

Full Length Research Paper

Gross margin analysis of rubber based cropping systems in Nigeria

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The study aims at determining the economic impact of the rubber based cropping system introduced to rubber farmers in Nigeria by Rubber Research Institute of Nigeria under the sponsorship of the Common Fund for Commodity (CFC) project in Nigeria coded CFC-IRSG 21. Thirty three farmers were randomly selected in five states in Nigeria (Edo, Delta, Ogun, Kaduna and Akwa Ibom) using interview schedule. The profitability of rubber based cropping systems on farmers' farms in the five states was determined using gross margin analysis. The study revealed that rubber based cropping systems in the study area were profitable with positive gross margins for all the identified cropping systems in the study area. Furthermore, the study revealed that a gross margin of ₦178, 000/ha and return on investment of ₦4.79 was the highest for the two cropping system identified in Edo state. A gross margin of ₦331, 000/ha and return on investment of ₦7.76 per Naira was the highest for the three cropping system adopted in Delta state. For the four crop combination in Ogun state, a gross margin of ₦181,000 and return on investment of ₦6.32 per Naira was the highest. In Akwa Ibom state, a gross margin of ₦402, 100 and return on investment of ₦8.05 per Naira was the highest for the three crop combination. For the four crop combination in Kaduna state, gross margin of ₦488,000 was the highest. The study however, concluded that cassava featured more in the intercropped combination and it gave higher gross returns in the rubber based cropping systems in Nigeria compared with other crops across the states.

Key words: Gross margin, profitability, rubber, intercropping, cropping systems.

INTRODUCTION

Rubber industry in Nigeria suffered significant decline by almost 50% in the past two decades (NRAN, 2014). Some of the reasons for the decline include; demand for large expanse of land and almost 70% of the vast inter-row spaces are underutilized. Secondly, long gestation period of the crop (about 5 to 7 years), a period during which the rubber plantation cannot be tapped for latex and hence no income accrued from the huge capital

investment and maintenance of the plantation. This situation has remained a disincentive to rubber farmers and has made rubber enterprise unattractive, especially to small-scaled farmers in Nigeria.

One possible approach that may assist smallholder rubber farmers is to create a source of income capable of back rolling the cost of plantation maintenance, take care of his family food needs and other personal expenses.

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Table 1. Distribution of selected farmers by state.

State	Respondents
Delta	5
Edo	6
Ogun	9
Akwa Ibom	7
Kaduna	6
Total	33

Hence, a timely adoption of appropriate plantation management practices that is capable of utilizing the under-utilized land resources and increases the revenue base of the enterprises is important to the attainment of the drive for increase rubber production in Nigeria.

Intercropping of rubber with arable crops has been found to be beneficial to the growth of rubber and capable of improving the economy of the rubber enterprise thereby reducing the need for subsidies and credit to rubber farmers (Zainol et al., 1993, Haliru et al., 2014). Many researchers have demonstrated that intercropping of rubber with arable crop is advantageous in boosting yield crops (Masea and Cramp, 1995). It has also been reported that intercropping of rubber increase the rate of growth of rubber thereby reducing the gestation period of rubber (Esekhade and Idoko, 2009). Rubber Research Institute of Nigeria through the project 'Promote economically viable small holding rubber production in West Africa' funded by the Common Fund for Commodity (CFC) and the International Rubber Study Group (IRSG) have encouraged several farmers in Nigeria to go into rubber farming and intercropped their plantations with arable and bi-annual crops during the immature phase. Surveys have established, however, that rubber smallholders are practising intercropping (Mesike et al., 2009; Uzokwe U.N., 2009). The component food crops recommended to smallholder farmers as intercrop with rubber in Nigeria are maize, soybean, pepper, cowpea, tomato, yam, or cassava (Rosyid et al, 2008). This system has been reported to improve the soil (Masea and Cramp, 1995), enhance the growth rates of rubber (Abdul Razak and Barizan, 2001), increase land productivity, and reduce cost of plantation management by ensuring early income generation to farmer during the period of immaturity (Abraham, 1980; Zainol et al., 1993). Despite these positive benefits of rubber based intercropping system, there are still pockets of scepticism by some farmers in adopting this technology. Hence, there is need for a research to quantify in monetary terms, the derivable gains in adopting the system. Hence, this study was carried out to determine the actual economic benefit of different arable crops and their combinations as intercrop with rubber in Nigeria.

