Macro-economics Policies and Deforestation in Côte d'Ivoire

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Abstract: The development of Côte d'Ivoire is due to the agricultural sector at the expense of forest land. The objective of this study was, first, to describe the characteristics of agriculture and agricultural practices as well as their consequences on deforestation; secondly, to deal with macroeconomic policies, their impact on deforestation and on the environment, and their impacts assessment methodologies; but also to illustrate the opportunities available to the Ivorian agriculture. The results of our study indicated that the country had abundant natural resources (forest land) which have not been rationally managed. The majority of the population was rural, possessing many small farms. The agriculture sector was diverse regarding crops and production systems of which the most dominant was the traditional or extensive system. This sector is very important for the economy of the country, from the standpoint of revenue provided to the State and the significant number of jobs created. Agricultural practices have not been able to ensure a sustainable management of natural resources of the country, including the conservation of primary forests now fast disappearing. For the development of the agricultural sector induced by macroeconomic policies was made at the expense of forest land. Population growth impacts negatively also on the deforestation. This enables us to advance that introduced policies to revive the economy have only increased the extensive production system, which leads to deforestation and ecological imbalance. Despite all the investment in the agricultural sector, crops were only 38% of their potential. The environmental annual costs were estimated at 2.72% of 2015 GDP, or 545 billion CFA francs. This is a significant financial loss for an economy of an undeveloped country. However there is hope due to the opportunities offered by the intensification of the agriculture sector. Identifying determinants or causes of deforestation and presentation of opportunities would help the government adjust its resources for future forest recovery projects in order to significantly revitalize the agriculture and forest sector which is the main pillar of the country's economy and the principal provider of employment. One advantage of this strategy will be to considerably decrease the rural exodus, and improve the government incomes.

Keywords: Forest, Deforestation, Production System, Macroeconomic Policies, Environment, Environmental Costs

1. Introduction

Among the countries of the CFA zone, Côte d'Ivoire is one of the most important economically. It has about 20 million inhabitants and its GDP amounts to $ 20 billion in 2015. The agricultural sector contributes about 33% of the GDP and 66% of national export earnings (including agro-industrial products) and employs more than two thirds of the country's workforce. Also, if we move forward that agricultural performance of the country since 1960 that indicated, this sector was the country's development factor. But, statistical analysis of agricultural production, cultivation methods, the influence of cultivated land on the territory, and farms typology shows that the agriculture sector has been developed without consideration of environmental concerns, only pillar of sustainable development. After two decades of rapid growth that followed the country independence, the agricultural sector's performance deteriorated sharply in parallel to the country economy. And this mainly because of:

- An unfavorable evolution of the terms of the exchange;
- A continuous loss of competitiveness;
- The structural rigidity of the economy, not compatible with balanced development;
- The abusive use of forest land.

To address the economic situation of the country, the Ivorian government made a commitment, from the beginning of the 1980s, in a series of stabilization and structural adjustment program with the support of the Bretton Woods institutions. It will be a question in this study, on the one hand, to describe the characteristics of agriculture and agricultural practices as well as their consequences on deforestation, secondly, to deal with macroeconomic policies, their impact on deforestation and the environment, and their impact assessment methodologies; but also to illustrate the opportunities available to the Ivorian agriculture.

2. Literature Review

In this study, the literature review will focus on the description of the characteristics of the Ivorian agriculture, the presentation of the major regional systems of production, presentation of the impact of agricultural practices on the environment, as well as key tools for identifying determinants of phenomena.

2.1. Characteristics of the Ivorian Agriculture

2.1.1. Natural Resources

Côte d'Ivoire has relatively abundant natural resources as 70% of the total area (320,000 km2) is potentially usable for agriculture. On the 22, 5 million useful hectares, 17 million are farmlands among which 9, 5 millions of ha are really cultivated. The remaining 5, 5 million ha consist of forest and national parks largely in degradation [1]. On these 5.5 million ha of forest, there is actually only 1.5 million ha unexploited in agriculture. The soils are known for their poor to moderate fertility. Their cultivation was subjected for a long time to the practice of slash-and-burn crops, followed by long fallows. But the reduction of the duration of the fallows, consecutive to the increase of the rural population and the weakness of the contributions of fertilizing elements lead to a progressive decrease of the fertility. This evolution calls profound transformations in the cultural and agricultural practices (increased recourse to the fertilization, the development of the association farming - breeding, etc.) and the ownership status of land, if the country wants to preserve its productive potential and develop its agricultural

production. The country has two major agro-climatic regions. The forest region in the south (140,000 km2) characterized by two rainy seasons (total 1200-2500 mm per year), with more or less irregular multiannual or inter-annual distributions (especially in the central region where there are some difficulties of determine the periods of crops implementation). The low insolation and humidity greater than 80% between June and October promote crops and animals diseases. The savannah region in the north (180,000 km2) has a rainy season (900-1300 mm) between June and October. Although the timing of crops implementation is easy, the seven months of drought are a major constraint for crops and livestock [2].

2.1.2. Agricultural and Rural Populations

The rural population has declined relative to the total population: it accounted for almost 80% of the total population at the independence of the country; this percentage is only 51% currently. In absolute terms, it continues to increase at an annual rate higher than 2%, slightly. These trends have been combined at a major rural exodus of young educated people. This situation would constitute a serious handicap for agriculture and its necessary transformation and intensification. The Ivorian agriculture, according to the reference [2], is based on approximately 2,980,000 family of very small farms, with 24% of them being located in forest areas and nearly 41% in pre-forest zone, with average area of about 2.7 ha (half of this area is cultivated and half consists of fallow and uncultivated land). The farms in the savannah zones account for 35%, with an average surface of 4.5 ha [1, 2]. Large public and private farms (mostly oil palm plantations, coconut, rubber, sugar cane, pineapple, banana and fruit) cover approximately 150,000 ha. [2].

2.1.3. Main Productions

- Food production (plant, animal and fish) account for nearly two thirds of the Agricultural Gross Domestic Product (AGDP) versus 50% in 1986. Among food crops, rice cultivation is the most important in the economy and the most consumed (especially in cities). See the data in table 1 below.

Table 1. Production trends (T) and rice area (ha).

