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An Evaluation of the Relative Profitability of Coconut Farming in Guyana.

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Abstract

This study examined the average profitability of coconut farming in Guyana, as this is a major crop associated with agricultural diversification and improving the level of food security in Guyana, both through the provision of income for improved access to food for farmers, as well as providing food products for the Guyanese households. The main objective of the study was to compare the average profitability of the two main producing agro-climatic zones of Guyana the coastal area or Regions versus the riverain or Pomeroon area (in Region 2). The study also sought to discover the factors that determine the average profitability of the coconut farming.

Primary data were collected from 201 coconut producers from the two major producing areas. A regression model was used to discover the factors that significantly determine the profit per acre of coconut farming. The results indicated that the variety of coconut grown and the total labour cost were the most significant variables in determining the average profitability of coconut production. The age of the farmer and his/her educational level also tended to affect the average profitability of the farms.

The Chow test carried out indicated a structural difference between the two areas of coconut production with respect to the average profitability of coconut production, whereby the tall variety of coconut was present on a significantly greater number of farms in the Coastal area, than in the Pomeroon area, which had farms with higher average profitability and dwarf varieties. These dwarf varieties allowed a wider range of coconut products including coconut water. These results help to explain the developments in the coconut industry in Guyana where the Pomeroon is now touted to become "the coconut capital of Guyana", and coconut water the "national drink".

Keywords: *Guyana, Pomeroon, Profitability, Coconut, Diversification*

Introduction

Guyana has emerged as a major supplier of coconuts and coconut products to the Caribbean Region recently. The country's exports of coconut and coconut products had an estimated total value of US$4.35 million in 2013 (Sealey-Adams & Hanif, 2015). As seen in Table 1, the highest ranked coconut product by export value was de-husked (dry) coconuts, accounting for approximately 70% of total export value in 2013 and almost 97% by 2016.

Table 1: Export Volume of Coconut Products (2009 -2016)

Commodity	Export Volume (tonnes) 2009	Export Volume (tonnes) 2010	Export Volume (tonnes) 2011	Export Volume (tonnes) 2012	Export Volume (tonnes) 2013	Export Volume (tonnes) 2014	Export Volume (tonnes) 2015	Export Volume (tonnes) 2016
Coconut (dry)	2706.89	5448.57	7882.99	8630	10,213.36	11,165.17	8,092.94	6,987.40
Coconut Oil (crude)	594.37	360.67	357.36	334	288.92	7.95	234.65	41.75
Coconut Choka	0.25	3.57	5.63	3	5.66	539.65	10.80	4.95
Coconut Water	111.68	231.12	461.02	132	93.79	6.09	134.78	158.77
Copra	3249.28	901.00	733.66	971	754.51	92.18	310.44	36.3
Copra Meal	178.81	82.21	6.81	0	61.27	217.00	0	0
Coconut Oil	0.00	0.00	0.00	0.04	0.02	36.00	4.18	0.94
Total	**6,841**	**7,027**	**9,447**	**10,070**	**11,417**	**12,064.04**	**8,787.82**	**7,230.11**

Source: *Sealey-Adams & Hanif, 2015*

The second ranked coconut product was copra, or dried coconut kernel, followed by crude coconut oil, each respectively, accounting for 15% and 9% of total export value in 2013 (Sealey-Adams & Hanif, 2015). The share of non-traditional products - primarily coconut water- was still very small, at about 2% of total export value in 2013 and in 2016.

There has been an ongoing focus on the diversification of the Guyanese economy. Kirwan and Craig (2017a) have reported that currently 92% of Guyanese exports are the minerals (gold and bauxite) and the primary agricultural exports of rice and sugar. They report therefore that the Ministry of Business in Guyana within its strategic plan has "identified that export diversification should be bolstered, such that the economy is not so dependent on volatile commodity prices" (Kirwan and Craig, 2017a). Thus the Government has focused its export thrust on "… improving the output of value-added products in sectors with opportunity for export growth" and the fostering of "micro and small enterprises" (Kirwan and Craig, 2017a).

