PRODUCTIVITY AND PROFITABILITY OF SUGARCANE FARMING

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Abstract

Sugarcane is one of the most important industrial crops in the world. It is cultivated for various food and non-food products and by-products. This study aimed to evaluate the productivity and profitability of sugarcane farming by farm size and by a number of ratoon crops.Results revealed that there was a significant difference in the productivity of inputs by farm size and by a number of ratoon crops. Large sugarcane farm size and first ratoon utilization were highest and most productive significantly than other farm sizes and number of ratoon crops. Regarding profitability by farm size and by a number of ratoon crops, it revealed that there was a significant difference at one percent (1%) level of probability. Moreover, large sugarcane farm was the most profitable of the three farm sizes. The first ratoon, on the other hand, was the most profitable of the three ratoon croppings.

Keywords: sugarcane, productivity, profitability, ratoon, farm size

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1.0 Introduction

Sugarcane is one of the most important industrial crops in the world. It is cultivated for various purposes. Its food and non-food products and by-products include: as the common ingredient in many body scrubs and exfoliating products, molasses, raw sugar, alcohol, compostable bioplastics, bioethanol, organic fertilizer and soil conditioner, power generation, etc. Worldwide production of sugarcane stood at 737.16 metric tons in 2014. The Philippines ranked eight (8th) in the world on production volume with 32.46 million metric tons (www.statistica.com).

In the Philippines, sugarcane is grown primarily for sugar, bioethanol, and power-generation. The crop year 2014-2015, 416,893 hectares was planted to sugarcane with a total raw sugar output of 2,323,817 metric tons. Average yield was 111.48 kilograms per hectare (SRA, 2014). However, several factors affect productivity and profitability of sugarcane farming.

Some of the factors affecting productivity and profitability of sugarcane farming are farm size, capital, etc. High price of inputs, lack of resources and technical constraints were major problems in sugarcane production (Nazir et al, 2013).

Prices of sugarcane products and by-products have risen in past years, and several studies have been conducted on the profitability of sugarcane farming. Dlamini and Masuku (2012), indicated that farm size, labor, basal and topdress fertilizers significantly influenced sugarcane productivity; Naeem (2007) assessed the profitability of sugarcane; Kamruzzaman and Hasanuzzaman (2007) compared the profitability of sugarcane production as monoculture and as intercrop. Padilla-Fernandez and Nuthall (2012) examined the productivity efficiency of sugarcane production across farm size in the Philippines. They indicated that small farm group appears to be not as economically efficient as the larger ones. The higher input usage by the large farms tends to increase the quantity produced and, with the low price of inputs, generates a larger profit per hectare. Salassi and Delibert (2011) used a model to serve as producer farm planning and decision tool to project and evaluate the impact on net returns above variable and total production costs from sugarcane production.

This study was aimed to determine productivity and profitability of sugarcane farming by sizes of farm and by a number of ratoon crops.

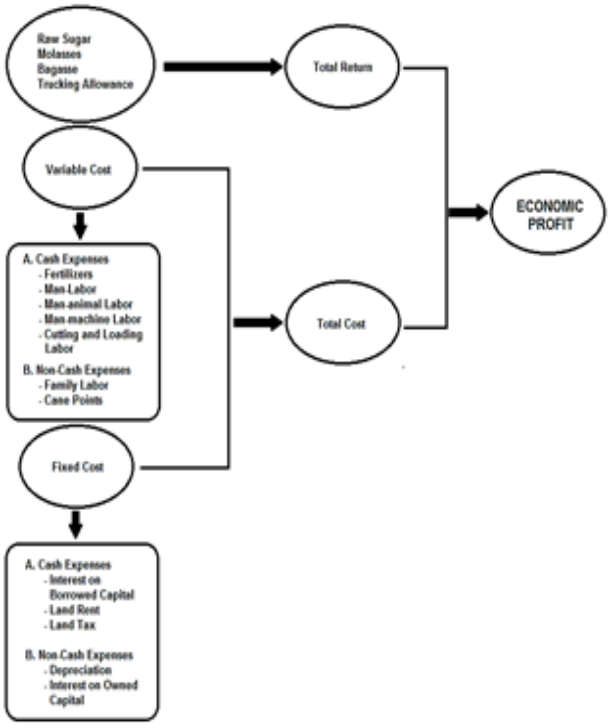

Figure 1. Schematic diagram of the study

2.0 Conceptual Framework

Figure 1 shows the relationship between costs and returns in sugarcane production. The total return of sugarcane venture involves raw sugar, molasses, and bagasse. On the other hand, total costs include variable costs and fixed cost composed of cash expenses considered as explicit costs and non-cash expenses as imputed costs. The explicit costs refer to fertilizer, man

