EFFECTS OF FARMERS' EDUCATION ON AGRICULTURAL PRODUCTIVITY EFFICIENCY IN CÔTE D'IVOIRE

BY

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TABLE OF CONTENTS

PAGES

LIST OF TABLES

TABLES PAGES

LIST OF ABBREVIATIONS

BCEAO = Banque Centrale des Etats de l'Afrique de l'Ouest(Central Bank of West African States Grouping Côte d'Ivoire, Senegal, Niger, Benin, Togo, and Burkina Fasso (formely Upper Volta).

CAISSTAB = Caisse de Stabilisation et de Soutien des Prix et des Produits Agricoles (Agricultural Exports Stabilization Fund)

FAO = Food and Agriculture Organization of the U.N.

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CHAPTER ONE

INTRODUCTION AND OBJECTIVES

The growth of the agricultural sector is a significant factor in the economic development of a country. From historical records, only few countries have experienced sustained economic development without growth of the agricultural sector. Similarly, all countries that have experienced significant growth in agriculture have also achieved a more rapidly growing economy. Côte d'Ivoire's economic history perfectly illustrates such an agricultural based economic development.

Côte d'Ivoire [1]/ is a west African cocoa-and coffee-exporting nation with a relatively stable and prosperous economy. It possesses diverse natural resources and a climate conducive to high agricultural production. Agriculture, which includes the forestry industry, remains the key economic sector, generating one-fourth of GDP and over three-fourths of the nation's total export earnings. For many years, this agricultural sector has been a determinant factor of growth of the Ivorian economy. The conventional wisdom regarding the prospect for the key commodities of the Côte d'Ivoire agricultural development is that, because of their over-production and world surplus situation, these major export oriented commodities may face difficult competition.

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[1]/ Since January 1st, 1986 the name Côte d'Ivoire was officially adopted for use throughout the world. It replaces the anglicized "Ivory Coast" in english-speaking nations.

Although Côte d'Ivoire still has a comparative advantage in the production of these commodities, it is doubtful that this can be sustained under conditions of lower prices resulting from the continued surpluses of these products. Since Côte d'Ivoire, to a large extent, is a price taker in the international markets of these commodities, the profitability of production in this case will depend on costs saving output-increasing cultivation methods.

The major potential for increasing agricultural output lies in raising the productivity of existing resources. However, there is a gap existing between known and feasible agricultural technologies and the actual practices of the majority of farmers. Government attempts to close this gap have included programs that emphasize primarily the delivery of physical inputs such as fertilizer, water, seeds, as well as those aimed at improving farming practices. Given the tight budgetary and heavy debt burdens plaguing Côte d'Ivoire at this moment, such subsidies cannot be sustained without sacrifice of other important government programs. To increase farming productivity, the government will have to seek, or foster other measures.

A major channel for improving farming practices and technology which contributes to a greater productivity is formal as well as non-formal education. Education of farmers has been empirically verified as an important factor of production. In a study of farming areas in Nepal and in India, Ramesh C. Agrawal[1] established a relationship between agricultural perfomance and education of farmers arguing that:

> "Education to farmer improves his productivity by giving him new information about improved/yield-raising methods, techniques and materials of agricultural production, widening his horizon of thinking and knowledge about what to grow, how to grow and how much of each to grow, how much to keep for home consumption, how much to sell, where and at what prices, what inputs to give and in what amounts. He also becomes aware of sources of such information. However, education is not a material input in itself. It improves and enriches the quality of human capacity and thereby helps the farmer to make better use of his resources and earnings. It helps in raising his standard of life by not only enabling him to earn more income from the same set of resources but also allowing him to spend his income more judiciously affording him greater consumer surplus". [1].

Also, Craig C. Wu[34], in a study on education in farm production in Taiwan suggests: "education contributes to production in several dimensions.., one way to increase the use of inputs is to increase the education of farmers". Futhermore, Dean T. Jamison and Lawrence J. Lau[12] in their study on individual farm in Thailand, Korea, and Malaysia, found that there is a positive correlation between farmers' education and productivity. The importance of the contribution of education of farmers in the Ivorian agricultural production is still an open question.

The purpose of the present study is an attempt to provide an answer. The specific objectives of the study are these:

1. To provide an overview of the educational system along with its role in the agricultural production;

2. To measure the influence of education on farm productivity and farm efficiency by estimating the agricultural production function;

3. To assess the viability of the current policy in fostering the influx of young high school and University graduates to the farming in the rural areas.

After this introductory part, the remainder of this study is organized as follows: Chapter II consists of the background on Côte d'Ivoire with a particular emphasis on the agricultural sector and the status of farming technology; Chapter III reviews the theoretical attempts to address the linkage between education and farming productivity and efficiency; Chapter IV provides an empirical model for testing the significance of such a linkage in the case of Côte d'Ivoire, as well as a description of the data sets used for the statistical estimation, and the results of the model estimation. Finally chapter V concludes the study.

CHAPTER TWO

BACKGROUND OF THE STUDY

A. OVERVIEW OF THE AGRICULTURAL SECTOR AND ITS IMPORTANCE IN THE ECONOMIC DEVELOPMENT OF CÔTE D'IVOIRE

Before we survey the structure of the agricultural production system in Côte d'Ivoire, it is worth having a quick look at its overall economic performance from 1960 to the present.

Over the past twenty five years, the economic development of Côte d'Ivoire went through different phases. The period of 1960-1980 was characterized by rapid growth within a stable economic environment. This growth was based essentially on a successfull development of the agricultural sector which generated surpluses for investment. Since the beginning of the crisis in 1980, the Ivorian economy has been dominated by the deterioration in external and domestic economy, including a decline in the balance of trade between 1980 and 1982. The crisis was also accompanied by a sharp drop in the agricultural ouput in the 1983-1984 crop year due to the severe drought. Since the agricultural sector which is the engine of growth, is undergoing a critical transition phase, a closer analysis of the sector needs to be done in order to reveal the circumstances for future development.

1. OVERALL ECONOMIC PERFORMANCE FROM 1960 TO 1980

During the first two decades after its independence, Côte d'Ivoire has experienced an annual rate of growth of GNP [2]/ of 7.6 percent in real terms while its population grew annually by 4.7 percent. This performance has been based on a successfull development of its agricultural sector which generated surpluses for investment. During the same period, real GDP [3]/ generally increased as well, even though with some fluctuations. From 1960 to 1970 the Ivorian GDP grew at an average annual rate of 8.0 percent. Between 1970 and 1980, despite the effects of the Sahelian drought, increased petroleum prices and world recession, annual growth rate averaged 6.7 percent. In 1979, however, the rate fell below 2 percent, and in 1980 below 1 percent, largely as a result of lower world market prices for the three major export crops (coffee, cocoa, and timber). With an annual population growth of 4.3 percent (including 1.5 percent due to immigration), per capita income increased by 3.5 percent per year until the end of the 1970's. In 1981, it was estimated at $1,200, making it the highest income per capita in West Africa and second in Sub-Saharan African after Gabon.

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[2]/ GNP(Gross National Product) measures the total domestic and foreign output of goods and services claimed by residents of a country.

[3]/ GDP(Gross Domestic Product) measures the total final output of goods and services produced by an economy-that is, within a country's territory by residents and non-residents, regardless of its allocation to domestic and foreign claims.

