

FIELD EVALUATION OF FORECASTING MODEL FOR CASHEW YIELD IN LARGE PLANTATIONS

M. V. GEORGE, C. H. AMARNATH, S. BHAGAVAN¹ and K. VIJAYAKUMAR*

ABSTRACT

A method to forecast the cashew yield from large plantations based on biometrical characters and yield attributes was developed and field tested in the four cashew estates at Muliyar, Periya, Adhur and Perla in Northern Kerala covering an area of about 2100 ha belonging to the Plantation Corporation of Kerala in Kasaragod district and at National Research Centre for Cashew (Experimental Station), Shanthigodu, D. K., Karnataka covering an area of about 40 ha. The yield estimates arrived at were found to be reasonably precise with an average deviation of 6.7% at Kasaragod and 17.9% at Shanthigodu with the actual yield.

Introduction

The harvest of cashew extends to 3-4 months and it is difficult to collect the yield data from a large number of trees from larger area. Hence the estimates available with the various agencies on the production of cashew are not generally realistic. George and Vijayakumar (1979) identified the biometrical characters and yield attributes which contribute for the yield of cashew and observed that the peak flowering phase viz. Feb-March is the most suitable period for recording these observations. George *et al* (1982) detailed a procedure for estimation of cashew yield from any single tree with one snap observation made during the peak flowering phase Feb-March. Further a procedure to estimate the yield from large gardens/estates was worked out by George *et al* (1986). In this paper an attempt made to simplify the calculation of the yield forecasting model replacing the canopy area with an easily observable character canopy area index along with the results of the field testing of the above procedure are detailed.

Material and Methods

George *et al* (1986) observed that in a garden ranging from 100 to 300 cashew trees, a maximum of 200 trees for recording the condition of flowering graded 0 to 5 and a subsample of 20/25 trees for recording the canopy area and estimated number of nuts at all stages of maturity are sufficient to give an yield forecast of the garden with 20 percent deviation at 5 percent level of significance. The formula used for forecasting the yield from individual trees was

$$Y = -1.644 + 0.017 \times_1 + 0.008 \times_2 + 0.775 \times_3 \quad (R^2 = 0.70)$$

(0.001) (0.0004) (0.033)

where \times_1, \times_2 and \times_3 are the observed values for the canopy area in square meters, estimated number of nuts at all stages of maturity and the condition of flowering graded 0 to 5 respectively recorded during the peak flowering phase Feb-March for estimating the total yield of cashew (Y) in Kgs. Here, the canopy area was worked out using the formula for the surface area as given by Mohapatra *et al* (1973). As the calculation of canopy area was complicated, another variable canopy area index = $D \times H$ was considered, where D is the average diameter in meters of the drip area of the canopy and H is the canopy height in meters. Replacing the canopy area by the canopy area index the entire set of regression equations on the data on 314 trees from Periya for 3 years (1982, '83 and '84) 146 trees from Perla for 2 years (1982 and 1983) and 114 trees from Muliyar for two years (1982 and 1983) were recalculated and the final equation was worked out pooling over the years and over the locations.

For the field verification of this methodology, 3 plots from Muliyar, 5 plots from Adhur, 3 plots from Periya and 6 plots from Perla cashew estates in Kasaragod district belonging to the plantation corporation of Kerala and 2 plots from National Research Centre for Cashew Experimental Station, (NRCC (ES)), Shanthigodu were selected as first stage units. Twenty-five trees each from the 17 plots from Kasaragod and 20 trees each from the two plots of Shanthigodu were selected at random. Observations on the canopy area index (sq. meters), estimated number of nuts at all stages of maturity and condition of flowering graded 0 to 5 were taken from all these selected trees and the yield of individual trees were estimated using the modified formula. Condition of flowering were recorded from the remaining trees subject to a maximum of 175 trees more from each plot and the yield

*Central Plantation Crops Research Institute, Kasaragod-670 124, Kerala.

¹National Research Centre for cashew, Puttur (Contribution No. 692).

forecast were made for each plot and for the entire estates using ratio estimates as described in George *et al* (1986). For confirmity of the forecast model the yield data were collected separately for each of the selected trees by daily harvest and the average yield per tree was calculated for each plot.

The estimate of the average yield of a tree in a plot of N_1 tree is given by

$$\frac{\bar{Y}_{N_1}}{\bar{X}_n} = \frac{\bar{Y}_n}{\bar{X}_n}$$

where \bar{Y}_n is the average yield estimated for the sample of n trees selected for detailed observations, \bar{X}_n is the average grading per tree for the condition of flowering for the same set of trees and \bar{X}_n' is the estimate of the average grading for the condition of flowering for the entire plot of N_1 trees, scores for the condition of flowering is given as follows:

0. no flowering
1. poor flowering
2. average flowering
3. above average flowering
4. good flowering
5. very good or profuse flowering.

