A price analysis of the agricultural sector of Western States, Nigeria

A PRICE ANALYSIS OF THE AGRICULTURAL SECTOR OF WESTERN STATES, NIGERIA

by

Bamidele Olufisan Durojaiye

A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 8 1

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: [signature]

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Eric A. Monke
Eric A. Monke
Assistant Professor
of Agricultural Economics

February 18, 1981
Date

ACKNOWLEDGMENTS

First, I will like to thank the International Agriculture Programs of The University of Arizona for funding the thesis under Title XII, Strengthening Grant Program, Project number 867494/3AE.

My sincere appreciation also goes to Dr. Eric Monke for his invaluable guidance in the collection of data, organization, and writing of the thesis. The constructive advice and comments of Drs. Roger Fox and Roger Selley are also appreciated. I am, however, responsible for any error of fact or interpretation.

Further appreciation is extended to Nia Clark for typing the many drafts of the thesis.

Finally, I thank my parents, Mr. and Mrs. M. O. Durojaiye, for their sacrifices and encouragement; and my fiancee, Yetunde, whose patience, love, and faithfulness have always been my source of happiness.

TO

Dr. Olu Olawoye, a benefactor, an excellent motivator, and without whose efforts and assistance my graduate study at The University of Arizona may not have been possible.

TABLE OF CONTENTS

TABLE OF CONTENTS--continued

LIST OF TABLES

LIST OF TABLES--*continued*

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS--*continued*

ABSTRACT

The recent growth of the oil sector has had a major impact on Nigerian agriculture, through increases in food demand and demand for unskilled labor. Food prices and labor wage rates have increased at unprecedented rates during the 1970's. This study examines the seasonality of agricultural product prices, and the supply response to higher prices during the 1970's in Western Nigeria. Seasonal price patterns became more variable, though seasonality is still present. The unreliability of national and regional production data preclude a statistical estimation of supply response. Nevertheless, the inflexibility of the production coefficients, as indicated by farm management surveys, indicates it is inelastic. Aggregate agricultural surveys must be improved before agricultural policy can be effectively formulated.

CHAPTER 1

INTRODUCTION

The agricultural sector has always played a prominent role in the Nigerian economy. Before the emergence of the petroleum industry in the 1970's, the Nigerian agricultural sector was the principal source of income and foreign exchange and employed over 60 percent of the population. Agricultural taxes, dominated by taxes on export crops, were the main source of government revenue. In the Western States, for example, agricultural taxes accounted for an average of 48 percent of total government revenue between 1959 and 1969 (Table 1). Though the bulk of government revenue and foreign exchange earnings are no longer generated by the agricultural sector, the sector remains the largest source of employment. In 1976, for example, the Nigerian population in agriculture was estimated to be about 56 percent (FAO, 1976).

In recent years, increases in the value of petroleum exports have been the principal source of economic growth. These increases have had a major impact on agriculture through their effects on consumer incomes and the demand for unskilled labor. They caused increases in food demand and increases in production costs. As a result, food prices

Table 1. Western States' revenue.

Year	Total Revenue (₦)*	Agricultural Revenue Amount (₦)	Agricultural Revenue % of Total
1959/60	48,384,514	32,596,440	67.4
1960/61	70,744,764	43,053,694	60.9
1961/62	52,149,734	31,666,214	60.7
1962/63	87,988,434	38,960,846	44.3
1963/64	56,676,866	28,854,540	50.9
1964/65	61,945,966	18,405,846	29.7
1965/66	54,788,438	23,750,732	43.3
1966/67	68,015,922	27,850,324	40.9
1967/68	55,290,016	24,665,902	44.6
1968/69	47,126,506	17,439,146	37.0
Average percentage contribution of agriculture			48.0

*Nigeria's currency is the naira (₦). In 1980, one naira was worth U.S. $1.85.

Source: Ajobo, O., 1979, "The Importance of CRIN's Scheduled Crops and the Impact of Research on Them".

increased at unprecedented rates. The consumer price index for food and drink in Ibadan, the center of commercial activities in Western Nigeria, increased over 400 percent between 1970 and 1978, in contrast to the non-food item increase of about 200 percent. In addition to the effect on price level, the rapid increases in demand led to less predictable seasonal price patterns.

On the supply side, aggregate responses to increases in prices appeared to be limited. The agricultural and food production indices for Nigeria, for example, increased by only 10 percent between 1970 and 1978 (FAO, 1978). Wage rates for unskilled labor increased by more than 400 percent in the same period. The production response to higher prices led primarily to changes in cropping patterns, as increases in prices and wage rates changed the relative profitability of agricultural crops. Cocoa, and palm oil, the major export crops of Western Nigeria, became unattractive compared to the competing food crops.

The phenomenal increase in food prices and the inelasticity of supply became important sources of consumer discontent and suggest the need for a study of food production and marketing in Western Nigeria. This study focuses on three aspects of the agricultural sector performance. First, the structure and efficiency of staple food marketing will be examined through seasonal price analyses. The results of the analyses will indicate if seasonal prices reflect only storage costs or a tendency for marketing intermediaries to control prices. Particular attention will be devoted to the 1970-78 period, a period of rapid increases in aggregate income and rapid shifts in the demand for food. Second, the supply response of the agricultural sector will be explored for both aggregate output and that of individual crops. It is hoped that the supply response study will be able to confirm or deny the generally held view that food production in Western Nigeria is price inelastic. The third objective of the study is to assemble widely dispersed data into consistent time series and to examine their reliability. This exercise is particularly useful for a developing economy, where data paucity and reliability are usually cited as major constraints to serious analysis.. The analyses will serve as empirical tests of the reliability of the existing data.

Some salient features of Western Nigeria, and the economic and technical characteristics of the crops to be studied are discussed in Chapter 2. Seasonal price patterns for the crops are described in Chapter 3, and the nature of supply response in the agricultural sector is explored in Chapter 4. The policy implications of the preceding analyses are presented in Chapter 5.

CHAPTER 2

ECONOMIC AND TECHNICAL CHARACTERISTICS OF THE PRINCIPAL CROPS OF WESTERN NIGERIA

Western Nigeria has an estimated population of about 12 million (Olayide, S. O., 1973) and an area of 30,500 square miles, making it one of the most densely populated regions of Nigeria. Both the agricultural and non-agricultural population are concentrated in towns of 5,000 or more. This feature is due to the urban inclinations of the Yoruba, the main tribal group of the region. Although no reliable estimate of the agricultural population exists, an educated guess may have it between 40 to 50 percent of the total population. Western Nigeria is also served by a relatively good network of roads and feeder roads. Some of the feeder roads connecting rural towns to the urban centers and to one another may become impassable during the rainy season. These features suggest it may be relatively easy to develop a marketing system (Jones, W. O., 1972).

Western Nigeria can be divided into three major ecological zones, the Northern savannah zone, the Central cocoa belt, and the Southern rainforest zone. These divisions are based on the amount of annual rainfall (Figure 1).

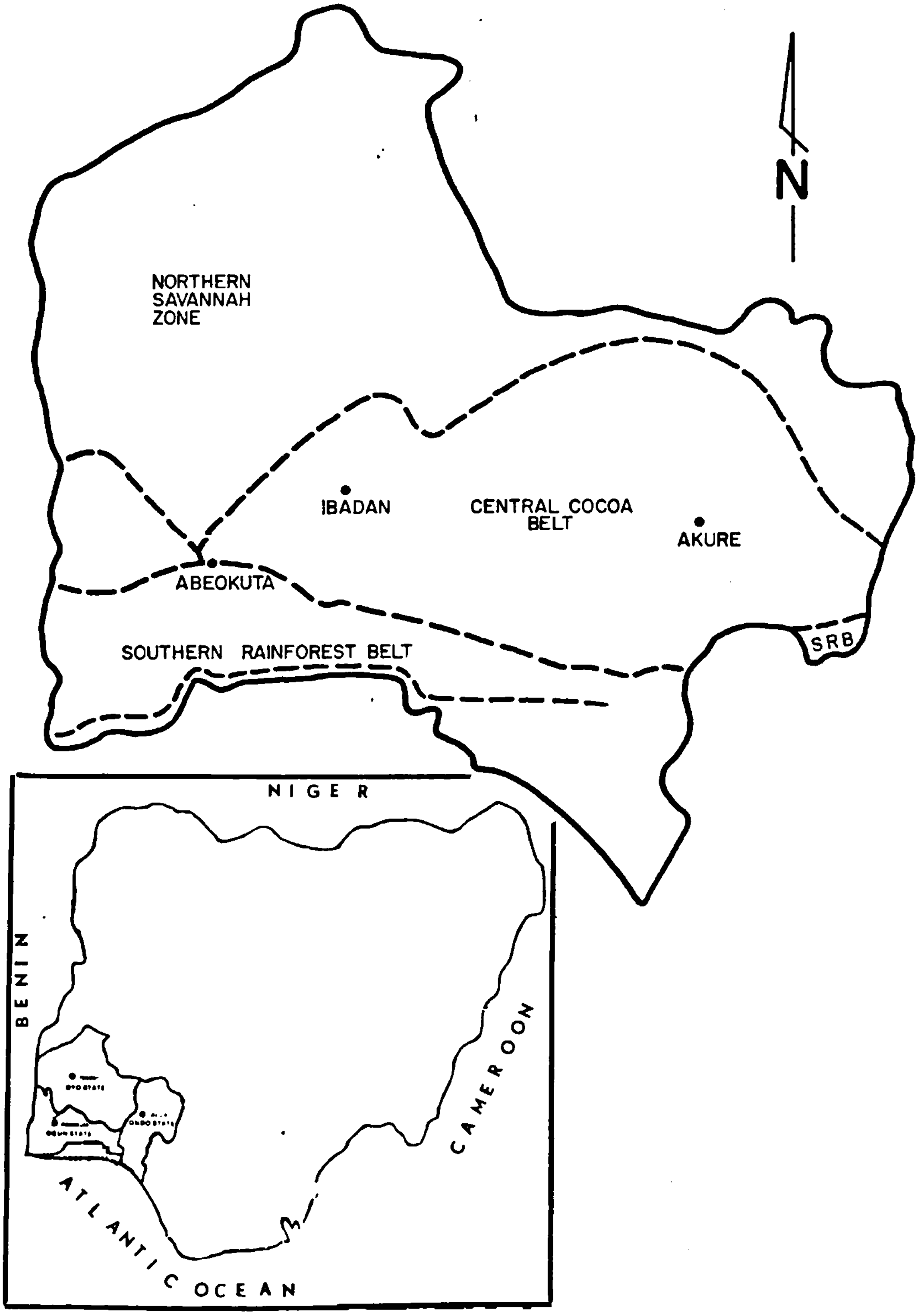


Figure 1. Western Nigeria.

The Northern savannah zone receives an annual rainfall of about 1,000 - 1,250 mm and supports mainly food crops such as yams, maize, cassava and rice. The Central cocoa belt receives about 1,125 - 1,500 mm of rainfall per annum. As the name suggests, cocoa is the major crop of the zone. The Southern rainforest belt gets about 1,500 - 2,000 mm annual rainfall and supports mainly tree crops, such as oil palm, rubber, kolanut and sometimes cocoa. These ecological zones are not contiguous, but overlap considerably. Temperatures in Western Nigeria range from about 70 F (21 C) to 90 F (32 C).

The six crops of interest in this study can be classified into two categories, food crops and export crops. Cassava, maize, rice and yams are essential staples of the people of Western Nigeria. Palm oil is the principal cooking oil. Until recently, a substantial part of production was exported. Cocoa is not consumed locally and is produced entirely for export. Crops differ in important economic and technical attributes such as (1) the geographical zones of production, (2) the time lapse between planting and harvest (3) the ease of storage and relative cost of storage (4) the amount of processing the crop must undergo before being offered for retail sale, and (5) the non-food requirements for the crop for seed, feed, industrial use, and exports. These attributes will influence the extent to which changes in demand are transmitted to producers, the response of producers to price changes, the magnitude of seasonal price changes during the crop year, and the relative importance the government attaches to each crop (Jones, W. O., 1972). Therefore, an understanding of these attributes is an essential complement to price analysis.

Farm Organization

Farmers in Western Nigeria grow a mixture of food crops and usually, two or more crops are grown on each farm plot. In contrast, cocoa, is usually planted as a single crop, except for the early stages of growth when it is normally interplanted with shade-providing food crops such as bananas. This practice also guarantees the farmers a source of income before cocoa matures. Some farmers own separate farm plots for food and export crops, though the plots may be miles apart. Most plots are between 2 - 5 hectares in size. Zonal specialization is generally absent despite the fact that each zone is principally suitable for certain kinds of crops.

The relationship between the production of food crops and export crops is one of competitive substitution. The decision to commit resources, primarily labor, to the production of one implies withdrawal of resources from the other. This decision is largely determined by the profitability of each enterprise, which in turn is influenced by such factors as climatic requirements, the time lapse between planting and harvest, and the time lapse between harvests.

Marketable food surpluses are usually taken to the rural markets where they are sold to the rural public or wholesalers from the urban centers. Wholesalers who have established contact with farmers by past trading activities may buy at the farm. Farmers rarely take their marketable surpluses to the urban centers. Because of the subsistence level of production, marketable food surpluses are generally much lower than the total of harvested crops. Export crops are sold directly to government licensed buyers at officially determined prices.

Food Crops

Cassava

Two species of cassava, sweet cassava (*Manihot palmata*) and bitter cassava (*Manihot utilissima*) are cultivated in virtually all parts of Nigeria. For optimum yield, however, a rich, well drained sandy loam soil, light or medium rainfall and hot, dry climate are most favourable. These requirements thus limit commercial cassava production to areas receiving between 640 mm and 2,030 mm of rainfall per year (FDA, n.d.). All ecological zones of Western Nigeria meet this requirement.

Cassava is planted between March and October. Mature stem cuttings, usually 20 - 30 cm long, are planted either in a slanting or straight-up position. Two-thirds of the cutting is buried, leaving the remainder exposed. Between 7,000 to 14,000 stem cuttings are required per hectare. Sprouting occurs after 7 to 14 days. Tending activities, such as weeding may follow planting, but many farmers do not follow these practices. Grasshoppers (Zonocerus variegatus) and small animals are the most important pests, and cassava mosaic virus is the most important disease.

Local varieties of cassava mature twelve to twenty-four months after planting. Harvesting is done manually by detaching each tuber from the root. Certain varieties may be left in the ground up to a year after maturing, although quality deteriorates because the texture becomes increasingly fibrous.

Cassava is one of the most productive crops in the world. The local varieties yield as much as 26 metric tons (mt) per hectare. Depending on previous land use, crop mixture, and management practices, average yield may be much lower, about 10 mt per hectare. Because of the high yield, cassava usually exhausts the soil on which it is grown. Fertility is traditionally restored to the soil by leaving it fallow for several years.

In Western Nigeria, most cassava is marketed in processed forms, mainly gari and flour (lafun). The processing is usually done by the farmers' wives. In some cases, farmers may sell fresh tubers to other women whose main occupation is cassava processing. Gari is prepared from the fresh tubers by peeling, grating, fermenting, and toasting. Lafun is prepared by grinding the dried chunks or slices of peeled cassava tubers. Both products can be stored for more than 3 months under conventional methods.

To the extent that cassava can be harvested throughout the year, the magnitude of the seasonal price changes of gari and lafun should be low. Farmers' response to price changes will be limited only by the time requirement for harvesting and processing. Changes in demand may be slowly transmitted to producers because cassava products are easily stored and substantial quantities may be in the processing network.

Maize

Maize (Zea mays) originated from Guatemala or Mexico and has been cultivated in West Africa since about 1600. Maize can be grown in any area with temperature of about 18 C and annual rainfall between 760 mm and 1,520 mm although good yields are obtainable in areas with only 460 mm to 760 mm of annual rainfall. As a result maize can be cultivated throughout Nigeria. For optimum yield, a rich, well-drained, neutral or alkaline soil is required. These characteristics limit heavy or primary cultivation of maize to the Northern savannah zone of Western Nigeria.

Due to the occurrence of two distinct rainfall peaks, maize is cultivated twice a year in Western Nigeria. The early maize is usually planted between March and April and the late maize between August and September. Maize is a secondary crop, and is normally intercropped with yams or cowpeas. Planting on well-cleared and tilled soil is done manually on hills and ridges. The seeds are sown 2 to 4 cm deep at a spacing of 30 cm along the rows, with the rows spaced 90 cm apart. About 2 or 3 seeds are sown per stand or hole. Germination begins after four days. Thinning to one or two seedlings per stand or hole is often desirable when they are about 2.5 cm high. Weeding and other tending activities generally follow planting. Important diseases include maize rust and corn smut, both of which are caused by fungi. Stem borers, army worms and weevils are the most important pests.

Depending on variety, maize matures in 14 to 20 weeks. Harvesting is usually done manually. Yield ranges between 900 and 1,300 kg of dry maize per hectare, depending on variety, intercropping patterns and cultural practices. The yield of the early crop is usually greater than that of late maize because of the shorter duration of August rains.

Most maize is consumed either in the form of dry grains or fresh on the cob. A relatively small percentage enters the market in form of semi-processed products such as ogi or eko. Industrial usage, such as feed, is very minor. Dry maize grains are usually stored by the farmers in earthenware containers or in bins made of earth or plant material raised above ground level and covered with a thatched roof. Losses in storage may average about 5 percent (Miracle, M. P., 1966).

The possibility of two harvests in a year, and the relative ease of storage may be expected to moderate fluctuations in supply within a year. Thus, seasonal fluctuations in the price of maize are not expected to be large. Farmers' response to price changes will also be relatively fast, limited only by the 14 to 20 weeks between harvesting and planting. Unlike cassava, demand changes should be transmitted to the producer quickly since a large percentage of maize goes to consumers in unprocessed forms, and storage is done mainly on the farm.

Rice

Oryza sativa is the most widely cultivated species, and was introduced about 60 years ago. *Oryza glaberrima*, an indigenous West African species, is also grown in small quantities.

The major rice production systems in Nigeria are Upland, Mangrove Swamp, Deep-water/floating rice, Inland Swamps, and irrigated rice. Upland rice production or rainfed cultivation is by far the most important production system. In 1975, it accounted for about 55 percent of the total land area under rice cultivation and produced about

43 percent of Nigeria's total rice output (FDA, 1978). The bulk of rice cultivation in Western Nigeria, an area that produced about 34 percent of total Nigerian rice output between 1970 and 1974, falls within the upland production system (Oni, et al., 1979). Ofada is the most common traditional variety cultivated.

Upland rice cultivation is practiced on well-drained land not subjected to flooding, and rainfall is the only source of water supply. Rice seeds are sown between April and May. The seeds can either be broadcast or drilled in rows about 90 cm apart. The use of pure seeds ensures higher yield, uniform ripening, better quality and better milling percentage. Handweeding is the usual management practice.

Ofada matures about 6 to 7 months after planting. Rice is harvested manually, and may be spread over a three month period. Yields range between 900 to 1,700 kg of paddy rice per hectare, with an average of about 950 kg per hectare.

Rice is usually sold to traders in the form of paddy. The traders parboil and mill the paddy before marketing. About 85 percent of Nigerian rice is now milled through the small scale milling system (Oni et al., 1979). Since most rice milling is done by small scale operators, the possibility of price manipulation which might occur if only a few large mills are involved is largely eliminated. Rice storage is done mainly by the traders. Storage is efficient, as losses may be less than 5 percent in six months (Thodey, R. A., 1968). Seasonal fluctuations in price are expected to be small because of ease of storage.

Yams (Diascorea spp.)

The three major species of yam cultivated in Nigeria are D. rotundata (White yam), D. cayenensis (Yellow yam), and D. alata (Water yam). All but D. alata are indigenous to West Africa. Yams grow well on fertile, free draining, well prepared loamy soils and in areas with annual rainfall of 1,020 - 1,780 mm. A clearly defined dry season of about 2 - 5 months is also desirable. These requirements limit most yam cultivation to the Northern savannah zone of Western Nigeria.

Yams are planted while dormant, towards the end of the dry season, around March and April. The setts, living yam chunks, are planted on mounds of varying sizes with the soil loosely packed to ensure large tuber growth. Water-logged soils hinder root and tuber development and cause rotting of newly planted setts. The setts germinate with the onset of the rains, and the tubers start to grow about three months later. Training of vines, cultural practices such as mulching, weeding normally follow planting.

White yam, Yellow yam and Water yam mature in 8, 12 and 10 months after planting, respectively. Manual harvesting can extend over two or three months and pre-harvest supplies are usually augmented by a selective harvest one or two months before the main harvest. Average yield varies from about 7.5 to 8.5 metric tons of tuber per hectare (Coursey, D. G., 1967).

Most yams enter the market without processing. A relatively small percentage enter the market in the form of dried yam slices and flour. Yam tubers are usually stored by farmers in yam barns, covered areas in which the yams are tied to poles in such a way as to permit maximum aeration. Tubers stored in this manner are free from insect pests, rodents, and microbiological attack. Nevertheless, storage losses are high because of the respiration of living tubers. Coursey, D. G. (1967) estimates storage losses to be as high as 10 to 15 percent by weight during the first three months and may approach 30 to 50 percent after six months. Dried yam slices and yam flour, by contrast, are easily stored and lose less weight in storage. Processed yam is stored mainly by traders.