Agriculture is the key of the Ivorian economy and the basis of its development. Over the past twenty five years, the development of the agricultural sector has been remarkable on several accounts. It has contributed one-fourth to GDP, it has provided and still provides for about three-fourth of the nation's total export earnings, and employs an estimated 75 percent of the labor force of which 13 percent are immigrants. This impressive performance is supported by abundant availability of fertile land, the efforts of farmers, high immigration of productive and cheap labor from neighbouring Sahelian countries, relatively favorable international prices and market prospects and stable political and economic environment combined with Government support of the agricultural sector and considerable technical assistance. As it can be seen in Table 1, the place of the agricultural sector in the Ivorian economy is still dominant. In 1960 agricultural output, in real terms accounted for 13.9 percent of the Ivorian GNP. This share remained fairly constant throughout 1973. In 1974, the agriculture share rose to 16 percent of GNP and has been steadily increasing, reaching almost 20 percent in 1975, and 30 percent in 1980. From 1960 to 1979, the agricultural sector employed more than 80 percent of the Ivorian active labor. Table 2 provides more evidence on the strengh of the agricultural sector in the Ivorian economy. During the 1960-1981 period this sector has resisted more effectively the external and internal shocks than the remaining sectors of the economy. Industry and services experienced relatively higher rates of growth during 1960-1970 but had slightly slower rates during 1970-1981. On the other hand, the agricultural sector kept almost the same rate of growth during these

two periods.

Although the share of the agricultural sector in the overall GDP has declined from 1960 to 1981, this share is still high compared to the share of the other sector of the economy during the same period. As shown in Table 3, Agriculture's share was 43 percent in 1960 and 27 percent in 1981. On the other hand, the shares of industry and manufacturing were respectively 14 and 7 percent in 1960, and 23 and 12 percent in 1981. Services accounted for 43 percent in 1960 and 50 percent in 1981. Agricultural production ,which includes nonfood crops, has generally increased as well, albeit with more fluctuation.

Making agriculture its first priority has resulted in focusing on the most profitable commodities such as coffee, cocoa, and timber. Today, Côte d'Ivoire leads the world in the production and export of cocoa and ranks third as a producer and exporter of coffee after Brazil and Columbia.

Table 1:

Share of Agricultural Production in

GNP and Total Employment

	Share (%) in		
	GNP		
Years	Nominal	Real	Total Employment
1960	46.4	13.9	88.8
1963	39.4	12.6	88.8
1966	37.2	12.2	86.7
1969	31.7	12.2	84.0
1972	29.3	11.8	84.0
1975	31.3	19.2	81.6
1978	26.6	27.9	80.1
1981	30.2	34.7	79.0

Source: - Les comptes de le Nation - BCEAO
- Ministère du commerce, direction du commerce extérieur (1974-1977).
- Côte d'Ivoire en chiffre 1980-1981.
- World debt tables 1980, Second Edition (real GNP in constant 1977 prices)

Table 2:

Growth of Production
(in percent)

Years	GDP	Agriculture	Industry	Services
1960-1970	8.0	4.2	11.5	9.7
1970-1981	6.2	4.7	9.3	5.8

Source: World Bank, World Development Report 1983 (New-York: Oxford University Press, 1983), page 150.

Table 3:

Structure of Production in Côte d'Ivoire: 1960-1981
(in percent)

Years	Agriculture	Industry	Manufacturing	Services
1960	43.0	14.0	7.0	43.0
1981	27.0	23.0	12.0	50.0

Source: World Bank, World Development Report 1983 (New-York: Oxford University Press, 1983), page 152.

Food Production

Unlike many countries in the sub-saharan Africa, the Ivorian agricultural sector produces enough food to feed its population. Over the period of 1960-1980, total agricultural food production increased at annual rate from 3.5 to 6.5 percent while agricultural food comsumption experienced an average rate of growth of 5 to 6.6 percent per year during the same period. As shown in Table 4, total agricultural food production has increased consistently between 1960 and 1980. From 1960 to 1970, on average, total agricultural output grew by 3.2 percent per year. From 1970 and 1975, the rate of growth was 11.5 percent per year but it slowed down during 1975-1980. In the same way, during the first decade after the country's independence, Côte d'Ivoire's total agricultural food consumption grew at a rate of 3.8 percent per year; it reached 9.6 percent per year between 1970-1975 due to urbanization and faster population growth. From 1975 to 1980, the average consumption growth rate declined to 6.6 percent per year. These statistics clearly show that agricultural food production lagged behind food consumption during the first decade (1960-70), whereas the two grew at almost the same rate during the following decade. The trend is more revealing when we consider per capita food production and consumption.

In fact, while Sub-Saharan Africa has received much publicity for its

recent famine and declining per capita food production, Côte d'Ivoire has run counter to this trend. Table 4 shows that per capita food production grew faster than per capita food consumption between 1960 and 1975. Since 1975, the trend has been reversed and by 1980, the Ivorian agricultural farmer could meet only 89 percent of the country's food consumption, compared to 116 percent in 1960 and 106 percent in 1975.

Table 4:

Indices of Agricultural Food Production and Food Consumption: 1960-1980
1970 = 100

Years	Food Production		Food Consumption	
	Total	Per Capita	Total	Per Capita
1960	72.3	114.9	62.1	98.7
1965	86.5	105.7	81.9	100.2
1970	100.0	100.0	100.0	100.0
1975	157.7	130.0	148.2	122.2
1980	159.0	105.8	177.7	118.3

Source: - BCEAO
- Statistiques Agricoles 1960-1980
- Côte d'Ivoire en chiffres 1978-1979
- Situation Economic de la Côte d'Ivoire
- FAO Trade Yearbook.

Agricultural Exports

The production of export crops is a major component of the agricultural production and therefore contributes significantly to the growth of the overall economy. Table 5 shows a breakdown of the sec-

torial distribution of the total merchandise exports. The share of agricultural exports reached 98 percent in 1960 but declined slightly to 87 percent in 1980. On the other hand, the share of merchandise exports such as fuel, mineral and metal, textile and clothing, machinery and transport equipment increased slightly. However these shares are still negligeable when compared to the share of the agricultural exports. Despite the slight decrease of the agricultural exports during the period 1960-1980, agricultural exports overall still remained the major component of GDP with 49 percent in 1980. Exports of industry and services sectors accounted for only 28.4 and 22.2 percent, respectively, during the same period. (See Table 6).

These data confirm that agriculture is expected to remain for many years the pilar of the Ivorian economy and its economic development. This does not imply that the government has been neglecting the other sectors of the economy. In fact, manufacturing activities have been developing along with the development of the agricultural sector. Table 7 shows the linkages between the agricultural sector and the manufacturing sector. In 1970, 24 percent of the value added in manufacturing originated in processing agricultural goods. This share increased to 38 percent in 1983 due to new manufacturing activities such as sugar, textile, rubber, and palm oil processings. During the same period, the share of manufacturing accruing to textile, clothing, chemicals has also expanded. The share for textile and clothing increased from 24 percent in 1970 to 27 percent in 1983, and for chemicals from 6 percent in 1970 to 8 percent in 1983.

Table 5:

Structure of Merchandise Exports
(in percent)

Years	Percentage Share of Merchandise Exports				
	Fuel, Minerals, and Metals	Other [4]/ Primary Commodities	Textiles and Cloth.	Machin. and Transp. Equip.	Other Manufac.
1960	1	98	0	-	1
1980	5	87	3	2	3

Source: World Bank, World Development Report 1983 (Oxford university Press, 1983), page 166.

[4]/ Other primary commodities comprise food and live animal, beverages and tobacco, inedible crude materials, oils, fats, and waxes. In the case of Côte d'Ivoire, food and beverages are the major component of this section.

Table 6:

Structure of the Economy in Three Sectors (1980)
(in percent)

	Gross Output	Exports	Imports	Domestic Demand	Value added (at factor prices)
Agriculture [5]/	23.3	49.4	5.1	19.1	33.1
Industry [6]/	43.1	28.4	78.2	47.8	29.1
Services [7]/	33.6	22.2	16.7	33.1	37.8

Source: Ministry of Finance, Economics Budgets 1982 (Côte d'Ivoire).

