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AN ECONOMIC ANALYSIS OF FOOD POLICY  
IN THE IVORY COAST

by

Yao Prao Felix

A thesis submitted in partial fulfillment  
of the requirements for the degree

of

MASTER OF SCIENCE

in

Agricultural Economics

Approved:



UTAH STATE UNIVERSITY  
Logan, Utah

1984

## ACKNOWLEDGMENTS

From the bottom of my heart, I would like to express my sincere appreciation to Dr. Herbert Fullerton for his supervision and encouragement at times when I was about to give up, to Dr. Allen Lebaron for his advices throughout my academic years at USU, to Dr. Alison Thorne for her openness and vital literature she provided and to Dr. Basudeb Biswas for his counsel and wisdom.

Appreciation is also extended to my best friend in in the USA, Willie Johnson, who cheered me up many times on the phone and through her letters and to my friend Faa Kuen for his precious help in editing my work.

YAO PRAO FELIX

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## LIST OF ACRONYMS

- BNDA : Banque Nationale pour le Developpement Agricole  
(National Agricultural Development Bank)
- CFA : Communauté Financière Africaine  
(common currency unit for 11 African countries)
- FAO : Food and Agriculture Organization of the United Nations
- IRAT : Institut de Recherches Agronomiques Tropicales et des cultures  
Vivrières (Institute for Research in Tropical Agriculture and  
Food crops)
- OCPA : Office de Commercialization des Produits Agricoles.
- SODE : Société de Développement (Development Company)
- SODEFEL : Société de Développement des Fruits et Légumes  
(Fruit and Vegetable Development Company)
- SODEPRA : Société pour le Développement des Productions Animales  
(Livestock Production Development Company)
- SODERIZ : Société pour le Développement de la Riziculture  
(Rice Development Company)
- SODESUCRE : Société pour le Développement des Plantations de Cannes à  
Sucre, l'Industrialization et la Commercialization du Sucre  
(Sugar Development Company)
- USDA : U.S. Department of Agriculture.

## ABSTRACT

An Economic Analysis of Food Policy  
in the Ivory Coast

by

Yao Prao Felix, Master of Science  
Utah State University, 1984

Major Professor: Dr. Herbert Fullerton  
Department: Agricultural Economics

Ivory Coast covers an area of 124,000 square miles with reasonable rainfall for food crops production. But besides what has been called the economic "miracle," the country relies on increasing food imports (rice, wheat, meat, and milk products). At the same time, the country's earnings from the major export commodities are shrinking. So the primary objective was to identify the main causes and circumstances that have resulted in reductions in food production. The major hypothesis was that the present situation is simply the result of policies that have favored cash crops relative to food products. A formal treatment and an analysis of the institutional and structural setting were made.

The results of the formal treatment showed relatively high trend growth rate in cash crops compared to food products. Some food crops experienced high trend growth rate but exhibited a very erratic pattern in their production. And this seems to support the hypothesis made.

A Ministry of Rural Development has been created in November, 1983, and increasing food production is one of its main objectives. However, profound and appropriate studies prior to any move towards total

reliance on domestic food production are crucial for the country's resources allocation.

(50 pages)

## INTRODUCTION

### Problem

Ivory Coast is a relatively small western African country covering an area of 124,000 square miles. According to a 1980 Food and Agriculture Organization (FAO) estimate, over four-fifths of that area was considered as arable land. Fertile land for food production is available in spite of recent high rate of population growth (5.5 per cent per annum between 1970-79). The country's rainfall has been satisfactory for crop production; and even though the South receives more rain than the North, no part of the country has been classified as belonging to the sahel zone. And from a relatively poor country at independence in 1960, the Ivory Coast has achieved an average real growth rate of 7.3 per cent in gross domestic product for the 1960-1979 period (12, p 25). The process of economic development is characterized by an export-led growth based particularly on the production of two major crops grown by the hundreds of thousands of small-holders: cocoa and coffee. But besides what some experts have called an economic "miracle" in the Ivory Coast, the country has placed increasing reliance on foodstuff imports (particularly rice, wheat, meat and milk products) which remain an exception to the success story. There has been a decreasing trend in proportion of food supplied from subsistence farming. From 1965 to 1975 for instance, the production share of subsistence farming in total output declined from 45 to 32 per cent in the forest zone and from 64 to 46 per cent in the savannah zone (8, p 12). The situation has led to the creation of the Ministry of Rural Development in November 1983 with

increasing food production as its main objective. However, further research of this policy decision should be useful to determine the extent that it is supported with economic studies from the development literature and from other empirical applications using data and price conditions present in West Africa and the Ivory Coast.

### Reasons for concern

The average annual growth rate of food production was 4.6 per cent between base-year 1969-71 and 1977-79 while the average annual growth of population in percentage was 3.7 for 1960-70 and 5.5 for 1970-79 respectively. And this situation resulted in an average growth of total food production per capita for 1969-71 to 1977-79 of  $-0.9^{2/}$  (20, p 167). As shown in Table 1, food imports represent a relatively high percentage of total imports in the Ivory Coast. Given the foreign exchange requirement for massive industrialization and oil imports, it is surprising to find that the food percentage in total imports has remained relatively so high.

Table 1. Percentage of food imports in total imports (1960-1979)

Year	Percentage	Year	Percentage
1960	20.0	1970	17.0
1961	18.8	1971	17.0
1962	18.3	1972	17.5
1963	15.6	1973	20.9
1964	15.4	1974	16.5
1965	16.1	1975	16.4
1966	17.8	1976	12.5
1967	13.0	1977	13.3
1968	14.8	1978	13.3
1969	14.5	1979	14.3



Also a breakdown of intended imports by major sector from the 1976-80 National plan (11, p 609) is presented in Table 2 below.

Table 2. Intended import proportions 1975, 1980, 1985 (10).

