

ECONOMIC ASPECTS OF PEASANT RUBBER PRODUCTION
IN MIDWESTERN NIGERIA

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ABSTRACT

ECONOMIC ASPECTS OF PEASANT RUBBER PRODUCTION IN MIDWESTERN NIGERIA

by Kurt R. Anschel

Production of rubber, the primary industry of Midwestern Nigeria, utilizes about 10 percent of the Region's land and labor resources. Smallholders who grow most of the rubber produced in Nigeria own an average of ten fragmented acres planted with unselected seedlings. Itinerant laborers whose main interest is maximizing their own short-run gains tap the rubber. The marketing system discourages production of high quality rubber by paying farmers a uniform price regardless of quality. The result is low volume production of the lowest quality rubber.

The rubber industry is now faced with a declining market for rubber. Because of competition with synthetics many experts predict a continued decline of rubber prices until the Malaysian price of high quality sheets is approximately 18 cents per pound, about 5 cents less than current prices.

The objectives of this study are: (1) to provide a description of the techniques of Nigerian rubber production, (2) to determine the relative profitability of the various organizations now extant, (3) to evaluate the impact of falling world market prices on the profitability of ordinary smallholdings as they are now organized, (4) to evaluate the profitability of farms planting high yielding trees under alternative price and cost assumptions and (5) to suggest methods for implementing change in the rubber industry.

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Surveys of 111 smallholders in 19 villages in six divisions of Mid-western Nigeria were conducted to determine technology, resources availability and farm organization. A subsample of 18 farms were surveyed to determine actual inputs and production of rubber. Budgets of these farms were then constructed assuming alternative rubber prices and factor costs. In addition, 30 smallholders who planted clonal seedlings purchased from the Ministry of Agriculture and Natural Resources were surveyed and budgets assuming alternative yields, costs and prices were then constructed. It was found that all existing organizations of rubber production at 1964 prices and costs provide only slightly more than a £2 per acre income to the farmer. The most profitable organization, the production of sheets processed in privately-owned factories and smokehouses, yields owners who hire tappers £3 to £5 per annum per acre, and the production of ordinary lump and low quality sheets provides incomes of £2/15/- and £3/14/- respectively. When rubber prices are decreased 20 percent and domestically produced input prices increased 20 percent, the incomes generated by private processing fall to £1 to £3 per acre and incomes from ordinary lump and R.S.S. VI production fall to £1/10/- and £1/12/- respectively. At 1964 prices and costs, smallholder rubber production provides approximately the same earnings as smallholder oil palm production, but if rubber prices fall 20 percent and costs increase 20 percent, palm production will be more profitable.

Production of rubber from trees purchased from the Ministry of Agriculture and Natural Resources yielding 800 pounds per acre provides and income of over £20 per acre currently and will provide £10 even if prices fall 20 percent and costs increase 20 percent. At 1964 prices

and costs, mature rubber yielding 800 pounds or more provides returns to the economy and owner equal to or greater than oil palms producing 9,000 pounds of bunches. But if rubber prices fall 20 percent and costs increase 20 percent, yields of 1,000 pounds of rubber must be achieved to exceed the returns from oil palm.

It is recommended to the Government of Midwestern Nigeria that its rubber planting program insure yields of 1,000 pounds by continuing farmer supervision and training after planting. Further, it is suggested that the Government undertake a thorough investigation of the alternative organizations of rubber processing so that when the high-yielding trees are tapped, the most effective organization can be utilized. Finally, in order to encourage production of higher quality lumps and sheets, it is recommended that the Government develop grades for lumps and initiate grading of all rubber produced in the Region.

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CHAPTER ONE

INTRODUCTION

Nigeria, like other newer nations, hopes to improve its economy by more fully utilizing its agricultural resources. At present, rubber ranks with the most important of these resources, with production accounting for approximately one percent of Nigeria's Gross Domestic Product, one percent of Federal Government revenues and, most significantly, seven percent of export sales. Although the industry has grown rapidly since 1936, future progress is jeopardized. Costly, primitive production methods and decreasing prices in the world markets may combine to undercut these economic contributions. Little can be done to temper the external threat; rather, production improvements must be found. This thesis will suggest several improvements and methods for implementing these improvements.

Four major areas will be considered: decreasing world market rubber prices, the techniques of Nigerian rubber production, the economy of rubber production and the before mentioned suggestions for improvement. Because most of the rubber is produced in Midwestern Nigeria, the discussion will pertain mainly to this region. Before proceeding to this main discussion, however, it is important to discuss in some detail the problem situation -- the importance of rubber to Nigeria's economy and the threats to the future of Nigeria's rubber industry -- to present in more detail the objectives and justification of this work and to briefly recount previous pertinent studies of rubber production in Nigeria.

The Problem Situation

Importance of the Rubber Industry to Nigeria

The rubber industry contributes significantly to Nigeria's foreign exchange earnings, tax revenues, income and employment. Since 1962, when it comprised seven percent of merchandise exports, rubber has been Nigeria's fifth most important export. Rubber exports have doubled since 1955, making rubber Nigeria fastest growing agricultural export. (See Table 1.)

Table 1: Monthly Average Value of Principal Nigerian Agricultural Exports, 1955-1962.¹

Year	All Exports	Rubber	Cocoa	Ground-nuts	Palm Kernels	Palm Oil
----- <u>Thousands</u> -----						
1955	£ 10,818	£ 465	£ 2,182	£ 1,928	£ 1,600	£ 1,096
1956	11,022	534	1,999	2,314	1,703	1,239
1957	10,348	585	2,170	1,678	1,497	1,150
1958	11,066	636	2,222	2,246	1,704	1,055
1959	13,375	967	3,191	2,293	2,160	1,146
1960	13,802	1,187	3,064	1,906	2,172	1,165
1961	14,172	919	2,812	2,686	1,657	1,102
1962	13,668	946	2,779	2,702	1,407	744

Source: Federation of Nigeria, Federal Office of Statistics, Digest of Statistics, Vol. XII, No. 4 (October 1963), p. 12.

¹Petroleum is fourth in importance.

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Moreover the rubber industry, taxed for £1,275,000 in 1963, an important source of Federal Government revenues.¹ These funds, collected by a ten percent ad valorem duty, constitute over ten percent of all export duties and about one percent of Federal Government revenues from all sources. In addition, the regions collect a farthing per pound sales tax.

Because no estimates are available, it is necessary to estimate the rubber industry's contribution to Nigerian gross domestic product. Gross domestic product is the sum of personal consumption, domestic investment, government purchases and net foreign balance. The rubber industry primarily affects net foreign balance. If ten percent of the value of rubber exports is deducted to offset imported capital equipment, profits transferred out of the country by foreign-owned firms and personal income exported by foreign nationals working in Nigeria, the industry's contribution is about £10,000,000. In 1963 gross domestic product was £1,125,000,000, hence, the rubber industry adds about one percent of the total G.D.P.²

Obviously the rubber industry provides substantial employment opportunities. But, because no published estimates exist, employment must be estimated by examining data available. The Industrial Directory 1964 categorizes 50 rubber processors, plantations and manufacturers according to number of employees: 50-99, 100-199, 200-499, 500-999,

¹Federation of Nigeria, Federal Office of Statistics, Digest of Statistics, XII, No. 4 (October 1963), p. 12

²"Report on the Nigerian Economy," Economic Development Institute, University of Nigeria, Enugu, March 18, 1964, p. 1. (Mimeographed.)

1,000-1,999, 2,000 and over.³ Assuming each firm hires the middle number of its category and those in the highest category hire 2,500 employees, about 14,000 are employed by the 50 firms.

Smallholders own 900,000 to 1,500,000 acres of rubber in holdings averaging ten acres; hence, there must be 90,000 to 150,000 smallholders in the Midwest. Assuming each tapper can tap three acres and they tap between 225,000 and 375,000 acres, then 75,000 to 125,000 workers must tap rubber. If another 5,000 to 15,000 workers help market, then 184,000 to 304,000 workers earn their incomes in the rubber industry. Table 2 summarizes the above computations. If 60 percent of the total population of Nigeria is of working age, then the rubber industry employs

Table 2: Employment in the Nigerian Rubber Industry, 1963-64.

Subsector	Employment	
	Low Estimate	High Estimate
Plantations, Processing and Manufacturing	14,000	14,000
Farming	90,000	150,000
Tapping	75,000	125,000
Marketing	5,000	15,000
Total	184,000	304,000

from five-tenths to nine-tenths of one percent of the working age

³Federation of Nigeria, Federal Ministry of Commerce and Industry, Industrial Directory 1964, Lagos, p. 16.

population.

Importance of the Rubber Industry to Midwestern Nigeria

With the exception of a few plantations and rubber manufacturing plants, Nigeria's entire rubber industry is located in the Midwest Region.⁴ Midwestern Nigeria exports annually rubber valued at approximately ₦9,000,000, over 80 percent of all Nigerian rubber exports, and approximately one half of the region's exports.⁵ In addition to providing the Regional Government with about ₦100,000 annually through a farthing per pound sales tax, the industry employs from 12 to 20 percent of the region's 1,500,000 residents of working age. Table 3 shows that between 178,000 and 298,000 people are employed in the Midwest's rubber industry.

Table 3: Estimate of Employment in the Rubber Industry of Midwestern Nigeria, 1963-64.

Subsector	Employment	
	Low Estimate	High Estimate
Plantations, Processing and Manufacturing	8,000	8,000
Farming	90,000	150,000
Tapping	75,000	125,000
Marketing	5,000	15,000
Total	178,000	298,000

⁴A region is analogous to a state in the United States.

⁵"Midwestern Nigeria," New York Times, January 20, 1964, p. 63.

The importance of the Midwest to the rubber industry is indicated in Table 4.

Table 4. Production of Rubber in Nigeria by Region, 1962-63.¹

Region	Production	Proportion of Total
	<u>Pounds</u>	<u>Percent</u>
Midwest	115,824,000	91
West	3,304,000	3
East	7,708,000	6
Total	126,836,000	100

Source: Mulder, unpublished paper prepared as background for the Nigerian representative to the International Rubber Study Group, May, 1964.

¹There are only a few rubber trees in Northern Nigeria.

Problems of Nigerian Rubber Production

The Nigerian rubber industry is dominated by peasant smallholders who own 95 percent of the rubber growing in the country.⁶ Of the country's 1962-63 exports of 127,000,000 pounds, peasant smallholders produced 86 percent.⁷ But this production is far below the country's potential. Low yielding planting materials, poor planting technique, infrequent maintenance and destructive tapping result in low production per acre, and poor marketing organization results in low quality

⁶A. Mulder, Unpublished paper prepared as background for the Nigerian representative to the International Rubber Study Group, May, 1964.

⁷Ibid.

of the rubber produced.

The smallholder usually plants unselected seedlings volunteering in mature farms. The 400 pounds per acre average yield of these unselected seedlings compares unfavorably with the 1,000 to 3,000 pounds average yield of selected seedlings.

Planting techniques delay and reduce production. Typically, after completing the sowing of food crops, the peasant goes to an old rubber farm, pulls two or three years old volunteer seedlings and transplants them to his food crop farms. To plant a seedling, a sharpened stick is pushed into the ground, the seedling is placed in the hole and the earth is pressed around it. To assure that a sufficient number of trees survive to maturity, 500 seedlings or more are planted to the acre. Because of the high density and crude method of planting, maturity is significantly delayed and yields are permanently reduced.

Poor maintenance further reduces yields. Maturity is delayed by allowing the trees to grow choked by weeds. Usually farmers weed their rubber once a year or less and allow weeds completely to cover the seedlings. Plantations tap five or six years after planting, but the typical smallholder seldom taps before the eighth year and usually not before the tenth.

Poor tapping is the most important cause of low productivity of peasant smallholding. Nigerian tappers have little conception of how to treat the tree to obtain the maximum lifetime output. Instead, they attempt to extract as much rubber from the trees as possible currently without concern for future productivity. They often tap a

tree in several places and usually cut too deeply, thus, ruining the tree's long term potential. Because of these practices, the life-time output of the trees is reduced to a half or a third.

Poor organization of marketing contributes to the low quality of the Nigerian product. Smallholders sell their rubber to middlemen, who in turn sell it to dealers who sell it to exporters for processing and packing. All sales except to exporters are by gross weight only, without deductions for moisture, dirt, sand or stones. Because sales are by weight, no attempt is made to grade the rubber. Therefore, smallholders are not motivated to incur expense to improve the quality of their products. On the contrary, because rubber adulterated with dirt, stones and sticks weighs more, most smallholders producing lumps purposefully adulterate them. Sheets cannot be seriously adulterated, but, without price motivation, the producer has no reason to produce a high quality sheet.

A. S. Cook of the Nigerian Federal Institute of Industrial Research estimates that Nigerian exports could be at least 100,000 tons, approximately 40,000 tons greater than 1963 exports given the land area planted to rubber.⁸ Moreover, 56 percent of current exports is low quality crepe. If yields and product quality are improved, the value of rubber exports would be increased by £8,000,000.

Declining Rubber Prices

The most significant problem facing the Nigerian rubber industry

⁸A. S. Cook, Rubber Production and Utilization in Nigeria, Technical Memorandum No. 16 (Lagos: Federal Ministry of Commerce and Industry, December 1962), p. 4.

is the declining world market price of rubber. Relatively cheap synthetic rubber is increasingly substituted for natural rubber. Since World War II, the physical characteristics of the synthetics have gradually improved so that today, they are almost perfect substitutes for natural rubber. Only one major use of rubber remains in which natural rubber is the superior ingredient, heavy duty tires.⁹

Most authorities now agree that the price of rubber will fall to between 15 and 20 cents (U.S.) per pound. L. C. Bateman, Director of Research for the Natural Rubber Producers Association, argues that the rubber industry must be prepared to sell its rubber at 18 cents.¹⁰

Some observers believe that the falling price of rubber may eliminate the Nigerian rubber industry. Because smallholders are high cost producers, they will not be able to compete. This is the rationale of the Rubber Improvement Campaign initiated by the Western Nigeria Ministry of Agriculture and Natural Resources in 1957. Introduction of the announcement of the campaign to the field staff states:

The future level of management of Nigerian rubber plantations and the handling and processing of the latex will need to conform to a very high standard because of the high-level of efficiency which is being attained both in the plantation and small holding industries in competing countries. The world market for rubber is at present an expanding one but in view of the large acreages now being planted in all the rubber producing countries of the world, it must be expected that in the not too distant future, there will be competition for markets and inefficient

⁹Tropical Products Institute, The Rubber Trade (London: Tropical Products Institute, January 1963), p. 11.

¹⁰Tropical Products Institute, loc. cit., p. 15.

producers will either have to drop out or be satisfied with lower return per unit of effort and hence a lower standard of living than their competitors.¹¹

The writer of the introduction perceived the danger of falling prices to Nigerian smallholders: elimination or lower incomes.

Objectives

This study is conducted in the context of a declining world market for rubber and inefficient use of existing resources in the Nigerian rubber industry. The Midwestern Nigeria Ministry of Agriculture and Natural Resources has recently redesigned its program to help the region's farmers to adjust to the changing market and to utilize their resources more effectively. To provide the continuing leadership that is so essential at this juncture in the development of the country and region, the Ministry will reappraise and redesign its programs as further experience is gained with them. The purpose of this study is to provide some of the information necessary for such a step.

Specifically the objectives are: (1) to provide a description of the techniques of peasant rubber production, (2) to determine the relative profitability of the various organizations now extant, (3) to evaluate the impact of falling world market prices on the profitability of peasant smallholdings as they are now organized, (4) to evaluate the profitability of farms planting high yielding trees under alternative price and cost assumptions and (5) to suggest methods for implementing change in the rubber producing industry.

¹¹Western Nigeria Ministry of Agriculture and Natural Resources, "Rubber Improvement Campaign," Benin Circle File No. 5806, Ogba Farm, Benin City, p. 1.

Justification

To determine policy and construct programs for the improvement of the rubber industry, it is necessary to know how the industry functions. Government planners must predict their program's impacts. But they cannot predict accurately unless they understand the economic, social and political structure of the industry. The fulfillment of objective (1) will, in part, satisfy the needs of the policy makers for understanding the industry.

Objective (2) provides for determining the profitability of the three most important productive organizations: lump production, sundried sheet production and cooperative processing. The purpose for doing so is two-fold. First, it is essential to know if a primary reason for the partial failure of the government's program to establish processing cooperatives is their relative unprofitability. The failure of many cooperatives has usually been blamed on causes other than the most obvious one, that farmers can make more money by producing lump or sundried sheet rather than high quality sheet. If the Ministry is to design effective policy, it must know the relative profitability of cooperative processing. Second, it is commonly thought that lump producers are being cheated by the processors, that the price they are being paid is inferior to the one they would receive producing sundried sheet. It is a hypothesis of this study that lump production is more profitable than low quality sheet production and that a program to force farmers to produce sheets rather than lumps will decrease farm incomes.

The Nigerian rubber industry's most critical problem is the impact of prospective lower prices. To determine whether the industry as it is presently organized can survive, the study investigates the profitability of the present productive organizations under low price and high cost assumptions.

The most commonly suggested solution to the problem caused by the declining market for rubber is the introduction of high-yielding trees. A major determinate of whether such a program will successfully solve the problem is the profitability of producing rubber with high-yielding trees.

Finally, methods for implementing changes in the industry are suggested based on the empirical results of the study.

Previous Research

Nine studies and reports of the Nigerian rubber industry exist of which eight are descriptive.¹² The descriptive reports are general

¹²The eight descriptive reports are: C. G. Ackhurst, Report to the Government of Nigeria on Natural Rubber Production, Etap Report No. 1526 (Rome: Food and Agricultural Organization of the United Nations, August 1962); Peter von Blanckenburg, "Rubber Farming in Benin Area," Nigerian Institute of Social and Economic Research, University of Ibadan, Ibadan, N.D. (Mimeographed.); C. W. Brookson, J. E. Morris, and Wong Mun Yun, Report on Rubber Research in the Federation of Nigeria and in the Cameroons (Kuala Lumpur: Rubber Research Institute of Malaya, August 1961); "Caoutchouc au Nigeria (Le)," Revue Generale de Caoutchouc, XXV (February 1958), pp. 138-43; A. S. Cook, Rubber Production and Utilisation in Nigeria, Technical Memorandum No. 16 (Lagos: Federal Ministry of Commerce and Industry, December 1962); E. O. Ojurongbe, "Rubber Rehabilitation and Tapping Technique," Ibadan, (December 1963), (Mimeographed.); H. A. Oluwasanmi, "Notes on Peasant Rubber Production in Nigeria," Ibadan, 1962 (Mimeographed.) and H. A. Oluwasanmi, "Rubber Production and Marketing in Nigeria: A Preliminary Survey," Ibadan, 1962 (Mimeographed.); The only empirical study of the industry is A. S. Cook and J. B. Downes, Preliminary Report on Rubber Production Costs in Nigeria (Lagos: Federal Ministry of Commerce and Industry, December 1962).

studies of the industry's structure, government programs and production and processing techniques. Very little detail is provided. Often the data that does exist come from untrustworthy sources and conflict with other existing information. The two most important works are by Brookson, Morris and Wong Mun Yun of the Rubber Research Institute of Malaya and by von Blanckenburg of UNESCO.

Brookson, Morris and Wong Mun Yun visited Nigeria in 1960 to evaluate the need for a rubber research station. Their report contains the most complete description of the industry available. Included is a general description and discussion of the technical problem of producing rubber. Peter von Blanckenburg conducted a socio-economic study of rubber farmers in three villages near Benin City. This study had the dual objectives of investigating the relationship between location and change and describing the rubber growing economy. His conclusions are (1) cultural values depreciate farming, (2) the tenure system encourages uneconomic planting of rubber, (3) the share tapping system causes waste of rubber, (4) the marketing system does not encourage high production and (5) there is a need to improve the extension service.¹³

The ninth study, by Cook and Downes, analyzes cost-profit relationships in the various subsectors of the industry. They collected data

¹³Peter von Blanckenburg, "Rubber Farming in Benin Area," Nigerian Institute for Social and Economic Research, University of Ibadan, Ibadan, N.D., pp. 36-39.

in February and March of 1960 from 15 dealers, exporters, government employees and plantation managers. The data are unreliable and because they are aggregated in large categories, unusable.

CHAPTER II

THE WORLD RUBBER MARKET

Current Trends

Production of Rubber

The most striking trend in the world rubber market is the increasing production and consumption of synthetic rubber. In 1939, natural rubber was virtually a unique material, but only six years later, synthetic rubber was produced in large quantities. As shown in Table 5, this production increased steadily through the 1950's and early 1960's; production in non-communist countries increased from 25,000 tons in 1939, to 908,000 tons in 1953 to 2,425,000 tons in 1963.

Table 5: Production of Synthetic and Natural Rubber, Non-Communist Nations and U.S.A., 1939, 1951 and 1963.

Year	Natural	Synthetic in U.S.A.	All Synthetic
	----- Thousand Tons -----		
1939	1,005	.3	25
1951	1,885	845.2	908
1963	2,050	1,608.0	2,425

Source: Commodity Research Bureau, Inc., Commodity Year Book 1941 (New York: Commodity Research Bureau, Inc., 1941), p. 465. Commodity Research Bureau, Inc., Commodity Year Book 1950 (New York: Commodity Research Bureau, Inc., 1950), p. 236. Commodity Research Bureau, Inc., Commodity Year Book 1964 (New York: Commodity Research Bureau, Inc., 1964), p. 276. Enrico Ferraris, "SBR," Materie Plastiche Ed Elastomeri, XXIX (1963), p. 1012.

Although natural rubber production also increased during this period, it was surpassed by the increase of synthetic rubber production. Between 1939 and 1963, natural rubber production increased 104 percent while synthetic rubber production increased nearly one hundred fold. More significant, because of the comparison between two already established industries, are the 1951 to 1963 rates of growth: only 9 percent for natural rubber compared with 169 percent for synthetic rubber. By 1963, 54 percent of all rubber produced was synthetic, compared with 33 percent in 1951 and 7 percent in 1939.

United States Production and Consumption

Nowhere was this increase more striking than in the United States, the world's largest consumer of rubber and producer of synthetic rubber.¹ From negligible amounts prior to World War II, U. S. production of synthetic reached 845,200 tons in 1951. About 93 percent of all synthetic rubber produced in the non-communist nations in 1951 was produced in the U. S. From 1951 to 1963, U. S. production of synthetic rubber grew 190 percent to 1,608,000 tons. During this same period, the proportion of natural rubber in total U. S. rubber consumption fell from 38 percent to 26 percent.² In 1963, the rest of the world consumed 63 percent natural rubber. Many experts believe that the U. S. pattern will become

¹Kurt Maier, "Die Synthesekautschuk - Kapazitäten der Welt," Kautschuk und Gummi Kunststoffe, XVII (May 1964), pp. 287-290.

²Commodity Research Bureau, Inc., Commodity Year Book 1964 (New York: Commodity Research Bureau, Inc., 1964), p. 277.

world wide.

Rubber Prices

Despite the tremendous increase in the production of rubber, the prices in the 1950's were higher than in any decade since the 1920's. (See Table 6.)

Table 6: Unweighted Average of Annual Prices of R.S.S. No. 1 on the New York Market by Decade, 1900-1963.

Decade	Average Price per Pound
	<u>U.S. Cents</u>
1900-09	109.8
1910-19	93.6
1920-29	32.75
1930-39	12.09
1940-49	21.45 (19.92) ¹
1950-59	28.73 ²
1960-63	30.73

Computed from: Commodity Research Bureau, Inc., Commodity Year Book 1940 (New York: Commodity Research Bureau, Inc., 1940), p. 472. Charles F. Phillips, Jr., Competition in the Synthetic Rubber Industry (Chapel Hill: The University of North Carolina Press, 1961), p. 258. Commodity Research Bureau, Inc., Commodity Year Book 1964 (New York: Commodity Research Bureau, Inc., 1964), p. 279.

¹ Average omitting 1941-46 when price was fixed by the government at 22.50 cents.

² Omits 1951 when all sales were to the U.S. Government after March 31.

These higher prices resulted from a .60 percent increase in

consumption during the decade.³ Since the combined production of natural and synthetic rubber did not exceed this higher consumption, prices were high. But synthetics absorbed most of the demand increases, thus, preventing further price rises for natural rubber.

Since mid-1960 the price of natural rubber has steadily declined, the first period in history of falling rubber prices during an industrial expansion. The average spot price in New York was 38.5 cents in 1960 and 26.3 cents in 1963.⁴ Because price continues to fall while industrial output increases, it appears that the demand for natural rubber is not increasing as rapidly as it did during the 1950's.

The Supply of Natural Rubber

The Supply Function

The supply function of natural rubber on the world market is summarized by the equation:

$$S_n = f(P_N, M_A, M_P, M_C, O, P_F, W, I, \dots) \quad (1)$$

where S_n = quantity of natural rubber, P_N = price of natural rubber, M_A = mature acreage of natural rubber, M_P = age composition of the mature acreage, M_C = clonal composition of the mature acreage, O =

³Commodity Research Bureau, Inc., Commodity Year Book 1963 (New York: Commodity Research Bureau, Inc., 1963), p. 274

⁴Commodity Research Bureau, Inc., Commodity Year Book 1964, op. cit., p. 279.

price of products using the same factors, P_F = price of factors in rubber production, W = weather and I = stock of rubber.⁵ Because acreage, age and clonal composition of mature rubber are not subject to rapid change, the supply of rubber is very inelastic. A resource is fixed when the marginal value product of that resource is less than the cost of acquiring another unit and greater than the amount received by selling a unit.⁶

Prices of Rubber and Factors of Production

At any given time, the stock of living trees is fixed; trees are both difficult to acquire and unprofitable to sell in any market except rubber. It takes five to seven years to grow a tappable rubber tree; as far as the total rubber industry is concerned, rubber trees cannot be acquired in any other way, or within a shorter time. Firewood is the next best use for the rubber trees. The price of rubber must fall considerably before the marginal value product of a tree is below its salvage value as firewood.

⁵The classical work on the economy of the rubber industry is P. T. Bauer, The Rubber Industry (London: The London School of Economics and Political Science, 1948). The best available recent discussion of the rubber economy is Clifton R. Wharton, Jr., "Rubber Supply Conditions: Some Policy Implications," The Political Economy of Independent Malaya, ed. T. H. Silcock and E. K. Fisk, (Canberra: The Australian National University, 1963), pp. 121-162.

⁶This study utilizes Glenn L. Johnson's "fixed asset theory" to explain changes in resource use.

But the fixity of trees does not imply that all other inputs are fixed. Land and trees clearly are nearly perfect complements, but labor and processing facilities are less than perfect complements of land or trees. It would be very unusual for insufficient processing facilities to limit increases in production because capacity can be increased in a few months. Also, plantations have sufficient unused processing capacity to accommodate any increases in production. On the other hand, capacity cannot be reduced easily because processing facilities are primarily buildings and equipment which can only be sold as scrap. The price of rubber would have to fall to very low levels before the marginal value product of processing facilities would be less than scrap value.

The extent of labor use could vary when the price of rubber changes. The acquisition cost and salvage value of labor are nearly equal, because it costs little to expand or decrease the labor force in the rubber industry. Labor use could be altered by changing the frequency of tapping, periodicity of tapping or the length and number of tapping cuts. Empirical supply response studies indicate that plantations do not alter resource use when prices change, but that smallholders do. Wharton, utilizing estimates computed by Chan, states that while the price elasticity of supply from plantations does not differ significantly from zero, the price elasticity of supply from smallholders varies between +0.13 and +0.37, differing significantly from zero.⁷ Plantations do not alter tapping procedures in response to price changes; they only increase

⁷Wharton, op. cit., pp. 145-146.

or decrease rates of planting. Although the smallholders' supply response is also rather inelastic, they do alter the intensity of resource utilization in response to price changes. When prices change, smallholders adjust the intensity of tapping by altering the number of trees in tapping and the length of time each tree is tapped.

Stock

The supply of natural rubber is also a function of the stocks of rubber held in the producing countries by producers, traders and processors. The volume of stocks depends on the frequency of sales; when prices are high, the stocks are depleted. And in succeeding periods, sales will be lower because of smaller stocks. When prices are low, larger stocks are maintained in hopes of a price increase. Because rubber deteriorates with time, sales must be increased above normal levels after any period of holding. Horowitz tests the importance of stocks in determining supply by fitting a supply function in which the exogeneous variables are the prices in the last two quarters. He finds an insignificant coefficient for the last quarter, but a significant and negative coefficient for price during the quarter before the last.⁸ Horowitz also finds that the supply in the New York market is significantly price inelastic (+0.46).⁹ In view of the much lower producers' price response reported by Wharton, fluctuation probably results from behavior in the market involving variations of stocks.

⁸Ira Horowitz, "An Econometric Analysis of Supply and Demand in the Synthetic Rubber Industry," International Economic Review, IV (September 1963), p. 333.

⁹Ibid., p. 334.

Price Fluctuations

Because the supply of natural rubber is price inelastic, prices formerly fluctuated wildly when demand shifted. (Table 7 shows the high and low spot price on the New York market experienced each decade since 1920.) The advent of synthetic rubber dampened price fluctuations.

Table 7: High and Low Spot Price for R.S.S. I and High and Low Annual Average Spot Price for R.S.S. I on the New York Market During Each Decade Since 1920.

Decade	Price	<u>Daily</u>	Year	<u>Annual Average</u>	Year
		Price per Pound		Price per Pound	
		Cents (U.S.) per pound		Cents (U. S.) per pound	
1920	High	121	1925	72.46	1925
	Low	11 1/2	1921	16.36	1921
1930	High	26 7/8	1937	19.39	1937
	Low	2 1/2	1932	3.49	1932
1940 ¹	High	25	1947-48	22.50	1943-46
	Low	15 7/8	1949	17.57	1949
1950 ²	High	86	1950	41.10	1950
	Low	18	1950	23.61	1954
1960 ³	High	46	1960	38.50	1960
	Low	23	1963	26.30	1963

Source: Charles F. Phillips, Jr., Competition in the Synthetic Rubber Industry (Chapel Hill: The University of North Carolina Press, 1961), p. 258.

¹The U. S. Government fixed the price at 22.5 cents on August 6, 1941. Free trading resumed May 1, 1947.

²Free trading suspended from March 31, 1951 to July 1, 1952. Government price ranged from 52-66 cents.

³1960 to 1963 only.

During the 1920's, the highest recorded price differed 110 cents from the lowest recorded price. Excluding the high prices of the Korean War period, the difference between the highest and lowest prices of the 1950's was 34 cents. For several reasons, the price now fluctuates less. Most important is the response of synthetic rubber producers to changes in demand. When demand increases, the synthetic producers expand output, absorbing the increased demand in greater sales rather than higher prices. Because the synthetic industry is oligopolistic, individual producers find it difficult to revise their prices. During May, 1956, Goodrich-Gulf increased its price of Styrene-Butadiene Rubber (SBR), but was forced to retract the increase when the other firms maintained the former price.¹⁰ When one company decreases its price, the others follow, so that no firm can win customers from its competitors through price reductions. Lowering the price only moves the whole industry downward on its demand function. Since World War II, the quoted price of SBR has changed only three times; it has been 23 cents since the early 1950's.¹¹

Mature Acreage

Three variables have been assumed fixed in the above discussion, M_A , M_p , and M_C . These variables are fixed in periods of less than five to seven years, the time it takes to grow a mature tree. To simplify

¹⁰Charles F. Phillips, Jr., Competition in the Synthetic Rubber Industry (Chapel Hill: The University of North Carolina Press, 1961), p. 182.

¹¹Ibid.

the following discussion of the fixed variables, it will be assumed that all variables other than the one under discussion are constant.

Table 8: Estimated Acreage of Rubber in the World for Selected Years.

	1937-39 Average	1960	1962
	<u>Thousand acres</u>		
Malaysia	3,332	3,500	4,572
Indonesia	4,687	4,453	4,469
Thailand	339	1,004	1,400
Ceylon	608	669	674
Viet Nam	319 ¹	178	260
Nigeria	---	---	288 ²
Congo (Leopoldville)	21	230	---
Cambodia	319	93	123
Other	674	1,173	---
Total	9,980	11,300	11,786

Sources: Commonwealth Economic Committee, Plantation Crops (London: The Commonwealth Economic Committee, 1963), p. 149; International Rubber Study Group, Prospects for Rubber and a Programme for Action: International Commodity Problems (Geneva: United Nations Conference on Trade and Development, 1964), p. 9.

¹Includes all of the former French Indo-China.

²No estimate included.

Mature acreage (M_A) is the most important determinant of long run production. At any given time the acreage planted more than five to seven years ago will be the current mature acreage. The amount of acreage planted is primarily a function of three variables: rubber prices, prices of products competing for the same resources and acreage available for planting. Unfortunately, acreage statistics are poor

throughout the world. Usually plantation acreage is known, but information about smallholdings is unreliable. As can be seen in Table 8, the International Rubber Study Group estimates that there were 11,786,000 acres of rubber in the world in 1962. The Commonwealth Economic Committee estimates that in 1960 there were 11,300,000 acres in the principal producing countries. The best available evidence indicates that the area under rubber has increased only slightly in the last 30 years. The estimated 1937-39 average acreage is 9,980,000 acres, only 800,000 acres less than the estimated acreage in 1962. Acreage is expected to be stable in the near future.

Age Composition

Changes in the age of mature acreage (Mp) can significantly alter output. When a tree is first tapped, its yield is only about 1/4 of maximum. Output per tree reaches a peak in the sixth or seventh year after tapping begins and stays at that level until the eleventh or twelfth year, when renewed bark is first tapped. Not much is known about the age composition of the world population of rubber trees, but Cyriax estimates that about 40 percent of all trees are over 30 years old.¹² Because of low prices, World War II and pessimistic market projections, little planting took place between 1930 and 1950. Since 1950, replanting with high-yielding clones has been extensive. About 725,000 acres were replanted in Malaysia during the 1950's.¹³

¹²George Cyriax, "The Next Steps for Rubber," Rubber World, CL (June 1964), p. 42.

¹³Ooi Jin-Bee, "The Rubber Industry of the Federation of Malaya," The Journal of Tropical Geography, XV (1961), p. 63.

Replanting has continued at a rapid rate in the 1960's. During the last few years, the other major producing countries have also initiated replanting programs. As the new trees become mature, the average age of the mature acreage will fall significantly, resulting in increased output.

Clonal Composition

Clonal composition (M_C) determines the potential yield per acre of currently mature acreage. Unselected seedlings yield between 200 and 500 pounds per acre.¹⁴ Pre-war high yielding materials produce 450 pounds per acre the first year of tapping, reach 1,200 pounds in the seventh year and slowly decline to 1,000 pounds after the tenth year.¹⁵ Modern materials yield about 500 pounds the first year, 1,500 pounds the seventh and then slowly decline.¹⁶ Because of replanting, the clonal composition of Far Eastern rubber is changing rapidly. In 1950, Malaysian holdings contained 1,300,000 acres of old seedling materials and about 400,000 acres of pre-war high yielding materials.¹⁷ By 1959, only about 800,000 acres of old seedling materials remained.¹⁸ In 1970, Malaysia will contain 200,000 acres of unselected seedlings, 200,000 acres of pre-war high yielding materials and 1,200,000 acres of post-war materials.¹⁹ Although Malaysia has replanted the most, other countries have also initiated programs.

¹⁴ "Editorial: Malayan Rubber Production 1960-1970," Planters Bulletin of the Rubber Research Institute of Malaya, LIII (March 1961), p. 44.

¹⁵ Ibid., p. 45.

¹⁶ Ibid.

¹⁷ Ibid., p. 44

¹⁸ Ibid.

¹⁹ Ibid.

Table 9 contains estimates of future production increases resulting from changes in the age and composition of mature acreage. If these increases actually occur, they will be the largest since World War II. George Cyriax projects a 2.5 percent increase per annum from 1963 to 1967 compared to an average annual increase of 0.75 percent from 1951 to 1963. The International Rubber Study Group projects production of 2,865,000 tons in 1969, a phenomenal 33 percent increase over the 1963 level. Compared to other sources, You's prediction seems conservative.

Table 9: Projections of World Production of Natural Rubber, 1966, 1967, 1969, 1980.

Year	Production	Source of Estimate
	<u>Thousand Tons</u>	
1966	2,350	Cyriax
1967	2,400	Cyriax
1969	2,725	IRSG
1980	2,865	You

Sources: George Cyriax, "The Next Steps for Rubber," Rubber World, CL (June 1964), p. 40. "International Rubber Study Group," Rubber World, CL (July 1964), p. 62. Man He You, "A Study of the Natural Rubber Industry with Special Emphasis on its Future Prospects" (Unpublished Ph.D. dissertation, Dept. of Economics, University of Oregon, 1963), p. 150.

The Demand Function

The demand for natural rubber (D_N) is a function of income (Y), price of substitutes (P_S), preferences and technologies employed by rubber manufacturers (T) and the price of natural rubber (P_N). This relationship may be written:

$$D = h(Y, P_S, T, P_N \dots) \quad (2)$$

Income

The demand for raw rubber is a derived demand, derived from the demand for consumer products containing rubber. The demand for these products is, in turn, related to the income of the final consumer. As income increases, consumption increases. The level of income does not, however, determine the distribution of demand between natural and synthetic rubber, but determines some aggregate demand for both. The other variables in equation (2) influence the distribution of demand between synthetic and natural rubber.

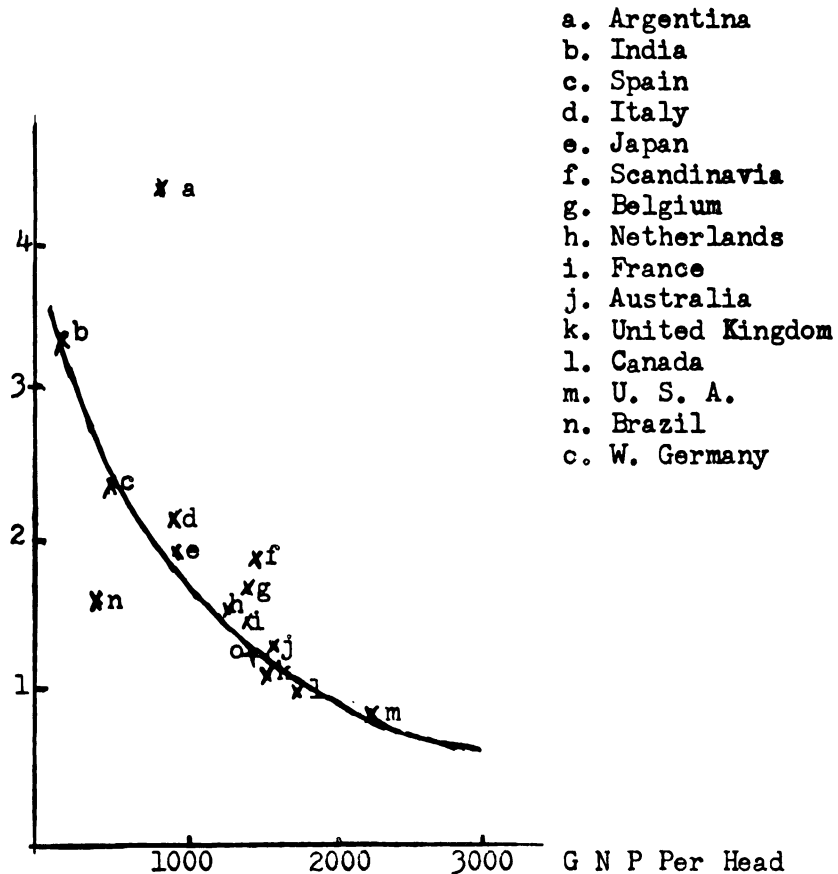
The income elasticity of demand for rubber is high. Allen finds that the income elasticity varies from just under 1.0 in the U.S.A. to over 4.0 in Argentina.²⁰ As might be expected, income elasticity varies inversely with income. Figure 1 summarizes Allen's findings. The correlation coefficient between gross domestic product and consumption of rubber also measures the relationship between income and demand for rubber. Nehmer estimates that between 1947 and 1957, the correlation coefficient was 0.96 for Western Europe and 0.71 for the United Kingdom.²¹ He finds that the coefficient varied between 0.66 and 0.86 in the United States during four different time periods in this century.²² The correlation coefficient between rubber consumption and an

²⁰P.W. Allen, "Rubber in 1970," Rubber Journal, CXLVI (August 1964), p. 30.

²¹Wharton, op. cit., p. 136.

²²Ibid.

Figure 1: The Income Elasticity of Demand for Rubber as a Function of Income, Selected Countries, 1952-1962.



Source: P. W. Allen, "Rubber in 1970," Rubber Journal, CXLVI (August 1964), p. 30.

index of industrial production is even higher. Nehmer finds that the coefficient varied between 0.82 and 0.98 except during the

depression years when it was 0.28.²³ Man He You reports a correlation of 0.98 between consumption of rubber and an index of industrial production in both the U.S. and in Western Europe.²⁴

Projections of demand for rubber based on changes of income are unreliable because it is very difficult to forecast changes in the growth rate. Wars, depressions and recessions significantly alter income levels and are unpredictable. Several projections of demand are summarized in Table 10. Cyriax, Allen and You estimate an average

Table 10: Projections of Consumption of Rubber in the Non-Communist Nations, 1965-67, 1969-70, 1980.