Table 7:

Structure of Manufacturing in Côte d'Ivoire

		Distribution of Manufacturing Value Added (percent; 1980 prices)				
Years	Value Added in Manufact. (millions of $1980)	Food and Agric.	Textiles and Clothing	Machinery and Trai. Equip.	Chemical	Other
1970	680	24	24	18	6	29
1983	1,204	38	27	8	8	19

Source: World Bank, World Development Report 1986 (Oxford University Press, 1986), page 192.

[5]/ Agriculture includes integrated industries: Sugar, rubber, palm oil.

[6]/ Industry includes energy, utilities and contruction.

[7]/ Services includes transportation.

2. ECONOMIC PERFORMANCE FROM 1981 TO 1987

The 81-85 period was the most difficult for Côte d'Ivoire in its economic development. Faced with rapid deterioration of the economic and financial conditions since the begining of the crisis in 1980, the government of Côte d'Ivoire launched at the end of 1981 a structural adjustment program aimed at promoting a healthier economy, and improving macroeconomic management. After the government implemented the first phase of the program, it recognized that the structural adjustment process would be a long term effort as it represented a fundamental change in attitudes, institutions, and policies.

The performance of the economy under the program showed success in some areas, less so in others, as well as unresolved problems. Concerning the overall domestic growth, real GDP declined by 4.0 percent per year on average between 1981 and 1984. After registering a sligthly positive growth in real GDP of 1.2 in 1981, Côte d'Ivoire suffered three successive years of recession. In 1982, the growth of real GDP was -4.0 percent, followed by -4.4 in 1983, and -4.1 in 1984. These drops in the real GDP were translated into a cumulative decline in the GDP per capita over the same period. In 1985, the growth of GDP returned to its normal trend with approximately 5.3 percent. As indicated in Table 8, the growth among the economic sectors was also uneven during the same period. Between 1981 and 1984, industrial value added decreased by almost 26.8 percent and services value added declined by about

8.2 percent in real terms. In 1985, both sectors witnessed a slight turnaround in their growth.

The situation was also dramatic in the agricultural sector. After stagnating in 1981 and 1982, agricultural value added dropped by 11.0 percent in 1983 and remained at the same depressed level in 1984 as a result of the 1983-84 drought. In 1985, with the return of normal rainfall patterns, agricultural value added recovered by an estimated 9.0 percent and thus regained the output level achieved prior to the drought. These dropouts were even more revealing in the agricultural subsectors. As shown in Table 9, the evolution of coffee and cocoa output suffered also from this drought. Coffee output, after virtually stagnating at about 250 thousand tons in 1982 and 1983, decreased abruptly to 105 thousand tons in 1984 as a result of the drought, but recovered sharply to 295 thousand tons in 1985. Cocoa output, with about 500 thousand tons in 1982, dropped dramatically to 307 thousand tons in 1983, before recovering to 550 thousand tons in 1984.

Table 8:

Structure and Growth of Production

	1980 Percent of GDP	Value Added: Real Change from Previous Year in percentage. 1981	1982	1983	1984	1985
Agriculture	34.6	+2.1	-1.4	-11.0	+0.1	+9.0
Industry	20.7	+10.0	-15.0	+3.1	-24.1	+0.6
Services	44.7	-0.2	-3.3	-0.4	-4.5	+1.5

Source: Ministry of Finance (Côte d'Ivoire).

Table 9:

Cocoa and Coffee Output: 1980-1985
(in thousand of tons)

	1980	1981	1982	1983	1984	1985
Cocoa						
Vol. of Output	397.7	455.6	501.6	307.0	550.5	475.0
Vol. of Export	331.1	436.4	326.4	271.3	417.0	403.0
Coffee						
Vol. of output	253.3	366.5	253.8	253.5	105.5	295.5
Vol. of Export	211.7	233.3	271.0	226.2	197.7	262.0

Source: CAISSTAB Fund Estimates (Côte d'Ivoire)

With the stabilization phase(1980-1985) of the structural adjustment process largely completed, Côte d'Ivoire needs to establish a sustained growth pattern while maintaining internal and external equilibria and progressively reducing the burden of external debt. Under the policy framework assumed for the transition phase, GDP is projected to grow at an average annual rate of 3.0 percent between 1986 and 1990. This result is essentially due to the anticipated good performance of the industry and services value added which are estimated to grow on average by 5.1 and 3.6 percent per year, respectively, between 1986 and 1990; and also by a recovery of the agricultural value added which is expected to grow by 2.1 percent per year on average

during the same period, after virtually stagnating during the first half of the eighties.

In the subsectoral of agriculture, growth is essentially led by the continued expansion of cocoa value added which grows by 3.5 percent per year and by an acceleration in the growth of diversification crops value added to 6.0 percent per year, follow by coffee and forestry value added by 2.0 and 1.5 percent per year, respectively, during the period 1986-1990. Tables 10 and 11 show these statistics.

Table 10:

Structure and Growth of Production: 1986-1990

	1985 Percent of GDP	Value added: Real Change from Previous Year in Percentage				
		1986	1987	1988 (proj.)	1989 (proj.)	1990 (proj.)
Agriculture	37.3	1.5	1.8	2.4	2.4	2.5
Industry	15.5	5.4	5.2	5.3	5.4	4.4
Services	47.1	4.3	3.5	3.5	3.5	3.5

Source: World Bank Report: No.6051-IVC vol.II, page 32.

Table 11:

Projected Annual Real Growth Rate by Sector

	1986-1990	1990-1995
Agriculture	+2.3	+3.8
Industry	+5.1	+6.5
Services	+3.5	+5.3
GDP	+3.0	+5.0

Source: World Bank Report: No.6051-IVC vol.II, page 32.

B. THE STRUCTURE OF THE AGRICULTURAL PRODUCTION SYSTEM

1. GEOGRAPHIC ENVIRONMENT

Located in West Africa, 5 to 10 degrees North of the equator, Côte d'Ivoire is bordered in the South by the Atlantic Ocean, in the West by Guinea and Liberia, in the East by Ghana and in the North by Mali and Burkina Fasso (formely Upper Volta). Covering an area of 322,000 square kilometers (roughly the size of New Mexico), its population was estimated in mid-1985 at 10.1 million people.

Its climate is affected by both the tropical continental air streams and the tropical maritime air streams. There are two rainy seasons and two dry seasons in the South. In the north, there is one dry season and one rainy season due to the drier and hotter intertropical air streams from the Sahara. In the Central part, the number of rainy and dry seasons vary from year to year.

Due to this climate, there are several basic soil types in Côte d'Ivoire. In the South, the vegetation is of a rain-forest type and a significant source of income because of the important timber production. In the central part, there is a mixture of rain-forest and savannah due to the unstable climate and the year to year variation in the rainfall. The North is covered by savannah type of vegetation which is woody.

2. LAND USE AND CULTIVATION PRACTICES

With the total area of 322,000 square kilometers, the forest zone occupies about 140,000 square kilometers while the savannah zone occupies 180,000. With higher and more reliable rainfall and good soils, the forest zone has a richer resource bases than the savannah. With almost 16 million hectares of dense tropical forest, leaving about 3 million hectares for forest reserves and national parks, the forest zone is the main source of economic growth.

The regional distribution of crops reflects this regional

variation in the vegetation. The main crops grown in the forest zone are shown in Table 12, coffee and cocoa occupy two-third of the total cropped area, and dominate the forest region's economy. Annual food crops such as rice, maize, yams, plantain, cassava, and cocoyams account for about 25 percent of the area. The other tree crops such as palm oil, coconut and rubber cover about 5 percent and less than 1 percent of the area is devoted to export crops such as bananas and pineapples.