Years	Production x 1000	Area x 1000	Years	Production x 1000	Area x 1000
1960	160	194	1988	610	519
1961	156	206	1989	635	545
1962	230	260	1990	657	572
1963	220	245	1991	683	625
1964	248	271	1992	710	649
1965	250	261	1993	738	506
1966	275	258	1994	678	624
1967	347	301	1995	692	650
1968	365	299	1996	705	482
1969	303	288	1997	585	482
1970	316	289	1998	598	383
1971	385	282	1999	610	342
1972	320	282	2000	622	341
1973	335	290	2001	634	341

Years	Production x 1000	Area x 1000	Years	Production x 1000	Area x 1000
1974	406	317	2002	647	340
1975	496	390	2003	660	340
1976	460	398	2004	681	341
1977	477	409	2005	704	353
1978	504	428	2006	716	370
1979	534	448	2007	606	356
1980	420	360	2008	680	367
1981	390	340	2009	688	377
1982	450	350	2010	1206	395
1983	360	380	2011	873	560
1984	514	411	2012	1562	672
1985	540	450	2013	1934	785
1986	560	509	2015	900.	1077
1987	580	512	2016	1150	1200

Source: [1, 2]

However, local production being lower than the growing demand will result in a high import of foodstuff. Moreover, this strong demand induced changes in rice acreage at the expense of forests, increasing from 160,000 ha to 677,000 ha in 1960, 1993, 1.200 million ha in 2016 [2].

The contribution of export crops to the AGDP has declined sharply since 1985: they represent a third of the AGDP now, versus 50% in 1986. They remain the "spearhead" of the economy by the incomes they generate directly and from agro-industrial and commercial activities they induce. Among them, cocoa (raw and processed) accounts for 54% of national exports in 2016. With a respective annual potential output of 150,000 t and 1,450,000 t, for cultivated areas respectively estimated about 623 000 ha and 2.3 million ha, the Coffee and Cocoa are the backbone of the national economy. The country is the first world cocoa producer with over 40% of world production. Second export product after cocoa, coffee cultivation employs more than 6,000,000 people or 40% of the Ivorian population in forest areas. Coffee represents 24% of exports, and the Country is the first African producer and the fourth largest world producer after Brazil, Colombia and Malaysia. Coffee procured 10% of the GDP. Tables 2 and 3 present the data of production and prices of these crops.

Table 2. *Evolution of the production, areas, yield and price for coffee farmers, from 1960 to 2016.*

Years	Production (x 1000 t)	Area (x 1000 ha)	Yield (kg/ha)	National market Price (F CFA / kg)
1960	186	350	468	90
1961	186	396	468	90
1962	97	460	211	75
1963	195	516	377	75
1964	261	560	466	90
1965	202	587	344	90
1966	273	615	443	76
1967	131	632	206	90
1968	288	649	443	90
1969	210	665	322	91
1970	280	652	429	96
1971	240	674	356	105
1972	269	695	387	105
1973	302	741	407	106
1974	196	847	231	124
1975	271	863	313	150
1976	308	901	342	154
1977	291	921	316	180
1978	196	950	204	250
1979	277	1007	275	250
1980	250	1033	242	311
1981	367	10733	342	302
1982	248	1110	223	304
1983	271	1153	235	306
1984	85	1079	79	358
1985	277	1073	258	354
1986	265	1102	241	399
1987	270	1113	243	400
1988	187	1135	164	400
1989	221	1040	213	404
1990	199	1323	215	419
1991	199	1000	199	175
1992	257	800	321	175

Years	Production (x 1000 t)	Area (x 1000 ha)	Yield (kg/ha)	National market Price (F CFA / kg)
1993	139	800	173	175
1994	146	800	182	530
1995	195	920	212	400
1996	168	792	212	400
1997	279	819	341	400
1998	311	883	352	400
1999	307	819	375	400
2000	380	829	458	400
2001	301	602	500	500
2002	182	455	400	500
2003	140	410	341	500
2004	154	740	208	250
2005	230	719	320	415
2006	187	747	250	448
2007	171	777	220	500
2008	173	650	266	623
2009	143	623	229	403
2010	94	450	210	500
2011	130	538	250	500
2012	160	590	250	600
2013	150	610	250	600
2014	160	630	250	600
2015	175	640	250	600
2016	150	623	250	600

Source: References [1, 2, 6].

Coffee acreage has been increasing for 30 years to the detriment of forests before declining considerably since the 1990s (Table 1). It should also be noted that yields are very low (250 kg / ha in 2015) and have decreased compared to those of the 1960s (468 kg / ha). This illustrates the lack of intensification of crops after 56 years. As for cocoa-culture, it is a little more devouring forest than coffee culture. The evolution of the surfaces has always been increasing, and the yields, although small, have remained slightly stable (Table 2). The next section will discuss the modes of production.

Table 3. Evolution of the production, areas, yeald and price for coccoa farmers, from 1960 to 2016.

Year	Production (x 1000 t)	Area (x 1000 ha)	Yield (kg/ha)	National market Price (F / kg)
1960	94	373	358	89
1961	85	260	358	89
1962	110	277	303	65
1963	115	292	372	55
1964	139	308	337	70
1965	122	327	479	70
1966	150	343	346	65
1967	147	358	437	70
1968	144	371	410	70
1969	181	387	389	76
1970	179	404	467	83
1971	226	423	443	85
1972	185	440	534	85
1973	209	497	421	102
1974	242	471	420	149
1975	231	498	513	175
1976	232	526	464	178
1977	304	698	442	229
1978	318	740	545	250
1979	398	785	543	281
1980	417	837	533	300
1981	465	901	537	300
1982	360	953	516	300
1983	411	953	378	350
1984	565	1029	432	375
1985	555	1100	549	400
1986	611	1174	505	400
1987	664	1234	520	400
1988	832	1566	537	400
1989	780	1373	463	400
1990	807	1566	360	200

Year	Production (x 1000 t)	Area (x 1000 ha)	Yield (kg/ha)	National market Price (F / kg)
1991	765	1412	360	75
1992	813	1450	360	75
1993	804	1436	360	200
1994	809	1500	360	350
1995	1120	1900	360	500
1996	1235	1782	360	500
1997	1119	1814	360	500
1998	1201	1800	450	500
1999	1163	1900	500	550
2000	1401	2000	50	600
2001	1212	1777	500	600
2002	1265	1880	500	625
2003	1351	2000	500	675
2004	1407	2050	500	700
2005	1286	2194	500	700
2006	1409	2281	500	700
2007	1230	2372	500	700
2008	1382	2300	500	700
2009	1223	2176	500	750
2010	1301	2150	510	800
2011	1320	2460	520	800
2012	1800	2500	550	750
2013	2002	2500	580	750
2014	2130	2500	600	750
2015	2189	2525	600	70
2016	2200	2600	600	1000

Source: References [1, 2, 6].