Year	Consumption	Source of Projections
	<u>Thousand Tons</u>	
1965	4,870	Cyriax
1966	5,000	Cyriax
1967	5,100	Cyriax
1969	5,850	IRSG
1970	5,450	Allen
1980	6,999	You

Sources: George Cyriax, "The Next Steps for Rubber," Rubber World, CL (June 1964), p. 40. "International Rubber Study Group," Rubber World, CL (July 1964), p. 62. P.W. Allen, Rubber Journal, CXLVI (1964), p. 32. Man He You, "A Study of the Natural Rubber Industry with Special Emphasis on its Future Prospect," (Unpublished Ph.D. dissertation, Dept. of Economics, University of Oregon, 1963), p. 75.

²³Ibid.

²⁴You Man He, "A Study of the Natural Rubber Industry with Special Emphasis in its Future Prospects," (Unpublished Ph.D. dissertation, Dept. of Economics, University of Oregon, 1963), p. 73.

increase of about three percent per annum and the International Rubber Study Group estimates an increase of about five percent per annum.

Price of Synthetics

The price of synthetic rubber partially determines the distribution of demand between synthetic and natural rubber. Assuming a fixed quantity of natural rubber, a change in the price of synthetic rubber will alter the price of natural rubber. If the price of synthetic rubber falls, the demand for natural rubber also falls; if the price of synthetic rubber increases, the demand for natural rubber rises.

The cost of producing synthetic rubber and the degree of competition in the industry primarily determine the price of synthetic rubber. Assuming some freedom of entry, reductions in cost will be translated into lower prices. The continuous entry of new firms into the industry provides ample evidence of relatively free entry. Cheaper inputs or changes in technology reduce costs. Phillips states that the cost of inputs fell in the late 1950's.²⁵ Technological improvements in production techniques also resulted in lower costs. The continuous SER plant introduced in 1957 exemplifies such an innovation.²⁶

²⁵Charles F. Phillips, Jr., "Market Performance in the Synthetic Rubber Industry," Journal of Industrial Economics, IX (April 1961), p. 137.

²⁶Charles F. Phillips, Jr., "The Competitive Potential of Synthetic Rubber," Land Economics, XXXVI (November 1960), p. 327.

This improvement allowed production at a ton per man rate equal to that of a plant four or five times as large. As this innovation and other similar ones are adopted by the industry, costs per unit fall.

Synthetic Rubber Capacity

The expanding market for synthetic rubber has made investment in production facilities very attractive. As recently as 1955, production facilities in the non-communist nations were concentrated in three countries, the United States, Canada and West Germany. But by only nine years later, plants were operating or under construction in 20 countries: Western Germany, France, Italy, Netherlands, Belgium, Great Britain, Spain, India, Canada, Australia, the United States of American, Argentina, Brazil, Mexico, Venezuela, Israel, the United Arab Republic (Egypt), South Africa and Japan.²⁷ From 1955 to 1959, following denationalization of the U.S. synthetic rubber industry, U.S. production capacity increased 74 percent, from 1.06 to 1.84 million tons while world capacity increased 111 percent from 1.16 to 2.45 million tons. (See Table 11.) U. S. capacity increased only slightly from 1959 to 1964, but world capacity increased another 15 percent, to 2.83 million tons. Much of the increase has occurred in countries which cannot utilize the full productive capacity of the facilities. In most cases, producers attempt to export supplies which exceed domestic demand. The result has been a burgeoning productive capacity in excess of demand at current prices. Table 12

²⁷Maier, op. cit.

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Table 11: Synthetic Rubber Capacity, Production and Utilization,
Non-Communist Nations 1955, 1959, 1962, 1963.

Year	Capacity				Production	Utilization of Capacity
	United States	Canada	Western Europe	All Non-Communist Countries	All Non-Communist Countries	All Non-Communist Countries
	<u>Million Tons</u>					<u>Percent</u>
1955	1.06	0.10	---	1.16	1.09	94
1959	1.74	0.14	0.34	2.35	1.63	73
1962	1.85	0.16	0.16	2.52	2.24	89
1963	1.85	0.20	0.59	2.83	2.43	86

Sources: Charles F. Phillips, Competition in the Synthetic Rubber Industry (Chapel Hill: The University of North Carolina Press, 1961), pp. 63, 64, 69, 70. Charles F. Phillips, Competitive Potential of Synthetic Rubber, Land Economics XXXVI (November 1960), pp. 323-326. George Cyriax, "The Next Steps for Rubber," Rubber World, CL (June 1964), p. 41.

Table 12. Projections of Synthetic Rubber Capacity in Non-Communist Nations.

Year	Capacity	Source of Prediction
	<u>Million Tons</u>	
1964	3.10	Cyriax
1965	3.46	Cyriax
1969	3.85	IRSG

Sources: George Cyriax, "The Next Steps for Rubber," Rubber World, CL (June 1964), p. 40. "The International Rubber Study Group," Rubber World, CL (July 1964), p. 62.

contains several estimates of future capacity. When capacity exceeds demand, prices will fall because each producer tries to maintain the level of his output.

During the last few years, the fraction of productive capacity actually utilized has fallen slightly. In 1955, the industry operated at 94 percent of capacity, in 1963 at 86 percent of capacity. During the same period, costs fell significantly, and prices fell as a result. Although basic price quotations have remained unchanged for most synthetic rubbers, quantity discounts increased, reducing the real price. If costs are lowered more in the future and capacity continues to outstrip demand at current prices, the price of synthetic rubber will continue to fall.

Rubber Manufacturers' Technology and Preferences

The last variable of equation (2) to be discussed is T, technology and preferences of the rubber manufacturers. Synthetic rubber has several advantages over natural rubber which are not likely to be overcome. Among them are stable prices, uniform quality, integration of producer and user and proximity to the buyer. The price of synthetic rubber is very stable because the industry is oligopolistic, making it difficult for the individual producer to change his price. Synthetic rubber is graded according to technical specification, whereas natural rubber grades are based on visual properties. Because trees rather than machines produce natural rubber, the natural rubber producer cannot fully control the exact composition of the product. Vertically integrated firms produce a large share of synthetic rubber; they would not shift to natural rubber unless its price fell to the variable cost of producing synthetic. In 1958, 56.7 percent of all SBR sales were between associated firms.²⁸ Phillips

²⁸Ibid., p. 324

estimates that the variable cost of SBR in 1955 was 17.75 cents.²⁹

Finally, the manufacturer who uses synthetic rubber lessens the possibility of interruptions in the supply of his input. Natural rubber is produced far from its points of consumption and distance increases the danger of interruptions in delivery because of international crises, strikes, wars, etc.

Shifts in the demand for natural rubber have resulted from changes in technology and manufacturers' preferences. Most importantly the quality of the new synthetics has improved remarkably. When SBR was first introduced, it was so inferior to natural rubber that it could only be used as an extender. Today SBR is superior to natural rubber in wear, cracking and aging resistance, and is inferior in only one major property, heat build-up.³⁰

The last decade has seen the advent of new synthetics which are far superior to any of the older ones. Tires made from stereo rubbers, polyisoprene and polybutadiene (introduced in the late 1950's), are equal to tires of natural rubber in all but one property, chip resistance. In 1964, Goodrich announced development of a new synthetic rubber which is superior to natural rubber in all properties.³¹ If it proves possible to produce this rubber commercially, the demand for natural rubber may be significantly diminished. In time, synthetic rubbers which surpass the

²⁹Charles F. Phillips, Jr., "Market Performance....," op. cit., p. 136.

³⁰F. W. Hibbert, "A Review of the World Trade in Rubber." Tropical Science, V (1963), p. 110.

³¹"Synthetic Tire Material Developed by Goodyear," New York Times, April 30, 1964, p. 55.

quality of natural rubber will probably be developed.

In order to meet the competition, the natural rubber industry has been trying to improve natural rubber.³² In order to make the product more uniform and reduce costs new methods of processing have been developed. New formulas have been invented for compounding rubber. Producers are using new grading techniques which reflect the technical requirements of the buyers of raw rubber. All these improvements have been designed to increase the demand for natural rubber.

The Future Market for Natural Rubber

Any discussion of the future in rubber must consider both the short term and long term. The short term is the period during which the preferences of rubber buyers and users, and the technology of production, remain unchanged. Long-term considerations must include preferences and technology. For obvious reasons, most writers have been content to deal with the short-term.

Those who do speculate on the long-term generally agree that the price of rubber will continue to fall during the next few years, and that it will eventually stabilize near 20 cents per pound (R.S.S. I on the New York Market). The prediction that price will fall is based on estimates of natural rubber production and synthetic rubber capacity during the next few years. The International Rubber Study Group's projection of demand for rubber in 1969 is 5,850,000 tons, but their

³²Iain MacNaughton, "Natural Rubber Faces the Challenge," Rubber Plastics Age, XLIII (1962), pp. 447-448.

projection of natural rubber production plus synthetic rubber capacity is 6,575,000 tons.³³ Even if all natural rubber clears the market and no excess synthetic rubber is produced, the synthetic rubber industry will operate at 81 percent of capacity. Cyriax is even less optimistic. Combining natural rubber supply with synthetic rubber capacity, he predicts an excess of 940,000 tons in 1965.³⁴ On the other hand, the International Rubber Study Group believes the excess will be only 725,000 tons in 1969. Regardless of the projection one prefers, it is clear that downward pressures on rubber prices will be felt during the next few years.

One thing which is uncertain is the level of the new equilibrium price. The figure most commonly mentioned is 18 cents (U.S.) in Malaysia. Apparently the Blackman Advisory Committee in 1957 was the first to suggest this level. "...the industry should have as its future aim the profitable production of good quality natural rubber at not more than 60 [19.6 cents U.S.] and possibly 55 [18 cents U.S.] Malayan cents a pound (f.o.b.)."³⁵ Leslie C. Bateman, a spokesman for the Malaysian natural rubber industry, suggested the same figure to the 1962 Symposium on the Future of Natural Rubber.³⁶ The suggested

³³"International Rubber Study Group," Rubber World, CL (July 1964), p. 62.

³⁴Cyriax, op. cit., p. 40.

³⁵Charles Gamba, Synthetic Rubber and Malaya (Singapore: Donald Moore for Eastern Universities Press Ltd., 1959), p. 36.

³⁶Hibbert, op. cit., p. 112.

natural rubber price is probably based on estimates of the minimum costs of SER and polyisoprene. Since production costs are lower than 18 cents on estates utilizing high-yielding clones, rubber production will be profitable as long as this price prevails.

Two commentators on the long-term market for natural rubber are not encouraging. T. R. McHale says:

Over time, therefore, the competitive position of natural rubber and its synthetic counterparts will depend to a large extent on the movement of key factor costs unique to each rather than common to both. It is unlikely at this stage of agronomic and technological development, and at this stage of sunk costs, that either natural or synthetic will gain complete dominance over the other. At the same time, it is also unlikely that the world's natural rubber industry will remain unscathed by the emergence of a new area of competition, and its future is probably less promising now than at any time in its history.³⁷

Horowitz is even less optimistic. Utilizing quantitative techniques, he analyzed the causes of the shift to synthetic rubber by American rubber product manufacturers. In his concluding paragraph Horowitz says:

Even though natural rubber prices might stabilize and decline, rubber manufacturers will continue to turn to synthetic rubber. The stability that it offers together with the prospect that eventually it may surpass the natural product in the technical qualities that it offers means that competition on a price basis alone may not be sufficient to prevent decreases in demand in the American market for natural rubber. Stabilizing and reducing price may help, but the uncertainty surrounding the international political

³⁷T. R. McHale, "The competition Between Synthetic and Natural Rubber," Malayan Economic Review, VI (April 1961), pp. 30-31.

situation would seem to mean that the swing towards synthetic rubber is not a current phenomenon, but a long-run swing of great economic importance both here and abroad which is not likely to be reversed.³⁸

Implications for the Nigerian Rubber Industry

Obviously, the future of the world rubber market cannot be predicted with absolute precision. Still, an informed guess can be made on the basis of observable facts, such as the cost of synthetic rubbers, approximately 18 cents. The Nigerian prices would have to fall 22 percent in order to meet the projected price, that is, decrease 5 pence per pound, from 20 to 15 pence.

If the actual producers of rubber (plantations and smallholders) absorb the 5 pence decline, the producer price of R.S.S. I will fall from the 1964 price of 14 pence to 9 pence. Five pence would be a decline of 22 percent for the exporter, but for the producer this is a 36 percent drop. If the same price differential is maintained between grades, the producer price of sun-dried sheet would fall about 42 percent (from the 1964 price). Assuming that lump contains 30 percent dry rubber, a 5 percent decline in the price of dry rubber would convert to a 50 percent decline in lump prices. Alternatively, the full price decline may not be passed on to the producer, but shared equally by all handlers of the rubber, including the producer. In this case, the price of R.S.S. I would decline 22 percent.

The F.A.O., to predict the income from Nigerian rubber production, utilizes two alternative f.o.b. prices of rubber, 18 and 15 pence

³⁸Horowitz, op. cit., p. 345.

(10 and 25 percent reductions from the 1964 price).³⁹ In addition, the F. A. O. assumes two producer prices for R.S.S. I, 12 and 10 pence.⁴⁰

This study assumes a more conservative decline, 10 percent and 20 percent less than 1964 prices. The three alternative prices of R.S.S. VI sheets budgeted are 10.75, 9.675 and 8.6 pence. The 1964 price of R.S.S. I is assumed to be 13.88 pence; the 1964 price reduced by 10 percent and 20 percent is 12.49 and 11.104 pence respectively. The 1964 producers' average price of lump approximates 2.7 pence; this price, reduced 10 to 20 percent is 2.43 and 2.16 pence. These prices are considerably higher than either those assumed by F. A. O. or those prices which would result if the total decline was absorbed by the producers.

³⁹Food and Agriculture Organization of the United Nations, Agricultural Development in Nigeria 1964-1980 (Rome, January 1964), p. B218.

⁴⁰Ibid.

CHAPTER III

OIL PALM AND FOOD: ALTERNATIVE CROPS TO RUBBER

Rubber is Midwestern Nigeria's main cash crop, but it is not the only crop. Oil palm is second in importance as a cash crop. Subsistence food crops are also of great importance. Other cash crops, cocoa, cotton and rice, are less important. The predominant pattern is food crops combined with either oil palm or rubber production. This chapter will discuss the possibility of substituting oil palm or commercial food production for rubber production.

Food Crops

No matter what other agricultural commodities they produce, almost all Midwestern farmers produce food. Most do not produce it commercially, but grow only enough for their own needs. When an excess occurs and is sold, it is not a major source of income.

Most farmers who grow both rubber and food first plant the food crops and then interplant rubber between them. When rubber is planted, the land cannot be used for food crop production until the rubber is cut down, 30 or 40 years after planting, but if rubber is not planted, the land is left fallow about 10 to 20 years and then used for food again. Although rubber and food crops are substitutes, that is, when more rubber is grown, less food can be grown, the land resources of the region are not fully developed. The period of bush fallow could be shortened and jungle land not now utilized could be brought into production.

Because food crops do not enter the export market, the extent of food crop production is determined by a domestic market limited by low per

capita incomes. Farmers would produce food commercially if food prices rose relative to the prices of rubber and palm products. Prices of food may increase from population growth and from income increases. Or, urban population may expand faster than food production and increase food prices. Moreover, many rural residents, particularly young men, are moving to urban areas. Conceivably the population flow with the resulting changes in wage rates could be of such a magnitude that agricultural production would be hindered by labor shortages. The current prediction, however, is for adequate food supplies in the immediate future.¹ Thus, food prices will probably not increase significantly and rubber will still be preferable to commercial food production for most Midwestern smallholders.

Oil Palm

Palm oil production is the chief alternative to rubber production as a source of cash income for Midwestern Nigeria smallholders. Prior to the Second World War, oil palm products were the primary exports of the Midwest; even today they are second only to rubber, amounting to £5,000,000 annually.² For the most part, palm is grown in areas where rubber cannot be cultivated. Where both crops can be grown, rubber usually dominates.

The primary reason rubber rather than palm is the Midwest's primary export is the Government's policy of heavily taxing the palm

¹U. S. Department of Agriculture, Economic Research Service, Nigeria (Washington, D. C.: U.S. Government Printing Office, 1962), p. 105.

²"Midwestern Nigeria," New York Times, January 20, 1964, p. 63.

industry and lightly taxing the rubber industry. Because of the tax structure, producer prices are weighted in favor of rubber production. The primary agents for carrying out this policy are the regional Marketing Boards, which set the prices and buy all the palm oil, palm kernels, cocoa, cotton and peanuts produced for export in the region. By setting the prices they pay very low in relation to the prices at which they sell, the Marketing Boards, in effect, tax the producers. In 1965, when the producer price of palm oil was #41/10/- per ton, the London price was over £109 per ton of special grade oil. Between 1947 and 1961, the Marketing Boards earned surpluses of £106,000,000 from all the products which they purchased.³ Palm produce contributed a large portion of this surplus: #48,000,000. In addition to the Regional Marketing Board's tax on oil palm and kernels, the Federal Government taxes exports. Between 1955 and 1961, these two taxes extracted £50,000,000 from the palm product industry -- 20 percent of the total value of palm exports during that period.⁴ Since 1947, the palm industry has paid taxes of over £100,000,000.⁵

As a result of the low prices paid to farmers, smallholders' net revenues from commodities subject to Marketing Board control are greatly reduced. For example, the F. A. O. estimates that a Nigerian smallholder earns 62 to 84 shillings per mature acre, when the price

³Gerald K. Helleiner, "The Fiscal Role of the Marketing Boards in Nigerian Economic Development, 1947-61," The Economic Journal, LXXIV (September 1964), p. 603.

⁴Ibid., pp. 608-609.

⁵Ibid.

per ton of palm oil and palm kernels are £36 and £24 respectively.⁶ (See Table 13.) If smallholders had received £50 per ton for palm oil and £30 for palm kernels (these being the approximate prices that they would have received in 1964 without the Marketing Boards), they would have earned 90 to 136 shillings per acre. These crude data help illustrate the point that palm producers receive about two-thirds their potential income without Marketing Boards.

Table 13: Owners Returns from Production of Oil Palm from Wild Trees: Alternative Prices, Costs and Yields.

Wage Rate	Bunches	Producers Price		
		£50 per ton for Palm Oil	£41 per ton for Palm Oil	£36 per ton for Palm Oil
		£30 per ton for Palm Kernels	£27 per ton for Palm Kernels	£24 per ton for Palm Kernels
Shillings per day	Pounds per acre	-----Shillings Per Acre-----		
4	2,240	136	96	84
	2,000	101	86	73
	1,800	90	72	62
6.25	2,240	127	87	75
	2,000	92	78	64
	1,800	81	63	53

Computed from: Food and Agriculture Organization of the United Nations, Agricultural Development in Nigeria, 1964-80 (Rome, January 1965), p. B-308.

Similarly, the F. A. O. has estimated income to the owners of the new high yielding palm seedlings developed at the Nigerian Institute for Oil Palm Research. (See Table 14.)

⁶The F.A.O. estimated net revenue assuming that smallholders receive the Marketing Board's Producers Price. In practice, about 10 percent of this price is absorbed by the marketing system.

Table 14: Owners Returns from Improved Oil Palm Production:
Alternative Prices and Wage Rates.^{1,2}

Wage Rate	Producer Prices		
	£50 per ton for Palm Oil	£41 per ton for Palm Oil	£36 per ton ³ for Palm Oil
	£30 per ton for Palm Kernels	£27 per ton for Palm Kernels	£24 per ton for Palm Kernels
	----- Shillings per acre -----		
4 Shillings	592	467	406
6.25 Shillings	547	422	361

Source: Food and Agriculture Organization of the United Nations, Agricultural Development in Nigeria, 1964-1980, Rome, January 1965, p. B-295.

¹ Depreciation charges of 33 shillings not included.

² Yield 8,000 Pounds of Bunches per Acre.

³ F. A. O. used £30 per Ton.

When prices of palm oil and kernels are £36 and £24 respectively (approximate 1964 prices actually paid to smallholders), improved smallholders average about 406 shillings per mature acre of oil palm. But they would earn 592 shillings per acre in the absence of Marketing Boards, one-third more than the estimated actual earnings.

The heavy taxation of the palm industry results in: (1) decreased expansion of palm product production, (2) increased sales of oil on the domestic market and (3) increased production of palm wine. After reaching a peak in 1956, within the next seven years palm kernel exports fell 12 percent. Because palm kernels could not be consumed domestically prior to 1965, this export decrease probably reflects diminished production or collection. Oil exports fell 32 percent during the same period because an additional amount of oil was diverted to the domestic market.

Although no data are available, palm wine, which competes with the production of palm oil, seems to be produced in larger quantities. One palm plantation and many smallholdings have substituted rubber for palm in order to take advantage of the greater profits available to rubber producers.

Oil palm production is probably slacking off in Nigeria, even though it is highly profitable to the total economy. An acre planted with the high yielding seedlings developed by the Nigerian Institute for Oil Palm Research provides a gross income to the economy of £56 net of Marketing Board's costs.⁷ Under their assumptions, the tax receipts from a mature acre of high yielding palm over £20.⁸

Nevertheless, as long as current prices and tax policies continue, rubber production will probably remain more profitable than oil palm production for Midwestern farmers. The balance could be shifted in favor of oil palm by either raising the taxes on rubber, lowering rubber prices, or lowering palm product taxes.

Summary

Smallholders in those areas of Midwestern Nigeria which are suitable for rubber cultivation do not commercially produce the two major alternatives to rubber. Oil palm produces a very high return to the Nigerian economy as a whole, but because of the high taxes imposed by the Marketing

⁷ David L. MacFarlane and Martin A. Oworen, "Investment in Oil Palm Plantation Operations in Nigeria: An Economic Appraisal," Economic Development Institute, University of Nigeria, Enugu, Nigeria, December 1964, p. 81. (Mimeographed.)

⁸ Ibid., p. 81.

Boards and Federal Government, the farmer receives only a very small proportion of the returns. Future price changes, effects of new governmental policies, changing world market conditions, population growth and urbanization, could lead to substitution of palm or food crops for rubber, but this does not appear to be likely in the immediate future.

CHAPTER IV

THE MIDWESTERN NIGERIA RUBBER INDUSTRY

The Development of the Industry

The Early Years: 1894-1921

The history of rubber in Nigeria begins in 1894 when the Governor of the Colony of Lagos brought a group of Ghanians to Nigeria to introduce methods for exploiting indigenous sources of rubber. In a year, exports rose from virtually nothing to over 5,000,000 pounds. The primary source of wild rubber was Funtumia elastica, a tree found in the rain forests of Africa. But after a few years, crude and intensive tapping had killed the trees, and the species almost disappeared in many areas. Thus, industry reached its maximum output only two years after the introduction of tapping and had ruined the trees in many areas within three years. The Government tried to prevent the destruction of rubber-bearing trees by limiting the number of tappers, but did not succeed. In an attempt to replenish the trees, the Government also required all villages to plant communal stands of Funtumia. Villages in the Benin area responded enthusiastically to this regulation; Christy reports that every village, big or small, had its communal plantation.¹ Approximately 700 Benin area villages planted 1,000,000 trees.² Exports of wild rubber exceeded 1,000,000 pounds for the last time in 1913.

¹Cuthbert Christy, The African Rubber Industry and Funtumia elastica (London: John Bale, Sons & Danielsson, Limited, 1911), pp. 13-14.

²E. D. Morel, Nigeria (London: Smith, Elder & Co., 1911), p. 69.

The rubber tree, Hevea brasiliensis, arrived in Nigeria in 1895 and the first estate was planted at Sapele approximately ten years later.^{3,4} In 1906, the Department of Agriculture planted its first plot of rubber.⁵ In 1912, an English firm established the second Nigerian estate at Ikotmbo in the Eastern Region. In 1925, 2,500 acres of European-owned rubber stood in what is now Midwestern Nigeria. The first major Nigerian-owned plantation was established near Sapele in 1916. Restrictions on alienation of land by foreigners brought new plantation development to a halt from 1917 until 1952.

Planting of rubber trees in smallholdings began soon after their introduction into the country. During the first 20 years of the century, the Department of Agriculture encouraged smallholders to grow rubber by distributing seedlings and providing advice on cultivation and processing. The Department of Forests and the Department of Agriculture planted numerous demonstration plots throughout Southern Nigeria from which they supplied seedlings. According to the files of the Department of Agriculture, peasants planted approximately 5,400

³K. M. Buchanan and J. G. Pugh, Land and People in Nigeria (London: University of London Press Ltd., 1955), pp. 152-153.

⁴The date of the establishment of the first estate has been lost. Several authors state that the Sapele Rubber Estate was begun in 1903, but some evidence indicates that it may not have been established until 1908 or 1909. The manager of Jathomas Estates Limited believes his firm first planted in 1899 but the Industrial Directory 1964 indicates that it was established in 1916.

⁵Memorandum of the Director of Agriculture, "Rubber Growing," Memorandum No. 2961/DA/252, May 25, 1939, p. 1., "Rubber Industry in the Cameroons and Nigeria," File No. 14451, I, National Archives, Ibadan, p. 46.

acres of rubber between 1909 and 1917 in Midwestern Nigeria.⁶ But smallholders did little planting after 1917; in 1916, the Department of Agriculture distributed 149,000 seedlings, but because of declining markets, five years later only 32,000 seedlings could be distributed.⁷ In 1925, there were 5,400 acres of native-owned rubber in Midwestern Nigeria, all planted between 1909 and 1917.⁸

Prior to 1915, almost all exports of rubber were from wild trees. The situation began to change about 1915 when the estate at Sapele (now the Sapele Rubber Estate owned by Pamol (Nigeria) Limited, a subsidiary of Unilever) must have begun production, increasing exports during the late 1910's. The Jameson River Estate (now also owned by Pamol) probably started producing rubber about 1925. The trees first planted at Pamol's Ikotmbo Estate matured around 1920, but this estate remained small for the next ten years. By 1921 Hevea trees probably were providing most rubber exports.

Period of Stagnation: 1921-1935

In 1921, a new Director of Agriculture reversed the established policies of the Department. He wrote, "The distribution of rubber seedlings to ordinary farmers should be discontinued as it is not desirable

⁶Memorandum of the Director of Agriculture, "Rubber in the Cameroons," Memorandum No. 1297/DA/252, June 1925, p. 2, "Rubber Industry in the Cameroons and Nigeria," File No. 14451, I, National Archives, Ibadan, p. 18.

⁷Memorandum of the Director of Agriculture, "Rubber Growing," op. cit., p. 1.

⁸Memorandum of the Director of Agriculture, "Rubber in the Cameroons," op. cit., p. 2.

that we should appear to be in any way advocating the planting of this product."⁹ He reasoned that Nigerians should not plant rubber because peasant producers could not obtain a reasonable price.¹⁰ The change in policy was also motivated by a desire to coordinate Nigeria's policies with British colonial policy to control the expansion of rubber acreage although Nigeria was not a party to the formal agreement.¹¹ As a result of this decision, the Department of Agriculture and its successors played a minor role in the development of the rubber industry for the next 36 years.

Between 1921 and 1935, rubber exports increased reflecting changing price levels and the growing acreage of mature plantations. Growing production at the Pamol Plantations and the Jathomas Estate accounts for a large share of the increases in exports during the late 1920's. After 1930, exports first fell and then rose as a result of changes in world market prices and further increases in mature plantation acreages. But the acreage of peasant-owned rubber did not increase during this period.

⁹Memorandum of the Director of Agriculture, "Rubber Growing," op. cit., p. 1.

¹⁰Memordum of the Director of Agriculture, "Rubber Cultivation at Sapele," Memorandum No. 1951/DA/259, 29 September 1925, pp. 2-3, "Rubber Industry in the Cameroons and Nigeria," File No. 14451, I, National Archives, Ibadan, pp. 26-27.

¹¹P. A. Bower, A. J. Brown, C. Leubrischer, J. Mars and Alan Pim, Mining, Commerce and Finance in Nigeria, Vol. II of The Economics of a Tropical Dependency, ed. Margery Perham (2 vols.; London: Faber and Faber, 1948), pp. 153-54.

The Modern Rubber Industry: 1936 to the Present

Rubber prices increased in 1936 because the major rubber producing and consuming countries initiated marketing controls. At the same time, world palm oil and palm kernel prices fell, shifting the competitive advantage for the Nigerian farmer away from palm products and towards rubber. Because of the rising value of rubber, two foreign firms, British Bata Shoe Company and the United Africa Company, actively sought to purchase rubber and to lease mature rubber trees for tapping. Most of the existing smallholdings had been planted before 1921, and the Nigerian peasant quickly saw the advisability of expanding his acreage.

Early in 1939, the Colonial Government became aware of the increased interest in rubber and considered revising its rubber policy. Before they could make a decision, World War II began, causing a postponement of the discussion. During the War, the Government encouraged rubber production from both Hevea and wild trees by raising lump prices from $2\frac{1}{2}^d$ to 6^d per pound and raising high quality sheet prices from $6\frac{1}{4}^d$ to 9^d per pound. After the fall of Singapore in 1942, prices went even higher.

During World War II and since, Government policy has tacitly encouraged the expansion of rubber production. Following the War, the Marketing Boards paid a relatively low price for the Nigerian producer for palm products despite high world market prices. As a result, production of oil palm products decreased and resources shifted into rubber production in the Midwest.

In 1952, the Government of Nigeria reversed its policy and permitted

Table 15: Nigerian Rubber Exports by Grade, 1959-1963.¹

Grade	1958		1959		1960		1961		1962		1963	
	Quan- tity	Value	Quan- tity	Value	Quan- tity	Value	Quan- tity	Value	Quan- tity	Value	Quan- tity	Value
	Thou- sand tons	Thou- sand £	Thou- sand tons	Thou- sand £	Thou- sand tons	Thou- sand £	Thou- sand tons	Thou- sand £	Thou- sand tons	Thou- sand £	Thou- sand tons	Thou- sand £
RSSI-RSSV	11	2,266	14	3,139	17	4,448	20	4,207	20	4,146	22	4,465
RSSVI (B-2)	17	2,914	15	3,150	15	3,759	11	2,187	7	1,293	4	815
Crepe	14	2,447	19	3,731	25	6,035	24	4,573	32	5,806	36	6,393
Cup, Lump, Scrap and Cuttings	--	60	--	3	--	11	--	43	1	108	--	86
Other ²	--	4	--	2	--	4	--	11	--	5	--	29
Total	42	7,691	47	10,025	57	14,256	55	11,021	60	11,357	63	11,788

Source: Federation of Nigeria, Nigeria Trade Summary (Lagos: Chief Statistician, 1958-1963).¹Corrected for computational error.²Wild, other waste and scrap rubber.

the alienation of land by foreigners. As a result, several new rubber plantations were established, three by a consortium of Malayan rubber firms and one by Dunlop Tyres. A total of 28,548 acres of foreign owned rubber now stands in Nigeria.

Exports have continued to increase at a rapid rate, exceeding 63,000 tons in 1963. Appendix B lists the exports of rubber from Nigeria since 1894. Between 1953 and 1963, volume of rubber exports doubled and the value almost quadrupled. The grades of exports also improved. Production of sheets of grades higher than B-2 increased from 10,942 tons in 1958 to 22,205 tons in 1963 while B-2 production fell from 16,911 tons to 4,386 tons. (See Table 16) A large share of the increase of high quality sheet exports results from increased mature acreage on plantations, as opposed to smallholdings. Plantation exports in 1958 totaled about 2,230 tons. In 1963, they reached nearly 8,400 tons, an increase of 6,000 tons, which represents over half the increase in high quality sheet exports. At the same time, crepe exports almost tripled, to 36,111 tons. In fact, the most significant change is the substitution of crepe for sun-dried sheets (B-2 grade) exports. The establishment of a large number of crepe factories caused the shift from sheet to lump production. In 1958, when only 13 crepe factories existed most farmers produced B-2 sheets. Today 30 factories bid up the price of lumps, diverting production from sheet to lump.

Table 16: Three Classes of Exports as a Percent of Total Exports, Nigeria, 1958-1963.

Year	R.S.S. I R.S.S. V	R.S.S. VI (B-2)	Crepe
----- <u>Percent</u> -----			
1958	26.17	40.45	33.19
1959	28.68	31.57	39.73
1960	29.98	27.05	42.86
1961 ²	35.72	20.25	43.57
1962	33.75	11.75	53.63
1963	35.11	6.94	57.10

Source: Computed from Table 15.

¹R.S.S. signifies ribbed smoked sheets.

²The trend was probably retarded in 1961 by legislation against adulteration of lump in Benin Division.

Table 17: Plantation Rubber Production, Nigeria, 1958 and 1963.

Plantation	1958	1963
----- <u>Pounds</u> -----		
Asaboro		
Ifon	---	340,000
Ovade	---	384,000
Illushin	---	322,000
Araromi	---	2,250,000
Dunlop	---	1,708,000
Oban	---	3,000,000
Pamol		
Ikotmbo	2,320,416	3,703,424
Sapele	2,366,560	3,778,442
Uronigbe	---	2,371,626
Jathomas	325,000	325,000
Total	5,011,976	18,182,492

Sources: A. Mulder, unpublished paper prepared as

background for the Nigerian representative to the International Rubber Study Group, May, 1964; Personal conversations with the managers of Jathomas Estates, Asaboro Estates and Urhonigbe Rubber Estate; Letter from J. L. Bryan, Managing Director, Pamol (Nigeria) Ltd., July 31, 1964.

The Organization of the Nigerian Rubber Industry

Nigerian Rubber Plantations

Nigeria's 26 largest estates contain 67,981 acres of rubber. (See Table 18.) Eastern and Midwestern Nigeria each contain 10 estates and six are in Western Nigeria. The Eastern Region has the largest acreage of plantation rubber, 29,897 acres. Western Nigeria is second with 22,772 acres, followed by the Midwest with 15,312 acres. The figures in Table 18 are misleading because they indicate that the average estate in the Midwest is much smaller than in other regions. This study was conducted in the Midwest and, as a result, additional small Nigerian-owned plantations in that area came to light. If the true number of estates in other regions was known, that average would drop as well.

The Midwest, West and East contain one, two and six publicly-owned estates respectively, managed by the regional development corporations. The publicly-owned estates tap only 8,833 acres on two estates; the remaining acreage is immature.

Eleven Nigerian-owned plantations containing almost 10,000 acres are shown in Table 18. Because no attempt was made to locate all privately-owned domestically financed estates, the list only includes the larger holdings obtaining planting materials from the Midwestern Nigeria Ministry of

Agriculture and Natural Resources, and does not include many other estates obtaining materials from other sources. Of the 3,568 acres in the Midwest, two companies own 2,928 acres at four different locations. The sizes of two other estates are not known.

Table 18: Location, Ownership and Acreage, Nigerian Rubber Plantations, 1963-64.

Region	Ownership	Number of Estates	Acreage
Midwest	Public Nigerian	1	5,469
	Private Nigerian ¹	7	3,568
	Private Foreign	<u>2</u>	6,275
	Total	10	15,312
West	Public Nigerian	2	11,787
	Private Nigerian	3	5,974
	Private Foreign	<u>1</u>	5,011
	Total	6	22,772
East	Public Nigerian	6	4,480
	Private Nigerian	1	350
	Private Foreign	2	17,262
	Mixed, Private Foreign and Public Nigerian	<u>1</u>	7,805
	Total	10	29,897
All Regions	Public Nigerian	9	21,736
	Private Nigerian	11	9,892
	Private Foreign	5	28,548
	Mixed, Private, Foreign and Public Nigerian	<u>1</u>	7,805
	Total	26	67,981

¹Includes 2,400 acres projected for planting by 1963-64.

Nigeria contains five foreign-owned rubber plantations, two in the Midwestern Region, one in the Western Region and two in the Eastern Region. Eastern Nigeria contains the largest planted area of foreign-owned estates,

17,262 acres; Western Nigeria contains the smallest, 5,011 acres.

British interests own three estates and a Malayan firm owns two. In addition, one estate has mixed capital sources, a joint venture of the Eastern Nigeria Development Company and a Malayan firm.

In the Industrial Directory 1964, an estimate of employment indicates that nine plantations employ over 8,000 people.¹² Actually this figure includes employees making crepe sheets on three estates which also buy lumps produced by smallholders, but the error is offset by the lack of figures for the publicly-owned plantations in the Midwest and West and one of the foreign-owned plantations in the Midwest. The estimated 8,000 workers are employed on estates owning 35,170 acres, one-half the total acreage of estates in Nigeria. Thus, employment on estates is probably at least twice as high.

Mulder estimates that estates produced 17,000,000 pounds of rubber, 14 percent of the total in 1962-63. He predicts that plantation production will increase to 50,000,000 pounds, 30 percent of production by 1970-71, on the assumptions that smallholder production in the Midwest will not increase and that all estates already planted by 1964-65 will have come into production.¹³

According to available reports, yields on Nigerian estates are high. One foreign-owned estate had an average yield in 1963-64 of 1,100 pounds

¹²Federation of Nigeria, Federal Ministry of Commerce and Industry, loc. cit., p. 16.

¹³A. Mulder, unpublished paper prepared as background for the Nigerian representative of the International Rubber Study Group, May, 1964, unpagged.

per acre.¹⁴ This was an older estate, planted in the 1940's and 1950's mostly with clonal seedlings. One Nigerian-owned firm has yields of 400 pounds on one of its holdings and 800 pounds on another, both planted in the late 1950's with a mixture of low and high yielding trees. In comparison, estates in the Far East average about 600 pounds per acre. Apparently, the potential yield of rubber in Nigeria may be very high.

Nigerian estates all produce ribbed smoked sheets (R.S.S.) as their primary product; and they mill cup and tree scraps into estate crepe, also a high quality product. One estate also produces small quantities of concentrated latex for domestic use.

Nigerian Rubber Smallholdings

Nigeria contains between 900,000 and 1,500,000 acres of rubber smallholdings, most of which is in the Midwest. (Table 19 presents data indicating the relative importance of plantations, smallholders and farm settlements in the Nigerian rubber industry.) The other three regions only contain a few thousand acres, probably not more than 10,000 acres in total. About half of the total acreage in the Midwest was planted since 1955 and is not yet tapped. According to a survey conducted in 1958 by the Eastern Nigeria Ministry of Agriculture and Natural Resources, Benin and Urhobo Divisions contain most of the rubber found in the Region. (See Table 20.) Personal observation indicates that Ishan and Asaba also contain large acreage of rubber. Between 170,000 and 290,000 people own, tap and market rubber from Midwestern smallholdings.

¹⁴Letter from John L. Bryan, General Manager, Pamol (Nigeria) Limited, Calabar, Nigeria, July 18, 1964.

Table 19: Area and Production of Rubber Plantations, Smallholdings and Farm Settlements, Nigeria, 1962-63.

Producer Organization	Production		Land Area ¹	
	Output	Proportion of Total	Area	Proportion of Total
	Thousand Pounds	Percent	Thousand Acres	Percent
Smallholders	109,000	86	1,200	95
Plantations	17,836	14	68	5
Farm Settlements ²	---	---	2	+

Source: A. Mulder, unpublished paper prepared as background for the Nigerian representative to the International Rubber Study Group, May, 1964.

¹Area estimates based on the data collected in this study.

²Not yet tapped.

The average smallholder owns about 10 acres of rubber in a number of small plots. Because rubber is usually interplanted with food crops, the trees owned by one man are scattered over a wide area. Rarely do individual plots of trees cover more than four acres. Extrapolation of a six-week sample of rubber production on 14 farms indicates that smallholdings yield approximately 400 pounds of dry rubber per acre per year.

The rubber produced on smallholdings is converted on the farm into a marketable product for sale to a middleman. Most farmers coagulate their latex into lumps of rubber, often adulterating the product with sand, stones and sticks for added weight. Others produce sun-dried sheets, rubber which is rolled out and then dried in the sun or over the

hearth, or in the case of a few rich farmers, dried and cured in a smokehouse. At this stage, sheet rubber is nearly ready for exporting and lump must be converted to crepe sheets, but both kinds are sold to middlemen. Farmers try to sell lumps before they dry, preferably the day of production, but they accumulate a quantity of sheets before they sell.

Table 20: Smallholder Rubber in Midwestern Nigeria by Divisions, 1958-59.

Division ¹	Area	Proportion of Total
	<u>Acres</u>	<u>Percent</u>
Benin	204,000	58
Urhobo	130,000	37
Ishan	6,210	2
Asaba	4,250	1
Aboh	3,000	1
Afenmai	2,000	1
Western Ijaw	850	⁻ 2
Warri	500	⁻ 2
Total	350,810	100

Source: Western Nigeria Ministry of Agriculture and Natural Resources, "Agricultural Statistics," Benin Delta Circle File No. 2608, pp. 16, 28, 41, 55, 62.

¹ Divisions are the largest administrative units within a region. The Midwest had eight divisions until two more were added in 1963.

² Less than .5 percent.

Middlemen

After processing their sheets and preparing their lumps, farmers sell to middlemen, private businessmen, whose capital usually consists

only of a bicycle and scale. They weigh lumps on a small spring scale and transport them, hanging on wires from the fenders and handlebars of their bicycles. Middlemen pay according to weight alone, regardless of the quality of the sheets or lumps; and prices vary very little throughout the entire region, although they tend to be lower in the more inaccessible villages.

Dealers

Middlemen sell to dealers either in the larger towns or at specific collecting points by the roadside. Typically, the dealers supply the middlemen with cash to buy rubber from the producers. Instead of charging interest, the dealers expect the middlemen to sell their purchases to the lender in return for the service. The transaction between middlemen and dealer also proceeds by weight only.