In the central part, coffee and cocoa can also grow, but their life expectancy as well as their yields are lower than those in the South. Cotton, tobacco, sugarcane, plantain, cocoyam, and yam are also grown by small farmers.

The farming in the Northern part is based on the cultivation of annual crops in pure or mixed farming systems and it is interspersed with periods of bush fallow. The dominant cropping system is rainfed food crops practiced by over 60 percent of the region's farming families; about three percent of the farmers grow rainfed cotton and food crops; and the remaining third grow irrigated rice and food crops. Maize, the dominant crop, accounts for about 26 percent of the total cultivated area, followed by yams at 24 percent. Cotton which is the major cash crop of the savannah zone is grown on about 16 percent of the total cropped area. The remaining area includes almost 13 percent in rice, 9 percent in sorghum/millet, 7 percent in groundnuts, and 4 percent in cassava. Table 12 shows the statistics on agricultural land utilization by crops.

Table 12

Agricultural Land Utilization by Crops [8]/
(1981-82 season. 'ooo ha)

Crops	Forest Zone	%	Savannah Zone	%
Cash Crops				
Coffee	1,190	30	-	-
Cocoa	1,177	30	-	-
Oil Palm	100	3	-	-
Rubber	41	1	-	-
Cotton	-	-	125	14
Sugar	-	-	31	3
Coconut	47	1	-	-
Food Crops				
Rice	186	5	114	13
Maize	206	5	232	26
Sorghum/Millet	-	-	83	9
Yams	115	3	218	24
Cassava	102	3	36	4
Plantains	438	11	-	-
Cocoyam	300	8	-	-
Groundnuts	13	1	60	7
Total cropped area	3,915		899	
Total land area	13,700		18,400	

Source: -Rapport Commission No.5, Plan Vivrier, Ministère de l'Agriculture.

[8]/ Other crops such as pineapples, bananas, mangoes, fonio, citrus, vegetables, also cashew, soja, avocado, and tobacco make up a further 20,000 ha mostly in the forest region.

Cultivation practices also vary from one crop to another. There are three major practices:

Traditional agriculture: It is characterized by cut and burn, shifting of cultivation, long fallows and intercropping. The tools are simple and the use of fertilizer and pesticides is virtually unknown. In fact, it is under this type of agriculture that farmers have integrated coffee and cocoa production.

Semi-improved agriculture: This type of agriculture is a little more improved than the previous one. It deals mainly with cotton production and does use tractors, fertilizer, pesticide and improved seeds. In addition, a concentrated extension service supplies information on cultivation practices to farmers.

Improved agriculture: This agriculture uses a high level of technology. In this type of agriculture, land clearing, in most cases, is done by the use of buldozers. Crops such as rubber, palm oil, coconut, banana, and pineapple that require higher techniques are of this type of agriculture. Farmers have to master new techniques and follow schedules provided by the extension services.

Averaged yield and net returns per hectare differ from one practice to another. Table 13 shows these statistics. Although some crops are produced under relatively modern techniques, in general, Côte d'Ivoire farming is still for the most part primitive. Technology levels and yields are very low relative to their potential and the use of modern inputs and mechanization is almost rare. This is true for cocoa and coffee management practices that have changed very little

since the country's independence except for cocoa where, during the 60's and 70's, more information was disseminated regarding the improved planting materials which had some impact on the use of better varieties. On the other hand, cotton yields/ha have doubled over the past two decades due to the use of intensive fertilization and spraying, better planting density and improved weeding practices. Also, the production of rubber and palm oil now uses much more intensive crop management and input use. Tables 14 and 15 show the percentage of farmers using purchased inputs by region and the share of expenditure in individual inputs in total inputs expenditure by region, respectively.

Table 13:

Net Returns to Farmers by Crops and Cultivation Practices

Crops	Cultivation Practices	Averaged Yield (kg/ha)	Net Returns [9]/ Per Hectare (CFAF)
Cash Crops			
Cocoa	Traditional	400	145,000
	Improved	700	242,000
Coffee	Traditional	300	117,000
	Semi-improved	450	138,000
Palm oil	Improved	8,000	95,000
Coconuts	Improved	3,000	175,000
Rubber	Improved	1,800	248,000
Cotton	Traditional(manual)	1,250	100,000
	Improved(oxen or mechanized)	1,400	98,000
Food Crops			
Rainfed Rice	Traditional(manual)	1,600	99,000
	Semi-improved(oxen)	2,000	109,000
	Improved (tractor)	2,000	107,000
Irrigated Rice	Traditional(manual)	4,000	278,000
	Semi-improved(power tiller)	5,000	320,000
Maize	Traditional(manual)	1,400	72,000
	Improved(oxen:sav.; intensive:forest)	2,300	75,000
Groundnuts	Traditional(manual)	1,000	81,000

Source: World Bank Report No.6051-IVC, vol II, page 124.

[9]/ After amortization.

Table 14:

Percentage of Farmers Using Purchased Inputs by Region

	West Forest	East Forest	Savannah	All
Fertilizer	7.1	6.4	36.1	15.9
Insecticide	30.7	20.1	29.0	25.3
Seed	18.9	46.6	29.6	34.9
Storage	0.8	1.3	0.9	1.1
Containers	41.2	27.6	15.9	27.1
Transport	17.2	13.7	14.3	14.7
All inputs	70.6	72.4	72.3	72.0

Source: Côte d'Ivoire's 1985 Households Survey.

Table 15:

Share of Expenditure in Individual Inputs in Total Inputs Expenditure by Region

	West Forest	East Forest	Savannah	All
Fertilizer	5.6	3.9	42.9	16.5
Insecticide	24.6	16.1	6.8	15.1
Seed	16.3	50.7	29.5	36.2
Storage	0.3	0.6	0.4	0.5
Containers	40.5	19.4	10.3	21.4
Transport	12.1	9.3	10.1	10.3
Total	100.0	100.0	100.0	100.0

Source: Côte d'Ivoire's 1985 Household Survey

3. LAND TENURE SYSTEM

Officially all the land belongs to the government as stated in a 1964 law, but an automatic ownership right is given to whoever brings a parcel of land into cultivation. In the case where the land is under the control of the rural communities, an outsider to the community has to have a permission from that community to have access to the land. This ruling has not affected the transference of land by native population of the forest zone to immigrant. The guarantee of security of tenure and unrestricted transfer have provided considerable incentives to immigrant farmers from other regions of Côte d'Ivoire and from the neighbouring countries, to settle in the southern zone where cocoa and coffee can be grown.

Owner-operated land is the major land tenure system in the country. This is the case for almost all the food crops and cotton. For the other crops such as coffee, and cocoa, there is a form of share-cropping called ABUSUAN, a system in which the share-cropper gets one-third of the products and the farm owner gets two-thirds.

4. FARM STRUCTURE

In 1985, the rural population in Côte d'Ivoire was estimated at 5.3 millions, representing almost 52 percent of the total population

Among this rural population, 3.2 million live in the forest zone with an estimated 490,000 farming families, and 2.1 millions, or 300,000 farming families live in the savannah zone. Family size, averaging 6 to 7 persons per rural household, does not vary greatly by region. On the other hand, the farm size depends largely on the family size especially in the savannah zone where family is the sole source of power on most farms.