Kirwan and Craig (2017b) examined the percentage contribution to Guyanese exports of the fruit and vegetable sub-sector in 2016. They found that coconut and coconut products comprised 65% of the value of these exports in 2016. In fact they stated that these represented "… the only significant export marketed crop currently in play" with the next closest products being pumpkin, mango and pepper products which accounted for 4% of exports each and "with eddo, watermelon, pineapple and breadnut completing the top 10". Thus there have been activities aimed *inter alia* "…at re-educating Guyanese about the diverse benefits of the coconut fruit focusing on its economic diversification and multipurpose use ..." (NAREI, 2017).

Pemberton and Pemberton (1990) have emphasized the importance of the economic and technological dimensions for devising successful diversifications strategies. They argue that the development of diversification alternatives may require new and relevant technology. Also with respect to the economic dimension, they state that the goal of economic efficiency "… is of utmost importance". They argue that without efficiency in resource allocation, the long term survival of

any enterprise will always be suspect and that "there can be little support on strictly economic grounds for any enterprise that does not demonstrate economic efficiency" (Pemberton and Pemberton, 1990).

Profitability is a useful measure of economic efficiency; therefore this study examined the average profitability of coconut farming in Guyana to determine the area of Guyana that is most likely to foster the diversification efforts with respect to coconut and its value added products. A study of the profitability of coconut production in Guyana is also justified as this is also a major crop associated with improving the level of food security in Guyana, both through the provision of income for improved access to food for farmers, as well as providing food products for domestic households.

The Guyana Marketing Corporations had estimated that around 2010, there were 24,000 hectares under coconut cultivation in Guyana, with an average yearly production of 92 million nuts (Guyana Marketing Corporation GMC). Coconut is cultivated in two main agro-climatic zones - the coastland and the riverain areas. Among the ten administrative regions, coconut farms that are located along the coastland are mainly in Regions 4, 5 and 6. In the riverain area of Region 2, the farms are located specifically along the Pomeroon River. In excess of 60 % of coconut cultivated in Guyana were in this Pomeroon area, while Regions 4, 5 and 6 produced smaller quantities. (Stabroek News, 2010). With respect to varieties of coconut in Guyana, there is a prevalence of tall types, with the noticeable exception of the Pomeroon area, where a large percentage of Dwarf types exists. (Guyana Marketing Corporation)

According to Compete Caribbean (undated), coconut production is of particular importance to the Pomeroon area, which is in an agricultural Region, in northwest Guyana. Production here is largely by small farmers. However, over the years, the prices for their dry coconuts were generally below their costs of production for these farmers. Thus, the farmers tended to seek jobs elsewhere, in gold mining for example, and to neglect maintenance of the fields and of the drainage ditches, which resulted in low production and greater unprofitability of the coconut farms (Compete Caribbean). Despite this situation, however, much of the development of the coconut industry in Guyana over the past five years has been concentrated in the Pomeroon as opposed to the Coastal area of Guyana along the Atlantic Ocean.

The main hypothesis of this study was that the profitability of coconut production in the Pomeroon area was greater than that of the Coastal area and thus this could therefore be a factor why the development of the coconut industry in Guyana in recent years has been concentrated in the Pomeroon area. Thus, the study had two major objectives. The first was to discover the factors that determine the average profitability of the coconut farms and the second was to compare the average profitability (measured by the profits per unit of land) of the two main producing agro-climatic zones of Guyana: the Coastal area or Regions versus the riverain, Pomeroon area of Region2.

Economic studies on the coconut industry world-wide have concentrated on the productivity and profitability of different farming systems involving coconuts (for example Gosh and Bandopadhyay, 2011 and Pemberton, Harris and Lall, 1995) and studies on the economics of resource use (for example Nagaraja, 2016). This study may therefore be a pioneering effort in comparing the relative profitability of coconut production in different production areas.

Analytical Approach

The data analysis utilized in this study was based on a general approach which allows for the discovery from populations of conclusions based on the use of a number of analytical procedures, particularly statistical analysis, and especially multivariate analysis. In this application, given the

hypothesis and objectives stated above, there was a phase of data acquisition (data exploration and preparation) to obtain the data necessary to test the hypothesis and meet the study objectives.

