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THE METHODS OF IMPROVING THE AGRICULTURAL PRODUCTION IN THE IVORY COAST

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DECLARATION

I am declaring, that the diploma work on the topic „The methods of improving the agricultural production in the Ivory Coast" I have used only the sources quoted in reference.

Set up separately and used only sources that the quote in enclosed list literature.

In Prague,

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CONTENT

LIST OF ABBREVIATIONS

CAISTAB	Society for Verification Prices, Gualities and Agricultural Export
CFA	Financial African Company Currencies (1€ = 655.955 CFA)
EUROSTAT	European Statistical Office
FAO	Organization OSN for Food and Agriculture
GATT	Universal Agreement on Duty and Business
IMF	International Monetary Fund
HDP	Gross Domestic Product
HZP	Gross Agricultural Product
IRHO	Institution Research Oils and Oilseeds
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
PALMINDUSTRIE	State Organization Forth Development Oil, Cocoa Pal Mand Copra
SWOT	Strengths - Weakness - Opportunities - Threats
UN	United Nations

THE LIST OF TABLES AND FIGURES

ABSTRACT

This document has been written as a graduation thesis at the Institute of Tropics and Subtropics at Czech University of Agriculture in Prague. The topic is "The methods of improving the agricultural production in the Ivory Coast".

Agriculture is the oldest economic activity. The history of agriculture is a major element of human history, agricultural progress has been a crucial factor in worldwide social change, including the specialization of human activity when farmers became capable of producing food beyond the needs of their own families, others in the tribe or nation or empire were feed to devote themselves to something other than food acquisition.

It has developed along side the development of human society. During this period of development it has had continuously an irreplaceable role.

The agriculture sector continued to contribute to the overall development of the economy and remained resilient despite the economic slowdown. The development thrust of the sector was to improve the levels of productivity, competitiveness and dynamism, and hence incomes, through greater commercial orientation and the wider adoption of new technologies and modern management systems.

The agriculture development programmers were aimed at expanding production of food commodities to improve the food trade balance, increasing export of industrial commodities and ensuring sustainable supply of raw material to support the growth of domestic agro-based industries.

Agriculture of Ivory Coast plays a remarkable role in its national economy, where it participates dramatically in the production of Gross Domestic Product (GDP). The agricultural policy has been focused on the specialization of export products.

The primary aim of this work is an analysis of contributions to improving agricultural production in the Ivory Coast.

1 Introduction

Agriculture production is indispensable and basic part of human society from its very beginning. In a human history it is seen as a basis cause of revolutionary improvements in society development in a period from tenth to third millennium ad. (Neolith) Man started intentional cultivation of plants and it led to structure changes as movement from picking and hunting (collection of food) to plant domestication (wheat, barley, corn, millet) and lather domestication of animals (first sheep goats and later cattle and pigs. This initiated development of new technologies (craftsmanship) and lather it lad to founding stable sidles and development of "first civilizations" (third millennium ad) abundance of food implied development of new society life aspects, mainly culture and religions based on archeologists finding we may date first traces of agriculture to eighth millennium and mainly on Near East and Asia Mexico, Peru.

The long time from the beginning of first civilizations did not diminish the importance of agriculture. Agriculture was always a supplier of food for the people and raw material for subsequent processing and in the same time was main economic activity in habitants living outside the city.

Today agriculture and its contribution to society are undergoing structural changes which, according to some authors, we may compare to Neolithic revolutions on its beginning. There is no unified approach to agriculture it differs in relation to economic development of particular country. It is important part of national economic as a source of food, raw material and employment for countries with low developed economic while agriculture in developed countries has far different dimension. In this countries agriculture is loosing its priority in quit a short time of one millennium because of globalizations, world trade liberalization and because of putting and accent to "sustainable development" of society and with respect to the environmental aspects and development of other parts of national economics. Agriculture production stays unique producers of food but this function has lawyer importations in develop world as reactions to above mentioned factors. Other functions of agriculture, related to its influence to the environment, have higher importance in relation to its influence to the environment landscape and social development in the country. Agriculture was almost equal partner to other sectors of national productions to first half of 20th century. But new it is a sector which is not competitive to the production in secondary and tertiary sphere. Because of differences in commodity markets and in relations to above mentioned functions. It is a sector which in developed countries currently needs protection through tools so called "agriculture politics." This politics is called professionalism and it is criticize by many economists. Practical tools of protectionism are mainly

protective polices of nationals sectors against competition, supporting subsidy policies including specific price policies, and regulatory actions into agriculture sector (Bohacova, 2004).