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Table 1.Average gross production (piculs) of sugarcane farming per hectare, by farm size and number of ratoon crops.

Number of Ratoon Crops	Farm Size			
	Small	Medium	Large	Mean
First Ratoon	91.800	101.490	105.000	99.430[a]
Second Ratoon	84.660	91.800	93.840	90.100[a]
Third Ratoon	70.180	79.560	88.230	79.323[b]
Mean	82.213[b]	90.950[ab]	95.690[a]	

Means with common letter are not significantly different (DMRT) from each other.

labor, man-animal labor, man-machine labor, cutting and loading and land rent, interest on borrowed capital and land tax. On the other hand, implicit costs refer to family labor, cane points, depreciation and interest on owned capital. Profit is determined by deducting the total cost of the total return.

3.0 Research Methodology

The study utilized quantitative descriptive survey method. The respondents were classified according to small, medium and large groups depending on the hectarage of land they planted.

According to the Sugar Regulatory Administration (SRA) standards, small farms are those measuring 0.1 to 10 hectares, medium farms from 10.01 to 50 hectares, and large farms having over 50.01 hectares. Since the analysis was done by the number of ratoon crops, three groups of sugarcane farmers were stratified into first, second, and third ratoon crop farmers. For each number of ratoon crop, ten farmers were interviewed at random, so there were thirty farmer-respondents for each farm size or a total of ninety respondents.

The Cobb-Douglas production function and one-way ANOVA were used for average input productivity, a rate of return to capital and productivity of inputs for analysis of the profitability and productivity of sugarcane.

4.0 Results and Discussion

Table 1 shows the average gross production per picul of sugarcane farming per hectare by farm size and by a number of ratoon crops. It reflects that large sugarcane farms had the highest average gross production of 95.690 piculs, followed by the medium farms with 90.950 picul gross production and small sugarcane farms have the lowest average gross production of 82.213 piculs.

The Duncan's Multiple Range Test (DMRT) showed that the average production of large sugarcane farms was significantly higher from that of the small sugarcane farms but was not significantly different from that of the medium sugarcane farms.

In terms of a number of ratoon crops, first ratoon showed the highest average gross production of 99.430 piculs and was significantly higher compared to other groups. This was because first ratoon crops were considered as secondary tillers.

Earlier flushers of tiller competition were desirable because they gave more uniform plants resulting to a lesser degree of tiller competition. Besides, secondary tillers were closer to the soil. Therefore, the roots could penetrate deeper to the soil and could absorb more nutrients compared to those of the preceding ratoons (Philippine Recommends Series No. 88).

Table 2 shows the average input utilization of sugarcane production per hectare, by farm size and by a number of ratoon crops. The amount of fertilizers applied were 948.33 kgs per hectare for large sugarcane farms, 873.33 kgs per hectare for medium farms and 573.33

Table 2. Average input utilization of sugarcane production per hectare, by farm size and by number of ratoon crops.

Particulars	Farm Size				Number of Ratoon Crops			
	Small	Medium	Large	Mean	First Ratoon	Second Ratoon	Third Ratoon	Mean
Fertilizer (kg)	573.33[b]	873.33[ab]	948.33[a]	797.78**	773.33	803.33	818.33	798.33
Cane points	0.127	0.181	0.187	0.165	0.125	0.165	0.204	0.165
Man-labor (man-day)	26.31[a]	23.93[ab]	22.60[b]	24.01*	23.91	24.92	24.01	24.28
Man-animal labor (Man-animal day)	5.60[a]	3.85[b]	3.80[b]	4.42**	4.42	4.42	4.42	4.42
Man-machine labor (man-machine hours)	2.50[b]	3.90[a]	4.35[a]	4.62*	3.58	3.58	3.58	2.58
Total Number of respondents	30	30	30		30	30	30	

***,* = significant at 1.0 and 5.0 percent level, respectively*
Means with common letter are not significantly different (DMRT) from each other.

