

Economic prospects of a rubber-cassava agroforestry in Nigeria

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Abstract. A study to determine the financial benefits of intercropping immature rubber plantation with cassava in South Eastern Nigeria was carried out at the Rubber Research Institute of Nigeria, Iyanomo near Benin City. The study was set up in a randomized complete block design with each treatment replicated three times. Yield data generated were used to determine the profitability of the systems. The results showed economic yield from rubber as the rubber trees did not attain tappable girth throughout the duration of the study. a mean yield of about 25.72 tonnes of cassava tuber were generated from the sole cassava treatments for the four years period while a mean yield of about 22.92 tonnes of cassava tuber per hectare were generated from the cassava + rubber intercrop treatments in the same period. A total amount of 160,000 Naira was spent in four years as cost of intercropping. Total revenue generated from the sales of cassava in the rubber + cassava system was 900, 000.00 Naira per hectare with a Gross Margin and profit margin of 740,000 Naira and 673, 090.98 Naira respectively. A profitability index of the rubber + cassava system was 0.75, indicating that, 75% of the total amount invested in the rubber + cassava system was recovered in the first four years compared to the additional costs incurred in the sole rubber plantation treatment. This study showed that intercropping cassava with rubber during the immature phase of rubber plantation guarantee early return on investment and more profitable compared with sole rubber plantation systems.

Keywords: Rubber, intercropping, sole, cassava, cropping systems, profitability, Nigeria.

1 Introduction

Rubber plantation enterprise requires a large expanse of land and almost 70% of the vast inter-row spaces are underutilized. Rubber has a long gestation period of rubber (5 – 7 years), a period when no income accrue from the huge investment and the maintenance of the crop at this stage is so critical, hence the farmer need additional funds to weed the farm [9]. This situation has remained a disincentive to rubber farmers and has made rubber enterprise unattractive, especially to small-scaled farmers in Nigeria [6]. Hence, a timely adoption of appropriate plantation management practices that is capable of utilizing the under-utilized

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land resources and increases the revenue base of the enterprises is important to the attainment of the drive to increase rubber production in Nigeria.

Recently, 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 [19, 16, 6]. Cassava has been found to be one of the most promising among the arable crops evaluated in Nigeria [6,5]. Recently, intercropping of rubber with arable crops has been demonstrated to be beneficial to the growth of rubber plants and can thus improve the economy of the rubber enterprise [19, 6 and 5]. Rubber intercropping serves as additional sources of organic materials to the soil and help create a micro climate that leads to soil moisture conservation and subsequent encouragement of a more robust girth of young rubber saplings in the field [7]. [Esekhade *et al.*, (1996), 9] demonstrated that intercropping of rubber with arable crops before the closure of the rubber canopy helps to reduce the cost of rubber plantation establishment by generating income to farmers during the immature phase of rubber trees. Cassava is a very important crop in Africa, with very high comparative production advantage over other crops (Facayode, *et al.*, 2008). It requires less labour per unit output compared with other crops, making it a major crop attractive to resource poor farmers. It is Africa's second most important staple food, after maize, in terms of calories consumed. Cassava is a major source of calories for roughly two out of every five African's. It contributes more than 1,000 calories per person per day to the diet and many families eat cassava for breakfast, lunch, and dinner [13, 10, 11]. The intercropping of rubber with cassava has already been widely adopted by the small-scale farmers, but the practice is still not popular among the large-scale estate in Nigeria despite the potential benefits of the practice.

Therefore, this paper seeks to demonstrate clearly, the financial benefits of intercropping immature rubber with cassava plantation in Nigeria.

