ON- STATION PRODUCTION OF HEVEA PLANTING MATERIALS: AN APPLICATION OF PRODUCTION FUNCTION ANALYSIS

D. Y Giroh; O. Aghughu and Waizah Yakub

Abstract

On station production of Hevea planting materials at the Rubber Research Institute of Nigeria (RRIN) main station nursery Iyanomo was evaluated using production function analysis. Empirical results indicated that 96.30% of the variations in the production of Hevea planting m`aterials was explained by the endogenous variables. Production had decreasing rate of returns to scale (RTS = 0.804). Labor and number of seedlings allotted for budding were significant (p>0.01). Cost and return analysis revealed a gross margin and net farm income of ₦17, 757. 20 and ₦7, 445.61 respectively.

Introduction

Production of *Hevea* seedlings for planting is mainly by vegetative propagation where Hevea genotype with high latex yielding ability is desired. This can be obtained through budding techniques. The principle involved is the replacement of the shoot system of a rootstock with that of the desired ones (scion). The patch of the bark of the seedling plant (stock) is replaced with a patch of the bark with dominate bud (bud patch) taken from the genotype to be multiplied (scion) and this preserved the genetic constituent of the desired genotypes from one generation to the next (Delabarre and Serier, 2000; Idoko *etal.*,2007a).Seedling production in Nigeria has been dominated by the use of exotic clones such as Gondang Tapen (GT1), Rubber Research Institute of Malaya's 600, 700 (RRIM 600, RRIM 700, etc) despite reported high advantage of RRIN developed clones. This was attributed by Aigbekaen *etal.*,(2000) to lack of awareness of the high yield potential of NIG 800 and 900 series by farmers . However, there is a short supply of seedlings for use by farmers. To address this problem and move the nation from monoculture economic trend with heavy dependence on crude oil, the Federal government of Nigeria introduced the National Accelerated Industrial Crops Production Programme (NAICPP) in 1994 and the Presidential Initiative on natural Rubber (PIR) in 2006(Giroh *et al.*, 2007). This short supply of rubber planting materials to farmers was also reported by Giroh *et al.*, (2007) to be in the ratio of 3: 1 i.e demand- supply. The implication is that farmers resorted to using unselected and unimproved seedlings for plantation establishment rather than the improved budded stumps. This has a number of disadvantages of low yield and other undesirable secondary characteristic such as poor bark regeneration, poor girth, etc.

Budding is a specialized and skillful exercise. Budded stump i s of paramount importance in the establishment of rubber plantation and thus calls for efficient budding method. The dearth of skilled budders has also forced majority of farmers to use unselected and un improved seedlings for plantation establishment materials or adopt the use of seedlings. This study was therefore conducted to evaluate on station production of Hevea planting materials. The specific objectives were to describe socio- economic characteristics of budders in relation to production, estimate cost and return to seedling production and estimate the influence of total seedlings allotted, labour, variable and fixed cost on the success of budding.

Materials and Methods

The study was conducted at Rubber Research Institute of Nigeria (RRIN) Main station nursery Iyanomo (latitude 6^0 and 7^0 N, longitude 5^0 and 6^0 E). It falls within the humid rain forest zone of southern Nigeria. The area is rich in fertile soil suitable for the cultivation of natural rubber. The soil pH ranges between 4.0 and 5.5 with an estimated annual rainfall of 1800 mm to 2000 mm (Aigbekaen *et al.*, 2000).

Production activities for 2007 on rubber budders were collected. A sample of 33 rubber budders were selected and structure interview schedule was administered on the budders to collect primary data as well as secondary data (budders' productivity, man days of labour and wages). Data collected were analyzed using descriptive statistics and budgetary technique while the production

function analysis was employed to determine the contribution of total seedlings allotted, man days of labour, variable and fixed cost on the success of budded clones.

The budgetary technique used was the Gross margin to estimate cost and returns to budding. It is expressed as:

$$GM = TR - TVC \quad (1)$$

$$NFI = GM - TFC \quad (2)$$

Where: GM = Gross margin, TR = total revenue, TFC = total fixed cost (depreciation on fixed cost items was computed by using straight line method) and NFI = Net farm income.

The production function postulated for rubber budders in the study area is implicitly presented by equation:

$$Y = f(X_1, X_2, X_3, X_4, \mu 1) \quad (3)$$

Where: Y_i = budding success by the ith budder (number), X_1 = total seedlings allotted, X_2 = Labour (measured in standard man days, SMD), X_3 = variable cost (naira), X_4 = depreciation on fixed cost items and μ_1 = the error term (assumed to have zero mean and constant variance).

Four functional forms (Linear, Semi-log, Exponential and Cobb-Douglas) were tried using ordinary least square technique (OLS). The estimated functions were evaluated in terms of the statistical significance of R^2 as indicated by F-value, the significance of the coefficients as given by the t-values, the signs of the coefficient and the magnitude of standard errors. Based on these statistical, economic and econometric criteria, the Cobb-Douglas functional form was selected as the lead equation which is explicitly represented by equation:

$$\text{Log}Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 \quad (4)$$

Where: β_0 = A constant, $\beta_1, \beta_2 \ldots B_4$ are regression coefficients to be estimated while other variables are as previously defined.