In addition to financing the middlemen, dealers also assemble the rubber, transport it to the exporter-processor and smoke whatever sheets require it. A few dealers have integrated their services to include purchasing, processing and exporting. Some small dealers buy from middlemen and sell to other dealers rather than directly to exporters. Dealers usually rent a store in a large urban area where they buy the rubber from middlemen and accumulate it. They often own trucks for transporting the rubber to the exporters.

Processor-Exporters

Exporters pay according to the quality of the rubber. Usually an exporter samples a lump and pays for the whole lot on the basis of the

sample's quality. The exporter weighs the lumps and removes a 10 percent sample. He mills the sample into wet crepe sheets and pays the dealer according to the weight of the clean crepe produced from the lumps. A few exporters process each delivery separately, but most prefer to process only the samples separately and mix all the remaining lumps together. Exporters buy sheets in much the same way. After the delivery has been weighted, a 10 percent sample is removed and graded and the entire delivery is bought according to the quality of the sample.

After purchasing, the processors clean the sheets, manufacture the lumps into crepe and prepare both for exporting. (Appendix A explains the manufacturing of crepe.) Because the producers add so many adulterants to lump, most crepe factories use a machine which breaks down and washes the lumps. Most processors first cut open lumps by hand to insure that no hard adulterants such as scrap metal damage the mills. Because of adulteration, Nigerian crepe is among the lowest quality crepe in the world and its price is somewhat below the price of R.S.S. VI sheets.

The exporters usually clean sheets of dirt and mold before packing them. In this way, the quality can be increased significantly, usually by about two grades. Exporters claim that this is the sole source of their profit, and that, in fact, they pay the dealers virtually the same price they receive for each grade. Some exporters smoke wet sheets, but usually this is left to middlemen and dealers. After washing, the exporters pack the sheets into bales of 224 pounds.

The major weakness of the organization of the industry is its failure to reward high quality production. The producers primarily

determine the grades of rubber; since they are not rewarded for good rubber, they make no attempt to improve quality. Indeed, the producers actually find it profitable to deliberately reduce quality. The resulting loss to the Nigerian economy probably exceeds £1,000,000 a year.

Prices paid to middlemen and producers are relatively stable because the processing industry is oligopsonistic. The number of processors is so small that if a single firm changes its price, it noticeably affects all the others and they react. If the individual firm should lower its prices, the others might not follow, and its purchases would be reduced. Firms are also reluctant to raise prices because the other processors would probably do the same, so that no large increase in volume would result. Changes in price occur only when world market prices change enough to force all firms to move together.

Government Programs to Improve the Smallholder Industry¹⁵

Rubber Improvement Campaign, 1957-64

In 1957, the Western Nigeria Ministry of Agriculture and Natural Resources initiated its Rubber Improvement Campaign, the first time since 1921 that the government had encouraged the cultivation of rubber by smallholders. The Rubber Improvement Campaign attempted to lower costs of producing rubber in Nigeria in order to maintain the competitive position of the Nigerian product on the world market and increase the incomes of rubber producers.

¹⁵From 1954 to 1963, the two provinces of Midwestern Nigeria were part of Western Nigeria. In August 1963, the Midwest became a region.

The Campaign had two phases. Phase I consisted of projects intended to immediately increase the income of producers: training in proper tapping and processing, and establishment of processing cooperatives. Phase II projects were intended to improve the long-term competitive position and earnings of rubber farmers by encouraging them to utilize high yielding planting materials. There were five major projects: (1) tapper training, (2) processor training, (3) maintenance training, (4) establishment of processing cooperatives and technical advice to builders of private factories and (5) sale of clonal seedlings.

In terms of total participation, tapper training was the largest project of the Campaign. Between 1957 and 1962, the Ministry trained over 49,000 rubber tappers in a free five-day course.¹⁶ But the Western Nigeria Ministry cancelled tapper training in 1962 because it did not significantly improve tapping practices on most farms. The program had failed because: (a) many farmers, even after training, did not tap their own trees; (b) itinerant tappers quickly revert to old techniques because short-run income is higher when using poorer techniques; and (c) sons of farmers soon leave the farm even though they might have been tappers at the time of training.

Also under the program, farmers were trained to process rubber and maintain their trees. Over 17,000 farmers and tappers were trained to process rubber at the cooperative processing centers.¹⁷ Training in proper maintenance never received as much attention as the two other training programs. Between 1957 and 1963, the Western Nigeria Ministry

¹⁶E. O. Ojurongbe, "Rubber Rehabilitation and Tapping Techniques," Ibadan, (December 1963), p. 3. (Mimeographed.)

¹⁷Ibid.

only trained 1,400 farmers in maintenance.¹⁸

The most complex and expensive program was the establishment of cooperative processing factories (farmer's unions). For each cooperative, the Ministry of Agriculture and Natural Resources provided the technical skills to build a factory and smokehouse and arranged a loan of imported materials and equipment from the Association of Nigerian Cooperative Exporters (ANCE). Until the loan was fully repaid, the cooperative was obligated to sell its rubber to ANCE. The members of the cooperative paid an entrance fee based on the actual cost of building the facilities plus two pence per pound of rubber processed and sold through the cooperative. The cooperative supplied their members with all equipment and chemicals.

The Ministry aided the construction of approximately 200 processing units, of which 70 were cooperatives.¹⁹ But the cooperative program was only moderately successful. Less than half of the cooperatives still operate today and even fewer repaid their loans. Since 1962, few new factories have been built because ANCE refuses to extend more credit. Among the reasons given for the unsatisfactory performance of the cooperatives are: (a) the cooperatives failed to produce the highest quality products, so that the profits of cooperative members are not much higher than if they produce B-2 sheets, (b) they became entangled in the politics of the region and village, (c) ANCE failed to pay competitive prices, (d) itinerant tappers refused to utilize the services of the cooperatives, (e) poor management, (f) the difficulties of transporting the sheets to Sapele for sale to ANCE and (g) the price of lump was high.

¹⁸ Ibid.

¹⁹ Ibid., p. 4.

The major project of Phase II, the long-term improvement of the rubber industry, was the sale of high quality seedlings. Between 1958 and 1961, the Western Nigeria Ministry of Agriculture and Natural Resources sold enough seedlings to plant 2,580 acres. (See Table 21.) Data for more recent years are incomplete, but they indicate that annual sales were even higher except in 1964 when, because of administrative difficulties resulting from establishing the new Region, the Midwest Ministry distributed only unselected seedlings intended for budding. The Ministry charged 1 1/2^d per seedling, a net subsidy of about 8 1/2^d to 10 1/2^d. Technical advice and training in proper planting and maintenance are associated with the sale of seedlings.

Table 21: Acres of Rubber Replanted with Seedlings Sold by the Western Nigeria and Midwestern Nigeria Ministry of Agriculture and Natural Resources, Midwestern Nigeria, 1958-64.

Division	1958-1961	1962 ¹	1963 ¹	1964 ¹
----- <u>Acres</u> -----				
Aboh	207	65		
Warri and				
Western Ijaw	25	250		
Urhobo	942		935 ²	64
Asaba	85			
Benin	384			
Ishan	706	126.3		
Afenmai	231			
Total	2,580			

Source: Western Nigeria Ministry of Agriculture and Natural Resources, "Rubber Policy and General," Benin/Delta Circle, File No. 5800, Ogba Farm, Benin City, pp. 261-269, 278-301, 307A, 307B, 307C, 307D, 307E, 307F, 307G, 307H, 311-324, 333, 340-346, 348; Letter from the Senior Agricultural Superintendent, Urhobo Division, Reference No. 13133/245, July 27, 1964.

¹Data incomplete.

²Includes 1962.

In order to publicize the need for replanting with high quality seedlings, the Western Ministry planted five to ten acre demonstration plots in public places throughout the region. It cut down old rubber plantations, replanted them with clonal seedlings and maintained them. Thus far, none have matured and no plans have been made for their tapping.

Rubber Rehabilitation Scheme and World Bank Rubber Project, 1964

As part of its 1964-68 Development Plan, the Midwestern Government initiated a new program for aiding the region's farmers to establish improved smallholdings. Under the Rubber Rehabilitation Scheme, each participating farmer is subsidized £20 per acre in cash and in kind to replant up to six acres of rubber. In order to qualify for the program, the farmers must belong to a cooperative with at least 50 members. During the four years of the plan period, the Government expects to replant 15,000 acres for which £271,515 have been allotted.

Midwestern Nigeria, in collaboration with the World Bank for Reconstruction and Development, also plans to establish two estates of 5,000 acres each which will be divided into six acre smallholdings after the trees have been tapped for two years. The workers on the estates will become the owners of the smallholdings. The total cost is expected to be about £1.5 million, of which the Government will pay about half.

Summary

This chapter has sketched the development of the Nigerian rubber industry from the simple exploitation of wild rubber plants around the turn of the century to its present status as the largest producer of

natural rubber outside the Far East. The personal initiative of Midwestern smallholders has been the main force behind this progress. Nigeria's smallholders began the major expansion of planting rubber without specific governmental encouragement, and today rubber is the Midwest's most important export industry. But because rubber production in Nigeria is a peasant industry, modern technology has not influenced practices greatly. Farmers plant unselected seedlings, progeny of the seedlings first brought into the country even though materials are available which produce two or three times as much rubber. Because of ignorance and because they want to maximize short-term income, Nigerian smallholders handle their trees so crudely that yields are reduced and trees are killed. Because they lack the capital to build adequate processing facilities, smallholders produce very low quality products. Since 1957, the governments of Midwestern Nigeria have tried to improve technology by selling high-yielding seedlings, establishing processing cooperatives and teaching the modern techniques of rubber production. The importance of rubber to the Nigerian economy makes it imperative to determine means of further improving the industry.

CHAPTER V

METHODOLOGY FOR DATA COLLECTION ON ORDINARY SMALLHOLDINGS

This study comprises three surveys: (1) a general survey of taxpayers in six divisions of Midwestern Nigeria, (2) a survey of a sub-sample of the taxpayers who are rubber farmers and (3) a survey of farmers who bought improved seedlings from the Ministry of Agriculture and Natural Resources between 1958 and 1962. Chapter V describes the methods used to collect data from taxpayers and a sub-sample of taxpayers.

The survey of taxpayers, called the general survey, had the following objectives: (1) determining the acreage of rubber grown by peasants in Nigeria, (2) delineating alternative organizations and practices, (3) providing information about the sources and availability of resources for growing rubber and (4) providing the sub-sample for intensive study.

The survey of a sub-sample of taxpayers, called the input-output survey, determined the physical inputs and outputs and the costs and returns of producing rubber.

Sample Selection

General Survey

The sampling procedures were designed to satisfy three criteria: (1) unbiased sample, (2) minimum costs and (3) a population of known size. The first two criteria are obviously desirable. The third makes it possible to extrapolate from the sample to the full population.

In order to reduce costs, the survey only includes six of the

eight Midwest divisions.¹ According to previous estimates, the other two contain very little rubber. In 1958, the Ministry of Agriculture and Natural Resources estimated that while the two omitted divisions, Afenmai and Western Ijaw, contained only 2,850 acres of rubber, the six divisions included in the survey - Benin, Asaba, Ishan, Urhobo and Warri - contained 347,960 acres. (See Table 20.)

To reduce the time required for locating respondents, the survey included only villages with less than 3,000 inhabitants. Twenty villages were selected randomly from the 1,694 which according to the 1952 Census had populations of less than 3,000.² If a substitute was required, the village in the same administrative group having the numerically closest male population was selected. Table 22 is a list of villages where the enumerators actually interviewed taxpayers. Because only 19 interviewers were available, the last village selected was not utilized. The enumerators held interviews in seven substitute villages because they could not locate four of the villages, the elders of one village refused permission to randomly select farmers and in two villages the interviewer failed to collect reliable data.

Every tenth person on the village tax roll was selected for interviewing. The tax roll consists of every adult male and those

¹When the study was already in progress, two new divisions were organized out of Urhobo and Afenmai Divisions. They are not treated separately in this study.

²Federation of Nigeria, Population Census of the Western Region of Nigeria, Bulletin Nos. 1-9 (Lagos: the Census Superintendent, June 1955), Nos. 6 and 9.

Table 22: Villages in the General Survey, Midwestern Nigeria, 1963-64.

Division	Village	1952 Male Popu- lation over 14	1952 Total Population	1963 Number on Tax Roll	Selection
Aboh	Umaujie	33	122	41	Substitute
	Umusedeli	83	342	73	Substitute
Warri	Omodimo	60	174	50	Substitute
	Orere	65	208	50	Original
Urhobo	Ekrijesue	25	97	23	Substitute
	Ovbor	165	762	176	Substitute
	Oku Elume	26	104	17	Original
	Ekrota	40	163	24	Original
	Uduere	64	313	68	Original
Asaba	Owere	249	1642	231	Original
Benin	Ugo - Ugbayon	37	157	32	Substitute
	Ehor	701	2385	545	Original
	Unario	26	123	27	Original
	Ekae	28	118	25	Original
Ishan	Idinegbon	96	394	70	Original
	Egbaiki	192	854	122	Original
	Eko Ugboho	34	118	32	Substitute
	Ogemere	29	137	16	Original
	Eko Elo	29	137	16	Original

females who earn over £300 annually. In the event the original could not be interviewed, the individual listed next on the tax roll was chosen to be a substitute. When a substitute could not be interviewed, the enumerator simply reduced the number of interviews in the village by one. The probability of selecting any particular person is $1/16,940$ and the probability of selecting a substitute is $1/16,940 + 1/16,940$ times the probability that the original could not be interviewed. Because the probabilities of selecting an original and a substitute are so close,

the two groups are not differentiated except for estimating the aggregate number of farmers and rubber acreage.

Of the 130 individuals selected from the tax rolls, 44 were not interviewed for the reasons listed in Table 23. Of the 44 substitutes, 25 were interviewed and 19 were not.

Table 23: Success in Locating Respondents for the General Survey, Midwestern Nigeria, 1963-64.

Selection	Outcome	Number
Original		130
	Interviewed	86
	Dead	2
	Away Temporarily	16
	Away Permanently	16
	Others Not Interviewed	10
Substitute		44
	Interviewed	25
	Dead	1
	Away Temporarily	6
	Away Permanently	5
	Others Not Interviewed	7

Input-Output Survey

Rubber farmers selected for the input-output survey included approximately equal numbers of sheet and lump producers, no more than two farmers per enumerator and different size farms. The taxpayers who had been interviewed in the general survey were first sorted into two groups: rubber producers and others. Then the rubber producers were separated into those who were tapping at the time of the interviews and those who were not. Finally, the farms being tapped at the time of the initial interview were classified according to the estimates of their

acres and 22 farms were selected. The location, size and product of the 22 farmers selected for the input output survey are listed in Table 24. Input data were obtained from 18 farmers and output data from 14 farmers. Four farmers had discontinued tapping or refused to cooperate. One farmer had switched from sheet to lump production and all lessees of farms produced lumps.

Table 24: Location, Product and Estimated Acreage of Farmers in the Input-Output Survey, Midwestern Nigeria, 1964.

Division	Villages	Product ¹	Estimated Holding ²	Notes
			Acres	
Aboh	Umualjie	Sheets	16	Input only
	Umusedeli	Sheets	4	Cooperated
Urhobo	Ekrijesue	Sheets	48	Cooperated
	Ekrijesue	Sheets	30	Not tapping
	Ovbor	Sheets	50	Not tapping
	Ovbor	Sheets	30	Not tapping
	Oku Elume	Sheets	8	Cooperated
	Ekrota	Sheets	4	Refused to cooperate
	Ekrota	Leased	4	Cooperated
Asaba Benin	Uduere	Leased	3	Input only
	Owere	Leased	36	Input only
	Ehor	Leased	24	Cooperated
	Ehor	Leased	16	Input only
	Ehor	Leased	20	Cooperated
	Ehor	Sheets	15	Cooperated
	Unario	Lumps	20	Cooperated
	Unario	Sheets	64	Cooperated
	Ekes	Lumps	36	Cooperated
	Idinegbon	Lumps	9	Cooperated
Ishan	Idinegbon	Lumps	6	Cooperated
	Egbaiki	Lumps	2 1/2	Cooperated
	Eko Ugboho	Lumps	15	Cooperated

¹Hired laborers or family members tap farms producing lumps or sheets. The others are leased to non-family for a fixed monthly rent.

²Estimated in the taxpayers survey.

Population Size

Although a primary criterion for selecting sampling techniques was a known population size, the total number of taxpayers in villages of less than 3,000 inhabitants in 1952 was not known. Thus, estimation procedures had to be used to determine the number of taxpayers. The correlation coefficient between the 1952 adult male population and the number of taxpayers in 1963 in the 19 villages surveyed is 0.98. Linear regression was used to estimate the equation:

$$Y = 3.368 + 0.798X$$

where Y equals the number of names on the tax roll in 1963 and X equals the number of males 15 and over in 1952. The adult male population of villages of less than 3,000 inhabitants in the six divisions was 212,946 in 1952. Substituting into the equation, the estimated number of names on the nominal tax rolls in 1963 is 173,299.

Interviewers

General Survey

The Midwestern Nigeria Ministry of Agriculture and Natural Resources provided extension workers as interviewers. For the general survey, the Ministry supplied 19 rubber instructors, extension workers in charge of carrying out the Rubber Improvement Campaign. As preparation for carrying out the survey, the rubber instructors received three days of training, including the techniques of interviewing, the purposes of the survey, locating the individuals to be interviewed and an explanation of the questionnaire. After completing classroom instruction, these enumerators

interviewed farmers in the immediate vicinity of Benin City for practice.

Input-Output Survey

Two different groups collected data for the input-output survey. Eight rubber instructors and three hired enumerators collected output data on 14 farms; and two teams of Ministry and privately hired employees collected input data on 18 farms. The rubber instructors and hired enumerators all received two days of training in groups of four or less. Their training included instructions in keeping records of production and measuring the rubber content of latex.

Two teams, each including two interviewers and several laborers, measured inputs for the survey. An Agricultural Demonstration Officer from the Ministry of Agriculture and Natural Resources led one team and an experienced interviewer-interpreter, who was hired privately, led the other. Training consisted of two days in the classroom to explain the purpose of the research and to review the questionnaires, and four days in the field to practice interviewing and to learn to measure acreage.

Data Collection

General Survey

After their training, the interviewers for the general survey obtained a list of taxpayers and went to the villages. Before proceeding with the interviews, they requested permission to conduct the survey from the village elders. If they could not locate an interviewee

on the first attempt, the rubber instructors tried at least once more: in practice they usually made several attempts. After completing all the interviews, the enumerators returned the questionnaires to Benin City for verification. Appendix C contains copies of the questionnaires.

Input-Output Survey

Collection of input-output data was more complex. Measurement of output required living on the farm for six weeks. Every day the interviewer accompanied the tapper to the rubber plot where he counted the number of trees tapped, measured the volume of latex collected and tested the latex for its rubber content. If a farm had two tappers, the interviewer accompanied each on alternate days and recorded the number of trees tapped by each tapper and the rubber content of the latex every other day. Every day, they measured the volume of latex after the tappers returned from collecting to the place of processing. No enumerator was responsible for more than two tappers. In addition to measuring production, they recorded the quantity, price and grade of all sales and kept inventories of lumps and sheets.

All inputs except land were estimated from data collected in interviews. Labor inputs were determined by asking the farmers how many laborers carried out each major operation in 1963. Tools and equipment inputs were determined by asking the farmers how many they owned at that time, the cost of each tool and the life expectancy of each. Estimates of the cost of processing chemicals were made in the same way. The farmers and tappers were asked when they last purchased chemicals, how much they bought, what was the cost and how long they would last.

Because the farmers do not know the number of acres of rubber they own, every rubber plot had to be measured. A rubber plot consists of a group of trees planted in the same year on a contiguous area. Enumerators measured with a prismatic compass and tape measure and then plotted each plot on graph paper. A planometer was used to estimate the acreage.

At the request of the Ministry of Agriculture, trees on each farm over five years old were sampled for girth and tapping history. Every 500 feet, a square $1/40$ of an acre was marked out in the interior of the farm. The enumerator counted the number of trees in the square, measured their girths at 20 inches from the ground, counted the number of tapping cuts and measured the angles of the cuts. The results are shown in Appendix E, Table 9.

The results of the surveys described in this chapter will be presented in Chapters VI and VII.

CHAPTER VI

SMALLHOLDER RUBBER PRODUCTION IN MIDWESTERN NIGERIA

Because effective policy cannot be formulated without a concrete grasp of the industry's operation, this study describes the Midwestern Nigeria rubber producing industry. Policy makers in Nigeria have been forced to act without information because the literature is incomplete and contradictory. Descriptions conflict because non-representative sampling techniques have been used and information is incomplete because no thorough study has been carried out with the objective of describing the industry.

The Agricultural Economy

Land and Land Tenure

An Ishan or Bini may cultivate any plot in his village without permission, as long as no one already cultivates it or farms progressively towards it.¹ When a farmer harvests his crops and allows the land to return to fallow, he relinquishes all rights to the land. Because the village owns the land, the council of village elders, the executive of the village, administers it.

The Ibo and Urhobo tenure systems are quite different. Once a parcel of land is farmed, no one else may cultivate it.² Land passes from father to son or if there are no sons, from brother to brother. But, even though a family has continuous use of certain plots, it cannot

¹R. E. Bradbury, The Benin Kingdom and the Edo-Speaking Peoples of South Western Nigeria, Part XIII of Western Africa, ed. Daryll Forde (London: International African Institute, 1957), pp. 44-45, 76-77.

²Ibid., pp. 150-151.

sell them because the ultimate ownership remains with the community. Unowned parcels may only be cultivated with the elders' permission.

The tenure system is rapidly changing throughout the Midwest under the impact of the European tenure system and the introduction of a market economy. In urban areas, land is owned in fee simple. In rural areas where outside influences are strong, such as along main roads, sale of land is becoming increasingly common. In the general survey, farmers were asked whether they own farm land communally or privately. Private ownership was defined as the ability to sell land to an outsider without seeking the village's permission. Forty-eight of the 78 farmers replied that they own their farms privately and only 29 said they may not sell without seeking permission of the village elders. One did not reply.

Agricultural Labor

Tasks are customarily assigned by sex and age; men perform the heavy tasks while women and children perform the others. Typically a man and two or more women cultivate a farm jointly. Men clear and burn the plots and prepare the planting materials. Both women and men plant the crops and the women usually weed them. Men harvest while women transport the crops to the place of storage and women usually sell surplus in the market. Men own yams and women own cassava. In a few areas, women help plant and weed rubber, but usually rubber is the responsibility of men only. Women tap rubber during periods of high price, but this study only found one female tapper.

Farmers hire labor by the day, week, month or job. They pay men 3.5 to 7 shillings a day, women 2 to 5 shillings a day and children 1.5 to 3.5 shillings a day plus one or two meals in each case. Wage rates

vary according to the season and location.

Midwestern commercial farms commonly hire labor by the month and job. In Eastern Nigeria, Welsch reports, non-resident rice farmers hire labor by the job, and Miller reports that palm processors hire monthly wage labor.^{3,4} Only two cases of each were found among the farmers in the general survey.

Fifty-one of the 87 farmers interviewed in the general survey hired daily paid male labor. (See Table 25) They average 33.22 mandays annually and pay 4.75 shillings per day plus meals. Including farmers who do not hire any labor, the average is 19.47 mandays. Seventeen farmers hire an average of 30.12 mandays of female labor annually

Table 25: Hired Daily Labor and Wage Rates, General Survey, Midwestern Nigeria, 1963-64.

Labor Type	Number of Farmers Hiring	Average Days of Hired Labor		Average Wage Per Day
		Farms Hiring	All Farms	
		Mandays per year		Shillings
Men	51	33.22	19.47	4.75
Women	17	30.12	5.89	3.6
Children	13	33.38	4.99	2.65

³Delane Emil Welsch, "The Rice Industry in the Abakaliki Area of Eastern Nigeria," (unpublished Ph.D. dissertation, Department of Agricultural Economics, Michigan State University, 1964), p. 106.

⁴William L. Miller, "The Economics of Field Operations of the Stork Hand Hydraulic Oil Palm Press: Report to the Government of Nigeria," Economic Development Institute, University of Nigeria, Enugu, 1964, p. 12. (Mimeographed.)

and pay an average of 3.6 shillings per day. The average for all farmers is 5.89 mandays. Children are hired by 13 farmers for an average of 33.38 days and are paid an average of 2.65 shillings per day. All farmers in the survey hire 5.0 days of child labor per annum. For the labor needs of a hypothetical government program subsidizing rubber planting, the farmers have available 1.9, 1.4 and 1.4 men, women and children respectively. (See Table 26) The farmers participating in the input-output survey average 3.4 men, 1.8 women and 2.8 children working regularly on their farms, and 4.3 friends who occasionally help on a cooperative basis.

Table 26: Average Number of Free Farm Laborers, Midwestern Nigeria, 1963-64.

Type	Taxpayers Survey	Input-Output Survey
	----- <u>Individuals</u> -----	
Men	1.9	3.4
Women	1.4	1.8
Children	1.4	2.8
Cooperative	--- ¹	4.3

¹No question included.

Capital

Midwestern farms utilize very few tools -- only hoes, machetes, files, bicycles, baskets and knives. The hoe is the most important tool because it is the only one used to work the soil. It is constructed of a large flat pointed blade, usually about six inches across, attached to a

short handle about two feet long. Until recently, the whole tool was wood, but now the blade is iron or steel. Machetes are used to cut undesirable growth and files are for sharpening machetes. Bicycles are the primary means of transportation throughout Nigeria.

Tree Crops Grown in Midwestern Nigeria

Rubber is the most common tree crop in Midwestern Nigeria. Of the 87 farmers interviewed, 78 own some rubber trees. Every farmer interviewed in Urhobo, Benin and Ishan Divisions grows rubber. Sixty-nine also own plantain. Other important tree crops are cocoa, coconut, orange and banana. Significantly, only 17 farmers own oil palm. Before World War II oil palm was the main source of income to Midwestern farmers, but rubber has almost completely supplanted it.

Rubber Establishment Practices in Midwestern Nigeria

Clearing and Planting

First the farmer underbrushes each plot he plans to cultivate. Using a machete he cuts low growth, weeds, bushes, and young non-economic trees. Men and strong boys underbrush early in the dry season. (Table 27 shows the months during which farmers performed each major rubber growing operation during the 1963 farming year.) An average of 23.5 mandays per acre are required for underbrushing. After underbrushing, men fell the large non-economic trees. Hired workers supply about half the labor. Just prior to the beginning of the rainy season the farmer and his family burn debris. (See Table 27.) One to two months are allowed to elapse between underbrushing and burning.

Two-thirds of all rubber farmers in the taxpayers survey inter-plant their rubber in arable crop land. Only 26 said they plant rubber without first planting other crops on the same plot. Urhobo and Asaba Division farmers vary; some plant arable food crops first, others do not. The farmers of Aboh and Warri Divisions clear specifically for rubber only.

After planting arable crops, rubber is planted, usually in May, June or July.⁵

Table 27: Timing of 1963 Rubber Establishment Operations, Input-Output Survey, Midwestern Nigeria, 1964.

Month	Underbrushing	Burning	Planting	Weeding
----- Plots -----				
1962				
November	1			
December				
1963				
January	1			2
February	3	1		2
March	5	3		3
April	1	7		2
May			2	
June			7	3
July			3	5
August				3
September			1	
October				
November				4
December				6

Volunteer seedlings found under mature rubber trees are the most common planting material. Sixty-eight farmers plant volunteer seedlings and of these, eight also plant some clonal seedlings. Nine farmers plant

⁵One farmer planted in September because the ground was too wet earlier.

pure stands of clonal seedlings; none plant budded rubber. Of the 17 who plant clonal seedlings, 8 obtain them from the Ministry of Agriculture and Natural Resources, 4 buy from the Sapele Rubber Estate and 5 obtain them from other farmers. The five who obtain seedlings from other farmers may not be planting pure clones.

Volunteer seedlings are planted when they are one or two years old. Because the work is relatively light, children often pull the seedlings. The young plants are simply grasped near the ground and pulled out. Some farmers remove the seedling's leaves; others cut back the stems; and the rest plant without removing any top growth. The seedlings are replanted by pushing them into a hole made with a cutlass or pointed stick. Only four farmers use a spade to dig the hole. Fifty-five utilize a stick and 14 employ a cutlass. Four farmers plant seeds.

Thirty-one farmers plant their rubber trees in rows rather than just planting wherever it seems convenient. No attempt was made to measure the spacing actually utilized; rather each farmer was asked to mark out the distances between plants and between rows so that the interviewer could estimate the distances by eye. (Table 28 shows the estimated planting distances and the corresponding densities.) The other 42 farmers plant haphazardly.

The density of trees was measured in the input-output survey on sample plots in every farm planted before 1959. (Table 29 lists the average densities found on those farms.) The higher density on farms in the input-output survey is partially caused by the high densities on farms where the seedlings are planted haphazardly.

Table 28: Rubber Planting Distances Utilized by Farmers Planting in Rows, General Survey, Midwestern Nigeria, 1963-64.

Between Rows	Within Rows	Density	Number of Farmers
<u>Feet</u>	<u>Feet</u>	<u>Seedlings per acre</u>	
5 - 9	5 - 9	540 - 1760	1
10 - 14	5 - 9	345 - 840	5
10 - 14	10 - 14	223 - 436	13
15 - 19	5 - 9	256 - 583	2
15 - 19	10 - 14	180 - 290	1
20 - 24	5 - 9	202 - 438	3
20 - 24	15 - 20	91 - 110	1
30 - 34	5 - 9	143 - 290	2
		370	Average

Table 29: Actual Densities of Immature Farms, Input-Output Survey, Midwestern Nigeria, 1964.

Farm Number	Average Density	Farm Number	Average Density
	<u>Seedlings per acre</u>		<u>Seedlings per acre</u>
1	---	10	---
2	---	11	---
3	224	12	---
4	---	13	---
5	321	14	290
6	---	15	---
7	338	16	680
8	580	17	240
9	580	18	606
		Mean	429

Maintenance

Maintenance of rubber plots is at best irregular. Many farmers intend to weed more than one a year, but few weeded more than once in 1963. On the average, general survey respondents weeded 1.57 times a year for 4.15 years. The farmers practice several types of weeding. The most common, slashing, consists of cutting the top growth of competitive plants without attempting to remove roots or stems. Another is complete weeding in which competitive growth is totally removed. Several published reports mention burning undergrowth in older rubber plots, but no instance of this was found in either survey. Burning was observed on several occasions, but inquiries always indicated that it was accidental, the fires having spread from nearby arable crop farms.

Physical Inputs Required for Establishing Rubber

Land

To save expense, land was not measured for the general survey. Instead, the farmers simply estimated the sizes of their rubber farms by comparing their size to open areas in the vicinity of the place where the interviews were held. The enumerator would then estimate the size of the area which the farmer said was similar to the size of his farm. The farmers owned an average of 13.8 acres in 4.4 plots. The acreage weighted mean planting year is 1954 and the unweighted mean planting year is 1955. Planting reached a peak in 1959 and 1960 and declined slightly in 1961, 1962 and 1963. Table 4 of Appendix E

shows the number of plots and acres planted each year.

In the input-output survey, on the other hand, land was actually measured with compass and tape. The average farmer owns 10.5 acres of rubber in 6.1 plots. The average number of plots was higher than in the general survey because of a stricter application of the definition of "plot." In both surveys, a plot was defined as a contiguous area all planted at once. But most farmers usually consider trees planted in successive years on adjacent areas as one plot. Undoubtedly, many reported some farms as a single plot when actually the trees had been planted in different years.

The proportion of taxpayers reporting that they own some rubber was used to estimate the total number of rubber farmers in the Midwest and the total area of rubber. Given a taxpaying population of 173,000 in towns of less than 3,000 and given that 72.4 out of every 120 on the tax rolls own rubber, then 104,556 rubber farmers live in the smaller communities of Midwestern Nigeria.⁶ Assuming that 10 percent of the 1952 male population of urban areas not covered in the survey own rubber in holdings the same size as non-urban residents (10.5 acres), the total number of rubber owners is 113,500 and the total acreage is 1,215,092 or approximately 1,200,000 acres. Expanding the 90 percent confidence interval of the mean, the six divisions surveyed contain 863,056 to 1,521,170 acres of rubber.

The estimate of 1,200,000 acres is almost triple any previously published estimate. Two reasons explain the divergence between this

⁶See page 75 for the estimate of taxpaying population.

estimate and previous ones. First, prior estimates are based on exports and assume only a small untapped acreage. Second, other existing estimates simply update the 1958 Ministry of Agriculture and Natural Resource survey summarized in Table 20.

Nevertheless, the estimate of 1,200,000 acres can be substantiated utilizing export figures. The input-output survey farms average five acres of mature rubber of which half or 2.5 acres are tapped. Assuming that the entire rubber-owning population has five acres of mature rubber and taps 50 percent of it, then 288,462 acres are tapped. Mulder estimates smallholdings produced 109,000,000 pounds of rubber in 1963.⁷ Dividing production by tapped acreage, average yield is 378 pounds per acre, very close to the yield estimate of the input-output survey.

Labor

An average of 104.4 manday equivalents per acre are required to establish rubber: 23.5 for underbrushing, 9.2 for felling, 11.6 for burning, 10.3 for planting and 49.8 for weeding.⁸ (See Table 30.) All 104 mandays can be attributed to the costs of growing rubber when the farmer plants rubber alone. On the other hand, if farmers interplant their arable crops rather than clearing areas specifically for rubber, they underbrush, fell and burn whether rubber is planted or not. Then their

⁷A. Mulder, unpublished paper prepared as background material for the Nigerian representative to the International Rubber Study Group, May 1964.

⁸A manday equivalent is 1 day of a man's labor, 1 1/3 day of a woman's labor or 2 days of a child's labor.

Table 30: Average Labor Requirements for Establishing Rubber, Input-Output Survey, Midwestern Nigeria, 1964.

Operation	Total	Hired
	----- Mandays per acre -----	
Underbrushing	23.5	13.8
Felling	9.2	4.1
Burning	11.6	1.9
Planting	10.3	0.9
Weeding ¹	49.8	15.9

¹Three weeding.

Marginal cost of clearing for rubber is zero; only the costs of planting and maintaining the seedling are attributable to rubber. The average additional labor requirement of these farmers is 60.1 manday equivalents per acre.

Meals

Midwestern farmers often provide meals to their workers, particularly the unpaid ones. The number per day varies from place to place; one, two or three meals may be provided. (See Table 31.) A meal consists of a main course, a cigarette and palm wine. On the average, 0.83 meals are provided per manday of labor. The variation in meals per manday is related to the number of non-family workers utilized for the operation. Operations carried out with family labor only require very few additional meals. Large amounts of hired and non-family free labor are utilized for weeding and underbrushing, resulting in a large number of meals per manday.

Table 31: Meals Served Laborers by Operation,
Input-Output Survey, Midwestern
Nigeria, 1964.

Operation	Meals
	<u>Number per acre</u>
Underbrushing	12.26
Felling	5.50
Burning	4.39
Planting	3.51
Weeding ¹	60.45

¹Three weeding.

Tools

Table 32 shows the average number of tools owned by farmers, their average cost per unit, their average annual cost and their expected life. Average annual cost is estimated by multiplying the number of tools by the average unit cost and dividing the product by the average expected life of the tool. The major weakness of this technique is the difficulty of estimating the life of tools used for long periods, such as, bicycles.

Tapping and Processing

Tapping

Owners, their families and hired laborers tap rubber. Thirty farmers stated that they or their families tap their rubber and 14 said that only hired tappers tap their rubber. No evidence was found to support the belief that the Bini hire more tappers than other tribal

Table 32: Number, Unit Costs, Annual Cost of Tools and Expected Life per Item, Input-Output Survey, Midwestern Nigeria, 1964.

Tools	Number Owned	Average Expected Life	Average Unit Cost	Average Annual Cost
		<u>Months</u>	<u>Shillings</u>	
Hoes	2.5	33.9	4.2	3.7
Spades	0.8	40.4	10.1	2.4
Cutlass	4.7	19.8	4.3	12.3
Knives	1.1	13.2	1.1	0.9
Bicycle	1.0	106.9	290.8	32.3
Axe	1.6	63.3	6.1	2.5
Files	0.9	6.7	2.6	4.4
Scales	0.1	12.0 ¹	3.5	0.3

¹No estimate given. Twelve months arbitrarily assumed.

groups. The farmers of the input-output survey use equal amounts of family and hired tappers. The average Bini farmer hires one-third as much tapping time as he and his family provide.

Many hired tappers are Ibo from Eastern Nigeria and Asaba Division of Midwestern Nigeria, who have been forced by population pressure to seek their livelihood outside their village. Von Blanckenburg reports that tappers do not stay for long in one place, but move to another farm when yields decline and often return to their home villages to help during peak labor periods.⁹

Two hiring arrangements prevail between tappers and farmers, leasing and sharing. The more common system, sharing, consists of dividing gross income equally between owner and tappers. On some farms,

⁹Peter von Blanckenburg, "Rubber Farming in Benin Area," Institute for Social and Economic Research, University of Ibadan, Ibadan, N.D., p. 27. (Mimeographed.)

tapper and farmer share the variable tapping costs and on others, the owner pays all costs. In many areas, farmer and tapper divide the gross income from sheet production while the tapper retains all income from lumps. Because of the low price of rubber, leasing arrangements now are less commonly used. Leasing cost is usually a flat fee per tree, currently between three and four pence. The tapper retains all income and pays all expenses.

Tapping begins early in the morning, between 5:30 a.m. and 7:00 a.m. The tappers in the input-output survey tap an average of 271 trees per day. They usually dilute and coagulate the latex immediately after collecting. The most common coagulant is formic acid, but others frequently used are urine, lime juice and cassava juice. Few tappers use anti-coagulants although several are available. Tapping knives, imported from Germany and Great Britain, are readily available anywhere in Midwestern Nigeria. Snail and coconut shells are most commonly used for cups even though it is possible to obtain ceramic and aluminum ones in urban centers. Both snail and coconut shells are difficult to clean adequately, so the latex often coagulates in the cup.

Midwestern tappers, hired and family members, almost invariably remove the cambium layer from the trees. Nigerians know little about the physiology of trees so the importance of leaving the cambium is not understood. As a result, each area of bark can be tapped only once rather than three or four times as it is on estates.

Nigerian tappers practice what Wharton calls "Selective Slaughter

Tapping,"¹⁰ tapping a tree daily until its yield declines. Then it is not tapped until it is again capable of high yields. Only a small proportion of the trees in an area are tapped at any one time. Just the trees which produce the highest yields are tapped. (Table 33 contains a measure of the tapping life of each farm in the input-output survey.) The estimate assumes that all trees are tapped daily and each bark area can only be tapped once. The tapping life is highly variable, depending on the man-months of tapping in 1963. The shortest periods are on small farms where a high proportion of the trees are tapped continuously. Large farms only tapped briefly in 1963 have long estimated tapping life. The average is 18 years.

Table 33: Estimated Tapping Life, Input-Output Survey, Midwestern Nigeria, 1964.

Farm Number														
1	5	6	7	8	9	10	11	12	13	14	15	16	18	
Years														
48 divided														
by man-months	7	12	22	54	15	35	18	15	18	15	7	6	18	7
of tapping,														
1963														

Processing

Tappers usually process in the afternoon after the latex

¹⁰ Clifton R. Wharton, Jr., "Rubber Supply Conditions: Some Policy Implications," The Political Economy of Independent Malaya; A Case-Study in Development, ed. T. H. Silcock and E. K. Fisk (Canberra: The Australian National University, 1963), p. 149.

coagulates. If the tapper plans to sell the rubber as lump, it is adulterated with sand and sticks. To make a sheet the tapper lays the rubber on a flat surface such as a table or paved road and rolls it flat with a beer bottle. He then passes the flat sheet through a marked roller and leaves it outside to dry. Often he places the sheet near the cooking fire to dry and partially smoke. After a week or more the sheet is sold. Rent for marked rollers is based on the number of sheets to be rolled each day. The farmer pays a flat fee per month for rolling a fixed number of sheets per day, currently, 6 pence per month to roll one sheet each day.

Yields

The average yield per acre is slightly under 400 pounds. The acreage weighed average of yield per tree is 5.23 pounds. On each farm, yields were measured daily for four to six weeks between January and May. Annual yield is estimated by weighting the measured output by an index of monthly production constructed from the experience of four estates. The volume of latex was measured directly and weights of lumps and sheets were recorded at the time of sale. Annual production was estimated in the same way.

An independent survey was conducted to see whether middlemen manipulated weights to their advantage. Lumps were weighed before the middleman appeared and without their knowledge on 24 different farms selling to 24 different middlemen. Although the two weights differ considerably, the difference appears to be random, a result of poor equipment rather than technique. The difference between

the true weight and the middleman's is not significantly different from zero at the five percent level.

Table 34: Estimated Yields of Dry Rubber Per Annum,
Input-Output Survey, Midwestern Nigeria, 1964.

Farm	Yield per Acre	Yield per Tree
	----- Pounds -----	
1	752	3.25
5	535	10.90
6	154	7.47
7	176	11.57
8	406	3.69
9	190	4.10
10	814	8.11
11	232	2.73
12	128	2.44
13	509	7.73
14	418	3.99
15	260	5.50
16	542	6.97
18	346	3.05
Simple average	390	5.82
Acreage Weighed Average	398	5.23

Tapping Equipment

Equipment requirements for owners and tappers are shown in Table 35. Estimates of average costs are computed in the same way as establishment equipment costs. The costliest equipment is cups, an average of 36.75 shillings per annum. Coconut shell cups are the most commonly used, but snail shell cups are also very popular.