The agriculture production of Ivory Coast is important part of his national production. Agriculture politics is concentrated on a specialization of exported goods in a frame of liberal politics. This is advantageous for the producers and was based on motivation of price and supporting policy of rural areas and helped to reach satisfactory results of production growth.

2 Background

The Republic of Ivory Coast lies on the west coast of Africa, with Ghana to the east, Liberia to the west and Guinea, Mali and Burkina Faso to the north. The country, with its capital at Abidjan, is divided into 26 administrative departments grouped into six regions with their regional centers as follows: Nord (Korhogo), Centre (Bouaké), Ouest (Man), Centre-Ouest (Daloa), Est (Abengourou) and Sud (Abidjan).

Human population, land and socio-economics

Human population	16.4 million
Population density in total land	51.5 persons/sqkm
Annual growth rate (1990-2000)	2.1 %
Population in agriculture	47.0 %
Total land area	318,000 sqkm
Agricultural land	199,000 sqkm
Land under pasture	130, 000 sqkm
Irrigation area	730 ha
Agricultural land per 100 people	122 ha
GDP	12,810 million US $
GDP annual growth rate (1990-2000)	2.3 %
GDP per capita/year	776 US $
GDP per capita annual growth (1990-2000)	-0.4 %
Agriculture, GDP 3,	353 million US $

The history of the country as a political unit dates from 1893 when it becomes a colony of the French Empire. Without the consent of the people most closely involved and for administrative convenience, more than fifty ethnic groups, with many different languages, were brought together in a political entity called the Ivory Coast. Agreements determining the eastern and western boundaries of the colony were signed with Liberia and Great Britain at about time, while the northern boundary was not established until 1947.

In 1900 France initiated a policy of economic self-sufficiency for its colonies. Each colony was made responsible for raising the funds for its own administration and defense, while France was to

offer assistance when needed. The Ivory Coast with a flourishing trade had little difficulty in complying for other countries, especially the landlocked ones; the new procedure posed difficult problems. In 1904 this situation resulted in the formation of the federation of French West Africa, which encompassed the territories known today as Mauritania, Senegal, Mali, Ivory Coast, Niger, Guinea and Benin. The economic purpose of the federation was to pool the resources of all French West African colonies and make the richer ones help support the poorer. The Ivory Coast, however, objected to the fact that it had no direct control over the distribution of funds. Other economic grievances developed over time. In the period between the two World Wars the expansion of coffee and cocoa production gave rise in the Ivory Coast to an African planter class that competed with the European planters. During World Wars II, with production quotas and intensified recruitment of forced labor, resentment grew.

French colony policy in principle, applied a theory of assimilation, which was based on the assumption that all men are equal and thus should be treated alike. It condemned slavery and colonial exploitation. The assimilation policy meant extension into the colonies of the French language, institutions, laws and customs. The French trained native elite in their administrative practices and this corps in turn formed an intermediary group between the French and the Africans. This policy of assimilation, together with the lack of unity among the individual ethnic groups is probably largely responsible for the absence of major outburst of violent nationalism. It is also probably the reason opposition to colonial status centered mainly on economic grievances. By the late 1950s the local political leaders realized that assimilation could in fact never be achieved and that real equality could be obtained only through independence. In August 1960, of its own choice, the Ivory Coast withdrew form the French Community. This was done quietly and without economic disruption.

Close ties to France since independence in 1960, the development of cocoa production for export, and foreign investment made Ivory Coast one of the most prosperous of the tropical African states, but did not protect it from political turmoil. In December 1999, a military coup - the first ever in Ivory Coast's history - overthrew the government. Junta leader Robert Guei blatantly rigged elections held in late 2000 and declared himself the winner. Popular protest forced him to step aside and brought runner-up Laurent Gbagbo into power. Ivorian dissidents and disaffected members of the military launched a failed coup attempt in September 2002. Rebel forces claimed the northern half of the country and in January 2003 were granted ministerial positions in a unity government under the auspices of the Linas-Marcoussis Peace Accord. President Gbagbo and rebel forces resumed implementation of the peace accord in December 2003 after a three-month stalemate, but issues that sparked the civil war, such as land reform and grounds for citizenship, remain unresolved. The central government has yet to exert control over the northern

regions and tensions remain high between Gbagbo and opposition leaders. Several thousand French and West African troops remain in Cote d'Ivoire to maintain peace and facilitate the disarmament, demobilization and rehabilitation process (Kozel, 1990).