Results and Discussion

Seedling production and budding operations: Seedlings production from 1994 to 2007 (Table 1) revealed that a total of 1,553,764seedlings were budded with 856,027successes. This is 55.09% rate. The government has introduced substantial levels of input subsidy on the production of planting materials as incentives to encourage rubber farmers to adopt the use of improved rubber clones rather than the volunteer seedlings for planting in their fields. Budding activities as reflected in Table 2 showed that GT1, RRIM 600 and PR107 featured prominently despite reported high yield in NIG 800 and 900 series clones. This result is in agreement with the findings of Delabarre and Serier (2000) who reported wide adoption of GT1 and RRIM 600 clones in many rubber producing countries of the world. Budding success depends on several factors such as time of budding, rainfall, budder's temperament and skill. Other factors include clonal variation, genetic make up and other environmental factors.

The socio- economic characteristics of budders revealed that females were the dominant source of labour for budding activities (60.61%). The result is in consonance with earlier studies that revealed high involvement of women in agricultural production (Sigot, 1995; Umoh, 2006; Idoko *et al.*, 2007b). All of the budders are educated and attained one form of formal education or the other. This implies that their productivity is expected to be high. Age distribution of respondents also shows that 84.37% of them are in their economically active age (25 to 40 years) with a mean age of 27 years (Table 3).

Table1: Seedling production RRIN Main station

Year	Total seedlings budded	Total success	Percentage Success	Percentage Failure
1994	146,710	53,875	36.72	63.28
1995	130,164	56,134	43.13	56.87
1996	214,911	86,993	40.48	59.52
1997	143,235	76,864	53.66	46.34
1998	116,336	63,176	54.30	45.70
1999	200,866	102,268	50.91	49.09
2000	109,480	91,186	83.29	16.71
2001	94,938	80,347	84.43	15.37
2002	52,862	29,316	55.46	44.54
2003	24,768	21,329	86.12	13.88
2004	54,210	48,856	90.12	9.88
2005	72,235	38,628	53.48	46.52
2006	86,592	44,580	51.48	48.52
2007	106,439	62,475	58.69	41.31

Source: Field survey, 2007

Table 2: Budding per month and clonal type

Month	**Clones**		
	GT1	**RRIM600**	**PR107**
March	-	4580(4255)*	20(4)
April	12780(8928)	3720(2448)	9670(4599)
May	7070(4885)	12350(6854)	12320(5100)
June	2110(1965)	8920(4255)	-
Total	**21960(15778)**	**29570(17812)**	**22010(9703)**

Source: Field survey, 2007. * Figures in parenthesis are budding success

Cost and return to seedling production: Result of budgetary technique (Table 4) revealed that seedling production is profitable at the non-presidential price of ₦12.50/ stump while a negative return was observed for the presidential initiative price of ₦5.00 per stump indicative of high input subsidy on the production of planting materials. Labour cost in the production of planting materials accounted for 76.09%. This is as a result of the fact that the Nigeria rubber belt corresponds with the oil block of the country with scarcity and high cost of labour.

Production function analysis: Result of the production function analysis indicated that the coefficient of determination (R^2 = 0.963) was significant at 1% level. This showed that the independent variables explained about 96.30% of the variations in output of budders. The entire estimated coefficients except X_3 and X_4 (variable cost and fixed cost items) carried the expected positive sign, which indicated that an increase in these variables would lead to increase in output of rubber budders (Table 5). The coefficient for total seedlings allotted was significant ($p>0.01$) implying that increase in the total number of seedlings would increase the success of budding. Labour measured in standard days was significant ($p>0.01$) and recorded the highest average physical productivity of 46.6849 (Table 7). The result confirms a number of findings on the use of manual labour widely used in the developing countries of the world where mechanization is very low (Utomakili and Molua, 1998; Umoh, 2006).

Return to scale (RTS) of 0.804 indicated decreasing return to scale. This shows that production is in stage II (rational zone) of production where resources were used within economic relevant range. This however, does not mean that the inputs were optimally used, as maximum efficiency requires the equality of marginal value products to resources inputs and their unit prices.

Conclusion and Recommendation

The study revealed that seedling production is profitable at the non-presidential price of ₦12.50/ stump while a negative return was observed for the presidential initiative price of ₦5.00 per stump reflective of high input subsidy on the production of planting materials. The result also showed that the independent variables explained about 96.30% of the variations in output of budders. Total seedlings allotted and labour were significant factors in the production of planting materials. Return to scale (RTS) of 0.804 indicated decreasing return to scale. This shows that production is in stage II (rational zone) of production where resources were used within economic relevant range.