Due to the heavy loss in storage, seasonal fluctuations in the price of yam tubers are expected to be large. Since most yam tubers are stored by the farmers, any change in demand will be quickly transmitted to producers. Sluggishness may occur if large quantities of yam flour are present. This effect is particularly important in the Western part of Nigeria.

Export Crops

Oil Palm

Oil Palm (*Elaesis guineensis*) is indigeneous to tropical West Africa. Few trees have as many uses as oil palms. The leaves are used for making brooms and roofing materials; the back of the frond is peeled and woven into baskets; the main trunk can be split and used for supporting buildings; a sap tapped from the female flower is made into palm wine. Red palm oil, an essential cooking oil and raw material in the production of candles, margarine and soap, is extracted from the fibrous layers (mesocarps) of the fruits. A clear oil from the palm kernel is used for making pomade; palm kernel meal is used as animal feed; and the empty fruit bunch, the shells and fiber which remain after oil extraction, are used as fuel.

Oil palm grows wild near rivers, in river valleys under escarpments, and where underground water supplies are available. The large moisture requirements of oil palm limit its cultivation in Western Nigeria principally to the Southern rainforest belt. Most of the palm-oil and allied products are from the wild groves. Only a few private plantations of oil palm presently exist in Nigeria due to the difficulty of establishment and maintenance, the long gestation period, low efficiency and extraction rates of traditional processing methods, and lack of economic incentives. Many of the existing oil palm plantations are government owned.

Two major varieties, the dura and tenera palms, are grown. They mature six to seven years and three and a half to five years after planting, respectively. Total bunch yield is the principal measure of tree productivity, and is computed as the product of bunches and the weight per bunch. A mature yield and bunch production of 20,000 kg per hectare in the second bearing year is common, but this figure disguises substantial variation among individual trees. The annual bunch yields per palm varies from 40 to 70 percent. Bunch number depends largely on sex ratio, a characteristic which varies widely between individual progenies and between palms of different fruit forms. Individual bunch weights vary from a few kilograms when first in bearing to over 100 kg in weight when mature, depending on locality, fertility and inherited characteristics. Bunch weight of a mature plantation averages about 20 kg. Tenera palms have a higher sex ratio than dura palms and thus produce a higher mean weight per bunch than tenera palms.

Oil palm fruits can be harvested throughout the year in most areas. Palm fruits deteriorate rapidly after picking, and must be processed promptly. Processing of the fruits is done mainly by traditional methods. Mechanized methods are employed by a few individuals and cooperative societies. Palm oil can be stored for more than three months under conventional methods.

Since palm fruits can be harvested throughout the year, and oil can be easily stored, palm-oil will be expected to show little seasonality. Changes in demand will be transmitted to producers sluggishly due to the large quantities which may be in storage and in processing.

Cocoa

Cocoa (Theobroma cacao) was introduced into Nigeria in 1874 by Chief Squiss Bamego, a former cocoa plantation laborer in Equatorial Guinea. The spread of cocoa cultivation to Western Nigeria, an area that accounts for about 94 percent of Nigeria's total cocoa output (Olayemi, J. K., 1974), took place in about 1880. Once established, cocoa cultivation expanded at a phenomenal rate. Total hectarage of cocoa planted in Western Nigeria jumped from about 185 hectares in 1900 to 566,802 hectares in 1970.

Cocoa is a tropical crop and thrives in a hot rainy climate within 20 degrees latitude of the equator. The main cocoa growing areas of Nigeria, the Central cocoa belt of Western Nigeria, receive between 1,125 mm and 1,500 mm of rainfall and have temperature fluctuations of 20.6 C to 31.7 C (69 F to 89 F). Areas with annual rainfall more than 1,500 mm in Nigeria commonly have soil types that are unsuitable for cocoa production, while flushing and flowering are suppressed at temperatures below 28 C (83 F).

Cocoa production in Western Nigeria is now beset with the problem of decline in yield due to old age. Production has been declining at an alarming rate (Appendix B11). Oni, S. A. (1971) observed that over 40 percent of cocoa trees in Western Nigeria are over 35 years old and are producing at a level which may be uneconomic at current producer prices. The establishment of new plantations appears unattractive to farmers.

The three main cocoa varieties grown in Nigeria are the Amelonado, which constitutes over 90 percent of the total, the Triniado, and the Amazons. Farmers usually plant cocoa seeds to coincide with the onset of the rains. Close-spaced sticks are put beside each planting site so that when subsequent weed growth is cut the young seedlings can be spotted. Three or four month old bare-root seedlings are sometimes planted, with the aid of a pointed stake to make a hole for the taproot. The use of nursery-raised seedlings is limited to government plantations and the few farmers reached by the government extension service.

Cocoa is usually intercropped with yams, maize, cow-peas, cassava, or bananas, either after clearing or in the second year after planting. The food crops provide the lateral shade necessary for the establishment of the young cocoa seelings. Yields may be substantially reduced if inter-cropping is continued after the fourth year.

Cocoa trees become productive five years after planting. Thereafter, the yield per hectare increases until the trees are about 15 to 18 years of age. Peak production is maintained until about the 30th year. Yield varies widely due to differences in management capability of farmers, soils, and climatic conditions. On the average, small holders, who control about 97 percent of cocoa hectarage in Western Nigeria (Olayemi, J. K., 1974) may expect about 300 kgs of dry cocoa beans per hectare (Ajobo, O., 1979).

Harvesting is a simple manual process. Trunk pods are removed with a machete, while branch pods are removed with a push-pull knife on a long pole. Care must be taken not to damage the fruit cushions on which the pods are borne. The pods are taken to a central point on the farm where they are broken, usually by cutting across the pods with a machete. The wet beans are then fermented, either at the farmer's home or on the farm. Fermentation takes place in baskets lined with banana leaves or in heaps on ground covered with banana leaves. The fermentation process takes about five to six days during which the cocoa "aroma" is developed. The beans are then dried, usually for 8 to 10 days on mats or cement floors. The dried beans are graded and sold to government-licensed produce buyers.

Improved Varieties

For maize, rice and cocoa, improved varieties have been or are being developed. These improved varieties are generally more resistant to diseases, mature earlier, and have higher yields than traditional varieties. For instance, improved rice varieties such as OS_6[FARO II], and Agbede [FARO 3] mature in 4 - 5 months and yield about 1500 kg per hectare, compared with 6 - 7 months and a yield of about 950 kg per hectare for the traditional Ofada variety. However, their use has not gained wide acceptance among the farmers. This is due mainly to the absence of an infrastructure to provide fertilizers, irrigation, pesticides. Since these inputs are complements to the use of the improved varieties, adoption rates have been slow.

CHAPTER 3

SEASONAL PRICE PATTERNS OF THE FOOD CROPS

This chapter attempts to derive the seasonal price patterns of the major food crops grown in Western Nigeria. Information on the seasonal price patterns of the crops is useful to producers as well as consumers. Such information will assist in making marketing and production decisions, helping producers to take advantage of these regularities. Consumer purchasing decisions may also be assisted by such information. The outcome of the analysis will also influence the user's confidence in the price statistics. The Nigerian monthly price statistics, as noted by Jones, W. O. (1972), provide no information about the quality of product priced, the date within the month when the price was observed, how customary units and volumes of sale were converted into weights for which the prices were reported, and some appear faked. If the crops show seasonal price patterns consistent with their relative ease of storage, and with theoretical expectations, confidence in reliability of the price statistics will be enhanced, the defects notwithstanding. In a period of steady demand, as in the 1960's, seasonal price patterns will be expected to be very distinct. For a period of strong income growth and presumably rapid shifts in demand as in the 1970's, the average pattern is still expected but may be less distinct.

Theoretical Construct[1]

Seasonal price patterns exist when production and consumption occur at different points in time. The time lag between production and consumption must be bridged by a productive activity (storage) to ensure consumption in periods of no production, and can be accomplished only at a resource cost. No producer or trader will willingly incur this cost without an expected return. It follows, therefore, that for a commodity to be willingly stored from one production period to a future consumption period, the expected return to storage must be at least equal to the storage cost. Storage operations usually involve the provision of facilities such as warehouse space and grain silos, and operating costs such as commodity handling and transport, and interest on earnings foregone from immediate sale of the commodity. The fixed costs will include costs associated with the physical facilities, and any other costs that will be necessary without regard to the length of storage period. The variable costs will include handling expenses, protection costs, and any other cost related to the length of storage period.

The expected return to storage shows up in the form of a price differential between the harvest price and the price at the time of consumption.

The harvest period price (starting price for any season) may vary from one year to another depending on supply and demand situations. A bumper crop year, for instance, will have a lower harvest period price than a short crop year, assuming the same demand situation. Nevertheless, the sequence of monthly prices within each of these years will be expected to be roughly the same, reflecting the costs of commodity storage.

To illustrate these principles, suppose there are only two periods in a crop year. Harvest occurs in period 1, and may be consumed in Period 1 or in Period 2 where no production takes place. The harvest will have to suffice for the entire crop year. If the demand situations for both periods are known at the time of harvest, the appropriate allocation of supply over the two periods can be determined.

The demand situations in periods one and two, D_1 and D_2, and the supply situation, S, are shown in Figure 2. The excess supply curve (the amount by which supply exceeds demand at each price level) for Period 1 is ES_1. The excess demand curve for Period 2 is the mirror image of the demand curve for Period 2 since supply in Period 2 is zero.

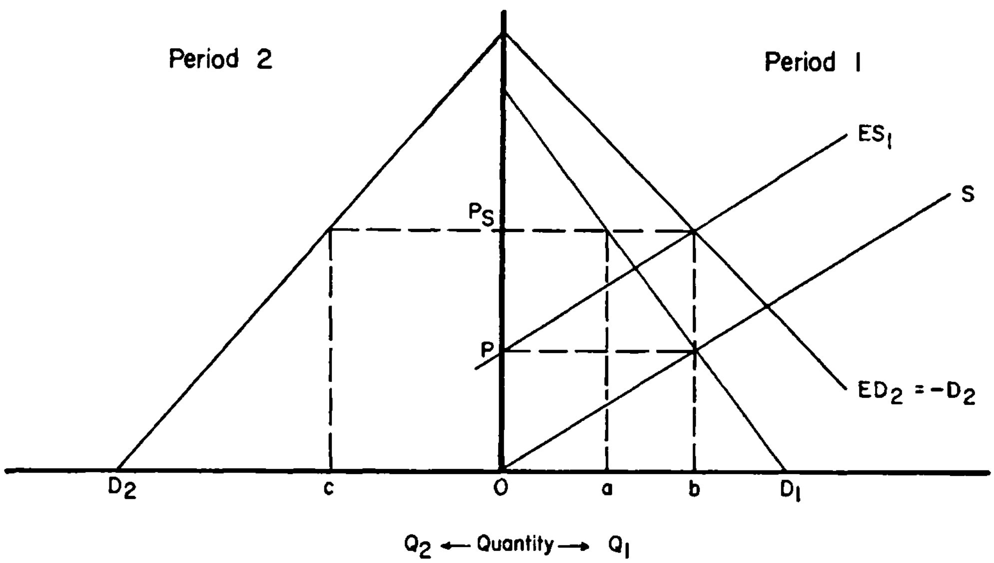


Figure 2. Allocation of supply when there is no storage and when there is storage without cost.

Without storage, or if for any reason the crop cannot be stored, quantity Ob will be supplied and consumed at price level P in Period 1 and no consumption will occur in Period 2. With storage, but without cost, the intersection of the excess supply and excess demand curves will determine the equilibrium price Ps. Quantity Oa is therefore consumed in Period 1 and Oc stored for consumption in Period 2. The net effect of storage is to increase the price from P to Ps, and to reduce consumption from Ob to Oa in Period 1, while making available the consumption of Oc in Period 2. Annual average price must be higher, even without storage costs, so as to extend consumption over a greater time period.

With storage and a unit cost of storage t, represented on the price axis as shown in Figure 3, a horizontal line can be drawn from t to meet a new curve, ED_2-ES_1 at d. This new curve indicates the deficit between the excess supply in Period 1 and the demand in Period 2.

A vertical line drawn from d to meet ES_1 and ED_2 indicates price levels P_1 and P_2 that will be paid in Periods 1 and 2, respectively. Also a horizontal line from these price levels to their respective demand curves shows that quantities Oe will be consumed in period 1 and Of (=Og) in period 2. P_1 and P_2 are therefore separated by the unit cost of storage, i.e. $P_2 = P_1 + t$. In this case, relatively more is consumed in Period 2 than in Period 1. It can be

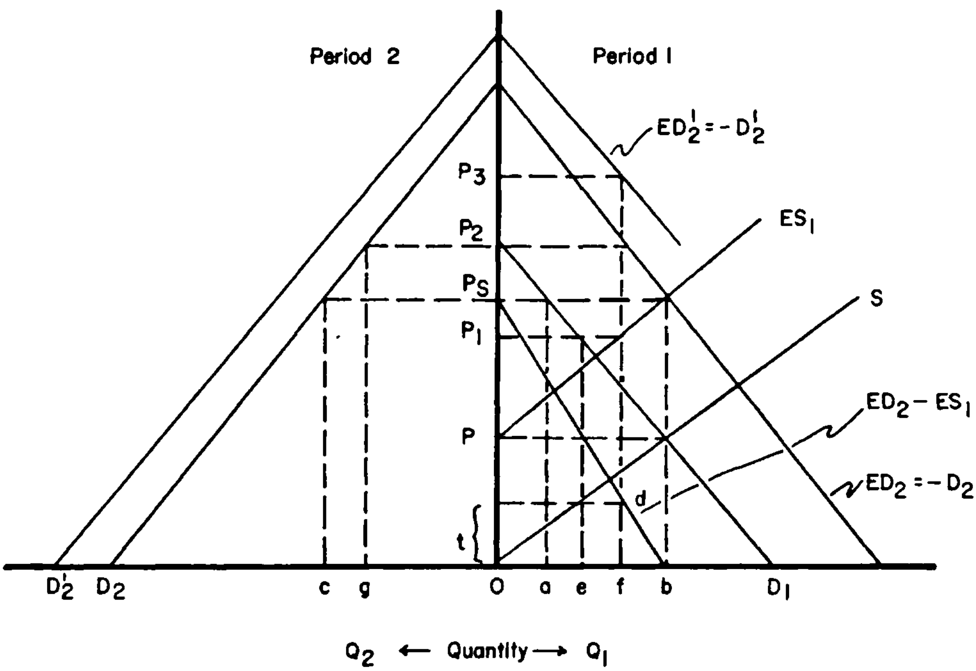


Figure 3. Allocation of supply when there is storage and t unit cost of storage.

shown that higher unit cost of storage will encourage consumption in Period 1 and decrease consumption in Period 2, leading to higher seasonal fluctuation in price. Crops that are relatively easy to store are, therefore, expected to show less seasonal fluctuation in price than those that cannot be easily stored.

This discussion illustrates the notion that there is essentially one price for the crop (the annual average price), with seasonal differences performing the allocation of supply throughout the entire season. Over several years, the difference between the seasonal high price (P_2) and the seasonal low price (P_1) should average to cover the cost of storage. This difference may vary from one year to another. If, for instance, the demand for Period 2 is underestimated during the harvest, i.e., if D_2' turns out to be the demand in Period 2, it could be shown from Figure 3 that the price P_3 will be paid in Period 2 and the difference between the seasonal high price and seasonal low price will be more than the unit cost of storage. The total seasonal rise will, in this case, be the summation of expected normal seasonal rise (P_2 - P_1 or t) and a changing price level (P_3 - P_2). The converse will be true if the demand for Period 2 is overestimated during the harvest. The difference may also depart widely from the expected normal seasonal rise if there are many traders engaged in monopolistic practices.

Many assumptions have been made to derive the above model. Only two periods are assumed. The same demand curve is assumed to hold for every point in a period. Third, the post-harvest demand was assumed known at the harvest period. Fourth, the intertemporal storage cost was treated as a constant. Finally, all the harvest in a year was assumed to last for only that year, i.e., no carryovers. These assumptions notwithstanding, the basic propositions may still remain valid. If actual consumption of the crop in the year is not known with certainty, the emerging difference between actual price change and expected seasonal price change will reflect the extent to which future demand has changed and the presence of random elements in the actual price series. Over several years, they may average out to be zero as demand will be both over and underestimated. But in the case of Nigeria, where a tremendous increase in aggregate income has occurred in the last ten years, the difference between actual price change and expected seasonal change may not average out to be zero. They may, in fact, be continuously positive if the market consistently underestimates future demand. In this case, the actual price changes averaged over the latter period covered in this study (the 1970's) would be greater than expected seasonal change (storage cost), and thus significant seasonal price patterns may be difficult to identify.

Technique and Data Used for Deriving the Seasonal Price Index

The ratio-to-centered-moving average technique[2] was used to isolate the seasonal price patterns of the crops. This method rests on the assumption that observed monthly price is composed of four elements: a long-term trend, a cyclical element, a seasonal factor, and a random component. The ultimate goal of the technique is to isolate the systematic seasonal pattern in the price data. The effects of the long-term components, the trend and the cyclical elements, are eliminated from the data series by taking successive 12-month moving averages and placing the resulting average on the middle of the 12-month period. The series of moving averages obtained are then averaged out two at a time and the average centered in-between them. The appropriate monthly prices are divided by the centered moving averages to isolate the seasonal ratios and random effects. Finally, the random effects are eliminated by averaging the ratios over several years to obtain the desired seasonal price patterns.

Due to the fact that the farmgate prices for the crops are not available, the monthly retail prices of major foodstuffs collected by the Federal Office of Statistics for Ibadan, the center of commercial activities in Western Nigeria, is used in this study. This procedure rests on the assumption that the monthly retail prices bear a constant relationship to the unavailable farmgate prices over the 12-month moving average, i. e., marketing costs are assumed to to increase in proportion to retail prices. Also, the price series for cassava was not available. The price series of gari, the major processed form of cassava, was therefore used in the analysis on the assumption that processing adds a small proportion to the value of cassava in a manner analogous to the behavior of marketing costs.

Results

The prices used in this study cover the period 1960-1978[3]. Because of the huge increase in aggregate income in Nigeria since 1970, seasonal indices were calculated for 1960-69, 1970-78, and both periods combined (1960-78)[4]. The effects of continuous shift in demand curve should be more pronounced in the 1970-78 period and will be reflected by a wider amplitude of annual price movements (the difference between seasonal high and seasonal low). Attempts were made to compare the results with previous studies of seasonal price movements of the crops, their storability, and storage costs. Seasonal price patterns have different implications and are crop specific. The crops will therefore be treated individually.

The seasonal price indices for the crops are presented in Tables 2 to 4 and plotted on Figures 4 to 8. The solid lines depict the average seasonal price patterns, expressed

Table 2. Seasonal price indices for gari, maize, palm-oil, rice and yams (1960-69).

Month	Gari	Maize	Palm-Oil[a]	Rice	Yams
January	95.1 (2.3)	93.3 (2.5)	121.0 (20.6)	95.2 (1.3)	90.4 (2.4)
February	95.0 (1.7)	97.2 (2.2)	109.7 (13.8)	95.3 (1.1)	97.4 (2.7)
March	94.6 (1.5)	104.9 (3.2)	90.7 (3.5)	96.1 (1.1)	105.0 (3.4)
April	93.4 (1.8)	109.1 (3.1)	86.3 (2.8)	99.1 (1.8)	110.6 (3.3)
May	107.0 (3.0)	121.0 (4.2)	89.3 (3.3)	101.9 (1.2)	135.1 (6.3)
June	111.0 (2.6)	124.6 (6.3)	82.7 (5.1)	99.3 (2.2)	152.9 (8.9)
July	106.2 (2.0)	109.1 (4.7)	86.2 (4.7)	103.6 (2.2)	120.0 (5.8)
August	104.6 (1.9)	90.1 (3.9)	107.5 (8.1)	104.0 (1.5)	86.6 (4.8)
September	101.0 (2.0)	85.6 (2.8)	102.0 (8.3)	102.1 (1.3)	72.1 (4.5)
October	96.9 (1.9)	84.0 (2.5)	106.3 (9.5)	101.1 (1.2)	75.0 (3.5)
November	92.7 (2.0)	88.3 (2.6)	103.3 (9.5)	99.8 (1.3)	73.3 (4.5)
December	93.1 (2.0)	91.7 (2.1)	108.5 (2.3)	98.2 (0.8)	80.9 (5.3)

[a]1965-69 for palm oil.

Figures in parentheses are standard errors of the indices. The higher the standard error, the less reliable is the index.

Table 3. Seasonal price indices for gari, maize, palm-oil, rice and yams (1970-78).