	1975	1980	1985
Primary Prod. (Food only)	8	7	6
Processed Goods	81	83	84
Services	11	10	10
Total Imports	100	100	100

Source: Ministry of Planning (11)

Increasing public external debt ratio can make it difficult for the country to buy food (see table of debt service ratio shown below). And a look at Table 2 reveals that the 1976-80 five-year plan projected a twenty-five per cent decline in imports of primary products (food products) as a proportion to total imports between 1975 and 1985. Given a relatively high income elasticity of wheat and rice (also a high rate of population growth), products which constitute a large amount in total food imports, this projected decline seems unlikely to happen. The problem is further complicated by the fact that wheat cannot be grown economically within the Ivory Coast and cash crops have strong comparative advantage and will therefore provide strong competition for resources. So the above conditions could be expected to contribute to an increasing public external debt, given a continuation of recent economic trends. Table 3 presents data which demonstrate these very

Table 3. Service payments on external public debt as a percentage of exports of goods and services between 1965 and 1983

Year	Percentage	Year	Percentage
1965	4.3	1975	8.8
1966	4.8	1976	8.8
1967	6.5	1977	10.1
1968	5.7	1978	12.8
1969	5.3	1979	18.3
1970	6.7	1980	25.0
1971	7.1	1981	29.0
1972	8.1	1982	na.
1973	7.2	1983	40.0
1974	7.9		

Source: World Bank Reports (20)

significant increases. Given these trends, it seems appropriate to focus research attention on comparative advantage and the potential for expanding food crop production in the Ivory Coast.

### Objectives

The primary objective for the present work will be to identify causes and circumstances that have led to reductions in food production for a country which is predominantly agricultural (more than 75 per cent of the labor is in agriculture and a majority of earnings come from agricultural products). Put another way, the objective is to determine what constraints have limited expansion of food production in the Ivory Coast.

### Specific research objectives

1. To establish trends in the production of the food (rice, maize, cassava) and cash crops (cocoa, coffee).

2. To determine significant changes in the output, usage of selected inputs and possible interrelationships between food and cash crops.

3. To conduct tests of relationships which may have had significance for food and cash interventions by the Government.

As presented, the first two specific objectives will serve as a basis for the third objective. A linear regression model will be used for the formal analysis. However only selected food crops will be examined in the formal models because of data availability and because some food crops are of greater importance in the diet.

#### Sources of data

Several international publications were relied upon to give a general but objective picture of prevailing food levels in the Ivory Coast. Data on food and cash crop productions and area of main food crops came from the International Historical Statistics: Africa and Asia (2). Data such as area of cash crops, producer prices of cash and food crops, the "rural consumer price index" were from the World Bank report on the Ivory Coast (1).

Complementary data have been drawn from The Europa Yearbook for the recent production figures on food and cash crops (14). Data on service payments on external public debt as a percentage of export of goods and services were from different issues of the World Bank Annual Report (20); percentages of food imports were taken from different publications of the Yearbook of International Trade Statistics (17).

#### Review of literature

Major areas of literature search focused on literature dealing with,  
1) food problems in Africa in general and in the Ivory Coast in

particular, 2) theoretical considerations of an overevaluation of the exchange rate on the agricultural sector and especially on the food production sector, 3) the law of comparative advantage, 4) the case of widespread import-substitution strategy in developing countries will be reviewed; 5) the section concludes by summarizing implications of the literature for the present research.

Food problems in Africa in general and in the Ivory Coast. Sub-Saharan Africa was the single part of the World where food production and consumption declined for the period 1960-1975 according to Pearson, Stryker and Humphreys (12, preface). Many other studies have predicted a sheer continuation or worsening of the situation. Food problems in Sub-Saharan countries have been studied extensively by the Food and Agriculture Organization. An interesting action program for agriculture in general and for food production in particular was written in 1978 for African countries by the FAO: it was the Regional Food Plan for Africa (20, p 49). This study resulted in the special meeting of African Chiefs of State held in Lagos (Nigeria) in April 1980 and gave birth to what is known as "The Lagos Plan of Action". From there, these Chiefs of State were to look for means to substantially increase food production and so move towards self-sufficiency in food (21, p 5). Concerning a particular staple food, rice, the West African Rice Development Association aimed also at achieving self-sufficiency in rice production at its annual meeting in 1975 (12, p 2). Very recently, in his attempt to evaluate changes in food crop sector in the Ivory Coast, Eddy Lee (5) provided the following information. Area cultivated of food crops (rice, cassava, yams, sorghum, maize, millet and groundnuts) increased only by 1.92 times between 1950 and 1977 while over almost the

same period, 1950-1975, rural population increased by 2.25 times, thus showing a less than proportional expansion of food production area. Expressed in terms of growth rates, cultivated food crops area increased by 2.56 per cent per annum while rural population increased by 3.45 per cent every year (5, p 105). The same study estimated growth trends for total physical production and yields per hectare for the food crops cited above. Apart from rice and maize, this study revealed that growth in food crops has been significantly lower than that for export crops and rural population. Lee's conclusion relating to food crops was that, except for rice and maize, production and yield of staple food were, on the whole, stagnant while export crops experienced strong growth in production.

Exchange rate and the agricultural and food production sectors. If the agricultural sector is considered as a whole and it can be assumed that the sector has an export potential, and that consideration is limited to a "small country" in the sense that production from that country is not a significant part of world production given that production changes will not have significant impact on world market prices, then domestic price is determined by foreign market and long-run conditions of supply in other countries. Further, if it is assumed that the exchange rate was at equilibrium in the first place, then domestic supply and demand functions, and an international demand for the products coming from that agricultural sector, can be specified and the sector is strictly a "price-taker" in the world market. These conditions are further demonstrated below in Figure 1.