MATERIALS AND METHODS

The study was conducted in 5 states in Nigeria which include; Delta, Edo, Ogun, Akwa Ibom and Kaduna state. Rubber plantations were established using the doubled row planting system at a spacing of 2.5 x 2.5 m and 10 m avenue between each double row of rubber. The component crops were planted in the inter rows at a spacing of at least 1.0 m away from the rubber. Component crop spacing was the recommended spacing for each crop. Based on soil test results, fertilizer were applied (uniform broadcast) at the rate of 19.0, 60.0, 36.0 and 5.0 kg ha⁻¹ N, P₂O₅, K₂O and MgO; using urea, single super phosphate, muriate of potash and magnesium sulphate as sources respectively. The fertilizers were divided into two equal doses and applied at planting and 3 months after planting. All farmers were encouraged to observe all agronomic protocols up to harvesting, processing and marketing. Data were generated using the primary data collected through personal interview schedule and structured questionnaires administered to the beneficiaries of CFC-IRSG 21 project in Nigeria. Altogether, 33 respondents were randomly selected across the states (Table 1). The major economic activity of the respondents is farming. The major crops cultivated are rubber, cassava, yam, maize, plantain, cassava, pineapple, watermelon, cocoyam and different types of vegetables. A whole farm budgetary technique was used to assess the profitability of rubber-based cropping systems among the beneficiaries of the project. The farmers made use of traditional farm implements like hoes, cutlasses with negligible depreciation. The profitability of the farm was determined using gross margin analysis as follows:

$$\text{Gross Margin} = \text{Total Revenue} - \text{Total Variable cost}$$

Where Total Revenue (TR), $TR = P_r Q_r + P_n Q_n$, P_r = Price of rubber (₦), Q_r = Output of rubber (Kg), P_n = Price of crop (n) intercropped with rubber (₦), Q_n = Output of crop (n) intercropped with rubber (Kg)

Variable costs include cost of labour, fertilizer, chemicals and other variable inputs. Returns per Naira (₦) invested (RI) was computed as $RI = \text{Gross Returns}/\text{TVC}$. The higher the value of RI the more profitable is the cropping system.

RESULTS AND DISCUSSION

The total variable cost per hectare for each cropping system is shown in Table 2. There are many intercropped combinations with rubber but the major crops intercropped with rubber include cassava, yam, maize, plantain, pineapple, watermelon, melon and millet. Labour costs incurred by farmers for the cropping systems were due to land preparation, planting, weeding,

Table 2. Total variable cost and relative input cost per hectare.

State	Cropping systems	Labour cost	fertilizer	Planting material	Chemicals	Total variable cost
Edo	Rubber/cassava/yam/maize	30,000	15,000	20,000	2,000	67,000
	Rubber/cassava/plantain/maize	20,000	15,000	10,000	2,000	47,000
Delta	Rubber/cassava	20,000	15,000	2,000	2,000	39,000
	Rubber/cassava/plantain/pineapple	20,000	15,000	12,000	2,000	49,000
Ogun	Rubber/cassava/maize	20,000	15,000	6,000	2,000	43,000
	Rubber/maize	10,000	15,000	6,000	2,000	33,000
	Rubber/maize/watermelon	10,000	15,000	8,000	2,000	34,000
	Rubber/plantain	20,000	15,000	20,000	2,000	57,000
Akwa Ibom	Rubber/cassava	30,000	15,000	5,000	2,000	52,000
	Rubber/cassava/Telfera/cocoyam	30,000	15,000	10,000	2,000	57,000
	Rubber/cassava/okro	30,000	15,000	7,000	2,000	54,000
Kaduna	Rubber/cassava/Telfera	30,000	15,000	7,000	2,000	54,000
	Rubber/cassava/yam/melon/maize/rice	25,000	15,000	20,000	2,000	62,000
	Rubber/yam/millet/maize/melon	20,000	15,000	20,000	2,000	57,000
	Rubber/maize/millet	10,000	15,000	10,000	2,000	37,000
	Rubber/yam/maize/millet	20,000	15,000	20,000	2,000	57,000
	Rubber/maize/millet/bitter leaf/pepper	15,000	15,000	10,000	2,000	42,000
	Rubber/cassava/maize/bitter leaf/pepper	25,000	15,000	10,000	2,000	52,000

Table 3. Gross returns per hectare of rubber-based cropping system in Edo state.