Month	Gari	Maize	Palm-Oil	Rice	Yams
January	97.9 (1.9)	93.3 (2.4)	106.6 (7.9)	97.5 (2.0)	96.0 (5.2)
February	101.0 (3.5)	104.1 (4.7)	106.0 (6.1)	97.0 (2.0)	109.5 (10.3)
March	98.0 (3.2)	113.2 (5.5)	92.4 (3.9)	94.6 (2.7)	105.0 (7.7)
April	99.0 (2.0)	115.4 (3.7)	84.3 (2.4)	99.6 (3.8)	116.0 (6.5)
May	107.1 (4.5)	124.0 (3.4)	89.0 (3.9)	102.5 (3.7)	125.4 (3.1)
June	108.7 (1.5)	120.7 (4.7)	90.2 (3.3)	103.8 (2.3)	152.3 (19.5)
July	106.6 (2.6)	106.7 (3.9)	99.2 (4.2)	103.5 (2.0)	114.4 (10.0)
August	100.2 (4.2)	94.9 (6.8)	99.9 (4.7)	103.0 (2.5)	86.0 (6.7)
September	96.8 (3.4)	79.6 (3.1)	99.8 (3.9)	100.0 (3.2)	86.5 (6.7)
October	96.0 (2.8)	77.1 (2.4)	100.8 (2.7)	96.1 (3.1)	73.0 (4.2)
November	98.0 (1.2)	80.3 (1.8)	118.7 (7.7)	100.0 (3.5)	63.4 (5.4)
December	91.4 (1.6)	83.0 (2.7)	111.6 (6.1)	96.9 (2.4)	91.7 (4.7)

Table 4. Seasonal price indices for gari, maize, palm-oil, rice and yams (1960-78).

Month	Gari	Maize	Palm-Oil[a]	Rice	Yams
January	97.4 (1.7)	94.2 (1.8)	112.8 (7.8)	96.3 (1.1)	92.9 (2.5)
February	98.1 (1.9)	100.9 (2.4)	108.9 (5.6)	96.1 (1.1)	101.7 (4.2)
March	96.3 (1.6)	108.6 (3.0)	94.2 (3.5)	95.6 (1.3)	105.1 (3.1)
April	95.6 (1.4)	111.9 (2.3)	86.4 (2.2)	99.4 (1.8)	113.3 (3.0)
May	106.2 (2.5)	121.8 (2.6)	89.2 (2.5)	101.9 (1.7)	130.9 (4.1)
June	110.1 (1.5)	122.1 (3.8)	87.2 (2.7)	101.7 (1.6)	150.8 (7.4)
July	106.1 (1.5)	108.3 (2.9)	94.9 (3.3)	103.9 (1.4)	119.0 (4.7)
August	102.3 (2.1)	91.9 (3.5)	102.8 (3.7)	103.6 (1.3)	86.1 (3.5)
September	99.3 (1.9)	82.7 (2.0)	100.5 (3.3)	101.3 (1.6)	77.9 (3.9)
October	96.3 (1.5)	80.9 (1.8)	102.0 (3.2)	98.9 (1.6)	74.3 (2.4)
November	94.2 (1.5)	85.5 (1.9)	111.3 (6.0)	99.9 (1.4)	70.5 (3.4)
December	91.8 (1.3)	87.9 (1.9)	108.9 (4.1)	97.6 (1.1)	85.8 (3.5)

[a]1965-78 for palm oil.

as a percentage of the annual average price. If, for instance, the average crop-year price is ₦5, the expected price for a month with a 90 percent index value will be ₦4.50. The dashed lines on either side of the seasonal patterns represent a 95 percent confidence interval of the indices. The further these lines are from the solid lines, the less reliable is the pattern.

The strength of seasonal forces, or the extent to which they dominate other influences on prices is also measured by the degree of coincidence. The degree of coincidence is defined as the number of years in which the actual highest price fell in the same or adjacent months as the highest value of the seasonal index, divided by the number of years in the series[5]. A large value, near one, suggests strong influences of seasonal forces while a small value, near zero, suggests strong influences of factors other than seasonal forces.

Gari or Processed Cassava

The seasonal price pattern for gari is presented in Figure 4. From figures 4a to 4c, the seasonal low occurred in November in the period 1960-69, and December in 1970-78 and 1960-78. For all the three periods, June was the month of seasonal high price. The seasonal indices range from 92.7 to 111.0 in 1960-69, 91.4 to 108.7 in 1970-78, and 91.8 to 110.1 in 1960-78. Cassava can be harvested any time of the

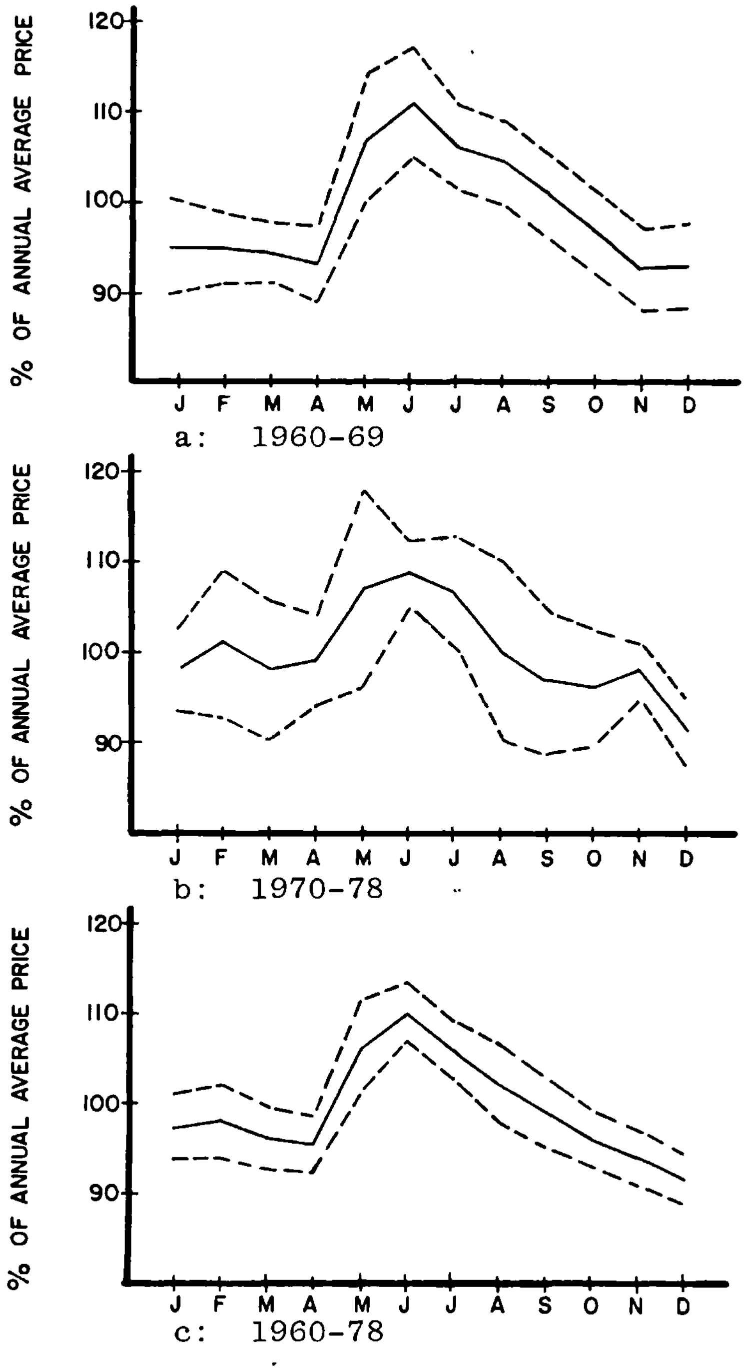


Figure 4. Seasonal price index: Gari.

year. Gari, the major processed form of cassava, is also storable under conventional methods with little loss in quality. The crop may therefore be expected to show little fluctuation in price within a year. The narrow range of the indices over the entire period 1960-78 (18.3 percent) agrees with expectation. The monthly average percentage rise in seasonal price (3.00) compares closely with Thodey's finding (2.6) but unfortunately no detailed study of storage cost exists with which the figure can be compared. But, significant returns appear only from April - June, implying near zero storage cost for remaining months due to ground storage. Most harvests appear to occur between November and April, even though cassava can be harvested any time of the year.

The wide confidence interval for the seasonal pattern in the 1970-78 period and large values of the indices' standard errors suggest the relative unreliability of the pattern and characterize the period as one of continuous demand change. As expected, a period of increased demand fluctuation results in increased price uncertainty, even though the average seasonal pattern is roughly the same as that of the earlier period (1960-69).

Period	No. of Coincidence	Degree of Coincidence	Months between seasonal low and seasonal high prices	Percentage rise in seasonal price: Monthly Average	Total
1960-69	5	0.5	7	2.6	18.3
1970-78	3	0.33	6	2.9	17.3
1960-78	8	0.42	6	3.05	18.3

The degree of coincidence over the entire period 1960-78 (0.42) suggests strong influences of factors other than seasonal forces on gari prices. As expected, the strength of seasonal forces on prices appears stronger in the immediate post-independence period (1960-69) with 0.5 degree of coincidence, and weaker between 1970-78 with a 0.33 degree of coincidence. The number of months between the seasonal low and the seasonal high prices does not correspond to the period between harvests mainly because of ground storage of cassava.

Maize

The seasonal price patterns for the different periods are presented in Figures 5a to 5c. The seasonal low price occurred in October in all the three periods. The seasonal high price was in May between 1970 and 1978, June in the other two periods. Prices rise and decline rapidly. The May and June indices are very close, separated at most by three percentage points, while the difference between May and April indices or June and July indices may be as high

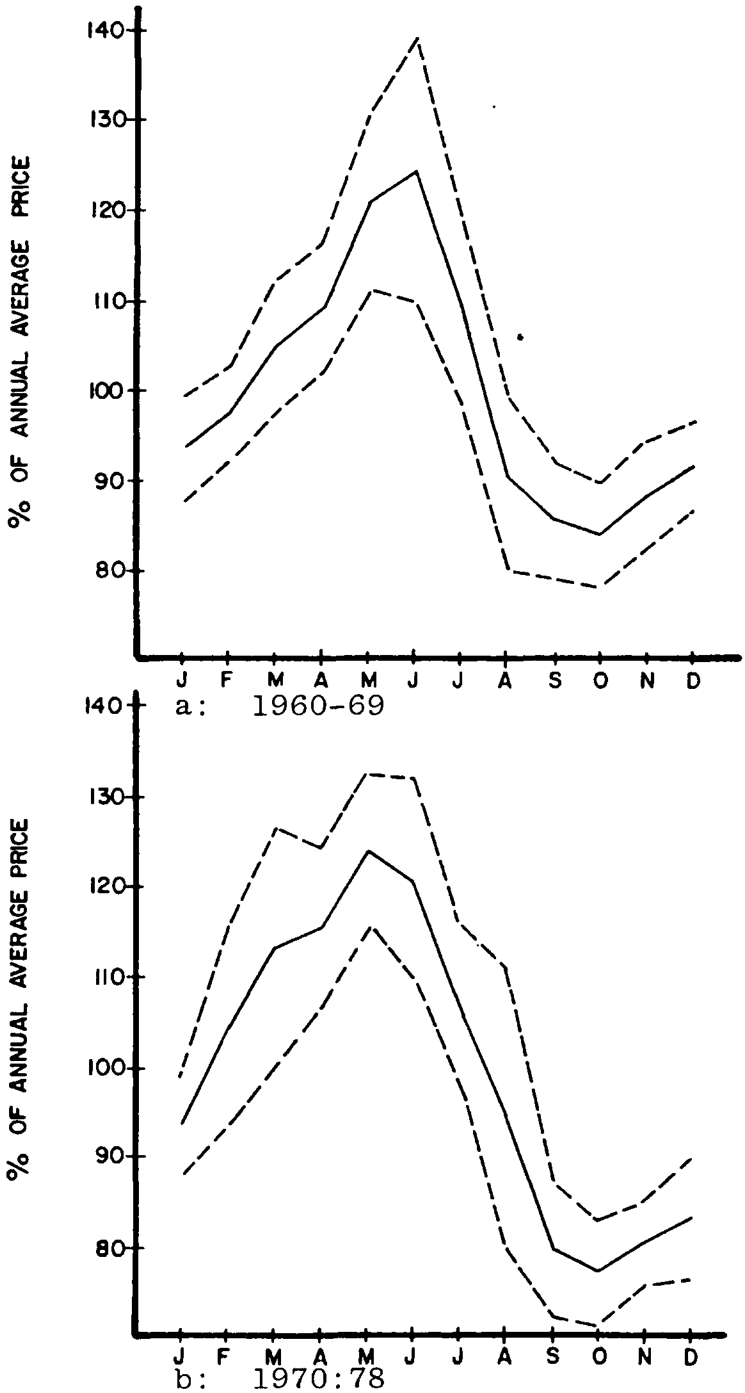
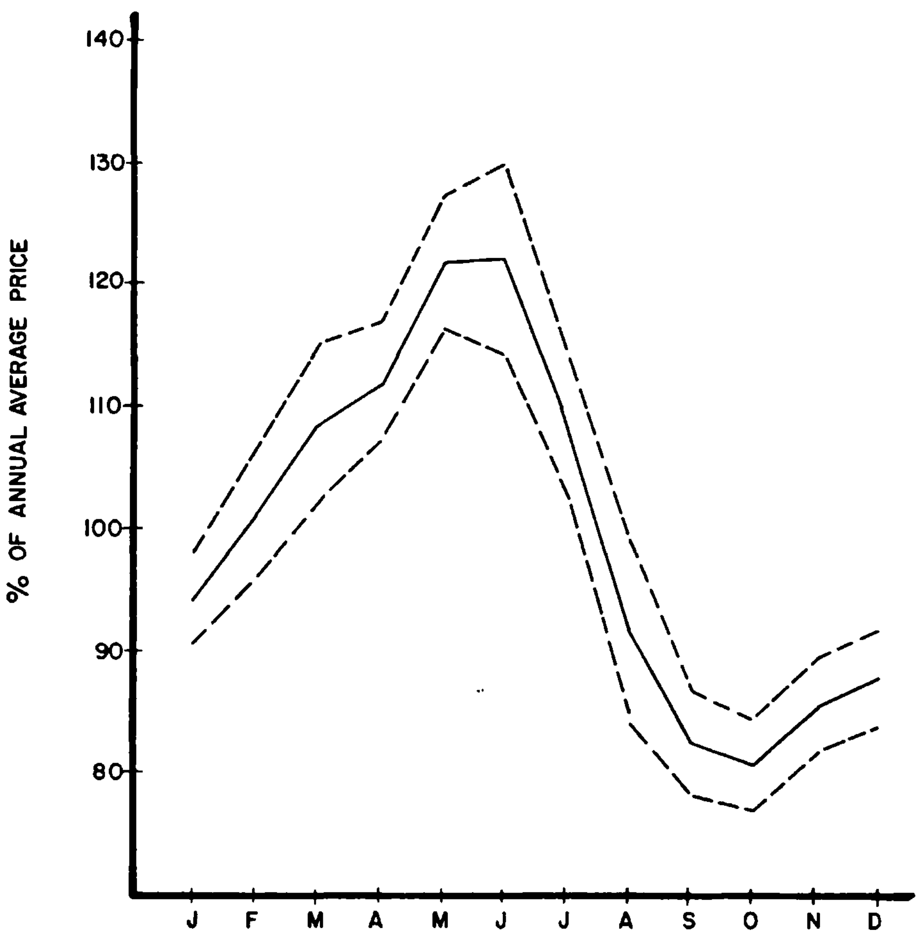


Figure 5. Seasonal price index: Maize.



c: 1960-78

Figure 5. Seasonal price index: Maize (continued).

as 10-15 percentage points. The seasonal indices range from 84.0 to 124.6 between 1960 and 1969, 77.1 to 124.0 in 1970-78, and 80.9 to 122.1 over the entire period 1960-78.

The possibility of two harvests in a year in the study area is expected to even out supplies and reduce the seasonal movement of price. The difference between the seasonal high and seasonal low prices over the 1960-78 period (41.2 percent) agrees with expectations based on the cost of storage. The monthly average percentage rise in price was 5.15 percent. This figure is comparable to cost of storing cowpeas: 4.2 percent per month, (Gilbert, E. H., 1969), which Thodey suggests may be close to that for maize.

The possibility of two harvests in a year also suggests two occurrences of seasonal low price which is not evident in any of the seasonal price patterns. One possible explanation for this is that late maize harvests, which are usually smaller than the early maize harvests, are not large enough to depress price to an appreciable extent. Instead they may have a moderating effect on the seasonal price movements. The small increases in the indices between November and February when late maize is harvested compared to the jump in the indices after February, suggests this moderating influence. Early maize is planted between March and April and harvested around September, although selective harvest is possible before this time. This pattern corresponds to the seasonal price pattern derived where the seasonal low price occurred in October.

In comparison with the 1960-69 period, the 1970-78 period price pattern has a wider confidence interval, range of indices (46.9 percent), and many of the indices have higher standard error values, thus reflecting the strong influences of changing demand.

Period	No. of Coincidence	Degree of Coincidence	Months between seasonal low and seasonal high prices	Percentage rise in seasonal price: Monthly Average	Percentage rise in seasonal price: Total
1960-69	10	1.0	8	5.08	40.6
1970-78	7	0.78	7	6.70	46.9
1960-78	17	0.89	8	5.15	41.2

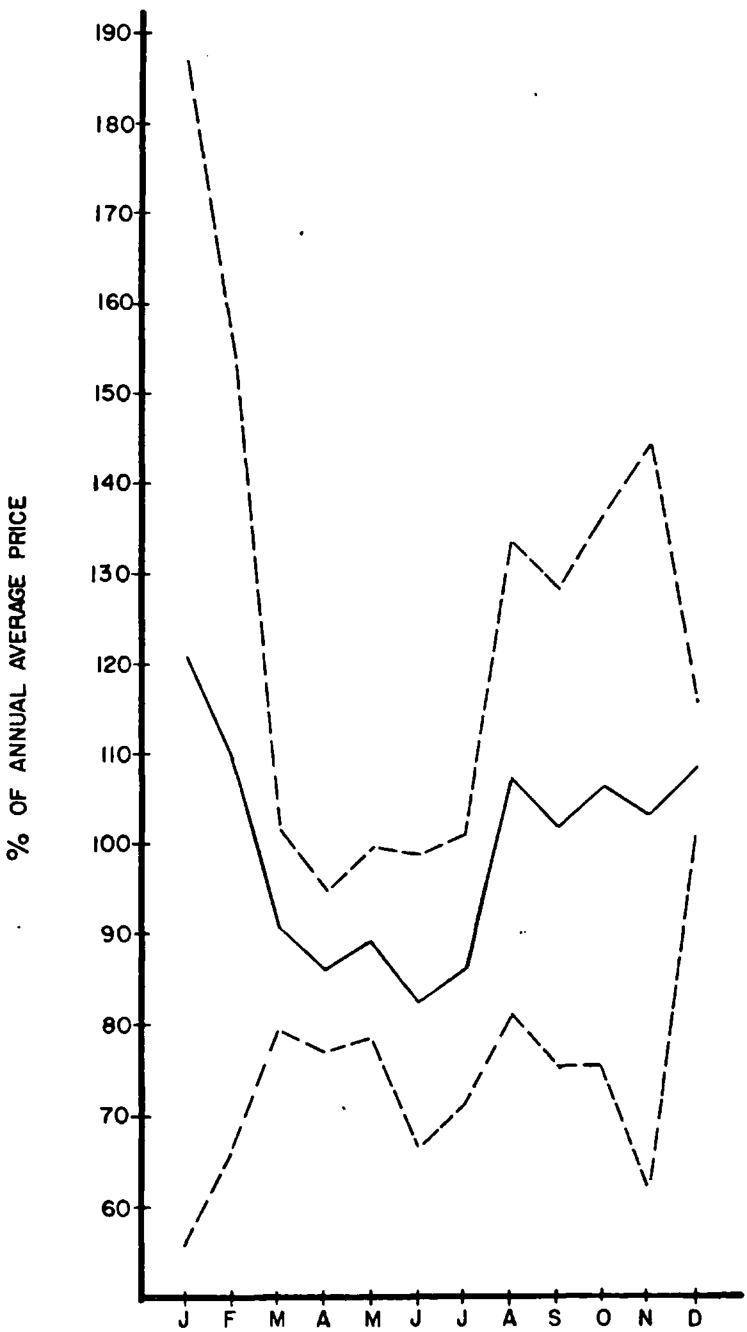
The high degree of coincidence obtained for maize for both periods shows the strong effect of seasonal forces on its price. The 1970-78 period shows a lower degree of coincidence, but seasonal patterns continue to dominate. The number of months between the seasonal low and seasonal high prices fails to correspond with the period between harvests mainly because of the two harvest characteristics, one of which has only a moderating influence on the price pattern.

Palm-Oil

The seasonal price patterns for palm-oil are presented in Figures 6a to 6c. In the first period, 1965-69, the seasonal low price occurred in June, April in the other two periods. The seasonal high price was in January in the 1965-69 and 1965-78 periods, November in the 1970-78 period. The difference between the November and January indices for the period 1965-78 was only 1.5 percent, which makes them comparable. The indices range from 82.7 to 121.0 percent between 1965-69, 84.3 to 118.7 percent in 1970-78 and 86.4 to 112.8 percent over the entire 1965-78 period.