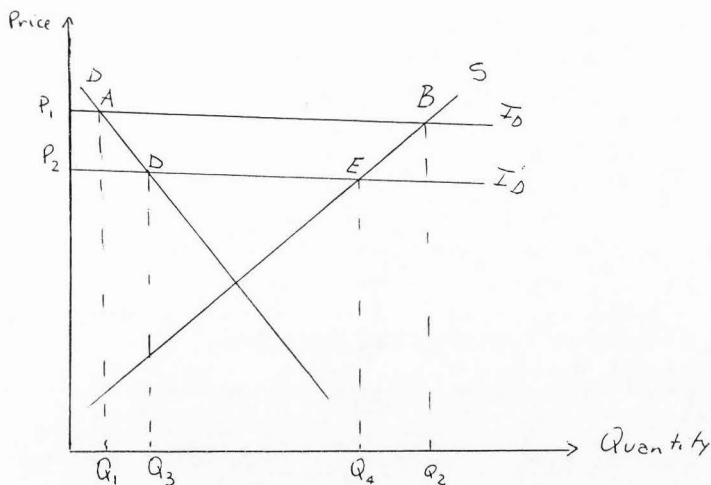


Figure 1. Illustration of an agricultural sector producing for both domestic and foreign markets.

Since the agricultural sector is a "price-taker", the price is determined by  $I_D$  the international demand. The market equilibrium price is  $P_1$ . At  $P_1$ , quantities produced and consumed in the domestic market are respectively  $Q_2$  and  $Q_1$  leaving  $Q_1Q_2$  for export purpose at price  $P_1$ . The total export earnings are represented by  $Q_1ABQ_2$ .

Now, if for one reason or another, the exchange rate of the "small country" is overevaluated, the export price is increased and this has the effect of decreasing the quantity demanded by the world market. So the  $I_D$  curve shifts downward to  $I_D'$  with market equilibrium price of  $P_2$ . At

$P_2$ , the domestic demand becomes  $Q_3$  while supply decreases to  $Q_4$ . Export volume is now just reduced to  $Q_3Q_4$  with substantial reduction of export earnings. The amount of reduction is measured in Figure 1 as the difference between  $Q_1ABQ_2$  and  $Q_3DEQ_4$ ; the magnitude of this reduction in export earnings and in the gross income of the sector considered will hinge upon the different price elasticities, between the two price levels and the amount and the persistence of the currency overvaluation. This problem is one of several effects which can have a tremendous negative impact on production incentives. This model appears to be most applicable to cash crops production in the Ivorn Coast since mid-seventies.

The law of comparative advantage. David Ricardo's law of comparative advantage states that a country should export the product in which it has the greater advantage or comparative advantage, and import the commodity in which it has a comparative disadvantage. The theory compares the relative prices of commodities under autarky (absence of trade) in a two-country commodity model. Such a model is shown in Figure 2. Consider the situation where  $P^A$  and  $P^B$  represent the equilibrium relative prices of commodity 1 (in terms of commodity 2) in countries A and B in the absence of trade. Assuming perfect competition and no impediment to trade and  $P^A$  is less than  $P^B$ , then

-country A will export commodity 1 and import commodity 2.

- $P^A < P^* < P^B$  where  $P^*$  is the equilibrium world term of trade.

Coming back to the present case, cash crops and foodstuffs may represent commodities 1 and 2, and country A (Ivory Coast) and country B (the rest of the world). Studies carried out by the World Bank in the mid-seventies have indicated that Ivory Coast had comparative advantage

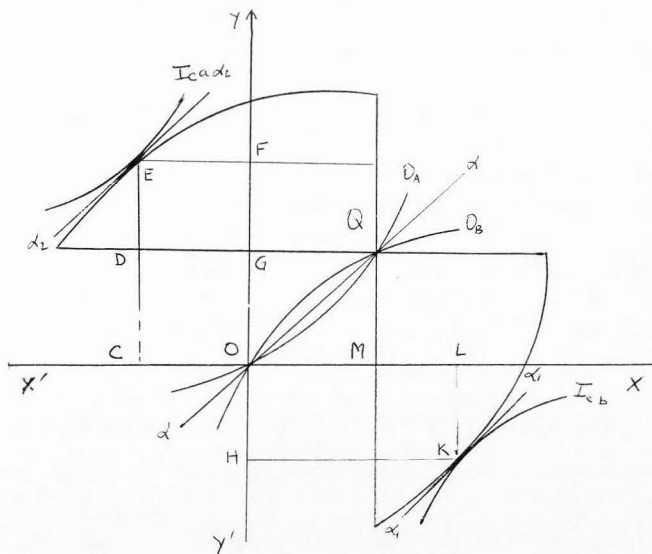


Figure 2. Illustration of a free-trade equilibrium between countries A and B in the absence of any surplus or deficit in the balance of trade.

in the production of coffee, cocoa, oil palm products, pineapple and others at that time. And using the domestic resources cost (DCR) criterion, cocoa and coffee had DCRs between 0.70 and 0.80 (1, p 37). Rice for example scored around 1.05 using simple techniques but this figure dropped to 0.80 when rice is grown (or associated) in rotation with cotton. So comparative advantage was high for cocoa and coffee in the seventies. But because of deep declines in coffee and cocoa market prices since 1977, the Ivory Coast terms of trade have deteriorated by about 40 per cent between 1977 and 1982 (20, "1982" p 68). And Ivory Coast authorities have stated that under current conditions, production and transportation costs are not covered. If this contention is proven



true and the decline in world market reflects long-term tendencies, then the comparative advantage of the country in cash crops would have disappeared. What is of great importance for food crop policy is to know which crop have comparative advantage now and in the foreseeable future.

Import-substitution in the use of foodstuff products. A number of developing countries faced with declining world markets for their exported primary products and balance of payment problems, have opted for an industrial development strategy of "import substitution". These countries are then "looking inward" by trying to replace some imported goods by domestic production. But still, importation of some raw materials and semi-finished products for the country's new industries is quite substantial. The arguments favoring such a policy state that:

- some newly established industrial activities experience initial high costs relative to multinational corporations and so these new industrial activities are not competitive,

- any entrepreneur will not invest at free trade prices because it does not pay him (or her) in so doing,

- the industrial activities will become more efficient with access to scale economies (cost reduction) through time; the scale economies will be sufficient to allow rates of return large enough to pay for initial losses,

- therefore, a "temporary" period of protection is necessary for that time span in which costs are supposed to fall so that assistance won't be needed.