Cropping system	Crops	Output(kg/Ha)	Average market price (₦/kg)	Total revenue (₦)
Rubber-cassava-yam-maize	Rubber	-	145	-
	Cassava	10,000	15	150,000
	Yam	5,000	10	50,000
	Maize	500	50	25,000
	Gross returns			225,000
Rubber/cassava/plantain/maize	Rubber	-	145	-
	Cassava	10,000	15	150,000
	Plantain	5,000	10	50,000
	Maize	500	50	25,000
	Gross returns			225,000

fertilizer applications and harvesting. Labour cost was the highest variable cost incurred and it accounted for over 40% of the total variable cost in Edo, Delta, Akwa Ibom and Kaduna states. The farmers used 2 to 4 L of herbicides per hectare with an average of 3 L per hectare. The cost of herbicides used was estimated at ₦3,000 per hectare. The price of 1 bag of fertilizer ranged from ₦4,500 to ₦5,500 for 50 kg bag with an average of ₦5,000 per bag. Fertilizer cost was about ₦15,000 per hectare.

Farm returns for the rubber based cropping system in each state are shown in Tables 3 to 7. The gross returns were calculated by multiplying the total quantity of the

outputs by the average market price prevailing at the period. The study revealed that cassava has the highest return per hectare when compared with other crops that were intercropped with rubber in Edo, Delta and Ogun states. However, coco yam and maize have the highest return in Akwa Ibom and Kaduna respectively. Data in Table 3 shows that the two cropping systems adopted by farmers in Edo state recorded gross returns of ₦225,000 per hectare. In Table 4, the combination of rubber-cassava-plantain-pineapple intercropping gave the highest gross returns of ₦380,000 per hectare in Delta state when compared to other cropping systems adopted in the state. In Ogun state, rubber-maize-water melon

Table 4. Gross returns per hectare of rubber-based cropping system in Delta state.

Cropping system	Crops	Output(kg/Ha)	Average market price (₦/kg)	Total revenue (₦)
Rubber/cassava	Rubber	-	145	-
	Cassava	10,000	20	200,000
	Gross return			200,000
Rubber/cassava/plantain/pineapple	Rubber	-	145	-
	Cassava	10,000	25	250,000
	Plantain	5,000	10	50,000
	Pineapple	1,000	80	80,000
	Gross return			380,000
Rubber/cassava/maize	Rubber	-	145	-
	Cassava	9,000	13	117,000
	Maize	2,000	25	50,000
	Gross return			167,000

Table 5. Gross returns per hectare of rubber-based cropping system in Ogun state.

Cropping system	Crops	Output(kg/Ha)	Average market price (₦/kg)	Total revenue (₦)
Rubber/maize	Rubber	-	145	-
	Maize	3,000	40	120,000
	Gross return			120,00
Rubber/maize/watermelon	Rubber	-	145	-
	Maize	2,600	37	96,200
	Watermelon	2,600	46	119,600
	Gross return			215,800
Rubber/plantain	Rubber	-	145	-
	Plantain	3,000	40	120,000
	Gross return			120,000
Rubber/cassava	Rubber	-	145	-
	Cassava	7,000	20	140,000
	Gross return			140,000

cropping system gave the highest gross returns of ₦215,800 per hectare when compared to other cropping systems in the area (Table 5). From the results in Table 6 and 7, rubber-cassava-telfera-cocoyam and rubber-cassava-yam-melon-maize-rice cropping system have the highest gross return of ₦459,000 and ₦550,000 per hectare respectively in Akwa Ibom and Kaduna state when compared with other cropping system in the states.

Table 8 shows that farmers make positive Gross Margin for the various types of cropping systems in the study area. For the cropping system used in Edo state, the combination of rubber-cassava-plantain-maize cropping system consistently gave higher gross margin

(₦178, 000/ha) and return on investment of ₦4.79 than the combination of rubber-cassava-yam-maize. The value of the return on investment indicated that for every ₦1 invested in the cropping combination, there was a return of ₦4.79. For Delta state, the intercropping of rubber-cassava-plantain-pineapple gave the highest gross margin (₦331, 000/ha) and return on investment (₦7.76) in the three cropping system used by the farmers. For the cropping combination in Ogun state, the intercropping of rubber-maize-watermelon consistently gave the highest gross margin of ₦181,000 and return on investment of ₦6.32. For the cropping combination used in Akwa Ibom state, the intercropping of rubber/cassava/telfera/

Table 6. Gross returns per hectare of rubber-based cropping system in Akwa Ibom state.

Cropping system	Crops	Output (kg/Ha)	Average market price (₦/kg)	Total revenue (₦)
Rubber/cassava/Telfera/cocoyam	Rubber	-	145	-
	Cassava	112,200	15	168,000
	Telfera	8,000	12.50	100,000
	Cocoyam	14,700	13	191,000
	Gross return			459,000
Rubber/cassava/okro	Rubber	-	145	-
	Cassava	11,000	15	165,000
	Okro	500	60	30,000
	Gross return			195,000
Rubber/cassava/Telfera	Rubber	-	145	-
	Cassava	11,000	15	165,000
	Telfera	8,000	12.50	100,000
	Gross return			265,000

Table 7. Gross returns per hectare of rubber-based cropping system in Kaduna state.