2.2. Great Regional Production Systems

2.2.1. Main Production Systems

Agricultural activities are conducted according to several production systems compiled by region in table 4: traditional, modernized, more or less extensive and intensive. We can find below a brief presentation of these production systems for plant, animal and fish.

Table 4. Agricultural characteristics of the regions.

Characteristics	Lower côte d'ivoire forest area	Middle côte d'ivoire forest area	côte d'ivoire pre-forest area	côte d'ivoire sub-Sudanese	côte d'ivoire mountain area
Soil	ferrallitic highly desaturated	ferralliticmoderately desaturated	ferralliticmoderately and low desaturated	ferralliticmoderately desaturated andferruginous	ferralliticmoderately desaturate
Food crops	Cassava, upland rice, corn, plantain bananas	yam, cassava, Upland rice, corn, plantain	millet, yams, corn, upland rice	millet, yams, corn, upland rice, irrigated rice	upland rice, irrigated rice, cassava,, plantain
Tree crops	cocoa, coffee tree	cocoa, coffee tree	Cashew	Cashew	cocoa, coffee tree
Fruit trees			avocado, citrus, cashew	avocado, citrus, cashew	citrus
Industrial crops	oil palm, coconut, rubber, pineapple, banana, coconut	cotton sugar cane, pineapple, rubber, oil palm	cotton, sugar cane	cotton, sugar can, irriguated rice	
Reforestation	acajou, niangon, framiré, fraké, acacias, eucalyptus	sipo, teck, samba, fraké, cadrela	teck, gmelina, eucalyptus	teck, gmelina, (protection des sols), eucalyptus (production)	
Breeding	poultry, swine, bovine lagoon	poultry, swine, bovine baoulé	poultry, swine, bovine-baoulé, ovine	poultry, swine, ovine, bovine	poultry, swine, bovine ovine
production System	production system base on cassava and of tree crops, poultry farming, traditional farming	cropping systems based on yams, rice, traditional breeding	production system based on rice, yam and cotton, bovine and ovine breeding	Production systembase on rice, bovine breeding	
cultural practices	intensive in industrial blocks, traditional dominated	traditional dominated	low animal traction and intermediate mechanization	Animal traction and intermediate mecanization	traditional dominated

Source: Reference [3]

The rice production system in Côte d'Ivoire is based, on the one hand, on individual peasants and, on the other hand, on peasants governed by the State through its structures. Traditional cropping systems, still widespread in the country, are characterized by low cultivated areas, "roaming", lack or weakness in the use of chemical inputs, low yields and the laboriousness of work because of its dominant manual character. They are no longer adapted to long-term demands resulting from population growth, land pressure and the growing monetary needs of the agricultural population.

Semi-intensive farming systems due to the introduction into the traditional systems some innovations such as animal traction, improved seeds, phytosanitary treatments, etc. They allow an expansion of cultivated areas, improved yields and reduced drudgery. Intensive cropping systems are essentially those practices by the agro-industry firms. These farms are often mechanized, extensive use of purchased inputs (seeds and selected plants, fertilizers, pesticides, etc.). They are characterized by high technical performance (regular increase in yields) and they have relationship with research centers. Their rational management is based on the optimization of cash income and enhancement of capital and wage labor.

2.2.2. Consequences of the Traditional Production Systems (Extensive)

The existence and development of agriculture requires the consumption of forest lands unfortunately, using these resources are not always carried out rationally management with extensive production systems. As a result, farming is one of the causes of environmental degradation [4]. The scarcity of forest land, the destruction of plants and wildlife, soil depletion [5], pollution of the receiving water, etc., are some of the manifestations of this degradation. The damage due by agricultural practices compromise eventually the exercise of agricultural activity [6]. It is therefore essential to seek ways and means of striking a balance between agricultural practice and nature conservation, which, unfortunately, macroeconomic policies have failed to maintain.

2.2.3. Main Tools for Identifying the Determinants of Deforestation

The regression analysis is to perform regression variables or parameters on a number of technical and socio-economic variables. Two estimation methods are used:

- The regression of qualitative variables with econometric models such as TOBIT. The Tobit refer generally to regression models in which the dependent variable definition area is constrained in one form or another. Its analysis focused on durable goods and consumer spending based on a regression taking into account specifically the fact that such expenditure cannot be negative. The dependent variable was thus subject to a constraint of non-negativity. Tobin [7] described his model as a limited dependent variable model. Thus models with limited dependent variables are models for which the dependent variable is continuous but is observable only over a certain interval. In total, 5 Tobit models exist in the literature: the simple Tobit called model I. There is the model II Tobit, model III, model IV and V. TOBIT is used in studies to identify the determinants of the adoption of a technology, to identify the determinants of poverty, deforestation, etc. [8].

- Regression of quantitative variables, econometric models with single or multiple regression. Regression can be done with one variable, it is called simple regression; or with several variables, in this case, we called it multiple regression [9]. A correlation coefficient will be measured to assess how independent variables can explain the dependent variable. These tools are generally used in many studies (environmental impact assessment, simulation, causes of deforestation etc.) in order to understand relationship between causes and effects of many phenomena's [10].

Partial conclusion

The country has got an abundant forest lands that have not been rational use. The majority of the population is rural, with many small farms, which were conducted according to an extensive production system. And, finally we can notice that, there are many tools, which can be used to identify scientifically the variables able to explain the deforestation like Tobit and regression models.

3. Methodology

3.1. Method

The method used in this study will be to:

1) Describe macroeconomic policies apply in and agricultural sector, his consequences on the deforestation and the forest land use.

2) Identify through a simple regression method, on which our choice was made, for reasons of adaptation to our data, from 1960 to 2015, the relationship between dependent variable Y represented by the stock of forest land, and the independent variables X, which are:

- Demographics;
- The production and the price of the main cash crops such as coffee, cocoa, palm, rubber;
- The production and prices of major food crops such as rice and cassava.

3) Implement the regression model, defined by:

$$Y = f(x_1, x_2, \ldots x_{13}) + \varepsilon \qquad (1)$$

Where:

- Y is the dependent variable or dependent variable;
- $x_1 \ldots x_{13}$ are the explanatory or predictor variables or regressor;
- ε is the forecast error of Y with f(x) or residue. The correlation coefficient (R^2) calculated, expresses the degree of independent or explanatory variables to predict or explain the dependent or explained variable.

This indicator will be used to identify variables that may explain deforestation.

3) Assess the environmental costs of the current GDP percentage from PALLIX and Comolet approach, based on:

- Prime loss woods;
- The loss of biodiversity;
- Soil degradation;
- The quality degradation of water quality and health problems resulting, and;
- Coastal erosion.