2.1 The agricultural development

Agriculture was the foundation of the economy and its main source of growth. In 1987 the agricultural sector contributed 35 percent of the country's GDP and 66 percent of its export revenues, provided employment for about two-thirds of the national work force and generated substantial revenues despite the drop in coffee and cocoa prices. From 1965 to 1980, agricultural GDP grew by an average 4.6 percent per year. Growth of agricultural GDP from coffee, cocoa, and timber production, which totaled nearly 50 percent of Côte d'Ivoire's export revenues, averaged 7 percent a year from 1965 to1980 (Kozel, 1990). Contributing to this impressive performance was an abundance of fertile land, cheap labor, the collective efforts of many farmers cultivating small plots, relatively favorable commodity prices and a stable political environment.

Success in the 1960s and 1970s overshadowed major problems developing in the agricultural sector. By the late 1980s, despite efforts to diversify its crops, 55 percent of Côte d'Ivoire's export earnings still came from cocoa and coffee. Moreover, highly volatile world markets for both commodities caused sharp fluctuations in government revenues and made development planning difficult (Kakwani, 1990). In addition, Côte d'Ivoire was not yet self-sufficient in food production and imported substantial quantities of rice, wheat, and red meat. Finally, despite an enormous increase in the volume of agricultural output since independence, there was little improvement in agricultural productivity. To achieve higher production figures, traditional farmers using traditional technologies simply cleared more and more land.

To overcome Côte d'Ivoire's excessive dependence on coffee and cocoa (the prices for which were set by consumers), on timber (the supply of which was nearly exhausted) and on imported food, the government in the mid-1970s embarked on a series of agricultural diversification and regional development projects with the hope of boosting agricultural production by 4 percent per year (Kakwani, 1990). The plan, estimated to cost CFA F100 billion per annum (with just over 50 percent coming from foreign lenders) would allow the country to become self-sufficient in food (with the exception of wheat) and expand (Kozel, 1990).

The sharp increase in the importation of sugar, rice, and animal products demanded by the urban population, especially in Abidjan, the state set new goals: increase production to decrease imports, and in some cases even produce enough for export. This latter goal was achieved for sugar through the establishment of several

costly public agro-industrial compounds, run by SODESUCRE, in the savanna zone. For the other product, two new state companies were created, but they did not show very impressive results. In the animal sector, the industrial farms are doing well, with modern private swine and poultry farms, public and cattle ranches. For rice, high guaranteed farm-gate process provided great encouragement for cultivation, but because the processing and marketing structures were too weak to cope, financially or physically, with the production increases, the producers finally become discouraged. During the 1970s, up to 1977-1978, the international market for export crops continued to progress nicely. The traditional crops were grown without state aid. Production increased at about the same rate as the population. Plantain bananas and root crops (yams, cassava) primed in the most densely populated area, the forest zone. Maize and other cereals (millet, sorghum) were predominantly found in the savanna.

In conclusion, its effectiveness is attested to the fact that the national average agricultural production growth rate 3.9 % per annum. This sector is by far the main source of employment (79 % of economically active population was employed in agriculture in 1980) and generates on average about 90 % of the total export earnings. For certain products results have been spectacular. Ivory Coast has become the world's largest producer and exported cocoa, the third largest coffee exporter, and is now becoming the largest African producer of palm oil and the leading producer of cotton and sugar of West Africa.

2.2 The production conditions

Production conditions for agriculture

As every production material estates, requires even production agricultural the conditions. These conditions we can divide on the conditions economics and natural.

The Economic conditions for agriculture

The economic conditions for agriculture constitute complex different factors; the priority from them is capital. It is concerned the resources that coming from the external sources. These sources they may constitute the state resources, the bank's loans, the sources intended agriculture from state budget.

In agriculture works 2/3 population and on GDP partake from 1/3. Unemployment notching 13 %, inflation is low, economic growth is all the time in red numbers, measure indebtedness be high (over most half HDP).

2.3 The natural conditions for agriculture

The natural conditions representative main and decisive groundwork for agricultural basic industry.

2.3.1 Climatic conditions

Ivory Coast has 3 climatic zones:

Southern doldrums climate, along foreshore. These climate conditions features temperatures from 21 ºC to 33 ºC, a higher percentile dampness (80 90 %) and rainfall that reaches as far as 2.500 mm in some areas within a 140 day span.

The climate is separated into 4 periods:

- the drought period: between December and April, the temperature is more than 25ºC,
- the big rainfall period, from May until July,
- the short dry spell, from mid July to the end of September,
- The short raining season, in October and November.

Damp tropical climate, with overbearing woods and savannas. The temperature ranges from around 14 ºC to 39 ºC. The percentile dampness is 70 % and the rainfall ranges from 1.000 to 2.500 mm.