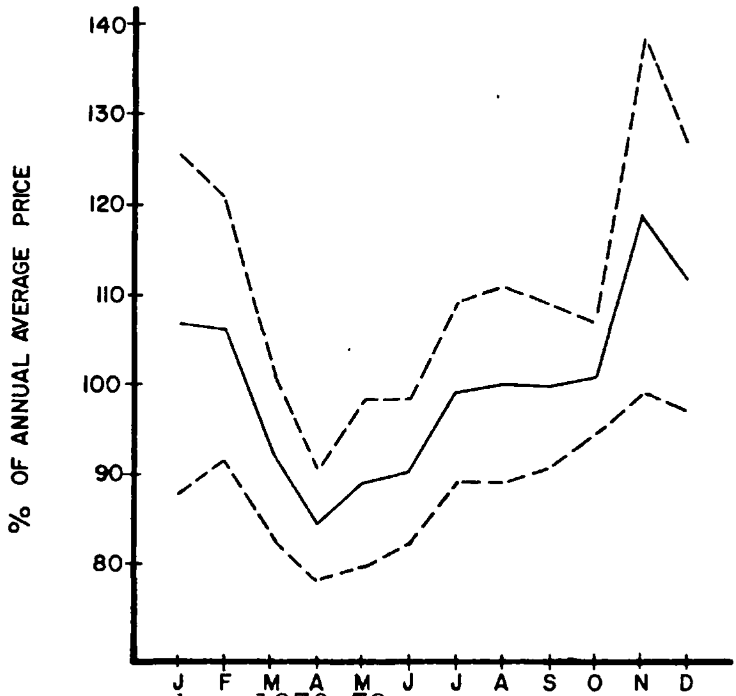
Although palm-fruits can be harvested any time of the year, most harvesting is expected when farmers are less busy, usually in March-April after the planting period. Seasonal low prices of palm-oil can therefore be expected to occur in April or later months. This reasoning agrees with the obtained seasonal low price period for palm-oil. The monthly average percentage rise in seasonal price was 3.56. Unfortunately, there is no detailed study of storage cost with which to compare this figure.

The unreliability of the seasonal pattern for 1965-69, as reflected by the wide confidence interval, stems mainly from the relatively short length of the series (5 years) and the prominence of palm-oil exports in the period. The wider confidence interval of the 1970-78 seasonal

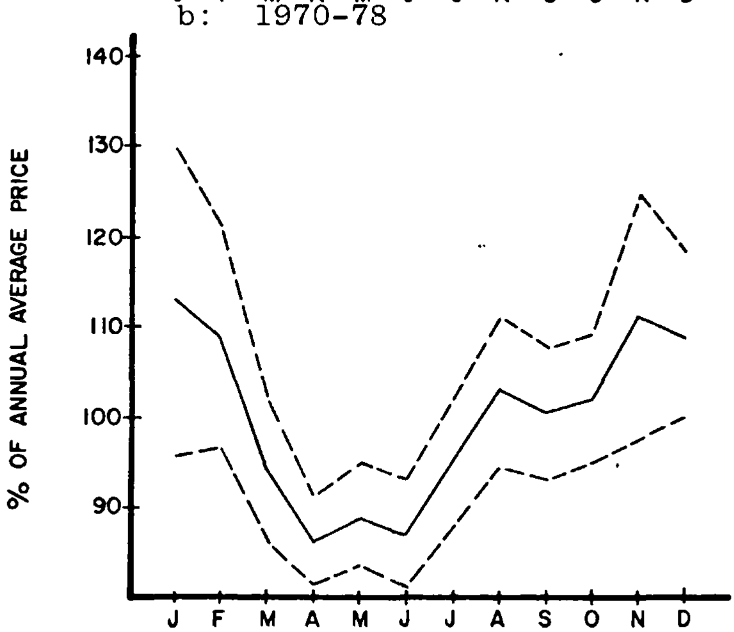


a: 1965-69

Figure 6. Seasonal price index: Palm-Oil.



b: 1970-78



c: 1965-78

Figure 6. Seasonal price index: Palm-Oil (continued).

pattern, and the higher values of the indices' standard errors (11 out of the 12 indices have greater standard errors in 1970-78 period, compared to 1965-78 period) again reflects the importance of changing demand and the transition of the palm-oil market from an export orientation towards an emphasis on domestic production.

Period	No. of Coincidence	Degree of Coincidence	Months between seasonal low and seasonal high prices	Percentage rise in seasonal price: Monthly Average	Percentage rise in seasonal price: Total
1965-69	2	0.40	7	5.47	38.3
1970-78	4	0.44	7	4.91	34.4
1965-78	9	0.64	7	3.56	24.9

The 0.64 degree of coincidence over the entire 1965-78 period indicates the relative strength of seasonal forces in determining palm-oil prices. The 0.44 degree of coincidence for the 1970-78 period undermines the strength of seasonal forces and indicates increased influence of factors other than seasonal forces during the period.

Rice (brown)

Figures 7a to 7c show the seasonal price patterns for rice in the three periods. The seasonal low price occurred in January/February in the 1960-69 period, in March for both 1970-78 and 1960-78 periods. The seasonal high price occurred in August, June and July for periods 1960-69, 1970-78 and

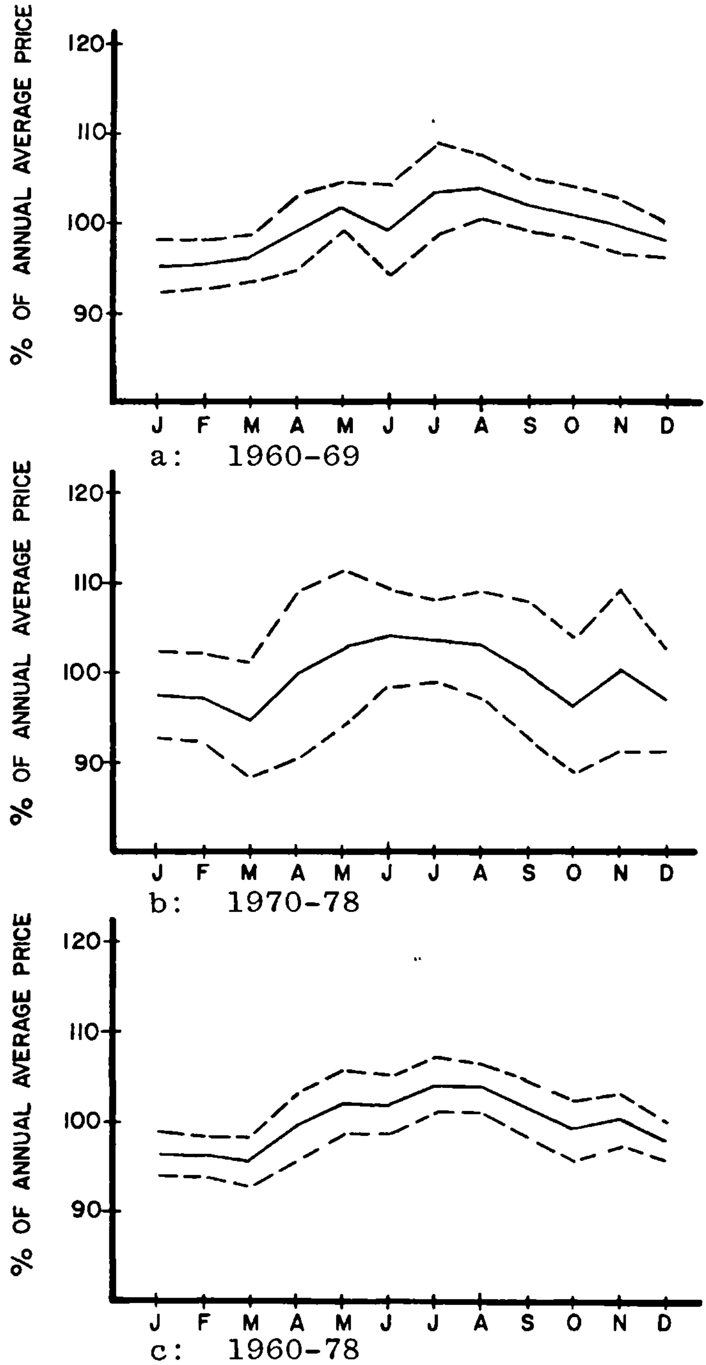


Figure 7. Seasonal price index: Rice

1960-78, respectively. The indices range from 95.2 to 104.0 in 1960-69, 94.6 to 103.8 in 1970-78 period, and 95.6 to 103.9 over the entire 1960-78 period. Rice is storable and storage losses are small. Rice prices are also potentially influenced by international trade. Rice is grown for export in such geographically diverse areas as the United States, Thailand, China, Australia, Italy and Pakistan, so that harvests occur continuously. If rice can be imported without restriction, seasonal fluctuations in the price of domestically produced rice will be moderated. Table 5 indicates an upward trend in rice import between 1960 and 1978. Seasonal fluctuation in the price of rice is therefore expected to be subjected to the moderating influence of imports, particularly for 1977-78 when import policy was liberalized, and imports increased ten-fold.

The total seasonal rise in prices over the 1960-78 period is 8.3 percent. The monthly average percentage rise in seasonal price, 2.08 percent, is comparable to Thodey's estimate of storage loss of less than 5 percent in six months. The months of low seasonal price also corresponds roughly to the time of rice harvests. The seasonal pattern for 1970-78 shows a wider confidence interval and range of indices than any of the other periods. The degree of coincidence is also small, clearly indicating the importance of changing demand in the period. The low degree of coincidence

Table 5. Rice importation and import prices in Nigeria.

Year	Quantity Imported ('000 mt)	Value (₦)	Imported Price Per Metric Ton
1960	2.4	314,280	130.95
1961	1.1	142,857	129.87
1962	1.6	250,000	156.25
1963	1.3	192,855	148.35
1964	1.0	178,570	178.57
1965	1.375	214,300	155.85
1966	1.277	214,290	167.81
1967	1.459	283,986	194.64
1968	0.31	51,570	166.35
1969	0.641	50,382	78.60
1970	1.722	136,054	79.01
1971	0.251	50,708	202.02
1972	5.9	988,000	167.46
1973	0.4	266,000	665.00
1974	4.8	1,497,000	311.88
1975	6.7	2,377,000	354.78
1976	45.3	20,080,000	443.27
1977	381.438	127,900,346	335.31
1978	471.648	158,448,750	335.95

Source: 1960-64 from FAO Trade Yearbooks.

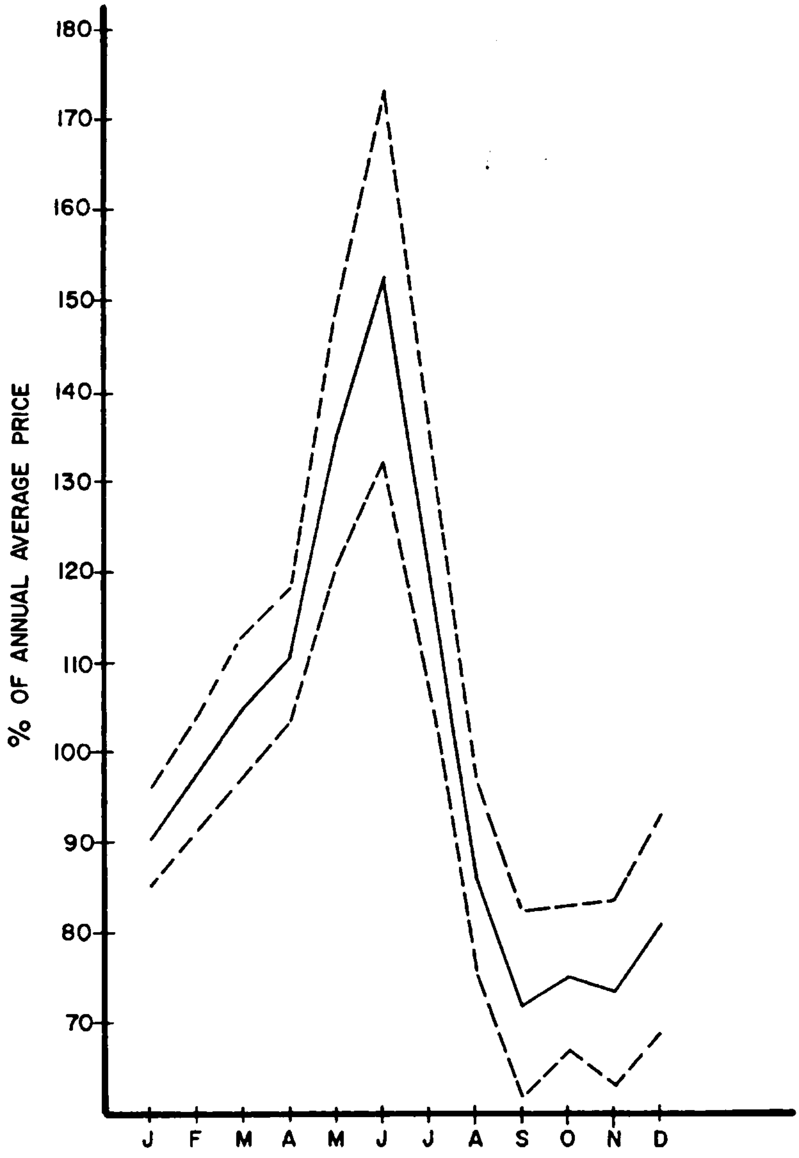
1965-78 from Oni, S. A. and A. E. Ikpi, 1979, "Rice Production and Marketing in Nigeria: An Economic Appraisal".

Period	No. of Coincidence	Degree of Coincidence	Months between seasonal low and seasonal high prices	Percentage rise in seasonal price Monthly Average	Total
1960-69	4	0.40	6	1.43	8.7
1970-78	2	0.22	3	3.07	9.2
1960-78	7	0.37	4	2.08	8.3

(0.37) obtained over the entire 1960-78 period shows the relatively small influence of seasonal forces on the price of rice. Considering the usual practice of spreading the harvest over two or three months, the number of months between the seasonal low and seasonal high corresponds to the period between harvests.

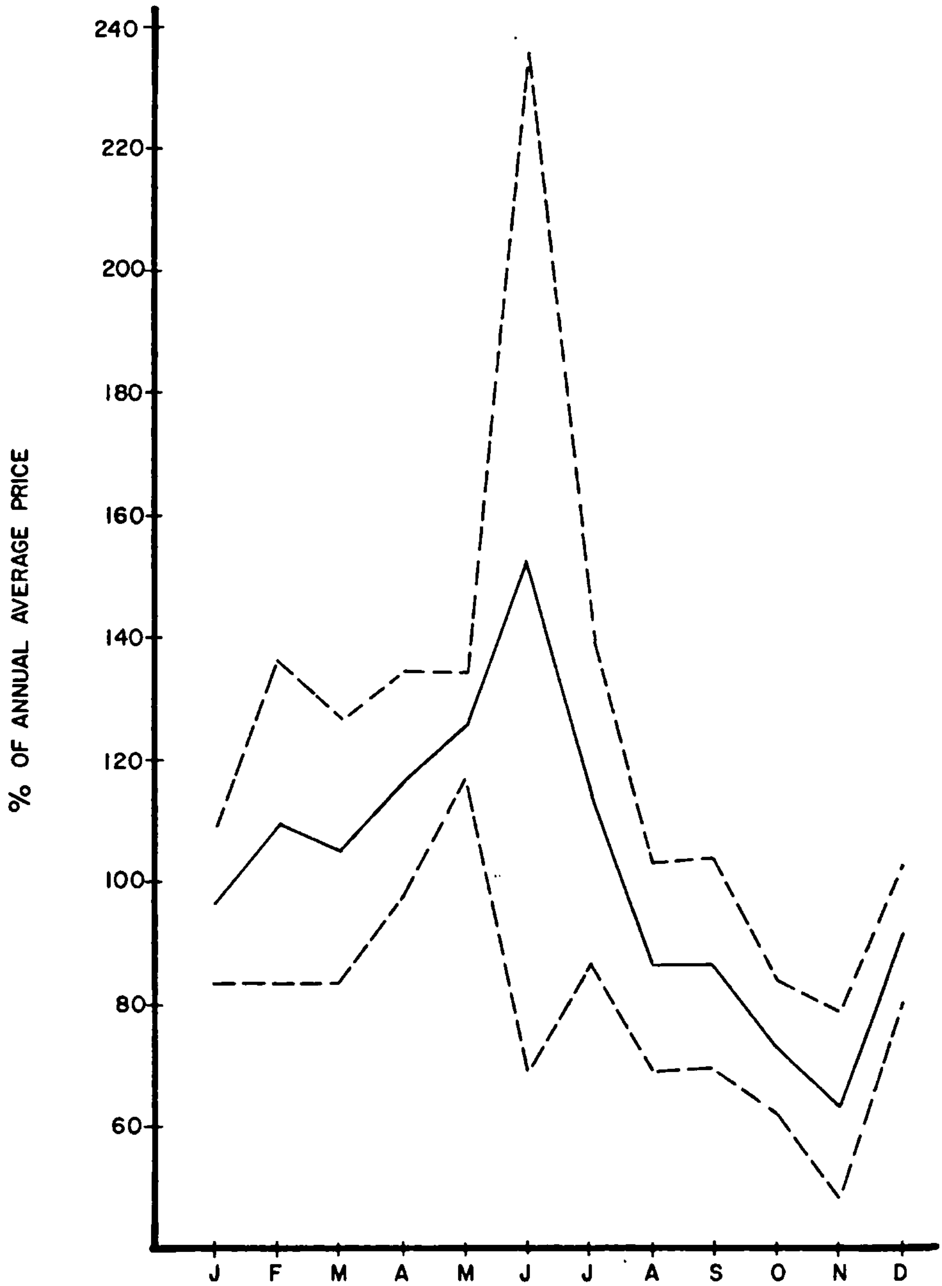
Yams

The seasonal price patterns for yams are presented in Figures 8a to 8c. The seasonal low price occurred in September in the 1960-69 period, and in November in the other two periods, 1970-78 and 1960-78. The September index for 1960-69 (72.1) is comparable to that of November (73.3). The seasonal high price occurred in June in all the three periods. The indices range from 72.1 to 152.9 between 1960 and 1969, 63.4 to 152.3 between 1970-78, and from 70.5 to 150.8 over the entire 1960-78 period. The monthly average percentage rise in seasonal price over the study period, 1960-78, was 11.47 percent. Considering the high storage losses, which



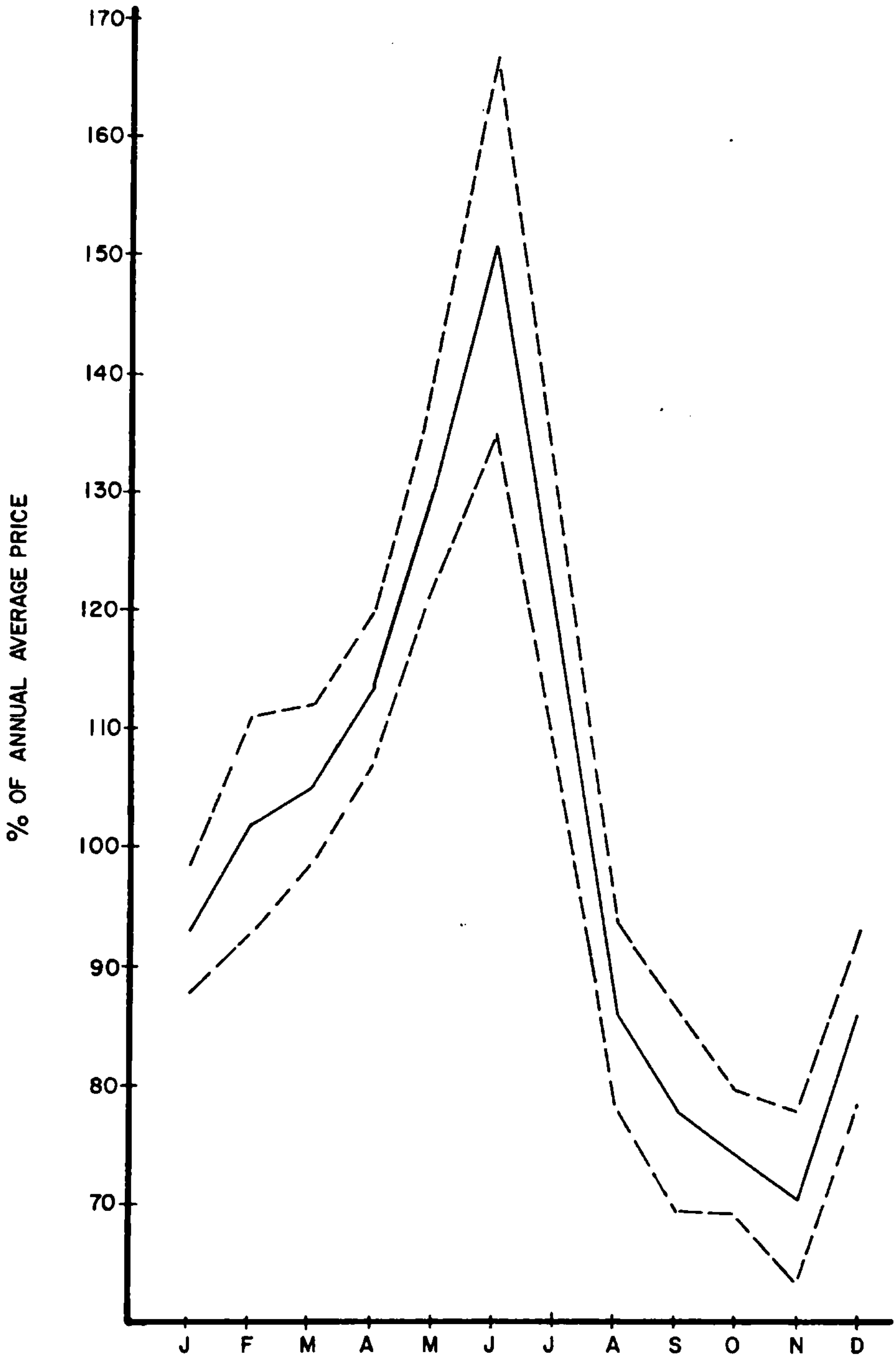
a: 1960-69

Figure 8. Seasonal price index: Yams.



b: 1970-78

Figure 8. Seasonal price index: Yams (continued)



c: 1960-78

Figure 8. Seasonal price index: Yams (continued)

Coursey estimates may be 30-50 percent after six months, this monthly average percentage rise in seasonal price seems reasonable. The seasonal low price corresponds roughly to the time of harvest.