In the Ivory Coast, for the same reasons referred to above, food industries have been developed and expanded since independence. And for

achieving that objective, foreign investment was encouraged by a very liberal investment code and a general policy to gain the confidence of investors. Thus there has been a very sharp growth in the agricultural foodstuff industry in general in the seventies (a real growth of 27.12 per cent per annum between 1970 and 1975). But even though the food industry does not import its raw materials, the exemption from duty on machinery and equipment (privilege of the investment code to selected firms) gives a bias in favor of capital-intensive techniques in an environment where there is no shortage of labor. Also, behind the walls of protection, the firms are not encouraged to decrease production costs. Another problem is that the internal effective market is not large enough and limits the ability of these firms to expand as they should. Another interesting import-substitution problem is to develop the efficiency or cost reduction conditions envisioned for the long run.

#### Implications for this research

Several implications can be drawn from this selection of literature which are instructive for analyses of the food production policies of the Ivory Coast. In November 1983 the Ivory Coast has created a Ministry of Rural Development for food and related matters. There exists in the country a relatively high growth rate of per capita income which can be expected to increase the demand for food. A line of reasoning can be constructed that the presence of the Ministry of Rural Development is to meet the increasing growth in demand due to population and income growth. And to increase food production, proper incentives are to be given to producers (price incentives). But an overvalued exchange rate makes food imports relatively cheap and so tends to

positively affect food imports which are then given an implicit subsidy (21, p 56). The concept of comparative advantage may become especially important as it may now be changing as between food and traditional cash crops and therefore affect their ability to compete for resources. To evaluate this situation and to provide the basis for policy formulation requires a careful study in the process of selecting food crops, to determine the extent, if any, they may be developed and expanded for moving towards food self-sufficiency.

## DEVELOPMENT OF MODEL USED AND PROCEDURE

Hypothesis

The basic hypothesis is that given the availability of fertile land not all currently used in managed agriculture, and taking into account the fact that farmers do react to price signals, the slow growth of food production experienced (compared at least to cash crops) is just the combined result of inadequate policies and a built-in bias in the Administration against food crops. Food prices have been pegged down in order to appease the small but vocal and growing urban population. Also considering that special attention has been paid to commercial crops, it is to be expected that farmers will produce very little food or just enough for their own needs. And since food production stems mainly from the subsistence sector (traditional) and a very small number of medium-scale farms, there can then be no doubt of food shortages without resorting to greater quantities of imports. A further contributing factor is the adoption of a European lifestyle, including a taste for food grown only in the temperate climate in the cities. The latter problem will be further described and examined by qualitative analysis.

Procedure for formal analysis

The primary tool employed to conduct the formal analysis will be a linear regression model. Considering a general three variable case, we can write:

$$Y = f(X_1, X_2) \text{ with}$$

Y: dependent (or explained) variable.

$X_1, X_2$  are called independent (or explanatory) variables

The specific model for explaining trends in the case at hand will be:

$$\ln Z_i = a + bT_i + u_i \quad \text{where}$$

$T = \text{time}$

$a, b$  are respectively intercept term and regression coefficient, and will be estimated by  $a$  and  $b$ . So  $b$  will represent the trend growth rate of either production or yields.

$u_i$  is the "stochastic disturbance" term which picks up the effect of all the independent variables not included in the single equation above.

$i$  is a subscript referring to the  $i^{\text{th}}$  observation.

The equation above provides a tool for examining trends since  $d\ln Z_i/dt = dZ_i/Z_i/dt$  which is the trend growth rate of the dependent variable  $Z_i$ . A t-test is used to test the null hypothesis that  $(b=0)$ . And this t-test reveals whether or not the regression coefficient  $(b)$  is statistically significant (different from zero) at the chosen level of significance.

Appendix Tables 9, 10 and 11 contain data used in the statistical analysis for food and cash crop total production, land area in main arable food crops and land area in cocoa and coffee, respectively.

### Structural and institutional setting

An important first step in analyzing food policy is to identify the major factors that have affected growth of food supplying the Ivory Coast for the period considered in this study, including a careful analysis of the institutional and structural setting. A general overview will be given of actions undertaken by the Ivorian government to

reverse trends in food production and to create conditions which would provide incentives for some farmers and young people to support this policy.

## ANALYSIS AND RESULTS

### Institutional and structural setting

The factors influencing demand, population, income, urbanization, tastes and preferences, are the main demand determinants under consideration.

Population. Judged by international standards, Ivory Coast population has increased very rapidly in the past two decades. The crude birthrate per thousand population in 1979 was 47 while the corresponding death rate for the same year was 18. And these relatively high rates reflect recent decreases in both birth and death rates, the latter experiencing a deep decline in the last two decades. Immigration has been impressive over the last two decades and has played an important role in the acceleration of the population growth. The average annual population growth rates of 3.7 and 5.5 per cent respectively for 1960-70 and 1970-79 are quite eloquent.

Income. Considering the relatively low income base in the country in general and a real per capita income growth of 2.55 per cent per annum between 1960 and 1978 for instance, it was reasonable to expect a high growth in demand for food products. The model explaining such event is extensively exposed in the process of computing the projected quantity of rice that will be imported in year the 2000 under specific conditions. Income elasticities of demand, together with other factors, contribute to the growth of demand. Data from the Ivory Coast are not available but income elasticities for West Africa estimated by the USDA (18, p 36), give a proper idea on what might be happening in the country. Income

elasticities of demand for wheat, rice, maize, millet and roots were respectively found to be 0.87, 0.65, 0.15, 0.09 and 0.12. Here, the relatively high income elasticities of demand for wheat and rice can be noted.

Urbanization. The relatively high rate of population growth, coupled with a massive external and internal migration to the cities, has resulted in increasing urbanization rate in the Ivory Coast. The average annual urban population growth rate went from 7.3 per cent per annum during 1960-70 to 8.5 per cent between 1970 and 1980. In 1980 for example, the urban population, as a percentage of the total in the country, was 38 while it was only 19 in 1960 (21, p 179). The impact of such a rapid urbanization on the demand for food products is quite obvious.

