Performance evaluation of coconut estates: developing an index to evaluate performance of coconut estates managed by Kurunegala Plantations Ltd

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Abstract — Coconut industry plays a vital role in the economy of Sri Lanka and in rural livelihood. Over 497,000ha of lands are cultivated with coconuts in Sri Lanka. Estate sector accounts for 25% of the land area for coconut cultivation and it contributes 40% of the national production. However the rest, 60%, is from smallholders' sector. Coconut production by both smallholders and estates managed by plantation companies show high variation in their performance. In this study, the performance evaluation of coconut estates was done by developing an index. It facilitated comparison of the performance at seven area-coconut estates of Kurunegala Plantations Ltd (KPL) which holds mature coconut area of 3,124.60ha. Ten variables were identified as the most vital pertning to estate performance. Weights for each variable was finalized through direct interviews with five plantation experts at KPL. Ten year data for each variable were collected and the average values were taken for analyses. Results revealed that Narammala area estates have excellent performance in profit per ha, field works, agronomic and other management practices, and immature coconut extent. The estate has done well in density per ha, net sales average, cost of production and progress in office work. Even though the estate has done good in many variables, yield per ha and nuts per palm were only at satisfactory level. Its yield per ha was the 2nd highest among all area estates. With all performances, Narammala area-estates ranked no. 1 in KPL, but needed to improve in diversification, yield per ha and nuts per palm.

Keywords— Coconut, Estate sector, Performance Index

Introduction

Coconut (Cocos nucifera L.) is extensively cultivated in all tropical regions of the world (Somasiri et al., 1994). It is grown in more than 86 countries worldwide, with a total production of 61 billion nuts per annum (Arancon, 2009). In the Asian continent, it grows well in Indonesia, Malaysia, India, Philippines, Thailand, Sri Lanka, Burma and Cambodia. Among them, Indonesia, India, Philippines, and Sri Lanka play a major role contributing 76% of the global coconut production (Krishna, 2011). Coconut is a rain-fed perennial crop that plays a major role in Sri Lankan

economy (Pathiraja et al., 2015). It spreads over 400,000 ha of land area in all administrative districts of Sri Lanka except those at elevations beyond 750 m msl (Somasiri et al., 1994; Central Bank of Sri Lanka, 2019). Every part of the coconut tree has its own commercial value. The coconut trunk can be used for building material, coconut fronds can be turned into brooms, coconut fibre can be turned into cushion,

coconut shell can be used to produce activated carbon and coconut flesh can be used to produce coconut milk. (Md Akhir et al., 2009). The main coconut growing areas in Sri Lanka consist of three administrative districts namely, Kurunegala, Puttalam and Gampaha and called the "Coconut Triangle". This region represents 57% of the total coconut extent. The remaining coconut land is distributed throughout the country except for the central hills where coconut is not grown due to low temperatures. It is cultivated in all three agro-climatic zones of Sri Lanka as 30% in the wet zone, 50% in the intermediate zone and 20% in the dry zone. Coconut is considered as a crop of multipurpose use; providing food, shelter, oil, medicine, fuel, building materials and beverage. Therefore, coconut is interwoven and highly attached with the lives of local people and considered as the "tree of life". The annual nut production was 3,056 million in the year 2015 (Central Bank of Sri Lanka, 2019). Coconut production has reduced in recent years due to lower amount of rainfall received in major coconut growing areas, increase of average temperature more than 32°C (Ranasinghe, 2012), and inefficiency in utilization by farmers.

The annual coconut production is mainly influenced by the productivity of estate sector. The estates of more than nine ha. represents 40% of the total bearing extent. The productivity of a coconut estate is determined by its land suitability classes for coconut, when other biotic factors are nonlimiting (Somasiri, et. al, 1994). An analysis of past data indicates that the gap between the potential and the actual coconut yield of the estate sector has been widening over the years in spite of the advances in agricultural technology and considerable efforts on subsidy programs of coconut. Based on the population growth rate of 1% per yearand the annual consumption rate of 110 nuts per head (Sri Lanka Coconut Statistics, 1998), the requirement for domestic consumption in the

year of 2005 would be 2185 million nuts. Sri Lankan coconut sector is monitored by the Coconut Research Institute (CRI), Coconut Cultivation Board (CCB) and the Coconut Development Authority (CDA). Coconut cultivation is dominated by the smallholders' sector accounts for 75% of the area (917,307 acres) and contributes 60% to the national production (Central Bank of Sri Lanka, 2016). Estate sector (RPCC & State Agency) accounts for 25% of the area (178,675 acres) and contributes 40% to the national production (Central Bank of Sri Lanka, 2016). Chilaw Plantations Limited and Kurunegala Plantations Limited play a prominent role in the estate sector.