Table 35: Average Tapping Equipment Requirements and Costs per Farm, Input-Output Survey, Midwestern Nigeria, 1964.

Tools	Number Owned	Expected Life	Average Unit Cost	Average Annual Cost
		<u>Months</u>	<u>Shillings</u>	
Tapping Knives	2.86	6.6	3.78	1.92
files				
Pails	2.79	19.9	4.98	8.37
Cups (Snail Shells)	515.38	29.6	.05	10.46
Cups (Coconut Shells)	640.31	29.4	.05	13.09
Cups (Cans)	1.50	16.0	2.74	3.10
Cups (Sardine Cans)	5.57	9.0	1.60	10.10

Chemicals

The farms using formic acid to coagulate consume an average of 64.34 ounces per annum. The average cost for all farms is 18.44 shillings per year for 55.15 ounces. Anti-coagulant, usually potassium, is used by so few farmers that the average cost is only 6.58 shillings per annum.

Table 36: Average Chemical Costs per Acre, Input-Output Survey, Midwestern Nigeria, 1964.

Chemical	Average Consumption Farms Using Chemical	Average Consumption All Farms	Average Cost
	<u>Ounces</u>		<u>Shillings</u>
Acid	64.34	55.15	18.44
Potassium	---	---	6.58

Conclusions

Nigerian smallholder producers of rubber use techniques which reduce production of rubber below its potential. A most important cause of low yields is the use of unselected seedlings rather than clonal seedlings or budded stumps. At maturity an unselected seedling has a productive potential of about 500 pounds per acre. Clonal seedlings and budded trees produce 1,000 pounds per acre and some have been developed which produce 3,000 pounds. A second major cause of the low productivity of Nigerian smallholders is poor tapping techniques. A properly tapped tree will produce rubber for about 25 years, but trees tapped by Nigerian smallholders produce eight years. Thus, life time production is cut by about a third.

The poor organization of the marketing of rubber also prevents the efficient use of rubber industry resources. Because producers do not receive monetary rewards for producing high quality products, they make no attempt to do so. The result is a very poor product, one of the worst on the international market.

CHAPTER VII

BUDGETARY ANALYSIS OF ORDINARY SMALLHOLDINGS

This chapter evaluates the alternative organizations of the inputs utilized for growing rubber specified in Chapter VI. The chapter has four objectives: (1) to compare the four most common smallholder organizations, (2) to determine the impact of a decrease in prices and an increase in costs, (3) to determine the effect of improved tapping methods on profits and (4) to evaluate the returns to farmers producing clean lumps under hypothetical price assumptions. The four organizations are compared by determining their profitability, the income they provide to owners of 10 acres, and the taxes and foreign exchange they yield.

Budgeting as a Tool of Analysis

Definition of Budgeting

Bradford and Johnson define a budget as:

"...a written plan for future actions.
.
Basically, a budgeting process for a given period converges on two figures. One of these figures is total revenue for the period or situation under consideration. The other figure is total expenses for the same period. When the difference between these figures is found, it is called net profits or net return or net loss, depending upon whether net revenues are greater or less than expenses. All other parts of budgets are details leading up to this result."¹

A budget is a detailed projection of a firm's income and expenses over

¹Lawrence A. Bradford and Glenn L. Johnson, Farm Management Analysis (New York: John Wiley & Sons, Inc., 1953), pp. 328-329.

some specific time period. Partial budgeting consists of altering one assumption of a budget, such as product price, in order to predict its effects on the endogenous variables.

Budget Assumptions

The assumptions of static-micro economic theory underlie the budgeting done in this thesis. In addition, this study assumes perfect competition, proportionality and continuity of the production function. The assumption of perfect competition implies that factor and product prices are independent of the actions of any single buyer or seller. Thus, budgets can be constructed over the relevant firm sizes without adjusting prices. There is little evidence to indicate that the markets for inputs and rubber at the farm level in Nigeria are less than perfectly competitive. The number of buyers and sellers is too great to permit significant market control.

Continuity which permits expansion of the budgets to any size farm, occurs when all inputs are divisible. In actual fact, however, one major input in rubber production, processing facilities, is indivisible. To expand firm size, all other inputs and output are expanded before including the costs of the processing plant. Fortunately, processing plant size does not effect output, except to determine the maximum product of a farm. Both plants included in the study are assumed capable of processing the latex produced on a 20-acre farm.

The Applications of Budgeting

Budgeting is useful for choosing between alternative enterprises, for choosing between alternative organizations or technologies and for

projecting the returns from a given organization under alternative assumptions about endogenous variables. But, budgeting cannot be used to determine the optimum output level of a given productive organization.

The Budgeting Process

Budget Descriptions

Six budgets are computed for each of four organizations: ordinary lump production, sun-dried sheet production, cooperative processing and clean lump production. Expenses and revenues are computed with three price combinations: current (1964) prices and costs, a 10 percent decrease in rubber prices and a 10 percent increase in domestically produced input costs, and a 20 percent increase in costs and a 20 percent decrease in prices. Each price-cost combination is computed both with and without clearing costs, thus, bringing the total to six budgets for each organization.

Private processing of sheets is budgeted for three farm sizes: 5, 10 and 20 acres. Private processing is the only organization under which expenses and revenues vary with farm size because it is the only organization which has a large, fixed cost, processing plant. In addition to the six budgets listed above, each farm-size is budgeted with two processing plants, one costing £222 and the other costing £100. Thus, 12 budgets are computed for each of the three farm sizes, making a total of 36.

Assumptions Common to All Budgets

The budgets all assume communal land which costs the user no money. Because land can either be sold or another crop planted on it, it does have an opportunity cost. Since net revenue is computed as a residual, it includes returns to the land. Even though many laborers are unpaid, the budgets assume that all are currently paid 4.75 shillings a day. Tappers receive one-half of gross returns and do not pay any part of variable costs. Budgets for farms intercropping rubber with arable crops do not include clearing costs, but budgets of farms planting rubber alone include the costs of labor, meals and equipment used for clearing. Although equipment is a fixed cost, it is treated as a variable cost to simplify computations. The average cost of equipment on a three-acre farm is included in the budgets. Inasmuch as equipment costs are a negligible part of total costs, e.g., about three percent for a one-acre farm, the effects on the results are insignificant. All labor, meals and equipment costs presented in Table 37 are derived from the data collected in the input-output survey and reported in the previous chapter.

Three alternative assumptions are made about the costs of domestically produced inputs: current costs, costs inflated by 10 percent and costs inflated by 20 percent. Domestically produced inputs include all labor, except tappers, coconut shell and snail cups and meals. They do not include tapping labor, pails, knives, buckets and processing plants. All world market prices except rubber prices are assumed constant. The budgets use alternative levels of input prices because domestic prices in Nigeria are increasing steadily. No adequate price

Table 37: Costs per Acre Included in the Budgets of Five Ordinary Smallholder Organizations, Midwestern Nigeria, 1964.

Expense	Ordinary Lump	Clean Lump	B-2 Sheet	Cooperative Sheet	Private Sheet
<u>----- Shillings per acre -----</u>					
Clearing Labor	194.2	194.2	194.2	194.2	194.2
Clearing Meals	39.5	39.5	39.5	39.5	39.5
Clearing Equipment	5.4	5.4	5.4	5.4	5.4
Planting Labor	49.1	49.1	49.1	49.1	49.1
Planting Meals	5.3	5.3	5.3	5.3	5.3
Maintenance Labor	78.9	78.9	78.9	78.9	78.9
Maintenance Meals	30.2	30.2	30.2	30.2	30.2
Coagulant	18.4	11.5	18.4	11.5	11.5
Anti-coagulant	--	17.5	6.6	17.5	17.5
Cooperative Charges	--	--	--	60.7	--
Marked Roller Rent	--	--	12.0	--	--
Processing Equipment	17.9	39.0	25.5	43.8	43.8

index for the country as a whole exists, but price indices in selected cities have increased significantly. The Ibadan and Lagos consumer price indices rose from 100 to 137 and to 145 respectively between 1953 and 1962.² In addition, a recent increase in wage rates paid the employees of government and foreign firms will probably accelerate inflation. In view of the inflation experienced over the last decade, the projection of a 20 percent price rise is very conservative.

Rubber output of all organizations is computed assuming an annual average yield per acre of 188 gallons of latex containing 2.15 pounds of dry rubber per gallon. These parameters are based on the averages of farms participating in the input-output survey. Tapping is budgeted to begin in year 10 and to continue for 18 years.³ Yields in years 10, 11 and 12 are adjusted for the immaturity of trees by computing them at 81, 88 and 96 percent of mature output respectively.

Yields per acre and per tapper were hypothesized to be higher when producing lumps than when producing sheets. To produce sheets, the tapper must return to the trees quickly to collect the latex before it coagulates, but if he produces lumps, he can allow the latex to coagulate in the cup. The number of trees tapped can, therefore, be increased when producing lump. Assuming a fixed acreage per tapper, then yield per acre and per tapper will be higher when producing lumps.

²Federation of Nigeria, Federal Office of Statistics, Digest of Statistics, XII, No. 4 (October 1963), p. 12.

³Year one is the year of planting.

Although the mean yield per acre of lump producers is 50 gallons more than the yield of sheet producers, the difference is not significant at the ten percent level. Possibly if the sample had been larger, the hypothesis would have been substantiated. The yields of the budgeted organizations are assumed to be equal.

Assumptions of the Individual Budgets

The current price of ordinary lump is 2.7 pence per pound which was the average price early in 1964. Adulteration is assumed to increase the quantity of lump per gallon of latex from 6 to 6.6 pounds. Coagulant costs are the average of costs collected in the input-output survey. Processing equipment includes knives, coconut and snail shell cups, files and buckets, but not strainers.

Budgets for sun-dried sheet production assume that one-third of the dry rubber content of latex is sold as lump and the remainder is sold as R.S.S. VI grade sheets. The current (1964) price for lump is 2.7 pence per pound and the current (1964) price of sun-dried sheets is 10.75 pence, the average prices received by farmers in the input-output survey. Processing costs include costs of strainers and pans and rent for a marked roller.

Cooperative processing budgets assume that 10 percent of the dry rubber content of the farms' output is sold as adulterated lump and the remainder is sold as high quality sheet. Equipment charges include the costs of aluminum cups, spouts, strainers and pans. The costs of formic acid and ammonia are derived from the quantities recommended by the Mid-western Nigeria Ministry of Agriculture and Natural Resources. The

current price of sheets is 13.88 pence, the input-output survey average price of sun-dried sheets, plus the average difference between the prices of sun-dried sheets and R.S.S. II between 1959 and 1961. The budgets exclude fees for joining the cooperative because they are insignificant when the farm is relatively large and the cooperative has many members. Most cooperatives charge two pence per pound of sheet, which the budgets include.

The private sheet processor is assumed to make his sheets in one of two facilities, one costing £222 and the other costing £100. Otherwise, the assumptions underlying the budgets of private sheet producing are the same as those made for cooperative sheet processing. The two pence per pound cooperative charge and the costs of building the cooperative processing facilities are not included. The higher cost processing plant is the average cost of cooperative plants in the Region and the lower is a minimum figure quoted by a larger farmer in the Midwest.

This study envisions clean lump production which does not generally occur in the Midwest. Because the marketing system does not differentiate prices of different qualities of lump, most farmers adulterate and none attempt to keep their lumps clean. The budget for clean lump assumes an adjusted marketing system in which middlemen pay higher prices for high quality lumps. The budgets assume a gallon of latex yields six pounds of lump and that the current price of clean lump is four pence per pound, derived by assuming the full difference in the price of high and low quality crepe, the product made from lumps, is passed on to the producer. In view of the severe competition between

the crepe factories in Nigeria, this assumption does not appear unrealistic. The budget includes the costs of recommended amounts of ammonia and formic acid, and the equipment costs include aluminum cups and spouts and strainers.

Budget Computations

The calculations provide an estimate of the annual income earned by each productive factor: capital, labor, land and owner. These estimates provide a measure of the impact of investment in the alternative productive organizations on the individual and through him, on the economy. Using these data, the welfare implications of the alternative investments can be analyzed. They indicate the level of income individuals earn and the rate of return on investment.

Annual income is estimated by first computing gross revenue per acre, the sum of the two products, lump production per acre times its price and sheet production per acre times its price. To determine capital investment, establishment and maintenance costs during the first nine years are inflated by 7 percent per annum up to the first year of tapping, year 10. Annual depreciation is obtained by dividing capital investment by 18, the number of years of tapping. Then depreciation, tapping, collecting and processing costs are subtracted from gross revenue to determine the sum of the returns to capital, tappers, land and owners, called residual returns. Tappers' income, one-half of gross income is then deducted. Interest on capital is seven percent of the undepreciated balance remaining at the beginning of the year. Subtracting the interest leaves net revenue, the returns

to land and ownership.

In the budgets of private processing, capital costs include the per acre cost of smokehouses and factories. The initial cost of the factory and smokehouse, £222 or £100, is first divided by the assumed acreage to determine the cost per acre and this amount is added to establishment costs. The total is then divided by 18 to derive annual depreciation and the undepreciated balance is multiplied by seven percent to determine annual returns on capital. Subtracting the interest on capital from the difference between half of gross revenue and the costs of depreciation, tapping, collecting and processing determines net revenues.

Because mature annual yields are assumed constant, gross revenue is constant and interest and net revenue change by the same, constant amount. In reality, yield declines towards the end of a tree's life, but no adequate data were found quantifying the decline. Trees are first tapped when they are 9 years old, in year 10, but do not mature until year 13. From year 13 to year 27 yields are assumed constant and gross revenue and tapper's income do not vary. Only interest on capital and net returns change. Interest on capital decreases each year by seven percent of depreciation and net revenue increases by the same amount. For this reason, the tables summarizing annual costs and returns included in this chapter contain incomes only for the immature years, 10, 11 and 12, and years 13 and 27. During the intervening years, tapper's income and residual returns are constant, interest decreases by the interest of year 27, and net revenue increases by the same amount.

To make costs and returns comparable over long periods of time, they are discounted to year 1. Since incomes and expenses incurred during different years cannot be added together without some adjustment, returns are discounted to take into account the individual's preference for immediate income rather than future income. Discounting by 7 percent indicates that the average individual is indifferent when asked to choose between 1 shilling now and 1.07 shillings in a year. If asked to choose between a shilling now or less than 1.07 shillings in a year, he will always choose the shilling. But if offered more than 1.07 shillings in a year, he will prefer to wait. Thus, the discount is the cost of waiting for the income rather than having it immediately; discounting allows income from different years to be combined.

Capital costs are discounted because a future investment does not entail as great a sacrifice as an immediate one when the actual amounts are equal. During the period before an investor relinquishes his capital, he can use it for other purposes. A discount rate of 7 percent means that he is willing to pay 7 percent of the principal to keep the capital an additional year.

Discounted net revenue is computed by first subtracting processing, collecting, tapping costs and tapper's income from each annual gross revenue, discounting them by 7 percent to the year of planting and summing. Then establishment, processing, maintenance and factory costs are also discounted to year 1 and deducted from the sum of the discounted annual revenues. The result is discounted net revenues. Dividing discounted net revenues by the discounted capital costs yields the discounted rate of return.

Poor tapping is the chief cause of the short productive life of Nigerian trees. A tree tapped in the usual way has a productive life of less than one-third that of a tree tapped properly. In order to determine the impact of improved tapping on income, budgets assuming twice the normal productive life of the trees are constructed. Annual income is the same, but discounted net revenues are increased because of the longer tapping life of the trees. Discounted net revenues are recomputed assuming 18 additional tapping years at mature yields.

Subsistence Income

Obviously, comparing the incomes generated by each organization of rubber production is not completely satisfactory without comparing the incomes with some absolute standard. In this study, subsistence income is used as the absolute standard. Subsistence income is defined as the income needed to maintain life at minimal Nigerian standards. Average per capita income in Nigeria is about ₦30 per annum, only slightly above the subsistence level. Subsistence, then, is quantified arbitrarily at between ₦15 and ₦25 annual income. That means that a family of four must earn ₦60 to ₦100 per year. P. N. C. Okigbo reports that one-third of agricultural income in the old Western Region (this includes the Midwest) is derived from export crops and two-thirds from food crops.⁴ Application of this average to Midwestern rubber farmers who hire tappers and, therefore, can utilize their family labor to produce food, indicates they must earn ₦20 to ₦33 from

⁴P. N. C. Okigbo, Nigerian National Accounts 1950-57, (Enugu: The Federal Ministry of Economic Development, [1962]), p. 163.

rubber and the remainder from their food crops. But farmers and their families who tap their own trees must earn their entire income from rubber. Assuming that one in every five is a dependent incapable of tapping because of age, then the remaining four must earn £75 to £125 annually, an average of £18/15/- to £31/5/- each. Whether the owner hires tappers or taps, the rubber must provide approximately £20 to £30 income for subsistence.

Taxes and Foreign Exchange Earnings

In addition to farmers' earnings, the returns to the Government and the economy as a whole are also computed. The per acre tax revenues and foreign exchange earnings are calculated for each organization under the three price assumptions. Nigeria levies two taxes on rubber; the Regions exact a farthing per pound sales tax on all rubber exported; and the Federal Government collects a 10 percent ad valorem duty. Because the regional sales tax does not vary with value or type of rubber, but is simply a flat rate tax on each pound of rubber exported, it takes a larger proportion of the value of low quality exports. The Federal duty is much more complex because it varies with the average price of each grade on the Singapore market during the previous three months. As long as the average price is above 20 pence, the Government collects a flat 10 percent. When the price is below 20 but above 18 pence, the duty is the difference between the average and 18 pence. When the price falls below 18 pence, the duty is zero.

To compute the taxes from each organization, the following 1964 Malayan prices are assumed: high quality sheets, 21.5 pence;

sun-dried sheets, 18.75 pence; crepe produced from ordinary lump, 18 pence; and crepe produced from high-quality lump, 21.5 pence. Revenues when these prices fall 10 percent and 20 percent are also computed. All farms are assumed to produce 404 pounds of dry rubber per acre. To determine the quantity of crepe obtained from lump produced on farms also selling sheets, the weight of sheet is deducted from 404 pounds.

Foreign exchange earnings per acre from each organization is the product of the price of sheet less 2 pence times the weight of sheet plus the price of crepe less 2 pence times the weight of crepe. Two pence are deducted for freight costs because most Nigerian rubber is shipped in foreign ships. Foreign exchange earnings are equal to the total gross earnings to the economy from producing rubber.

Budget Results

Ordinary Lump

At current prices and costs, an average mature acre of ordinary smallholder rubber used to produce ordinary lumps generates residual returns of 202.7 shillings per acre. (Table 38 summarizes the budgets of ordinary lump production.) The largest share goes to the tapper, 68 percent. The remainder, 64.3 shillings, goes to the owner or owners. A ten-acre farm which is not tapped by its owner is estimated to provide an income of £32/3/- annually at maturity. If the owner and his family tap the farm, they will earn £101/7/- annually for a 4.5 man-years of tapping of £22/10/- per man-year. Estimated discounted net revenues are 210 shillings over the life of the

Table 38: Revenue from Ordinary Lump Production: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Inter- planted	Residual Returns	153.6	171.6	192.5	202.7	202.7
		Tapper's Income	112.2	121.9	133.0	138.5	138.5
		Interest	74.1	44.5	41.9	39.3	2.6
		Net Revenue	- 5.7	5.4	17.6	25.0	61.7
Current Prices and Costs	Planted Alone	Residual Returns	130.1	148.3	169.1	179.4	179.4
		Tapper's Income	112.2	121.9	133.0	138.5	138.5
		Interest	77.2	72.9	68.6	64.3	4.3
		Net Revenue	- 59.1	-46.4	-32.5	-23.4	36.7
20% Price Decrease and 20% Cost In- crease	Inter- planted	Residual Returns	101.9	116.1	132.5	140.5	140.5
		Tapper's Income	89.7	97.5	106.4	110.8	110.8
		Interest	56.4	53.3	50.1	47.0	3.1
		Net Revenue	- 44.2	-34.6	-24.0	-17.2	26.6
20% Price Decrease and 20% Cost Increase	Planted Alone	Residual Returns	73.8	88.0	104.3	112.4	112.4
		Tapper's Income	89.7	97.5	106.4	110.8	110.8
		Interest	91.9	86.7	81.6	76.5	5.1
		Net Revenue	-107.8	-96.2	-83.7	-78.2	- 6.7

farm, a return of 58 percent on discounted capital costs. (See Table 39.) If the trees are planted alone (i.e., without interplanting), owners income at maturity averages 24.3 shillings less per annum and discounted net revenue is only 23 shillings. A mature acre provides only 8.4 shillings in tax revenues and £26/19/- in foreign exchange earnings. (See Table 40.)

Table 39: Discounted Net Revenues and Discounted Rate of Returns from Ordinary Smallholdings: Alternative Products, Prices, Costs and Planting Methods, Midwestern Nigeria, 1964.

Products	Current Prices and Costs		10 Percent Increase in Costs and 10 Percent Decline in Prices		20 Percent Increase in Costs and 20 Percent Decline in Prices	
	Net Revenue	Discounted Returns	Net Revenue	Discounted Returns	Net Revenue	Discounted Returns
	<u>Shillings</u>	<u>Per-cent</u>	<u>Shillings</u>	<u>Per-cent</u>	<u>Shillings</u>	<u>Per-cent</u>
Ordinary Lumps						
interplanted	210	58	96	24	- 19	- 4
no arable crops	23	4	-161	-25	-294	- 41
Sun-Dried Sheets						
interplanted	257	70	123	31	- 12	- 3
no arable crops	24	4	-134	-20	-287	- 40
Cooperative Processing						
interplanted	149	41	- 15	- 4	-179	- 41
no arable crops	- 85	-14	-272	-41	-455	- 64
Private Sheet Processing						
interplanted	493	135	329	82	165	38
no arable crops	259	43	72	11	-111	-16
Clean Lump						
interplanted	305	83	162	54	26	6
no arable crops	71	12	- 95	-14	-249	-35

Table 40: Government Revenue and Foreign Exchange Per Acre of Mature Ordinary Smallholdings, Midwestern Nigeria, 1964.

Organization	Prices	Government Revenues			Foreign Exchange
		Regional Sales Tax	Federal Export Duty	Total Revenue	
		<u>Shillings per acre</u>			
Ordinary Lumps	Current	8.4	0	8.4	438.7
	Reduced 10%	8.4	0	8.4	484.8
	Reduced 20%	8.4	0	8.4	430.9
Sun-Dried Sheets and Lumps	Current	8.4	18.9	27.4	559.7
	Reduced 10%	8.4	0	8.4	503.8
	Reduced 20%	8.4	0	8.4	447.8
Private and Cooperative Processing	Current	8.4	65.2	73.6	644.8
	Reduced 10%	8.4	41.0	49.4	580.4
	Reduced 20%	8.4	0	8.4	515.9
Clean Lumps	Current	8.4	72.4	80.8	656.5
	Reduced 10%	8.4	45.5	53.9	590.9
	Reduced 20%	8.4	0	8.4	525.2

When prices decrease 20 percent and costs increase 20 percent, estimated revenues fall significantly. Residual returns at maturity are estimated to be 140.5 shillings, only 69 percent of their returns with current prices and costs. Because of higher costs and lower gross revenue, net revenues are negative until year 19 and discounted net revenues are negative, -19 shillings. The budgets indicate that a farmer providing only capital and ownership earns only 39.7 shillings at maturity or £1917 = annually on a ten-acre farm. If the owner and

his family tap, they earn £70/5/- annually once the trees are mature. A ten-acre rubber farm which is not interplanted provides a negative income to the owner who hires tappers and only provides £56/4/- to the family that taps. Because current price is below the minimum on which a duty is charged, a fall in price does not decrease the tax revenues from an acre of trees producing ordinary lump. Foreign exchange earnings fall the assumed 20 percent to £20/9/-.

Sun-Dried Sheet Production

Sun-dried sheet production provides higher incomes than ordinary lump production. (Table 41 summarizes the budgets of sun-dried sheet production.) At current (1964) prices and costs, production of sun-dried sheet from mature interplanted rubber provides residual returns of 247.4 shillings per acre, 44.7 shillings more than residual returns from ordinary lump production. A large proportion of the increase goes to the tapper. Estimated tapper's income is 173.6 shillings per acre annually, a 35.1 shilling increase. Interest on capital is unchanged because capital costs are the same. Average returns to owner and land at maturity increase 9.5 shillings. Because annual net revenue only increases a small amount, discounted net revenues are only 47 shillings higher, 257 shillings per acre. Owners of ten acres who hire tappers earn £36/17/- when their trees mature and families who tap earn £123/14/- annually, £27/10/- each, a subsistence income. Trees planted alone provide a negative discounted net revenue and lower net revenues, but more interest and about 25 shillings less in residual returns each year. But, because capital costs are greater, interest is 64 percent higher each

Table 41: Revenue from Sun-Dried Sheet Production: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Inter- planted	Residual Returns	185.8	209.1	234.7	247.4	247.4
		Tapper's Income	140.5	153.0	166.8	173.6	173.6
		Interest	47.1	44.5	41.9	39.3	2.6
		Net Revenue	= 1.8	11.6	26.0	34.5	71.1
Current Prices and Costs	Planted Alone	Residual Returns	161.9	185.3	210.8	223.5	223.5
		Tapper's Income	140.5	153.0	166.8	173.6	173.6
		Interest	77.2	72.9	68.6	64.3	4.3
		Net Revenue	= 55.8	= 40.7	= 24.6	= 14.5	45.6
20% Price Decrease and 20% Cost In- crease	Inter- planted	Residual Returns	122.2	140.6	160.6	170.6	170.6
		Tapper's Income	112.4	122.4	133.4	138.9	138.9
		Interest	56.4	53.3	50.1	47.0	3.1
		Net Revenue	= 46.5	= 35.1	= 22.9	= 15.3	28.5
20% Price Decrease and 20% Cost In- crease	Planted Alone	Residual Returns	94.1	112.4	132.5	142.4	142.4
		Tapper's Income	112.4	122.4	133.4	138.9	138.9
		Interest	91.9	86.7	81.6	76.5	5.1
		Net Revenue	= 110.1	= 96.7	= 82.6	= 73.0	= 1.6

year. The result is a very low net revenue. Net revenues are negative the first seven years of tapping and never exceed 45.6 shillings per acre. Government revenue and foreign exchange earnings generated by an acre are 27.4 shillings and £28 respectively.

When prices fall 20 percent and domestic costs increase 20 percent, residual returns from producing sun-dried sheets decline to 170.6 shillings per acre, 31 percent lower than residual returns when prices and costs are at current levels. Farmers hiring tappers earn 31.6 shillings per annum when their trees mature or £15/16/- from a ten-acre holding. This is less than subsistence. Families tapping ten acres of interplanted trees average £18/19/- per man-year of tapping, also less than subsistence. Tax revenue per mature acre declines to 8.4 shillings because the price is below the taxable minimum and foreign exchange earnings per mature acre are £22/8/-.

Cooperative Processing

Residual returns from producing high quality sheets cooperatively exceed those from either sun-dried sheets or ordinary lumps, but because processing costs are very high, net revenues are low. The tapper earns 80 percent of residual returns as compared to 70 percent in the other organizations. (Budget results are presented in Table 42.) A farmer hiring tappers earns 54.8 shillings per acre at maturity or, if he owns ten acres, £26/8/- annually, a subsistence income. This is less than owner's earnings when hired tappers produce ordinary lump or sun-dried sheets. Estimated discounted net revenue is only 14 shillings per acre. But a family which does its own tapping earns considerably

Table 42: Revenue from Producing High Quality Sheets Processed Cooperatively: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method	Revenue Source	Year				
			10	11	12	13	27
----- Shillings per acre -----							
Current Prices and Costs	Inter= planted	Residual Returns	211.7	237.2	266.1	280.5	280.5
		Tapper's Income	182.8	198.6	216.7	225.7	225.7
		Interest	47.1	44.5	41.9	39.3	2.6
		Net Revenue	- 18.2	- 6.0	- 7.6	15.6	52.2
Current Prices and Costs	Planted Alone	Residual Returns	187.9	213.3	242.2	256.6	256.6
		Tapper's Income	182.8	198.6	216.7	225.7	225.7
		Interest	77.2	72.9	68.6	64.3	4.3
		Net Revenue	- 72.1	- 58.2	- 43.0	- 33.4	26.7
20% Price Decrease and 20% Cost In= crease	Inter= planted	Residual Returns	131.3	150.3	172.0	182.9	182.9
		Tapper's Income	146.3	158.9	173.3	180.6	180.6
		Interest	56.4	53.3	50.1	47.0	3.1
		Net Revenue	- 71.4	- 61.9	- 51.4	- 44.7	- .8
20% Price Decrease and 20% Cost In= crease	Planted Alone	Residual Returns	103.2	122.2	143.9	154.7	154.7
		Tapper's Income	146.3	158.9	173.3	180.6	180.6
		Interest	91.9	86.7	81.6	76.5	5.1
		Net Revenue	-135.0	-123.5	-111.1	-102.4	- 31.0

more than when producing ordinary lump or sun-dried sheet. Income from a mature acre is 280.5 shillings per annum and from a ten-acre farm is £31/3/- per man-year of tapping. If the trees are planted alone, residual returns are lower, but still are substantial. A mature farm tapped by hired laborers provides its owner with 8.4 shillings per acre or £4/4/- from ten acres and a mature farm tapped by its owner and his family provides an income of 234.1 shillings per acre or £29/16/- per tapping man-year. Discounted net revenue from the average farm is negative, -85 shillings. Taxes collected by the Government on the rubber produced by a mature acre are considerable, 73.6 shillings per acre, and foreign exchange earnings are £32/5/- per acre.

Tapper's income exceeds residual returns during the immature years and is only 2.3 shillings less than residual returns after the trees mature. Net revenue is negative throughout the life of the farm, but because the owner also earns interest on his capital, he receives 2.3 shillings per acre once the trees have matured. Discounted net revenue, however, are negative. The owners of average mature ten-acre farms can only earn £1/3/- annually if they hire tappers, but if they and their families tap, they will earn a minimum subsistence, £20/5/- each. Farmers who plant their trees alone will earn a negative income if they hire tappers, but will earn £81/1- or £18/2/- per tapping man-year if they themselves tap.

Private Processing

The budgets of farms that process rubber privately are computed with three farm sizes, 5, 10 and 20 acres and two processing plants,

one costing £222 and the other costing £100. Returns vary widely according to the combination. Residual returns from a five-acre farm processing privately with the £100 plant approximately equal residual returns from processing cooperatively, but residual returns, when processing in the £222 plant, are considerable less. Owners of five-acre holdings processing in a £100 plant average 53.3 shillings per acre if they hire tappers and 279.0 shillings per acre or £21 per tapping man-year if they and their families tap. (See Table 43.) If they own the larger plant, their income is -22.6 shillings per acre when hired tappers are utilized and 203.1 shillings if they and their families tap. Producers of sun-dried sheets earn more whether they tap or hire tappers. Government tax revenues and foreign exchange earnings from an acre of rubber are the same as those generated when the latex is processed cooperatively, 73.6 shillings and £32/3/- respectively. (See Table 40.)

When prices fall and costs increase 20 percent, private processing of latex produced on an average five-acre farm will provide its owners relatively low incomes if they hire tappers, but relatively high incomes if they do their own tapping. Net revenues on a five-acre farm are always negative. Because interest is substantial, owners income is small, but positive with the £100 plant, but still negative with the large one. Residual returns per acre, however, exceeds the amount which can be earned producing sun-dried sheets or ordinary lumps if the small plant is used. The large plant provides less residual returns than all other organizations. Farmers tapping and processing in the £100 plant are estimated to earn £20/3/- per man-year of tapping, a low subsistence

Table 43: Revenues from High Quality Privately Processed Sheet Production on a Five-Acre Smallholding: Alternative Prices, Costs, Planting Methods and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- Shillings per acre -----							
Current Prices and Costs	Interplanted £222 Plant	Residual	122.8	152.4	186.2	203.1	203.1
		Returns					
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	109.3	103.2	97.1	91.1	6.1
		Net					
		Revenue	-169.3	-149.5	-127.7	-113.7	- 28.7
Current Prices and Costs	Planted Alone £222 Plant	Residual					
		Returns	99.0	128.5	162.3	179.2	179.2
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	139.4	131.6	123.9	116.2	7.7
		Net					
		Revenue	-223.2	-201.7	-178.3	-162.6	- 54.3
20% Price Decrease and 20% Cost Increase	Interplanted £222 Plant	Residual					
		Returns	42.3	65.5	92.1	105.4	105.4
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	118.6	112.0	105.4	98.8	6.6
		Net					
		Revenue	-222.5	-205.4	-186.7	-173.9	- 81.7
20% Price Decrease and 20% Cost Increase	Planted Alone £222 Plant	Residual					
		Returns	14.3	37.4	63.9	77.3	77.3
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	154.0	145.5	136.9	128.3	8.6
		Net					
		Revenue	-286.1	-277.0	-246.4	-231.6	-111.8
Current Prices and Costs	Interplanted £100 Plant	Residual					
		Returns	198.7	228.3	262.1	279.0	279.0
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	75.1	70.9	66.8	62.6	4.2
		Net					
		Revenue	- 89.2	-41.3	-21.4	- 9.3	49.1

Table 43. (Continued)

Prices and Costs	Planting Method and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Planted Alone	Residual					
		Returns	174.8	204.4	238.2	255.1	255.1
	£100 Plant	Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	105.2	99.3	93.5	87.7	5.8
	Net						
		Revenue	-113.2	- 93.6	- 72.0	- 58.3	23.5
20% Price Decrease and 20% Cost Increase	Interplanted	Residual					
		Returns	118.3	141.4	168.1	181.3	181.3
	£100 Plant	Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	84.4	79.7	75.0	70.3	4.7
	Net						
		Revenue	-112.4	- 97.2	- 80.4	- 69.6	-3.9
20% Price Decrease and 20% Cost Increase	Planted Alone	Residual					
		Returns	90.1	113.3	139.8	153.2	153.2
	£100 Plant	Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	119.9	113.2	106.5	99.9	6.7
	Net						
		Revenue	-176.0	-158.8	-140.0	-127.3	- 34.0

income. Tax revenues are 8.4 shillings per acre and foreign exchange earnings are £25/16/- per acre.

Because processing plant costs are divided among more acres, the revenues earned on a ten-acre holding exceed those earned on a five-acre farm. (See Table 44.) At current prices and costs, residual returns exceed those of any other organization except cooperative processing, but are less than net revenues from all other organizations except private processing with five acres. At current prices and costs, residual returns from a mature acre are 272.1 shillings with the large

Table 44: Revenues from High Quality Privately Processed Sheet Production on a Ten-Acre Smallholding: Alternative Prices, Costs, Planting Methods and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Interplanted £222 Plant	Residual	191.8	221.4	255.2	272.1	272.1
		Returns					
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	78.2	73.9	69.5	65.2	4.3
		Net					
		Revenue	- 69.2	- 51.1	- 31.0	- 18.8	42.1
Current Prices and Costs	Planted Alone £222 Plant	Residual	168.0	197.6	231.3	248.2	248.2
		Returns					
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	108.3	102.3	96.2	90.2	6.0
		Net					
		Revenue	-123.1	-103.3	- 81.6	- 67.7	16.5
20% Price Decrease and 20% Cost Increase	Interplanted £222 Plant	Residual	111.4	134.6	161.1	174.5	174.5
		Returns					
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	87.5	82.6	77.8	77.9	4.9
		Net					
		Revenue	-122.3	-106.9	- 90.0	- 79.0	- 10.9
20% Price Decrease and 20% Cost Increase	Planted Alone £222 Plant	Residual	83.3	106.4	133.0	146.3	146.3
		Returns					
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	122.9	116.1	109.3	102.4	6.8
		Net					
		Revenue	-185.9	-168.6	-149.6	-136.7	- 41.1
Current Prices and Costs	Interplanted £100 Plant	Residual	229.8	259.4	293.2	310.1	310.1
		Returns					
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	61.1	57.7	54.3	50.9	3.4
		Net					
		Revenue	- 14.1	3.0	22.2	33.4	81.0

Table 44. (Continued)

Prices and Costs	Planting Method and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Planted Alone £100 Plant	Residual					
		Returns	205.9	235.5	269.3	286.2	286.2
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	91.2	86.1	81.1	76.0	5.1
		Net					
		Revenue	- 68.1	- 49.2	- 28.4	- 15.5	55.4
20% Price Decrease and 20% Cost Increase	Interplanted £100 Plant	Residual	149.4	172.5	199.1	212.4	212.4
		Returns					
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	70.4	66.5	62.6	58.7	3.9
		Net					
		Revenue	- 67.3	- 52.9	- 36.8	- 26.8	27.9
20% Price Decrease and 20% Cost Increase	Planted Alone £100 Plant	Residual					
		Returns	121.2	144.4	170.9	184.3	184.3
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	105.9	100.0	94.1	88.2	5.9
		Net					
		Revenue	-130.9	-114.5	- 96.5	- 84.5	- 2.1

plant and 310.1 shillings with the small plant. Net revenue is 42.1 shillings and 81.0 shillings using the large and small plants respectively. Farmers owning ten mature acres but not themselves tapping earn 46.4 shillings per acre with a £222 plant and 84.4 shillings per acre with a £100 plant. In total, the farmer earns £23/4/- annually and 42/4/- annually with the large and small processing facilities respectively. Farmers and their families who tap earn the entire residual returns, 272.1 shillings per acre if they process in the £222 unit and 310.1 shillings per acre if they process in the £100 unit. These earnings are equivalent

to £30/4/- and £34/9/- per tapping man-year at maturity. Trees planted alone combined with the small processing plant provide higher residual returns than any other organization using interplanted trees. Farmers and their families tapping trees planted alone and processing in the £100 plant earn £31/16/- per man-year. If they hire tappers, the owners receive £42/4/- annually. Tax revenues and foreign exchange earnings are not affected by the size of the holding and are equal to earning from five acres.

When prices are decreased 20 percent and costs increased 20 percent, residual returns average 174.5 shillings per mature acre with the large facility and 212.4 shillings per acre with the small processing plant. With the low price and high cost assumption, both exceed the residual returns of all the other organizations already discussed except cooperative processing. Net revenues are negative in both cases for much of the tapping period, but because interest is high, owners of the small plant earn a positive return. Owners of ten acres and the large plant earn -6.0 shillings per acre if they hire tappers, and owners of ten acres and the small plant earn 31.8 shillings per acre. Both groups earn less than subsistence. If the owners tap their farms, they earn 174.5 shillings per acre with the £222 processing plant and 212.4 shillings with the £100 plant. Government tax revenues and foreign exchange earnings fall to 8.4 shillings per acre and £25/16/- per acre respectively.

A 20-acre holding provides a larger income than any other organization discussed thus far. (See Table 45.) Assuming current prices and costs, residual returns per acre at maturity with either plant are higher than revenues from all other organizations, 306.7 shillings with the larger

Table 45: Revenues from High Quality Privately Processed Sheet Production on a 20-Acre Smallholding: Alternative Prices, Costs, Planting Methods and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- Shillings per acre -----							
Current Prices and Costs	Interplanted £222 Plant	Residual					
		Returns	226.4	256.0	290.0	306.7	306.7
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	62.7	59.2	55.7	52.2	3.5
		Net					
		Revenue	- 19.1	- 1.8	17.4	28.7	77.5
Current Prices and Costs	Planted Alone £222 Plant	Residual					
		Returns	202.5	232.1	765.9	282.8	282.8
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	92.7	87.6	82.4	77.3	5.2
		Net					
		Revenue	-73.0	- 54.1	- 33.2	- 20.2	51.9
20% Price Decrease and 20% Cost Increase	Interplanted £222 Plant	Residual					
		Returns	145.9	169.1	195.7	209.0	209.0
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	71.9	67.9	63.9	59.9	4.0
		Net					
		Revenue	- 72.3	- 57.8	- 41.6	- 31.5	24.5
20% Price Decrease and 20% Cost Increase	Planted Alone £222 Plant	Residual					
		Return	117.8	141.0	167.5	180.9	180.9
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	107.4	101.4	95.5	89.5	6.0
		Net					
		Revenue	-135.9	-119.4	-101.3	- 89.2	- 5.7
Current Prices and Costs	Interplanted £100 Plant	Residual					
		Returns	245.4	274.9	308.7	325.6	325.6
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	54.1	51.1	48.1	45.1	3.0
		Net					
		Revenue	8.4	25.2	44.0	54.8	96.9

Table 45. (Continued)

Prices and Costs	Planting Methods and Pro- cessing Plant	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Planted Alone £100 Plant	Residual	221.5	251.1	284.9	301.8	301.8
		Returns					
		Tapper's					
		Income	182.8	198.6	216.7	225.7	225.7
		Interest	84.2	79.5	74.8	70.2	4.7
		Net					
		Revenue	- 45.5	- 27.1	- 6.7	5.9	71.4
20% Price Decrease and 20% Cost Increase	Interplanted £100 Plant	Residual	164.9	188.1	214.6	228.0	228.0
		Returns					
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	63.4	59.8	56.3	52.8	3.5
		Net					
		Revenue	- 44.7	- 30.7	- 15.0	- 5.4	43.9
20% Price Decrease and 20% Cost Increase	Planted Alone £100 Plant	Residual	136.8	159.9	186.5	199.8	199.8
		Returns					
		Tapper's					
		Income	146.3	158.9	173.3	180.6	180.6
		Interest	98.9	93.4	87.9	82.4	5.5
		Net					
		Revenue	-108.3	- 92.3	- 74.7	- 63.1	13.8

processing facility and 325.6 shillings with the smaller processing unit. Net revenues also exceed net revenues of any other organization. Farmers who hire tappers earn 81.0 shillings per acre with the £222 processing plant and 99.9 shillings per acre with the small processing plant. If they and their families tap, income per man-year of tapping averages £34/2/- with the £222 plant and £36/4/- with the £100 plant. If the trees are planted alone, residual returns and net revenues decline about 25 shillings per acre. Tax and foreign exchange earnings are the same

for all farms processing privately regardless of size.