In general, holdings in Côte d'Ivoire are of medium size. About 88 percent of the holdings have less than 10 hectares. Only a few farmers can claim to having more than 100 hectares. All these large farms are located in the forest zone. In the savannah zone, holdings rarely reach 50 hectares. The government and few corporations possess estates reaching 1,000 hectares. These plantations are concerned mainly with production of palm oil and rubber. Table 16 shows the size distribution of farms in Côte d'Ivoire. [10]/

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[10]/ Farm sizes overmore than one hundred hectares and government estates are not included in the table.

Table 16:

Size Distribution of Farms in Côte d'Ivoire

Size (ha)	Percentage of Farms in Size Category		
	Forest	Savannah	Overall
Less than 0.5 ha	3.5	3.7	3.5
0.5 - 0.99	5.5	8.2	6.0
1.0 - 1.99	14.5	23.7	16.3
2.0 - 4.99	36.5	44.7	38.1
5.0 - 9.99	27.1	15.7	25.0
10.0 - 19.9	10.7	3.6	9.3
20.0 - 49.9	2.1	0.4	1.8
50.0 and over	-	0.1	-

Source: National Agricultural Census Data, Côte d'Ivoire: 1974

Farm income is function of farm size and of regional location. In general, net farm income is much higher in the forest zone than in the savannah. Net farm income [11]/ in the forest zone averages CFAF 860,000 (US$2,457) per annum and CFAF 120,000 (US$343) per capita. In the savannah zone, the average farm earns a net income including the value of food crops of CFAF 260,000 (US$743) and an

[11]/ At rate of US$1 = CFAF 350.

annual per capita income of CFAF 37,000 (US$106). Incomes such as these are considered very low relative to urban wages and the country's per capita GDP, which was estimated in 1984 at US$684. Clearly the farm incomes provide very limited scope for investment.

Farm and per capita incomes are presented for a number of representative farms in Table 17. Income disparities between savannah and forest zone are clearly apparent. A traditional foodcrops farmer in the savannah area earns a net farm income of CFAF 235,000, which is about US$671.50 per annum or a per capita income of CFAF 34,043, which is about US$97.50 per annum. Under improved techniques and the inclusion of cotton, the manual cultivation farmer averages about CFAF 474,000 (US$1,354) or a per capita income of about CFAF 68.000 (US$94.50) per year. As shown in the table, the situation is much better in the forest zone where a traditional foodcrops farmer gains CFAF 258,000 (US$737.50) or a per capita annual income of about CFAF 37,000 (US$106). With the use of improved farming techniques, the income can reach CFAF 373,000 (US$1,066) per year or a per capita income of CFAF 53,350 (US$152.50) per annum.

Off farm-incomes are not included in Table 17 because there is limited development of non-farm economic activities in rural Côte d'Ivoire. In 1985, out of about 3,500 individuals with primary job agricultural activities, only about 230 (approximately 6 percent) had secondary jobs. Most of the individuals with the secondary jobs were women and they were involved in sales of food products. This shows that off-farm activities by members of farm households are almost non-existent in côte d'Ivoire.

Table 17:

Farm Income in Côte d'Ivoire

		Total[13]/ HA	Family Size	Net Farm Income[12]/ Total CFAF'000	Per Capita CFA	Per Capita US$[14]/
Savannah						
Interm. mech.						
Foodcrops-cotton	(N)	28.6	20	1,785	89,255	225
	(W)	30.5[15]/	20	2,296	114,822	328
	(C)	34.0[15]/	20	2,084	104,214	298
Oxen						
Foodcrops/cotton	(N)	5.0	8	433	55,467	158.5
	(W)	6.5[15]/	10	731	80,376	229.5
Manual						
Tradit. foodcrops		3.6	7	235	34,043	97.5
Improv. fdcps/cot.	(N)	2.6	6	237	40,794	116.5
Improv. fdcps/cot.	(C)	4.0	7	474	67,669	193.5
Improv. fdcps-cot.	(C)	4.7[15]/	5	405	83,434	238.5
Forest						
Cash crops						
Tradit. cocoa/cof.	(E)	6.0	7	856	122,236	349.5
Tradit. coffee	(W)	4.7	7	494	70,659	202
Cocoa/coffee	(E)	11.0	7	1,558	222,541	636
Foodcrops						
Tradit.foodcrops		2.3	7	258	36,893	105.5
Improv.foodcrops		2.3	7	373	53,350	152.5

Source: World Bank Estimates.

[12]/ Net of amortization and hired labor, excludes non-crops income.

[13]/ This is the total hectare of food-crops and export crops combined.

[14]/ At rate of $US 1 = CFAF 350.

[15]/ Double-cropping.

C. FACTS ABOUT EDUCATION

In the two decades following independence, Côte d'Ivoire has established a considerable capacity for education and training. From 1960 to 1980, primary school enrollments grew at about 7.2 percent per year, while secondary school enrollments increased about 11 percent over this period. The University of Abidjan, which was established in 1959, had by 1985 a student population of about 14,000, and several large-scale higher technical institutions were established in the late 1970's. Education at all levels is free, and in 1982/83, the number of students enrolled at all levels of education and vocational training was estimated at 1.4 million, comprising 15 percent of the total population. In 1980, according to the World Bank estimates, adult literacy averaged 35 percent. Table 18 and 19 show some statistics.

Table 18:

Literacy Rate by Region and Age
(In percent)

Sex	Abidjan	Other Urban	East Rural Forest	West Rural Forest	Savannah Rural	All Côte d'Ivoire
Men	69.1	52.5	30.9	30.3	15.2	40.3
Women	48.5	34.0	13.6	11.1	3.6	22.4
Total	58.5	42.9	21.8	20.1	9.1	31.0

Source: Côte d'Ivoire's 1985 Households Survey.

Table 19:

Literacy Rate by Region and Sex
(In percent)

Ages	Abidjan	Other Urban	Rural Areas			All Côte d'Ivoire
			Forest		Savannah	
			East	West		
6-14	48.7	29.3	20.5	17.7	14.2	25.9
15-24	78.2	69.9	44.2	40.5	15.8	54.9
25-34	68.0	52.5	23.6	28.8	7.6	38.6
35-44	46.2	28.0	10.4	11.4	3.8	19.9
45-54	32.9	17.9	4.6	5.1	1.0	10.8
55 +	25.4	14.0	3.3	3.2	-	5.8
Total	58.5	42.9	21.8	20.1	9.1	31.0

Source: Côte d'Ivoire 1985 Households Survey.

Although much progress has been made in education since 1960, there are still many areas where improvements are needed. Schooling in Côte d'Ivoire closely follows the French system which was inherited under French colonial rule. After six years of elementary school, a certificate (C.E.P.E.) [16]/ is awarded to students who pass a nationwide examination. This certificate verifies that students have successfully completed primary school. The entrance to secondary school is determined by the score obtained from this examination. The first four

[16]/ C.E.P.E. stands for Certificat d'Etude Primaire et Elémentaire.

years of secondary education leads to a certificate (B.E.P.C.) [17]/ which can be used, like the first one, to enter certain vocational training program. The next three years of secondary school, which are only for students that have successfully completed the first four years, lead to the baccalaureate, a certificate awarded to students who have successfully completed this part of their schooling, and allows them to enter the university. Three years of college lead to a licence degree, and a maitrise (masters) can be obtained in one additional year.

Every child is eligible to go to school, but the final decision rests primarily with the parents. Because of the recent stagnation in enrollment due to the limited number of school places at all levels, repetition and dropout rates are very high (especially at primary and secondary schools). Most of these dropout students, without jobs, become a burden for their families. Only a few return to the rural areas where they become farmers by joining their parents on the farms. With the high dropout rate, the government has taken a number of measures, including the current policy to foster the influx of young high school and university graduates as well as the dropouts to farming in rural areas.