The main analytical procedure utilized in this study was regression analysis. Regression models were developed and applied to the acquired data. The models and their results were then subjected to evaluative procedures to determine the adequacy and reliability of the models themselves as well as to determine the utility of the results of the model in terms of providing a test of the study hypothesis and meeting the study objectives.

Thus the modelling process involved repeated estimations of econometric models with alterations to the variables included in the models until a final model was obtained that gave the best explanation of the average profitability of the coconut farmers. This final model included cost related variables as well as variables associated with the nature of households of the farmers and their farming and marketing systems. In this study, the evaluations of the models and their results were based largely on econometric post-estimation testing of the significance of the coefficients of the included variables and the conformity of coefficients to theoretically expected signs, which would indicate rational economic behaviour on the part of the farmers.

- ***Empirical Procedures***

  Data Acquisition - The Survey

A multi-stage sampling procedure was utilized in the survey of farmers conducted to provide the primary data for this study. In the first stage, the two main coconut producing areas - which constituted four regions of Guyana - were chosen. The villages containing coconut farms within these regions were first identified. In the case of Region 2 (which comprised the riverain area of the Pomeroon), after ranking the villages in terms of the number of coconut farms, all of the coconut farmers within these villages were interviewed in the order of the village rank. This was done until the desired 104 respondents were obtained. In the case of Regions 4, 5 and 6 (collectively referred to as the Coastal area), villages containing coconut farms were randomly selected and ranked in order of selection. All coconut farmers were interviewed within the villages in the ranked order, until 97 farmers had responded in the Coastal area. Twenty-one farmers were interviewed from Region 4, 51 from Region 5 and 25 from Region 6. The field survey was conducted during the months of February to April 2010 and data collected for farming operations for 2009.

The questionnaire was designed to yield data required for the estimation of average profitability of the farms, in keeping with the objectives of the study. On the questionnaire, there were seven main sections soliciting information on:

1. Household characteristics such as household size, age and education level and the agricultural experience of the farmer.
2. Farming operations such as: size of coconut farm; labor inputs for land clearing and maintenance, application of pesticides and harvesting; cost of inputs such as planting materials, fertilizers and pesticides; and capital inputs for the purchase of tools, equipment, machinery and repairs to fences.
3. Marketing: which identified the quantity and prices of coconut and coconut products (copra, dried and green coconuts etc.) sold locally, as well as exported and any problems with marketing.

- ***Regression Analysis***

The final average profitability regression model estimated in this study was:

$$Y = b_0 + a_1 D_1 + b_1 X_1 + a_2 D_2 + b_2 X_2 + a_3 D_3 + b_3 X_3 + b_4 X_4 + u \quad (1)$$

Where:
Y = ProfitsPerAcre = Profit per acre in Guyana dollars: the dependent variable.
D_1= VarietyCoconut = Dummy variable for variety or type of coconut: 1 – Tall variety, 0 - otherwise.
X_1= Totlabourcost = Total Labour Costs
D_2 = Gender = Dummy Variable for Gender of farmer: 1 - Male, 0 - Female
X_2 = Age = Age of the farmer
D_3 = MStatus = Dummy variable for marital status of farmer 1 = Married, 0 - Otherwise
X_3 = HholdsAdults = Number of adults living with farmer in household
X_4 = Education = Level of education of farmer 1 – Primary to 5 - Masters level
u = Random error term

This model was subjected to tests for heteroscedasticity (Breusch-Pagan) as well as tests of the significance of the regression coefficients (t-tests) and the general test of significance of the regression model (the F-Test). An indication of the presence of multicollinearity was also obtained by the estimation of variance inflation factors. A Chow test was carried out to test whether a significant difference existed between the average profitability of coconut farming in the two areas, Pomeroon (riverain) and Coastal, and the causes of any such difference. This was achieved by utilizing the dummy variable form of the Chow test as available in the Gretl regression program.