Table 3. Average productivity of inputs in sugarcane production per hectare, by farm size and by number of ratoon crops

Particulars	Farm Size (Piculs/Unit input)				Number of Ratoon Crops (Piculs/Unit input)			
	Small	Medium	Large	Mean	First Ratoon	Second Ratoon	Third Ratoon	Mean
Fertilizer (kg)	0.220	0.133	0.106	0.181	0.208	0.140	0.107	0.181
Cane points	219.52[b]	563.83[a]	624.63[a]	469.33**	618.67[a]	460.08[b]	329.24[b]	469.33**
Man-labor (man-day)	3.550	3.935	4.259	3.915	4.365[a]	3.849[b]	3.529	3.915**
Man-animal labor (Man-animal day)	15.371[b]	25.514[a]	26.673[a]	22.193**	26.600	22.684	20.610	23.298
Man-machine labor (man-machine hours)	21.082	22.753	25.055	22.963	17.736	20.271	23.460	25.284
Mean	51.949[b]	123.233[a]	136.145[a]		133.516[a]	101.405[a]	75.389[b]	

*** = significant at 1.0 percent level, respectively*

Means with common letter are not significantly different (DMRT) from each other.

kgs per hectare for small farms. This implies that large farms utilize a greater quantity of fertilizers since they have enough capitalization.

However, medium sugarcane farms were not significantly different from small and large sugarcane farms. On the other hand, there was no significant difference in the utilization of cane points of sugarcane in terms of farm sizes. Meanwhile, the average utilization of man-labor was significantly highest in small sugarcane farms with 26.31 man-days compared to medium and large sugarcane farms having 23.93 and 22.60 man-days respectively.Nevertheless, medium sugarcane farms were not significantly different from other farm sizes.

In terms of man-machine labor, large sugarcane farms were significantly highest in the utilization of hours followed by medium sugarcane farms having lesser animal-labor. It implies that small sugarcane farmers depended more on animal-labor while medium and large sugarcane farms depended highly on machine labor as the source of farm power in farming operations.

In terms of a number of ratoon crops, the third ratoon had highest fertilizer utilization compared to first and second ratoons. According to experts in sugarcane production, the third ratoon requires a larger amount of nutrients needed for the development of cane stalks to produce more contents of sugar. However, results showed no significant difference between a number of ratoon crops. Also, the average utilization of cane points was also highest in the third ratoon compared to first and second ratoons. This is because of a high percentage of missing hills in the third ratoon compared to other ratoons.

Table 4. Productivity of Input Using the Cobb-Douglas Production Function estimates on a per hectare basis for sugarcane farming by farm size (double log)

Factors	Farm Size			
	Small	Medium	Large	Pooled
Constant	1.110	3.138	1.651	1.714
Man Labor	0.690*** (0.177)	0.577*** (0.230)	0.354* (0.246)	0.167*** (0.108)
Man- Animal Labor	0.391* (0.053)	0.132 (0.075)	-0.576** (0.150)	0.225** (0.038)
Man-Machine Labor	0.365* (0.073)	0.211* (0.051)	0.677*** (0.108)	0.173** (0.034)
Fertilizer	0.365*** (0.073)	0.411** (0.024)	0.406** (0.019)	0.300*** (0.010)
Cane Points Cost	-0.238 (0.136)	-0.079 (0.103)	0.234 (0.041)	0.097 (0.048)
Land	0.049 (0.094)	0.152 (0.088)	0.031 (0.049)	0.157 (0.023)
Other Cost	0.568* (0.018)	0.001** (0.042)	0.540*** (0.036)	0.402*** (0.012)
Farming Experience	-0.129 (0.103)	0.097 (0.086)	0.048*** (0.036)	0.280*** (0.039)
Other Income	0.102 (0.016)	0.094 (0.008)	-0.224 (0.008)	0.118 (0.006)
Years of Schooling	0.290* (0.132)	0.363* (0.124)	0.349* (0.062)	0.161* (0.068)
Coefficient of Multiple Determination (R^2)	0.687	0.544	0.619	0.360
Coefficient of Multiple Correlation (R)	0.823	0.738	0.787	0.600

***, **, * significant at 1.0, 5.0 and 10.0 percent level.*

Note: Numbers in parenthesis are standard error.