The study recommends that input subsidy on the production of planting materials be sustained by government and non governmental organizations through financial support and capacity building efforts to revamp the ailing rubber industry. Ministry of Agriculture and Private estate owners should also be encouraged to establish nurseries for the production of planting materials for rubber farmers. Public enlightenment campaign should be mounted by government to create awareness among rubber farmers on the availability of highly subsidized planting materials. Extension activities should be strengthened for technology delivery to the farmers.

Table 3: Socio- economic characteristics of respondents

Variable	Frequency	Percentage
Gender		
Male	13	39.39
Female	20	60.61
Literacy level		
Primary	26	78.78
JSS 3	1	3.03
Secondary	6	18.18
Age		
Less than 25	4	12.12
25 – 30	14	42.42
31 – 40	10	30.30
41 and above	5	15.15

Source: Field survey, 2007

Table 4: Average cost and return of seedling production

Variable	Value	Percentage
Variable cost	₦5, 855.30	36.22
Fixed cost	₦10, 311.59	63.78
Total cost	₦16, 166.89	100.00
Total output	1889 budded clones	
Total revenue	₦ 236,125.00(₦ 9,445)*	
Gross margin (TR – TVC)	₦ 17,757.20(₦3, 589.70)	
NFI (GM – TFC)	₦ 7,445.61(- ₦6, 721.89)	

Source: Field survey 2007. * Values in parenthesis are predicted on presidential initiative price of ₦5.00/stump.

Table 5: Determinants of budding success

Variable		Coefficient	Standard error	t. value
Constant		1.683	0.702	2.396**
Total seedlings	(X_1)	1.129	0.098	11.489***
Labour	(X_2)	0.178	0.027	6.592***
Variable cost	(X_3)	-0.033	0.063	-0.530
Fixed cost	(X_4)	-0.470	0.045	-1.050

Source: Field survey, 2007

$R = 0.984$, $R^2 = 0.968$ R^2 adjusted $= 0.963$ Standard Error of the estimate $= 0.256$
F value =197.780***

, * indicate significance at 5&1 percent respectively.

Table 6: Production elasticity

Variable		Elasticity
Total seedlings	(X_1)	1.129
Labour	(X_2)	0.178
Variable cost	(X_3)	-0.033
Fixed cost	(X_4)	-0.470
RTS		0.804

Source: Field survey, 2007

Table 7: Average Physical productivity (APP) of inputs used

Variable		APP
Total seedlings	(X_1)	0.5549
Labour	(X_2)	46.6849
Variable cost	(X_3)	0.3226
Fixed cost	(X_4)	0.1832

Source: Field survey, 2007

Acknowledgements

Authors are grateful to Messrs. Yabagi Nma and Job Irelen of Nursery Unit for assistance in data collection.

References

Aigbekaen, E.O, Imarhiagbe, E.O & Omokhafe, K.O. (2000): Adoption of some recommended Agronomic practices of natural rubber in Nigeria, *Journal of Agriculture Forestry& Fisheries* 1 *&2: 51-56*

Delabarre, M.A & Serier, J.B (2000*): Rubber: The tropical agriculturalist.* CTA Macmillan Education Ltd London .pp 22-23

Giroh, D.Y., Ephraim, I.J., F.O. Igbinosun & P. Ogwuche.(2007).A quantitative Analysis of adoption of natural rubber technologies among farmers in Southern Nigeria. *Journal of sustainable tropical agricultural research* 21: 11 – 18

Giroh, D.Y & Adebayo, E.F. (2007). Comparative Productivity Analysis of permanent and non-permanent Rubber Tappers in State rubber farms of Nigeria. *Journal of Agriculture and Social Science* 3(4): 107- 111

Giroh, D.Y., A.A.Awah, Balogun, F.E., F.O. Igbinosa & Wuranti, V. (2008). An Overview of the Presidential Initiative on natural rubber in the Agricultural reform in Nigeria. Proceedings,13th Annual Conference, Agricultural Extension Society of Nigeria. Pp 67 – 75

Idoko S.O, O Aghughu, H Umar, M. Abubakar, & V I Omorusi. (2007a).three years of rubber budded stump production in rubber research institute of Nigeria: demand and supply. *Knowledge review* vol. 14(2):50-54.

Idoko, S.O., Haliru, U.Y, Abubakar, M., Oghide, E.A. & Waizah, Y. (2007b). Labour Stability in Budded stumps Production at Rubber Research Institute (RRIN) Nursery Iyanomo, Benin City, Nigeria. *ChemTech Journal* 3: 668 – 672.

Sigot, A.J (1995): Discourse on Gender and Natural Resource Management In: Towards Common Ground: Gender and Natural Management in Africa. Sigot, A.J., L.A.Thrupp and J. Green (eds). ACTS press Nairobi .Pp 1-13

Umoh, G.S. (2006): Resource Use efficiency in Urban farming: An Application of Stochastic Frontier Production Function. *International Journal of Agriculture and Biology* 8(1): 38 – 44

Utomakili,J.B. & Molua,E. (1998). Analysis of Resource Use efficiency in Banana Production in the south west province of Cameroon. A case study. *International Journal for Tropical Agriculture* 1(4): 113 – 118