Again, the seasonal price pattern for the 1970-78 period has a wider confidence interval and range of the indices than any of the other periods. Nine out of the twelve indices have greater standard error values in the period when compared to 1960-69 period.

Period	No. of Coincidence	Degree of Coincidence	Months between seasonal low and seasonal high prices	Percentage rise in seasonal price: Monthly Average	Percentage rise in seasonal price: Total
1960-69	10	1.00	7	11.37	79.6
1970-78	5	0.56	7	12.70	88.9
1960-78	15	0.79	7	11.47	80.3

The high degree of coincidence (0.79) over the 1960-78 period suggests the relatively strong influence of seasonal forces on prices of yams. As expected, the seasonal influence appears weakest during 1970-78. The possibility of a selective harvest before the main harvest makes the number of months between the seasonal low and seasonal high prices comparable to the period between harvests.

Conclusion

The influence of seasonal forces on price seems strong for maize and yams, and weak for the other crops. For all the crops, influence of seasonal forces on prices was stronger between 1960 and 1969 than it was between 1970 and 1978, though the average seasonal patterns are similar. The similarity of the patterns undermines the hypothesis that demand is consistently underestimated in the 1970's, and suggests that everyone knows about the rising prices in Nigeria, and storage occurs based on some expectations about increasing demand. In some years, however, this increase will be overestimated, too much will be stored, and the price rise will not cover the costs of storage. In other years the reverse will be true. Seasonal fluctuations in price were also greater in the 1970-78 period, usually above the total percentage rise in seasonal price over the 1960- 69 period. This phenomena, and the wide confidence intervals persistently exhibited by the seasonal price patterns for all the crops in this period typify it as one of constant demand changes and of price uncertainty.

The seasonal low prices of the crops, with the exception of those that can be harvested any time of the year, occurred roughly at the harvest period. The seasonal prices for all the crops tend to peak around the middle of the year. This occurrence suggests a high positive price correlation among the crops, thus limiting consumption substitution when it is most desirable.

Yams show the highest seasonal price movement (11.47 percent per month), followed by maize (5.15 percent per month), palm-oil (3.56 percent per month), gari (3.05 percent per month), and rice (2.08 percent per month). The monthly average percentage rise in seasonal price for each crop agrees with previous studies of their storage costs and their relative ease of storability. However, since most of these studies are based on limited data, the monthly percentage rise in seasonal prices can only place an upper limit on the storage cost. Thus the evaluation of new storage methods can identify inefficient techniques only when their costs rise beyond the level of monthly average percentage rise in seasonal price for each crop.

CHAPTER 4

SUPPLY RESPONSE IN THE AGRICULTURAL SECTOR

In the previous chapter, demand changes were found to have substantial influence on price, particularly in the 1970's, a period of high income growth and, presumably, rapid shifts in demand. The net effect of a rapid shift in demand, in the short run, is an increase of crop prices. In the long-run, the effect of demand increase on price will depend on the supply response of farmers and the elasticities of input supplies. If farmers individually produce more in response to price increases, and the supply of variable inputs is perfectly elastic, the long-run supply curve for aggregate output will also be perfectly elastic, there will be a net increase in the number of farmers, and output prices will decline to their original levels. Other alternatives, ranging from perfectly inelastic to perfectly elastic long-run aggregate supply curve, are also possible. The exact response depends on the elasticities of input supplies, the relative increases in the prices of fixed and variable inputs, and the new least-cost combination of the inputs. A general understanding of the agricultural inputs, their price increases over time, their supply elasticities and technically possible substitutions among them are thus essential to the understanding of farmers' long-run response to price increases.

In this chapter, available agricultural technologies and their relative use among farmers will be examined. The nature of production trends and economic responses to output price increases will also be appraised in the light of the dominant technologies.

Agricultural Technology in Western Nigeria

Agriculture is entirely manually operated in Western Nigeria. Activities such as land clearing, weeding and harvesting are generally very labor intensive. Depending on previous land-use, rainfall and soil fertility, level of production, the share of total labor input may be over 70 percent. Knipscheer, H. C. (1980) provides a comprehensive summary of empirical or farm management surveys of labor utilization in tropical agriculture. Based on the widely different survey results, yams appear the most labor-intensive food crop, followed by rice, cassava, and maize. The surveys indicate no significant trends in labor utilization over time, either by activities or crop. The same number of mandays are required to cultivate food crops today as were required 20 years ago.

Capital is scarce, and plays a minimal role in agriculture. Short handled hoes and machetes of various sorts are the major capital implements employed by farmers. They are used for land clearing, breaking the soil, heaping it up, planting, weeding, and harvesting. These implements are made locally and cost very little.

Land in not a scarce resource. Many farmlands are inherited. In some communities, members are allocated land by cultural rather than economic mechanisms. Where lands are available for sale or rent, they command relatively low value. In most areas, land is not yet fully utilized. Fallow periods can be shortened considerably, particularly if alternative methods of replenishing the soil fertility are available to the farmers.

Labor appears as the major input and wages the major component of cash expenditure on production. Significant input substitution has not occurred over the years. Further evidence in support of this view is revealed by an examination of the use of improved inputs in Nigeria. Table 6 shows the import of tractors into Nigeria in recent years. Due to high cost, beyond the reach of a small farmer and problems with maintenance, the use of tractors is restricted to a very small number of farmers and government plantations. The unit import cost of tractor has been increasing rapidly, and has tripled between 1970 and 1977. Less expensive methods of mechanization involving smaller

Table 6. Import of tractors to Nigeria (1970-77).

Year	Quantity	cif value ('000 N)	Unit Cost (N)
1970	1,223	4,774	3,903
1971	1,255	5,911	4,710
1972	3,251	6,651	2,046
1973	1,067	5,640	5,286
1974	879	5,409	6,154
1975	4,981	45,237	9,082
1976	4,397	48,892	11,119
1977	4,450	51,580	11,591

Source: FAO Trade Yearbook, 1975 and 1978.

tractors capable of performing the specialized functions of land clearing, preparation, planting, and harvesting have not yet been introduced. In addition, the maintenance infrastructure necessary to repair and maintain such equipment does not exist in rural areas. Thus, over the short and medium run ($\sim$10 years), mechanization appears unlikely to assume a prominent role in Nigerian staple crop production.

Table 7 also shows fertilizer import and consumption in Nigeria. Even though fertilizer import has increased thirteen times in value and over six times in quantity between 1965 and 1978, with the federal government providing a 70 percent subsidy, the level of fertilizer use in Nigerian agriculture is still low and restricted to large farms. This is caused mainly by the inefficient distribution network[6]. Only very few farmers get fertilizer at the official subsidized price of ₦ 1.50 per bag (₦ 30 per ton) or ₦ 2 per bag for certain kinds, compared to the import cost of about ₦ 100 per ton in 1976. Unless the distribution network is improved, fertilizers are not likely to contribute significantly to Nigerian agriculture.

The use of improved varieties of crops is limited by lack of required infrastructure. Most improved varieties require the use of fertilizers, insecticides, and irrigation, almost all of which are not available to farmers. The number

Table 7. Fertilizer import and consumption (1965-78), Nigeria.

Year	Import Value (million Naira)	Imports (1,000 mt)	Consumption (1,000 mt)
1965	1.4	36.7	3.9
1966	1.4	31.9	6.4
1967	1.8	66.7	15.6
1968	1.2	39.4	11.9
1969	1.3	45.3	6.5
1970	1.6	34.1	9.8
1971	1.8	52.0	11.1
1972	4.0	83.0	15.3
1973	3.1	84.4	n.a.
1974	6.1	83.7	n.a.
1975	12.3	150.9	n.a.
1976	20.4	207.8	n.a.
1977	n.a.	n.a.	n.a.
1978*	18.2	234.8	n.a.

n.a. - not available

*Fertilizer orders for 1978.

Source: World Bank, 1979, Supporting papers I-V, Volume II, Nigeria Agricultural Sector Review.

of extension workers, who are supposed to transmit improved varieties from researchers to farmers, is also grossly inadequate for the farming population. The efficiency of the available extension workers is further limited by lack of all-season roads, transportation facilities and inadequate training. These deficiencies must be corrected in order to change the agricultural technology.

The Dynamics of Output, Input Price Increases and the Supply in a Fixed Agricultural Technology

As long as farmers do not have alternatives to human power for land preparation, weeding, harvesting, the labor input and physical productivity will remain unchanged in response to price changes. This phenomena demonstrates a fixed relationship between inputs and outputs, or, in other words, fixed coefficients of production. Thus, an increase (decrease) in agricultural product prices will result in an increase (decrease) in labor wage rate. The relationship between price increase of agricultural products and wage rate increases can only be offset by increases in the use of alternative technologies, and imply increases in the level of fertilizer use and increases in the adoption rate of improved varieties. None of these changes have occurred to a significant extent in Nigerian agriculture.

Since land is relatively abundant, labor and capital are the two important inputs in Western Nigerian agriculture.

The relationship between output price and prices of factors used in producing the output can be analyzed by the general two-factor equilibrium model. Under the assumptions of constant returns to scale, continual full employment of resources, excess profits equal zero and unit cost of production equals marginal revenue (price). In a competitive equilibrium,

$$P = A_L w + A_K r$$

where P = price of output, w = wage rate, r = interest on capital, A_L and A_K = quantities of labor and capital used in producing one unit of output, respectively.

The assumption of continual full employment implies that changes in output prices will affect factor prices. With constant returns to scale, a first-order approximation of factor price changes is expressed by the following equation (Jones, R. W., 1965):

$$\frac{dP}{P} = \theta_L \frac{dw}{w} + \theta_K \frac{dr}{r}$$

where θ_L and θ_K are the shares of labor and capital in production cost, respectively. θ_L and θ_K must add up to one. As noted earlier, θ_L is very large relative to θ_K and close to one.

This relationship guarantees that any increase in agricultural product prices will lead to wage rate increases almost of the same magnitude. The relationship between wage rate increases and the supply response when input coefficients are fixed is depicted in Figure 9.

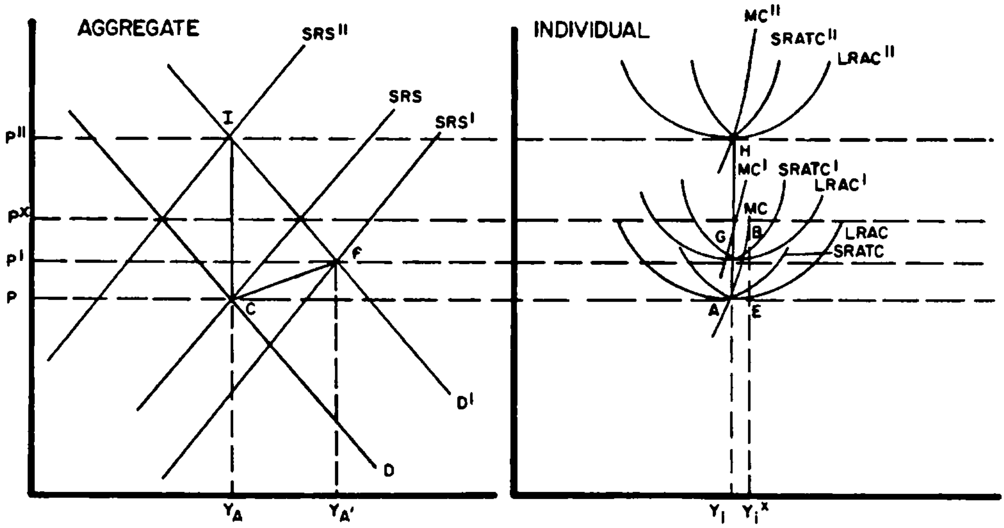


Figure 9. Supply curve in a fixed technology.

In the long run, a farmer will have optimum farm size that permits production at the minimum average cost. At equilibrium, the unit price of output will be equal to the short-run marginal cost, short-run average total cost, long-run average cost and long-run marginal cost. An individual farmer will produce Y_i and the aggregate output will be Y_A. The number of farmers in the agricultural sector will be Y_A divided by $Y_i (\frac{Y_A}{Y_i})$.

If demand increases from D to D', output price will increase from P to P*. Farmers will react to the price increase along their short-run marginal cost and will produce Y_i* where the new price equals the short-run marginal cost. The existence of excess or pure profit, BE, the difference between the short-run marginal cost and long-run average cost, may result in increases in the number of farmers. The wage rate will be bid up and will increase until the excess profit becomes zero. Since other factors of production cannot substitute for labor, the long-run average cost curve will shift upward vertically in response to the wage rate increases. Individual farmers will find themselves on LRAC'and produce output Y_i, the same as before. However, if new farmers have been attracted by the initial excess profit of BE, aggregate output will increase to Y'_A. Equilibrium long-run price will increase to P'. In this case, the farmer's long-run supply curve may be perfectly inelastic GA, while the aggregate long-run supply curve, CF, will be more elastic. If farm population is fixed, the aggregate long-run supply curve for an individual crop can be elastic only if the output of another crop declines.

The aggregate long-run supply curve does not have to be elastic as illustrated in the preceding discussion. If, for instance, wage rates increase initially due to increased demand for labor elsewhere in the economy, no new farmers will be attracted. The long-run average cost curve of the individual farmer will shift vertically upward, LRAC", and the aggregate long-run supply curve will be perfectly inelastic, IC. In this case output price increases follow rather than initiate increases in wage rates.

Technological improvements such as increased use of improved seeds, fertilizer and mechanical inputs have similar effects as decreases in input prices. They increase the average physical product and/or marginal physical product and decrease average cost and/or marginal cost. The exact effect will depend upon the type of technology change. Any technological improvement, however, will result in some shift of the aggregate supply curve to the right. These improvements, as explained in the previous section, have not occurred to a significant extent in Nigerian agriculture.

There have been increases in both agricultural product prices and labor demand in Western Nigeria. Thus, the nature or form of the supply curve may be difficult to identify. However, if the aggregate supply curve is elastic and technology is fixed, as in CF, increases in the number of farmers will be expected. Insignificant changes in the number of farmers will suggest an inelastic aggregate supply curve as in IC. Based on national and regional sample surveys, the estimated number of farming households in Western Nigeria declined by about 9 percent between 1958 and 1972 and increased by about 52 percent between 1972 and 1975 which suggests the aggregate supply curve may be elastic, assuming the estimates are true.

The theory described above applies to a purely competitive market and profit maximizing producers. To the extent that a market is not purely or perfectly competitive and producers do not behave in an economically rational manner, the theory may not be applicable. Among many other essentials of a purely competitive market, individual producers cannot influence the market prices of inputs and products. The producer must essentially be a price taker. Jones, W. O. (1972) confirmed that individual marketplaces for agricultural products in Western Nigeria approximate a purely competitive market, even though some deficiencies exist when all market places are grouped together (p. 104). The large number of farmers and the small off-farm input requirements indicate that none of the farmers are likely to be able to influence input prices and suggest that the input market may also approximate a purely competitive market. Many studies in Africa and elsewhere have also shown that farmers in developing nations behave in an economically rational manner (Dean, E., 1966; Schultz, T. W., 1966; and Behrman, J. R., 1968). The burden of proof, as concluded by Behrman, "now seems even more to lie with those who maintain that for peasant behavior, noneconomic constraints reduce to insignificance the relevance of traditional economic analysis."

Reliability of the Data

The result of any empirical analysis is only as good as the primary data used. Thus, the reliability of the available primary data needs to be examined before proceeding to the empirical analysis. Two national agricultural surveys were conducted in 1958 and 1963 by the Federal Office of Statistics, Lagos. This office also estimates annual agricultural production in all the States of the Federation. From 1972 until 1976 when Western State was divided into three states (Ogun, Ondo and Oyo), the Ministry of Economic Development, Ibadan, conducted annual agricultural surveys in Western State. The responsibility of continuing the annual agricultural survey fell on the Ministries of Economic Development of the three states since 1976. The reported hectarages for four staple food crops (Cassava, Maize, Rice and Yams) are plotted in Figure 10. Between

Figure 10. Hectarage of four staple food crops, Western Nigeria.

1959 and 1968 reported hectarage increased over 200 percent. There are no apparent reasons for this phenomenon. The consumer price index for food was relatively stable, and the number of farmers reportedly declined in the period. Between 1969 and 1978, when there were major increases in both the consumer price index for food and the reported number of farmers, the hectarage of the food crops, surprisingly, was reported to have declined over 75 percent despite the insignificant improvement in the agricultural technology. If these figures were true, the consumers must have been eating less or there must have been a big shift from the consumption of domestic crops to consumption of imported food and a big increase in staple food imports. Neither of these alternatives are true in Western Nigeria. The wide variation of the yield estimates from one year to another (Table 8) without any reported weather variation also appears totally implausible. These deficiencies undermine the reliability of the national and regional production survey data, at least on the aggregate level.

In contrast, the output price data appear reliable and wage rate data are well known for a number of recent years. These data allow estimation of the trend of labor production costs and gross revenue for the different crops (Figures 11 to 15). Labor input costs for cocoa are based only on variable input and not initial labor investment. Cocoa appears less profitable and unattractive, particularly

Table 8. Yield estimates (Kg/ha) for Cassava, Maize, Rice and Yams.

Year	Cassava	Maize	Rice	Yams
1958/59	9,980	760	n.a.	9,434
1959/60	n.a.	n.a.	n.a.	n.a.
1960/61	n.a.	n.a.	n.a.	n.a.
1961/62	n.a.	n.a.	n.a.	n.a.
1962/63	n.a.	n.a.	n.a.	n.a.
1963/64	11,878	1,163	n.a.	13,092
1964/65	n.a.	n.a.	n.a.	n.a.
1965/66	n.a.	n.a.	n.a.	n.a.
1966/67	n.a.	n.a.	n.a.	n.a.
1967/68	10,938	905	2,318	11,610
1968/69	9,179	742	1,553	9,111
1969/70	11,388	1,274	1,490	9,851
1970/71	15,980	908	899	10,197
1971/72	2,413	5,604	1,213	6,874
1972/73	3,748	4,404	1,420	6,183
1973/74	4,022	2,199	1,692	4,011
1974/75	9,668	2,145	3,254	14,363
1975/76	n.a.	n.a.	n.a.	n.a.
1976/77	n.a.	n.a.	n.a.	n.a.
1977/78	9,232	2,106	2,935	20,122

n.a. -- not available

Source: Computed from the survey data.

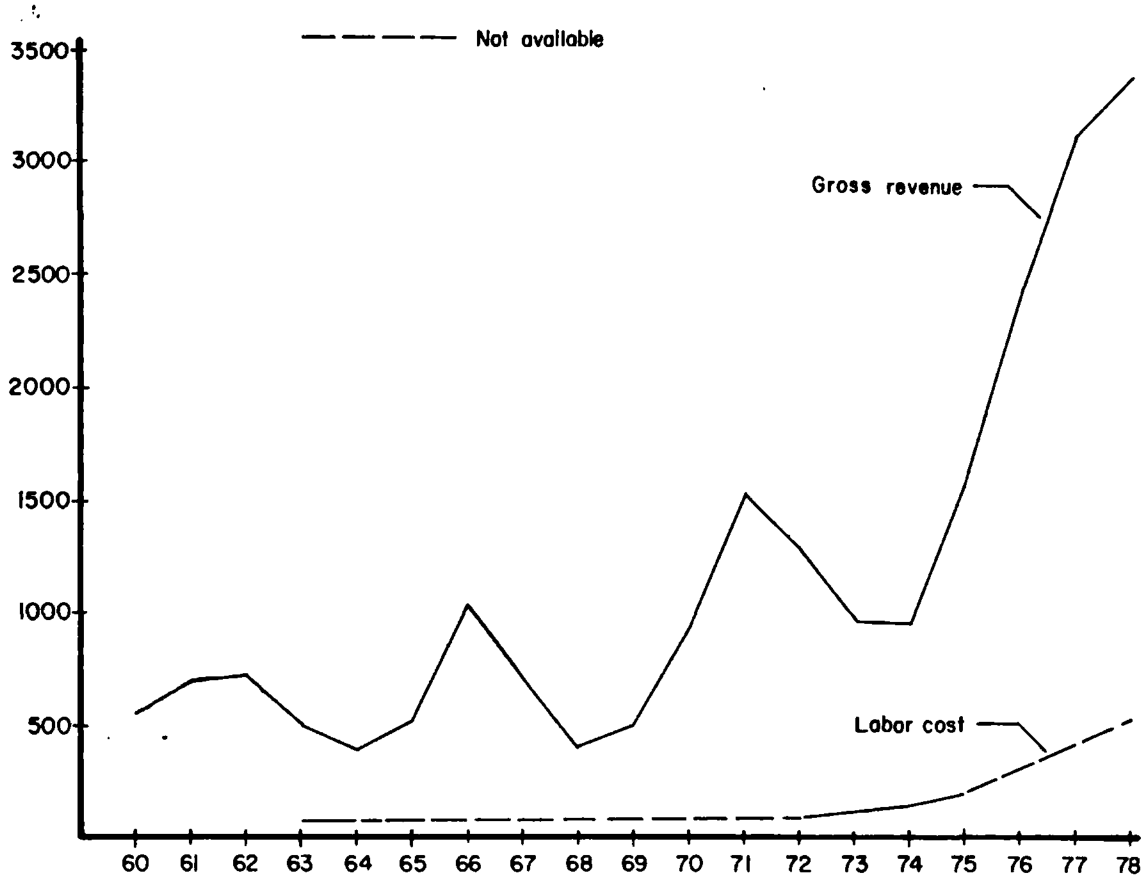


Figure 11. Gross revenue and labor cost (₦/ha) for cassava.