4) Finally evaluate opportunities of potential yields of cultivated products, than their valorization does not lead to consumption of forest land. This calculating the intensification ratios as shown below:

Potential intensification of a culture (%)=Real Yield / Reference Yield.

3.2. Data and Study Area

Based on the Ivorian territory, our primary and secondary data, were obtained respectively from surveys conducted with farmers (agricultural production yield, forestland prices), institutions such as the Ministry of Agriculture [2], Ministry of Environment [11], Ministry of Waters and Forests [12] (statistics regarding agricultural production, agricultural surfaces, forest area, forest production, agriculture and forestry incomes), National Institute of Statistics of Cote d'Ivoire- Ministry of Planning [13], Ministry of Economy and Finances [14], National office of Study for Development (BNETD)[15], World Bank [16] and IMF [17] for data on agricultural production and areas, forest stock, agricultural and forestry incomes, etc.

The study area was the forest region of the country represented in green Figure 1.
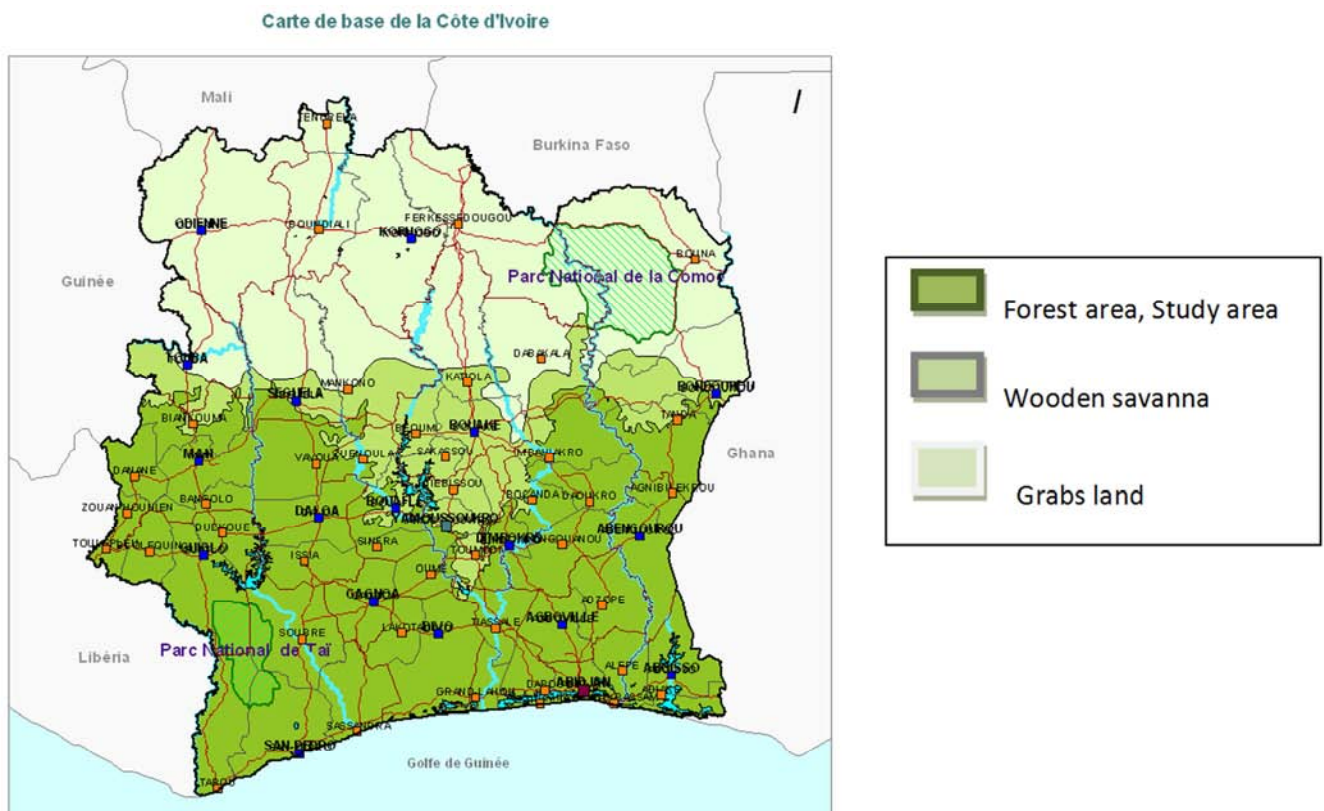

Figure 1. Forest area (green color) in Côte d'Ivoire, 1900 [18].

4. Macro-economic Policies and Their Impact on the Environment

4.1. Evolution of Macroeconomic Policies

Côte d'Ivoire is an agricultural nation. The export agriculture has been and continues to be the pillar of economic development. It represents between 25 and 35% of GDP, between 40 and 70% of the global export of the country and provides 2/3 of jobs. The country has a leading position in many export markets: the first world producer (40%) and exporter of cocoa, the third producer of coffee in the world, the first African producer of rubber, the fifth producer of palm oil, the second world producer of cashew.

The volume of food production in Côte d'Ivoire accounts for more than 10.7 million tons per year. The supply of food products consists mainly of tubers (49.09% yam), roots (21.15% cassava), plantain (14.96 plantain) and cereals (6.4% rice, and 5.9% corn). The country produces annually 1 150 000 tons of rice in 2015, for the annual needs of 2.5 million tons. The deficit also concerns dairy products (88% of import), gardeners (60%) fish (80%), and meat (56%). The diversity of environments encountered in Côte d'Ivoire

explains the regionalization of agricultural activities [2].

Several policies have been carried out since 1960, transforming Côte d'Ivoire into a country whose economy is based on agriculture. These policies are as follows:

4.1.1. Specialization Policy, and Forest Zone Development (1960-1970)

At independence, Côte d'Ivoire was a sparsely populated country despite two poles of population with a higher density: the north of the country and the region of Abidjan.

To valorize the south, first by wood harvested activities and crops of coffee / cocoa, the colonial state and the independent state has encouraged the migration of northerners and foreign labor coming from Mali, Burkina Faso and Ghana. The model was made possible by intensive clearing of forest policies. The immigration rate is among the highest in the world. Extensive farming of coffee and cocoa is established. Nearly, one active on two Ivorian becomes farmer. The price stabilization fund (Caistab) single public authority of the coffee / cocoa sector, has had a decisive role. It allowed remunerative prices both in the international market, playing a role of storage for farmers.