According to *Gretl* (Cottrell, 2018) in this program the Chow test procedure tests the null hypothesis of no structural break in the data at the selected split point. The procedure creates a dummy variable equal to unity from the split point selected by the specific observation to the end of the sample, 0 otherwise. The procedure also creates interaction terms between this dummy and the original regressor variables. “An augmented regression is run including these terms. By default, an F statistic is calculated, taking the augmented regression as the unrestricted model and the original as the restricted. But if the original model used a robust estimator for the covariance matrix, the test statistic is a Wald chi-square value based on a robust estimator of the covariance matrix for the augmented regression." (Cottrell, 2018). In this application of the Chow procedure, the split dummy takes a value of 1 for the Coastal area and zero for the Pomeroon area.

Results

- ***Descriptive Statistics***

Findings of the study reveal that more than 50% of the coconut farmers in Guyana are above fifty years old with mean age of the farmers of 53 years. On average they had been growing coconuts for about 32 years which is indicative of substantial a long period and experience in growing this crop. Most of the coconut farmers interviewed were owners of their coconut estates which had an average size of 39.6 acres (Table 2). With respect to the number of adults in the household the Coastal area tended to have a smaller number of adults in the household but what was noticeable was the much greater variance in the number of adults in the household in the Coastal area.

Table 2: Descriptive Statistics of Variables (*n* = 201)

Variables	Mean	Standard Deviation
Profits per Acre (ProfitsPerAcre) $G	16927.4	44336.58
Profits per Acre Pomeroon area	32599.79	39395.34
Profits per Acre Coastal area	124.02	43344.32
Age	52.99	14.237
Number of Adults in Household (HholdsAdults)	2.085	1.516
Number of Adults in Household Pomeroon area	2.144	1.471
Number of Adults in Household Coastal area	2.021	1.568
Number of Children in Household	1.891	2.284
Acreage (Acres)	39.59	101.244
Years Growing Crop	31.66	17.251
Total Labour Cost (Totallabourcost) $G	481534.2	1,238,767.38
Total Chemical Cost $G	48140.5	127,870.69
Total Capital Expenditure $G	203998.5	1,506,119.65
Total Revenue $G	955284	1,691,072.96
Profits $G	208658.8	1,765,433.29

Table 2 also presents figures for the financial operations in terms of revenue and expenditure for the crop year for the sampled coconut farms. Here it is seen that the total labour costs were the highest contributor to total farm costs followed by total capital expenditure in that year. Profits were calculated as Total Revenue less the stated items of costs in Table 2. However some adjustments in the total costs were made on the larger farms to account *inter alia* for the use of acquired capital items such as vehicles acquired prior to the crop year. Average profitability was measured in the study and in Table 2 by the profits per acre.

As seen in Table 2, the farms in the Pomeroon area had a much higher average profitability than the farms in the Coastal area. Indeed 91.35% of the farms in the Pomeroon area reported positive profits while only 65.98% of the farms in the Coastal area reported positive profits and as seen in Table 2, the variance of the profit per acre (or average profitability) of farms in the coastal area was higher than in the Pomeroon area.

Table 3 shows that 71.6 % of farmers were male, 77.6% were married. With respect to education, 71.6% had obtained only a primary level of schooling. The majority of farmers grew the hybrid variety of coconuts or a mixture of tall and hybrid varieties, with only 48.8% of farmers growing only the tall variety of coconuts (Table 3). Only two farmers in the Pomeroon area grew the tall variety and this variety was grown mainly in the Coastal area.