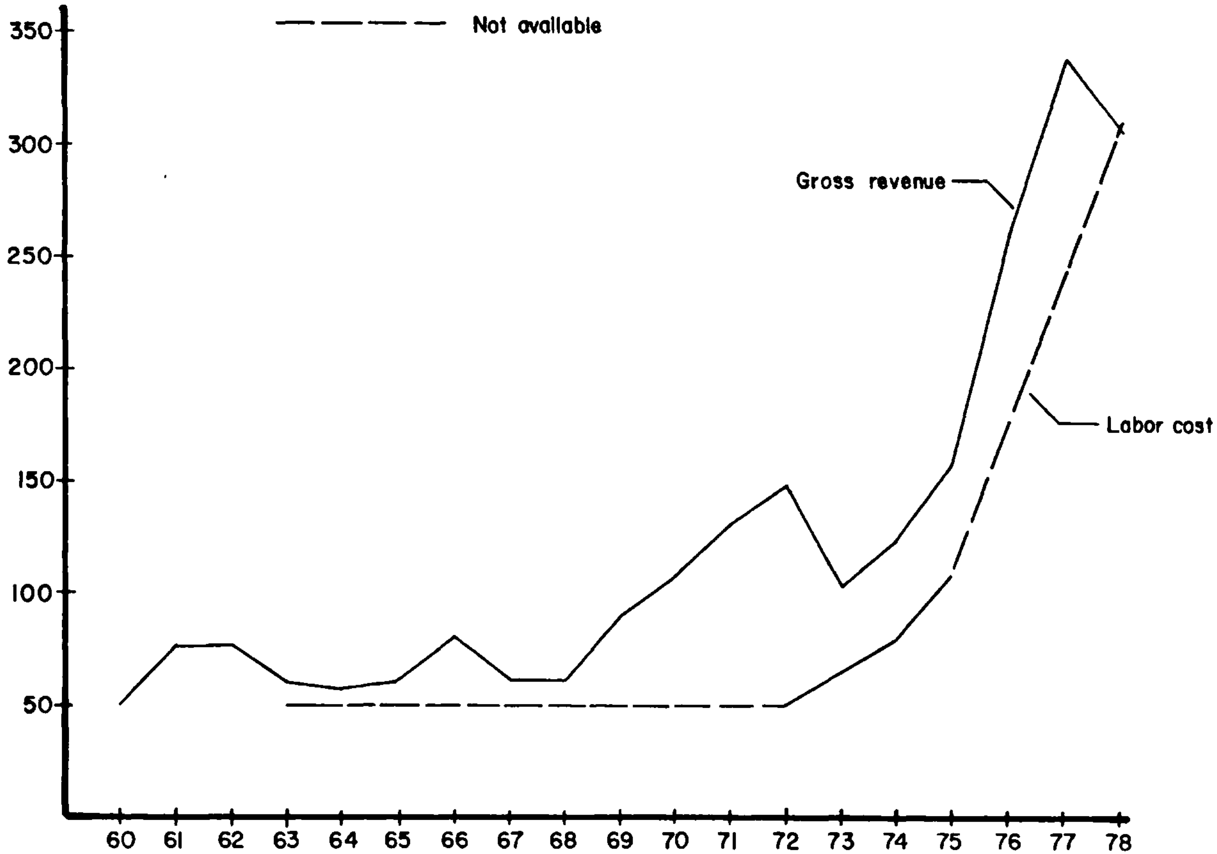


Figure 12. Gross revenue and labor cost (₦/ha) for Maize.

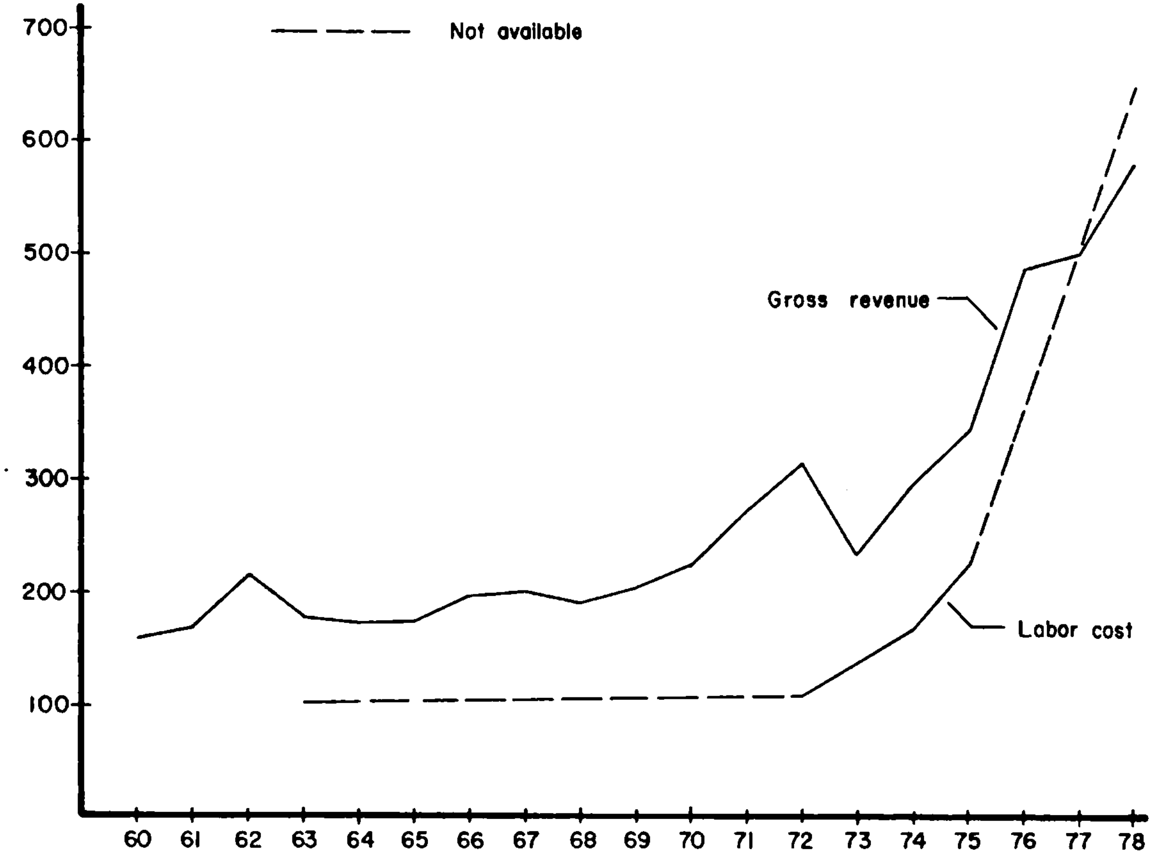


Figure 13. Gross revenue and labor cost (₦/ha) for rice.

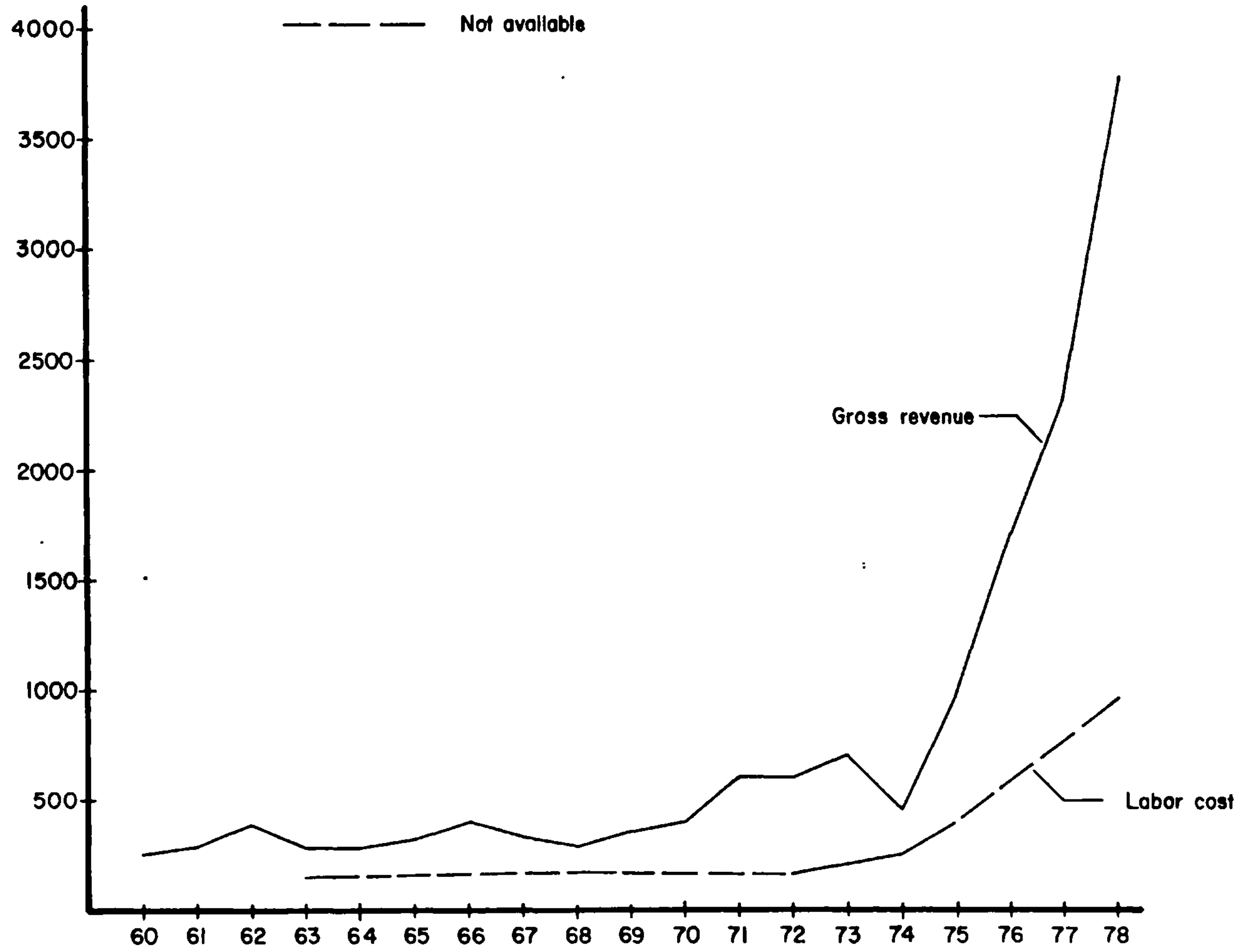


Figure 14. Gross revenue and labor cost (₦/ha) for yams.

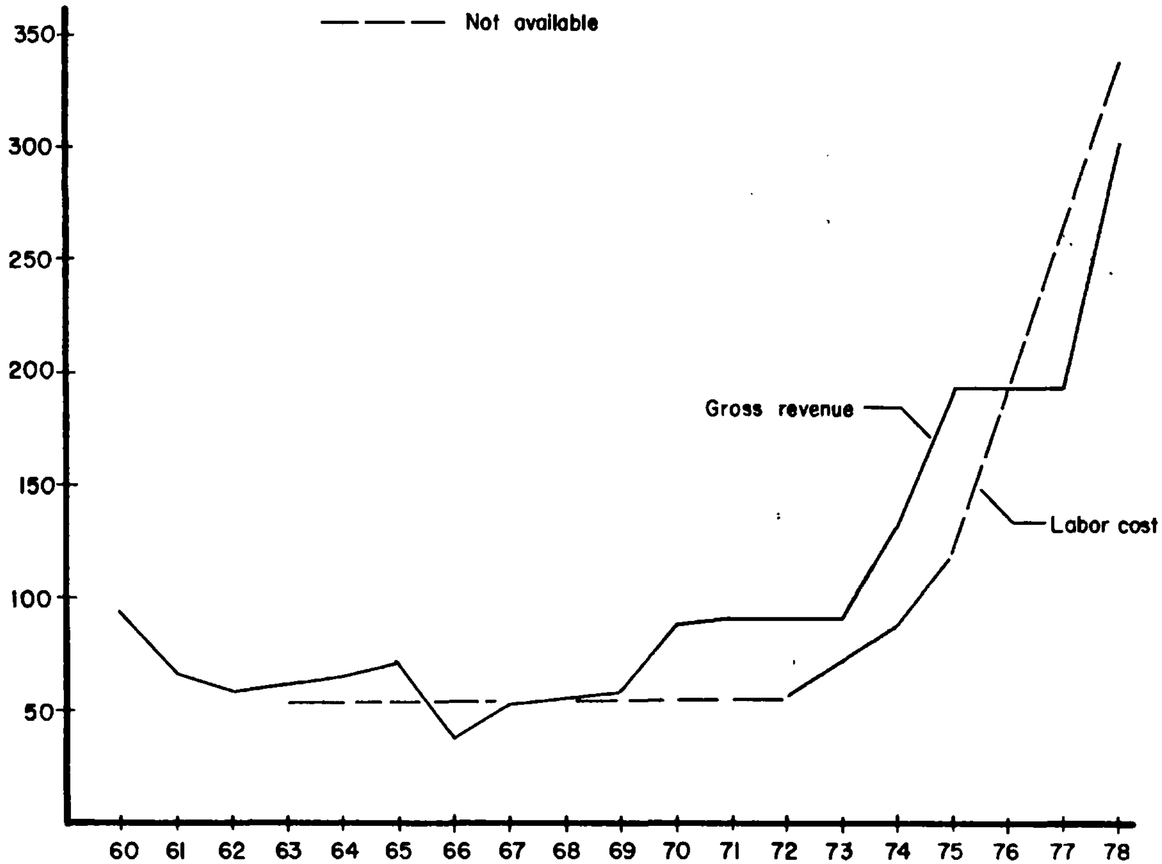


Figure 15. Gross revenue and labor cost (₦/ha) for cocoa.

at the recent levels of wages. Not only do new cocoa farms appear unprofitable, maintenance of existing farms also appears unprofitable. These phenomena explain the decline in cocoa production in the 1970's, from 285,000 mt in 1971 to 151,000 mt in 1977. Among the food crops, tuber crops (cassava and yams) are generally more profitable than the grains (maize and rice). Maize, rice, and cocoa, in fact, became unprofitable at the 1978 level of wages. Despite the relative profitability of the crops, the available statistics neither reflect a major shift from production of export crops to food production nor production of grains to production of tuber crops. Surprisingly, the hectarages and production of all the food crops declined. The failure of the available production survey data to indicate any economic behavior does not necessarily suggest irrational economic behavior of producers, rather, it suggests that the data are totally unreliable.

Unreliability of the data suggest that an empirical or statistical estimation of the supply response may not be worth doing. However, the result of such statistical estimation may additionally assist in judging the quality of the data. The empirical estimation which follows is based on this premise.

Empirical Tests

Production decisions are usually determined by the real prices producers expect. In a labor-intensive agriculture, the expected real wage rate will also play a significant role in the decision. If the expected real price and labor wage rate of a given year is based on the price and wage rate of the previous year, the supply function can be estimated by the following equation:

$$Q = aP_A'^{\,b}\, W'^{\,c} T^{d},$$

or $$\log Q = \log a + b \log P_A' + c \log W' + d \log T,$$

where Q represents the food production index[7], P_A' the lagged real price index of food $(\frac{P_A}{P})$, W' the lagged real labor wage rate index $(\frac{W}{P})$, and T the time trend. P is the all-item price index.

To permit a sufficient number of observations for the regression, labor wage indices were estimated on the following basis. The 1960's was a period of relatively stable wage rate and the 1970's a period of high and unstable wage rates. This phenomenon is further indicated by the small difference between the available 1964 and 1972 wage rates. On this basis, a constant and 1972 wage rate was assumed for the period between 1964 and 1972. The period before 1963 (1960-1962) was similarly treated and assigned the available 1963 wage rate. The missing 1976 and 1977 wage rates were exlcuded from the analysis.

A relatively high food price will be expected to lead to increases in food production. Hence the regression coefficient of the real price index of food will be expected to have a positive sign. The exact effect of a relatively high labor wage depends on the source of labor. If farmers rely on hired labor, high levels of wage rates may lead to decline in production. In the case of Western Nigeria where there has been increasing reliance on hired labor, high levels of wage rates may be expected to have had a dampening effect on production.

Once in agriculture, a farmer's decision to produce a particular crop will be determined by the real price he expects to receive for that crop. Since he can also earn revenue from other crops, their expected real prices will be considered before arriving at a final decision. In the model used here, the expected real prices of a given year are based on the real prices of the previous year. In Western Nigeria, cassava, maize, rice and yams are the major food crops and cocoa is the major competing export crop. For the individual crops, equations similar to that used for the whole sector are used to estimate the supply response, i.e.,

$$Q_i = F(P_i, P_1' \; . \; . \; . \; P_3', P_{co}', T)$$

where Q_i = quantity of crop i produced, P_i' = lagged real price for crop i, P_1' . . . P_3' = lagged real prices of the other competing food crops, P_{co}' = lagged real price of cocoa, T = time trend. For instance, the cassava equation can be represented as:

$$\log Q_{ca} = \log a + b \log P_{ca}' + c \log P_m' + d \log P_y' + e \log P_{co}' + f \log T$$

where: Q_{ca} = quantity of cassava produced

P_{ca}' = lagged real price of cassava (gari)

P_m' = lagged real price of maize

P_y' = lagged real price of yams

P_{co}' = lagged real price of cocoa

T = time trend

If the expected price of a particular crop increases, farmers would like to produce more of that crop and less of the other crops. The price coefficient of the crop will, therefore, be expected to show a positive sign while the price coefficients of the others will be of negative signs. The possibility of intercropping the food crops may, however, lead to an unexpected sign for any of the food crops. Nevertheless, the sign of cocoa price coefficient will be expected to be consistently negative.

Rice was dropped from the analysis because of insufficient number of data. Cocoa was also dropped because its supply function is definitely more complex than as presented by the equation and because cocoa prices are exogeneously determined by the marketing board. As indicated in the last chapter, farm-gate prices were not available. The annual average retail prices of the food crops and gari, and cocoa producers' price were, therefore, used.

Results

The following food production supply function was obtained:

$$\log Q = \underset{(0.31)}{0.63^{d}} - \underset{(-9.20)}{5.15^{a}} \log P'_{A} + \underset{(1.93)}{0.5^{b}} \log W' + \underset{(2.2)}{1.07^{b}} \log T$$

$R^2 = 0.99$ $\bar{R}^2 = 0.99$ DW = 2.42

Figures in parenthesis are the t values.
a-d have the same meanings as on Table 9.

The regression coefficient of real price of food shows an unexpected negative sign and is statistically significant at the 5 percent level. The labor wage rate coefficient shows a positive sign and is significant at the 10 percent level. The constant term is small but only significant at over the 20 percent level. Small and insignificant constant terms suggest that production decisions are governed by market forces, while large and highly significant constant terms suggest otherwise. The coefficient of multiple determination, R^2, is large (0.99) indicating a high proportionate reduction of total variation in production associated with the use of the variables.

The negative sign shown by the coefficient of food price indicates the unreliability of the data rather than irrational behavior of producers.

The regression results for the individual crops are presented on Table 9. The coefficient of own price variables of all the crops have unexpected negative signs and are not significantly different from zero at the 5 percent level. The coefficients of price variables of the competing food crops showed mixed signs and are also not significantly different from zero at the 5 percent level. Only with cassava does the coefficient of cocoa have the expected negative sign. None of the coefficients, again, is significantly different from zero at the 5 percent level. All the constant terms are large and are also not significantly different from zero at the 5 percent level.

The fact that price coefficients are not significantly different from zero and the large constant terms suggest that supply may be perfectly inelastic or that production data are too poor to allow significant estimation, i.e., no better than a series of random numbers.

Conclusion

The unreliability of the production data collected from national and regional sample surveys precludes estimation of

Table 9. Regression results for Cassava, Maize and Yams.