4.1.2. Stabilization Policy in Producer Prices (1960 to 1998)

Since 1960, Côte d'Ivoire opted for a stabilization of producer prices. This policy was interest to ensure a constant but low revenue producer, and use the difference of the price compared to international prices, for public investments. In 1975 to 1977 the world cocoa prices increase respectively third and fourth time for cocoa and coffee. Caistab don't reflected this upward price to producers 'immediately. The government use the surplus of money, for an important investment programs, by creating numerous public companies (in agro-industrial sector in particular). The country became the most industrialized country in Africa, a part of South Africa and the Maghreb, with a GDP per capita reached to $ 2,237 in 1978 (it is now less than $ 800).

4.1.3. Agricultural Diversification and Agro-industries Development (Since 1970)

In 1970s, the government tried to correct regional imbalances through major projects like improvement of the Bandama Valley (AVB). The objective of those programs was to diversify agriculture production, by developing other export crops (oil palms and fruit in the south, cotton and irrigated cane in the North) and promote food production, that of rice, but also mainly the production of animal proteins. They were conducted mostly through state companies (SODE). The model returned fairly quickly into an economic, financial, environmental and social crisis. Revenues from exports products collapsed. They were too dependent on international market prices. The government did not have the means to pursue its investments. The social contract between the different actors has been shattered. The crisis has become social and general. They focused on the means of production (primarily land) and on income distribution. The social crisis has led to the end of a model of openness.

Despite the crisis, despite recent events, the Agriculture sector remains a powerful. The power of agriculture is also reflected in subsistence agriculture, developed in response to the food needs of cities. The degradation of soil fertility requires the intensification of the agriculture. Production systems are too extensive and too dependent on forest land and labor qualify or educated. The geographic diversity allows the country many productions, both for raw materials and food for people in the regions. The Infrastructures are good quality even if they require maintenance. The food chain are built with strong potential for transformation. The support mechanisms for agriculture exist even if they are to be renovated.

The country lead on a strong engagement of the government, linked to a clear perception, a vision of the importance of agriculture to the country's development. The entrepreneurial spirit and dynamism explain the responsiveness of agriculture sector to the market incentives and public policies.

4.1.4. Structural Adjustment Program (SAP) from 1980 to 1996

Since 1980, the drastic decline in international prices of agricultural products and the deterioration of terms of exchange of these agricultural products lead the country into a financial crisis. The country thus goes into debt to maintain the viability of infrastructure. But the deficit of the trade balance was so deep, that the Bretton Wood institutions have subjected the country to a structural adjustment program, which consist of reducing investment budgets, reducing the number of agricultural extension structures, the crown corporations, as well as their operating budgets. [19]

4.1.5. Devaluation of the Local Currency the CFA Franc in 1994

In order to rebalance the trade balance for a long time negative, and thereby improve the state's revenue, the local currency was devalued by 50%. Unfortunately, as agricultural products are inelastic goods, the expected impact of this monetary policy which was to increase demand for agricultural export products and, in turn, government revenues, was not significant and sustainable. Indeed, it has relieved the economy for 2 or 3 years and the crisis has re-established.

4.1.6. Privatization and Liberalization of Agro-industrial Sectors Since 1998

In order to stem the economic crisis which has created the seeds of social tension, the government decided to break with the stabilization of producer prices by dissolving the State Company in charge of this policy, the Stabilization Fund (Caistab) in 1998; In favor of a minimum price policy. Then sell the state companies to foreign capital, and allow producers to enter the boards of directors of these companies through the sale of shares. This new agricultural policy will lead to further negative turbulence in the agricultural landscape, to the organizational level of the producers, to the

management performance of the big business by producers who are not prepared for these new responsibilities and to compete between family agriculture and capitalist agriculture (agro-industrial).

4.2. Impact of Policy on Deforestation and the Environment

Before presenting the consequences of macroeconomic policies on deforestation, we will present, in a more precise manner, those related to the search for a new economic equilibrium and the standard of living of the populations.

4.2.1. Consequences of Policies on the Search for a New Balance

Nevertheless, a number of challenges can be identified. They relate mainly to the "development model" insufficiently taking into account environmental issues according to reference [1] Another question is related to the conditions of adaptation and coherent of a global project (modernization of production systems of family farming in synergy with the initiative of firms for the development of food factories sector) to diversify the situations in a perspective of transition. In fact, it is daily operationalize the guidelines given to manage the balances, necessary for sustainable development: balance between modernization objectives and maintaining rural employment; regional balance; balance between family farming and agribusiness; balance between industrial and food production; balance between centralized marketing and short circuits; balance between consumption and market integration.

4.2.2. Impact on the Standard of Living of Populations

In summary, after two decades (1960-1980) of strong economic growth (an average of 6% per year), the country has entered a period of economic and financial crisis. Since 1980 economic growth fails to consistently exceeding the growth rate of population is 3.3%. This then results in a lower standard of living. The data from the various surveys on the living standards of households by reference [20], indicate a strong increase in poverty from 1985 to 2008. Indeed, while poverty hit 10% of the population in 1985, it touches 32.3% of the population in 1993. Despite the economic recovery that took place after the 1994

devaluation, people's living conditions have not improved. The incidence of poverty reached 36.8% in 1995, 33.6% in 1998 and 38.4% in 2002. The socio-political crisis that crossed the country plunged thousands more people below the poverty line, bringing the poverty rate to 48.9% in 2008. The crisis in the agricultural sector has been the determining factor of the economic recession affecting the country since 1986 and the serious problem of foreign debt. The economic crisis, combined with the high population growth, led to a sharp deterioration of the population's living standards.

4.2.3. Impact on Forest Land Situation

Because of the lack of quality data on the real deforestation effects, due to both the deficiencies of the Ivorian statistics system and the recent nature of these macroeconomic measures, that give us step back and examine the current process, results of our analysis often carry assumptions made based on:

- Observation of recent trends in Côte d'Ivoire and explanatory concrete mechanisms of these trends;
- Logical reasoning a priori on the changing behavior of economic agents, supposed to be rational in the sense commonly understood economic theory, face the measures analyzed.

Before the devaluation of 1994, the question of the impact of macroeconomic policies and, structural adjustment on the environment in Côte d'Ivoire has been the subject of little specific analyzes. The Ivorian center for Economic and Social Research (CIRES), on one hand, and reference [19] on the other hand, however, possible to provide a first insight into this. At the most general level, the analysis made by reference [19] sums up the situation: the agro-export growth model promoted in Côte d'Ivoire in the early 1960s, driven by incentive and stabilizing price policy (maintaining a guaranteed price), whose primary objective was to increase exports of cash crops in order to improve the level of national income (and from 1980, the internal and external balances), resulting in a sharp increase in agricultural land (agricultural area is reduced from 6% of the country in 1965 to 23% in 1989 and 39.8% around 2014), extension achieved mostly at the expense of forest cover (average deforestation rate of 300,000 ha / year in the 1970s).