Kurunegala Plantations Limited is fully government owned public company with limited liability. The companies core business interests continue to be in cultivation, production, processing and sale of coconut, rubber and ancillary crops with a portfolio of seven Area Estates which span varying agro climatic zones in the four district of Kurunegala, Gampaha, Matale and Anuradhapura. KPL doesn't have a criteria to evaluate the performances of Area Estates. Need to identify a method to evaluate the maximum usage of inputs, management, resources and to identify most important variables which affects the performances of estates. To develop an index for performance evaluation of Area Estates in order to rank them based on different variables.

Thus, this study was conducted with the objective of developing an index for performance evaluation of coconut estates in order to rank them based on their current performance levels and identifying the constraints and suggesting appropriate measures to increase the sustainability. The study also focused on identifying the important variables which affect the overall performances of coconut estates.

Methodology

Ten variables were identified as most important in performance evaluation through direct interviews with five plantation experts in KPL. Gathered 10 years data of each variable for all seven Area Estates and calculated 10 year averages. Scoring criteria was developed by direct interviews with the plantation experts in KPL based on country averages of coconut plantations and KPL norms. Each variable was awarded points according to the scoring criteria. All the variables were given weightages by the experts through questionnaires circulated among five experts of KPL of their importance to the performances of the Area Estates. Accordingly, the Coconut Plantation Performance Index was calculated and each Area Estates was ranked. The model can be specified as given bellow equation.

Coconut Plantation Performance Index (CPPI)

$$= \sum_{i=1}^{n} \left[\frac{W_i L_i}{n} \right]$$

Where, Wi is weightage given by the experts, Li is score for each variables and N is the total Nnmber of variables. When considering the Estates, E_1 is Attanagalla, E_2 is Dambadeniya, E_3 is Dodangaslanda, E_4 is Hiriyala, E_5 is Katugampola, E_6 is Kurunegala and E_7 is Narammala., The variables represented as V_1 for profit & loss per hectare, V_2 for yield per hectare, V_3 for nuts per palm, V_4 for density per hectare, V_5 for net sales average per nut, V_6 for cost of production per nut, V_7 for field works, agronomic & other management practices (Timely application of fertilizer, Application of soil & water conservation methods, Weeding, Pest & disease management etc.), V_8 for percentage of immature coconut extent from total coconut extent, V_9 for percentage of diversified extent from coconut bearing extent and V_{10} for progress of office works (Timely submission of documents, Accuracy of information, Record keeping and maintenance, Correspondence etc.)

Results and Discussion

Narammala araea estate has excellent performance in profit per ha (V_1), Field works, agronomic & other management practices (V_9) and immature coconut extent (V_{10}). The Estate has done good in density per ha (V_4), net sales average (V_5), cost of production (V_6) and progress of office work (V_7). Even though Estate has done good in many variables, yield per ha (V_2) and nuts per palm (V_3) are only in satisfactory level, but yield per ha is the 2 nd highest in all area estates. Percentage of diversified extent (V_8) is very poor. With all performances, Narammala area estates ranks no. 1 in KPL, but need to improve in diversification, yield per ha and nuts per palm. Over the last 15 years, AEIs have been successfully applied in Dutch research, playing, amongst others, an important role in research projects such as 'De Marke', 'Cows and Opportunities' and 'Farming with a future'. Nitrogen Surplus has played by far the most important role in both analysis and communication, being the starting point in most projects and discussions, providing quick but limited insight in N management (Aarts et al., 1999; Schro¨ der et al.,2003). Kurunegala area estates havedone excellent in profit per ha and cost of production, but only has done good in net sales average, the progress of office works and field works, agronomic practices and other management practices. The estate has done satisfactory level in yield per ha, nuts per palm and density per ha, but poor in diversification and immature coconut extent. The estate ranks 2nd in KPL, but need to improve in yield per ha, nuts per palm, density per ha, diversification extent and immature extent. Dodangaslnda Area Estates has excellent performances in profit per ha (V_1) and net sales average (V_5). The estate has done good in cost of production (V_6), progress of office works (V_7) and field works, agronomic practices and other management practices (V_9). The Area Estate has done yield per ha,

nuts per palm, density per ha and immature coconut extent as at satisfactory level, but diversified extent is at a poor level. The Area Estate ranks 3rd in KPL, but need to improve yield per ha (V_2), nuts per palm (V_3), density per ha (V_4), diversified extent (V_8) and immature coconut extent (V_{10}). Although Attanagalla Area Estates has excellent performances in net sales average, cost of production and field works, agronomic & other management practices, only done good in profit per ha and progress of office works

per ha and reduce the cost of production. Dambadeniya Area Estates only done excellent in immature coconut extent and performed good in profit per ha density per ha, net sales average, progress of office works and field works, agronomic & other management practices. The state has performed statisfactorily in nuts per palm and cost of production.