This policy strategy includes:

a) Examination: All participant students have to take an exam.

b) Training program in agriculture: This program of one or two years, is only for students who pass successfully the examination. All the fees or tuitions are paid by the government.

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[17]/ B.E.P.C. stands for Brevet d'Etudes du Premier Cycle.

c) Supply of agricultural equipment: After the training, each student has to go to his or her native village where a portion of land and some mechanized equipment are provided.

All the expenses made by the government are expected to be reimbursed by each farmer according to his annual earnings.

This policy, if it works, will partially solve the problem of unemployment and it will also permit the government to concentrate more on some other problems such as :

a) Provide better access and expansion at all level of education (especially at primary and secondary levels).

b) Raise adult literacy rates which will improve the living standard that is still low for a large segment of the population.

D. ROLE OF EDUCATION IN AGRICULTURAL PRODUCTION

According to George F. Patrick and Earl W. Kehrberg[25], One way of showing the role of educational activities (information or extension) in agricultural production is to consider education's impact on production of a firm. For the present study empirical data are used in order to measure that impact. Welch[10] has attributed the value of education to a "worker effect" and an "allocative effect" which are directly related to the labor and managerial input components of the human factor (or capital). The worker effect arises because increased

education may improve the quality of the labor component and can be defined as the ability to produce more, given the same resources other than labor. Thus the worker effect refers to education's effect on technical efficiency.

Increased education may also improve the decision-making functions of the managerial component by increasing the farmer's ability to acquire, interpret, and evaluate information, giving rise to the allocative effect. The allocative effect has two aspects. The first one refers to the allocation of resources, in the case of multiproduct firm, among competing products [25] such as coffee and cocoa trees. More nearly optimum allocation of resources amomg products by farmers with more education would be reflected by greater output, other factors being constant. Determination of the types and quantities of resources to be used in production is the second part of the allocative effect. Farmers with more education may adjust production plans according to changes in input prices and maybe able to identify and utilize properly "new" inputs[25]. This approach of education views human capital formation as one of several factors determining increased national production and consumption. As production processes become more complicated through time due to technological changes, more skills, experience, education, and information remain the safeguards to modern agriculture. This study deals only with the education'effect on the technical efficiency: the ability of farmer to produce larger output quantities from a given bundle of inputs.

E. PROBLEM DEFINITION

The farming systems in developing countries have failed to increase the agricultural output because farming is based on traditional techniques transferred from generation to generation. The low level of literacy characterizes the agricultural sector and it remains one of the main problems in this sector. During the past two decades, government policies in Côte d'Ivoire have been more concerned about providing subsidies to farmers in terms of lower prices for agricultural inputs, such as fertilizers and pesticides. These policies, however, have failed to increase production of many crops such as coffee, cocoa, as envisioned and targeted by the four-year economic plans. This attempt has failed because most farmers do not know how to use inputs efficiently. Furthermore, the extension services were not available to farmers when they needed them. The value of information and farmer's education has been overlooked when the problem of modernization of agricultural sector was considered. With the recommendations of the World Bank, the government of Côte d'Ivoire has since encouraged a nationwide farmer's education program that began in the 1970's.

The purpose of the current study is therefore to investigate the contribution of education to agricultural production efficiency in Côte d'Ivoire. Although the present study focuses only on production of some major crops, it is hoped that valuable insight will be gained to drawing inferences for the whole agricultural sector.

CHAPTER THREE

EDUCATION AND PRODUCTIVITY

THEORETICAL FRAMEWORK

A. OBJECT OF STUDY

As mentioned earlier, the purpose of this study is to examine the effect of farmers' education on farm productivity in Côte d'Ivoire. The basic concept used in the analysis of productivity is the production function. Thus to analyse this impact, a production function for agricultural output will be estimated.

B. METHODOLOGY

Estimation procedure

To estimate the production function for agricultural output in Côte d'Ivoire, the OLS (Ordinary Least Square) regression method will be used. The basic assumptions [3] when using OLS methods are that:

a) The disturbance terms have mean zero, are correlated, and have common variance and,

b) The independent variables and the stochastic term are uncorrelated. Any violation of the conditions above might lead to some

problems. But depending on the nature and the seriousness of the violation, some alternatives exist.

Statistical model and functional form

Given a set of data, and assuming that each farm has a set of production possibilities, a production function can be constructed by relating the value of farm output to different quantities of inputs[12] including the farmer's education (formal as well as non-formal). This relationship can be expressed as:

$$Y = f(X, E) \qquad (1)$$

Where Y = Total value of farm output

X = Quantity of inputs

E = Variables that characterize the farmer (Age, education, sex, and exposure to extension services).

Marginal productivity can be used to measure the change in output resulting from a unit change in inputs. Thus to measure the influence of farmers' education on farm output, marginal product of education is used, that is:

$$\partial Y / \partial E = \alpha$$

Where α measures the amount that total output (Y) increases or decreases as educational level (E) increases. This marginal product is simply the "worker effect" of education. The appropriate formula will depend on the specification of the production function in the study. The functional form chosen for the production function estimated is the Cobb-Douglas production function.

If we begin with the Cobb-Douglas model in its simplest form, education excluded, we have:

$$Y = A\, X_1^{b_1} \ldots X_i^{b_i} \ldots X_k^{b_k} \qquad (2)$$

Where Y is the total value of farm output, the Xs represent the different inputs, and the bs represent the elasticity of Y with respect to the Xs. In linear form of the model we have:

$$\mathrm{Ln}Y = \mathrm{Ln}A + b_1\, \mathrm{Ln}X_1 + \ldots b_i\, \mathrm{Ln}X_i + \ldots b_k\, \mathrm{Ln}X_k \qquad (2.1)$$

With N farms, equation(2) can be rewritten as:

$$Y_j = A \prod_{1}^{N} (X_{ij}^{b_i}) e^{u_j} \qquad (3)$$

Where Y_j is the total value output of the j^{th} farm

A is the constant term

X_{ij} is the use of the i^{th} input by the j^{th} farm

b_i is the elasticity of Y with respect to X

u_j is the error term.

The linear model can be expressed as:

$$LnY_j = LnA + \sum_{1}^{N} b_i \, LnX_{ij} + u_j \qquad (3.1)$$

Assuming that E_i is a measure of education in the j^{th} farm, one way that it (education) might be considered to enter the production function is in neutral fashion, that is without altering the elasticity (bs) of any of the Xs. In this kind of formulation, E will appear as an additional multiplicative input.

Thus under the neutrality assumption, the Cobb-Douglas production function can be written as:

$$Y_j = A \prod_{1}^{N} (X_{ij}^{b_i}) e^{\alpha i \, Ei + uj} \qquad (3.2)$$

or in linear form

$$LnY_j = LnA + \sum_{1}^{N} b_i \, LnX_i + \sum_{1}^{M} \alpha_i \, E_i + u_j \qquad (3.3)$$

in which the bs are the production elasticities, and the α_i has the interpretation of percentage change in output in response to a unit change in the E_i, other inputs and characteristic variables being held constant. That is:

$$\alpha_i = \partial \, LnY_j \, / \, \partial \, E_i$$

If the E_i variable is measured in term of years, of say education, the

α_i is approximately the percentage change in output in response to an increase of one year of education at the margin, other things being constant [12]. In the empirical analysis, this model is used by including additional relevant exogenous variables.

The implicit assumption in this study is that all the conventional inputs such as land, labor, capital, and purchased inputs (fertilizer, seeds, insecticides...) are always included in the production function. Also as stated before, the effect of education or any other characteristic variables on the agricultural production function is neutral. That is education does not affect the productivity of labor, capital, purchased inputs, and land differentially.