Table 5. Evolution of the types of land use between 1969 and 2004 (in ha). [6].

Types of land use	1969		2014		Variation (%)
	ha	%	ha	%	
Country areas	32 076 300	100,0	32 076 300	100,0	
Dense Forest	10 364 198	32,1	3 157 048	9,8	- 69,5
Degraded forest	6 375 927	19,8	4 971 932	15,4	-22,0
Degraded forest Non denseForest and tree savanna	1 364 013	4,2	1 513 263	4,7	+10,9
Wooden Savannah	7 026 463	21,8	8 133 732	25,2	+15,8
Cultivated area and fallow	5 489 778	17,0	12 828 239	39,8	+133,7
Infrastructures and naked grounds	1 625 821	5,0	1 641 986	5,1	

The reference[21] adds that the low level of stumpage fees and development charges has in turn provided incentives to mining timber, which itself, through routes access created for

timber extraction, facilitated the penetration and clearing of forest land by peasant populations. In 1988, the cost of various taxes and fees that loggers had to pay represented

18% of the FOB price of wood.

Beyond the quantitative increase in production of agricultural commodities the statistics show (which requires constant yield an increase in cultivated area), the expansion of the "agricultural frontier" is in large part by maintaining traditional extensive and itinerant agricultural practices. If the years of strong growth during the post-colonial era have not been utilized to improve the technical level of agriculture, it is for two reasons: the first is the relative abundance of virgin land (including forestry), which, for lack of land regulation and appropriate protection, were of a very low cost of access; the second the result of insufficient development of agricultural income, not allowing the shift to more technical users of capital and productive. This means in plain that the policy of encouraging the production by agricultural prices favored an increase in production without allowing an intensification of agriculture, mainly because of the weight of the tax burden on the agricultural products. Political accountability is here obvious because:

• Arbitration in favor of the income of the urban population, on the one hand has the effect that discriminatory relations between urban and rural populations are unfavorable to the latter, prohibiting any intensification;

• An absence of the thrust control of agricultural land, including forest area.

In addition, clearing for agricultural purposes, facilitated by pathways created by the industrial extraction of timber, have been encouraged for a long time by a conquering ideology of development ("pioneer fronts"). In the wake of the clearings,

and in a few years, there was the loss of soil fertility and erosion under the impact of climatic factors. Thus the lands were left in fallow after three or four years of annual crops. The conversion to coffee and cocoa plantations delays the phenomenon of soil depletion but does not cancel it.

The described dynamic substance is as follows: macroeconomic policies aimed at promoting the development of extensive cash crops thanks to a double incentive pricing action: first, lowering input prices (which had the effect of reducing operating costs, all things being equal), and secondly, maintaining a guaranteed purchase price to the producers. This policy of encouraging the development of agriculture, taking into account the farming practices implemented (extensive agriculture), has resulted in an increased of pressure on the environment, mainly on the forest and the soils.

To farmers, the forest is indeed a source (so far inexhaustible) of land with good agricultural potential, also easy to exploit because unregulated and uncontrolled. This abundance of virgin land, offered to whom takes the trouble to conquer them have little incentive to sustainable land management. However, we can consider that the effect of the lower cost of inputs (fertilizers and pesticides) had a negative and marginal impact (pollution) on the environment, to the extent that the amounts used by surface unit remained modest. The foresters, from their part, were never incited to manage durably their concessions, so that the exploitation of mining type was the rule within the professionals.

Figure 2. illustrates the actual evolution of forest and agricultural areas since 1960.
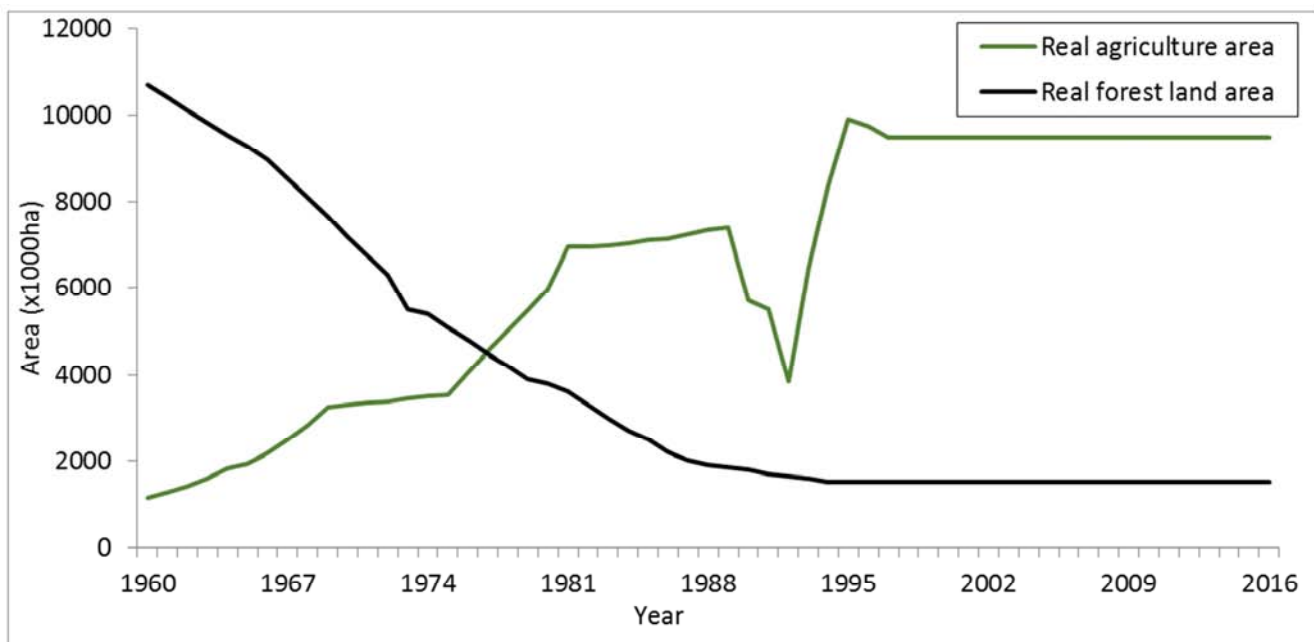

Figure 2. Trends in the actual area of forest stocks and cultivated areas.

