (such as local climate and pests and diseases), (ii) world coffee prices and (iii) the level of productive inputs committed in the production process. The former two are outside the farmer's sphere of influence. Gibson (1994) however, argued that providing subsidies to tree crop producers might create a high cost, inefficient industry that might not withstand competition on the world market. Nevertheless, institution of producer price stabilisation/subsidy policies during depressed world prices would ensure that the industry survives and also would enhance increased production. At the farm level, actual output is depen-

[1] PNG University of Technology, Agriculture Department, Private Mail Bag, LAE, Morobe Province.

dent on the level of quantity and quality of inputs incurred in production. Inputs include land, labour and capital.

Most smallholders are uneducated. Provision of extension education improves the farmer's management skills (such as allocation of inputs) and technical knowledge (such as correct pruning) in this situation. However, farmers often do not have complete information on changing management practices and coffee prices. Thus, the positive net incomes made by farmers during a given production season do not necessarily reflect better farmer's management performance nor efficient allocation of farm inputs.

Coffee was introduced to the Southern Highlands Province (SHP) in the late 1960s. About 3,000 families were involved in smallholder coffee production there by 1975 (French and Walter 1984) and by 1986 an estimated 24,176 more families were growing coffee (Department of Primary Industry 1986). In the 12 year period, this was an increase of 805 percent or an annual growth rate of 8 percent.

This study was undertaken in Nipa District, Southern Highlands Province. Agricultural extension is provided to the district's 3956 smallholder coffee producers by 3 extension officers or one extension officer is responsible for 1319 farmers on personal contact basis.

Given the small extension input, exactly which farm input variables (apart from environmental factors and changing world coffee prices) influence producer performance has not been the focus of any study. The objective of the paper is therefore, to examine the inputs that affect production and production decisions of the smallholder farmers.

The Data

The relevant input-output data and relative prices were collected from 30 farmers randomly selected from a list of 50 farmers obtained from the Nipa District's Department of Agriculture and Livestock (DAL) officers. A sample size larger than 50 farmers was not possible due to (i) non-existence of a smallholder coffee directory and (ii) time and money liminations. However, the average farm size found in this study is 0.21 of a hectare. This is comparable to the provincial estimate of 1.18 ha (Department of Primary Industry 1986) and 0.25 ha, the overall esti-

mated average in the country (Underwood and Lahis 1986). Therefore, it is reasonable to believe that the sample finally selected is representative of Nipa coffee producers.

The data were generated by interviewing the farmers using a questionnaire prepared for the purpose of this study. The questions related to types and quantities of inputs used, purchased input prices, labour used in different farm tasks, output and output prices. Since one farmer was not available at the time of interview, 29 farmers were actually interviewed. All farms covered in the study were located within a 7 kilometre radius from the DAL district office. The study pertained to the 1986 production period. Since the farmers continue to operate on low input-low output philosophy and no significant improvements in world coffee prices over the past decade, it is less likely that significant changes may have occurred in smallholder production in the district.

METHODOLOGY

Two analytical tools were employed to analyse the data collected. They are the tabular and multiple regression analyses. The tabular method was used to analyse the costs and incomes of smallholder farms.

The multiple regrssion analysis was performed to study the input productivity of smallholder farms. The single equation model fitted was of the form:

$$(1) \quad Y = AX_1{}^a X_2{}^b X_3{}^c X_4{}^d$$

To estimate the values of the parameters by ordinary least squares, equation (1) was transformed into logarithm of the form:

$$(2) \quad LnY = LnB_0 + B_1\,LnX_1 + B_2\,lnX_2 + B_3\,LnX_3 + B_4\,LnX_4$$

where in the variables: Y is output and X_1, X_2, X_3, and X_4 are farm size (in hectares of land under mature coffee trees), family labour (in mandays), capital services (depreciation value of tools) and age of coffee trees (in number of years) respectively. A manday of labour is defined as the amount of work performed by an able bodied adult in eight hours. Plant density was highly correlated with farm size. It was therefore, dropped from the final equation fit-

Table 1. **Cost composition (in Kina) of smallholder farms.**

Item	Range	Average	% of total costs
Labour	96.37 - 205.64	130.10	95.30
Tools	1.26 - 12.08	3.71	2.72
Bags	0.60 - 3.20	1.38	1.01
Drying Mats	3.20	1.32	0.97

ted. The farm size of the sampled farms varied between 0.02 and 0.56 hectares with an average farm size of 0.21 of an hectare.