Dependent Variable	Constant Term	P'_{ca}	P'_m	P'_y	P'_{co}	Time	R^2	$\bar{R}^2$	DW Test
Q_{ca}	19.86^c (1.68)	-1.42^b (-2.01)	0.31^d (0.27)	0.71^d (0.44)	-0.55^d (-0.66)	-3.12^d (-1.09)	0.96	0.94	1.93
Q_m	-2.64^d (-0.26)	-0.01^d (-0.02)	-0.06^d (-0.06)	1.50^d (1.10)	0.07^d (0.09)	2.12^d (0.85)	0.96	0.94	1.79
Q_y	25.69^b (2.16)	-0.72^c (-1.44)	-0.24^d (-0.30)	-0.13^d (-0.11)	0.83^c (1.39)	-4.14^c (-1.46)	0.98	0.97	1.59

Figures in parentheses are individual t values.

a -- significant at the 5 percent or less significance level.

b -- " " " 10 " " " " "

c -- " " " 20 " " " " "

d -- " only at over the 20 percent significance level.

supply response. However, the inflexibility of the production coefficients indicated by farm management surveys suggests that the supply curve is inelastic. The absence of technical substitution possibilities among agricultural inputs and the inability to develop new least-cost combinations of inputs in the face of changing economic conditions appears as a major constraint on increases in agricultural production. As resources become scarce and other industrial sectors assume prominence, the impacts of limited substitution are likely to become profound. This problem poses a major challenge to future agricultural development in Western Nigeria and elsewhere in the country.

CHAPTER 5

POLICY IMPLICATIONS

The results of the analyses in the last two chapters are used to draw some policy implications on (1) marketing efficiency and storage costs, (2) crop profitability and supply response, and (3) the reliability of primary agricultural data.

Marketing Efficiency and Storage Costs

The price analysis showed that seasonal storage or seasonal movement in prices may not be a major problem for the efficiency of staple food marketing in Western Nigeria. All the crops showed monthly percentage rise in seasonal prices consistent with their storage costs and relative ease of storage. There is no evidence of conscious efforts by traders to hike-up prices in a season.

One concern, however, is the extent to which seasonal prices need to rise 1) for storage to be attractive to farmers and traders, 2) and without becoming a source of consumer discontent and a constraint on demand. This is particularly relevant to Nigeria where there is a wide income disparity and where lack of effective demand may be a drag on production. Recognition of these consequences of seasonal price movements lead to serious concerns about storage methods and their costs. As indicated by the analysis, monthly percentage increase in price cannot be less than 2.08, 3.05, 3.56, 5.15 and 11.47 for rice, gari, palm-oil, maize and yams, respectively if storage is to remain profitable and attractive to farmers and traders. A government interested in the welfare of the low-income majority may view the monthly rise in seasonal prices, particularly for yams, as too high and undesirable. These goals, to decrease storage costs and thus diminish seasonal price movements, can only be achieved through the improvement of storage methods. Present methods of storage, at least for yams and maize, appear socially expensive. Research into improved and affordable methods of storing these crops is highly desirable if they are to retain their importance in consumption patterns.

Relative Profitability of the Crops and Supply Response

Although the data are too poor to allow significant estimation of the supply response, available evidence suggests it is inelastic. This evidence includes the fixed coefficients of production, labor wage increases of almost the same magnitude as price increases, and insignificant increases in the use of fertilizer and improved seeds during the 1970's. The introduction of affordable methods of mechanization that will substitute for labor in production and promotion of the use of fertilizer and improved seeds deserve high priority in order to curtail the growing divergence between demand and supply, and rising food prices.

Cocoa was found to be less profitable and unattractive when compared to the food crops. The government may have to revise its method of determining cocoa producer prices if the commodity is to regain its popularity in Western Nigeria. Maize and rice are becoming unprofitable with the rise in labor wage rate and unless there is an increase in output prices or in the use of high-yielding varieties of these crops, productions are likely to fall drastically in the next few years. Cassava and yams appear the most profitable and should remain attractive to producers.

Reliability of Data

The results of the analyses indicate the relative reliability of the price and the production data. The price analysis showed seasonal prices consistent with the relative ease of storing the crops, thus indicating the relative reliability of the price data. Nevertheless, the many defects in the method of collecting the prices pointed out by Jones, W. O. (1972) need to be corrected. The production data, on the other hand, are totally unreliable. They indicate no sign of economic behavior and show implausible fluctuation from year to year. The importance of reliable primary data to the formulation of good agricultural policies cannot be overemphasized. At present, little is known of agricultural production in Western Nigeria. The agricultural surveys require a huge improvement if policy formulation is to be based on estimates better than random numbers.

NOTES

1. p. 24, The theory of price determination over time described here draws heavily on "Intertemporal Price Equilibrium by P. A. Samuelson; Markets, Prices and Interregional Trade by R. G. Bressler and R. A. King, Chapter II; Seasonal Price Behavior for Indiana farm Commodities by A. E. Peck and H. A. Baumes, Jr.

2. p. 31, Details of this technique and the underlying assumptions can be found in "Seasonal Price Behavior for Indiana farm commodities by Peck and Baumes; Yamane, T., Statistics: An Introductory Analysis.

3. p. 32, 1965-1978 for palm-oil.

4. p. 32, The difference in the number of observations in the 1960-69 and 1970-78 periods accounts for only about 0.5 percent of the difference in standard errors for the two periods, and is therefore ignored in the following discussion.

5. p. 36, This is a slight modification of W. O. Jones' technique which excludes the adjacent months.

6. p. 62, During an informal discussion with an extension officer, he pointed out that influential traders and/or government officials buy fertilizer at subsidized prices, and sell them to another person or trader who may or may not sell directly to the farmer. The number of links between the government and the farmers may be large enough to push the cost per bag of fertilizer beyond what an average farmer can afford, and certainly cause the farm gate price to differ from the official subsidized price.

7. p. 80, The procedure for calculating the indices is described in "Consumption and Utilization of Agricultural Products, Major Statistical Series of the U. S. Department of Agriculture, Vol. 5.

APPENDIX A

Table A1. Ibadan monthly retail prices for Gari (Kobo*/kg).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1960	5.02	5.29	5.07	5.13	5.36	5.42	6.14	5.99	5.75	5.84	5.68	5.60	5.52
1961	6.17	6.32	6.30	5.95	6.15	7.92	7.31	7.37	7.24	7.09	7.09	7.15	6.84
1962	7.17	7.15	7.24	7.46	8.01	8.40	7.46	7.48	7.46	6.54	6.34	6.10	7.23
1963	6.63	6.26	5.68	5.47	5.40	5.09	5.03	4.81	4.59	4.30	3.84	3.67	5.06
1964	3.71	3.75	3.58	3.62	4.26	4.52	4.46	4.15	3.93	3.86	3.80	3.88	3.96
1965	4.08	4.43	4.41	4.32	5.99	6.25	6.01	5.79	5.59	5.59	5.51	5.92	5.32
1966	6.58	7.33	8.16	9.35	11.26	11.67	11.94	12.29	12.07	11.26	10.56	10.21	10.22
1967	9.70	8.49	7.72	7.22	8.02	7.80	6.75	6.78	6.06	5.42	5.08	5.22	7.02
1968	4.86	4.66	4.64	4.08	4.21	4.08	4.01	3.77	3.82	3.79	3.67	3.83	4.12
1969	3.73	3.78	4.11	4.21	5.52	5.59	5.21	5.41	6.05	5.69	5.39	5.59	5.02
1970	8.00	7.52	7.74	7.50	8.05	10.06	9.67	9.81	10.66	10.47	11.20	11.45	9.34
1971	12.14	12.95	13.45	14.38	16.93	17.00	16.83	17.23	16.74	16.44	15.97	14.04	15.34
1972	14.18	15.24	14.71	14.37	14.25	13.96	13.46	12.20	10.77	9.92	n.a.	8.60	12.88
1973	9.22	8.74	8.79	9.19	9.90	10.69	10.07	11.03	9.74	9.59	n.a.	9.63	9.69
1974	10.06	10.55	9.49	10.00	10.61	10.29	9.83	8.81	7.46	8.57	9.94	8.33	9.50

Table A1, continued.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1975	9.78	11.74	13.26	---	---	---	16.88	13.49	17.84	18.09	19.80	20.29	15.69
1976	23.72	26.45	24.05	24.46	25.98	25.07	24.69	25.05	23.72	23.25	23.08	22.80	24.36
1977	25.19	23.98	22.86	25.43	25.43	34.35	39.40	35.51	35.96	37.90	34.72	33.74	31.21
1978	36.33	34.57	34.54	34.54	42.92	---	34.73	34.47	31.53	31.53	28.56	28.32	33.82

*100 Kobo = ₦1 = $1.85 in 1980.

n.a. means not available

-- means no Gari found in the market.

Source: Federal Office of Statistics, Retail Prices in Selected Centres and Consumer Price Indices, monthly issues 1960-79, Lagos, Nigeria.

Table A2. Ibadan monthly retail prices for maize (Kobo*/kg).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1960	4.67	4.59	5.13	6.26	6.06	6.52	6.52	6.14	5.66	5.25	5.62	5.59	5.67
1961	5.88	6.71	7.11	7.37	8.93	11.59	10.09	7.51	6.38	5.51	6.36	7.62	7.59
1962	8.60	8.80	8.71	8.82	9.41	9.31	7.18	6.69	6.19	5.79	6.15	6.06	7.64
1963	5.90	6.03	5.81	6.08	6.65	6.83	6.32	4.98	5.71	5.84	6.25	6.30	6.06
1964	6.06	5.95	6.01	6.30	7.29	6.94	7.28	4.32	4.37	4.63	5.07	5.20	5.79
1965	5.27	5.59	5.62	5.77	6.67	6.71	6.72	6.52	6.41	5.77	5.68	6.61	6.11
1966	6.93	7.22	8.91	10.18	12.11	12.92	6.94	5.71	6.21	6.36	6.56	6.72	8.06
1967	6.56	6.40	6.58	7.29	7.88	7.38	6.44	5.29	5.00	5.10	4.73	4.73	6.12
1968	4.80	5.13	6.01	6.38	6.39	6.45	6.71	6.21	4.95	5.96	6.74	6.75	6.04
1969	7.01	7.80	10.22	9.49	10.08	10.30	10.44	7.97	7.84	8.05	8.98	9.28	8.96
1970	11.05	10.99	10.96	11.46	12.09	11.83	10.72	10.74	9.94	9.10	9.29	10.25	10.70
1971	10.90	11.30	13.46	13.92	15.71	15.96	14.34	13.31	12.42	11.05	12.35	12.83	13.13
1972	14.95	19.99	22.09	20.47	20.59	18.54	12.99	9.27	9.05	8.75	n.a.	8.23	14.99
1973	8.62	10.21	11.28	11.91	11.95	12.67	10.69	8.95	8.41	8.92	n.a.	9.55	10.29
1974	12.20	13.72	14.12	14.36	14.28	14.47	14.79	11.83	8.97	9.67	9.69	9.76	12.32

Table A2, continued.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1975	13.39	14.53	17.81	18.53	17.20	16.92	17.07	14.95	14.32	14.79	14.71	15.97	15.85
1976	20.13	22.94	24.07	24.09	31.58	32.22	32.34	25.68	24.53	24.04	24.60	26.70	26.08
1977	26.42	26.75	29.53	36.18	45.14	48.72	36.70	46.64	25.56	23.47	29.37	32.63	33.93
1978	32.21	35.20	34.68	34.68	---	30.44	30.62	30.64	28.84	25.34	26.28	26.89	30.53

*100 Kobo = ₦1 = $1.85 in 1980.

n.a. means not available.

--- means no Gari found in the market.

Source: Federal Office of Statistics (Op. cit.)

Table A3. Ibadan monthly retail prices for Palm-Oil (Kobo*/litre).

Year**	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1965	n.a.	n.a.	10.93	10.09	n.a.	n.a.	10.67	11.71	11.24	11.21	n.a.	11.20	11.01
1966	10.94	10.96	10.67	10.25	10.28	10.32	11.35	11.70	11.58	12.03	13.06	17.83	11.75
1967	28.99	24.20	15.70	14.13	16.12	12.74	14.27	20.43	17.73	19.90	17.66	17.48	18.28
1968	17.46	17.16	14.47	13.07	12.46	12.12	11.73	17.72	17.41	17.62	17.00	16.04	15.36
1969	13.82	12.35	12.11	13.12	14.04	13.65	14.44	17.26	17.26	17.00	16.65	16.38	14.84
1970	24.06	24.15	22.90	19.06	17.10	15.63	16.65	16.88	17.45	19.09	20.12	18.71	19.32
1971	17.14	16.40	15.10	14.72	15.18	15.32	17.74	18.89	18.71	18.38	18.33	18.22	17.01
1972	20.04	25.86	21.01	18.29	18.94	21.17	26.86	25.53	25.39	26.98	n.a.	30.21	23.66
1973	30.11	27.11	22.63	23.84	24.55	24.85	31.87	30.98	31.29	31.25	n.a.	34.73	28.47
1974	43.07	35.03	30.07	30.49	34.94	33.14	33.54	38.53	37.93	36.20	35.40	32.75	35.09
1975	33.29	32.00	33.08	34.63	37.29	37.86	36.51	37.33	43.12	51.26	70.31	92.80	44.96
1976	94.90	91.68	74.45	57.84	54.81	54.81	82.96	81.12	81.42	72.66	109.00	79.78	77.95
1977	75.10	65.48	60.22	61.67	65.55	84.73	89.25	94.49	94.47	103.00	144.00	135.00	89.41
1978	84.12	138.00	133.00	---	130.00	125.00	108.00	123.00	128.00	127.00	123.00	123.00	122.01

Table A3, continued.

*100 Kobo = ₦1 = $1.85 in 1980.

**1960-64 prices not available

n.a. means not available.

--- means no Palm-Oil found in the market.

Source: Federal Office of Statistics (Op cit.)

Table A4. Ibadan monthly retail prices for Brown Rice (Kobo*/kg).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1960	17.60	17.49	16.81	16.74	16.59	16.50	16.61	16.46	16.35	16.22	16.06	16.11	16.63
1961	16.70	16.50	16.39	16.33	17.49	17.51	16.72	17.86	18.63	18.59	19.33	19.55	17.63
1962	19.14	19.24	19.92	24.82	23.81	24.43	26.97	24.84	23.52	22.05	21.77	21.90	22.70
1963	19.11	19.42	19.31	18.68	18.63	19.05	19.11	18.79	18.17	18.45	18.28	17.34	18.74
1964	16.46	16.42	16.68	17.38	18.50	17.78	18.78	20.50	20.03	18.87	18.63	19.29	18.28
1965	18.50	18.41	18.54	18.52	19.51	19.18	18.54	18.41	17.78	17.82	17.78	17.84	18.40
1966	18.06	18.08	17.93	19.75	20.67	20.37	22.34	22.25	23.42	23.53	22.80	21.02	20.85
1967	22.05	22.43	21.85	21.36	22.26	21.83	22.01	22.74	21.32	20.37	19.13	19.06	21.37
1968	17.94	18.28	19.85	19.92	18.95	19.74	20.80	20.74	19.93	21.92	22.08	20.47	20.05
1969	20.37	20.06	20.25	20.32	22.29	17.99	23.79	22.81	22.80	22.40	22.09	21.99	21.43
1970	22.09	21.89	22.60	23.23	22.96	25.33	24.45	24.63	24.91	25.11	24.65	25.82	23.97
1971	32.34	33.77	33.38	31.97	33.60	31.03	28.43	26.45	23.45	21.39	n.a.	21.50	28.85
1972	28.81	29.24	24.83	28.67	36.55	36.22	37.01	38.97	36.79	36.00	35.03	33.12	33.44
1973	22.29	22.26	22.15	22.52	23.58	26.46	27.34	27.69	24.88	24.54	n.a.	26.44	24.56
1974	27.65	28.62	30.28	35.00	34.17	33.62	34.09	33.38	30.79	27.92	29.07	30.30	31.24

Table A4, continued.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1975	30.73	31.03	33.94	37.90	37.2	37.45	37.43	35.76	35.54	36.93	38.61	40.67	36.13
1976	42.60	44.82	44.82	46.60	47.68	52.44	52.28	52.29	54.75	58.05	59.92	58.67	51.24
1977	57.60	54.66	48.63	45.44	43.40	47.15	49.44	54.49	61.11	54.71	57.41	54.95	52.42
1978	52.32	50.75	51.88	---	59.52	60.61	72.99	71.24	65.39	63.75	62.86	62.60	61.26

*100 Kobo = ₦1 = $1.85 in 1980.

n.a. means not available.

--- means no Brown Rice found in the market.

Source: Federal Office of Statistics (Op. cit.).

Table A5. Ibadan monthly retail prices for Yams (Kobo*/kg).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1960	2.88	3.16	3.33	3.22	3.40	3.84	3.80	3.23	2.43	2.79	3.29	3.22	3.22
1961	2.96	3.38	3.69	3.69	3.89	4.12	3.95	3.80	3.29	3.34	3.71	3.64	3.62
1962	4.17	4.89	5.25	5.09	5.99	6.39	6.63	5.11	4.10	3.71	3.34	2.98	4.80
1963	4.41	4.08	4.32	4.52	5.46	4.70	2.99	2.09	1.87	2.31	2.33	3.40	3.54
1964	2.96	3.05	3.49	3.31	4.35	6.23	4.46	3.10	2.92	3.07	2.31	2.63	3.57
1965	3.38	3.44	3.47	4.21	6.87	7.90	5.81	3.07	2.24	2.54	2.57	2.87	4.03
1966	3.91	4.06	4.50	5.90	6.60	8.58	6.26	4.37	4.34	4.26	3.78	3.51	5.01
1967	4.57	4.79	5.04	4.96	5.91	7.15	5.33	3.53	2.22	2.45	2.39	2.80	4.26
1968	2.86	3.98	4.31	4.19	5.09	5.43	4.06	2.85	2.69	2.50	2.61	3.77	3.70
1969	3.83	3.97	4.37	4.85	5.47	6.07	6.00	3.79	3.60	3.59	3.90	4.30	4.48
1970	4.58	4.60	5.23	6.23	6.02	6.41	6.19	4.45	4.08	4.06	4.08	4.45	5.03
1971	6.29	6.47	6.98	7.88	10.07	14.32	11.05	6.60	5.85	5.45	4.81	6.88	7.72
1972	8.00	9.72	8.15	---	---	9.15	9.33	5.59	5.54	5.76	n.a.	6.89	7.57
1973	8.24	11.60	---	10.18	11.75	---	---	9.40	7.84	6.01	n.a.	6.41	8.93
1974	4.49	4.49	---	7.72	6.74	---	4.78	---	---	---	---	---	5.64

Table A5, continued.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
1975	---	---	---	---	---	---	---	10.42	---	---	8.10	18.13	12.22
1976	17.15	23.21	15.52	19.51	24.56	30.86	22.14	18.51	19.70	19.98	18.30	24.04	21.12
1977	23.75	---	28.86	---	---	---	---	---	39.00	22.40	23.85	39.53	29.57
1978	44.00	44.00	50.00	56.60	56.60	---	45.60	---	42.75	46.00	46.42	39.53	47.15

*100 Kobo = ₦1 = $1.85 in 1980.

n.a. means not available.

--- means no Yams found in the market.

Source: Federal Office of Statistics (Op. cit.).

Table A6. Price indices for Gari, Maize, Palm-Oil, Rice, Yams and Cocoa.

[1960(1959/60 = 100]

Year	Gari	Maize	Palm-Oil	Rice	Yams	Cocoa
1960	100	100	---	100	100	100
1961	124	134	--	106	112	70
1962	131	135	---	137	149	62
1963	92	107	---	113	110	66
1964	72	102	---	110	111	69
1965	97	108	100	111	125	75
1966	185	142	107	125	156	41
1967	127	108	166	129	132	56
1968	75	107	140	121	115	59
1969	91	158	135	129	139	62
1970	169	188	175	144	156	94
1971	278	232	155	201	240	97
1972	233	264	215	173	235	97
1973	176	181	259	148	277	97
1974	172	217	319	188	175	141
1975	284	278	408	217	380	206
1976	441	460	708	308	656	206
1977	565	598	812	315	918	206
1978	613	538	1108	368	1464	322

Source: Computed from the annual average price of the food crops and Cocoa Producers prices.

APPENDIX B

Table B1. Estimated number of farming households by age group, Western Nigeria.

Year	AGE 15-24	25-34	35-44	45-54	55 and up	TOTAL
1958/59						996,000
1972	5,092	108,471	219,271	323,327	253,617	909,778
1973	20,024	163,305	287,326	217,602	295,398	983,655
1974	18,857	171,707	266,735	275,891	260,125	993,315
1975	20,691	201,629	394,596	357,411	406,978	1,381,305

*Household defined as a group or a collection of persons living together under the same roof and eating from the same pot.

Source: 1958/59 estimate obtained from Statistical Abstract, Ministry of Economic development, Western State of Nigeria, June and December 1970.

1972-75 estimates obtained from Report of Agricultural Survey, Ministry of Economic Development, Western State of Nigeria, Annual issues.

Table B2. Estimated labor utilization (Mandays/ha) for Yams according to different authors and institutions.