4.2.4. Determinants of Deforestation

To identify the determinants or causes of deforestation, we proceed to a multiple regression as already stated in the methodology. The results of this regression are compiled in Table 6 below.

Table 6. Correlation relative to changes in deforested area or culture.

Item	PARAMETERS					
	Constant	Standard deviation	Number of observations.	R^2(%)	Fc	DF
Demography	12549.16	406.71	55	91.96	337.46	54
Cassava, prod.	199.79	16.88	54	3.16	146.46	53
Rice, prod.	58.29	39.13	54	68.97	71.11	53
Rice, prices	207	40.6	54	38	19.95	53
Coffe, prod.	400846.8	168166.8	55	14.77	5.72	54
Coffee, prices	677603	96789.17	55	4.95	1.72	54
Cocoa, prod.	327042.9	50258.58	55	86.66	214.49	54
Cocoa, prices	401843.6	84234.08	55	63.72	54.97	54
Palm Tree, prod.	80112.94	15421.4	55	0.05	0.01	54
Palm, prices	20305.68	718.84	55	68.90	73.12	54
Rubber, prod.	9336.94	1757.39	52	87.51	210.21	51
Rubber, price	-5305.96	4064.22	52	73.33	82.46	51

NB: R^2: Correlation coefficient; Fc: f calculated; DF: Degrees of freedom.
Note: The dependent variable is the area of the forest. The independent variable is whether the population, crop production or crop prices. Items who's R^2 are above 50%, indicate that, this element is closely correlated to deforestation.

Factors explaining the drastic reduction in the current forest, are in ascending order: the demography, the income (international trade) and the agricultural policy. Indeed, in the light of the calculations of regression which were made (Table 6), on one hand, on the evolution of the population and the deforested total surface; and, on the other hand, on the evolution of the production or the price of agricultural products and surfaces cultivated of every product, we are allowed to advance that agriculture and demographic change have been largely responsible for deforestation.

With the exception of cassava which R^2 was low (3%), all other factors (production and / or prices) were responsible for deforestation, according to Table 5; especially the population for whom R^2 was around 92%. This confirms the comments made by reference [22] on the main causes of deforestation illustrated by econometric models.

It is clear indeed that the population growth leads to higher demand for agricultural products, which, according to the technology will be more or less processed. The satisfaction of a part of this demand by imports is conditioned by the government policy of Food self-sufficiency, economic structures of the country and its ability to drain external resources. If the national foodstuffs supply increases, the demand for new land will be based on the improvement of the productivity of the farming sector.

Population growth is also reflected in an increase in domestic demand for timber and wood fuel. It causes a further increase in labor supply. If there is no opportunity for off-farm employment, it will be absorbed mostly by agriculture, resulting in increased of demand for land, depending also in productivity in this sector. The state revenue exclusively from exports of agricultural or agro-industrial products, have led it to encourage farming activities with low yields at the expense of the forest considered an inexhaustible resource. The country being integrated in international trade and as a result for the deterioration of the terms of trade, the state has had to encourage more production to get a higher income. In feedback to the increase in production, prices fell, and the country had to produce more through extensive agricultural activity, to the detriment of forest lands.

The poverty led the rural population to use more and more resources to increase its income. But, as the production increases at the expense of forest land, prices fall according to the law of supply and demand. And the more the poverty settles down, more new technology becomes increasingly inaccessible, intensifying increasingly impossible and the development increasingly compromised. Thus, it can be argued that the institutional and economic context explains the increasing pressure of the rural population on the natural environment, a trend that was amplified later with the worsening economic situation in the 1980s.

In times of economic crisis (characterized by a reduced income and a reduction in access to public services), the survival instinct prevails and leads to pull the indispensable immediate environment riches by hunting and occupation of classified forests. With specific regard to structural adjustment policies (SAPs) carried out in 1981, the authors of the White Book considers that the measures advocated in the context of the implementation of successive adjustment programs were a continuation and encourage (through fertilizer subsidies and seed) development of cash crops.

Such an approach, supported by the incentive policy by prices set to the producers and the dynamics of extensive farming, designed economically, was not concerned with the environmental aspects in particular about important forest clearings consecutive to the extension of the orchards of coffee trees and cacao trees. The following section will concern the evaluation of the environmental impacts.

4.3. Assessing the Environmental Costs of Macroeconomic Policies

The works of evaluation of the environmental costs according to reference [3] are still in its infancy in Côte d'Ivoire, and no serious attempt was made to determine the cost of the environmental degradation. The first estimates available were established in the report of the World Bank "Towards sustainable development - Côte d'Ivoire". These estimates have focused on the following priority areas:

- Timber loss;
- The loss of biodiversity;

- Soil degradation;
- The degradation of water quality and health problems that result;
- Coastal erosion.

The table below indicates, for each domain, the method used and the cost estimated monetary value of the environmental degradation.

Table 7. Method and evaluation of environmental costs in priority areas.

FIelds / Items	Method	Costs (US $ 1,000 / year)
Forest	• Multi-criteria evaluation • Willingness to pay	6700-44000 *
Loss of biodiversity	• Willingness to pay	1000-100000
Land degradation	• Replacement cost of mineral elements and loss of fertility + indirect costs (silting)	300000-400000
Air pollution inside the premises.	• Costs of treatment of diseases associated + costs of lost productivity.	300
Degradation of water quality.	• Cost of avoidance expenditures: treatment of diseases associated + water bottles expenses + cost of treatment / water sanitation; • Willingness to pay.	-------------------
Coastal erosion	• Willingness to pay	25
TOTAL	Together	308025-544325
Cost / GDP in 2015	--------------------------------	1.54 to 2.72%

NB: * the lowest value corresponds to the assumption of maintaining soil productivity, the highest value corresponds to the abandonment of land cleared after three years of cultivation.
** 2015 GDP: US $ 20 billion. Source: [3] and calculation of the author.

The estimated environmental cost attributable to the implementation of macroeconomic policies has a threefold purpose:

- notify public authorities on the scale of the costs associated to the lack of consideration of the environment;
- Alert the authorities about the magnitude of costs associated with the lack of the environment into account;
- Enable them to define priorities for action in the field of the environment from product evaluation components;
- Provide information on the cost of policies or actions to promote to limit these costs, in order to compare these costs with the benefits resulting from their application.

In general, the estimated annual cost of the damage is in the range from 308 to 550 million US $, or 1.5 to 2.72% of GDP; which is huge as financial loss. The methods used to achieve this differ from one area to another as indicated in the table above.