Taste and preferences. A somewhat less obvious but important factor is the nature of development that has favored the more affluent and politically powerful 10 or 15 per cent of the population. In the urban areas a minority has come to exhibit a very strong desire for imported foodstuffs. And progressively but surely, there has been a "contagion" on the other citizens outside the urban centers. Some foodstuffs such as rice and flour have been subsidized by the Government, so consumers have not borne the real costs of their consumption expenditures. One result is the emergence of strong taste for food products which the domestic agricultural sector either cannot produce at all (wheat) or can produce at high cost relative to other production regions in the world (rice). The final result has been a weak demand for local products even where produced at lower domestically cost because of a preference for imports. The extent of this condition is shown in Table 4. Increases



between 1975 and 1985 have strong implications for future demand for food imports when viewed with the knowledge that wheat can not be grown in the country and that rice is marginal in an agronomic sense.

Table 4. Plan projections for per capita net consumption of main food staple, 1975 and 1985 (kilograms per capita)

Food staple	1975			1985		
	Rural	Urban	Average	Rural	Urban	Average
Cereal						
Rice	34	72	47	35	77	55
Maize	40	14	31	41	13	28
Wheat flour	4	30	13	7	30	18
Millet and other	8	4	7	8	3	5
Roots						
Yams	200	102	168	199	103	153
Cassava	122	59	101	122	61	93
Plantain	130	68	109	128	68	99
Taro and other	34	14	27	34	14	24

Source: den Tuinder (1)

Five salient factors influencing supply of food products in the Ivory Coast are examined: market, price policy, migration, research and extension.

Market. Problems encountered are sub-standard roads for gathering of food products within the production areas, and a situation where movement of primary products from the different production centers to the southern cities is in one direction, North to South. Lack of organization precludes the communication of information from a region to another in response to changing supply and demand conditions. One result is that some regions may be experiencing temporary food shortages while others have food in excess (6, p 54). Aware of these market

limitations, the Government is trying to create a proper environment (storage, information on food products) to encourage an efficient private sector to mitigate the interseasonal variations in inventory and secure food crop supply and demand. To that end, the Ministry of Commerce is expected to play a sizable role (6, p 55). These inefficiencies in the marketing system have a negative impact on the farmers' willingness to increase food production. To the extent that transport costs are often borne by the producer, the cost of sub-standard roads will result in lower farmgate prices of food crops.

Price policy. In an effort to encourage higher food crop prices, the Government may fix a price for the food crop which then must be bought by a state agency. But the people working for those agencies do not always get to the farmers on a timely enough schedule to secure the crop without loss and damage. So parallel private buyers, who stand ready to buy, receive the products or a substantial part of the farmers' output rather than the Government and at prices substantially lower than the Government's official price. Two examples can be used to illustrate this situation for rice and maize. In August 1983, the official Government maize price was set at 40 CFA per kilo. But needy farmers who could not wait for the official Government buyers were offering their products to private buyers at a price of 25 CFA per kilo. It is also noted that in 1975, farmers had to sell their production of rice on parallel private markets at about 60 per cent of the Government announced price (1, p 39).

The Government general price policy is to fix a "good" but stable price for the producer. But, at the same time the constraint of

avoiding a rapid cost of living increase for those who must purchase food in the market has received much thought (6, p 55).

Apart from substantial subsidies received by rice producers in the mid seventies, virtually no subsidy is paid in the food production sector. Cash crops, on the other hand, benefit from grants of credit from the BNDA (Banque Nationale pour le Developpement Agricole), and from other subsidies in kind or cash. Considerable attention has been paid to cash crops (particularly cocoa and coffee) where the Government has successfully promoted their production. Beginning in 1965, a succession of bonus programs was initiated (13, p 32). For instance, a bonus was provided to serve as an incentive to farmers to increase acreages planted to cash crops such as cocoa, so as to boost total yield over 480,000 metric tons in 1985-86 (15, p 12). Farmers making new plantings were offered 60,000 CFA (then 242.92 U.S. dollars) per hectare. With the exception of 1965, nominal producer-price increases have given the impression of positive price incentives for farmers. Although the amplitude will not be fully determined in this work, there is little doubt that lack of modern inputs precludes farmers doing more to increase production. Inefficiency in the food crop marketing system, and the bonus and incentives paid for expansion of cash crops have had negative effects on food production.

Resource availability. As in many developing countries, inputs and appropriate technology are scarce. Farmers find it expensive to incorporate new methods, especially when price and income incentives available to them do not fully support them. In many instances, they try to satisfy new needs with old methods with little output. The International Labor Office (ILO) has conducted studies of African

agriculture in general, and has reported that it takes 500 hours of physical labor for a man to prepare one hectare of land for planting, if done with human labor and hand tools. The same work can be done in 60 hours with oxen plowing, and 25 hours with a tractor (19, p 2897). And even though comparable data for the Ivory Coast are not available, personal observation suggests that there is general lack of modern and efficient inputs at the farmers' disposal, which limits farmers' ability to produce enough for both their own needs and for the market. However the cost in economic terms for these alternatives may be much higher than for the alternative in using human labor.

Another negative factor affecting food production is the urbanization that has been taken place in the Ivory Coast in recent years. The problem is serious because the country is reaching a situation where young people needed at critical planting and harvesting seasons to increase production of agricultural products and particularly food-stuffs, are found in the cities (mostly Abidjan) where they are often unemployed or underemployed. In 1980, 40 per cent of all young people were living in the cities where they could not find employment (16, p 25). So incentives in the economy, including low returns to food crop producers may accelerate the kind of urbanization that the Ivory Coast is experiencing and thus deprives it of food by reducing the agricultural labor force.

Research and extension. Throughout the world, research in agriculture has proven to pay large dividends, both in terms of increased product and in terms of unit cost of food. However, in this general area, the food research agency (IRAT) which exists amid the host of

research institutes (or agencies) on cash crops traditionally has been understaffed and has not achieved noticeable results.