When prices are decreased 20 percent and costs increased 20 percent, earnings fall. Residual returns decrease almost 100 shillings per acre at maturity and net revenue decline over 50 shillings. Even so, private processing on 20-acre farms is the most profitable organization when prices fall 20 percent and costs increase 20 percent. The larger processing facility and a 20-acre farm provide its owner with 28.5 shillings per acre if the owner hires tappers, and 209.0 shillings per acre if the owner and his family tap. Average income per tapper is £23/4/- with the large plant and £25/6/- with the small one.

Clean Lump Production

Clean lump production is the most profitable of all the organizations budgeted. (Revenues are shown in Table 46.) It returns 362.9 shillings per acre residual returns when the trees mature and 125.9 shillings net revenue during the last year of tapping. Farmers owning ten acres from which clean lumps are produced average £64/5/- when their trees are mature if they do not tap, and average £40/6/- per tapper if they and their families tap. When the trees are planted alone, residual returns and net revenue fall about 25 shillings per acre at maturity. Discounted net revenues from interplanted trees are approximately 305 shillings per acre. Government revenues and foreign exchange earnings exceed all other organizations, 80.8 shillings per mature acre and £32/17/- per mature acre respectively.

When prices fall 20 percent and domestic costs increase 20 percent, returns from clean lump production decline, but are still high.

Table 46: Revenues from Clean Lump Production: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Prices and Costs	Planting Method	Revenue Source	Year				
			10	11	12	13	27
----- <u>Shillings per acre</u> -----							
Current Prices and Costs	Interplanted	Residual					
		Returns	279.2	310.1	345.3	362.9	362.9
		Tapper's					
		Income	189.8	206.3	225.0	234.4	234.4
		Interest	417.1	44.5	41.2	39.3	2.6
		Net					
		Revenue	42.3	59.3	78.4	89.2	125.9
Current Prices and Costs	Planted Alone	Residual					
		Returns	255.9	286.7	321.2	339.5	339.5
		Tapper's					
		Income	189.8	206.3	225.0	234.4	234.4
		Interest	77.2	72.9	68.6	64.3	4.3
		Net					
		Revenue	-11.1	7.6	27.6	40.8	100.8
Prices Decrease 20% and Costs Increased 20%	Interplanted	Residual					
		Returns	196.5	220.8	248.4	262.3	262.3
		Tapper's					
		Income	151.8	165.0	180.0	187.5	187.5
		Interest	56.4	53.3	50.1	47.0	3.1
		Net					
		Revenue	-11.8	- 2.5	18.3	27.8	71.6
Prices Decreased 20% and Costs In- creased 20%	Planted Alone	Residual	168.3	192.6	220.3	234.1	234.1
		Returns					
		Tapper's					
		Income	151.8	165.0	180.0	187.5	187.5
		Interest	91.9	86.7	81.6	76.5	5.1
		Net					
		Revenue	-75.4	-59.1	-41.4	-29.9	41.5

Residual returns are 262.3 and 234.1 shillings per acre from trees interplanted and planted without arable crops respectively. Farmers income is 74.7 shillings and 46.6 shillings per acre respectively.

The average farm of ten mature acres provides an income to families who tap of £37/12/- annually, if interplanted with arable crops and £26 if planted alone. Discounted net revenues are 71 shillings per acre. Tax revenues, however, are the same as those of all the other organizations, 3.4 shillings per acre. Foreign exchange earnings are £26/3/- per mature acre, only 13.5 shillings less than earnings provided by ordinary lump at current prices.

Improved Tapping

Table 47 shows the additional discounted net revenues that accrue when tapping is improved so that each panel can be tapped twice. Improved tapping techniques would assure the profitability of all the organizations except cooperative processing under all conditions of price and costs. Profits per acre would be substantially increased under all organizations.

Conclusions

Current Prices and Costs

At current prices and costs, clean lump production provides the largest residual returns of any of the alternative products of the ordinary smallholder. The next most profitable is private processing, then cooperative processing, sun-dried sheet production, and finally, ordinary lump production. Because residual returns are high, a family that performs all operations, including tapping, on its own farm would get the highest income possible from clean lump production; the same family would get the lowest income producing sun-dried sheet or ordinary lump. Only private processing on a five-acre holding provides as low

Table 47: Increase of Discounted Net Revenue from Improved Tapping Techniques: Alternative Products, Costs and Prices, Mid-western Nigeria, 1964.

Product	Increase of Discounted Net Revenue		
	Current Costs and Prices	10% Increase in Costs and a 10% Decrease in Price	20% Increase in Costs and a 20% Decrease in Price
-----Shillings per acre-----			
Ordinary Lump	175	151	128
Sun-Dried Sheets	190	161	131
Cooperative Processing	158	119	81
Private Processing	263	224	184
Clean Lump	205	173	141

an income. With ten-acre or larger holdings, incomes from clean lump production, private processing and cooperative processing are all above subsistence; incomes from sun-dried sheet and ordinary lump production on a ten-acre farm are at subsistence. Because their capital investment is large, incomes of farmers processing privately contain large amounts of interest. Income from the other organizations consists of a larger proportion of net revenue. The three organizations for producing clean lumps and high grade sheets provide large tapper's income. So farmers who tap their own farms earn large incomes primarily because they receive the tapper's income.

In addition to residual returns with present costs and prices, clean lump also provides the highest net revenue per acre of any of the

organizations. Private processing on a 20-acre farm or a ten-acre farm with the inexpensive factory and smokehouse follow. Sun-dried sheet production provides the next highest net revenue followed by ordinary lump production and cooperative processing. Private processing on a five-acre holding, using either plant, or a ten-acre holding, using the large plant, provides the smallest net revenues. The profitability of these organizations to farmers who hire tappers and thus earn only interest on their capital and net revenue fall in the same order. The relatively high place of sun-dried sheet production reflects its high net revenues and low tappers' incomes. Clean lump production and private processing on a 20-acre holding provide incomes far in excess of subsistence to the owner who hires tappers. Private processing on a ten-acre farm, with the £100 plant, sun-dried sheet and ordinary lump production all provide incomes above subsistence; the remaining organizations except private processing in a large plant with five-acres - which provides a negative income - all provide subsistence incomes.

Prices Decreased 20 Percent and Costs Increased 20 Percent

The relative profitability of the different organizations is virtually unchanged when prices fall and costs increase. The primary difference is the level of profits and income. When 1964 prices and costs are budgeted, all organizations provide at least subsistence income to farms tapped by the owners and their families, and provide subsistence incomes to farmers who hire tappers except those producing high quality sheet in a private plant from only five acres of rubber. But when prices are reduced 20 percent and costs are increased 20 percent,

most of the organizations provide inadequate incomes. Average ten-acre farms totally operated by owners and their families provide less than subsistence income to those producing sun-dried sheet and ordinary lumps, and provide only subsistence incomes to all other organizations. Farmers who hire tappers can only earn subsistence income or more by processing privately on a 20-acre holding with the small plant or producing clean lumps on a ten-acre farm. High-quality sheet production processing privately on a ten-acre or smaller farm processing cooperatively on any sized farm or producing ordinary lump or sun-dried sheets provide less than subsistence. Thus, when prices fall 20 percent and costs increase 20 percent, farmers will probably find that rubber production is only profitable if they tap and process themselves.

With prices reduced 20 percent and costs increased 20 percent, the budgets of the two most common organizations of ordinary smallholder rubber production indicate that they provide less than subsistence income. Thus, if prices fall and costs increase, these organizations may disappear. Smallholders will probably find it more profitable to produce other agricultural commodities or produce rubber in a different way. Because ordinary smallholders producing high-quality sheets cooperatively or privately will earn only a subsistence income, these alternatives will probably not be substituted, either, but some new commodity or improved rubber smallholdings will be selected instead.

Tax Revenues and Foreign Exchange

Because they have higher world market prices, high quality sheet and lump production provide the most tax revenues and foreign exchange.

At current prices, average tax revenues per mature acre vary from £4/16/- from clean lump production to 8 shillings from ordinary lump production, and foreign exchange per mature acre earnings vary between £32/16/- to £26/17/-, also for clean lump and ordinary lump production. A 20 percent reduction in prices causes all prices to fall below 18 pence per pound, the minimum price on which a duty is charged, so only the flat per pound regional sales tax is collected, 8 shillings per pound. Foreign exchange earnings vary between £26/5/- and £21/12/- per mature acre when prices decrease.

CHAPTER VIII

SURVEY AND BUDGETS OF IMPROVED SMALLHOLDINGS

Introduction

Since 1958, the Ministry of Agriculture and Natural Resources has encouraged smallholders to improve their rubber farms by selling them clonal seedlings and providing them with free instructions for planting and maintenance. Underlying the Ministry's program is the belief that improved smallholdings can compete on the world market because of their high yields. A major proportion of the Ministry's expenditures on the rubber industry have been devoted to encouraging farmers to plant clonal seedlings.

This chapter contains an analysis of the returns which can be expected from planting clonal seedlings bought from the Ministry. The cost data come from a survey of farmers who actually bought seedlings from the Ministry between 1958 and 1962. This chapter describes the collection of data for the survey, the survey findings and the resulting budget analysis.

Data Collection

Sample Selection

The sample was selected from a list of 1,079 farmers, living in all eight divisions of Midwestern Nigeria, who bought clonal seedlings from the Ministry of Agriculture and Natural Resources between 1958 and 1962. Although this list is the best available at the Benin City offices of the Ministry, it does not include farmers who purchased seedlings in Afenmai and Asaba Divisions during 1961 and 1962 or in

Urhobo Division during 1962. The records include the names of the farmers, the villages in which they live, the villages where the seedlings are planted, the number of seedlings each farmer purchased and the planting distances they used.

The sample was selected by first randomly choosing an area and then sampling the farmers living in the area. To select the area in which the survey was conducted, the farmers were first classified according to the area in which they live. All farmers living in villages within three miles of each other or living in the same clan or council were grouped together. Then the areas to be surveyed were selected by numbering the farmers from 1 to 1,079 and selecting 18 at random. The areas from which farmers were selected were sampled in the order in which they were chosen, but the farmers that were selected were not necessarily interviewed.

The particular farmers to be interviewed were picked by ordering all the farmers in the area randomly and then going down the list until six were interviewed. Assuming no substitution, the probability of selecting any farmer is $6/1,079$. The probability of interviewing the seventh farmer on the list for each village is $6/1,079 + 6/1,079$ times the probability that one of the first six could not be interviewed. The probability of interviewing the eighth is $6/1,079 + 6/1,079$ times the probability that two farmers higher on the list could not be interviewed. A farmer's availability and his costs are not related in any obvious way.

Although the probability of selecting any individual farmer is virtually constant, the probability of selecting farmers living in areas where many bought seedlings is higher than the probability of selecting

farmers in areas where few bought seedlings. The probability of selecting any area is in proportion to the number of farmers who purchased seedlings from that area so that if only a few farmers owning improved smallholdings live in a given area, the probability of selecting it is small. The substitution technique compounds this characteristic of the sample because in areas having many farmers, six farmers could easily be interviewed, but not in areas containing few. The techniques are purposefully designed to sample concentrations of improved rubber smallholders so that transportation costs of the enumerators are minimized.

The selection techniques bias the sample toward small farmers living in areas where planting clonal seedlings is common. The farmers are likely to be the most progressive, well-informed in the population. Hence, costs are probably lower for these farmers under any conditions than they would be on the average. Still these were the first years that Nigerian smallholders had ever planted clonal seedlings; techniques never before used on smallholdings were being tried for the first time; and inevitably costs must have been high. Hence, it can be expected that in the future establishment costs will be reduced even below the levels found in this survey.

Sample Size

Initially 48 farmers were to be interviewed, six in each of the eight areas and 24 per interviewer. One enumerator interviewed 32 farmers and the other 12, but the latter's work was discarded because of a significant upward bias in the estimate of costs. This enumerator had phrased his introductory statement so that the farmers believed that the Government planned to reimburse them for their expenses. Table 48

Table 48: Number of Improved Farmers Interviewed and Number of Observations, Improved Smallholders Survey, Midwestern Nigeria, 1964.

Village	Division	Number of Interviews	Number of Usable Observations
Ogiedi	Urhobo	6	3 ¹
Iselegu	Aboh	6	7 ²
Enevor	Urhobo	6	6
Benin City	Benin	6	5 ³
Okuigbimi	Urhobo	8	9 ²
Total		32	30

¹Farmers could not recall establishment costs.

²A farmer planted in more than one year.

³A farmer could not recall establishment costs.

lists the central villages of each area and the number of farmers interviewed at each.

Interviewer Background and Training

The enumerator was a college student who had completed one year of university education at the time of the survey. Previously, he had collected data from farmers in the Abakaliki area of Eastern Nigeria as the leader of students working for an American graduate student. His training consisted of two days on the purposes and methods of the study and one day on the questionnaire. Following the classroom training he spent a day in the field testing the questionnaire and practicing interviewing.

Interviews

Many substitutes were used because greater emphasis was placed on speed and size of sample than on obtaining the first six randomly selected farmers. In practice the enumerator spent one or two days in each village. If on the first day he could not interview the first six, then on the second day he interviewed the remaining farmers up to six. Because most of the farmers in Okuigbimi are members of a processing cooperative, they were readily located at the processing factory and more than six were interviewed. Agricultural Extension workers helped to locate the villages and farmers.

Survey Findings

Labor and Meals

In order to estimate the labor and food costs of each operation, the interviewer asked each farmer the number of laborers required for each operation, the number of days they worked, the wage rate, the number of meals served each day and the total cost of meals. Labor inputs of men, women, children and Ministry employees are catalogued separately. Next, man-day equivalents are calculated by weighting a day of child labor at one-half a man-day and a day of adult female labor at three-fourths of a man-day. An extension worker's labor is accorded the same weight as adult male labor, one man-day.

Table 49 summarizes the results of the survey. The columns headed labor contain the labor requirements for establishing the improved seedlings and the first subheading under labor (entitled "Total") is the sum of free and paid labor. About two-thirds of the total labor

required for establishment is used for land preparation. Over 40 percent of the total is used to underbrush, the single most important operation. Labor required for felling is 25 percent of the total. Very little labor per acre is required for burning. Pegging and lining and planting an acre require five man-days each. Holing requires even less, just under two man-days. The average farmer weeds each farm 1.2 times a year using 10.5 man-days each time.

The second column under "Labor" indicates the average number of man-days hired for each operation. The free labor used in each operation is the difference between the total and the paid columns. Hired labor in addition to available free labor is essential for underbrushing, felling, holing and weeding. These, the hardest operations, are done by men only; and because most families do not contain enough men, help must be hired. Women and children help with burning, pegging and lining and planting. Only those families which contain few women and children hire additional labor for these tasks. Extension workers are treated as free labor which explains in part the larger amount of free labor used for pegging and lining.

Two columns of Table 49 are under the general heading "Costs," one for labor and the other for meals. Labor costs include an imputed cost of free labor valued at the same wage rate paid hired labor plus the cost of hired labor. The cost of free labor on farms not hiring is imputed at the wage rate paid on other farms in the village.

Meal costs include only extra meals; that is, the cost of feeding family members normally fed by the farmer is not included. Because of the custom of feeding friends and distant relatives who donate time,

Table 49: Cost and Quantity of Labor and Meals per Acre, by Establishment Operations, Improved Smallholdings, Midwestern Nigeria, 1964.

Operation	Labor		Costs	
	Total	Paid	Labor	Meals
	Man-days ----- per acre -----		Shillings ----- per acre -----	
Underbrushing	14.85	12.01	71.27	0.89
Felling	9.45	7.96	45.57	0.26
Burning	0.59	0.15	4.15	---
All Land Preparation	24.89	20.79	120.98	1.16
Pegging & Lining	4.37	1.94	22.86	0.91
Holing	1.72	1.67	8.71	0.09
Planting	5.44	1.71	26.05	0.58
All Planting	11.53	5.32	57.62	1.58
All Establishment	36.42	25.39	178.62	2.73
Weeding ¹	10.51	7.25	43.48	2.41

¹One weeding.

the operations for which free labor is important also entail the highest food costs. But the total cost of meals is negligible when compared to the cost of labor.

Tools for establishment cost 18.92 shillings per acre, a figure estimated by averaging the cost per acre on the 30 farms. The cost per acre on each farm is the product of the number of tools times their cost, divided by the useful life of each tool. Annual repair costs are then added to determine total equipment costs. The total farm cost is

divided by the acreage to determine cost per acre.

Because the farmers had not tapped their improved seedlings, it was not possible to estimate tapping costs or returns.

Budgetary Analysis

Budget Descriptions and Assumptions

Two general organizations (identical except for processing method) of improved smallholdings are budgeted: private processing and cooperative processing. All budgets employ establishment costs determined in the survey of improved smallholdings. It is assumed that clonal seedlings are purchased from the Ministry of Agriculture and Natural Resources at the cost of $1\frac{1}{2}$ pence per seedling and are planted at a rate of 207 per acre, a cost of 25.9 shillings per acre. To establish an acre the farms in the improved smallholders survey utilized 36.4 man-days at an average cost of 180.1 shillings. Meals cost 2.7 shillings per acre for establishment. Improved smallholdings are too recent an innovation to determine the frequency of weeding, but it is assumed that smallholders weed 10 times: once in the first year and once annually during the following nine years. Average cost per weeding is 43.5 shillings for 10.5 man-days and 2.4 shillings for meals. The annual cost of tools is the average level found in the survey. It is assumed these costs are incurred for 10 years, making no distinction between the cost of establishment tools and weeding tools. (See Table 50.)

Because none of the farms included in the survey have been tapped, purely hypothetical yield and tapping cost data are utilized. Three alternative yield figures are budgeted, 1,000, 800 and 600 pounds per

Table 50: Establishment Costs, Discounted by 7 Percent to Year of Planting, Improved Smallholders, Midwestern Nigeria, 1964.

Cost Item	Current Costs	Costs Increased 10%	Costs Increased 20%
----- <u>Shillings per acre</u> -----			
Clearing and Planting Labor and Meals	180.1	198.1	216.2
Weeding Labor and Meals	344.8	379.3	413.8
Tools	142.2	156.4	170.6
Seedlings	25.9	28.5	31.0
Total	693.0	762.3	831.6

acre. These are mature yield figures used for the thirteenth and later years. Tapping is assumed to begin in the sixth year after planting when yields are only 27 percent of the mature output. Yield is increased each year in the following order: 27, 42, 58, 69, 81, 88 and 96 percent of mature yield.

Because the seedlings being distributed by the Ministry of Agriculture produce over 1,200 pounds per acre on plantations in Nigeria, a yield of 1,000 pounds is entirely possible. Still, a yield of 800 pounds is more likely for the Nigerian smallholder because of his inexperience in obtaining high yields. The 600 pound alternative yield represents the lowest limit.

Presumably, the difference in yields results from different soils, climates and maintenance. All other things being equal, rubber planted

in the northern part of the region, in Ishan and Afenmai Divisions, will produce lower yields because of the unfavorable climate. Poor maintenance will also cause low yields, but no attempt is made to quantify the lower costs of poor maintenance.

The assumptions are that tapping is alternate daily half-circumference, that each tapper taps 400 trees or two acres a day and that tapping continues for 24 years. Ninety percent of output is assumed to be made into R.S.S. II sheets and 10 percent into adulterated lumps, three pounds of lump per pound of rubber.

In keeping with the methods of Chapter VII, three levels of rubber prices are budgeted: current (1964) prices and current prices reduced by 10 and 20 percent. The current prices of sheets and lumps are 13.88 pence and 3.75 pence respectively. The hypothetical tappers' wages are four shillings per day. Since each tapper can tap two acres a day and only taps each tree every other day or 150 days per year, the annual cost for tapping is 300 shillings per acre. Budgets are also computed with wage rates inflated 10 and 20 percent.

Tapping tools included in the budgets are cups and hangers costing 16.67 shillings per annum, files costing 2.00 shillings per annum, tapping knives costing 1.75 shillings per annum and buckets costing 0.68 shillings per annum. Cost per year is the product of the average number of tools times the average unit price, divided by the average expected life. Also included is the cost of coagulation pans, six pans for the farm producing 1,000 pounds per year, five for the farm producing 800 pounds and four for the farm producing 600 pounds, at a shilling a pan per year.

The recommended amounts of chemicals are included in the budgets. The cost varies with the output assumed, 9 shillings for the 1,000 pound producer, 7 shillings for the 800 pound producer and 5 shillings for the 600 pound producer.

The processing cost of the two budgeted organizations is their only difference. The private processor budgets include the cost of building and maintaining a smokehouse and factory and the budget of the cooperative member includes the cost of joining a 40-member cooperative and a charge of two pence per pound of sheet. For the private processor, two factories are compared, one costing £222 and a second costing £100. All budgets include maintenance costs of 10 percent of the original cost. The two factories are combined with three different farm sizes, 5, 10 and 20 acres, for six different combinations of acreage and factory. These in turn are combined with three different yields and three price and cost levels. So in all there are 54 budgets for private processors. For a cooperative member, the budget assumes a union of 40 members owning a smokehouse and factory costing £222. Budgets for nine different combinations of yield, prices and costs are computed.

The budgets of improved smallholdings are computed in the same manner as the budgets for ordinary smallholdings. First, gross income is determined by multiplying the assumed price of each product by its output and summing. Then tapping, processing and collecting costs, and depreciation of establishment and processing facility costs are deducted from gross revenue to compute residual returns for each year. Tappers' wages, maintenance costs and interest on the undepreciated value of capital are then deducted from residual returns to determine net revenue.

Net revenues for each year are discounted by 7 percent and summed to derive the discounted net revenues.

In addition to computing annual and total profits and returns, government tax revenues and foreign exchange earnings are also estimated. Foreign exchange earnings are computed by subtracting two pence from the price per pound to allow for sea freight and then multiplying by production per acre to determine the total value. These prices of sheet and crepe are reduced by 10 and 20 percent to estimate government revenues when prices fall. Tax revenues are computed by estimating the tax on a pound of lump and sheet and then multiplying by the three assumed output levels.

Budget Results

Improved Smallholdings Yielding 1,000 Pounds

Improved smallholdings yielding 1,000 pounds per acre provide excellent incomes to their owners and tappers. Obviously, the larger the holding, the greater the earnings, but even five-acre holdings yield more than subsistence. (See Table 51.) At current costs and prices, mature five-acre improved smallholdings yielding 1,000 pounds of rubber per acre processed in a £222 plant provide residual returns of 895.3 shillings per acre annually. Twenty-acre holdings yield residual returns of 990.0 shillings, 105 shillings per acre more. Owners of five acres who hire tappers and hence only earn interest and net revenue make £148/16/- per annum. Families which own five-acre improved smallholdings and process the rubber in £222 plants earn £179/1/- per man-year of tapping. Twenty-acre holdings provide farmers who hire tappers

Table 51. Revenues from Improved Smallholdings Yielding 1,000 Pounds Per Acre: Alternative Acreages, Prices, Costs and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Size of Farm	Prices and Costs	Revenue Source	£222 Processing Plant Year			£100 Processing Plant Year		
			6	13	29	6	13	29
			Shillings Per Acre			Shillings Per Acre		
Five Acres	Current Prices and Costs	Residual Returns	104.5	895.3	895.3	173.9	964.4	964.4
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interest	99.4	70.4	4.1	65.2	46.2	2.7
		Net Revenue	-340.8	524.9	591.1	-237.2	618.2	661.7
Five Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	49.5	678.4	678.4	109.3	738.3	738.3
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	91.3	64.7	3.8	72.7	51.5	3.0
		Net Revenue	-446.9	253.7	314.6	-369.5	325.7	374.2
Ten Acres	Current Prices and Costs	Residual Returns	167.4	958.2	958.2	202.0	992.7	992.7
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interest	68.3	48.4	2.8	51.2	36.3	2.1
		Net Revenue	-246.8	609.8	655.3	-92.7	656.4	690.6
Ten Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	147.7	732.0	732.0	182.3	766.6	766.6
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	75.8	53.7	3.2	58.7	41.6	2.4
		Net Revenue	-343.2	318.4	368.9	291.5	365.0	404.2
Twenty Acres	Current Prices and Costs	Residual Returns	199.3	990.0	990.0	216.1	996.9	996.9
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interests	52.1	36.9	2.2	44.2	31.3	1.8
		Net Revenue	-198.7	653.2	687.9	-174.0	665.6	695.1
Twenty Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	134.6	763.5	763.5	151.8	780.8	780.8
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	60.2	42.7	2.5	51.7	36.6	2.2
		Net Revenue	-340.7	360.8	401.0	-314.9	384.2	418.6

£690/2/- annually and provide families who tap £198 annually for each of the five tapping man-years required. Discounted net revenues are positive for smallholdings producing 1,000 pounds. (See Table 52.) Government revenues and foreign exchange earnings are £10 and £81/10/- respectively.

Even when prices fall 20 percent and costs increase 20 percent, returns on smallholdings producing 1,000 pounds remain favorable. A five-acre holding with a large processing plant provides the lowest return, 8.4 shillings per mature acre. Farmers hiring tappers earn £79/2/- with five-acre farms and the large plants. Farmers who do their own tapping earn £135/14/- per year of tapping. Farmers owning 20 acres and a £100 processing plant earn £438/2/- per annum if they hire tappers and earn £199/8/- per tapping man-year if they and their families tap. Discounted net revenues are positive for all combinations of inputs. Tax revenues are low, only £1/16/- per mature acre, but nevertheless, foreign exchange earnings are £65 per mature acre. (See Table 53.)

Improved Smallholdings Yielding 800 Pounds

Improved smallholdings producing 800 pounds per acre, assuming current prices and costs, provide income in excess of subsistence, and positive discounted net revenues. A five-acre holding using the £222 processing plant, the least profitable combination of resources, provides residual returns per acre at maturity of 676.3 shillings and a net revenue of 372.1 shillings. (See Table 54.) Families owning and tapping a five-acre farm earn an average of £75/5/- per tapping man-year when the trees mature. Farmers hiring tappers earn £94/1/- per mature acre. The most profitable combination of resources, the 20-acre

Table 52: Discounted Net Revenue and Discounted Rate of Return from Improved Smallholdings Producing 1,000 Pounds Per Acre: Alternative Costs, Prices and Processing Plants, Midwestern Nigeria, 1964.

Acreage	Processing Facility	Current Prices and Costs		Prices Decrease 10% and Costs Increased 10%		Prices Decreased 20% and Costs Increased 20%	
		Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return
		<u>Shillings</u>	<u>Percent</u>	<u>Shillings</u>	<u>Percent</u>	<u>Shillings</u>	<u>Percent</u>
5	£222	3,049	142	1,935	87	1,311	57
5	£100	3,847	285	2,733	193	2,110	142
10	£222	3,776	266	2,662	179	2,038	131
10	£100	4,175	409	3,061	281	2,438	221
20	£222	4,139	392	3,025	269	2,402	201
20	£100	4,339	506	3,225	348	2,601	261

Table 53: Foreign Exchange Earnings and Tax Revenues from Mature Improved Smallholdings:
Alternative Yields and Prices, Midwestern Nigeria, 1964.

Yield	Prices	Government Revenues				Foreign Exchange
		Regional Sales Tax	Federal Export Duty	Total Revenue		
		-----Shillings per acre-----				
1,000 lbs.	Current	20.83	179.17	200.00	1,625.00	
	Reduced 10%	20.83	112.50	133.33	1,462.50	
	Reduced 20%	20.83	0	20.83	1,300.00	
800 lbs.	Current	16.67	143.33	160.00	1,300.00	
	Reduced 10%	16.67	90.00	106.67	1,170.00	
	Reduced 20%	16.67	0	16.67	1,040.00	
600 lbs.	Current	12.50	107.50	120.00	975.00	
	Reduced 10%	12.50	67.50	80.00	877.50	
	Reduced 20%	12.50	0	12.50	780.00	

Table 54: Revenues from Improved Smallholdings Yielding 800 Pounds Per Acre: Alternative Acreages, Prices, Costs and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Size of Farm	Prices and Costs	Revenue Source	£222 Processing Plant			£100 Processing Plant		
			6	13	29	6	13	29
			Shillings Per Acre			Shillings Per Acre		
Five Acres	Current Prices and Costs	Residual Returns	45.4	676.3	676.3	114.5	745.5	745.5
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interest	99.4	70.4	4.1	65.2	46.2	2.7
		Net Revenue	-401.0	305.9	372.1	-296.6	399.3	442.8
Five Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	2.3	503.9	503.9	62.2	563.7	563.7
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	91.3	64.7	3.8	72.7	51.5	3.0
		Net Revenue	-504.1	79.2	140.1	-426.6	151.2	199.6
Ten Acres	Current Prices and Costs	Residual Returns	108.2	739.3	739.3	142.8	773.9	773.9
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interest	68.3	48.4	2.8	51.2	36.3	2.1
		Net Revenue	-305.0	390.9	436.5	254.4	437.6	471.7
Ten Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	56.0	557.5	557.5	90.6	592.1	592.1
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	75.8	53.7	3.2	58.7	41.6	2.4
		Net Revenue	-434.9	143.8	194.4	-384.2	190.5	229.6
Twenty Acres	Current Prices and Costs	Residual Returns	140.2	771.2	771.2	157.1	788.1	788.1
		Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
		Interest	52.1	36.9	2.2	44.2	31.3	1.8
		Net Revenue	-257.8	434.3	469.0	-233.1	456.7	486.2
Twenty Acres	20% Price Decrease and 20% Cost Increase	Residual Returns	87.4	589.0	589.0	104.7	606.2	606.2
		Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
		Interest	60.2	42.7	2.5	51.7	36.6	2.2
		Net Revenue	-387.9	186.3	226.5	-362.1	209.6	244.1

farm with the small plant, provides £157/12/- per tapping man-year if the owner and his family tap, and it yields an annual income of £244/2/- if he hires tappers. Tax revenues and foreign exchange earnings per mature acre are £8 and £65 respectively.

Improved smallholdings producing 800 pounds per mature acre continue to earn high incomes even if prices fall 20 percent and costs increase 20 percent. Only the combination of a five-acre holding with the large processing plant provides a negative discounted net revenue and even it provides large annual incomes at maturity (£36 during the mature period). All other combinations earn positive discounted net returns. (See Table 55.) A farmer with 20 acres and the small processing plant has an income of £246/6/- when the trees mature if he hires tappers. If he and his family tap, they average £121/5/- for the five man-years of tapping. Foreign exchange earnings per acre are high even with the decline in prices, £52, but tax earnings are less than £1 per acre.

Improved Smallholdings Yielding 600 Pounds

Because of low yields without corresponding declines in capital costs, improved smallholdings producing 600 pounds are the least profitable of the improved smallholder organizations. At current prices and costs, discounted net revenue is negative on a five-acre farm utilizing the £222 processing facility, even in spite of the fact that annual net revenues are actually positive by the time the trees mature. (See Table 56.) Even though, relatively speaking, it is an unattractive investment, a five-acre holding with the large processing plant would provide subsistence incomes to owners if they hired tappers and greater-than-

Table 55: Discounted Net Revenue per Acre and Discounted Rate of Returns from Improved Smallholdings Producing 800 Pounds per Acre: Alternative Acreage, Costs, Prices and Processing Plant, Midwestern Nigeria, 1964

Acreage	Processing Facility	Current Prices and Costs		Prices Decrease 10% and Costs Increased 10%		Prices Decreased 20% and Costs Increased 20%	
		Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return
		Shillings	Percent	Shillings	Percent	Shillings	Percent
5	£222	1,469	68	515	23	- 272	- 12
5	£100	2,268	168	1,313	93	527	35
10	£222	2,196	155	1,242	83	455	29
10	£100	2,595	254	1,641	151	854	74
20	£222	2,559	242	1,605	143	819	68
20	£100	2,759	332	1,805	195	1,018	102

Table 56: Revenues from Improved Smallholdings Yielding 600 Pounds Per Acre:
Alternative Assumptions of Acreage, Prices and Costs and Process-
ing Plants for Selected Years, Midwestern Nigeria, 1964.

Size of Farm	Prices and Costs	Revenue Source	£222 Processing Plant Year			£100 Processing Plant Year		
			6	13	29	6	13	29
			Shillings Per Acre			Shillings Per Acre		
Five Acres	Current	Residual Returns	- 13.7	457.5	457.5	55.5	526.7	526.7
	Prices	Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
	and	Interest	99.4	70.4	4.1	65.2	46.2	2.7
	Costs	Net Revenue	-459.0	41.2	107.5	-415.6	134.6	178.1
Five Acres	20% Price	Residual Returns	- 44.8	329.3	329.3	15.1	389.2	389.2
	Decrease	Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
	and	Interest	91.3	64.7	3.8	72.7	51.5	3.0
	20% Cost Increase	Net Revenue	-551.2	-95.3	-34.5	-472.7	-22.3	26.2
Ten Acres	Current	Residual Returns	49.2	520.4	520.4	83.8	555.0	555.0
	Prices	Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
	and	Interest	68.3	48.4	2.8	51.2	36.3	2.1
	Costs	Net Revenue	-365.0	112.1	217.6	-313.4	218.7	252.9
Ten Acres	20% Price	Residual Returns	8.9	383.0	383.0	43.5	417.6	417.6
	Decrease	Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
	and	Interest	75.8	53.7	3.2	58.7	41.6	2.4
	20% Cost Increase	Net Revenue	-482.0	-30.7	19.8	430.3	16.0	55.2
Twenty Acres	Current	Residual Returns	81.1	552.3	552.3	98.0	569.2	569.2
	Prices	Labor Income	345.9	300.0	300.0	345.9	300.0	300.0
	and	Interest	52.1	36.9	2.2	44.2	31.3	1.8
	Costs	Net Revenue	-316.9	215.4	250.1	-292.2	237.8	267.3
Twenty Acres	20% Price	Residual Returns	40.3	414.4	414.4	57.6	431.7	431.7
	Decrease	Labor Income	415.1	360.0	360.0	415.1	360.0	360.0
	and	Interest	60.2	42.7	2.5	51.7	36.6	2.2
	20% Cost Increase	Net Revenue	-435.0	11.8	51.9	-409.2	35.1	69.6

subsistence incomes if the owners themselves tapped. Farmers owning mature 20 acres and the small processing plant earn £269/2/- annually if they hire tappers and earn £113/17/- per man-year of tapping if they and their families tap. Tax revenues and foreign exchange per mature acre earning are relatively low, £6 and £48/15/- respectively.

When prices fall 20 percent and costs increase 20 percent, production of 600 pounds of rubber on an improved smallholding becomes an unprofitable investment. Discounted net revenues are negative for every combination of land and processing plant. (See Table 57.) Even so, the incomes generated are not unreasonably low in the mature years. Twenty-acre holdings utilizing small processing plants provide their owners who hire tappers with £72/8/- when the trees mature and provide owners and their families who tap £86/9/- per man-year. But, because net revenue is negative during the years before full production is achieved, discounted net revenues are negative. Government revenues and foreign exchange earnings are only 12.5 shillings and £39 respectively.

Cooperative Processing

Cooperative processing, an alternative to processing is a privately-owned factory and smokehouse, lowers capital costs (and hence depreciation), but increases processing costs. Cooperative processing is advantageous for small farms with low yields because the per-acre and per-pound costs of building privately-owned facilities are high.

Cooperative processing returns higher profits than private processing on either five-acre improved smallholdings producing 600 pounds combined with either size plant or five-acre smallholdings producing 800 pounds per acre processed in a large plant. (See Tables 58 and 59.) At current prices

Table 57: Discounted Net Revenues and Discounted Rate of Returns from Improved Smallholdings Producing 600 Pounds per Acre: Alternative Acreages, Prices, Costs and Processing Plants, Midwestern Nigeria, 1964.

Acreage	Processing Facility	Current Prices and Costs		Prices Decreased 10% and Costs Increased 10%		Prices Decreased 20% and Costs Increased 20%	
		Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return	Discounted Net Revenue	Discounted Rate of Return
		Shillings	Percent	Shillings	Percent	Shillings	Percent
5	£222	- 110	- 5	- 659	- 30	- 1,499	- 66
5	£100	688	51	140	10	- 700	- 47
10	£222	616	43	68	5	772	- 50
10	£100	1,016	100	467	43	- 373	- 32
20	£222	980	93	431	38	- 409	- 34
20	£100	1,180	138	631	68	- 209	- 21

Table 58: Revenues From Improved Smallholdings Processing Cooperatively:
Alternative Yields, Prices and Costs for Selected Years,
Midwestern Nigeria, 1964.

Yield per Acre	Prices and Costs	Revenue Source	Year		
			6	13	29
<u>Shillings Per Acre</u>					
600 Pounds	Current	Residual Returns	22.1	497.3	493.3
	Prices	Labor Income	345.9	300.0	300.0
	and	Interest	37.2	26.4	1.6
	Costs	Net Revenue	-361.0	167.0	191.8
600 Pounds	20% Price	Residual Returns	- 18.2	300.8	300.8
	Decrease	Labor Income	415.1	360.0	360.0
	and	Interest	44.7	31.7	1.9
	20% Cost	Net Revenue	-388.6	-90.8	-61.0
800 Pounds	Current	Residual Returns	51.2	682.2	682.2
	Prices	Labor Income	345.9	300.0	300.0
	and	Interest	37.2	26.4	1.6
	Costs	Net Revenue	257.5	355.8	380.7
800 Pounds	20% Price	Residual Returns	- 1.1	500.4	500.4
	Decrease	Labor Income	415.1	360.0	360.0
	and	Interest	44.7	31.7	1.9
	20% Cost	Net Revenue	-460.9	108.8	138.6
1,000 Pounds	Current	Residual Returns	80.3	871.1	871.1
	Prices	Labor Income	345.9	300.0	300.0
	and	Interest	37.2	26.4	1.6
	Costs	Net Revenue	-302.8	544.7	569.5
1,000 Pounds	20% Price	Residual Returns	26.0	644.9	644.9
	Decrease	Labor Income	415.1	360.0	360.0
	and	Interest	44.7	31.7	1.9
	20% Cost	Net Revenue	-443.8	253.3	283.1
	Increase				

Table 59: Discounted Net Revenues and Discounted Rate of Returns from Improved Smallholdings Processing Cooperatively: Alternative Yields, Prices and Costs, Midwestern Nigeria, 1964.

Yield	Prices and Costs	Discounted Net Revenues	Discounted Rate of Returns
		<u>Shillings Per Acre</u>	<u>Per Cent</u>
1,000	Current Prices and Costs	3,693	228
	20% Price Decrease and	1,877	109
	20% Cost Increase		
800	Current Prices and Costs	2,237	162
	20% Price Decrease and	496	33
	20% Cost Increase		
600	Current Prices and Costs	860	73
	20% Price Decrease and	-529	-39
	20% Cost Increase		

and costs, private-processing five-acre farms producing 600 pounds per acre provide residual returns of 411.7 shillings per mature acre (large plant) or 480.0 shillings per acre (small plant), but with cooperative processing, residual returns become 493.3 shillings per acre. Whereas a five-acre smallholding yielding 800 pounds per acre provides residual returns of 676.3 shillings per acre using a privately-owned £222 plant, it provides residual returns of 682.2 shillings if the rubber is processed cooperatively. On the other hand, when prices fall 20 percent and costs increase 20 percent, private processing is more profitable than cooperative processing with any

combination of size, yield and processing plant.

Conclusions

At current prices and costs, improved smallholdings are very profitable. During the years after the trees mature, improved smallholders who own five acres or more earn subsistence or more whether they tap or they hire tappers. Obviously, the larger the yield, the greater the profits, but nevertheless, even the smallholder producing 600 pounds per acre earns an adequate income. Minimum discounted returns are 1.5 percent per annum. Government tax revenues exceed ~~£~~6 per acre in every case and are as high as ~~£~~10. Because of high processing costs per pound, cooperative processing is not as profitable as private processing for smallholders owning more than five acres; it is more profitable only for those who own five acres and either get 600 pounds per acre or produce 800 pounds of rubber per acre and own a large processing plant.

Improved smallholders who produce 1,000 or 800 pounds per acre of rubber earn substantial incomes even if prices fall 20 percent and domestic costs increase 20 percent. Farmers producing 600 pounds must own 20 acres to earn a subsistence income if they hire tappers, but can earn substantial incomes if they do not hire tappers. But investment in these farms is unattractive because discounted net revenues are negative. Government revenue from improved smallholdings is very low because presently the duty on rubber sold for less than 18 pence per pound is zero. Taxes could be increased substantially without deterring farmers from planting improved smallholdings.

In conclusion, improved smallholdings planted with the expectation of yields of 800 pounds or more would be very attractive investments even

if the price of rubber should decline. But such yields are very difficult to achieve, particularly in a peasant smallholding industry. Smallholdings achieving yields of only 600 pounds will make significant profits and incomes as long as prices stay at current levels but if prices fall, the negative discounted net revenues would make investment in such a farm unattractive.