Activity	Igwebuike	World Bank* (1977)	Veldkamp (1979)	Knipscheer (1980)	MANR (Existing Management)** (1972) a	b	c
Land Preparation	123	70	77	95	51	56	55
Planting	41	25	42	35	26	31	25
Fertilizer Application	--	5	--	15	--	--	--
Staking	59	20	88	50	32	37	34
Weeding	44	70	91	70	54	43	73
Harvesting	73	50	45	60	25	28	31
TOTAL	340	240	343	325	188	195	218

*Elsewhere referred to as WB

**Ministry of Agriculture and Natural Resources, Western State, Nigeria.

Sources: Knipscheer, H. C. (1980), Labor Utilization Data for Selected Tropical Food Crops (Maize, Cassava, Yam and Upland Rice).

MANR, 1972, Production, Production Requirements, Costs and Returns for Crops (a) Northern savannah zone, (b) Central cocoa belt and (c) Southern rainforest zone.

Table B3. Estimated labor utilization (Mandays/ha) for Cassava according to different authors and institutions.

Activity	Noyen (1949)	Parker (1973)	WB (1977)	Igwebuike	Veldkamp (1977)	Knipshceer (1980)	MANR* (1972) a	b	c
Land Preparation	18	45	11	76	77	40	51	64	49
Planting	12	12	7	27	13	13	11	11	33
Fertilizer Application	--	--	5	--	--	15	--	--	--
Weeding	12	67	20	25	149	45	51	72	32
Harvesting	40	--	105	17	147	70	25	25	39
TOTAL	82	124	148	145	386	183	138	172	153

*Ministry of Agriculture and Natural Resources, Western State, Nigeria.

Sources: Knipscheer, op. cit.

MANR, op cit.

Table B4. Estimated labor utilization (Mandays/ha) for Maize according to different authors and institutions.

Activity	CSM* (1978)	Ononiwo (1979)	Diehl (1979)	Idowu (1975)	WB (1977)	Parker (1973)	Knipscheer (1980)	MANR (1972) a	MANR (1972) b	MANR (1972) c
Land Preparation	16.4	41.7	12.0	22.5	15	27.8	24	46	55	38
Planting	7.1	16.3	35.0	2.5	5	13.4	10	6	8	6
Fertilizer Application	7.1	19.0	14.0	5.0	5	---	15	5	---	---
Weeding	15.7	40.9	21.0	35.0	30	22.2	25	35	42	47
Harvesting	17.5	12.6	---	20.0	20	10	16	26	28	23
Shelling	---	---	---	7.5	10	---	13.3	11	---	8
TOTAL	63.8	130.5	82.0	92.5	85	73.0	103.3	129	133	122

Other estimates: (1) Olayide/Olowude, 1972 (62.6); (2) Phillips, 1964 (100-125) and (3) Johnson, 1971 (155).

*CSM -- Cropping Scheme Meeting

Sources: Knipscheer, op. cit.
MANR, op. cit.

Table B5. Estimated labor utilization (Mandays/ha) for Upland, rainfed rice according to different authors and institutions.

Activity	Idowu (1975)	WB (1977)	Ononiwo (1979)	Fotzo* (1977)		Dadje (1977)	Veldkamp (1979)	Knipscheer (1980)	MANR (1972)		
				a	b				a	b	c
Clearing and Land Preparation	72.5	40	41.7	36.0	39	49.2	206	55	63	71	74
Sowing/ Planting	37.5	15.0	16.3	9.0	23	49.2	71	30	11	20	4
Fertilizer Application	---	5.0	19.0	2.5	---	2.7	0.9	5	---	---	---
Weeding	62.5	45.0	40.9	90.0	54.0	53.3	62.0	50	25	37	21
Bird Scaring	10	---	---	25.5	36.0	---	---	20	20	11	11
Fencing	---	---	---	8.5	2.0	---	---	---	---	---	---
Harvesting	37.5	20.0	12.6	38.0	36.0	107.7	36.0	35	24	33	27
Threshing and Winnowing	7.5	23.0	---	16.5	29.0	17.7	---	20	12	15	9
TOTAL	227.5	148.0	130.5	226.0	219.0	279.8	375.9	215	155	187	146

*a = with supervision of Extension Service; b = without supervision.

Sources: Knipscheer, op. cit.

MANR, op. cit.

Table B6. Estimate of labor utilization (Mandays/ha) for Cocoa.

Activity	Year												
	1	2	3	4	5	6	7	8	9	10	11	12——	25
Underbrushing (Stacking, etc.)	49	—	—	—	—	—	—	—	—	—	—	—	
Shade Adjustment	25	—	—	—	—	—	—	—	—	—	—	—	
Lining, peg cutting, pegging	10	—	—	—	—	—	—	—	—	—	—	—	
Holing for Cocoa	10	2.5	2.5	—	—	—	—	—	—	—	—	—	
Carrying cocoa seedlings	10	2.5	2.5	—	—	—	—	—	—	—	—	—	
(a) planting cocoa	12	2.5	2.5	—	—	—	—	—	—	—	—	—	
(b) planting intercrops	7.5	2.5	–	—	—	—	—	—	—	—	—	—	
Supplying cocoa (replacing dead stands)	—	2.5	2.5	—	—	—	—	—	—	—	—	—	
Shade Control	5	5	5	5	5	5.0	—	—	—	—	—	—	
Pruning	2.5	2.5	2.5	2.5	–	–	—	—	—	—	—	—	
Weeding	44.5	59	59	59	44.5	44.5	30	30	30	30	30	30——	25

Table B6, continued.

Activity	1	2	3	4	5	6	7	8	9	10	11	12 — 25
Fertilizer Application	15	15	15	15	10	10	10	10	10	10	10	10 — 25
Mulching	25	25	25	25	20	20	20	15	---	---	---	---
Capsid Control	10	10	10	10	10	12	12	12	12	12	12	12 — 25
Black Pod Control	---	---	---	12	12	12	12	12	12	12	12	12 — 25
Harvest and Pod Collection	---	---	---	7.5	7.5	7.5	15	15	15	22	22	22 — 25
Processing cocoa (depulping, drying, fermentation)	---	---	---	3.5	3.5	3.5	7.5	7.5	15	22	22	22 — 25
Harvesting (shade crops)	12	30	30	25	12	7.5	---	---	---	---	---	---
Transport												
(a) shade crops	5	10	10	5	2.5	---	---	---	---	---	---	---
(b) cocoa	---	---	---	1	1	2.5	2.5	5	5	5	5	5 — 25
TOTAL	242.5	169.0	166.5	158.5	128.0	124.5	109.0	106.5	99.0	113.0	113.0	113.0 — 25

Source: Ajobo, O., Cocoa Research Institute of Nigeria, Ibadan, Nigeria (personal communication).

Table B7. Ibadan consumer price index.

Year	Food and Drink	Non-Food	All Items
1960	100	100	100
1961	111	104	108
1962	121	112	117
1963	106	113	109
1964	104	113	108
1965	111	113	112
1966	133	115	125
1967	122	117	120
1968	114	119	116
1969	126	126	126
1970	148	134	142
1971	199	140	173
1972	201	140	174
1973[a]	207	146	180
1974	229	161	199
1975	317	215	272
1976	425	239	343
1977	497	261	393
1978[b]	615	299	476

[a]10 months only.

[b]9 months only.

Source: Computed from Federal Office of Statistics' data (*op. cit*.).

Table B8. Unskilled wage rates, Western Nigeria.

Year	N/Manday	Index
1960	n.a.	100
1961	n.a.	100
1962	n.a.	100
1963	0.475	100
1964	0.475	100
1965	n.a.	105
1966	n.a.	105
1967	n.a.	105
1968	n.a.	105
1969	n.a.	105
1970	n.a.	105
1971	n.a.	105
1972	0.50	105
1973	0.65	137
1974	0.78	164
1975	1.05	221
1976	n.a.	n.a.
1977	n.a.	n.a.
1978	3.00	632
1979	4.00	842

n.a. -- not available.

Sources: 1963 and 1964 data are taken from Anschel, K. R., 1965, Problems and prospects of the Nigerian rubber industry, The Nigerian Journal of Economic and Social Studies, vol. 9, No. 2.

1972-1975 data from Oni, S. A., and F. Ademehin, n.d., Inflation and Farm Prices: The Nigerian Experience, Mimeograph, Department of Agricultural Economics, University of Ibadan, Nigeria.

1978 and 1979 data based on personal communications with many Nigerian agricultural economists.

Table B9. Hectarage and production in Western Nigeria (1960 = 1959/60).

Year	Cassava		Maize		Rice		Yams	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
1958/59	102	1,023	253	193	n.a.	n.a.	143	1,346
1959/60	n.a.	958	n.a.	290	n.a.	n.a.	n.a.	2,423
1960/61	n.a.	1,089	n.a.	398	n.a.	n.a.	n.a.	4,643
1961/62	n.a.	1,262	n.a.	467	n.a.	n.a.	n.a.	2,753
1962/63	n.a.	1,490	n.a.	344	n.a.	n.a.	n.a.	2,820
1963/64	n.a.	1,542	n.a.	559	n.a.	n.a.	n.a.	4,349
1964/65	n.a.	1,324	n.a.	621	n.a.	n.a.	n.a.	4,817
1965/66	n.a.	1,450	n.a.	596	n.a.	n.a.	na.a	4,933
1966/67	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1967/68	180	1,971	598	542	26	60	265	3,073
1968/69	259	2,373	537	398	96	149	285	2,599
1969/70	190	2,169	528	673	37	55	285	2,806
1970/71	107	1,714	456	414	69	62	256	2,610
1971/72	137	329	194	1,087	42	50	108	744
1972/73	117	437	221	974	60	86	106	655
1973/74	119	477	325	714	61	103	233	935
1974/75	102	987	240	515	58	187	138	1,975
1975/76	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1976/77	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977/78	58	535	138	291	9	26	51	1,026

(1) Hectarage in thousands.

(2) Production in million kilograms.

n.a. -- not available.

Sources: 1958/59 estimates from Statistical Abstracts, Western State of Nigeria, June and December 1971. 1967/68 - 1970/71 estimates from Statistical Abstracts, op. cit., June and December 1972.

Table B9, continued.

Sources: 1971/72 and 1972/73 estimates from the Report of Agricultural Survey in the Western State of Nigeria, 1973.

1973/74 and 1974/75 estimates from the Report of Agricultural Survey in the Western State of Nigeria, 1975.

1977/78 estimates from the Federal Office of Statistics publication.

1959/60 - 1965/66, Godwin E. Okurume, Foreign Trade and Subsistence Sector in Nigeria: The Impact of Agricultural Exports in Domestic Food Supplies in a Peasant Economy, (New York: Praeger Publishers).

Table B10. Value of food production, Western Nigeria (million ₦ in 1960 Naira) [1960(1959/60) = 100]

Year	Cassava	Maize	Rice	Yams	Total[1]	Index
1960	52.88	16.44	n.a.	78.02	147.34	100
1961	60.11	22.57	n.a.	149.50	232.18	158
1962	69.66	26.48	n.a.	88.65	184.79	125
1963	82.25	19.51	n.a.	90.80	192.56	131
1964	85.12	31.70	n.a.	140.04	256.86	174
1965	73.09	35.21	n.a.	155.11	263.41	179
1966	80.04	33.79	n.a.	158.84	272.67	185
1967	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1968	108.80	30.73	9.98	98.95	238.48	162
1969	130.99	22.57	24.78	83.69	237.25	161
1970	119.73	38.16	9.15	90.35	248.24	168
1971	94.61	23.47	10.31	84.04	202.12	137
1972	18.16	61.63	8.32	23.96	103.75	70
1973	24.12	55.23	14.30	21.09	100.44	68
1974	26.33	40.48	17.13	30.11	96.92	66
1975	54.48	29.20	31.10	63.50	147.28	100
1976	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1978	29.53	16.50	4.32	33.04	79.07	54

[1]Excludes rice.

n.a. -- not available.

Source: Computed from the production estimates. Prices used are the 1960 12-month average of Ibadan monthly retail prices for the food crops and the 1960 producer price for cocoa.

Table B11. Cocoa production and producer prices, Western Nigeria.

Year	Production[a] (million kg)	Producer Price[b] (₦/metric ton)
1960	148	314.95
1961	185	220.46
1962	190	196.84
1963	174	206.68
1964	213	216.52
1965	289	236.21
1966	177	127.95
1967	250	177.16
1968	229	187.00
1969	180	196.84
1970	206	295.26
1971	285	305.10
1972	236	305.10
1973	219	305.10
1974	191	442.89
1975	195	649.57
1976	198	649.57
1977	151	649.57
1978	n.a.	1,013.73

n.a. -- not available

Sources: (a) cocoa purchases from Western States used as proxy for cocoa production

1960-66 data obtained from Godwin E. Okurume, "Foreign Trade and Subsistence Sector in Nigeria. Op. cit.

Table B11, continued.

1967-75 estimates from Cocoa Marketing Board, "Statistical Information on Western Nigeria Controlled Produce" (Ibadan, April 1976).

1976-77 estimates from personal discussion with the officer in charge of Statistics, Nigeria Cocoa Board.

(b) Cocoa Marketing Board, <u>op</u>. <u>cit</u>.

Table B12. Average revenue from the crops (₦/ha).

Year	Cassava	Maize	Rice	Yams	Cocoa
1960	552.0	56.7	158.0	257.6	94.5
1961	684.0	75.9	167.5	289.6	66.1
1962	723.0	76.4	215.7	384.0	59.1
1963	506.0	60.6	178.0	283.2	62.0
1964	396.0	57.9	173.7	285.6	65.0
1965	532.0	61.1	174.8	322.4	70.9
1966	1022.0	80.6	198.1	400.8	38.4
1967	702.0	61.2	203.0	340.8	53.2
1968	412.0	60.4	190.5	296.0	56.1
1969	502.0	89.6	203.6	358.4	59.1
1970	934.0	107.0	227.7	402.4	88.6
1971	1534.0	131.0	274.1	617.6	91.5
1972	1288.0	149.9	317.7	605.6	91.5
1973	969.0	102.9	233.3	714.4	91.5
1974	950.0	123.2	296.8	451.2	132.9
1975	1569.0	158.5	343.2	977.6	194.9
1976	2436.0	260.8	486.8	1689.6	194.9
1977	3121.0	339.3	498.0	2365.6	194.9
1978	3382.0	305.3	582.0	3772.0	304.1

Average Revenue = average yield X average annual price.

Based on average yields of 10 mt/ha for cassava, 1 mt/ha for maize, 950 kgs/ha for rice, 8 mt/ha for yams and 300 kgs of dry cocoa beans/ha for cocoa.

Table B13. Labor cost (₦/ha).

Year	Cassava	Maize	Rice	Yams	Cocoa
1960	n.a.	n.a.	n.a.	n.a.	n.a.
1961	n.a.	n.a.	n.a.	n.a.	n.a.
1962	n.a.	n.a.	n.a.	n.a.	n.a.
1963	86.9	49.1	102.1	154.4	53.7
1964	86.9	49.1	102.1	154.4	53.7
1965	n.a.	n.a.	n.a.	n.a.	n.a.
1966	n.a.	n.a.	n.a.	n.a.	n.a.
1967	n.a.	n.a.	n.a.	n.a.	n.a.
1968	n.a.	n.a.	n.a.	n.a.	n.a.
1969	n.a.	n.a.	n.a.	n.a.	n.a.
1970	n.a.	n.a.	n.a.	n.a.	n.a.
1971	n.a.	n.a.	n.a.	n.a.	n.a.
1972	91.5	51.7	107.5	162.5	56.5
1973	119.0	67.1	139.8	211.3	73.5
1974	142.7	80.6	167.7	253.5	88.1
1975	192.2	108.5	225.8	341.3	118.7
1976	n.a.	n.a.	n.a.	n.a.	n.a.
1977	n.a.	n.a.	n.a.	n.a.	n.a.
1978	549.0	309.9	645.0	975.0	339.0

n.a. -- wage rate not available.

Labor cost = labor use per hectare X wage rate.

Labor use per hectare based on Knipscheer's estimates of 183 mandays for cassava, 103.3 mandays for maize, 215 mandays for rice and 325 mandays for yams.

Source: Labor use per hectare for cocoa based on Cocoa Research Institute estimate of 113 mandays of variable labor input required from year 10 to 25.

Table B14. Profit/loss per hectare (₦).

Year	Cassava	Maize	Rice	Yams	Cocoa
1960	n.a.	n.a.	n.a.	n.a.	n.a.
1961	n.a.	n.a.	n.a.	n.a.	n.a.
1962	n.a.	n.a.	n.a.	n.a.	n.a.
1963	419.1	11.5	75.9	128.8	8.3
1964	309.1	8.8	71.6	131.2	11.3
1965	n.a.	n.a.	n.a.	n.a.	n.a.
1966	n.a.	n.a.	n.a.	n.a.	n.a.
1967	n.a.	n.a.	n.a.	n.a.	n.a.
1968	n.a.	n.a.	n.a.	n.a.	n.a.
1969	n.a.	n.a.	n.a.	n.a.	n.a.
1970	n.a.	n.a.	n.a.	n.a.	n.a.
1971	n.a.	n.a.	n.a.	n.a.	n.a.
1972	1,196.5	98.2	210.2	443.1	35.0
1973	850.0	35.8	93.5	503.1	18.0
1974	807.3	42.6	129.1	197.7	44.8
1975	1,376.8	50.0	117.4	636.3	76.2
1976	n.a.	n.a.	n.a.	n.a.	n.a.
1977	n.a.	n.a.	n.a.	n.a.	n.a.
1978	2,833.0	-4.6	-63.0	2,797.0	-34.9

n.a. -- means not available.

REFERENCES

Ajobo O., 1979, The importance of CRIN's scheduled crops and the impact of research on them, Mimeograph, Cocoa Research Institute of Nigeria, Ibadan, Nigeria.

Behrman J. R., 1968, The relevance of traditional economic theory for understanding peasant behavior, paper presented at the econometric society meetings, Washington, D.C.

Bressler R. G. and R. A. King, 1970, Markets, Prices, and Interregional Trade, (New York:John Wiley and Sons, Inc.)

Coursey D. G., 1967, Yams: An Account of the Nature, Origins, Cultivation and Utilization of the Useful Members of the Dioscoreaceae, (London: Longmans).

Dean E., 1966, The Supply Response of African Farmers: Theory and Measurement in Malawi, (Amsterdam: North Holland Publishing).

Food and Agriculture Organization of the United Nations, Production Yearbook, 1960, 1976 and 1978.

Food and Agriculture Organization of the United Nations, Trade Yearbook, Various Issues.

FDA, n.d., Agricultural Development in Nigeria, Federal Department of Agriculture, Lagos, Nigeria.

FDA, 1978, Annual Report: 1977, Federal Department of Agriculture, Lagos, Nigeria.

Gilbert E. H., 1969, The Marketing of Staple Foods in Northern Nigeria, Ph.D. diss., Stanford University.

Jones R. W., 1965, The Structure of Simple General Equilibrium Models, Journal of Political Economy, 73:557-572.

Jones W. O., 1972, Marketing Staple Food Crops in Tropical Africa, (Ithaca: Cornell University Press).

Knipscheer H. C., 1980, Labor Utilization Data for Selected Tropical Food Crops (maize, cassava, yam and upland rice), Agricultural Economics Information Bulletin No. 6, IITA, Ibadan, Nigeria.

Miracle M. P., 1966, Maize in Tropical Africa, (Madison: University of Wisconsin Press).

Nigeria Cocoa Board, Statistics Division, Ibadan, Nigeria, personal communications, July 1980.

Olayemi J. K., 1974, Cost and Returns of Cocoa and Alternative Crops in Western Nigeria, Economics of Cocoa Production and Marketing, eds. R. A. Kotey, C. Okali, and B. E. Rourke, (Legon: Institute of Statistical, Social and Economic Research, University of Ghana).

Olayide S. O., 1973, Agricultural Productivity and Increased Food Production under Economic Development in Nigeria, Rural Development in Nigeria, Proceedings of the 1972 Annual Conference of the Nigerian Economic Society, Ibadan, University of Ibadan, pp. 45-76.

Oni S. A., 1971, An Econometric Analysis of the Provincial and Aggregate Supply Responses among Western Nigeria Cocoa Farmers, Ph.D. diss., University of Ibadan, Nigeria.

Oni S. A., and A. E. Ikpi, 1979, Rice Production and Marketing in Nigeria: An Economic Appraisal, Rural Development Series, West African Rice Development Association, Monrovia, Liberia.

Peck A. E., and H. S. Baumes Jr., 1975, Seasonal Price Behavior for Indiana Farm Commodities, Station Bulletin No. 90, Department of Agricultural Economics, Agricultural Experiment Station, Purdue University, West Lafayette, Indiana.

Samuelson P. A., 1966, Intertemporal Price Equilibrium: A Prologue to the Theory of the Speculation, Reprinted in The Collected Scientific Papers of Paul Sameulson, (Cambridge: The MIT Press), pp. 946-984.

Schultz T. W., 1966, Transforming Traditional Agriculture, (New Haven, Conn: Yale University Press).

Thodey R. A., 1968, Marketing of Staple Food in Western Nigeria, 3 vols., draft of rept. Stanford Research Institute, Menlo Park, California.

U. S. Department of Agriculture, Consumption and Utilization of Agricultural Products, Major Statistical Series of the U. S. Department of Agriculture, vol. 5.

World Bank, 1979, Supporting Papers I-V, Volume II, Nigeria Agricultural Sector Review.

Yamane T., 1967, Statistics: An Introductory Analysis, (New York: Harper and Row Publishers).