Table 3: Descriptive Statistics for Dummy Variables (n =201)

Variable	1	0
Variety of Coconut Tree	Tall = 98 (48.8%)	Other =103 (51.2%)
Gender	Male =144 (71.6%)	Female = 57 (27.4%)

Marital Status	Married = 156 (77.6%)	Other = 45 (22.4%)
Marital Status Pomeroon	Married = 97 (93.3%)	Other = 7 (6.7%)
Marital Status Coastal	Married = 64 (66.0%)	Other = 33 (34.0%)
Education	Primary Level =144 (71.6%)	Other = 57 (27.4%)

- ***Regression Results***

Table 4 presents the results of the regression analysis. Here it is seen that the variety of coconut grown and the total labour cost were the most significant variables in determining the average profitability of coconut production. As expected, the higher the labour cost the lower the average profitability. Also, the farms with the tall variety of coconuts mainly in the Coastal area, experienced lower average profitability. As indicated earlier, this will suggest that the farms in the Pomeroon which grew the dwarf variety of coconuts were experiencing higher average profitability.

Table 4: Regression Results

Dependent variable: ProfitsPerAcre

Regressor Variables	***Coefficient***	***Std. Error***	***t-ratio***	***p-value***
const	73313	14901.3	4.9199	<0.0001***
VarietyCoconut	−31857.5	6151.25	−5.1790	<0.0001***
Totallabourcost	−0.00369081	0.00109523	−3.3699	0.0009***
Gender	−7063.22	6465.69	−1.0924	0.2760
Age	−294.749	149.165	−1.9760	0.0496**
Mstatus	−8211.58	5368.27	−1.5297	0.1277
HholdsAdults	−3193.88	2280.06	−1.4008	0.1629
Education	−3784.29	2237.47	−1.6913	0.0924*

Mean dependent var	16927.40		S.D. dependent var	44336.58
Sum squared resid	3.24e+11		S.E. of regression	40992.50
R-squared	0.175080		Adjusted R-squared	0.145161
F(7, 193)	7.143407		P-value(F)	1.35e-07
Log-likelihood	−2415.975		Akaike criterion	4847.950
Schwarz criterion	4874.376		Hannan-Quinn	4858.643

OLS, using observations 1-201 and Heteroscedasticity-robust standard errors, variant HC1

The results in Table 4 also show that the older farmers had a significantly lower profit per acre. Also there was a tendency for the average profitability to decrease with higher levels of educational achievement.

Table 5 provides the results of the Breusch-Pagan Test for heteroscedasticity. Here it is seen that the results show the existence of highly significant heteroscedasticity. Therefore, the regression model in Table 4 was estimated using heteroscedasticity-robust standard errors.

Table 5: Breusch-Pagan Test for Heteroscedasticity (Auxiliary Regression equation)

	coefficient	**std. error**	**t-ratio**	**p-value**
const	0.296464	1.56046	0.19	0.8495
VarietyCoconut	0.183394	0.647298	0.2833	0.7772
Totallabourcost	−1.16301e-07	2.47972E-07	−0.469	0.6396
Gender	−0.0509663	0.671482	−0.076	0.9396
Age	−0.00209337	0.0215054	−0.097	0.9226
Mstatus	0.420297	0.774234	0.5429	0.5879
HholdsAdults	0.287881	0.205652	1.4	0.1632
Education	−0.0766951	0.373456	−0.205	0.8375

Explained sum of squares = 60.6174

Test statistic: LM = 30.308678,
with p-value = P(Chi-square (7)) > 30.308678) = 0.000083

Table 6 presents the results of the multicollinearity analysis. As indicated in this table there is no evidence of the presence of this problem in the data.

Table 6: Multicollinearity Analysis

Independent Variable (j)	***VIF(j)***
TypeCoconut	1.229
Totallabourcost	1.103
Gender	1.076
Age	1.095
Mstatus	1.223
HholdsAdults	1.136
Education	1.148

Variance Inflation Factors = VIF(j): Minimum possible value = 1.0; Values > 10.0 may indicate a collinearity problem
VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient between variable j and the other independent variables.

Table 7 presents the results of the Chow test carried out. Here it is seen that the F-test and the chi square tests (because of the estimation of heteroscedasticity-robust standard errors) indicate a structural difference between the two areas of coconut production with respect to the average profitability of coconut production. Since the split dummy takes a value of 1 for the Coastal area,

the results indicate that the tall variety of coconut was present on a significantly greater number of farms in the Coastal area, than in the Pomeroon area, which had more farms with dwarf varieties and this had the effect of lowering the average profitability of the farms. Also the married farmers in the Pomeroon area caused a significant increase in average profitability. The results also show that number of adults in the households in the Pomeroon area also tended to contribute to the higher average profitability of this area.

