Variations in Major Operating Costs of Tolai Cocoa Project Fermentaries.*

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ABSTRACT.

The article discusses average operating costs of some cocoa fermentaries in the Gazelle Peninsula, New Britain, and examines variations in costs. The aim is to find if economies are likely to occur through increasing scale of fermentary operations.

INTRODUCTION.

The Tolai Cocoa Project, since its beginning in 1951, has established itself on the north-east of the Gazelle Peninsula, New Britain, to provide Tolai village growers with facilities for processing and marketing cacao. As a non-profit making public utility it was the first of its kind in Papua and New Guinea. Capital for the scheme was obtained by bank overdrafts guaranteed by the Administration.

The assets of the Project were at first vested in local government councils that were helped by the Administration to foster the Project. Ownership was assumed by the Gazelle Peninsula Local Government Council upon amalgamation of the five councils in 1964.

A Field Officer, seconded from the Department of Agriculture, Stock and Fisheries, undertakes general management of the Project. Each fermentary, however, is in many respects an autonomous unit. Growers served by each fermentary are able to decide some matters concerning its finances, but the day-to-day operation of it is the responsibility of a Tolai clerk, who usually is from the locality where the fermentary is situated.

This note represents the results of a survey of the scheme, undertaken to obtain information about :—

(1) The average operating costs of Project fermentaries ;

(2) The extent and causes of variations in these costs amongst fermentaries ; and

(3) Possible economies of scale in processing operations.

Costs were obtainable from the Project for only six-monthly periods, each of which included a time of cocoa flush. The data therefore does not dampen seasonal variations. The years include both good and poor seasons, and times of high and low cocoa prices.

Seventeen fermentaries were operating in the Project from January, 1963, until September, 1964, when an extra Project fermentary was opened.

Table 1, with frequency distributions of output, reveals that most of the fermentaries each period produced less than 50 tons of dry cocoa.

The major operating costs of fermentaries are : (1) the cost of dieselene and oil used by cocoa drying equipment ; (2) wages of manual labourers ; (3) the cost of bags and twine (including also ink and stencils) ; and (4) charges for cartage of bagged cocoa from each fermentary to Rabaul.

Non-operating costs (which are not considered in this note) are : (*a*) a levy of $1.20 on each bag of cocoa produced, to cover wages of fermentary and headquarters clerks, and minor overheads ; (*b*) a redemption charge of $30 per ton

Table 1.

Dry Cocoa Production (tons).	1963. Jan.-July	1963. June-Dec.	1964. Jan.-July	1964. June-Dec.	1965. Jan.-July	1965. June-Dec.
0 and under 25	5	1	2	6	2	2
25 and under 50	8	8	8	7	10	13
50 and under 75	3	2	4	4	3	2
75 and under 100	1	3	2	....	2	1
100 and under 125	....	3	1	1	....	....
125 and under 150	....	....	....	....	1	....
All Fermentaries	17	17	17	18	18	18

* The survey covers fermentary operations during three years from January, 1963, to December, 1965.

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Table 2.

Period.	Components of Average Operating Cost per Ton.[1]				
	Fuel and Oil.	Wages.	Bags and Twine.	Cartage.	Total.
	$	$	$	$	$
1963					
Jan.-June	10.5	10.6	7.1	4.6	32.8*
July-Dec.	12.1	8.9	6.3	4.7	32.0
1964					
Jan.-June	12.2	9.3	5.3	4.6	31.4
July-Dec.	10.9	10.8	4.5	4.6	30.9*
1965					
Jan.-June	17.4	11.1	6.0	4.6	39.0*
July-Dec.	8.0	9.3	6.0	4.5	27.8
Average for Six Periods	12.1	9.8	5.9	4.6	32.5*

[1] Excludes data on Watom fermentary.
* Discrepancy in addition due to rounding of components.

of cocoa, in order to repay bank overdraft and interest; (*c*) repairs and maintenance to plant and machinery; and (*d*) bank charges on accounts, audit fees, and sundry other items.

The actual wages of the clerk, or clerks, in each fermentary are not charged to it.

AVERAGE OPERATING COSTS.

Average operating costs at Watom fermentary were lowest of all such costs between January, 1963, and December, 1964. Whereas Watom, the smallest fermentary, relies entirely on the sun for drying cocoa beans, others rely partly on the sun, and partly on oil-fired hot-air driers.