Cropping system	Crops	Output(kg/Ha)	Average market price (₦/kg)	Total revenue (₦)
Rubber/cassava/yam/melon/maize/rice	Rubber	-	145	-
	Cassava	3,000	50	150,000
	Yam	1,000	50	50,000
	melon	500	50	25,000
	Maize	5,000	60	300,000
	Rice	500	50	25,000
	Gross return			550,000
Rubber/yam/millet/maize/melon	Rubber	-	145	-
	Yam	1000	50	50,000
	millet	1,500	50	75,000
	Maize	5,000	60	300,000
	Melon	1500	50	75,000
	Gross return			500,000
Rubber/maize/millet	Rubber	-	145	-
	Maize	4,000	50	200,000
	Millet	2,500	50	125,000
	Gross return			325,000
Rubber/yam/maize/millet	Rubber	-	145	-
	Yam	1,000	50	50,000
	Maize	5,000	60	300,000
	Millet	2,000	50	100,000
	Gross return			450,000
Rubber/maize/millet/bitter leaf/pepper	Rubber	-	145	-
	Maize	4500	50	225,000
	Millet	2,000	50	100,000

Table 7. Contd.

	Biter leaf	500	90	45,000
	Pepper	500	80	40,000
	Gross Return			410,000
	Rubber	-	145	-
	cassava	3,000	50	150,000
	Maize	4,000	50	200,000
Rubber/cassava/maize/biter leaf/pepper	Bitter leaf	500	80	40,000
	Pepper	500	100	50,000
	Gross return			440,000

Table 8. Gross Margins and Returns per Naira invested per hectare of rubber-based cropping system.

States	Cropping system	GR (₦/ha)	TVC (₦/ha)	GM (₦/ha)	RI (₦/ha)
Edo	Rubber/cassava/yam/maize	225,000	67,000	158,000	3.36
	Rubber/cassava/plantain/maize	225,000	47,000	178,000	4.79
Delta	Rubber/cassava	200,000	39,000	161,000	5.13
	Rubber/cassava/plantain/pineapple	380,000	49,000	331,000	7.76
	Rubber/cassava/maize	167,000	43,000	124,000	3.88
Ogun	Rubber/maize	120,000	33,000	87,000	3.64
	Rubber/maize/watermelon	215,000	34,000	181,000	6.32
	Rubber/plantain	120,000	57,000	63,000	2.11
	Rubber/cassava	140,000	52,000	88,000	2.69
Akwa Ibom	Rubber/cassava/telfera/cocoyam	459,100	57,000	402,100	8.05
	Rubber/cassava/okro	195,000	54,000	141,000	3.61
	Rubber/cassava/telfera	265,000	54,000	211,000	4.91
Kaduna	Rubber/cassava/yam/melon/maize/rice	550,000	62,000	488,000	8.87
	Rubber/yam/millet/maize/melon	500,000	57,000	443,000	8.77
	Rubber/maize/millet	325,000	37,000	288,000	8.78
	Rubber/yam/maize/millet	450,000	57,000	393,000	7.89
	Rubber/maize/millet/bitter leaf/pepper	410,000	42,000	368,000	9.76
	Rubber/cassava/maize/bitter leaf/pepper	440,000	52,000	388,000	8.46

cocoyam also consistently gave the highest gross margin of ₦402,100 and return on investment of ₦8.05. For the cropping combination used in Kaduna state, the intercropping of rubber-cassava-yam-melon-maize-rice have the highest gross margin of ₦488,000. However, the return on investment of ₦8.87 for cassava-yam-melon-maize-rice intercrop was not the highest in Kaduna state because of high labour cost recorded in the crop combination. However, the highest return on investment in Kaduna state was obtained from intercropped rubber-maize-millet-bitter leaf-pepper (₦9.76).

CONCLUSION AND RECOMMENDATIONS

The study shows that farmers in the study area used different crops like cassava, yam, maize, plantain, pineapple, millet, leafy and fruity vegetables for intercropping with rubber. The farmers made positive returns on capital invested for different combination of cropping systems used in the study area. Generally, cassava featured more in the intercropped combination and it gave higher gross returns in the rubber based cropping systems in Nigeria compared with other crops

across the states. In Edo and Delta State, cropping systems involving cassava and plantain gave the highest gross returns while in Ogun state it was maize and water melon. In Kaduna state, it was the cassava, yam, melon, maize while in Akwa Ibom it was cassava, telfria and cocoyam combinations.

Conflict of Interest

The authors have not declared any conflict of interest.

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