The Cobb-Douglas production function is chosen among several production functions for some standard reasons:

a) Its close accomodation with agricultural economics theory and
b) Its easy conversion into linear form which permits an estimation using the ordinary least squares procedures.

Another advantage of this model is that the coefficients obtained are elasticities of output with respect to each input. However, there are some limitations involved in the use of Cobb-Douglas production function. These problems are discussed in [9].

CHAPTER FOUR

EMPIRICAL ANALYSIS AND RESULTS

A. DATA SET

The data used in the empirical analysis were obtained from a household survey in Côte d'Ivoire which was conducted in 1985 by the World Bank's Living Standard Unit and the Department of Statistics, Ministry of Economy and Finance of Côte d'Ivoire.

The survey was based on questionaires about household production, family health and fertility, farmers'education and competences, and general household characteristics. The study do not address the health and fertility variables. Attention is restricted to agricultural production and more especially to the impact of education on farm productivity efficiency.

The sample is a two-stage sampling of 16 households from each of 100 clusters selected from representative regions of the whole country. Out of these 1,600 households, 65 percent were farm household, that is approximately 1,040 households. However, after eliminating households with missing and inconsistent data, we are left with a total sample size of 1,006 households.

B. DEFINITION OF VARIABLES

Dependent variable

The dependent variable in this study is the total crop value which is obtained from the sum of crop sales, the value of seeds, the value of payments in kind and gifts, and the value of crop for home consumption. The use of the total crop value in the study implicitly assumes that the crop composition of the total production is identical for all farms. The inclusion of regional dummies in the production function is expected to show some trends.

Independent variables

The education variable

In this study the educational level of the production unit was measured by either the education of the head of the family, the maximum education of the family members, or the average education of the members of the family. The quantity and the quality of education was measured by the number of years attented or completed. Thus the

level of education is converted into equivalent number of years.

Description	Years
Illiterate	0
Primary school	6
Secondary school	10
High school	13
College	17

Education is considered as a continuous variable in the model; that is, if they are individuals in the sample with no education, E will be equal to zero. In the same way, E = 1 for individuals with one year of education, E = 2 for individuals with two years of education and so on.

Other input variables

The capital input was obtained by adding the value of implements and mechanical equipment owned at 1985 market prices. Total labor is the total family labor which includes children and adults. Variable inputs such as fertilizer, insecticide, seeds, storage, container, and transport are also included in the production function. Since these inputs are entered in the model in value terms, the assumption is that their average prices are identical for all farms. Having a zero value for expenditure of variable inputs on some farms, a constant (one) was chosen to solve the problem when taking logarithm of zero in the Cobb-Douglas model.

All the variables used in the production function analysis

are defined in Table 20.

Table 20:

List of Variables

VARIABLES	DEFINITIONS	UNITS
Dependant Variable:		
TVALCROP	Total Crop Value	CFA
Independent Variables:		
TCROPH	Total Cultivated Land	HECTARE
TFLINP	Total Family Labor Input	HOURS
CASHEXP2	Expenditure on Fixed Capital	CFA
CASHEXP3	Hired Labor Expenses	CFA
CASHEXP6	Expenditure on Fertilizer	CFA
CASHEXP8	Expenditure on Insecticide	CFA
CASHEXP5	Exp. on Storage, Cont., Transp.	CFA
YRSEDUC	Educational Level	YEARS
EXTD	Extension Services Dummy	0-1
R1	West Forest Dummy	0-1
R2	East Forest Dummy	0-1
R3	Savannah Dummy	0-1

C. RESULTS AND INTERPRETATIONS OF THE STUDY

Since the effect of farmers'education on farm productivity is our major interest in this study, analysis of estimation of a production function model in which information about education is assumed to affect others inputs neutrally has been done. In this study, the educational level of the production unit was measured by either the education of the head of the household, the maximum education of the family members, or the average education of the family members. The regression results are summarized in Tables 22 and 23. As shown in Table 22, the first functional relationship (corresponding to the first column) deals with years of education of the head of the household, the second considers the maximum education of the family members, and the third functional relationship uses the average education of the family members. Table 23 shows the sample's data which are divided into two groups: The educated farmers and the non-educated farmers. In each table (Table 22 and 23), the estimated parameters and the t-statistics (in parentheses) of the particular parameter for all regressions are given.

Several observations can be made about this study from these regressions. From the estimation, the land variable is the most important because it has the highest coefficient. This is to be expected in a country like Côte d'Ivoire where land is also abundant. In rural areas, land used by households is the most important source of non-wage income.

The coefficient of total labor is also significant in the regression. It shows the importance of family labor. In some parts of Côte d'Ivoire, especially in the Savannah zone, family labor is the sole source of power on most farms.

Of the other conventional inputs, capital, hired labor, insecticide, and storage containers and transport contribute significantly in explaining the variation in farm output. The fertilizer coefficient is positive but not significant. This can be explained by the negligible amount of use of this input. As shown in Tables 14 and 15, only 16 percent of the farmers use fertilizer and the share of fertilizer in the total expenditure is only 16.5 percent.

Education and agricultural extension services parameters show different results. The coefficient of agricultural extension services is positive but insignificant in all regressions. According to Jamison and Lau(12), the contribution of the extension services is likely to be ineffective in the early stages of new technology adoption. What is surprising is that the results from different regressions show some unexpected outcomes with respect to the effectiveness of education as a factor of production in measuring its impact on total agricultural output. The t-values for the education variables are negative but statistically significant and that suggests the negative role of education in farm production.

In the sample, approximately 75 percent of the farmers are considered illiterate. The education mean in the estimation is 1.07 years which is almost one and half years of education. The negative coefficient of the education parameter may be explained by the fact

that one or two years of schooling may be too little education to make a significant impact on the agricultural production by farmers. Also, one might say that because Côte d'Ivoire's agriculture is still in its basic stage(relatively little or no use of high technology), there is no need for farmers to use their education in their farm works; However, none of these explanations adequately justify the outcome of the education parameter in this study because, although the education coefficient is negative, intuitively it is ordinarily postulated to be positive and significant. Another possible explanation is that there could be a problem of farm size. Higher educated farmers may have smaller farms size than less and non-educated farmers. If this is the case, the larger output quantities would be produced by the less and non-educated farmers. Even if the higher educated farmers were to use their education in their farm activities, it would not have any serious effect on the whole farm total output because of the small size of their farm. But still, this cannot truly explain the negative parameter of the education variable because in Table 23, where the results are reported from the two groups sample(educated and non-educated farmers), the education coefficient is negative and significant for both sets of data. However, the mean value for the total output is higher for educated farmers than for non-educated farmers.

Other possible explanations of the negative sign of the education variable are these: First the unexpected sign of the education variable may be attributed to the fact that the variable does not represent the use of education on farm activities. If the educated farmers use their education for non-farm purposes, the impact of this

variable on agricultural production may indeed be negative. Second there could be a problem of multicollinearity. In the regression, some input variables might be highly correlated with the education variable and cause it to behave this way. Third, a problem of misspecification is possible. If this were the case, some important input variables that were supposed to be included in the model were not specified and so their omission make the model behave in an unexpected way.