4.4. Opportunities in Agriculture

It is important to advance that there are opportunities for agriculture. Indeed, from the perspective of the potential offer, it is certain that with a favorable macroeconomic environment and an economic policy appropriate to stimulate the sectorial growth taking of course into account the need to ensure the conservation of environmental; Ivorian agriculture can meet the challenges and opportunities related to international demand. Indeed, many tropical products of countries of West Africa have a comparative advantage in the world markets. This is particularly true for Ivorian traditional exports such as coffee, cocoa, cotton and rubber. Domestic resource cost coefficients (Domestic Resource Cost - DRC) for these products are very favorable and the gap between actual and potential yields remains significant (Table 8).

The Côte d'Ivoire also has a great potential as regards certain non-traditional products for which the market is expanding rapidly (fruits, vegetables, flowers and other non-traditional agricultural products). Finally, the Côte d'Ivoire enjoyed favorable growing conditions for most food products where domestic demand is growing rapidly in parallel with the high population growth (3.8% currently). The substantial gap illustrated in Table 8 between current and potential yields, for most of the products, reflects the important possibility to increase agricultural exports and enhancing food security.

From the point of view of the overseas market, according to the World Bank, we expect that the global demand in traditional Côte d'Ivoire farm produces increases at the annual moderate rate of 2-3% over the next ten to fifteen years. The price prospects for these products should also be moderately favorable, the prices of the cocoa recovering gradually by year 2020 and those of coffee must stabilize at an average level following the fit which they know at the moment. The major challenge will be to capture market share by offering more competitive prices and better quality products. The increase in production of cotton, rubber and coffee seems feasible, as the share of the international market as the Côte d'Ivoire holds for these speculations is low. This is perhaps less safe for regard to cocoa, since the Côte d'Ivoire already dominates the world market. Thus any increase in production beyond the increase in world consumption (3-4.5%) should exert downward pressure on world prices.

However, the devaluation is being reflected in a strengthening of competitiveness, an increase of coffee production would allow Côte d'Ivoire to get back to its part of the market, as the Ivorian Robusta does not compete directly with Arabica whose production is in surplus. However, there is the problem of decline in production potential due to aging of the Ivorian plantations. In all cases, to obtain parts on market slowly evolving and very competitive, it is necessary to reduce costs and provide

higher quality products.

Thus, for most agricultural exports (excluding cocoa) Côte d'Ivoire will have to develop new niche in the international market if it wants these products to be the engine of global growth in the sector at a minimum rate of 4% annually. Much of this growth will come from exports of non-traditional agricultural products, for which the country fortunately has a solid potential, particularly as regards promising products such as exotic fruits, vegetables, flowers and ornamental plants.

***Table 8.** Yield potential of major crops (tons per ha) [2].*

	Experimental station	Real yield in the farms	Potential
	(tons / ha)	(tons / ha)	Yield (%)
Export Crops			
Cocoa	3.0	0.5	17
Coffee	2.0	0.25	12.5
Cotton	3	1.4	47
Palm oil	18	9	50
Rubber	2.2	1.8	82
cashew	2	0.5	25
Pineapple	60-70	30-35	50
Banana	55-60	30-35	58
Food Crops			
Upland rice	4-5	1.2-1.5	30
Irrigated rice	8-8.5	2.5-3.5	31
Corn	6-11	2.5	23
Sorghum	2.5-3	1.0-1.2	40
Mil	1.5-2	0.6	30
Yam	20-50	8-16	32
Cassava	15-35	8-12	34
Peanut	1.8-2.5	0.8-1	40
Plantain	50-60	20-30	40
Total	---------	--------	37.8

Côte d'Ivoire is already exporting a large quantity of pineapples and bananas, mainly to European markets. Ivorian producers are dynamic and have at their disposal structured marketing channels, efficient transportation and a solid infrastructure services (including financial services) which favor them compared with the majority of the African countries. It is clear that an incentive policy and appropriate institutional measures, the Ivorian producers could develop their competitiveness and increase their world market shares for some basic agricultural products. Côte d'Ivoire also exports small quantities of exotic fruits and tropical flowers for which demand is low, but in strong expansion (mangoes, papayas, limes, orchids, etc.).

Entrepreneurship, the ability of production / marketing and the existing infrastructure in the country constitute a solid basis for the development of these export products, as well as other horticultural products, for which the country has an advantage comparative, especially in the European markets of against-season. Although small at start this sector could become a crucial element for accelerated future growth of the agricultural sector. From the perspective of domestic demand, according to the World Bank, the population growth, increasing urbanization and rising incomes will be the determinants of demand for agricultural products on the internal market. The average rate of population growth over the next ten years is estimated at 3.8% (dropping to 3.3% between 2013 and 2028).

In urban areas, the growth will be much faster than in rural areas (5.8% and 1.8% respectively) and the rural / urban population ratio will fall by more than half. If the annual average increase of the per capita income is situated in 2%

and if the average elasticity of the income dedicated to the food is 0.3%, the global domestic demand for foodstuffs will increase by 4.5% a year. This great evolution of the domestic demand represents at the same time an opportunity to improve the agricultural income and put a challenge for the increase of the productivity. If this challenge is not raised, the food imports will increase, which will have negative consequences on the balance of payments. As Côte d'Ivoire has now a realistic exchange rate, it is well positioned to continue, without having to resort to protectionism, to ensure food security equal to that which it has always had.

However, an extroverted trade policy must necessarily be accompanied by a dynamic productivity growth. Following the analysis of all these results, we believe that all stakeholders involved in the use and management of this resource are challenged, to the extent that the continual bad management can only lead to compromise seriously the development of this country.

5. Conclusion

It appears from this study that the agriculture sector is diverse regarding crops and production systems, the most dominant is the traditional system (extensive). This sector is vital to the Ivorian economy from the standpoint of revenue provided to the State and the number of stakeholders. Also, agricultural practices have not been able to ensure the sustainable management of natural resources of the country, including the conservation of primary forests now in a fast disappearing. For the development of the agricultural sector induced by macroeconomic policies has been to the

detriment of forest lands. Population growth negatively impact on deforestation. This enables us to advance that introduced policies to revive the economy have only increased the extensive production system, which leads to deforestation and ecological imbalance. Despite all the investment in the agricultural sector, crops are only 38% of their potential. The environmental annual costs were estimated at 2.72% of 2015 GDP, or 545 billion FCFA. However there is hope thanks to the opportunities of the agricultural sector.

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