The climate is separate into 4 periods:

- 2 raining seasons with a large amount of rainfall from mid July to the end of October and the period with a smaller amount of rainfall from mid March to the middle of May
- 2 dry terms, from November to the middle of March and from May to the middle of July

The zone Sudanese climate, where predominate savannas with the exception of the southern part. This zone has 2 periods: the raining season from July to November and the dry spell from December to June, with a small amount of rain in April. „L'harmattan" – cold and dry wind, derivable from northeast parts of the country blow for several weeks throughout December and February, L´ Agriculture Ivorian Aujourd´hui (1982).

2.3.2 Field conditions

A large part of The Ivory Coast has a monotonous surface, which begins from the southern coastal plain and continues as far as its hilly country. Its mountains lie only in the western and northwestern areas of the country. The biggest mountain is Mont Nimba (1.768 m), which is situated on the boarder of Liberia. There is a little broken seaside with cliffs, in the East there is sand and most of the area has scallop - edged zone lagoons. The Ivory Coast has many rivers that mostly flow northern southwards

and flow into to the Atlantic. Best known rivers are Bandama (950 km), Komoe (900 km), Sassandra (650 km) and Cavally (600 km).

2.3.3 Soil conditions

The Ivory Coast has a total area of 32 million hectares. From this, the agricultural land presents approximately 7 423 000 hectares. The arable land and its lasting culture makes up 23, 1 %, 1, 0 % irrigated soil 76, 8 % grassland, woods and other soil, most of the area is made up of forests. Animals often graze in the North Country. At present, approximately 0, 50 ha agricultural soil falls on every inhabitant, virtually in the same way 0, 46 ha arable soil and 0, 0048 ha watered soil, which is very low. For agricultural development it is important to escalate share watered soil. The quality of soil resources, especially arable soil is given by the depth of arable land, content of humus and nutrient reserves.

From the general agricultural surface, merely 12, 7 % is arable soil, including surface perennial products. Grassland 40, 9 % and vet 34, 3 %. In this way soil cultivation dominates stale, after 3-4 years of soil cultivation it is then left to rest to renew its fertility so it can be used again in the future.

2.4 Structure of land resources

Table 1 - Structure of land resources

Land use (1000 ha)	Year				
	1999	2002	2003	2004	2005
Total surface	32 246	32 246	32 246	32 246	32 246
Land area	31 800	31 800	31 800	31 800	31 800
Agricultural land	19 750	19 800	19 700	19 900	19 900
Arable land	3 050	3 100	3 100	3 300	3 300
Grassland	13 300	13 000	13 000	13 000	13000

Source: www.faostat.fao.org

2.5 Structure of farmer's inhabitants

At present, 14, 5 million inhabitants live in the Ivory Coast. The density of settlement is 43 inhabitants/km2. The biggest part of the population is peasants. In the Ivory Coast there are many

private farmers, who get their family members to helper they employ part-time farmers. On large plantations a whole family of farmers is employed to help out.

Table 2 - Structure of inhabitants

	Inhabitants		Economically active inhabitants		
Inhab. (thousands)	Total	Inhab. in agriculture	Total	Inhab. in agriculture	% Inhab. in agriculture
1990	12 505	7 522	4 881	2 917	59,8
1995	14 365	8 372	5 694	3 108	54,6
2002	16 365	9 095	6 651	3 127	47,0

Source: www.faostat.fao.org

2.6 SWOT analyses

In the SWOT analysis of agricultural sector to point out its strengths, weaknesses, and opportunities or threats for further development. I also try to submit some possible solutions or ideas for the muse and progressive ones with strong research potential.

This analysis could serve as an overview of main points and as a recommendation for research and development projects targeting the weaknesses of Ivorian agriculture to make this sector more "flexible". To target the weaknesses it's crucial for reaching balanced situations in the whole country, where there is a high-successful service sector – outsourcing – with the best position on the world trade market, increasing the number of working positions, better equality between the income of people, and on the other hand the limping agriculture with millions of people dependent solely on natural resources, with ambiguous results.

I have summarized all of these features on the bases of my study listed above:

S (strengths)

- the environment is suitable for vegetation production
- sufficient man-power
- agriculture products for export

- plays an important role in economic development
- typical life for most of the provincial population
- it is a base manufacturing industry which establishes the capacity of the secondary sector

W (weakness)