Table 5. Average costs and return per picul by farm size, per annum, sugarcane farms

Items	Farm Size			Number of Ratoon Crops		
	Small	Medium	Large	First Ratoon	Secon Ratoon	Third Ratoon
Total Returns						
Raw Sugar	P 948.75	P 948.75	P 948.75	P 980.37	P 980.38	P 980.38
Mollases	40.05	22.73	22.66	46.39	32.21	28.83
Bagasse	1.31	12.75	-	8.45	2.81	2.79
Trucking Allowance	12.19	31.69	33.48	34.11	23.53	19.71
Total Return	***1,002.30***	***1,015.92***	***1,026.89***	***1,069.33***	***1,038.93***	***1,031.71***
Cost Expenses						
A. Variable Costs						
Cash Expenses	71.37	66.62	63.55			
Fertilizer	83.54	96.05	92.47	58.59	66.27	76.69
Man-labor	29.06	26.18	9.67	81.62	89.57	100.86
Man-machine labor	43.16	71.16	24.89	19.62	23.69	21.60
Cutting and Loading	122.01	111.61	110.62	30.29	48.23	60.69
Sub-total	***349.14***	***371.62***	***301.20***	***118.82***	***110.38***	***115.03***
Non-Cash Expenses						
Family Labor	63.76	6.96	-	25.71	17.72	27.30
Cane points	1.64	1.93	1.97	1.13	1.83	2.59
Sub-total	***65.40***	***8.89***	***1.97***	***26.84***	***19.55***	***29.89***
B. Fixed Cost						
Cash Expenses						
Interest on Borrowed Capital	9.33	2.87	11.78	5.06	6.68	12.25
Land rent	61.59	55.53	59.85	50.45	59.16	67.37
Land Tax	63.03	56.83	53.75	51.63	56.90	65.08
Sub-total	***133.95***	***115.23***	***125.38***	***107.14***	***122.74***	***144.70***
Non-Cash Expenses						
Depreciation	0.63	50.93	37.01	22.26	28.79	37.52
Interest on Owned Capital	20.59	33.37	30.09	27.82	25.94	30.30
Sub-total	***21.22***	***84.30***	***67.10***	***50.08***	***54.73***	***67.82***
Total Variable Costs	414.54	380.51	303.17	335.78	357.69	404.76
Total Fixed Costs	155.17	199.53	192.48	157.22	177.47	212.52
Total Costs	569.71	580.04	495.65	493.00	535.16	617.28
Net return Above Variable Costs	607.76	635.41	723.72	766.55	681.24	626.95
Net Return Above Fixed Costs	847.13	816.39	834.41	912.11	861.46	819.19
Net Return Above all Costs	432.59[b]	435.88[b]	513.24[a]	576.33[a]	503.77[ab]	414.43[b]

**Means having a common letter are not significantly different*

Table 3 showsthe average productivity of inputs in sugarcane production per hectare, by farm size and by a number of ratoon crops.

In terms of average productivity of cane points, large sugarcane farms were significantly productive with 624.63 piculs/input as compared to other farm sizes.Similarly, in terms of average man-animal labor productivity, large sugarcane farms were the most productive and significantly higher compared to small farms but not from medium sugarcane farms. The results show that the average productivity of inputs in sugarcane farms were 51.949, 125,693 and 135.945 piculs/input for small, medium and large sugarcane farms, respectively. It could be noted that large sugarcane farms were significantly highest among the three sugarcane farm sizes. This shows that large sugarcane farms were the most productive compared to other farm sizes.