They have at least one combination sun-drier and hot-air drier (the 'Universal' sliding roof drier), and one rotary drum drier. Most but not all of the fementaries were equipped with rotary driers by the beginning of 1963.

The components of average operating cost per ton of cocoa produced by all fermentaries except Watom are given below in *Table* 2.

Actual costs of dieselene fuel, and 'bags and twine', include changes both in prices and quantities. A standard cost—the average cost per gallon of dieselene for the six periods—has been applied to the number of gallons of dieselene each fermentary used, in order to remove the effect of changes in Project pricing of dieselene; similarly, the average cost per bag, of bags, twine, ink, and stencils, has been applied to the number of bags each fermentary used, in order to remove the effect of changes in pricing of bags. (The cost of twine, ink and stencils is negligible, and for the purpose of analysis is assumed to have varied directly with numbers of bags.)

Table 3.

Period.	Components of Average Operating Cost per Ton (Adjusted for Price Changes).[1]					
	Dieselene.	Oil.	Total Dieselene and Oil.	Wages.	Bags and Twine.	Output in Tons.
	$	$	$	$	$	
1963						
January to June	9.5	0.2	9.7	10.6	5.9	640.7
July to December	11.1	0.2	11.3	8.9	5.9	1,007.4
1964						
January to June	11.5	0.2	11.6*	9.3	5.8	827.0
July to December	11.3	0.2	11.5	10.8	5.9	670.7†
1965						
January to June	18.1	0.3	18.5*	11.1	5.9	842.0
July to December	8.4	0.2	8.6	9.3	5.9	624.6
Average for Six Periods	11.9	0.2	12.2*	9.9	5.9	Total 4,612.4

[1] Excludes data on Watom fermentary.
* Discrepancy in addition due to rounding of components.
† Excludes fermentary opened in September, owing to neligible fuel consumption.

Table 4.

Period.	Output in Tons.	Regression of Average Cost of Dieselene on Output.	Correlation Co-efficient.	
			(r)	r^2
1963				
January to June	640.7	Y = 9.4 + .005 X	+ .035	.001
July to December	1,007.4	Y = 13.2 — .029 X	— .423	.179
1964				
January to June	827.0	Y = 9.1 + .038 X	+ .368	.149
July to December	670.7*	Y = 8.5 + .051 X	+ .427	.182
1965				
January to June	842.0	Y = 18.5 — .007 X	— .045	.002
July to December	624.6	Y = 5.0 + .085 X	+ .330	.109

* Excludes fermentary opened in September.

Weekly wage rates were unchanged during the six periods, as was the pricing per gallon of oil. Variations in those cost items were therefore due solely to the quantities used.

A standard cartage rate per ton applied to each fermentary, but there were various rates. The lowest was charged to the fermentary closest to Rabaul, and the highest rate to three of the fermentaries most distant from Rabaul. Variants in the average cartage rate for all fermentaries indicate changing proportions of cocoa being taken to Rabaul from areas where differing rates were charged.

Each of the items 'fuel and oil' and 'bags and twine' priced at its respective standard rate, is set out in *Table* 3. The component 'fuel and oil' is divided into 'dieselene' and 'oil', to indicate the greater variability in the former.

It can be seen that the average cost of dieselene and average wages—the two major operating costs—were related less to output than were the other components of operating cost.

In order to measure the nature and strength of relationship between average dieselene cost and output, linear regression of the data on fuel costs (*Table* 3) has been calculated for all fermentaries each period, using the method of least squares. Regression equations are of the ordinary form $Y = a + bX$, where Y is the dependent variable (average cost of dieselene per ton), and X the independent variable (output in tons).

Regression of cost data in a arbitrarily chosen range of output is of less value than for the whole range. Similarly the value of regression of average cost data on output of individual fermentaries over the six periods is severely limited by the small range of output.

The regression equations, together with the respective correlation co-efficients that are derived, are given in *Table* 4.