Table 7: Chow Test Augmented Regression for Chow test

OLS, using observations 1-201
Dependent variable: ProfitsPerAcre
Heteroskedasticity-robust standard errors, variant HC1

	coefficient	**std.error**	**t-ratio**	**p-value**
const	45564.4	14366.5	3.172	0.0018***
TypeCoconut	9205.59	12481	0.7376	0.4617
totallabourcost	−0.0034	0.00158	−2.152	0.0327**
Gender	−11344.9	9014.57	−1.259	0.2098
Age	−125.629	201.536	−0.6234	0.5338
Mstatus1	7940.97	8170.21	0.9719	0.3323
HholdsAd	676.879	2860.78	0.2366	0.8132
Education	−3758.57	3525.42	−1.066	0.2878
splitdum	46239.4	36218.4	1.277	0.2033
sd_TypeCocon	−40435.8	18674.9	−2.165	0.0316**
sd_totallabourco	0.00051	0.0025	0.2	0.8417
sd_Gender	13696.8	11953.9	1.146	0.2534
sd_Age	−329.413	294.635	−1.118	0.265
sd_Mstatus1	−25993.7	10518.9	−2.471	0.0144**
sd_HholdsAdults	−8482.07	4521.1	−1.876	0.0622*
sd_Education	−1108.47	4820.93	−0.2299	0.8184

Mean dependent var	**16927.4**	**S.D. dependent var**	**44336.58**
Sum squared resid	3.04E+11	S.E. of regression	40532.88
R-squared	0.226906	Adjusted R-squared	0.164223
F(15, 185)	5.396732	P-value(F)	5.67E-09
Log-likelihood	−2409.454	Akaike criterion	4850.908
Schwarz criterion	4903.761	Hannan-Quinn	4872.294

Chow test for structural break at observation 105
Chi-square(8) = 22.7346 with p-value 0.0037

F-form: F(8, 185) = 2.84183 with p-value 0.0053

Conclusion

The study found that 91.35% of the farms in the Pomeroon area and 65.98% of the farms in the Coastal area reported positive profits. This augurs well for the continued survival of the coconut industry of Guyana and its prospects for fostering agricultural diversification. The results of the study supported the hypothesis that the profitability of coconut production in the Pomeroon area was greater than that of the Coastal area and these results help to explain the recent developments in the coconut industry in Guyana. For example in 2016, the Guyana Chronicle (2016) reported that the community of Pomeroon was set to officially become "the coconut capital of Guyana", and coconut water was set to become the national drink when "the Ministry of Agriculture hosts a grand Coconut Festival, from October 21 to 23, in observance of Agriculture Month 2016".

The Guyana Chronicle also stated that "the Pomeroon community reportedly has the best coconuts in the world. In the Pomeroon alone, there are about 20,000 acres of land that can be cultivated with coconuts, producing an estimated 140 million nuts per year. And at $50 per nut, it is a $7 billion enterprise waiting to be tapped."

The study also found that the cost of labor significantly and negatively affected the average profitability of coconut. Therefore there is still concern with the profitability of coconut production in Guyana, even in the Pomeroon area. This is borne out by the recent experience in the industry as reported recently. The Kaieteur News (2018) stated that: "Alarming reports have just begun to surface on the decline of the Pomeroon coconut industry. Pomeroon coconut farmers said that they are faced with multiple challenges, the weightiest being that of the unavailability of markets. This rapid downslide of the industry has left many farmers now fearful that there may be no hope for the once prosperous coconut industry."

Kaiteur News (2018) also reports that a farmer explained that: "The price for coconuts is very poor right now… from $40, we now getting $30… The thing is the cost for production really high, and so it can't pay." There is therefore the need for intensified research into especially improved technological practices in the coconut industry in Guyana to help to lower its cost of production and thus to improve its profitability.

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