Moreover, the first ratoon was significantly the most productive with 618.67/piculs/unit input compared to second and third ratoon crops for cane points and man-

Table 6.Average rate of return to capital of sugarcane farming per hectare, by farm size and by number of ratoon crops.

Number of Ratoon Crops	Farm Size			
	Small	Medium	Large	Mean
First Ratoon	0.492	0.501	0.529	0.507[a]
Second Ratoon	0.333	0.388	0.419	0.380[ab]
Third Ratoon	0.228	0.252	0.325	0.268[b]
Mean	0.284[b]	0.380[b]	0.506[a]	

c.v.=55.32%
Means with common letter are not significantly different (DMRT) from each other.

labor. In terms of average productivity of fertilizer, man-animal labor, and man-machine labor, the first ratoon was still the highest but not statistically significant compared to another number of ratoon crops. In other words, the average productivity of the inputs did not significantly among the number of ratoon crops.

Therefore, there is a significant difference in the productivity of inputs by farm size and by a number of ratoon crops.

Results showed that the coefficient of man-animal labor (-0.576) was significant at five percent probability level as shown in Table 4.

This implies that for every ten (10) percent increase in man-animal labor, output decreases by about 5.76 percent. This is because of delays in man-animal labor due to a wide coverage area in large farms while man-machine labor saves time in farm operations.

The average costs and return per picul of sugarcane production by farm size and by a number of ratoon crops are presented in Table 5. The average total returns for small, medium and large sugarcane farms were Php 1,002.30, Php 1,015.92 and Php 1,026.89 per picul, respectively.

It was observed that large farms have the highest total return among the three farms sizes. The average total cost for the small, medium and large sugarcane farms was Php 569.71, Php 580.04 and Php 495.65, respectively.

Among the variable cost items, cutting and loading was the highest followed by man-labor, fertilizer, man-machine and man-animal labor. The cane points were considered as non-cash variable expenses because the sugarcane farmers did not buy the cane points. They usually cut the top of cane stalks and used them for propagation.

Comparing the net return above all costs per picul by farm size and by a number of ratoon crops, large sugarcane farms and first ratoon were significantly the highest and most profitable. This is because large sugarcane farms have enough capital for financing while the first ratoon had the highest and the most profitable. It is because the yield of the subsequent ratoons declines.

Table 6 shows the average rate of return to capital of sugarcane farming per hectare by farm size and by a number of ratoon crops. The average rate of return was computed by dividing the return to total capital by total farm assets multiplied by 100. The results showed that in comparing the farm sizes, large farms have the highest average rate of return to capital (50.60%), followed by the medium with 38.00% and small farm with 28.40%. This means that a 0.50, 0.38 and 0.28 centavos net return per peso (P1) of capital was obtained. Also, it revealed that large sugarcane farms were the most profitable compared to other farms sizes.

On the other hand, in comparing the level of profitability by number of ratoon crops, first ratoon was the most profitable with 50.70% compared to the second with 38.00% and third having 26.80%) profitability.

The overall results showed that there was a significant difference in the level of profitability by farm size and by a number of ratoon crops at one percent probability level. Therefore, the null hypothesis was rejected for the alternative hypothesis.

5.0 Conclusion

Sugarcane farming is productive and profitable only for medium and large sized farms with the areas ranging from 10.01 hectares and above. This means that small sugarcane farming is not profitable.

First ratoon cropping in sugarcane production is the most productive and profitable. The technical explanation for this was given by the Philippines Recommends for Sugarcane that first ratoon crops were considered as secondary tillers. Earlier flushes of tiller competition were desirable because it gave more uniform plants resulting to a lesser degree of tiller competition. Besides, secondary tillers were closer to the soil. Therefore, the roots could penetrate deeper to the soil and could absorb more nutrients compared to those of the preceding ratoons.

To keep the sugar industry sustainable, the government must eliminate the tariff on inputs to reduce the costs of production such as fertilizers regarding lower prices. The reason why the local sugar industry is in the state of disarray is that local sugar is priced higher than imported sugar. This is due to the high cost of inputs. Lowering the domestic costs of production would make

the price of local sugar competitive in the world market.

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