CHAPTER IX

CONCLUSIONS, RECOMMENDATIONS AND SUMMARY

This dissertation has attempted to show how the economy of the Midwestern Nigeria rubber industry depends on uncontrollable factors (such as the world rubber market and the biology of the rubber plant) as well as controllable factors (such as the techniques of producing raw latex and saleable rubber, government taxation policies and cooperation among the rubber producers of Midwestern Nigeria). Chapter IX will draw general conclusions regarding the industry and make recommendations for government programs to improve the industry.

Conclusions¹

Ordinary rubber smallholdings no longer provide Midwest farmers with large incomes. At 1964 prices and costs, they earn only £2 to £5 per mature acre. Owners producing ordinary lumps and sun-dried sheets, the most common products, average £3/4/- and £3/14/- per acre respectively. Those producing high quality sheets either cooperatively or on a five-acre smallholding with privately-owned smokehouses and factories, earn approximately £2/10/- to £3. (See Table 60.) Farmers who produce high-quality sheets on 10- and 20-acre smallholdings and process in their own facilities earn the largest incomes from rubber, £4 to £5.

Oil palm production, the primary alternative to rubber production, probably provides approximately the same income as ordinary rubber production. The F. A. O. estimates that the ordinary smallholder in the

¹Data in this section were initially presented in Chapters III, VI, VII and VIII. Sources will not be repeated

Table 60: Foreign Exchange Earnings, Taxes, Returns to Owners and Wages from Ordinary Smallholder Production of Rubber and Palm: Alternative Prices and Costs, Midwestern Nigeria, 1964.

Prices and Costs	Ordinary Lump Revenues	Sun Dried Sheet	Cooper- ative Process- ing	Private Process- ing 5 Acres	Private Process- ing 10 Acres	Private Process- ing 20 Acres	Clean Lump Bunches	2,000 Pounds of Bunches	2,240 Pounds of Bunches	2,000 Pounds of Bunches	1,800 Pounds of Bunches
----- £ per acre -----											
Current Prices and Costs	Foreign Exchange	26/19	28/-	32/5	32/5	32/5	32/17	11/10	10/2	9/3	
	Taxes	-/8	1/7	3/14	3/14	3/14	4/1	3/12	3/4	2/19	
	Owners Income	3/4	3/14	2/15	2/13	4/4	5/-	6/9	3/13	3/2	
	Wages	6/19	8/14	11/6	11/6	11/6	11/14	-/16	-/16	-/16	
20% Rubber Price Decrease, 1963 Palm Prices and 20% Cost Increase	Foreign Exchange	22/11	22/8	25/16	25/16	25/16	26/5	11/10	10/2	9/3	
	Tax	-/8	-/8	-/8	-/8	-/8	-/8	3/12	3/4	2/19	
	Owners Income	1/9	1/12	-/2	-/1	1/7	3/15	3/15	3/4	2/13	
	Wages	5/14	6/19	9/1	9/1	9/1	9/8	1/5	1/5	1/5	1/5

¹Palm prices received by producers assumed to be 90 percent of Marketing Board's Producers Price in 1963: £36 per ton of palm oil and £24 per ton of palm kernels. Oil yield is 10 percent of bunch weight and kernel yield is 7 percent of bunch weight.

Midwest and West earns about £3/15/- per acre from palm production, almost exactly the amount earned by the rubber smallholders producing lumps or sun-dried sheets. (See Table 61.) Because palm yields are estimated to be higher, income from palm in Eastern Nigeria is estimated to be £4/4/-, an income only obtained by a rubber producer if he makes sheets on a 10- or 20-acre smallholding.

The crucial determinants of the future of Nigeria's natural rubber industry is the declining world market price of rubber and increasing Nigerian production costs. For the first time in the Twentieth Century, the price of rubber has declined during a period of world economic expansion. Between 1960 and 1963, the annual average New York price of R.S.S. I sheet fell 12.2 cents, and is expected to decrease still further to about 20 cents. A New York price of 20 cents would mean a decline of 20 percent or more from 1964 prices in Nigeria. In addition, over the past decade, Nigeria has experienced a sharp inflation, about 40 percent between 1953 and 1962.

If rubber prices were to fall 20 percent and the costs of domestically produced inputs were to increase 20 percent, the incomes of rubber smallholders would be less than subsistence. Rubber farmers will only earn £1/12/- producing sun-dried sheets and £1/9/- producing ordinary lumps. Smallholders utilizing 10 acres of rubber (the average size of a smallholding) would not even receive a subsistence income. Only production of clean lump in a reorganized market would provide as much income as palm production. According to estimates based on the F. A. O. calculations, palm production will pay between £2/13/- and £3/15/- per acre if domestic costs increase. Lower rubber prices and higher production costs will probably cause ordinary smallholders to gradually shift to the production

Table 61: Foreign Exchange Earnings, Taxes, Returns to Owners and Wages from Improved Smallholder Production of Rubber and Palm: Alternative Prices and Costs, Midwestern Nigeria, 1964.

Price and Costs	Revenues	Rubber		Palm	
		800 Pounds Per Acre	1000 Pounds Per Acre	8000 Pounds Per Acre	9000 Pounds Per Acre
Current Prices and Costs	Foreign Exchange	----- £ per acre ----- 65/-/-	----- £ per acre ----- 81/5/-	----- £ per acre ----- 64/5/-	----- £ per acre ----- 68/6/-
	Taxes	8/-/-	10/-/-	19/-/-	21/10/-
	Owners Income	23/13/-	34/12/-	18/13/-	20/19/-
	Wages	15/-/-	15/-/-	2/8/-	2/8/-
20% Rubber Price Decrease 1963 Palm Prices and 20% Cost	Foreign Exchange	52/-/-	65/-/-	64/5/-	68/5/-
	Taxes	-/10	1/-/-	19/-/-	21/10/-
	Owners Income	11/-	20/6/-	17/8/-	19/12/-
	Wages	18/-/-	18/-/-	3/5/-	3/5/-

of palm unless some external stimulus encourages them to produce improved rubber or palm.

Improved Smallholdings

The Government of Midwestern Nigeria considers improved rubber and palm production as logical replacements for ordinary rubber production. In its 1964-68 Development Plan, Midwestern Nigeria allocates £1.4 million to increasing rubber production, more than is allocated to any other agricultural commodity, over one-third of the allocation for primary production and almost 6 percent of the Plan's total allocation.² The Midwest also will invest about £900,000 in oil palm production and lesser amounts in cocoa, cotton, tobacco and food crops.³ This chapter evaluates the implications of allocating more funds to rubber than to oil palm. Four criteria are used: addition to gross domestic product, tax revenues, owner's income and amount of employment.

The primary objective of the 1964-68 Development Plan is to increase the rate of economic growth or, in other words, to increase the gross domestic product.⁴ Thus, a primary criterion for distributing funds between oil palm and rubber is their relative contributions to G. D. P.

A second objective is to increase government revenues. The development of Midwestern Nigeria will require large expenditures by the Regional Government. Inevitably, it will be difficult to obtain sufficient funds for development. In the Midwestern Nigeria Development Plan of 1964-68, the Government allocates £24.6 million, but at the time the Plan was published, the Government lacked over one-third of the total allocation.⁵

²Midwestern Nigeria, Mid-Western Nigeria Development Plan 1964-68
Benin City: Ministry of Internal Affairs, Printing Division, [1965], p. 20.

³Ibid.

⁴Ibid., pp. 3-4.

⁵Ibid., p. 61.

Thus, Government tax receipts will be an important factor in distributing funds between oil palm and rubber.

Ultimately, the objective of any development program is, of course, to raise the income of people. So a third criterion for evaluating planned expenditures is the owner's income generated by the alternative commodities. It should be realized that both government and private investment promote growth. While taxing personal income may augment government's investment capacity, it lowers private capacity to invest. No conclusion can be drawn here about the Plan's allocation between the Government and private sectors; only the owner's incomes generated by the two commodities will be compared.

Finally, an explicit objective of the Plan is to provide as many "... employment opportunities as is consistent with the rapid growth of the economy, ..."⁶ The writers of the Plan, while clearly perceiving that employment and development may be competing objectives, still place development as the primary goal. This study does not judge when greater employment hampers development; only the employment gained from alternative programs will be estimated.

As mentioned above, the first criterion is the comparative contribution of rubber and oil palm to gross domestic product. Because they are both export crops, the net addition of oil palm and rubber to G. D. P. is their free on board value (f.o.b.) less the cost of imports required for their production. Assuming that the values of imported inputs in rubber and oil palm production are approximately equal, the f.o.b. values alone can be used to compare addition to G. D. P. The 1964 f.o.b. values of rubber produced on smallholdings yielding 800 and 1,000 pounds per acre are £65 and £81/5/- respectively. The 1963 f.o.b. value of palm products from an acre producing

⁶Ibid., p. 3.

9,000 pounds of bunches is £58/5/9 and the f.o.b. value of palm products from a smallholding producing 8,000 pounds of bunches is £64.⁷ Thus, with 1963-64 prices, rubber provides at least as much per acre as palm to the economy, if the smallholders produce 800 pounds per acre or more. But if rubber prices fall 20 percent, the f.o.b. value of rubber produced on an improved rubber smallholding yielding 1,000 pounds would be £65, approximately equal to the f.o.b. value generated by a palm smallholding producing 8,000 or 9,000 pounds of bunches. A rubber smallholding which yields only 800 pounds provides only £52, considerably less than palm smallholdings. Hence, in the long-run, rubber smallholders must maintain yields of 1,000 pounds per acre to provide as much to G. D. P. as palm smallholders.

Assuming 1964 prices and taxes, palms contribute approximately twice as much per acre to taxes as rubber smallholdings yielding 1,000 pounds. Tax earnings from improved palms yielding 8,000 pounds of bunches per acre are approximately £19 and from a smallholding yielding 9,000 pounds of palm bunches are £21/10/-. But revenues from one acre of improved rubber producing 1,000 pounds are only £10. If rubber prices were to fall 20 percent, tax revenues would only be about £1 unless the tax structure is revised.

The third criteria is farmers earnings. Farmers producing 800 and 1,000 pounds of rubber on a ten-acre mature smallholding earn £23/13/- and £34/12/- per acre respectively. Improved palm smallholdings yielding 8,000 and 9,000 pounds of bunches provide incomes of £18/13/- and £20/19/-

⁷(The 1965 f.o.b. palm prices are considerably higher than the 1963 prices, but the 1963 prices are assumed to be more representative of the long-term market.)

respectively. If rubber prices were to fall 20 percent and Nigerian input prices were to increase 20 percent, rubber smallholders producing 800 and 1,000 pounds would earn £11 and £20/6/- respectively and palm smallholders would earn £17/18/- and £19/2/- from producing 8,000 and 9,000 pounds of bunches respectively. Thus, at 1964 prices, rubber smallholdings provide larger incomes than palm smallholdings, but if rubber prices were to decline 20 percent, only rubber smallholdings yielding 1,000 pounds would provide higher returns.

The final objective of the Development Plan is employment. Rubber production requires considerably more labor than palm production. Whereas mature oil palms requires about 16 man-days per acre per year, rubber requires about 75 man-days per acre per year. As a result, when gross revenues per acre are equal, rubber provides a smaller taxable residual because of higher labor costs. At 1964 prices, only improved rubber smallholdings producing 1,000 pounds per acre could be taxed more than improved palm smallholdings without lowering owner's income below the amount earned producing oil palm.

Thus, at 1964 prices, improved rubber smallholdings yielding 1,000 pounds provide greater returns to the economy and owner, more employment and less tax revenue than improved palm smallholdings producing 8,000 or 9,000 pounds of bunches per acre. Rubber smallholdings yielding 800 pounds provide about the same addition to G. D. P. as palm, but the distribution of these returns is quite different. The owners of rubber smallholdings yielding 800 pounds receive approximately £9 more income per acre and utilize about 60 more man-days of labor annually. The Government receives greater tax revenues from palm production. Because

under 1964 conditions, the total addition to the economy is the same, the choice between rubber yielding 800 pounds and palm may be based either on the income for farmers and tappers or on the Government's tax receipts.

On the other hand, assuming a rubber price decrease of 20 percent with rubber yields of 1,000 pounds, the situation changes. Palm and rubber production contribute approximately the same amount to G. D. P., but rubber production provides smaller tax revenues and greater returns to the owner and laborers. Rubber smallholders producing 800 pounds could earn greater amounts and considerably add to the economy by changing to oil palm. Only employment from rubber would be greater.

Thus, with 1964 prices, investment in rubber would probably provide at least as large an income to the economy as oil palm and has the potential for providing considerably more than palm production. But assuming a 20 percent price decrease, only the largest yields would provide returns to the economy and the farmers as high as those received from palm smallholdings. Also Government revenues from the high-yield rubber would be considerably less than those derived from palm production. Hence, under a decreased price, rubber investment is preferable if yields of 1,000 pounds or more can be achieved. By investing more in improved rubber production rather than in improved palm production, the Government, in effect, is expanding rural incomes and employment at the cost of higher tax receipts.

Recommendations

The Midwestern Nigeria Development Plan 1964-68 assumes that improved rubber smallholdings will produce 1,000 pounds of rubber per acre and that the rubber will be processed into high quality sheets.⁸ As

⁸Ibid., p.8.

indicated above, these assumptions must be fulfilled if the investment in rubber rather than oil palm is to be justified on economic grounds. Excellent planning and administration of the Government's programs will be necessary in order to achieve the goal of 1,000 pounds per acre. Such a product requires: (1) planting of clonal seedlings with high potential yields, (2) excellent planting and maintenance practices, (3) proper tapping and (4) careful processing.

Rubber Rehabilitation Scheme

The Midwestern Nigeria Development Plan 1964-1968 includes a Rubber Rehabilitation Scheme for subsidizing smallholders planting improved rubber. In order to grow trees which are capable of producing 1,000 pounds per acre, the smallholders must plant selected materials, plant at the recommended depth and distances, prune the seedlings properly and maintain them during their immaturity. Because most smallholders are totally inexperienced with these practices, intensive training and close supervision will be required if the program is to be successful in achieving yields of 1,000 pounds.

The Development Plan indicates that staff for carrying out the total program of the Ministry of Agriculture and Natural Resources will be in short supply during the plan period. The Ministry will require 20 more agricultural officers and 507 more agricultural assistants and agricultural superintendents than are available or in training.⁹ Unless more are trained, the Ministry will probably be unable to adequately train and supervise the farmers participating in the rubber rehabilitation

⁹Ibid., p. 67-68.

scheme and 1,000 pound yields may not be achieved. Rather than reducing farmer training and supervision, this study recommends that the Ministry consider reducing the acreage targets.

It is also possible that the Ministry will find that its budget allotment is inadequate to carry out the planned rehabilitation program. The Ministry intends to subsidize the farmers £20 per acre to replant 15,000 acres, but only £271,515 has been allocated in the Plan for the purpose.¹⁰ Moreover, the F. A. O. estimates that the in-kind subsidy alone will cost about £30 per acre, £10 more than the total cash and kind subsidy allocated in the Development Plan. If adequate subsidies cannot be given, this study recommends that the Ministry consider reducing the acreage targets rather than reducing the subsidy.

The Development Plan does not make clear if the Ministry of Agriculture and Natural Resources intends to supervise maintenance of the rehabilitated smallholdings. The traditional practice is to infrequently weed immature rubber plots, usually once a year. Additional weeding is not essential because so many seedlings are planted that a sufficient number of trees survive to maturity. Because of the high cost of improved seedlings, their planting density is much lower; infrequent maintenance might result in too few mature trees. The smallholder cost of the improved seedlings approaches the cost of the ordinary seedlings, so that without supervision smallholders may not weed often enough. Furthermore, disease control requires regular inspection of the seedlings, but most smallholders can neither identify nor treat diseased seedlings. This study, therefore, recommends that regular inspection of immature plantings be carried out to determine if the seedlings

¹⁰ Ibid., p. 8.

are weeded regularly and if they are diseased.

The probability of achieving yields of 1,000 pounds would be greatly enhanced if the Ministry of Agriculture and Natural Resources were to distribute seedlings with higher potential yields. The Ministry distributes the older improved seedlings developed before World War II with potential yields of under 1,500 pounds per acre, (PB 86 x PB 24, Tjir 1 x Tjir 16 and Tjir 1 selfed). Clones are under study in Nigeria which may yield considerably more. As soon as sufficient information is obtained about their behavior, these seedlings should be distributed.

Nucleus and Government Plantations

In addition to rehabilitating smallholdings, the Midwest also plans to establish both nucleus and ordinary plantations. The trees on nucleus plantations are eventually distributed to their workers as private smallholdings whereas ordinary government plantations remain a single unit. The nucleus plantation is an effective way to train and select smallholders and to achieve the yield target. On the other hand, because nucleus plantations cost considerably more than rehabilitation, the Government cannot establish very many. Full fledged Government-owned plantations provide greater income to the Government than any other organization, but have very little impact on the rural economy.

Tapping and Processing Rehabilitated Smallholdings

The long-term success of the Rubber Rehabilitation Scheme requires more than simply insuring that the trees are properly planted and maintained. The quality of tapping, collecting and processing is also critically important. Customary tapping procedures, if used on improved smallholdings, have four

flaws: (1) cuts are often too deep to permit regrowth of the bark; (2) cutting away too much bark shortens tapping life; (3) because the trees are not tapped at the angle which opens the most vessels, yield is lessened and (4) too frequent tapping causes diseases. Smallholders practice these methods on their ordinary smallholdings either because they do not realize their damage or because the techniques increase short-term yields.

Because Nigerian peasants know very little about the internal structure of the rubber tree, they do not realize that by removing the entire surface of the tree down to the woody center, they prevent regrowth and retapping of the bark. Similarly, smallholders do not know that the latex bearing vessels of the trees spiral up the tree counter-clockwise from left to right at an angle of approximately 65 degrees from horizontal so that, to cut the most vessels, the tree should be tapped by cutting downwards from left to right at an angle of 25 degrees. Only training and experience will teach smallholders the benefits of tapping properly.

Tappers maximize their returns by tapping daily as many of the highest yielding trees as possible. In order to tap many trees, they seem to tap quickly and carelessly, removing too much bark. A shortened economic life of the tree and panel disease result. Because mature trees are plentiful on ordinary smallholdings, intensive tapping of a few trees until their yields are reduced by disease or their bark removed is probably sensible. When the yield on one tree begins to decline, another can replace it in the tapping cycle with only a small loss in total production. But because of the relatively high cost of improved

trees, these practices would be extremely costly if utilized on rehabilitated smallholdings. Trees on improved smallholdings are used much more intensively over their life; once mature, they are tapped continuously. Disease would reduce overall yields because no trees are available to replace diseased trees in the tapping cycle. Similarly, if the available bark on a tree were consumed, new trees would not be available. Thus, tapping would have to be carefully supervised to assure the highest yields over the life of the trees. Intensive supervision would not be necessary once the farmers realized that maximizing their short-term gains will lower their long-run earnings, but this would take several years, probably until the farmers tap the panels for the second time.

Proper collecting will also be required to successfully carry out the Government's plans. High quality rubber, preferably R.S.S. I sheets, must be produced on improved smallholdings if high incomes are to be earned. High quality will require the use of manufactured cups rather than snail or coconut shells, clean pails for transporting the latex to the collecting point or factory and the use of anti-coagulants to prevent premature coagulation. If the smallholders collect carelessly, the latex will be contaminated with dirt and may coagulate into lumps.

Programs to encourage farmers to use recommended tapping and collecting techniques should either reward the use of proper techniques or, alternatively, penalize those who ignore recommended procedures. Adequate price differentials for varying quality latex would motivate the smallholders to produce clean uncoagulated latex. But tapping is not so easily influenced because short-term earnings can be enhanced by using poor techniques. Because tapping does not significantly influence the quality

of the product, only the economic life of the trees, some essentially artificial means must be found for rewarding proper tapping. A subsidy payment would be the most direct, but very difficult to administer. An alternative would be a supervised loan scheme. Most smallholders have to buy cups and pails. Possibly the threat of foreclosure of the loans would be sufficient to motivate owners to tap properly. Such a program would have many of the same administrative problems as a direct subsidy, but appears to be the best alternative. Intensive supervision and training will be needed if such a program is to be successful.

Processing must also be expertly carried out or the quality of the resulting product will be poor. The factories and smokehouses must be adequately designed, built, equipped and operated. Because the smallholdings being established by the Ministry are only six acres, it will not be feasible for each smallholder to own a processing plant. Some system will have to be implemented in which all the improved smallholders of a village participate. Four alternatives appear to be the most likely: (1) a cooperative factory and smokehouse, (2) a privately-owned processing unit, (3) a Government-owned and operated processing plant located in the village or (4) purchases of the liquid latex for processing at a centrally located factory.

The criteria for evaluating the alternatives must be quite similar to the ones already developed earlier in this chapter: to maximize G. D. P., to increase Government revenue, to maximize personal incomes and to provide additional employment. Maximization of G. D. P. requires production of the highest-priced products, thin crepes and R.S.S. I sheets. Technically skilled rubber processors are scarce. In order to get the maximum

amount of production under skillful supervision, processing in centrally located plants where the latex is brought by tank-truck would be preferable.

Increasing personal incomes does not lead to any clear conclusions because no individual group (i.e., farmers, tappers, middlemen, etc.,) has been specified. If the total income of all groups is to be increased, then the criteria implies increasing the export value of the rubber or producing the highest quality possible.

Reduction of Government costs suggests substituting private capital for Government capital. Cooperatives would require less Government capital than any other organization because the farmers would provide most of the labor for building the factory and smokehouse. Government-owned processing plants would entail the greatest public cost. Private ownership would be intermediate, because it would probably require Government loans.

Employment will be greatest with privately-owned processing units in each village. Cooperatives would probably provide somewhat less employment, because the smallholders themselves would supply some labor. Centrally located processing units would probably require the least employment.

Before electing to organize processing in one of the above suggested methods, each must be studied in detail. In addition to the criteria outlined above, costs, manpower requirements and technical feasibility must be considered. The Malaysian experience should also be investigated. It is recommended that the Ministry of Agriculture and Natural Resources immediately initiate such a study.

Product Quality

Throughout this study it has been argued that Nigeria and Midwestern Nigeria lose potential income because of the low quality of Nigerian rubber exports. Translating this statement into monetary terms, if the Region

could increase the value of 30,000 tons of rubber by 5 pence per pound, total returns to the Region would increase £1.4 million. This is equivalent to increasing annual income of each man, woman and child in the Midwest by about 10 shillings.

Because the Midwest rubber producers do not receive higher prices when they produce better qualities, they have no monetary incentive to produce the better qualities. On the contrary, they can increase their returns by adulterating the lumps. The processors' price differentials for quality paid to the dealers are too small to be translated into price differentials for the producers. In addition, Nigerian producers have no consistent set of grades for lumps or techniques for grading. The system used by the processors depends on the actual rubber content of the lumps, which cannot be determined without actually processing the lumps into crepe.

It is recommended that the Government of Midwestern Nigeria develop and publicize a rubber grading system. The system should be related to the actual quality of the crepe sheets manufactured from the lumps, should be relatively easy to apply and should not require complex expensive equipment. Furthermore, it is recommended that the Produce Inspection Service again inspect and grade all the rubber produced in the region. It is hoped that if produce inspectors actually sort the lumps into different grades then higher prices will be paid for the higher grades. And in turn, the dealers should be willing to pay higher prices for lumps which they know are better.

Grading will cost very little per pound of rubber. Assuming that the average weight of a lump or sheet is 2 pounds and the Midwest produces 50,000 tons, then Midwestern Nigeria produces 56,000,000 lumps and sheets

annually or 187,000 lumps and sheets per day in 300 working days. If an individual produce inspector can grade a lump or sheet in 30 seconds, he can then grade 480 lumps or sheets in an eight-hour day. Thus, 195 men would be required to inspect the entire rubber output of the region. Allowing an additional 5 supervisors, a total of 200 employees could probably inspect the entire product. Assuming an average salary of £500 per annum, the total annual cost is £100,000 or approximately 0.22 pence per pound.

After an interval of two or three years, if the quality composition of Nigerian exports has not improved, the Midwest should consider taxing the lowest quality products. Taxing of low quality exports has contributed significantly to the increased quality of Nigerian palm product and cocoa exports. These taxes, applied by the Marketing Boards, helped to motivate Nigerian smallholders to produce the highest quality. In only a few years, almost all the produce was of the highest grades.

Summary

The objectives of this study were: (1) to provide a description of the techniques of ordinary rubber production, (2) to determine the relative profitability of the various organizations now extant, (3) to evaluate the impact of falling world market prices on the profitability of ordinary smallholdings as they are now organized, (4) to evaluate the profitability of farms planting high-yielding trees under alternative price and cost assumptions and (5) to suggest methods for implementing change in the rubber producing industry.

(1) Technique was described in Chapter VI.

(2) All existing organizations of ordinary smallholdings provide either subsistence income (£30 per acre from a 10 acre farm) or slightly more to the farmer at 1964 price levels. The most profitable is the production of sheets processed in privately-owned factories and smoke-houses and the least profitable is the production of ordinary lumps and sun-dried sheets. The average farmer earns £36/7/- annually if he hires tappers to produce sun-dried sheet from mature trees and £32/6/- if he hires tappers to produce ordinary lump.

(3) If prices fall and domestic costs increase, the profits and income from current methods of producing rubber will fall to very low-levels, subsistence from private processing and less than subsistence from ordinary lump and sun-dried sheet production. As a result, the industry as it is now organized may disappear.

(4) Production of rubber using high-yielding plants and producing high-quality sheets provides substantial incomes presently. Farms achieving only 600 pounds per acre will not be profitable with any size organization budgeted in this study if prices fall. But a farm producing 800 pounds per acre on ten acres or 1,000 pounds on five acres will provide substantial incomes and rates of returns.

At 1963-64 prices and costs, improved oil palm production is not as profitable as owning an improved rubber smallholding yielding 800 or more pounds per acre, but if rubber prices decline 20 percent and costs increase 20 percent, only rubber smallholdings with yields of 1,000 pounds will provide larger incomes than palm production. The foreign exchange earnings of a rubber smallholding producing 800 pounds per

acre and a palm smallholding producing 9,000 are equal at 1964 prices, but if prices fall 20 percent, then yields of rubber must be 1,000 pounds per acre to match the total earnings from palm. Thus, if prices decline 20 percent, only rubber smallholdings producing 1,000 pounds per acre return more to the economy and their owners than palm smallholdings producing 9,000 pounds per acre.

(5) It is recommended the Ministry of Agriculture and Natural Resources provide the necessary physical inputs, instructions and supervision to insure that the rehabilitated smallholdings have the capability of producing 1,000 pounds per acre. If it is found that the required labor and financial resources are not available, then it is suggested that the acreage targets be reduced. To insure that the yields are obtained and the high quality sheets are produced, it is suggested the Ministry of Agriculture and Natural Resources supervise maintenance and disease control and provide for the supervision of tapping and processing. The first rehabilitated smallholdings will not be tapped for 4 or 5 years. The intervening period can be used to study alternative organizations of processing the rubber produced on the rehabilitated smallholdings.

Finally, to increase the quality of rubber exports, it is recommended that the Government of Midwestern Nigeria develop grading procedures and have them implemented by the Produce Inspection Service. If grading alone is not satisfactory for increasing the quality of Nigerian rubber exports, it is recommended that the Government consider imposing a discriminatory tax against the poor quality rubber exports.

APPENDIXES

APPENDIX A

AN INTRODUCTION TO RUBBER PRODUCTION

This appendix provides the general reader with sufficient background to understand the production of rubber and enable him to compare peasant and plantation techniques. It discusses the composition, sources and production of rubber. The productive methods described are the recommended ones. The estates in Nigeria generally adhere to them, but the smallholdings do not. Smallholders techniques are described in Chapter VI.

Natural Rubber Production

The Nature of Rubber

Rubber is the coagulate derived from latex, the white milky juice of certain plants.¹ The primary constituent of rubber, the hydrocarbon isoprene (C_5H_8), gives it resilience and elasticity. Isoprene units are arranged in a long chain called polyisoprene $(C_5H_8)_n$ where n is an indefinite but finite number. Each plant species producing rubber contains different proportions of polyisoprene. The latex of the tree Hevea brasiliensis, the chief commercial source of natural rubber, contains over 90 per cent polyisoprene. Raw rubber is not pure, but contains many substances including hydrocarbons, sugars, inorganic compounds and resins.

¹For a more complete description of rubber and its production the reader may consult the three works which provide the material for this appendix. J. J. Ochse and others, Tropical and Subtropical Agriculture, Vol. II (New York: The MacMillan Company, 1961), pp. 923-996, Loren G. Polhamus, Rubber ("World Crop Books," London: Leonard Hill (Books) Limited, 1962), and M. J. Dijkman, Hevea (Coral Gables, Florida: University of Miami Press, 1951.)

Crude rubber before vulcanization is a soft, elastic material which is brittle when cold and sticky when hot. It melts at approximately 300 degrees fahrenheit. It can be shaped into useful products such as erasers and shoes, but will not maintain these shapes permanently, particularly if subjected to heat. Vulcanization, the application of heat to a mixture of sulphur and rubber, gives rubber a permanent shape which can only be altered by cutting. The properties which make natural rubber useful commercially are abrasion resistance, elasticity, electrical insulation and impermeability to gases.

Hevea Brasiliensis - The Rubber Tree

Description, Source and Adaptation

Hevea is a member of the Spurge family. Other economically important members of the family are tung, candlenut, cassava and castor bean.

Hevea is a medium-sized tree, 10-20 m. high, with robust, glabrous branchlets and containing much milky juice. The leaves are alternate, long-petioled, trifoliolate, and glabrous. The petiole is thin, green, and 3.5-30 cm. long. The leaflets are shortstalked and elliptic-oblong or obovate-oblong; the base is narrow and acute; the apex is acuminate; individual leaflets are entire, pinnatinerved, dark green above, lighter colored and glaucous beneath, 5-35 cm. long, and 2.5-12.5 cm wide. The inflorescence is axillary and lateral, stalked, lax, paniculiform, many-flowered, and shortly pubescent. The flowers are unisexual-monoecious, small, and light yellow.²

The fruits are large, compressed, obtusely three-lobed, rarely four-to six-lobed, 3-5 cm. in diameter, and separating into three, four, or six two-valved cocci; the pericarp is coriaceous, the endocarp woody. The seeds are large, quadrangular-ovoid, compressed on one or two sides, shiny, frayish or pale brown colored, with irregular dark-brown dots and blotches, and are 2-3.5 cm. long, 1.5 cm broad, and 1.5-2.5 cm. thick.³

²Ochse and others, op. cit., p. 930.

³Ibid., p. 931.

Wild Hevea brasiliensis is found in the Amazon Valley south of the Amazon River in Brazil, Mata Grosso in Bolivia and in the Madre de Dios area of Peru. The Amazon Valley is a periodically flooded region but the other two are well-drained upland areas.⁴

Hevea is commercially grown in the lowlands between 10° north and 10° south of the equator with the best areas within 6° of the equator. Rainfall between 75 inches and 105 inches is ideal although rubber has been planted in areas with as little as 60 inches and as much as 230 inches.⁵ Rubber grows best where the rainfall is evenly distributed with 100 to 150 days of rain per annum and at altitudes less than 600 feet.

"Hevea possesses a strongly developed, widely ramified root system and requires deep, fertile, permeable soils for its best growth. In particular, the physical condition of the soil must be good, either naturally or made so artificially through such measures as drainage, irrigation, erosion control, cover crops, and aid plants."⁶

Cultivation of Hevea Brasiliensis⁷

Planting Materials

Three alternative materials are used to plant Hevea, unselected seedlings, clonal seedlings, and budded stumps. Unselected seedlings are grown from seeds of unknown parentage. They are highly variable in growth and

⁴Polanus, op. cit., p. 65.

⁵Ochs and others, op. cit., pp. 948-949.

⁶Ibid., p. 950.

⁷The three works listed in footnote 1 above and personal observation in Nigeria provide the material contained in this section.

branching characteristics, and are low in yields. Unselected materials usually yield 300 to 500 pounds per acre per annum.

Early in this century a technique for the vegetative propagation of rubber was discovered. Most plantations use this technique, called budding. Buds from the bark of a mother tree are implanted in the bark of young seedlings. The bud becomes the upper portion of the tree, and the seedling or root stock provides the roots. A clone is the progeny of a single mother tree. Plantings of budded stumps of a single clone are highly uniform in growth, yields and disease resistance.

Table 1. The Yields of Selected Planting Materials, Malaya.

Planting Material	Inland Estates	Coastal Estates
-----Pounds Per Acre-----		
Pre-War Clones		
Seedlings	1127 (26) ¹	937 (11)
Budded	885 (48)	1085 (40)
Post-War Clones		
Budded	1429 (22)	1214 (40)

Source: H. M. Burkill, "Large Scale Variety Trials of Hevea brasiliensis Muell-Arg. on Malayan Estates 1934-53," Journal of the Rubber Research Institute of Malaya, XVI (1959), p. 34.

¹Standard deviation in parenthesis.

Clonal seedlings are grown from the seeds of a single clone or the cross of two clones. They are not as uniform as budded seedlings although much more uniform than unselected seedlings. The performance of seedlings from different clones varies considerably, some approach the high yields of budded plantings; others are only slightly better than unselected seedlings.

Culture

Whether planting budded stumps, clonal seedlings, or unselected seedlings, it is necessary to germinate seed. The seed bed should be made of well-tilled crumbly topsoil and should be shaded. The seeds are half covered with dirt when planted. Nigerian planters use the older method of placing the seeds flat side down and slanting although it is no longer recommended. After two to three weeks the germinated seeds are transplanted to the nursery or the field.

The nursery is constructed in an area where rubber or other vegetation (such as cassava) susceptible to similar diseases have not recently been grown. The soil should be clean, friable and rich. It is mounded into beds one foot high and one to two feet wide. The height of the bed depends on local drainage conditions. The soil when broken deeply permits the unimpeded growth of tap roots. The arrangement of the seedlings in the nursery depends on their intended use. Seedlings which will be transplanted without budding are usually planted in rows one foot apart with one foot between the seedlings. Seedlings to be budded are planted in double rows 12 to 18 inches apart with 12 to 18 inches between the seedlings. The pairs of rows are separated by paths two to three feet wide.

The budwood nursery is usually placed near the root stock nursery. Budwood grows from budded stumps. The bud grows until it is four or five feet long and then is cut for its buds. The stump of the cut bud sprouts again as a source of future budwood.

When the root stocks are about eight feet tall, they are ready for budding. Two parallel cuts about an inch apart and one and a half inches long are cut vertically into the bark as close as possible to the root crown.

A third horizontal cut joins the top of the cuts. The bud is removed by cutting underneath it and removing a piece of wood along underneath the bud. The wood is removed and the cambium layer of the bud and stock aligned. The rootstock's flap of bark is pulled over the bud. Strips of banana leaf, waxed cloth or plastic are wrapped around the bud to hold it in place. After two or three weeks the wrapping is removed to see if the bud is still alive. The bud will remain dormant until the root is stumped. Once the bud is sprouted the seedling can be transplanted to the field.

Preparation of the planting site begins during the rainy season just prior to planting, in Nigeria about August 1. The first step is to determine the area and to mark out the blocks to be planted. Usually rubber is planted in square blocks of 40 acres with access roads running between the blocks. Blocking should be finished by the end of the rainy season so that underbrushing can be started at the beginning of the dry season.

Underbrushing consists of cutting the smaller growth with cutlass or machete and placing it in piles between the future rows. In Nigeria underbrushing starts around November 1 and should be completed by February 1. Sufficient time should be allowed after underbrushing to permit the refuse to dry thoroughly before the rains begin. After underbrushing, trees are felled with axes or chain saws. Felling should be carried out so that the trees fall between the future rows rather than across them. Only the trees growing directly in the row need be moved if felling is done properly. Usually all stumps except those growing directly in the row are left in the ground and poisoned to prevent future regrowth.

Just prior to the beginning of the rains, the dry refuse is burned. The primary purpose of burning is to retard weed competition by killing the

weed seeds and plants remaining after underbrushing. Herbicides may be used instead of burning.

After burning, the cover crop is planted. Usually cover crops are planted by spreading a mixture of soil, fertilizer and seed on the ground. The two cover crops most commonly used in Nigeria are Centrosema pubescens and Pueraria phaseoloides. On at least one older Nigerian plantation the cover crop was allowed to die and volunteer rubber seedlings left to replace it.

Once the rains are regular, the rubber seedlings can be safely transplanted to the field. Before transplanting, lining, pegging and holing must be carried out. With the use of chain and prismatic compass the lines are first marked out. Pegs are placed in the lines to mark the spot to be occupied by each seedling. A holing team digs a hole at least one foot square and 18 inches deep at each peg, making the field ready for planting.

In Nigeria, rubber is usually planted between May 1 and July 15. Before May 1, the rains are not regular so that drought may kill the seedlings. After July 15, the intensity of the rains declines and weed competition increases. If seedlings are to be planted, either as root stock for future field budding or as clonal seedlings, their stems are cut back so that only brown bark remains on the stem. The tap root is cut to about 18 inches and the side roots pruned to four to six inches to facilitate handling and planting. The stump is placed in the hole with a mixture of rich top soil and fertilizer. The dirt must be carefully tamped around the root stump to avoid air pockets.

Planting density and layout varies according to the custom of the area. Unequal spacing is usually preferred as it facilitates the production of

intercrops, the movement of large equipment and crown growth. A spacing of 30' x 7' is recommended by the Midwestern Nigeria Ministry of Agriculture and Natural Resources, but most experts agree this spacing is too extreme. Usually 10' x 20' or 12' x 22' is preferred.

Four operations are carried out after planting: fertilizing, pruning, supplying and slashing. Fertilizer requirements vary with soil and climatic conditions, but generally it is agreed that fertilizer is only necessary for young plants. A number of plantations in Nigeria fertilize only the first and second years after planting.

During the period after transplanting undesirable bud shoots are pruned; later branches must be pruned. Seedlings may develop several bud shoots, but all except one should be pruned. Budded stumps often develop several shoots from the root stock necessitating pruning. Once the tree is well established, all branches below eight feet on the stem should be pruned so they don't interfere with tapping.

Plants that fail to grow after transplanting are removed and new plants supplied. During the first two years, all vacancies are filled; later only spaces of three or more dead plants in succession can be replanted. Seedlings in the outer positions will not be able to compete with their larger neighbors so only the center positions are filled.

Slashing of the growth between the rubber tree rows should be carried out on a regular basis to prevent the weeds from retarding the growth of the trees. Most plantations slash the cover crop and weed around the base of the trees about once a month.

Tapping

Tapping is initiated when the tree has a girth of 18 to 22 inches three feet from the ground or bud union. Because the trees of a single planting reach this size at different times, tapping does not start until a certain number of trees are tappable, usually 50 or 70 percent. Only trees large enough are tapped; the remainder are tapped when they reach the minimum size.

Latex flows in tubes called latex vessels extending up and down the tree. They are concentrated near the base and the cambium and are scattered towards the periphery. Tapping attempts to cut these vessels so the latex flow is maximized and damage is minimized.

The yield of a tree is correlated with the number, shape and size of the latex vessels. Unselected seedlings have elliptical and budded trees have cylindrical vessels. Generally budded trees have more vessels than seedlings. The number and shape of the vessels are more uniform among the budded trees than among clonal seedlings and in turn the vessel of clonal seedlings of a single family are more uniform than unselected seedlings.

Tapping consists of cutting off a thin strip of bark about one sixteenth of an inch wide. The cut should be deep enough to sever most latex vessels, but not so deep that the cambium is injured. It is made horizontally around the tree. Typically, but not necessarily, half the circumference is tapped. Alternative systems tap one-third, one-quarter, two-thirds and three-fourths of the circumference. The area above the present tapping site where the bark has been removed is called the tapping panel. The tapping panel should be smooth and have a constant width.

Chief among the causes of failing to achieve the potential yield of a tree are injuries resulting from overtapping or improper tapping. Overtapping is the too frequent tapping of the tree. It causes the vessels and surrounding bark area to die, the first symptom of which is a reduction of latex production and sometimes the complete cessation of flow. Eventually the bark turns a brown color, hence the name of the disease, brown bark. The tree must be taken out of production until the wound heals and the bark returns to normal.

Improper tapping techniques also can cause a reduction in output. The depth and angle of the cut determine the number of vessels which will be cut. If the structure of the tree is not well understood there is a tendency to cut too deeply into the tree injuring the cambium. It is cambium which provides the cells for the regrowth of bark after tapping. If the cambium layer is completely or partially removed, scar tissue forms making future tapping of the area impossible or extremely difficult. If tapped carefully a given area can be tapped two or three times.

The angle of the cut is also very important. Given a cut of a certain length, it is desirable to sever as many vessels as possible. Research has shown that on the average the vessels spiral around the trunk upwards from left to right at an angle of 65 degrees from the horizontal. In order to maximize the number of vessels severed, the cut should be perpendicular to the vessels or downwards from left to right and 25 degrees from the horizontal.

Other important determinants of yields are the time of tapping, sharpness of the knife and the amount of bark removed. Early morning hours are best for tapping because the turgor pressure and hence the flow of latex is

greatest then. If the latex flows too slowly it coagulates at the surface of the cut preventing further flow. If a dull tapping knife is used, the vessels are not sliced but torn crushing the walls of the vessels together and impeding the flow.