2 Materials and Methods

The experiment was conducted at the Rubber Research Institute of Nigeria, Iyanomo near Benin City located in the rainforest region of Southern Nigeria. Annual rainfalls during the two seasons of the experiment were 2352mm and 2622mm. The area has a bimodal rainfall distribution. The temperature is high, with a mean of 29.0 – 32.1 °C and 25.7 – 31.4 °C in the first and second season respectively. Selected physicochemical properties of the soils before cropping shows that the pH of the area was 6.00 and 5.70 in H₂O and KCl respectively, the organic carbon was 13.7g kg⁻¹, Total N was 2.4 g kg⁻¹, available P was 4.77 mg P kg⁻¹. While the texture of the area was Loamy sand with a bulk density of 1.19g cm³⁻¹ and percentage moisture content of 12.2%. The experimental area was first opened for cropping about 50 years ago and has been under long periods of fallow, after two years of cropping. The last fallow before the start of the experiment lasted for five years after it had been cropped to maize, yam, cocoyam, plantain and bananas for three years. The plantation was planted with GT I rubber clone and divided into sole rubber and rubber + cassava intercropping systems. The experimental plots were arranged in a randomized complete block design, with three replicates. Each plots measured 92.12m² excluding 1.0m² border to give a total area of 0.304ha. The two rubber-based cropping systems were; Sole Rubber and Rubber + cassava. The cassava (*Manihot esculentus* Cranz cv 30572) were established in the inter-rows of rubber sapling at a spacing of 1.0 x 1.0 m, with at least 1.0 m away from the rubber saplings. Yield of the intercrops were determined at harvest. The samples of cassava harvested from each plot were oven dried to 12 percent moisture content at a temperature of 60°C. The economic implications of the intercropping systems were determined after the sales of cassava. The local prices of cassava at the time of harvest were used in the computation of

the economic viability of the farming systems. Rubber biomass was taken in place of latex yield because rubber trees had not reached tapping maturity.

The budgetary analysis technique emphasized the cost and returns to sole rubber and rubber + cassava production enterprise. The cost of establishing one hectare rubber plantation including all costs associated with land acquisition and farm implements form part of the fixed items. Depreciation on this equipment was calculated using the straight-line method with assumed salvage value of zero. The profit level and profitability ratios were calculated using gross margin and return to management [14].

The model specified in this study was as follows

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|---|-----------------------------------|
| 1. GM | = TR-TVC |
| 2. NI | = GM-TFC |
| 3. Profitability Index or Return on sale | =NI/TR |
| 4. The ratio of return on investment (%RRI) | =NI/TR X100 |
| 5. Rate of return on variable cost (%RRVC) | = $\frac{TR-TFC}{TVC} \times 100$ |
| 6. Operating Ratio | =TVC/TR |

Where

GM = Gross Margin

TR =Total Revenue

TVC =Total Variable Cost

NI =Net Income

PI =Profitability Index

TFC = Total Fixed Cost

TC = Total Cost

3 Results and discussion

3.1 Yield of rubber and cassava

The yield of rubber during the four years of the study was zero, because the rubber trees had not attained tappable maturity. However, the yields of cassava during the four years of the study are as presented in Table 2. The result showed that a mean yield of about 25.72 tonnes of cassava tuber were generated from the sole cassava treatments for the four years period while a mean yield of about 22.92 tonnes of cassava tuber were generated from the cassava + rubber intercrop treatments in the same period. The slight decrease in the yield of cassava in the rubber + cassava plots is attributed to competition between rubber and cassava. The competition is due to crop interactions in mixtures as the two crops have to struggle for the available below and above ground resources for their growth. This is consistent with the result of [5, 18, 1 and 17] they attributed the depression in growth and yields of crops in mixtures to competition for light, nutrients, and water.

Table 1. Agronomic Practice in Rubber + Cassava Intercropping System

Agronomic Parameters	Adopted Agronomic Options for Rubber + Cassava
Age of rubber at commencement of intercropping	At planting to the 4 th year
Cassava spacing	1.0 m x 1.0 m

Plant population per hectare	5000 plants
Quantity of planting materials	35 average sized bundles of 50 cassava stems
Variety	30555 and 30572
Time of planting	All the year round
Weed control	2 hand weeding at 4 weeks after planting and 8 weeks later; primextra, 3.0 kg/ha (ai) applied post emergence or Roundup at 1.5 kg/ha (ai) applied in the avenues before planting cassava.
Fertilizer application	126.4 kg/ha N; 28.2 kg/ha P ₂ O ₅ ; and 146.8 kg/ha K ₂ O applied in 2 split doses, at planting and 16 weeks after planting.
Expected yield	3.5 – 20 tonnes/ha