The estate has done poorly in yield per ha. The estate has ranked 6th in KPL and needs to improve nuts per palm, cost of production,

Table 1. 10 Year averaged (2009-2018) statistical data of each variable of seven Area Estates in KPL

Variable	Unit	E_1	E_2	E_3	E_4	E_5	E_6	E_7
V_1	Rs./ha	72,813	69,975	98,958	60,156	70,424	79,788	97,256
V_2	Nuts	3,717	4,632	5,423	3,899	4,289	5,054	5,317
V_3	Nuts	43	38	47	40	38	46	42
V_4	Palms	87	122	115	100	117	110	130
V_5	Rs.	32	2	30	26	30	28	29
V_6	Rs.	17	18	16	20	1	15	16
V_7	Progress	9	8	8	8	7	7	9
V_8	%	11	22	16	21	24	15	23
V_9	%	14	2	10	18	17	6	7
V_{10}	Progress	8	8	8	8	8	7	8

All the other variables are satisfactory or poor. The estates ranks 4th in KPL and need to improve in yield per ha, nuts per palm, density per ha, diversified extent and immature coconut extent. Intercropping enhances soil conservation and the sustainability of coconut lands. Monocrop stands of mature coconuts only partially cover the ground, thereby exposing soils to degradation (Liyanage et al., 1984).

Katugampola Area Estates has excellent performances only in net sales average and immature coconut extent and done wellin only profit per ha, the progress of office worksdiversified extent and field works, agronomic & other management practices. The estate has only done satisfactory level in nuts per palm, density per ha and cost of production, but has poor performance in yield per ha. The estate rank is 5th in KPL and needs to improve yield per ha, nuts per palm, density

yields per ha and diversified extent.

Although Hiriyala Area Estates were done in excellent in diversification and immature coconut extent, good in progress of office works and field works, agronomic & other management practices The estate ranks 7th in KPL, because it has satisfactory performances in profit per ha, nuts per palm, density per ha, net sales average per nut and poor performances in yield per ha and cost of production. All satisfactory and poor performances should be improved in the estate. Considering all the variables, it is observed that Narammala Area Estates has ranked one in KPL and the Hiriyala Area Estates has ranked 7th in KPL.

Table 2. Scoring criteria

Variable	Unit	E_1	E_2	E_3	E_4	E_5
V_1	Rs./ha	<75,000	75,000-63,000	63,000-37,000	37,000-20,000	>20,000
V_2	Nuts	<9,000	9,000-8,000	8,000-5,000	5,000-3,000	>3,000
V_3	Nuts	<60	59-50	49-30	29-20	>19
V_4	Palms	158-140	139-120	119-100	99-80	>79
V_5	Rs.	<30	29-27	26-24	23-21	>20
V_6	Rs.	<15	16-17	18-19	20-21	>21
V_7	Progress	10-9	8-7	6-5	4-3	>2
V_8	%	<20	19-18	17-16	15-14	>13
V_9	%	<18	17-16	15-14	13-12	>11
V_{10}	Progress	10-9	8-7	6-5	4-3	>2

Table 3. Calculation of weighted values

Variable	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Weight average
V_1	4.00	2.50	4.00	5.00	8.65	4.83
V_2	1.20	1.00	1.20	2.00	0.08	1.10
V_3	0.50	0.75	0.70	1.30	0.07	0.66
V_4	0.75	0.60	0.60	0.10	0.06	0.42
V_5	0.10	0.05	0.20	0.02	0.04	0.08
V_6	0.40	0.02	0.50	0.03	0.03	0.20
V_7	2.50	2.00	2.00	1.43	1.00	1.79
V_8	0.05	0.01	0.10	0.01	0.01	0.04
V_9	0.20	3.00	0.30	0.04	0.01	0.71
V_{10}	0.30	0.07	0.40	0.07	0.05	0.18

Table 4. Calculation of scores for each variables of all seven Area Estates, CPPI & ranking estates

	Variables	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	CPPI	Rank
	Weighted Average	4.83	1.10	0.66	0.42	0.08	0.20	1.79	0.04	0.71	0.18		
Area Estate	Attanagalla	4	2	3	2	5	5	5	1	3	4	**3.75**	**4**
	Dambadeniya	4	2	3	4	4	3	4	5	1	4	**3.46**	**6**
	Dodangaslanda	5	3	3	3	5	4	4	3	1	4	**4.04**	**3**
	Hiriyala	3	2	3	3	3	2	4	5	5	4	**3.20**	**7**
	Katugampola	4	2	3	3	5	3	4	5	4	4	**3.64**	**5**
	Kurunegala	5	3	3	3	4	5	4	2	1	4	**4.05**	**2**
	Narammala	5	3	3	4	4	4	5	5	1	4	**4.26**	**1**

Conclusion

As per the weighted values given by the experts of KPL, profit per ha is the most significant variable. Yield per ha, nuts per palm and density per ha is at a low performance level in most of all Area Estates and that directly affects the profit per ha and the company performances are not at the satisfactory level. Performances of net sales average and cost of production are low in few

Area Estates and percentage of diversified extent from coconut bearing extent is poor in most of the estates, except Hiriyala and Katugampola Area Estates.

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