Latex flow stops when the vessels become plugged with coagulum. To renew the flow, it is necessary to remove the scrap of rubber adhering to the cut's surface and to cut off a thin strip of bark. Not only does the coagulate rest on the surface of the cut, but each vessel has a small piece of coagulum in its tip acting as a stopper. Removing the scrap of rubber causes some latex to exude because some of the stoppers are removed. Cutting the bark opens up the remaining plugged vessels. The more bark cut at each tapping, the faster the bark is removed from the tree and the shorter the tapping life of the tree. The total time an area can be tapped depends on the frequency of tapping and the amount removed each time. Removal of three centimeters per 20 tappings is considered normal.

Tapping systems are classified according to the period (continual or periodic), frequency (daily, bidaily, or tridaily) and length of cut (one-quarter, one-third, one-half or whole-circumference). The recommended and most common system on Nigerian plantations is alternate daily, half-circumference, continuous tapping.

A tapper can tap 250 to 400 trees a day. If alternate daily tapping is used, then he taps two stands of 250 to 400 trees each. Because of rain, holidays and an annual rest period of two weeks, tappers work less than 300 days a year. Since each stand is tapped every other day, each tree is tapped about 150 days per year.

The tapper begins his round at dawn. Normally it takes one to two hours to complete tapping. He carries a pail for collecting the scraps torn from the previous days cut, a knife, spouts and cups. A few drops of an anti-coagulant, ammonia, sodium sulfite or soda solution, are left in the cup if there is a danger the latex will coagulate before processing. After completing the tapping round, the tapper returns to the beginning, pours the latex into a pail, collects the spout and cup, and moves on to the next tree. After collecting, each tapper takes his days product to a collecting station where it is weighed and recorded. As soon as all tappers finish their work, the latex is transported by tank truck or wagon to a factory for processing.

Processing

At the factory, the latex is pumped through strainers into holding tanks where it is diluted to the proper concentration for coagulating, 15 percent rubber for crepe production and 20 percent rubber for sheet production. Holding tanks, tank truck, pipes, screens, stirrers and valves are made of a noncorrosive material such as aluminum, stainless steel or concrete lined with glass.

From the storage tank the latex is piped to coagulation tanks. These tanks may be stationary or portable and vary in size from country to country, but they are always rectangular boxes open at the top approximately 10 feet long, 15 inches deep and two to three feet wide. After the latex is poured into the tank an acid is added which causes the latex to coagulate. Formic, acetic, sulfuric or sulfur dioxide can be used. After adding the acid, panels are inserted which separate the tank into compartments an inch and a half wide, 15 inches deep and two to three feet long. After coagulation is

completed, slabs of rubber having the dimensions of the compartments are ready for milling.

Two types of rubber sheets can be manufactured, ribbed smoked sheets (R.S.S.) and crepe sheet. Ribbed smoked sheets are made by passing the slabs through a battery of three to five mills. Each mill consists of two smooth iron rollers set a small distance apart. They are similar to the mangles set over wringer-type laundry washers, but the rollers have larger diameters. As the rubber slab passes through each successive mill it becomes thinner because the gap between each set of rollers is smaller. The last mill, called a printer or marked roller, has ridges running diagonally around the rollers. After passing through the printer, the sheet has a ridged surface.

Crepe rubber is made by passing the slabs through a battery of rollers with diamond-shaped studs on their surface. The rollers move at different speeds so that they tear the sheets into small lumps and knead them together. As the sheets pass through successive machines, the lumps become smaller and smaller giving the crepe a rough, but continuous, surface. Crepe sheets are about three feet wide and six feet long. Ribber smoked sheets are smaller, about two by three feet.

After milling, both crepe and ribbed sheets contain 20 to 30 percent water which must be removed. Surface moisture is removed by pre-drying crepe in a temperature of 93° F and sheets in 131° to 140° F or by hanging the rubber outside. The rubber is then placed in ovens. Crepe ovens are heated by forced air kept at 102° F with controlled humidity. It requires about eight days to dry crepe in a modern oven. Ribbed smoked sheets are preserved by smoking and drying for four days at 122° to 140° F.

Most plantations produce more than one product. They utilize liquid latex to produce ribbed smoked sheets and scraps to produce estate crepe. Other products are sole crepe, concentrated latex (produced in Nigeria), sprayed rubber, rubber powder and earth rubber.

Costs of Rubber Production

The cost of producing rubber is between 8 and 19 cents (U. S.) per pound. Ronald Ma estimated that for some thirty 'dollar companies' in Malaya during the period 1947 to 1958 that the cost per pound varied between 9 and 19 cents.⁸ Speakers at a symposium organized by the International Study Group in 1962 said costs on an estate producing 1,500 pounds per acre are 12 to 15 cents and the minimum cost for such an estate is 8 cents.⁹

About 40 percent of all costs are for collection, processing and dispatch. Upkeep and cultivation take another 15 percent of expenditures. General expenditures, which comprise depreciation, head office and administrative expenses, amount to 30 percent of all costs. Duties and cess make up the remainder. Table 2 reports the results of three studies of the relative sizes of costs. Labor costs are over 50 percent of total costs. Collection, processing, dispatch, upkeep and cultivation are almost completely labor costs. These two categories amount to 55 percent of total costs.

⁸Ronald Ma, "Company Profits and Prices in the Rubber Industry in Malaya, 1947-58," Malayan Economic Review, IV (October 1959), p.43.

⁹F. W. Hibbert, "A Review of the World Trade in Rubber," Tropical Science, V (1963), p. 112.

Table 2. Importance of Cost Items in Producing Rubber, Malaya.

Cost Item	Ma	Bauer	Malayan Mission of Inquiry
	-----Percent-----		
Collection, Processing and Dispatch	41	41	48
Upkeep and Cultivation	11	17	12 ¹
Duty and Cess	17	10	--
General Expenditure	27	--	--
Depreciation	4	33	30

Sources: Ronald Ma, "Company Profits and Prices in the Rubber Industry in Malaya," Malayan Economic Review, IV (October 1959), pp. 29-30; P. T. Bauer, The Rubber Industry (London: The London School of Economics and Political Science, 1948), p. 271; Charles F. Phillips, Jr., Competition in the Synthetic Rubber Industry (Chapel Hill: University of North Carolina Press, 1961), p. 161.

¹Plant upkeep included in general charges.

It is generally agreed in the literature that there is little relationship between plantation size and cost. Analysis of 138 firms no larger than 5,000 acres shows a nonsignificant correlation between size and costs.¹⁰ Ma found a correlation of +0.20 between size and costs for 36 dollar firms in 1956.¹¹ Ma also found that there is little relationship between price and output.¹²

In summary, labor is the most important cost in rubber production. In the immediate future, it will not be possible to reduce labor input absolutely. Introduction of high yielding planting materials can reduce the average unit

¹⁰P. T. Bauer, The Rubber Industry (London: The London School of Economics and Political Science, 1948), p. 272.

¹¹Ma, op. cit., p. 31.

¹²Ibid., pp. 332-333.

cost of labor about 35 percent, but it will still represent over half of total costs. Land costs will reduce almost in proportion. Savings of 60 percent of general charges per unit and 65 percent of cultivation costs per unit are achieved through the use of high yielding clones.¹³

Grades of Rubber

The world rubber industry uses two sets of grades for natural rubber. Grade distinctions are made on the basis of cleanliness, quality of curing, mold and rust content. The Nigerian industry uses Malayan grades rather than the Rubber Manufacturers Association grades. The major weakness of both systems is that they are based on visual characteristics rather than technical ones.

Wet, bleached, under-cured and virgin rubber and rubber that is not completely visually dry at the time of buyer's inspection is not acceptable. (Except slightly under-cured rubber as specified for No. 5 and No. 6 RSS).

Skim rubber made of skim latex shall not be used in whole or in part in the production of any grade.

Nothing but coagulated rubber sheets, properly dried and smoked, can be used in making these grades; block, cuttings or other scrap or frothy sheets, weak, heated or burnt sheets, air dried or smooth sheets not permissible.

No. IX RSS

The grade must be produced under conditions where all processes are carefully and uniformly controlled.

Each bale must be packed free of mould but very slight traces of dry mould on wrappers or bale surfaces adjacent to wrapper found at time of delivery will not be objected to provided there is no penetration of mould inside the bale.

¹³Charles F. Phillips, Jr., Competition in the Synthetic Rubber Industry (Chapel Hill: The University of North Carolina Press, 1961), p. 162.

Oxidized spots or streaks, weak, heated, under-cured, over-smoked, opaque and burnt sheets are not permissible.

The rubber must be dry, clean, strong, sound and evenly smoked, and free from blemishes, specks, resinous matter (rust), blisters, sand, dirty packing and any other foreign matter. Small pinhead bubbles, if scattered, will not be objected to.

No Official International Sample has been established for this grade.

No. 1 RSS

Each bale must be packed free of mould but very slight traces of dry mould on wrappers or bale surfaces adjacent to wrapper found at time of delivery will not be objected to provided there is no penetration of mould inside the bale.

Oxidized spots or streaks, weak, heated, under-cured, over-smoked, opaque and burnt sheets are not permissible.

The rubber must be dry, clean, strong, sound, and free from blemishes, resinous matter (rust), blisters, sand, dirty packing and any other foreign matter, except slight specks as shown in sample. Small pinhead bubbles, if scattered, will not be objected to.

No. 2 RSS

Slight resinous matter (rust) and slight amounts of dry mould on wrappers, bale surfaces and interior sheets, found at time of delivery will not be objected to, provided these conditions, either singly or in combination, do not exist to an objectionable extent on and in more than 5% of the number of bales included in the delivery, lot or tender as determined by the number of bales inspected.

Small bubbles and slight specks of bark, if scattered, will not be objected to.

Oxidized spots or streaks, weak, heated, under-cured, over-smoked, opaque and burnt sheets are not permissible.

The rubber must be dry, clean, strong, sound and free from blemishes, blisters, sand, dirty packing and all other foreign matter other than specified above as permissible.

No. 3 RSS

Resinous matter (rust) and dry mould on wrappers, bale surfaces and interior sheets, found at time of delivery will not be objected to, provided these conditions, either singly or in combination, do not exist to an objectionable extent on and in more than 10% of the number of bales included in the delivery, lot or tender as determined by the number of bales inspected.

Slight blemishes in color, small bubbles and small specks of bark permissible.

Oxidized spots or streaks, weak, heated, under-cured, oversmoked, opaque and burnt sheets are not permissible.

The rubber must be dry, strong and free of blemishes, blisters, sand, dirty packing and all other foreign matter other than specified above as permissible.

No. 4 RSS

Resinous matter (rust), dry mould on wrappers, bale surfaces and interior sheets, found at time of delivery will not be objected to provided these conditions, either singly or in combination, do not exist to an objectionable extent on or in more than 20% of the number of bales included in the delivery, lot or tender as determined by the number of bales inspected.

Medium size bark particles, bubbles, translucent stains, slightly sticky and slightly over-smoked rubber are permissible to the extent shown in the sample.

Oxidized spots or streaks, weak, heated, under-cured, oversmoked (in excess of the degree shown in the sample), opaque and burnt sheets are not permissible.

The rubber must be dry, firm and free of blemishes, blisters, sand, dirty packing and all other foreign matter other than specified above as permissible.

No. 5 RSS

Resinous matter (rust), dry mould on wrappers, bale surfaces and interior sheets, found at time of delivery will not be objected to provided these conditions, either singly or in combination, do not exist to an objectionable extent on or in more than 30% of the number of bales included in the delivery, lot or tender as determined by the number of bales inspected.

Large bark particles, bubbles and small blisters, stains, oversmoked, slightly sticky rubber, and blemishes are permissible of the amount and size shown in the sample. Slightly under-cured rubber permissible.

Weak, heated, burnt, oxidized spots or streaks NOT permissible.

The rubber must be dry, firm, free of blisters, except to the extent shown in the sample, dirty packing, sand, and all other foreign matter other than specified above as permissible.

No. 6 RSS

Resinous matter (rust), dry mould on wrappers, bale surfaces and interior sheets, found at time of delivery will not be objected to provided these conditions, either singly or in combination, do not exist to an objectionable extent on or in more than 35% of the number of bales included in the delivery, lot or tender as determined by the number of bales inspected.

Appendix B

Exports of Nigerian Rubber 1893-1963

Year	Quantity	Value	Price
	<u>Tons</u>	<u>Pounds Sterling</u>	<u>Pounds per Ton</u>
1893	negligible ¹		
1894	negligible ¹		
1895	2,320.00 ¹		
1896	3,067.00 ¹		
1897	2,230.00 ¹		
1898	2,050,000 ¹		
1899	1,560,000 ¹		
1900	1,271.27	185,528	145.94
1901	863.59	121,674	140.89
1902	454.04	56,217	123.82
1903	584.43	77,398	132.43
1904	1,193.92	181,952	152.40
1905	1,390.12	247,635	178.14
1906	1,533.16	307,076	200.29
1907	1,269.56	244,988	114.20
1908	545.63	98,529	180.58
1909	619.65	109,075	176.03
1910	1,175.80	311,691	265.09
1911	966.20	179,353	185.63
1912	705.00	125,021	177.33
1913	510.72	89,995	176.21
1914	166.47	38,854	233.26

Year	Quantity	Value	Price
	<u>Tons</u>	<u>Pounds Sterling</u>	<u>Pounds per Ton</u>
1915	248.42	38,112	153.42
1916	395.68	34,192	86.41
1917	392.09	32,350	82.51
1918	157.38	19,667	124.97
1919	398.25	43,903	110.24
1920	491.91	57,044	115.96
1921	85.19	10,248	120.67
1922	124.25	14,377	115.71
1923	213.58	21,221	99.26
1924	522.11	52,437	100.43
1925	950.21	108,234	113.91
1926	1,594.19	203,143	127.43
1927	1,997.12	256,020	128.19
1928	2,294.21	255,771	111.49
1929	1,974.05	163,684	82.92
1930	2,177.31	150,326	69.04
1931	1,821.36	71,319	39.16
1932	845.41	31,362	37.10
1933	1,007.29	33,089	32.85
1934	1,612.76	44,488	27.59
1935	2,058.89	61,572	29.91
1936	2,172.72	90,137	41.40
1937	2,573.21	126,055	48.99
1938	3,135.25	135,797	43.31

Year	Quantity	Value	Price
	<u>Tons</u>	<u>Pounds Sterling</u>	<u>Pounds per Ton</u>
1939			
1940	2,903.00		
1941	2,055.00		
1942	6,668.00		
1943	7,366.00		
1944			
1945	10,518.57		
1946	11,488.00	1,404,000	122.21
1947	7,445.00	677,000	90.93
1948	8,019.00	719,000	89.66
1949	6,858.00	591,000	86.18
1950	13,652.00	2,834,000	207.59
1951	20,856.00	7,483,000	358.79
1952	18,331.00	4,138,746	255.78
1953	21,260.00	3,286,522	154.59
1954	20,397.00	2,848,933	139.67
1955	30,329.00	5,566,859	183.55
1956	38,032.00	6,382,422	167.82
1957	39,946.00	7,012,201	175.54
1958	41,130.00	7,617,019	185.19
1959	53,352.00	11,602,402	217.47
1960	57,167.00	14,241,223	249.12
1961	55,054.00	11,010,145	199.99

Year	Quantity	Value	Price
	<u>Tons</u>	<u>Pounds Sterling</u>	<u>Pounds per Ton</u>
1962	59,635.00	11,355,880	190.42
1963	63,209.00	11,781,911	186.40

Sources: The Nigeria Handbook 1919, compiled by A. C. Burns (Lagos: The Government Printer, p. 159); The Nigeria Handbook, Ninth Edition, compiled in the Chief Secretary's Office (Lagos: The Government Printer, 1929), p. 247; The Nigeria Handbook, Tenth Edition, compiled in the Chief Secretary's Office (Lagos: The Government Printer, 1933); J. M. Mackie, Director Agricultural Department, "Rubber Growing." Memorandum No. 2961/DA/252, May 25, 1939, p. 1, File No. 14451 "Rubber Industry in the Cameroons and Nigeria," I, National Archives, Ibadan, p. 46; U. S. Department of Agriculture, Economic Research Service, Nigeria, (Washington, D. C.: 16 (Lagos: Federal Ministry of Commerce and Industry, December, 1962), p.11; Federation of Nigeria, Annual Abstracts of Statistics 1960, (Lagos: Federal Office of Statistics, 1960) p. 35; Federation of Nigeria, Nigeria Trade Summary, XLVII, (December, 1962), pp. 169-170; The Nigeria Handbook, (Second Edition; London: The Crown Agents for Overseas Governments and Administrations, 1954), p. 304; Federation of Nigeria, Nigeria Trade Summary, XLVIII, (December 1963); Cuthbert Christy, African Rubber Industry and Funtumia Elastics (London: John Bale, Sons and Danielsson, Limited, 1911), p. 10.

¹Approximate because estimated from a graph.

APPENDIX C
QUESTIONNAIRES

Smallholders Rubber Survey

Interviewer	Date	No. of Males
Village	Council	No. of respondent
Division	Province	

1. Name of respondent

Dead	Living elsewhere	Away temporarily
------	------------------	------------------

2. What is your tribe?

Edo	Bini	Urhobo	Ijaw	Other (specify)
Itsoko	Ibo	Yoruba	Itsekiri	

3. How many years education have you had?

0	1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	---	----	----	----	----

4. How old are you?

5. Do you grow most of the food you eat? Yes No

Is a portion of your income earned by selling agricultural products?

Yes No

Do you grow a cash crop which is not bearing yet? Yes No

Do you grow those crops yourself (not with your father or your senior brother)?

Yes No

If all four answers were No or if last answer was No, stop here.

6. What crops do you grow? Which do you consume yourself? Which do you sell?

	Grow	Consume	Sell
Rubber			
Cocoa			
Oil palm			
Coconut palm			
Mango			
Orange			
Grapefruit			
Lemon			
Lime			
Plaintain			
Banana			
Paw-paw			
Yam			
Cassava			
Coco-yam			
Beans			
Peppers			
Bitterleaf			
Other (specify)			

7. How many acres do you farm?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

How many plots do you farm?

0 1 2 3 4 5 6 7 8 9 10

8. Suppose the government sponsors a scheme for rubber planting. The scheme requires that the participating farmers provide all the necessary land and labor and some of the money.

How many acres of land could you provide in plots of 5 acres or more for new rubber plantings? 0 5 10 15 20 25 30 35

For cutting down old stands and replanting? 0 5 10 15 20 25 30 35 40 45 50

How many family members could help you plant and care for the rubber?

Men 0 1 2 3 4 5 6 7 8 9 10

Women 0 1 2 3 4 5 6 7 8 9 10

Children 0 1 2 3 4 5 6 7 8 9 10

How much money out of your own savings could you invest in a high yielding plantation? £

If the farmer indicated in question 6 that he has no rubber, stop here. If he does have rubber, continue on.

9. What are the sizes of your farms? (enter in table)
10. How old are they? (enter in table)
11. How long ago were they first tapped? (enter in table)
12. Are they being tapped now? Why not? (enter in table)

Size (acres)	No. of Trees	Age (years)	First Tapped (years)	Tapped Now (yes or no)	Why Not
					1. No tapper
					2. Tapped out
					3. Too young
					4. Other (specify)

1

2

3

4

5

6

7

8

9

13. How many family members help you with your farming during periods of much work?

Men 0 1 2 3 4 5

Women 0 1 2 3 4 5

Children 0 1 2 3 4 5

In 1963, did you hire anyone to help you farm? Yes No

Time Salary

Men

Women

Children

14. Are all your farms planted on communal lands? Yes No

If not, list those that are owned by farmer using numbers in left hand column of table.

1 2 3 4 5 6 7 8 9 10

15. Did you clear and burn the land for your youngest farm especially for rubber or did you plant the rubber after using the land for a food crop?

Especially for rubber

Food crop first

16. On the last farm you planted did you dig a large hole with a spade or a small one with a stick for the seedlings?

Spade

Stick

17. Did you plant your newest farm in rows? Yes No

If yes: How far apart are the rows?

8 9 10 11 12 14 16 18 20 21 22

How far apart are the seedlings in the row?

4 5 6 7 8 9 10

18. Do you weed your rubber farms? Yes No

How many times one year after planting? 1 2 3 4 5 6

How many years? 1 2 3 4 5 6

19. Did you interplant your last planting with any other crop?

Yes

No

What crops?	Yams	Cassava	Banana	Plaintain
	Coco-yams	Beans	Other(specify)	

How many years did you interplant?

1 2 3 4 5 6 7 8

20. What planting materials did you use when planting your youngest farm? Where did you get them? How much did they cost?

Source	Cost
--------	------

Ordinary seedling

Clonal seedling

Budded rubber

Mixture

Doesn't know

21. Have you ever manured your newest rubber farm? Yes No

How often?

At what age?

What type of fertilizer?

How much?

22. Have you ever seen mould on a tapping panel? Yes No

How do you treat it?

No treatment?

Other (specify)

23. Do you or one of your family tap your farms?

No	Owner	Son	Brother	Father
----	-------	-----	---------	--------

If not, why not?

24. How many tappers who are not family members are you employing today?

0 1 2 3 4 5 6 7 8 9 10

How many shillings per day?

How much per gallon?

50-50 share of all rubber produced

50-50 of sheets with lumps to the tapper

26. How many more tappers would you like to hire?

0 1 2 3 4 5 6 7 8

27. What was the production of your farms in October, 1963?

Pounds of lump

Number of sheets

Production thus far in 1963?

Pounds of lump

Number of sheets

If no lump was sold in 1963, skip on to question 30.

28. Do you put any foreign matter in your lump or roll them on the ground?

Yes

No

Why do you do that?

29. What price do you receive for lump now?

$$\frac{1}{2} \quad \frac{3}{4} \quad 1 \quad 1\frac{1}{4} \quad 1\frac{1}{2} \quad 1\frac{3}{4} \quad 2 \quad 2\frac{1}{4} \quad 2\frac{1}{2}$$

2 3/4 3 3 1/4 3 1/2 3 3/4 4

What are the lowest and highest prices you received this year?

$$\frac{1}{2} \quad \frac{3}{4} \quad 1 \quad 1\frac{1}{4} \quad 1\frac{1}{2} \quad 1\frac{3}{4} \quad 2 \quad 2\frac{1}{4} \quad 2\frac{1}{2}$$

2 3/4 3 3 1/4 3 1/2 3 3/4 4

What month did you receive the highest?

Jan. Feb. March April May June July Aug. Sept. Oct. Nov.

What month did you receive the lowest?

Jan. Feb. March April May June July Aug. Sept. Oct. Nov.

Do you receive a lower price when the lumps are very dirty? Yes No

What price now?

If no sheet was sold in 1963, finish here.

30. Do you own your own rollers and smokehouse? Yes No

If no, whose do you use?

Cooperative (Name)

Another farmers - What does he charge you?

Other (specify)

31. Do you belong to a processing cooperative?

No

Yes - Name:

32. What price are you now receiving for your sheets?

What is the highest price you have received this year?

Which month?

Jan. Feb. March April May June July Aug. Sept. Oct. Nov.

What is the lowest price you have received this year?

Which month?

Jan. Feb. March April May June July Aug. Sept. Oct. Nov.

Smallholders Rubber Survey - II

Owners Questionnaire

1. Background

a. Farm Labor

How many workers do you hire full time?

0 1 2 3 4 5 6 7 8 9 10

How much do you pay them per month?

What meals do you provide?

Breakfast

Lunch

Dinner

Do you give these workers free housing?

Yes

No

b. How many men in your family help you with your farm?

0 1 2 3 4 5 6 7 8

Do you ever give them money for working? If so, how much per day?

Yes

No

₦

If you don't usually eat from the same pot, do you give them meals?

Same pot

No. of meals

Breakfast

Lunch

Dinner

How many women in your family help you with your farm?

0 1 2 3 4 5 6 7 8

Do you ever give them money for working? If so, how much per day?

Yes

No

₦

If you don't usually eat from the same pot, do you give them meals?

Same pot

No. of meals

Breakfast

Lunch

Dinner

How many children in your family help you with your farm?

0 1 2 3 4 5 6 7 8

Do you ever give them money for working? If so, how much per day?

Yes

No

₦

If you don't usually eat from the same pot, do you give them meals?

Same pot No. of meals Breakfast Lunch Dinner

c. How many friends help you with your farm on a cooperative basis?

0 1 2 3 4 5 6 7 8 9 10

d. How many plots of arable crop did you grow in 1963?

0 1 2 3 4 5 6 7 8 9 10

How many plots did you plant to rubber in 1963?

0 1 2 3 4 5 6 7 8 9 10

How many plots do you own or control which had no crop on them in 1963 (were in bush)?

e. Do you have any permanent crops except rubber?
How much did you plant in 1963?

Growing	Acres	No. of Trees	No. of Farms	Acres	<u>1963 Planting</u>	
					No. of Trees	No. of Farms

Cocoa

Palm

Kola

Bananas

Plaintain

Grapefruit

Orange

f. Have you bought any land? Yes No
How much did it cost? £
How many acres was it?
When did you buy it?

g. Have you any land obtained by pledge? Yes No
When did you receive it? 19
How much was the pledge? £
How large was the farm? Plots:
 Acres:

- h. Has any land in the village been sold? Yes No
 To a stranger?
 To a local man?
 (Sold for permanent occupancy) How much was paid most recently?
 How much land was sold? £ Acres Plots
- i. When is it necessary to ask the elders' permission to plant rubber?
 Only when planting on communal lands Never Always
 How often have you been refused permission in the last 3 years?
 0 1 2 3 4 5 6
2. Preparing land for 1963 rubber farm
 (a) When did you clear and burn the rubber farm(s) you planted in 1963?
 1961 Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
 1962
 1963
 (b) How many people helped to clear the land? How many days did it
 take? What did you pay?

Unpaid Labour				Hired Labour			
<u>Number</u>	<u>Days</u>	<u>Meals</u>		<u>Number</u>	<u>Days</u>	<u>Wage</u>	<u>Meals</u>
Men							
Women							
Children							

 (c) How many people helped to fell the trees? How many days did it take?

Unpaid Labour				Hired Labour			
<u>Number</u>	<u>Days</u>	<u>Meals</u>		<u>Number</u>	<u>Days</u>	<u>Wage</u>	<u>Meals</u>
Men							
Women							
Children							

 (d) How many people helped to stack and burn the land? How many days
 did it take? How much did you pay?

Unpaid Labour				Hired Labour			
<u>Number</u>	<u>Days</u>	<u>Meals</u>		<u>Number</u>	<u>Days</u>	<u>Wage</u>	<u>Meals</u>
Men							
Women							
Children							

3. Planting of rubber in 1963

(a) Did you plant seeds or seedlings?

Seeds

Seedlings

If seeds - did you use a nursery and then transplant?

Yes

No

(b) Did you plant (replant) the seedlings whole with the stem cut or with the leaves removed?

Whole

Stem cut

Leaves removed

(c) During which month did you plant rubber in 1963? Jan. Feb.
March April May June July Aug. Sept. Oct. Nov. Dec.

(d) How much labour was required to pull and plant the seedlings (gather and plant the seeds)? What did you pay?

Unpaid Labour

Hired Labour

NumberTotalDaysMealsNumberTotalDaysWageMeals

Men

Women

Children

4. Maintenance

(a) In 1963 how many times did you weed your rubber farms planted since 1958?

Which months?

How many people helped?

How many days did it take?

What did you pay hired labour?

Planting year

Month weeded

Type weeding

(slash, ring, row, complete)

Paid Labour

Men

Number

Days

Wage

Meals

Women

Number

Days

Wage

Meals

Children

Number

Days

Wage

Meals

Unpaid Labour

Men

Number

Days

Women

Number

Days

Children

Number

Days

5. Tapping

(a) How many different hired tappers worked for you in 1963?

(b) When did each come and leave? How was he paid? How many trees did you give him to tap?

<u>Tapper</u>	<u>Month started</u>	<u>Month left</u>	<u>Payment</u>	<u>Trees</u>
			(1 1/2 all rubber)	
			(2 1/2 sheets all lumps)	
			(3 hire out - £)	

1

2

3

4

5

(c) How many family members tap on your farm? (include owner)

<u>Relationship</u>	<u>Months Tapped 1963</u>	<u>Payment</u>	<u>Trees</u>
		(1 1/2 all rubber)	
		(2 1/2 sheets all lumps)	
		(3 hire out - \$)	
		(4 No payment)	
1			
2			
3			
4			
5			

(d) What anti-coagulant do you use?

Soda ash, crystallized soda
Sodium sulfite liquid ammonia
Doesn't use anything
Doesn't know
Tappers buy

How much did you buy in 1963?

How much did it cost?

When did you last buy some?

Month Year

How much did you buy?

How much did it cost?

How long will it last?

6. Processing

(a) With what do you coagulate your latex?

How much did you buy in 1963?

How much did it cost?

When did you last buy some?

Month Year

How much did you buy?

What did it cost?

How long will it last?

(b) Do you:

1. Roll on smooth roller?
2. Roll with a bottle?
3. Roll on wooden mangling machine?
4. Roll on marked roller?

(c) Do you:

1. Smoke in a smokehouse?
2. Smoke in the kitchen?
3. Sun dry?
4. Sell wet sheets?

(d) What equipment do you rent? How much does it cost?

Cost per sheet per month

1. Plain roller
2. Marked roller
3. Smokehouse

(e) Do you belong to a rubber processing or marketing cooperative?

Yes

No

What is the name?

When did you join?

How much did it cost to join the processing cooperative?

What does it cost to use the cooperative?

7. How many of the following tools do you own?

How often must you replace them? What do they cost?

General Purpose Tools	Number	Cost	Replacement
Hoes (Native)			
Spades			
Cutlasses			
Knives			
Bicycle			
Saw			
Axes			
Others			

Rubber Growing Tools	Number	Cost	Replacement
Tapping knives			
Buckets			
Cups			
Snail			
Coconut			
Tins			
Manufactured			
Others			
Rubber Growing Tools			
Plain roller			
Marked roller			
Strainer			
Pans			
Files			
Others			

Tapper Questionnaire

NAME:

1. To what tribe do you belong?

Bini Ibo Urhobo Ijaw Ishan Afenmai
Isoko Calabar Yoruba Itsekiri Other

2. What is your Province? Division

3. What is your relationship to the farm owner?

Owner Father Son Brother Wife Daughter Sister Other

4. How many years of school do you have?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

5. What months in 1963 did you tap for this farmer? Jan. Feb.

March April May June July Aug. Sept. Oct. Nov. Dec.

6. Do you tap for more than one farmer? Yes No

If so, how often do you tap for this farmer?

1 2 3 4 5

7. How many trees do you tap for this farmer?

8. What tools do you supply? What are their costs? How often must you replace them?

Number Cost Replacement

File

Tapping knife

Pails

Cups

Snail

Coconut

Tins

Manufactured

Others

9. What anti-coagulant do you use?

None	Soda Ash	Crystallized Soda	Sodium	Sulfite
Liquid Ammonia	Doesn't know			

How much did you buy for this farm in 1963?

How much did it cost?

When did you last buy some?

How much did you buy?

How long will it last?

How much did it cost?

How do you mix it, if necessary

10. What coagulant do you use?

How much did you buy for this farm in 1963?

How much did it cost?

When did you last buy some?

How much did it cost?

How long will it last?

How do you mix it?

Questionnaire for Rubber Planters

Name _____ Date _____

Village _____ Interviewer _____

1. Purchases of Ministry of Agriculture and Natural Resources Seedlings

According to the records of the M.A.N.R. each year each year you bought the number of rubber seedlings shown in Table 1 below:

Table 1 - Purchases of Rubber Seedlings

Year	Number of Seedlings	Number Alive Today	Planting Distance
	(1)	(2)	(3)
(a) 1958			
(b) 1959			
(c) 1960			
(d) 1961			
(e) 1962			
(f) 1963			
(g) 1964			

If the number of seedlings bought is not shown correctly in Table 1, correct the error by crossing out the number shown and writing in the correct number. If he bought rubber seedlings from the Ministry in years where nothing is shown in Table 1, write in the number bought.

In column 2, please write down the number of the seedlings which still are alive. Count only those that he got from the Ministry, not ones grown from seed produced by the Ministry trees. If the number alive is unknown, write down number which have died.

In column 3, show the planting distances of each year's purchases. For instance, if the seedlings purchased in 1961 were planted in rows 20 feet apart and with 15 feet between the trees in the row, write down 20' x 15' in column 3 of row d. If no particular spacing was used, the trees were planted anyhow, write irregular.

2. Land for Planting Rubber

Were any crops planted on your farms before you planted rubber?

Table 2

Year of Planting	Big Bush- Virgin Forest Never Planted Before	Light Bush- Cultivated Before	Old Rubber Farm	Arable Crop Land- Grew Food Crops in Last Two Years
	(a)	(b)	(c)	(d)
(1) 1958				
(2) 1959				
(3) 1960				
(4) 1961				
(5) 1962				
(6) 1963				
(7) 1964				

Show the use of the land before rubber was planted. Tick (✓) the space. If the land cleared fits in two or more categories, show all the seedlings planted under the category which was largest. If you planted 200 seedlings in old rubber farm and 100 on light bush, write 300 under old rubber farm.

How did you get the land on which you planted your rubber farms?

Planting Year	Community	Father's Land	Purchased (Price)	Rent (Rent p.a.)	Pledge (amount)
1958					
1959					
1960					
1961					
1962					
1963					
1964					

3. Labor Requirements

The following questions are to determine how much labor was used to plant your seedlings the last time you bought some. If you purchased seedlings from the Ministry several times, include only the labor required for the most recent planting. If you purchased seedlings in 1961 and 1963, only include the labor used in 1963.

How many men helped you with each of the following planting operations? Include yourself if you worked.

Table 3 - Men

Operations	No. of Men (a)	Days Worked (b)	No. Hired (c)	Wage (d)	No. of Meals Daily (e)	Total Cost of Meals (f)
Clearing the Bush						
Felling the Trees						
Burning						
Planting Cover Crops						
Pegging and Lining						
Holing						
Planting Rubber						
Fertilizing						

Put the answer in column (a) of Table 3. In column (b) put down the number of days it took to complete the operation. Give the number of men hired in column (c) and the amount paid them for each day in column (d). In column (e) show the daily number of meals given men who normally do not eat from the same pot. The cost of each meal should be estimated in column (f) by estimating the cost of each item served.

How many women helped you with the following planting operations?
Include women who prepared meals.

Table 4 - Women

Operations	Number (a)	Days Worked (b)	No. Hired (c)	Wage (d)	No. of Daily Meals (e)	Total Cost of Meals (f)
Clearing						
Felling						
Burning						
Planting Cover Crops						
Pegging and Lining						
Holing						
Planting Rubber						
Fertilizing						

Put the number who worked at each operation in column (a) of Table 4. In column (b) write down the number of days the women worked. Write down the number of women who were paid in column (c) and their daily wage in column (d). If they received food, write down the number of meals served each day and the cost of each meal in columns (e) and (f) respectively.

How many children helped you plant your rubber?

Table 5 - Children

Operations	Number (a)	Days Worked (b)	No. Hired (c)	Wage (d)	No. of Meals (e)	Total Cost of Meals (f)
Clearing						
Felling						
Lining and Pegging						
Burning						
Fertilizing						
Planting Cover Crops						
Holing						
Planting Seed- ings						

Write down the number in column (a) In column (b) write down the total number of days the children worked on the farm. If any were paid, write down the number in column (c) and the wage rate in (d). Give the number of meals served each day child in column (e) and the cost of each meal in (f).

Did any Ministry employees help you?

Table 6 - Ministry Employees

	Number (a)	Days Worked (b)	No. of Meals (c)	Ranks (d)	Total Cost of Meals (e)
Clearing					
Felling					
Lining and Pegging					
Burning					
Fertilizing					
Planting Cover Crops					
Holing					
Planting Rubber					

Using Table 6, give their number in column (a), the number of days they helped in column (b) and the number of meals you gave them in column (c)

How many times have you weeded your youngest rubber seedlings since you planted them? _____ times. Include only the weeding of the last rubber seedlings you bought from the Ministry if you have bought seedlings more than once. In Table 7 show the amount of labor used in each weeding. Write the month and year of each weeding in column (a). Fill out columns (b) through (p) for each weeding in the same way you filled out Tables 3, 4 and 5.

Table 7 - Weeding Labor

[illegible]

4. Equipment

Please list all equipment used in your youngest rubber farm in column (a) below, the number of each item in column (b), the price of one in column (c) and how long you expect it to last in column (d). Some tools are already listed. Please write down any other you used.

Table 8 - Tools

Tool	Number Used	Cost of Each	Length of Use	Annual Repair Cost
(a)	(b)	(c)	(d)	(e)
Cutlass				
Hoes				
Spades				
Axes				
Knives				
Files				
Pails				
Fertilizer				
Poles				
Ropes				
Basins				
Buildings				

Do you own a smokehouse? (tick yes or no)

Yes _____ No _____

When did you build it? _____

How much did it cost to build? _____

shown in Table 9. Please add any others you have bought.

Table 9 - Tapping Tools

Tool	Number	Price	Length of Life	Annual Repair Costs
Tapping knives				
Files				
Cups				
Aluminum				
Snail				
Coconut				
Tins				
Pails				
Metrolac				

How much acid do you buy each month? _____

How much does the acid cost? _____

Do you use anything to prevent the rubber from getting hard in the cup?

Yes _____ No _____

What do you use? _____

How much does it cost? _____

How much do you use in a month? _____

If you rent rollers, how much do you pay? Plain _____

Marking _____

If you rent a smokehouse, how much does it cost? _____

Do you own a factory? Yes _____ No _____

How much did it cost to build? _____

When did you build it? _____

How much have you spent repairing them? _____

Smokehouse _____ Factory _____

Do you own rollers? Yes _____ No _____

How much did they cost? Smooth _____ Marking _____

When did you buy them? _____

What was the cost of their repairs? _____

How do you plan to process your rubber? Tick (✓) one.

Make lumps _____

Buy rollers and build a smokehouse _____

Use a cooperative processing factory? _____

Other (explain) _____

Who will tap your rubber and how will he be trained? _____

5. Tapping

If he is not tapping trees grown from seedling bought from the Ministry, stop here. Do not ask anymore questions. If he is tapping trees grown from Ministry seedlings continue.

What year were the trees in tapping planted? _____

How many tappers do you employ to tap the trees? _____

How are the tappers paid? _____

What tools do you supply? How many of each? What did you pay for them and how long do you expect them to last? Some tools are already

Table 10 - Sales During May, 1964

Grade	Weight	Price
RSS I		
RSS II		
RSS III		
RSS IV		
RSS V		
B - 2		
A - 1		
A - 2		
A - 3		
Cuttings		
Lumps		

APPENDIX D

Table 1. Synthetic and Natural Rubber Production in the World and Selected Countries, 1951-1963.

Year	Synthetic Rubber		Natural Rubber							
	World		World							
	Total		Total	Malaya	Indonesia	Thailand	Africa	Ceylon	Vietnam	Nigeria
-----Thousand Tons-----										
1951	9081		1885	605.3	814.4	108.8	72.5	105.0	35.7	20.9
1952	878		1790	584.3	750.5	97.9	73.5	96.5	44.9	18.3
1953	936		1730	574.4	694.6	95.6	78.5	98.6	52.4	21.3
1954	716		1810	586.5	744.4	116.7	82.8	93.9	54.1	20.4
1955	1085		1920	638.7	737.1	130.2	98.8	93.8	65.3	30.3
1956	1211		1888	626.0	686.7	133.6	113.5	95.4	69.1	38.0
1957	1263		1903	637.5	684.5	133.0	116.3	98.2	63.6	39.9
1958	1243		1940	662.9	667.6	137.4	123.3	100.2	70.5	41.1
1959	1633		2040	697.8	693.5	170.3	141.8	91.7	74.2	53.4
1960	1880		1985	708.4	629.8	167.2	146.0	97.5	75.4	57.2
1961	1978		2088	736.7	671.4	181.7	138.0	96.0	77.9	55.1
1962	2243		2105	751.6	658.6	190.8	142.0	102.4	74.0	59.6
1963	2425		2050	784.7	575.0	185.0	147.0	103.1	75.3	63.2

Sources: Commodity Research Bureau, Inc., Commodity Yearbook 1964 (New York Commodity Research Bureau, Inc., 1964), p. 276; Federation of Nigeria, Annual Abstracts of Statistics 1960 (Lagos: Federal Office of Statistics, 1960), p. 35; U.S. Department of Agriculture, Economic Research Service, Nigeria (Washington, D. C.: Government Printing Office), p. 120; Federation of Nigeria, Nigerian Trade Summary (Lagos: Chief Statistician, Vols. XLVI-XLVIII, Dec. 1961 - Dec. 1963).

Table 2. Nigerian Rubber as a Percent of African and World Natural Rubber Production.

Year	African	World
	-----Percent-----	
1951	29	1.1
1952	25	1.0
1953	27	1.2
1954	25	1.1
1955	31	1.6
1956	33	2.0
1957	34	2.1
1958	33	2.1
1959	38	2.6
1960	39	2.9
1961	40	2.6
1962	42	2.8
1963	43	3.1

APPENDIX E

Additional Survey Results

Table 1. Tribal Affiliation, General Survey, Midwestern Nigeria, November, 1963 - January, 1964.

Tribe	All Interviewees	Farmers Only
Eini and Ishan	40	33
Ibo	34	23
Urhobo	30	28
Itsekiri	7	3

Table 2. Comparison of Tribal Distribution in General Survey and 1952 Census, Midwestern Nigeria, November, 1963 - January, 1964.