Table 2. Effect of Rubber Based intercropping on the yields of cassava

Treatments	Yield (Tonnes/ha)				
	Year 1	Year 2	Year 3	Year 4	Mean
Sole cassava	21.19	42.80	19.44	19.44	25.7175
Cassava + rubber	20.90	37.73	16.52	16.52	22.9175
LSD	NS	NS	NS	NS	

3.2 Costs and returns analysis

Table 3 shows the cost and returns to rubber and cassava production. The total revenue generated from the sales of cassava intercropped with immature rubber including the revenue accruable to the farmer from the sales of cassava stem during the four years period was N900, 000. A total of N25, 000.00 worth of cassava stem was needed for one hectare of farmland during a planting season. Therefore, 25,000 bundles of cassava stem multiplied by N300.00 (which is the lowest price of a bundle of cassava sticks) giving a profit of N75, 000.00. Hence, it can be concluded that farmers can make additional income from cassava stem. Indeed, a wise farmer will exploit all the money-making opportunities in cassava business and stop complaining of cassava glut in Nigeria. This was also reported by [9]. The total fixed and variable inputs costs amounted to N226, 457.7 to give a profit of N673, 090.98. This shows that intercropping cassava during the immature phase of rubber is profitable, this is consistent with the submission of [9, 6; Esekade, et al., 1996; 2, 15]. The result of the profitability index of 0.75 in rubber + cassava intercropped system signals viability as this indicated that 75% of the total amount invested in the farm was recovered in four years when the plantation in intercropped with rubber. This result is in line with submission of [2], who reported high economic benefit of intercropping rubber with arable crops during the immaturity period of rubber. The total variable cost per hectare of the rubber + cassava intercropped accounted for 51.13% of the total cost, while the total fixed cost accounted for 48.87%.

Table 3. Average Costs and Returns to the Rubber and Cassava production for a 4 years period at Iyanomo

Revenue (Naira)		
	Sole Rubber	Rubber + Cassava
Sales from Latex	0	0
Sales of Cup Lump	0	0
Sales from Tubers	0	700,000.00
Sales from Stems	0	200,000.00

Total Revenue (TR)	0	900,000.00
Variable Cost (Naira)		
Fertilizer	30,000.00	60,000.00
Rubber Maintenance 2 x weeding/year (20 M/days/ha/weeding @ N250/M/day)	40,000.00	0,00
Labour for Cassava Establishment	0.00	50,000.00
Intercrop Maintenance 2 x weeding/year (20 M/days/ha/weeding@ N250/M/day)	0.00	50,000.00
Total Variable Costs (TVC)	70,000.00	160,000.00
Fixed Costs (Naira)		
1 ha rubber plantation + cost of Land	65,514.29	65,514.29
Cutlasses	342.30	342.30
Rain Coats	456.40	456.40
Rain Boots	453.40	453.40
Files	142.63	142.63
Total Fixed Cost (TFC)	66,909.02	66,909.02
Total Cost (TC)	136,909.02	226,909.02
Total Revenue	0.00	900,000.00
Gross Margin (GM)	-70,000.00	740,000.00
Net Income (NI)	-136,909.02	673,090.98
Profitability Index		0.75
Rate of Return on Investment		74.79%
Rate of Return on Variable Cost		420.68
Operating Ratio		0.18

4 Conclusion

These results showed that intercropping rubber with cassava at immature phase of rubber trees is agronomically and economically more profitable compared with sole rubber plantation. Because intercropping rubber with cassava resulted in the production of food for farmers family, guarantees early return on investment and boost farmers livelihood compared with sole rubber systems. It is hereby recommended that rubber farmers especially smallholders be encouraged to intercrop their immature plantation with food crops especially cassava to ensure early return on investment and boost the livelihood.

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