But the Government has begun to focus on the food situation and to implement means for creating incentives and a production environment which could prove more effective than the traditional methods. To that end, agricultural development companies (the SODE's) have been created for food crops: SODESUCRE (sugar), SODEFEL (fruit and vegetables), SODEPRA (livestock) and SODERIZ (for rice but taken over by OCPA). As an example of what these companies may do, with SODEPRA, the Ministry of Livestock Production has established decentralized experiments in the Center and North regions of the country. The North appears to have long-run economic potential for livestock and meat production based primarily on agriculture integrated with livestock and industrial possibilities. Examples of this type of development may be the use of by-products from rice and sugar firms located in these areas for livestock production. But according to the Minister of Livestock Production, the country will depend on external sources for meat for some time to come (7, p 39). Another very interesting and promising experiment is transformation of fresh cassava into a semifinished product. Such a project is under way in the Toumodi region (Center of the country). The pilot project if successful, will encourage easy and more direct human consumption (improved conservation of cassava) as well as livestock.

Similarly SODEFEL is working towards increase in the efficiency and output of vegetables. Most of its effort is directed to tomato production. The sugar development started under the 1971-1975 five-year plan and 12 complexes were scheduled, but because of underestimation of costs

and delays in project development, the number of 12 was reduced to half in 1978 (7, p 56).

Extension services regarding food products have been neglected until recent years. However the Government has recently established some experiment stations in regions where prospects of future development are promising.

Also efforts to organize and to extend management skills to farmers and particularly to young people are deployed by cooperatives. The Centre National de la Promotion des Entreprises Cooperatives (CNAPEC), an autonomous agency under the supervision of the Ministry of Agriculture, is the primary instrument in that attempt.

#### Formal analysis

Two broad areas under consideration in the formal analysis are: projected demand of imported rice in year 2000 and results of estimated supply trend growth rates experienced during the sixties and seventies.

Estimation of rice import. Projected rice imports in the year 2000 will reach 634,300.24 metric tons, if present trends in population and income growth continue. The period 1960-1980 has been characterized by a relatively high real growth rate of per capita income (2.55 per cent per annum between 1960 and 1978) in a context of low income base and rapid population growth. Given these conditions, it is quite certain that domestic food demand will grow rapidly. The starting point, to predict future quantities of food that will be imported, will be to take the time derivative of food, where food consumption (D) is a function of the time derivatives of population, per capita income and relative prices;  $\dot{D} = f(\dot{N}, \dot{Y}, \dot{P})$ . The time-rate relative change equation is

represented by  $\dot{D} = e_N \dot{N} + e_Y \dot{Y} + e_P \dot{P}$  where  $\dot{D}$ ,  $\dot{N}$ ,  $\dot{Y}$  and  $\dot{P}$  are growth rates respectively of quantity demanded, population, per capita income and price. The  $e$ 's are the respective elasticities. If it is assumed that relative prices are constant over time, and the population elasticity of demand is equal to unity, the above equation is reduced to  $\dot{D} = \dot{N} + e_Y \dot{Y}$ . This demand model was evaluated under conditions of West Africa and the Ivory Coast in the following manner. Income elasticities for food crops in West Africa were obtained from USDA estimations (18, p 36) as noted above, Ivory Coast population growth rates between 1980 and 2000, which assumed zero net international migration, were obtained from estimates prepared by the World Bank (20, p 193). Real per capita income growth between 1960 and 1978 was estimated directly as shown in Table 5.

Table 5. Computation of income per capita.

Year	National Inc. Bil. of CFA	CPI (1975=100)	Real NI	Popula. in Mil.	Real NI per capita
1960	133.5	47.3	282.241	3.25	86,843.385
1978	1,556.1	161.4	964.126	7.61	126,691.984

Income per capita growth between 1960 and 1978 is:

$$126,691.984/86,843.385 = 1.46 \text{ or } 146\%$$

$$146\% - 100\% = 46\% ; \text{ and } 46\%/18 = 2.55\% \text{ annual rate.}$$

So given information on income elasticity and for population growth for the period 1980-2000, and then extrapolating the per capita income growth to the period above, a demand growth rate for an individual commodity, rice, has been obtained. Knowing the 1980 base of rice

imported (242,502 metric tons), an estimate of the quantity of rice to be imported in year 2000 is given:

$$Q_{1980} = 242,502 \text{ metric tons}$$

$$Q_{2000} = 634,300.2497 \text{ metric tons}$$

Thus, rice imports are estimated to increase by 2.62 times their 1980 level by the year 2000. Because wheat has an even larger income elasticity of demand (0.87) and cannot be grown domestically, the expansion in wheat imports can be expected to be even greater than for rice.

Supply trends. The regression model used was:  $\ln Z_i = a + bT_i + u_i$ , where  $Z_i$  represents either physical production, yields or area (land) and  $T$  stands for time.

Production. Table 6 summarizes the results and selected statistical measures from this analysis for the growth rates observed for the five major crops: cocoa, coffee, cassava, maize and rice. The data period covered in this analysis was 1950-51 to 1975-76.

Values in parentheses under the regression coefficients are the standard errors(S) and calculated  $t$  values for each coefficient. And, with the exception of the trend growth rate of cassava production, all trend rates are statistically significant from zero at 1 and 5 per cent. With 24 degrees of freedom ( $n-2$ ), calculated  $t$  values are greater than 2.797 and 2.064 respectively at 1 and 5 per cent levels of significance.

Yields. Table 7 summarizes trend growth rates in yields over the period 1960-61 and 1975-76 and statistical measures of significance for cassava, maize and rice. Yield as used in this analysis is a measure of productivity for a unit of land producing a particular commodity. In this case it describes output per hectare (kilos/ha).



Table 6. Trend growth rates in total production for selected cash and food crops between crop year 1950-51 and 1975-76.