VALUATION OF INPUTS

Smallholder coffee farms occupied the most fertile land which was suitable for subsistence food production. There is a trade-off between coffee and food production in this situation. Sweet potato is the staple food crop in Nipa. The prices of land under coffee is therefore the value of sweet potato production foregone[1].

Similarly, family labour must be valued at its opportunity costs. Overfield (1994) noted the labour valuation problems involved in smallholder coffee production (for details, see his article). He implied that the net return to labour in coffee production could be used if no producer price support for a given production season existed. Since producer price support did not prevail during the study period (except December), family labour was valued using the sampled coffee farms' net return to labour[2].

Table 2. **Gross and net income (in Kina) of sampled farms.**

Description	Range	Average
Total gross income	30.88 - 333.52	136.26
Total cash costs*	3.72 - 42.26	6.41
Net farm income	26.72 - 321.02	129.86
Net return per manday	0.62 - 5.62	2.54

* Total cash costs excluding the imputed value of labour

RESULTS AND DISCUSSION

Costs Composition and Income of Sampled Farms

The results of smallholder farm investment situation are presented in Table 1. Family labour accounts for 95 percent of total cost of production. The value of family labour was inputed at K2.54, the net return to labour found in this study. In terms of actual cost of production, the farmers incurred minimal cash cost inputs. Family labour is therefore, the principal (non-cash cost input) input of smallholder farms. Similar studies (Finney 1969 and Anderson 1976) noted the same investment pattern, which imply that smallholder farm investment structure has not changed since the 1970s.

The yield of coffee depends upon producer price and management of gardens. For a given farm size, gross income can be affected by changes in either management and/or producer price. These changes would affect net income.

Given the yield levels and producer price, Table 2 shows the costs and returns of the sample farms. A representative farmer made a net profit of K129.86 with a net return of K2.54 per manday of labour. The return per manday of labour is comparable to the PNG rural minimum wages rate of K2.50 (prevailing in 1986) for an unskilled rural worker.

Despite the positive returns to smallholder coffee farming, average output of the sampled farms amounts to 0.9 tonnes per hectare which is less than 50 percent the plantation sectors' 2.2 tonnes per hectare.

Table 3. Estimated regression and elasticity coefficients.

No. of observations	constant	X1	X2	X3	X4	R^2	B_i
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
29	0.131 (0.15)	0.513*** (9.03)	0.085 (0.38)	0.120* (1.88)	0.176 (1.30)	0.86	0.894

Regression coefficient for

* Significant at 10 percent level of probability
*** Significant at 1 percent level of probability
B is the sum of output elasticities
Figures in parentheses are "T" ratios

Table 4. Marginal Value Products

No. of observations	Marginal value product for		
	X1	X2	X3
29	170.640	0.053	0.191

ELASTICITIES OF PRODUCTION

The coefficients of the log-linear function fitted directly measure the output elasticities. The elasticities are presented in Table 3. In view of the observed adjusted coefficient of multiple determination (R^2), all the explanatory variables contained in function (2) explained 86 percent of the variable in gross income. The high adjusted R^2 suggests that there is a good statistical fit for the underlying data used in the study.

The sum of output elasticities (B_i) of the production function was found to be less than one. This indicates decreasing returns to scale in smallholder coffee farming.

The elasticity coefficients with respect to farm size and capital inputs were positive and statistically significant at 1 percent and 10 percent levels of probability respectively. The elasticity of family labour and age of coffee trees were also positive but not significant. The non-significance of these variables (in particular labour) indicated that proportionate increases in family labour and age of coffee trees may not necessarily result in more than proportionate increase in gross income. The interesting feature noted was that the elasticity coefficient of family labour assumed a positive value. This may suggest excessive use of this input by the sampled smallhlder farms (an explanation is offered below).