Tribe	Survey	1952 Census
Eini and Ishan	36	33
Ibo	31	33
Urhobo	27	21
Itsekiri	6	2

Source: Federation of Nigeria, Population Census of the Western Region of Nigeria 1952, Bulletin Nos. 1-9 (Lagos: The Census Superintendent, June 1955), No. 6, pp. 31-32 and No. 9, p. 28.

Table 3. Educational Achievements, Participants, General Survey,
Midwestern Nigeria, November 1963 - January 1964.

Years of Education	Farmers	Non-Farmers
0	60	12
1	1	--
2	2	1
3	4	2
4	4	1
5	2	1
6	2	2
7	2	--
8	5	1
9	3	--
10	1	--
11	--	--
12	--	1
No Response	--	4
Mean Years of Education	1.7	3.2

Table 4. Rubber Plots and Acres by Year of Planting: General Survey,
Midwestern Nigeria, November, 1963 - January, 1964.

Year	Plots	Acres
1933	1	1
1934	-	-
1935	1	5
1936	2	3
1937	2	6
1938	4	14
1939	6	22
1940	2	8
1941	2	7
1942	4	14
1943	4	14
1944	5	21
1945	6	18
1946	4	14
1947	9	35
1948	9	24
1949	10	38
1950	12	40
1951	12	35
1952	14	45
1953	15	52
1954	15	62
1955	13	62
1956	15	47
1957	15	47
1958	23	77
1959	28	86
1960	30	79
1961	27	77
1962	24	60
1963	26	71
Mean Year	54.8	54.3

Table 5. Source of Tappers, General Survey, Midwestern Nigeria, November, 1963 - January, 1964.

Number	Owner	Sons	Brothers ¹	Fathers	Other Family	Non- Family
----- <u>Number of Farms</u> -----						
1	14	8	5		7	4
2		3	3		1	13
3		3				3
4						3

¹Includes non-relatives native to the owner's home village.

Table 6. Payment of Hired Tappers, General Survey, Midwestern Nigeria, November, 1963 - January, 1964.

Share All Production	Share Sheets - Lumps to Tapper	Leased
----- <u>Number of Farmers</u> -----		
14	11	7

Table 7. Estimated Yields Per Acre in Gallons of Latex, Pounds of Lump and Pounds of Sheet by Farm, Input-Output Survey, Midwestern Nigeria, 1964.

Farm Number	Acres Tapped	Latex	Lump	Sheets
		<u>Gallons per Acre¹</u>	<u>-----Pounds per Acre-----</u>	
1	3.6	301	577	579
5	2.5	271	1784	---
6	1.8	86	512	---
7	5.1	77	587	---
8	4.9	189	1353	---
9	5.2	77	540	28
10	3.3	439	2712	---
11	2.4	121	773	---
12	1.3	65	428	---
13	2.5	257	1697	---
14	4.9	158	301	328
15	2.3	102	92	232
16	2.6	273	1805	---
18	1.0	138	94	318

¹Imperial gallons

Table 8. Average Number of Trees Tapped Per Tapper by Farm,
Input-Output Survey, Midwestern Nigeria, 1964.

Farm Number	Trees Per Tapper
1	385
5	144
6	111
7	194
8	381
9	405
9	392
10	442
11	306
12	224
13	230
14	307
15	111
15	106
16	342
18	130
18	350
Average Per Tapper	271

Table 9. Tapping Characteristics Input-Output Survey, Midwestern Nigeria, 1964.

Farm Number	Average Angle	Average Length of Cut	Average Number of Panels Per Tree	Average Girth at 20 Inches
	<u>Degrees</u>	<u>Inches</u>	<u>Panels</u>	<u>Inches</u>
1	42.2	13.94	4.60	34.63
4	35.00	16.75	7.00	27.0
5 ¹	---	---	---	25.32
6 ¹	---	---	---	29.70
7 ¹	---	---	---	34.43
8	49.57	15.63	8.77	27.92
9	48.00	17.87	4.52	33.14
10	40.63	17.00	2.50	31.50
11 ¹	---	---	---	37.25
12	41.60	16.86	5.00	28.20
13	29.32	11.84	2.63	23.93
14	---	---	---	25.73
15	42.12	20.56	4.76	32.06
16	21.59	10.14	2.34	23.84
17 ¹	---	---	---	37.07
18	36.99	19.80	8.92	34.81

¹No record of tapping angle, length or number of panels.

APPENDIX F

Ordinary Smallholder Budgets

Table 1. Yields of Lump and Sheet: Alternative Organizations and All Years, Midwestern Nigeria, 1964.

Organization	Product	Year			
		S10	11	12	13-27
----- <u>Founds Per Acre Per Annum</u> -----					
Ordinary Lump	Lump	997	1083	1182	1231
Sun Dried Sheet	Lump	273	297	324	337
	Sheets	245	267	291	303
Private and Cooperative Processing	Lump	109	119	130	135
	Sheets	295	320	349	364
Clean Lumps	Lump	911	990	1080	1125

Table 2. Prices of Lump and Sheet: Alternative Products and Price Levels, Midwestern Nigeria, 1964.

Organization	Product	Price Level		
		Current Price	10% Price Decrease	20% Price Decrease
		-----	<u>Pence Per Pound</u>	-----
Ordinary Lump	Lump	2.70	2.43	2.16
Sun Dried Sheet	Lump	2.70	2.43	2.16
	Sheet	10.75	9.675	8.6
Private and Cooperative Processing	Lump	2.70	2.43	2.16
	Sheet	13.88	12.492	11.104
Clean Lumps	Lump	4.0	3.6	3.2

Table 3. Gross Revenue, Expenses and Residual Returns from Ordinary Lump Production: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Years				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	224.3	243.7	266.0	277.0	277.0
	Tapping, Collecting and Processing ¹	Both	32.8	34.1	35.6	36.3	36.3
	Depreciation	Inter- Planted	37.9	37.9	37.9	37.9	37.9
	Residual Returns ²	Inter- Planted	153.6	171.7	192.5	202.8	202.8
	Depreciation	Planted Alone	61.3	61.3	61.3	61.3	61.3
	Residual Returns ²	Planted Alone	130.3	148.3	169.1	179.4	179.4
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	201.9	219.3	239.4	249.3	249.3
	Tapping, Collecting and Processing ¹	Both	32.8	34.1	35.6	36.3	36.3
	Depreciation	Inter- Planted	41.1	41.1	41.1	41.1	41.1
	Residual Returns ²	Inter- Planted	128.0	144.2	162.7	171.9	171.9
	Depreciation	Planted Alone	67.3	67.3	67.3	67.3	67.3
	Residual Returns ²	Planted Alone	101.1	117.9	136.5	145.7	145.7

Table 3. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Years				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	179.5	194.9	212.8	221.6	221.6
	Tapping, Collecting and Processing ¹	Both	32.8	34.1	35.6	36.3	36.3
	Depreciation	Inter- Planted	44.8	44.8	44.8	44.8	44.8
	Residual Returns ²	Inter- Planted	101.9	116.1	132.5	140.5	140.5
	Depreciation	Planted Alone	72.9	72.9	72.9	72.9	72.9
	Residual Returns ²	Planted Alone	73.8	88.0	104.3	112.4	112.4

¹Does not include tappers' shares.

²Sum of net revenue, tappers' shares and interest.

Table 4. Gross Revenue, Expenses and Residual Returns from Sun-Dried Sheet Production: Alternative Prices, Costs and Planting Methods for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
			-----Shillings Per Acre-----				
Current Prices and Costs	Gross Revenue	Both	280.9	306.0	333.6	347.3	347.3
	Tapping, Collecting and Processing ¹	Both	57.8	59.5	61.6	62.5	62.5
	Depreciation	Inter- Planted	37.4	37.4	37.4	37.4	37.4
	Residual Returns ²	Inter- Planted	185.7	209.1	234.7	247.4	247.4
	Depreciation	Planted Alone	61.3	61.3	61.3	61.3	61.3
	Residual Returns ²	Planted Alone	161.9	185.3	210.8	223.5	223.5
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	252.8	275.4	300.2	312.5	312.5
	Tapping, Collecting and Processing ¹	Both	57.8	59.5	61.6	62.5	62.5
	Depreciation	Inter- Planted	41.1	41.1	41.1	41.1	41.1
	Residual Returns ²	Inter- Planted	154.0	174.8	197.7	209.0	209.0
	Depreciation	Planted Alone	67.3	67.3	67.3	67.3	67.3
	Residual Returns ²	Planted Alone	127.7	148.6	171.4	182.7	182.7

Table 4. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	224.7	244.8	266.9	277.8	277.8
	Tapping, Collecting and Processing ¹	Both	57.8	59.5	61.6	62.5	62.5
	Depreciation	Inter- Planted	44.8	44.8	44.8	44.8	44.8
	Residual Returns ²	Inter- Planted	122.2	140.6	160.6	170.6	170.6
	Depreciation	Planted Alone	72.9	72.9	72.9	72.9	72.9
	Residual Returns ²	Planted Alone	94.1	112.4	132.5	142.4	142.4

¹ Does not include Tappers' shares.

² Sum of net revenue, Tappers' shares and interest.

Table 5. Gross Revenue, Expenses and Residual Returns from Cooperative Processing: Alternative Assumptions of Prices, Costs and Planting Method for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	116.5	122.7	129.8	133.5	133.5
	Depreciation	Inter- Planted	37.4	37.4	37.4	37.4	37.4
	Residual Returns ²	Inter- Planted	211.7	237.2	266.1	280.5	280.5
	Depreciation	Planted Alone	61.3	61.3	61.3	61.3	61.3
	Residual Returns ²	Planted Alone	187.9	213.3	242.2	256.6	256.6
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	116.5	122.7	129.8	133.5	133.5
	Depreciation	Inter- Planted	41.1	41.1	41.1	41.1	41.1
	Residual Returns ²	Inter- Planted	171.5	193.7	219.0	231.7	231.7
	Depreciation	Planted Alone	67.3	67.3	67.3	67.3	67.3
	Residual Returns ²	Planted Alone	145.3	167.4	192.8	205.4	205.4

Table 5. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
----- <u>Shillings Per Acre</u> -----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	116.5	122.7	129.8	133.5	133.5
	Depreciation	Inter- Planted	44.8	44.8	44.8	44.8	44.8
	Residual Returns ²	Inter- Planted	131.3	150.3	172.0	182.9	182.9
	Depreciation	Planted Alone	72.9	72.9	72.9	72.9	72.9
	Residual Returns ²	Planted Alone	103.2	122.2	143.9	154.7	154.7

¹ Does not include Tappers' share.

² Sum of net revenue, Tappers' shares and interest.

Table 6. Gross Revenue, Expenses and Residual Returns from Clean Lump Production: Alternative Assumption of Prices, Costs and Planting Method for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	379.6	412.5	450.0	468.8	468.8
	Tapping, Collecting and Processing ¹	Both	62.5	64.5	66.8	68.0	68.0
	Depreciation	Inter- Planted	37.9	37.9	37.9	37.9	37.9
	Residual Returns ²	Inter- Planted	279.2	310.1	345.3	362.9	362.9
	Depreciation	Planted Alone	61.3	61.3	61.3	61.3	61.3
10% Price Decrease and 10% Cost Increase	Residual Returns ²	Planted Alone	255.9	286.7	321.2	339.5	339.5
	Gross Revenue	Both	341.6	371.3	405.0	421.9	421.9
	Tapping, Collecting and Processing ¹	Both	62.5	64.5	66.8	68.0	68.0
	Depreciation	Inter- Planted	41.1	41.1	41.1	41.1	41.1
	Residual Returns ²	Inter- Planted	238.1	265.7	297.1	312.8	312.8
	Depreciation	Planted Alone	67.3	67.3	67.3	67.3	67.3
	Residual Returns ²	Planted Alone	211.8	239.4	270.9	286.6	286.6

Table 6. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----<u>Shillings Per Acre</u>-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	303.7	330.0	360.0	375.0	375.0
	Tapping, Collecting and Processing ¹	Both	62.5	64.5	66.8	68.0	68.0
	Depreciation	Inter- Planted	44.8	44.8	44.8	44.8	44.8
	Residual Returns ²	Inter- Planted	196.5	220.8	248.4	262.3	262.3
	Depreciation	Planted Alone	72.9	72.9	72.9	72.9	72.9
	Residual Returns ²	Planted Alone	168.3	192.6	220.3	234.1	234.1

¹ Does not include Tappers' share.

² Sum of net revenue, Tappers' shares and interest.

Table 7A. Gross Revenue, Expenses and Residual Returns from Private Processing in a £222 Processing Plant on a Five-Acre Smallholding: Alternative Prices, Costs, Planting Method and Processing Plant For Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	88.8	88.8	88.8	88.8	88.8
	Depreciation	Inter- Planted	86.7	86.7	86.7	86.7	86.7
	Residual Returns ²	Inter- Planted	122.8	152.4	186.2	203.1	203.1
	Depreciation	Planted Alone	110.6	110.6	110.6	110.6	110.6
	Residual Returns ²	Planted Alone	99.0	128.5	162.3	179.2	179.2
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	88.8	88.8	88.8	88.8	88.8
	Depreciation	Inter- Planted	90.4	90.4	90.4	90.4	90.4
	Residual Returns ²	Inter- Planted	82.6	108.9	139.1	154.2	154.2
	Depreciation	Planted Alone	116.7	116.7	116.7	116.7	116.7
	Residual Returns ²	Planted Alone	56.3	82.6	112.8	128.0	128.0

Table 7A. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	88.8	88.8	88.8	88.8	88.8
	Depreciation	Inter- Planted	94.1	94.1	94.1	94.1	94.1
	Residual Returns ²	Inter- Planted	42.3	65.5	92.1	105.4	105.4
	Depreciation	Planted Alone	122.2	122.2	122.2	122.2	122.2
	Residual Returns ²	Planted Alone	14.2	37.4	63.9	77.3	77.3

1. Does not include Tappers' shares.

2. Sum of net revenue, Tappers' shares and interest.

Table 7B. Gross Revenue, Expenses and Residual Returns from Private Processing in a £100 Processing Plant on a Five-Acre Smallholding: Alternative Prices, Costs, Planting Method and Processing Plant For Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	40.0	40.0	40.0	40.0	40.0
	Depreciation	Inter- Planted	59.6	59.6	59.6	59.6	59.6
	Residual Returns ²	Inter- Planted	198.7	228.3	262.1	279.0	279.0
	Depreciation	Planted Alone	83.5	83.5	83.5	83.5	83.5
	Residual Returns ²	Planted Alone	174.8	204.4	238.2	255.1	255.1
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	40.0	40.0	40.0	40.0	40.0
	Depreciation	Inter- Planted	63.3	63.3	63.3	63.3	63.3
	Residual Returns ²	Inter- Planted	158.5	184.8	215.0	230.1	230.1
	Depreciation	Planted Alone	89.6	89.6	89.6	89.6	89.6
	Residual Returns ²	Planted Alone	132.2	158.6	188.7	203.9	203.9

Table 7B. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	40.0	40.0	40.0	40.0	40.0
	Depreciation	Inter- Planted	67.0	67.0	67.0	67.0	67.0
	Residual Returns ²	Inter- Planted	118.3	141.4	168.1	181.3	181.3
	Depreciation	Planted Alone	95.1	95.1	95.1	95.1	95.1
	Residual Returns ²	Planted Alone	190.1	113.3	139.8	153.2	153.2

1. Does not include Tappers' shares.

2. Sum of net revenue, Tappers' shares and interest.

Table 8A. Gross Revenue, Expenses and Residual Returns from Private Processing in a £222 Processing Plant on a Ten-Acre Small-holding: Alternative Prices, Costs, Planting Method and Processing Plant For Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	44.4	44.4	44.4	44.4	44.4
	Depreciation	Inter- Planted	62.1	62.1	62.1	62.1	62.1
	Residual Returns ²	Inter- Planted	191.8	221.4	255.2	272.1	272.1
	Depreciation	Planted Alone	85.9	85.9	85.9	85.9	85.9
	Residual Returns ²	Planted Alone	168.0	197.6	231.3	248.2	248.2
10% Price Decrease and 20% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	44.4	44.4	44.4	44.4	44.4
	Depreciation	Inter- Planted	65.7	65.7	65.7	65.7	65.7
	Residual Returns ²	Inter- Planted	151.6	178.0	208.1	223.2	223.2
	Depreciation	Planted Alone	92.0	92.0	92.0	92.0	92.0
	Residual Returns ²	Planted Alone	125.4	151.7	181.9	197.0	197.0

Table 8A. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	44.4	44.4	44.4	44.4	44.4
	Depreciation	Inter- Planted	69.4	69.4	69.4	69.4	69.4
	Residual Returns ²	Inter- Planted	111.4	134.6	161.1	174.5	174.5
	Depreciation	Planted Alone	97.6	97.6	97.6	97.6	97.6
	Residual Returns ²	Planted Alone	83.3	106.4	133.0	146.3	146.3

1. Does not include Tappers' share.

2. Sum of net revenues, Tappers' share and interest.

Table 8B. Gross Revenue, Expenses and Residual Returns from Private Processing in a £100 Processing Plant on a Ten-Acre Small-holding: Alternative Prices, Costs, Planting Method and Processing Plant For Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.1	451.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	20.0	20.0	20.0	20.0	20.0
	Depreciation	Inter- Planted	48.5	48.5	48.5	48.5	48.5
	Residual Returns ²	Inter- Planted	229.8	259.4	293.2	310.1	310.1
	Depreciation	Planted Alone	72.4	72.4	72.4	72.4	72.4
	Residual Returns ²	Planted Alone	205.9	235.5	264.3	286.2	286.2
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	20.0	20.0	20.0	20.0	20.0
	Depreciation	Inter- Planted	52.2	52.2	52.2	52.2	52.2
	Residual Returns ²	Inter- Planted	189.6	215.9	246.1	261.3	261.3
	Depreciation	Planted Alone	78.4	78.4	78.4	78.4	78.4
	Residual Returns ²	Planted Alone	163.3	189.7	219.8	255.0	255.0

Table 8B. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	20.0	20.0	20.0	20.0	20.0
	Depreciation	Inter- Planted	55.9	55.9	55.9	55.9	55.9
	Residual Returns ²	Inter- Planted	149.4	172.5	199.1	212.4	212.4
	Depreciation	Planted Alone	84.0	84.0	84.0	84.0	84.0
	Residual Returns ²	Planted Alone	121.2	144.4	170.9	184.3	184.3

1. Does not include Tappers' share.

2. Sum of net revenue, Tappers' share and interest.

Table 9A. Gross Revenue, Expenses and Residual Returns from Private Processing in a £222 Processing Plant on a 20-Acre Small-holding: Alternative Prices, Costs, Planting Method and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	22.2	22.2	22.2	22.2	22.2
	Depreciation	Inter- Planted	49.7	49.7	49.7	49.7	49.7
	Residual Returns ²	Inter- Planted	226.4	256.0	289.8	306.7	306.7
	Depreciation	Planted Alone	73.6	73.6	73.6	73.6	73.6
10% Price Decrease and 10% Cost Increase	Residual Returns ²	Planted Alone	202.5	232.1	265.9	282.8	282.8
	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	22.2	22.2	22.2	22.2	22.2
	Depreciation	Inter- Planted	53.4	53.4	53.4	53.4	53.4
	Residual Returns ²	Inter- Planted	186.2	212.5	242.7	257.8	257.8
	Depreciation	Planted Alone	79.7	79.7	79.7	79.7	79.7
	Residual Returns ²	Planted Alone	159.9	186.2	216.4	231.6	243.9

Table 9A. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	22.2	22.2	22.2	22.2	22.2
	Depreciation	Inter- Planted	57.1	57.1	57.1	57.1	57.1
	Residual Returns ²	Inter- Planted	145.9	169.1	195.7	209.0	209.0
	Depreciation	Planted Alone	85.2	85.2	85.2	85.2	85.2
	Residual Returns ²	Planted Alone	117.8	140.5	167.5	180.9	180.9

1. Does not include Tappers' shares.

2. Sum of net revenue, Tappers' share or interest.

Table 9B. Gross Revenue, Expenses and Residual Returns from Private Processing in a £100 Processing Plant on a 20-Acre Small-holding: Alternative Prices, Costs, Planting Method and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	29
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	Both	365.6	397.2	433.3	451.4	451.4
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	10.0	10.0	10.0	10.0	10.0
	Depreciation	Inter- Planted	43.0	43.0	43.0	43.0	43.0
	Residual Returns ²	Inter- Planted	245.4	274.9	308.7	325.6	325.6
	Depreciation	Planted Alone	66.8	66.8	66.8	66.8	66.8
	Residual Returns ²	Planted Alone	221.5	251.1	284.9	301.8	301.8
10% Price Decrease and 10% Cost Increase	Gross Revenue	Both	329.1	357.5	390.0	406.3	406.3
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	10.0	10.0	10.0	10.0	10.0
	Depreciation	Inter- Planted	46.6	46.6	46.6	46.6	46.6
	Residual Returns ²	Inter- Planted	205.2	231.5	261.6	276.8	276.8
	Depreciation	Planted Alone	72.9	72.9	72.9	72.9	72.9
	Residual Returns ²	Planted Alone	178.9	205.2	235.4	250.5	250.5

Table 9B. (Continued)

Price and Cost Level	Revenue or Expense	Planting Method	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
20% Price Decrease and 20% Cost Increase	Gross Revenue	Both	292.5	317.8	346.7	361.1	361.1
	Tapping, Collecting and Processing ¹	Both	67.3	69.4	71.6	72.8	72.8
	Plant Upkeep	Both	10.0	10.0	10.0	10.0	10.0
	Depreciation	Inter- Planted	50.3	50.3	50.3	50.3	50.3
	Residual Returns ²	Inter- Planted	164.9	188.1	214.6	228.0	228.0
	Depreciation	Planted Alone	78.5	78.5	78.5	78.5	78.5
	Residual Returns ²	Planted Alone	136.8	160.0	186.5	199.8	199.8

1. Does not include Tappers' shares.

2. Sum of net revenue, Tappers' shares and interest.

Table 10. Returns from Ordinary Lump Production, Sun-Dried Sheet Production, Cooperative Processing and Clean Lump Production: 10 Per Cent Price Decrease and 10 Per Cent Cost Increase, Alternative Planting Methods for Selected Years, Midwestern Nigeria, 1964.¹

Organization	Planting Method	Revenue Source	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Ordinary Lump	Inter-Planted	Residual Returns ²	128.0	144.2	162.7	171.9	171.9
		Tappers' Income	101.0	109.7	119.7	124.6	124.6
		Interest	51.2	48.9	46.0	43.1	2.9
		Net Revenue	-24.7	-14.4	-2.9	4.2	44.4
Ordinary Lump	Planted Alone	Residual Returns ²	101.1	117.9	136.5	145.7	145.7
		Tappers' Income	101.0	109.7	119.7	124.6	124.6
		Interest	84.8	80.1	75.4	70.7	4.7
		Net Revenue	-84.0	-71.9	-58.6	-49.7	16.3
Sun Dried Sheet	Inter-Planted	Residual Returns ²	154.0	174.8	197.7	209.0	209.0
		Tappers' Income	126.4	137.7	150.1	156.3	156.3
		Interest	51.8	48.9	46.0	43.1	2.9
		Net Revenue	-24.2	11.7	1.5	14.1	54.3
Sun Dried Sheet	Planted Alone	Residual Returns ²	127.7	148.6	171.4	182.7	182.7
		Tappers' Income	126.4	137.7	150.1	156.3	156.3
		Interest	84.8	80.1	75.4	70.7	4.1
		Net Revenue	-46.5	-35.1	-22.9	-15.3	21.7
Cooperative Processing	Inter-Planted	Residual Returns ²	171.5	193.7	219.0	231.7	231.7
		Tappers' Income	164.5	178.7	195.0	203.1	203.1
		Interest	51.8	48.9	46.0	43.1	2.9
		Net Revenue	-44.8	-33.9	-22.0	-14.6	25.7
Cooperative Processing	Planted Alone	Residual Returns ²	145.3	167.4	192.8	205.4	205.4
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	84.8	80.1	75.4	70.7	4.7
		Net Revenue	-104.1	-91.4	-77.6	-68.4	-2.4

Table 10. (Continued)

Organization	Planting Method	Revenue Source	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Clean Lump	Inter-Planted	Residual Returns ²	238.1	265.7	279.1	312.8	312.8
		Tappers' Income	170.8	185.6	202.5	210.9	210.9
		Interest	51.8	48.9	46.0	43.1	2.9
		Net Revenue	15.5	31.2	48.6	58.8	99.0
Clean Lump	Planted Alone	Residual Returns ²	211.8	239.4	270.9	286.6	286.6
		Tappers' Income	170.8	185.6	202.5	210.9	210.9
		Interest	84.8	80.1	75.4	70.7	4.7
		Net Revenue	-43.8	-26.3	-7.1	4.9	70.9

¹ See Chapter VII for returns under Alternative Price and Cost Combinations.

² Sum of following three items.

Table 11. Returns from Private Processing with Five and Ten-Acre Ordinary Smallholdings: Ten Per Cent Price Decrease and Ten Per Cent Cost Increase, Alternative Planting Methods and Processing Plants for Selected Years, Midwestern Nigeria, 1964.¹

Size of Holding and Processing Plant	Planting Method	Revenue Source	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Five Acres £222 Processing Plant	Inter- Planted	Residual Returns ²	82.6	108.9	139.1	154.2	154.2
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	113.9	107.6	101.3	94.9	6.3
		Net Revenue	-195.9	-177.4	-157.2	-143.8	-55.2
Five Acres £222 Processing Plant	Planted Alone	Residual Returns ²	56.3	82.6	112.8	128.0	128.0
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	147.0	138.8	130.7	122.5	8.2
		Net Revenue	-255.2	-234.9	-219.9	-197.7	-83.3
Five Acres £100 Processing Plant	Inter- Planted	Residual Returns ²	158.5	184.8	215.0	230.1	230.1
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	79.7	75.3	70.9	66.5	4.4
		Net Revenue	-85.8	-69.3	-50.9	-39.5	22.6
Five Acres £100 Processing Plant	Planted Alone	Residual Returns ²	132.2	158.6	188.7	203.9	203.9
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	112.8	106.6	100.3	94.0	6.3
		Net Revenue	-145.1	-126.8	-106.6	-93.3	-5.5
Ten Acres £222 Processing Plant	Inter- Planted	Residual Returns ²	151.6	178.0	208.1	223.2	223.2
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	82.8	78.2	73.6	69.0	4.6
		Net Revenue	-95.7	-79.0	-60.5	-48.9	15.6

Table 11. (Continued)

Size of Holding and Processing Plant	Planting Method	Revenue Source	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
Ten Acres £222 Processing Plant	Planted Alone	Residual Returns ²	125.4	151.7	181.9	197.0	197.0
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	115.9	109.5	103.0	96.6	6.4
		Net Revenue	-155.1	-136.5	-116.2	-102.7	-12.5
Ten Acres £100 Processing Plant	Inter- Planted	Residual Returns ²	189.6	215.9	246.1	261.3	261.3
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	65.8	62.1	58.4	54.8	3.6
		Net Revenue	-40.7	-24.9	-7.4	3.3	54.5
Ten Acres £100 Processing Plant	Planted Alone	Residual Returns ²	163.3	189.7	219.8	235.0	235.0
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	98.8	93.3	87.9	82.4	5.5
		Net Revenue	-100.0	-82.4	-63.0	-50.5	26.4

¹ See Chapter VII for returns under Alternative Price and Cost Assumptions.

² Sum of following three items.

Table 12: Returns from Private Processing on a 20-Acre Ordinary Smallholding; Ten Per Cent Price Decrease and a Ten Per Cent Cost Increase; Alternative Planting Method and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Processing Plant	Planting Method	Revenue Source	Year				
			10	11	12	13	27
-----Shillings Per Acre-----							
£222 Processing Plant	Inter-Planted	Residual Returns ²	186.2	212.5	242.7	257.8	257.8
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	67.3	63.6	59.8	56.1	3.7
		Net Revenue	-45.7	-29.8	-12.2	-1.4	51.0
£222 Processing Plant	Planted Alone	Residual Returns ²	159.9	186.2	216.4	231.6	231.6
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	100.4	94.8	89.2	83.6	5.6
		Net Revenue	-105.0	-87.3	-43.2	-30.5	22.9
£100 Processing Plant	Inter-Planted	Residual Returns ²	205.2	231.5	261.6	276.8	276.8
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	58.8	55.5	52.2	49.0	3.3
		Net Revenue	-18.1	-8.4	14.4	24.7	70.4
£100 Processing Plant	Planted Alone	Residual Returns ²	178.9	205.2	235.4	250.5	250.5
		Tappers' Income	164.5	178.8	195.0	203.1	203.1
		Interest	91.8	86.7	81.6	76.5	5.1
		Net Revenue	-77.5	-60.3	-41.3	-29.1	42.3

¹See Chapter VII for returns with Alternative Cost and Price Assumptions.

²Sum of following three items.

APPENDIX G

Improved Smallholder Budgets

Table 1. Yield of Dry Rubber: High, Medium and Low Assumptions, Midwestern Nigeria, 1964.

Mature Yield	Product	Year							
		6	7	8	9	10	11	12	13-29
-----Pounds Per Acre Per Annum-----									
1000	Sheet	243.0	378.0	522.0	621.0	729.0	792.0	864.0	900.0
Pounds	Lump	81.0	126.0	174.0	207.0	243.0	264.0	288.0	300.0
800	Sheet	194.4	302.4	417.6	496.8	583.2	633.6	691.2	720.0
Pounds	Lump	64.8	100.8	139.2	165.6	194.4	211.2	230.4	240.0
600	Sheet	145.8	226.8	313.2	372.6	437.4	475.2	518.4	540.0
Pounds	Lump	48.6	75.6	104.4	124.2	145.8	158.4	172.8	180.0

Table 2. Prices of High Quality Lump and Sheet: Alternative Prices, Midwestern Nigeria, 1964.

Product	Current Prices	10% Price Decrease	20% Price Decrease
----- Prices Per Pound -----			
Lump	2.70	2.43	2.16
Sheet	13.88	12.492	11.104

Table 3. Gross Revenue, Expenses and Residual Returns From a Five-Acre Improved Smallholding Yielding 1,000 Pounds: Alternative Prices, and Processing Plant, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	£ 222 Processing Plant			£ 100 Processing Plant		
		6	13	29	6	13	29
----- Shillings Per Acre -----							
Current Prices and Costs	Gross Revenue	299.3	1108.5	1108.5	299.3	1108.5	1108.5
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	59.2	59.2	59.2	38.8	38.8	38.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	104.5	895.3	895.3	173.9	964.4	964.4
10% Price Decrease and 10% Cost In- crease	Gross Revenue	269.4	997.7	997.7	269.4	997.7	997.7
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	61.4	61.4	61.4	41.1	41.1	41.1
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	782.3	782.3	782.3	141.5	851.4	851.4
20% Price Decrease and 20% Cost Increase	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	54.4	54.4	54.4	43.3	43.3	43.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	49.5	678.4	678.4	109.3	738.3	738.3

¹Does not include tappers' wage.

²Sum of net revenue, wages and interest.

Table 4. Gross Revenue, Expenses and Residual Returns from a Ten-Acre Improved Smallholding Yielding 1,000 Pounds: Alternative Prices, Costs and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
-----<u>Shillings Per Acre</u>-----							
Current Prices and Costs	Gross Revenue	299.3	1,108.5	1,108.5	299.3	1,108.5	1,108.5
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	40.7	40.7	40.7	30.5	30.5	30.5
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	167.4	958.2	958.2	202.0	992.7	992.7
10% Price Decrease and 10% Cost Increase	Gross Revenue	269.4	997.7	997.7	269.4	997.7	997.7
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	42.9	42.9	42.9	32.7	32.7	32.7
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	135.3	845.2	845.2	169.9	879.8	879.8
20% Price Decrease and 20% Cost Increase	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	45.1	45.1	45.1	34.9	34.9	34.9
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	103.2	732.0	732.0	137.7	766.6	766.6

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 5. Gross Revenue, Expenses and Residual Returns from a 20-Acre Improved Smallholding Yielding 1,000 Pounds: Alternative Prices, Costs and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue and Expenses	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
----- <u>Shillings Per Acre</u> -----							
Current Prices and Costs	Gross Revenue	299.3	1,108.5	1,108.5	299.3	1,108.5	1,108.5
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	31.0	31.0	31.0	26.3	26.3	26.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	199.3	990.0	990.0	216.1	1,006.9	1,006.9
10% Price Decrease 10% Cost Increase	Gross Revenue	269.4	997.7	997.7	269.4	997.7	997.7
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	33.6	33.6	33.6	28.6	28.6	28.6
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	166.8	876.7	876.7	184.0	893.9	893.9
20% Price Decrease and 20% Cost Increase	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.9	46.3	46.3	27.9	46.3	46.3
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	35.9	35.9	35.9	30.8	30.8	30.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	134.6	763.5	763.5	161.8	780.8	780.8

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 6. Gross Revenue, Expenses and Residual Returns from a Five-Acre Improved Smallholding Yielding 800 Pounds: Alternative Prices, Costs and Processing Plant Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
<u>-----Shillings Per Acre-----</u>							
Current Prices and Costs	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	59.2	59.2	59.2	38.8	38.8	38.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	45.4	676.3	676.3	114.5	745.5	745.5
10% Price Decrease and 10% Cost Increase	Gross Revenue	215.5	798.1	798.1	215.5	798.1	798.1
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	61.4	61.4	61.4	41.1	41.1	41.1
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	19.2	585.5	585.5	88.3	654.6	654.6
20% Price Decrease and 20% Cost Increase	Gross Revenue	191.6	709.4	709.4	191.6	709.4	709.4
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	54.4	54.4	54.4	43.3	43.3	43.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	2.3	503.9	503.9	10.8	563.7	563.7

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 7. Gross Revenue, Expenses and Residual Returns from a Ten-Acre Improved Smallholding Yielding 800 Pounds: Alternative Prices, Costs and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	40.7	40.7	40.7	30.5	30.5	30.5
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	108.2	739.3	739.3	142.8	773.9	773.9
10% Price Decrease and 10% Cost Increase	Gross Revenue	215.5	798.1	798.1	215.5	798.1	798.1
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	42.9	42.9	42.9	32.7	32.7	32.7
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	82.1	648.4	648.4	116.7	683.0	683.0
20% Price Decrease and 20% Cost Increase	Gross Revenue	191.6	709.4	709.4	191.6	709.4	709.4
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	45.1	45.1	45.1	34.9	34.9	34.9
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	56.0	557.5	557.5	90.6	592.1	592.1

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 8. Gross Revenue, Expenses and Residual Returns from a 20-Acre Improved Smallholding Yielding 800 Pounds: Alternative Prices, Costs and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
----- <u>Shillings Per Acre</u> -----							
Current Prices and Costs	Gross Revenue	239.4	886.8	886.8	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	31.0	31.0	31.0	26.3	26.3	26.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	140.2	771.2	771.2	157.1	788.1	788.1
10% Price Decrease and 10% Cost Increase	Gross Revenue	215.5	798.1	798.1	215.5	798.1	798.1
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	33.6	33.6	33.6	28.6	28.6	28.6
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	113.6	679.9	679.9	130.8	697.1	697.1
20% Price Decrease and 20% Cost Increase	Gross Revenue	191.6	709.4	709.4	191.6	709.4	709.4
	Tapping, Collecting and Processing ¹	27.2	43.5	43.5	27.2	43.5	43.5
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	35.9	35.9	35.9	30.8	30.8	30.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	87.4	589.0	589.0	104.7	606.2	606.2

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 9. Gross Revenue, Expenses and Residual Returns from a Five-Acre Improved Smallholding Yielding 600 Pounds: Alternative Prices, Costs and Processing Plants for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	179.6	665.1	665.1	179.6	665.1	665.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	59.2	59.2	59.2	38.8	38.8	38.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	-13.7	457.4	457.4	55.5	526.7	526.7
10% Price Decrease and 10% Cost Increase	Gross Revenue	161.6	598.6	598.6	161.6	598.6	598.6
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	61.4	61.4	61.4	41.1	41.1	41.1
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	-33.9	388.8	388.8	35.2	457.9	457.9
20% Price Decrease and 20% Cost Increase	Gross Revenue	143.7	532.1	532.1	143.7	532.1	532.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	88.8	88.8	88.8	40.0	40.0	40.0
	Depreciation	54.4	54.4	54.4	43.3	43.3	43.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns	-44.8	329.3	329.3	15.1	389.2	389.2

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 10. Gross Revenue, Expenses and Residual Returns from a Ten-Acre Improved Smallholding Yielding 600 Pounds: Alternative Prices, Costs and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
-----<u>Shillings Per Acre</u>-----							
Current Prices and Costs	Gross Revenue	179.6	665.1	665.1	171.6	665.1	665.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	40.7	40.7	40.7	40.7	40.7	40.7
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	49.2	520.4	520.4	83.8	555.0	555.0
10% Price Decrease and 10% Cost Increase	Gross Revenue	161.6	598.6	598.6	161.6	598.6	598.6
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	42.9	42.9	42.9	32.7	32.7	32.7
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	29.0	451.7	451.7	63.6	486.3	486.3
20% Price Decrease and 20% Cost Increase	Gross Revenue	143.7	532.1	532.1	143.7	532.1	532.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	44.4	44.4	44.4	20.0	20.0	20.0
	Depreciation	45.1	45.1	45.1	34.9	34.9	34.9
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	8.9	383.0	383.0	43.5	417.6	417.6

¹ Does not include Tappers' wages.

² Sum of net revenue, wages and interest.

Table 11. Gross Revenue, Expenses and Residual Returns from a 20-Acre Improved Smallholding Yielding 600 Pounds: Alternative Prices, Costs and Processing Plant for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	<u>£222 Processing Plant</u>			<u>£100 Processing Plant</u>		
		6	13	29	6	13	29
----- <u>Shillings Per Acre</u> -----							
Current Prices and Costs	Gross Revenue	179.6	665.1	665.1	179.6	665.1	665.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	31.0	31.0	31.0	26.3	26.3	26.3
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	81.1	552.3	552.3	98.0	569.2	569.2
10% Price Decrease and 10% Cost Increase	Gross Revenue	161.6	598.6	598.6	161.6	598.6	598.6
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	33.6	33.6	33.6	28.6	28.6	28.6
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	60.5	483.2	483.2	77.7	500.4	500.4
20% Price Decrease and 20% Cost Increase	Gross Revenue	143.7	532.1	532.1	143.7	532.1	532.1
	Tapping, Collecting and Processing ¹	26.4	40.7	40.7	26.4	40.7	40.7
	Plant Upkeep	22.2	22.2	22.2	10.0	10.0	10.0
	Depreciation	35.9	35.9	35.9	30.8	30.8	30.8
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	40.3	415.0	415.0	58.2	432.3	432.3

¹Does not include Tappers' wages.

²Sum of net revenue, wages and interest.

Table 12. Gross Revenues, Expenses and Residual Returns from Processing Cooperatively on an Improved Smallholding: Alternative Yields, Prices and Costs for Selected Years, Midwestern Nigeria, 1964.

Price and Cost Level	Revenue or Expense	1,000 Pounds			800 Pounds		
		6	13	29	6	13	29
-----Shillings Per Acre-----							
Current Prices and Costs	Gross Revenue	299.3	1,108.5	1,108.5	239.4	886.8	886.8
	Tapping, Collecting and Processing ¹	177.9	196.3	196.3	147.2	163.5	163.5
	Depreciation	22.2	22.2	22.2	22.2	22.2	22.2
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	80.3	871.1	871.1	51.2	682.2	682.2
10% Price Decrease and 10% Cost Increase	Gross Revenue	269.4	997.7	997.7	215.5	798.1	798.1
	Tapping, Collecting and Processing ¹	177.9	196.3	196.3	147.2	163.5	163.5
	Depreciation	24.4	24.4	24.4	24.4	24.4	24.4
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	48.2	758.1	758.1	25.0	591.3	591.3
20% Price Decrease and 20% Cost Increase	Gross Revenue	239.4	886.8	886.8	191.6	709.4	709.4
	Tapping, Collecting and Processing ¹	177.9	196.3	196.3	147.2	163.5	163.5
	Depreciation	26.6	26.6	26.6	26.6	26.6	26.6
	Tools	18.9	18.9	18.9	18.9	18.9	18.9
	Residual Returns ²	16.0	644.9	644.9	-1.1	500.4	500.4

Table 12. (Continued)

Price and Cost Level	Revenue or Expense	600 Pounds		
		6	13	29
-----Shillings Per Acre-----				
Current Prices and Costs	Gross Revenue	179.6	665.1	665.1
	Tapping, Collecting and Processing ¹	116.4	130.7	130.7
	Depreciation	22.2	22.2	22.2
	Tools	18.9	18.9	18.9
	Residual Returns ²	22.1	493.3	493.3
10% Price Decrease and 10% Cost Increase	Gross Revenue	161.6	598.6	598.6
	Tapping, Collecting and Processing ¹	116.4	130.7	130.7
	Depreciation	24.4	24.4	24.4
	Tools	18.9	18.9	18.9
	Residual Returns ²	1.9	424.6	424.6
20% Price Decrease and 20% Cost Increase	Gross Revenue	143.7	532.1	532.1
	Tapping, Collecting and Processing ¹	116.4	130.7	130.7
	Depreciation	26.6	26.6	26.6
	Tools	18.9	18.9	18.9
	Residual Returns ²	-18.2	355.9	355.9

1. Does not include Tappers' wages.

2. Sum of net revenue, wages and interest.

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