Crop	a	b	R <sup>2</sup>
Cocoa	10.6330	+ .0682	.9066
S <sub>C</sub>	(.0690)	(.0045)	
Coffee	11.1297	+ .0629	.7724
S <sub>C</sub>	0.1076	.0070	
Cassava	13.1686	+ .0038*	.0183
S <sub>C</sub>	(.0869)	(.0056)	
t	(151.5395)	(.6697)	
Maize	10.8203	+ .0372	.4959
S <sub>m</sub>	(.1182)	(.0076)	
t	(91.5736)	(4.8587)	
Rice	11.3013	+ .0661	.8387
S <sub>r</sub>	(.0913)	(.0059)	
t	(123.7417)	(11.1708)	

\*Not significant at 10, 5 and 1 per cent.

Table 7. Trend growth rates in yields (kilos/ha) for selected food crops between 1960-61 and 1975-76.

Crop	a	b	R <sup>2</sup>
Cassava	8.0274	+ .0017	.0010
S <sub>c</sub>	(.1396)	(.0144)	.0010
t	(57.5160)	(.1183)	
Maize	6.669	- .0169	.2059
S <sub>m</sub>	(.0860)	(.0089)	
t	(77.5016)	(-1.9053)	
Rice	6.6520	+ .0349	.8103
S <sub>r</sub>	(.0436)	(.0045)	
t	(152.3966)	(7.7343)	

Table 7 reveals that with 14 degrees of freedom ( $n-2$ ), only rice yields trend growth is significant at 1 per cent level because 7.7343 is greater than 2.977 while maize yields trend growth is significant at the 10 per cent level, and cassava yields trend growth rate is not even significant at 1, 5, and 10 per cent level.

Land. Trends in the amount of land (production area) devoted to the different cash and food crops (production area), are estimated and analyzed in the same manner as trends in production and yield. Results of this estimation and analyses are shown in Table 8.

Apart from growth rates in land area used for rice and cassava, all were significant at the 1 per cent level with the degrees of freedom  $n-2$ ).

### Results

It can be observed from Table 6 that cocoa and coffee showed high trend growth rates in total output of 6.82 and 6.29 per cent per annum between 1950-51 and 1975-76 while rates for maize and rice were 3.72 and 6.61 per cent a year, respectively. Cassava trend growth rate was only 0.38 per cent per year and not significant even at 10 per cent level.

In Table 8, corresponding trend estimates for land area to cocoa and coffee are 5.25 and 4.04 per cent per year during the relevant period. Only rice experienced a trend growth rate in land area used which was higher than those of cash crops; but the poor fit and the fact that the coefficient for rice (0.0619) is significant only at the 10 per cent level suggests that caution should be exercised in interpreting this trend growth rate.

Table 8. Estimated trend growth rates in land area for selected crops between 1960-61 and 1976-77<sup>a</sup>.

Crop	a	b	R <sup>2</sup>
Cocoa	12.5079	+ .0525	.8644
S	(.0498)	(.0063)	
t	(251.2922)	(8.3735)	
Coffee	13.1232	+ .0404	.8338
S	(.0432)	(.0054)	
t	(303.9921)	(7.4289)	
Cassava	12.1294	- .0016 <sup>b</sup>	.0040
S	(.0664)	(.0069)	
t	(182.6707)	(-.2366)	
Maize	11.5749	+ .0364	.8111
S	(.0454)	(.0047)	
t	(254.7967)	(7.7535)	
Rice	12.1404	+ .0619 <sup>c</sup>	.2365
S	(.2873)	(.0297)	
t	(42.2571)	(2.0827)	

a: No data were available on cash crops between 1961 and 1965.

b: Not significant at 10 per cent level.

c: Significant only at 10 per cent level.

In comparing cash crop and food crop equations across Table 6, 7 and 8, the  $R^2$  values for most of the cash crops equations are found to be consistently higher than those of food crops equations. This result reflects a relatively steady growth for cash crops compared to the more erratic pattern for food crops.

With the exception of rice, estimated yields trends are quite low for food crops, even negative for maize (-0.0169) over the period 1960 to 1975. As Table 7 indicates, cassava and rice, respectively, experienced 0.17 and 3.49 per cent per annum while the rates in yields for cocoa and coffee were 1.78 and 0.75 per cent for the period 1949-1977 (5, p 103). Caution is required in interpreting the results of trend growth rates in yields for cassava and maize because of the very poor fit implied by the test statistics which are obviously influenced very large year to year variability.

Care should also be exercised in interpreting the high trend growth rates for rice and maize production shown in Table 7 which was found to be 3.49 per cent per annum for trend growth rate in yield (rice). The reason lies in the initial low levels compared to other countries. For instance Lee (5, p 106), in reporting on yields for the Ivory Coast, gave an average of 0.48 tons per hectare for rice and 0.34 for maize during the period 1949-1951. Even by 1975-77, these yields remained relatively low by international standards: 1.2 tons per hectare for rice and 0.49 tons per hectare for maize.

Estimates of 3.72 and 6.61 found in Table 6 could also be interpreted to indicate a shift in the composition of food output in favor of maize and particularly rice (6.61 of growth per annum between 1950 and 1975). If true, this would suggest a somewhat elastic supply to offset

increases in demand in the fast-growing urban population. However, imports of rice have increased from 43,000 tons to 148,000 between 1962 and 1973 (5, p 107), which indicates that the domestic response, even with these high rates, was not sufficient to preclude expansion in imports.

And finally it should be noted from Table 8 that the trend growth rates in land usage of cash crops is higher (except for rice) than for the food crops. Very poor fit of the rice estimated equation should be kept in mind when interpreting the high trend growth rate of land area devoted to rice. Based on these results, it appears that the high trend growth rate in land devoted to cash crops has been maintained throughout the period of analyses. This result would appear to confirm the findings of the World Bank in the seventies that the Ivory Coast maintained a strong comparative advantage in the production of cocoa and coffee (1, p 37).