MARGINAL VALUE PRODUCTS

Exposition of the extent of farm input use efficiency in smallholder coffee farms was accomplished by comparing the marginal value products calculated at the geometric mean levels with the respective input prices. The results are presented in Table 4.

The marginal value products of farm size family labour and capital services were all found to be less than the respective acquisition prices. This indicates that these inputs were excessively used. The over-utilisation of farm size, family labour and capital can be attributed to how the coffee gardens were managed.

Plant density of the sampled smallholder coffee farms were found to be higher by 358 trees per hectare than the most recently recommended plant density of 2478 trees per hectare in the plantation sector (Coffee Industry Board 1987). This over-planting would have the effect of reducing the potential bearing capacity of the coffee trees due to over-exploitation of space, intense competition for soil nutrients, and under-utilisation of sunlight. The effect would be even more dramatic under heavy shading.

The trees have grown taller than the manageable height in an attempt to reach sunlight. Apparently, most farmers did very little to control the trees' growth by proper pruning and/or cutting back the trees to make them manageable. The outcome of the lack of adequate management of the trees is that harvesting of cherries was done by either climbing into the trees or pinning the trees into the ground with anchors. These activities required more than the normal time required for harvesting.

Weeding of the coffee gardens is done on irregular basis using spades and bushknives. Most farmers tend to weed the coffee gardens when the weeds were bushy. This required the extensive use of spades and bushknives. It also required more labour than needed for more frequent weeding.

CONCLUSION

The sampled farms made positive net returns. The net return of labour of K2.54 is comparable to PNG rural minimum wages rate of K2.50 for an unskilled rural worker. However, average smallholder production is less than 50 percent of the plantation sector production of 2.2 tonnes per hectare. This reflected poor management of the coffee gardens due to ineffective extension input.

The production function estimate showed the existence of decreasing returns to scale. The decreasing returns suggest that average product is diminishing and an economic optimum will exist. This optimum may occur even with constant prices. Even so, there is a need for farmers to make some adjustment in resource allocation.

———— —— —— —— —— —— —— —— —— ——

[1] No land markets exist in the rural villages. In this context, land was valued at its opportunity cost, the value of sweet potato foregone.

[2] The December coffee support price of bounty payment was only K0.10 per kilogram which was outside the flush period.

REFERENCES

ANDERSON, D. (1976). An Economic Survey of Smallholder Coffee Producers. Department of Primary Industry, Port Moresby, Papua New Guinea.

ARTHUR, W. (1975). Returns to Smallholder Coffee Production. Department of Primary Industry, Port Moresby, Papua New Guinea.

COFFEE INDUSTRY BOARD, (1987). PNG Export Tree Crop Study, Largeholder Summary Report. Coffee Industry Board, Goroka, Papua New Guinea.

DEPARTMENT OF PRIMARY INDUSTRY, (1986). Statistical Report on Southern Highlands Provincial Smallholding Crop Survey - 1984/85. *Rural Statistical Bulletin*, No. 3.

FINNEY, B.R. (1969). New Guinea Entrepreneurs. *New Research Bulletin*, No. 17. Papua New Guinea.

FRENCH, W and WALTER, A.H.B. (1984). What's Worth Evaluation? *Monograph* 24. IASER, Port Moresby, Papua New Guinea.

GIBSON, J. (1994). The Price Elasticity of Demand for Papua New Guinea Export of Cocoa and Coffee. *PNG Journal of Agriculture, Forestry and Fisheries Vol. 37 NO 2. pp 67-75.*

LONGMIRE, J. (1994). Marketing Systems for Agriculture: Diagnosing Problems and Price and Marketing Analysis for Papua New Guinea. *PNG Journal of Agriculture, Forestry and Fisheries Vol. 37 NO 2. pp 67-75.*

OVERFIELD, D. (1994). The Smallholder Coffee System: Production costs, Grower returns, and Economic Sustainability. Coffee Discussion Paper, No. 15. Industry Affairs Division. Coffee Industry Corporation, Goroka, Papua New Guinea.

UNDERWOOD, D.J. and LAHIS, S.B. (1986). A study of Agricultural/rural Extension Experiences in Papua New Guinea. Department of Primary Industry, Papua New Guinea.