The correlation co-efficients are too low to indicate a substantial relationship between average cost of dieselene and cocoa output. The fuel cost is affected by other stronger variables that cannot be quantified, such as weather conditions, efficiency of fermentary clerks, and the different equipment used amongst fermentaries. If these factors were quantifiable and controlled, one would expect a higher degree of linear correlation between average fuel cost and output. The low values of r^2 and the differing signs of the regression co-efficients suggest there were no economies in fuel cost each period over the range of output.

Fairly stable and low consumption of fuel per ton of cocoa was achieved in 1963, and 1964, by several fermentaries, of which some produced more than 100 tons of cocoa annually. In the first half of 1965, use of dieselene rose abnormally in many fermentaries (as can been seen from the rise in average cost in *Tables* 2 and 3). This sudden increase can hardly be explained by abnormal production; the most likely reason is that widespread wet weather forced fermentary clerks to use hot-air drying equipment more than usual.

In the second half of 1965, prolonged dry and windy weather which prevented cocoa trees from bearing well also reduced the average

operating cost of fermentaries significantly, mainly through the reduction in the use of dieselene.

The variability of wages per ton is much less than of average cost of dieselene. As one might expect, linear regression of average wages on output yields higher correlation co-efficients than for the equations in *Table* 4 above. Regression equations again are of the normal form, where Y is the dependent variable (average wages per ton), and X the independent variable (output in tons). *Table* 5 gives the regression equations and the derived values of r and r^2.

Even though the regression co-efficients are not very high, the squared co-efficients (r^2) in periods one to five indicate a fair percentage of relationship (between 40 per cent. and 64 per cent.) between the two variables. This, together with the consistency in sign of regression co-efficients, suggests that economies of labour cost were achieved each period over a rising range of output.

Project fermentary labour, of course, was influenced by other factors too. Labour was employed by the week, not just for the particular number of hours required each day, and the number of labourers was proportional more to the number of boxes of wet cocao beans being fermented rather than to drying requirements of beans. Because of this and the different methods of drying the beans, no attempt was made by the Project to set and adhere to a standard cost of labour per ton of cocoa.

The factors mentioned in regard to unexplained variations in average dieselene cost would certainly have affected average labour cost also.

The fermentary with tightest control over labour was Bitagalip, whose wages per ton of cocoa varied between $6.90 and $8.60, the lower figure at the highest output. This fermentary, the largest, produced approximately 180 to 220 tons each year. Amongst some fermentaries with larger outputs than Bitagalip, but in smaller fermentaries more especially, control over labour cost was considerably looser. Fluctuations of $5 and more, with average wages from $9 to $14, were common.

CONCLUSION.

In general there were no economies in the average cost of dieselene each period as with a rising scale of output some large fermentaries were able to economize on dieselene, but other large fermentaries could not do so as much as smaller ones.

In each period economies of labour cost were apparent over rising scale of output.

These operating costs are also dependent in varying degrees upon weather conditions, upon the efficiency in control of cost, on the part of fermentary clerks, the different methods of drying beans, and perhaps other unquantifiable factors. As a consequence there is no guarantee that average wages or average fuel cost would be prevented from rising with an increase in the average scale of output. Greater competition by fermentaries with other buyers of Tolai wet bean could raise the average output but this possibly would add to buying costs.

Table 5.

Period.	Output in Tons.	Regression of Average Wages per Ton on Output.	Correlation Co-efficient.	
1963			(r)	r^2
January to June	640.7	Y = 15.2 — .100 X	— .752	.565
July to December	1,007.4	Y = 12.5 — .048 X	— .795	.632
1964				
January to June	827.0	Y = 12.0 — .043 X	— .596	.355
July to December	683.2*	Y = 13.7 — .057 X	— .639	.408
1965				
January to June	842.0	Y = 15.9 — .076 X	— .682	.466
July to December	624.6	Y = 10.8 — .034 X	— .340	.115

* Includes fermentary opened in September.

These points are of interest and significance if consideration is to be given to saving of non-operating costs. The two largest non-operating costs—redemption and levy charges—could be reduced more by other means than through an increase in scale. To lessen significantly the redemption rate could require that the Project's overdraft be partly capitalized through an issue of shares. This would affect the nature of the Project as a public utility. The average fortnightly clerical wage, and the average number of clerks per fermentary, are relevant to a reduction of the levy rate per ton. Considerations such as these are independent of the average scale of output per fermentary and could achieve significant saving on non-operating costs.

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