## SUMMARY AND CONCLUSIONS.

### Statement of the problem

Food is one the most vital necessity for human life. The subsistence farming sector in the Ivory Coast remains the main source of food production. But the production share of that sector is declining in the total output in the presence of population and income trends expansion in demand for which demand exceeds increase in production. Such trends have resulted in increasing food imports. This trend is of great concern because the earnings from the sale of the cash crops may not permit the Ivory Coast to pay for the needed food for its fast-growing population. The reason lies in a deterioration of the country's terms of trade: 3 per cent over the 1970-75 period (10, p 603) and 40 per cent between 1977 and 1982 (14, '1982' p 68).

### Primary objective and procedure

The primary research objective was to determine possible factors that have caused the growth rates of food supply to lag behind cash crops even though the country is predominantly agricultural. In addition to a review of current economic studies, a limited descriptive analysis of factors and incentives for food and cash crops production was done. In other more formal analyses of agricultural trends, a linear regression model was used.

### Results

Trend growth rates of physical production of the cash crops (coffee and cocoa) were higher than the rates experienced by the food crops

(cassava, maize, yams). Trend growth rates of land used for crops were higher (except for rice) for the cash crops than for the food crops. This indicates that given the incentives present in the Ivory Coast during the period, it was more attractive, on the whole, to expand production of cash crops. And, based on trends in land area utilized, the only way for the hundreds of thousands of farmers to do that was to expand the land area. Also, given the relative high income elasticities of demand for rice and wheat, imports of these products are expected to increase with a higher rise in wheat imports.

#### Implications for food policy

Thorough studies concerning the food crops to be developed to secure a more satisfactory food supply to the country need to be carried out. Serious policies to make use of local resources may be economical for the country as a whole. It may be possible to gradually reverse or alter tastes and preferences of urban consumers towards using food commodities which can be produced with local resources. Some tropical food studies have shown that a combination of wheat and cassava flour, with the aid of a surfactant can greatly increase the nutritional value of bread and cakes prepared from it.

It appears that serious thought should be given to the possibility of abandoning the stabilization trade policies which involve subsidizing rice and wheat flour imports: the Caisse Generale de Perequation which is a state agency "stabilizes" prices of selected food products (rice, wheat flour).

Efforts to improve the marketing system and to provide incentives in the rural areas about minimizing urban attraction could be used to



reduce migration to the cities, particularly a full-hearted research and extension policy which would supply suitable inputs and methods to the farmers in order to transform the potentiality into reality. Storage devices and methods for a better conservation and transportation of food products appear to be in real need.

#### Suggestions for further research

This study raises numerous interesting questions which were not answered within the limited objectives of the present work and many other important points received only very limited treatment. A very brief list of these research subjects includes:

1. A more complete analysis of the extent to which the stagnation of the food crops is explained by shifts in the demand structure stemming from rising income levels.

2. A more complete analysis of the food availability per head in the rural areas and particularly on the rural poor.

3. Also in the environment of relatively high rates of population growth, it would be very relevant to think of stabilized agriculture progressively replacing the present shifting cultivation system. The Ministry of Rural Development could help in the first stage. But before offering such help, appraisal of the intervention on the use of labor and other inputs could be obtained by taking a transcendental production function. This function allows returns to scale to vary and so can give some answers to the question of the optimal scale in the production of a particular food product. For instance, as scale increases, does the productivity of the product at hand increase or decrease?

So this work is completed in the hope that further studies will go far beyond it to improve and design policies which are efficient in an economic sense and also point the way to achieving a more satisfactory food supply situation in the Ivory Coast.

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## APPENDIX

Appendix Tables 9, 10 and 11 contain data used in the statistical analysis for food and cash crop total production, land area in main arable food crops and land area in cocoa and coffee, respectively.

Table 9. Food and cash crop total production (thousands of metric tons)

Year	Time	Cocoa	Coffee	Maize	Rice	Cassava
1950	1	57	47	34	118	696
1951	2	45	64	48	105	715
1952	3	61	61	45	147	528
1953	4	53	87	44	93	511
1954	5	66	97	59	98	382
1955	6	71	119	71	114	370
1956	7	73	116	49	94	401
1957	8	46	108	112	133	412
1958	9	56	159	83	71	644
1959	10	62	140	141	143	787
1960	11	94	186	147	160	800
1961	12	81	97	49	156	760
1962	13	103	195	85	229	500
1963	14	98	261	84	219	470
1964	15	148	202	88	248	490
1965	16	113	273	90	250	500
1966	17	150	131	98	276	515
1967	18	147	288	111	345	520
1968	19	144	210	103	365	530
1969	20	181	280	130	303	532
1970	21	179	240	92	316	540
1971	22	225	269	112	385	567
1972	23	185	302	113	320	570
1973	24	209	196	93	335	625
1974	25	241	270	96	406	625
1975	26	227	305	131	461	625

Source: Mitchel (2)

Table 10. Data on land area of main arable food crops (hectares).

Year	Maize	Rice	Cassava
1960	137,000	218,000	153,000
1961	93,000	206,000	153,000
1962	111,000	260,000	176,000
1963	124,000	245,000	210,000
1964	127,000	271,000	220,000
1965	130,000	261,000	227,000
1966	137,000	258,000	192,000
1967	142,000	301,000	202,000
1968	150,000	300,000	200,000
1969	166,000	288,000	164,000
1970	164,000	289,000	163,000
1971	168,000	282,000	170,000
1972	170,000	282,000	175,000
1973	170,000	290,000	186,000
1974	180,000	317,000	185,000
1975	190,000	361,000	168,000

Source: Mitchel (2)

Table 11. Production area of cocoa and coffee (hectares)

Year	Cocoa	Coffee
1960*	243,000	534,000
1965	366,000	558,000
1966	340,000	473,000
1967	332,000	647,000
1968	347,000	652,000
1969	353,000	653,000
1970	373,000	658,000
1971	404,000	674,000
1972	430,000	689,000
1973	441,000	741,000
1974	480,000	760,000
1975	531,000	890,000
1976	550,000	820,000

\*No data available from 1961 to 1964.

Source: Mitchel (2)