Standard methodology given by Sukhatme and Sukhatme (1977) for multistage sampling with unequal number of second stage units was utilised for computing population mean/total and s.e./variance.

Results and Discussion

The modified formula was

$$Y = -1.709 + 0.058 \times_1 + 0.008 \times_2 + 0.775 \times_3 \quad (R^2 = 0.70)$$

(0.005) (0.0004) (0.033)

which was found almost the same except for the changes in the coefficient for the canopy area index (substituted in the place of canopy area) and the constant term. The estimate obtained by both the formulae were almost the same.

Table 1 gives the number of yielding trees, sample trees selected, estimated and actual average yields and estimated production in different blocks of cashew estates at Kasaragod and at Shanthigodu. The total area covered was about 2094 ha at Kasaragod and 40 ha at Shanthigodu. The deviation between the estimated and actual average yield was only 6.65%. The total production of cashew estimated based on the snap observation of the biometrical characters was

840 tonnes (estimate 1) whereas the estimated production based on the actual yield data, collected by daily harvest was 788 tonnes at Kasaragod. The total production estimated for Muliya estate was about 193 tonnes with a SE(%) of 2.5 and Adhur estate 272 tonnes (SE % 11.79). for Periya the total production was estimated at 116 tonnes (SE % 25.3) and Perla 258 tonnes (SE % 12.0). It can be seen from table that the estimates of production based on the actual yield harvested in these estates were very close to the estimates obtained based on the formula suggested, thereby suggesting that the forecasting model developed is quite efficient in predicting the yield from large estates. Standard errors workedout for these estimates also were low except for Periya estate where the SE % was of the order 25. This may not be due to the inefficiency of the model as the SE % for the estimate based on actual yield for Periya also was high (around 21). This was only due to the high variability observed between the plots selected, one plot was yielding very high and another very poor. The only way out in such cases is to take more number of blocks for sampling. Though the Plantation Corporation does not have correct estimates of their annual production, as the crop was sold every year before the harvest by public auction, this estimate was very much agreeing to their expected production.

In Shanthigodu also the average yield and estimated yield was found to be close to the actual average yield worked out based on daily harvest data which shows that the forecast model is quite satisfactory. The total estimated production (19.8 tonnes) was compared with the actual realised yield (16.8 tonnes), the actual realised yield was found to be short by 15%. This may be due to the fact that the collection of produce from non-experimental 2054 cashew trees was incomplete due to shortage of staff etc.

This methodology can be effectively adopted for the yield forecast in very large cashew plantations by subdividing the total area into blocks of 200-300 yielding trees, considering the natural boundries and selecting about 2 percent of such blocks as the first stage units. From these plots a maximum of 200 trees for recording the easily observable character condition of flowering and a subsample of 25 to 30 trees for recording the canopy area index and estimated number of nuts, are selected. The average yield per individual tree, plot average and estimated total yield can be worked as detailed in the Material and Methods. However for small estates the number of sample plots to be selected among the first stage units of blocks will have to be high for getting more precise yield forecast of the estate.

By this methodology the cumbersome procedure of cashew yield estimation by daily harvest can be replaced by a simple snap observation of three biometrical characters without much loss in precision. Generally it takes about 10-20 minutes only for recording the observations from any tree. This methodology is usefull in estimating the total production from large

estates much before the actual harvest. Most of the Public Sector/Government Cashew Plantations/Estates in India are selling their produce by Public auction well in advance every year and not having any scientific estimates of their total production of cashew from their estates. This procedure can definitely be utilised by them profitably for getting reasonable estimates of their production.

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Table 1—Estimated Production of Cashew from Estates of Plantation Corporation of Kerala, Muliyar (Kasaragod Dist.) and NRCC(ES) Shanthigodu

Location	Area (ha)	Number of trees Total	Sample	Mean yield (kg)		Estimated Total Yield in Tonnes	
				Estimated	Actual	1	2
Muliyar	387	45392	275	4.261	4.165	193.42	189.06
			208	(0.1067)	(4.843)	(4.194)	
			220				
Adhur	749	78108	200	3.488	3.036	272.44	237.14
			200	(0.4113)	(32.126)	(28.767)	
			200				
			250				
			200				
Periya	302	32763	270	3.554	2.878	116.44	94.29
			215	(0.9002)	(29.493)	(19.392)	
			213				
Perla	656	92140	300	2.797	2.901	257.72	267.30
			300	(0.3390)	(31.236)	(18.271)	
			300				
			254				
			238				
			284				
Total	2094	248403	4127	3.382	3.171	840.02	787.79
NRCC (ES)	36	5434	140	3.649	3.093	19.83	16.81
Shanthigodu			127	(0.206)		(1.117)	(0.103)

Figures in the parenthesis are the SE's of the estimates.

Estimate 1 is based on the biometrical observations.

2 is based on the yield data collected from the sample plots.