Table 21.a:

Summary Statistics: All Farmers

	MEAN VALUE	STANDARD DEVIATION
Dependent Variable		
TVALCROP (Total Crop Value)	836837.34394	1395357.625
Independent Variables		
TCROPH (Total Cultivat. Land)	9.68241	9.941
TFLINP (Total Fam. Lab. Inp.	4686.02286	4998.389
CASHEXP2 (Exp. on Fix. Cap.)	94837.98807	389632.450
CASHEXP3 (Exp. on Hir. Lab.)	82385.53479	386184.036
CASHEXP5 (Exp. on S. C. T.)	5825.54473	20977.838
CASHEXP6 (Exp. on Fertil.)	4788.31113	16478.244
CASHEXP8 (Exp. on Insect.)	3122.14414	14086.051
YRSEDUC (Yrs of Educ. of Head)	1.07356	2.508
MAXEDUC (Max. educ. of Mbers)	3.25373	4.087
AVFEDUC (Ave. Educ. of Mbers)	1.26758	1.917
EXTD (Extension Services)	0.19583	0.397
R1 (West Forest Dummy)	0.20278	0.402
R2 (East Forest Dummy)	0.38469	0.487
N = 1,006		

Table 21.b:

Summary Statistics: Educated Farmers

	MEAN VALUE	STANDARD DEVIATION
Dependent Variable		
TVALCROP (Total Crop Value)	867852.32412	1934909.606
Independent Variables		
TCROPH (Total Cultivat. Land)	10.01859	11.936
TFLINP (Total Fam. Lab. Inp.)	3406.69347	5315.862
CASHEXP2 (Exp. on Fix. Cap.)	111873.37688	635450.082
CASHEXP3 (Exp. on Hir. Lab.)	137502.46231	727742.130
CASHEXP5 (Exp. on S. C. T.)	9429.24623	37339.729
CASHEXP6 (Exp. on Fertil.)	3436.80906	15948.869
CASHEXP8 (Exp. on Insect.)	3803.44221	13717.653
YRSEDUC (Yrs of Educ. of Head)	5.42714	2.859
R1 (West Forest Dummy)	0.28141	0.451
R2 (East Forest Dummy)	0.42211	0.495
N = 199		

Table 21.c:

Summary Statistics: Non-Educated Farmers

	MEAN VALUE	STANDARD DEVIATION
Dependent Variable		
TVALCROP (Total Crop Value)	829189.28811	1227897.445
Independent Variables		
TCROPH (Total Cultivat. Land)	9.59950	9.391
TFLINP (TOtal Fam. Lab. Inp.)	5001.49566	4868.957
CASHEXP2 (Exp. on Fix. Cap.)	90637.19207	300018.101
CASHEXP3 (Exp. on Hir. Lab.)	68794.12392	234355.895
CASHEXP5 (Exp. On S. C. T.)	4936.89963	14220.256
CASHEXP6 (Exp. on Fertil.)	5121.58116	16598.922
CASHEXP8 (Exp. on Insect.)	2954.14126	14178.730
YRSEDUC (Yrs of Educ. of Head)	0.00000	0.000
R1 (West Forest Dummy)	0.18340	0.387
R2 (East Forest Dummy)	0.37546	0.486
N = 807		

Table 22:

Regression Estimates of Cobb Douglas Production Function

	Equation1 (YRSEDUC.)	Equation2 (MAXEDUC.)	Equation3 (AVFEDUC.)
INTERCEPT	9.488 (35.535)	9.400 (34.576)	9.410 (34.958)
TCROPH*	0.850 (21.245)	0.874 (21.772)	0.865 (21.568)
TFLINP*	0.025 (2.731)	0.033 (3.453)	0.029 (3.033)
CASHEXP2*	0.101 (3.885)	0.102 (3.875)	0.104 (3.948)
CASHEXP3*	0.014 (2.848)	0.013 (2.600)	0.013 (2.691)
CASHEXP5*	0.026 (4.566)	0.026 (4.472)	0.026 (4.536)
CASHEXP6*	0.007 (0.873)	0.008 (0.999)	0.007 (0.930)
CASHEXP8*	0.026 (3.672)	0.025 (3.512)	0.025 (3.530)
YRSEDUC	-0.048 (4.855)		
MAXEDUC		-0.010 (1.583)	
AVFEDUC			-0.036 (2.700)
EXTD	0.111 (1.639)	0.083 (1.228)	0.087 (1.283)
R1	0.081 (1.102)	0.046 (0.614)	0.062 (0.826)
R2	0.031 (0.500) R^2 = 0.56	0.015 (0.237) R^2 = 0.55	0.028 (0.441) R^2 = 0.55

The absolute values of the t-statistics are in parentheses.

Table 23:

Regression Estimates for Examining Educated and Non-Educated Farmers in Technical Efficiency

	Educated Farmers	Non-Educated Farmers
INTERCEPT	7.754 (10.031)	9.816 (35.539)
TCROPH*[18]	0.754 (8.013)	0.858 (19.042)
TFLINP*	0.056 (2.757)	0.017 (1.594)
CASHEXP2*	0.303 (4.047)	0.079 (2.935)
CASHEXP3*	0.011 (0.900)	0.016 (2.979)
CASHEXP5*	0.049 (3.559)	0.018 (2.928)
CASHEXP6*	0.010 (0.498)	0.011 (1.401)
CASHEXP8*	0.037 (2.283)	0.024 (3.039)
YRSEDUC	-0.060 (2.810)	0.000
R1	-0.050 (0.347)	0.090 (1.230)
R3	-0.159 (0.718)	-0.001 0.027)
R^2	0.637	0.542

[18]/ An asterisk indicates that the variable is entered in log form. The dependent variable is log of output.

CHAPTER FIVE

SUMMARY AND CONCLUSION

This study has focussed on a single aspect of production efficiency, that is the effect of education on technical efficiency: the ability of farmers to produce larger output quantities from a given bundle of inputs. Any form of education which imparts knowledge about the production process directly, or which enhances the capacity to acquire knowledge about the production process from other sources, should raise the farmer's frontier of production possibilities. With any particular combination of inputs, the farmer with production-relevant education can produce more output.

In this study, a sample of 1,006 households obtained from the World Bank was used to measure the impact of farmers' education on farm productivity. From the regression results, it seems that education does not result in a higher level of technical information. The education variable was consistently negative but statistically significant. This last point leads us to conclude that the unexpected sign of the education variable may be attributted to the fact that the variable does not represent the use of education on farm activities. Also, the existence of multicollinearity between the education variable used in conjunction with other variable inputs may have caused the

education parameter to have the unexpected negative a sign. The misspecification of some important input variables in the model may have also caused the education variable to behave that way. In sum, these implications depend to a large degree on the quality and the nature of the data used. An appropriate domestic data from the Ministry of Agriculture of Côte d'Ivoire would have been the ideal way to go about the present study.

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EFFECTS OF FARMERS' EDUCATION ON AGRICULTURAL PRODUCTIVITY EFFICIENCY IN CÔTE D'IVOIRE

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ABSTRACT

Education plays a crucial role in the process of Economic Development of a country. In Côte d'Ivoire, much progress has been made in education since 1960. The data (a sample of 1,006 households) from the World Bank allow us to investigate the contribution of education in the process of Economic Development in Côte d'Ivoire, more precisely the development of the agricultural sector.

The study has focused especially on the farmers'education and examined the effects of farmers'education on farm productivity. The data were analysed with the use of the Cobb-Douglas production function and the Ordinary Least Square regression procedures.
The empirical results of the study show that the agricultural extension services are positively related to the output, even though statistically the regression coefficients are not significant. This can be explained by the fact that the contribution of extension services is likely to be ineffective in the early stages of technology adoptions and in the unpreparedness of the farmers.

The education variable, which was expected to have a positive effect on farm productivity, was found to be negatively related to output. This unexpected negative sign for the education variable may be attributed to the fact that the variable does not represent the use of education on farm activities. If the educated farmers use their education for non-farm pursuits, the impact of this

variable on agricultural production may indeed be negative. Also, there may be problems of multicollinearity and misspecification of some variables which could cause the education variable to behave this way. Finally, these implications stemming from the quality and the nature of the data should not be overlooked.