- badly divided rain-fall during the year
- agriculture traditional in rural zones, a stagnation routing and structure agriculture infeasible rise new classes modern and responsible farmers
- until now agriculture has been traditional in rural zones, a stagnation of working procedure and the structure of agriculture doesn't allow the rise of modern and responsible farmers
- production system flounder on jogging and erosion
- swell ups down prices cocoa and coffee
- the rise and fall of prices of cocoa and coffee
- question of landownership
- cash flow problems, above all censured the loans
- bad infrastructure (roads, telecommunications, services, electricity, financial institutions)
- low quality and cover of rural services
- weak management of natural resources (soil conservation, sewage disposal)
- status and rights of women and children
- low responsibility for natural resources of local institutions and farmers
- insufficient irrigation system
- agriculture inputs – supply and availability
- weak purchasing power

O (opportunities)

- the chemical development and manufacturing industry
- the expansion of choice products
- the development of research
- the modernization evoked by using new technologies in big agriculture companies
- the development of the quality of products
- natural conditions suited to different crops
- contract farming

T (threats)

- the competition of products on the market
- the growth of population and urbanization
- the risks of natural disasters on the coastline
- poor sanitary conditions

From these SWOT analyses I've come to the conclusion that the obstacles of agriculture in the Ivory Coast are huge despite its important role in national economy. To align these inadequacies, it should receive definite procreation that would affect agriculture more productively and competitively.

- have to strengthen range agriculture
- should ensure access to the production factor at responsible prices
- the introduction of new progress above all on a small and middle criterion
- the development of infrastructure in provincial regions, so products are easily obtained on the market

3 Aim of thesis

This diploma thesis was written by means of gathering of various data, their subsequent analysis and synthesis. The primary aim of this work is a dissection of contributions to improving agriculture productivity in the Ivory Coast.

Solving given to problems, will schematic as well partial purposes. Partial purposes are given so, to helped clear up agriculture Ivory Coast and redounded by to achievement purposes main.

Intermediate objectives will be set during discussion of this main objective. These intermediate objectives will provide deeper insight to Ivory Coast agriculture, natural conditions such as climate soil and terrain. I would like to discuss economic conditions which we made define as external and internal. The degree of development of infrastructure is an external condition. The internal conditions are seen as liquidity of investments, availability of skilled workforce and available technology.

Another objective is to describe social conditions mainly on the role of agriculture on national productivity. I will provide overview of different branches plant and livestock productions. On the end I will discuss international commodities, the balance of international trade, and amount of balance foreign trade, agricultural research and extension.

A lot of important fact to be found in libraries, but the most valuable sources of information was also in the internet.

4 Materials and methods

My diploma thesis is an attempt to evaluate the situation in the Ivory Coast agriculture, whole economy accordingly to its function and importance.

The research was carried out by the use of the available reference that deals with the role of agriculture in economic development in general, but also by the help of piece of knowledge acquired studies accessible wells conversant questions of agricultural production, effectiveness production, performance vegetable and animal production.

It is multidisciplinary report that examines economic, social, institutional, financial issues. In additional, in some cases there is no or imprecise data available, although I was searching in different relevant sources. The review is based on evidence form the literature, review of project documents and files, annual reports and books form specialist with long-term knowledge and experiences in the Ivory Coast agrarian situation and its development in last decades.

To overall assessment agriculture in Ivory Coast was also used the method SWOT analysis. In terms of SWOT analyses summary the strengths, the weaknesses, the opportunities and the threats. The aim of SWOT analysis is to find weaknesses and make recommendation how to eliminate them, to find strong points and suggest how to promote them.

Information came from secondary sources, especially from agricultural economics textbooks, the analysis and conclusion are based on available information of international organizations such as United Nations Food and Agriculture Organization (FAO), World Bank (WB) and officially released papers from Ivory Coast authorities. The statistical method was used to illustrate data in appendices.

5 Discussion and results

5.1 Agricultural policy

Government programs have had a major influence on farming methods and systems. But, with a few notable exceptions, policies aimed at the direct transformation of traditional farming systems have made less impact than measures that have encouraged changes in the components of the system. Framer's response to new crops and techniques has been influenced most by policies that have affected market opportunity and the price paid for produce, the opportunities presented to farmers for increasing the return to investment and the availability of credit and inputs.

The state should play a supportive role in the development of a more sustainable agriculture. Although Ivory Coast has taken some action in individual sectors, there is still a need for more integration if a sustainable agriculture is to be widely promoted and adopted.

So, for the transition to a more sustainable agriculture to occur, governments must facilitate the process with an appropriate range and mix of policy instruments and measures. They could decentralize administrations to reach down to local people. They could reform land tenure to individuals and give communities the right to manage their local resources. They could develop economic policy frameworks that would encourage the more efficient use of resources. They could encourage new institutional frameworks that would be more sensitive to the needs of local people (Hubbard, 1991).

Governments wishing to support the spread of sustainable agriculture can either offer incentives to encourage resource conservation and penalize those polluting the environment. Although there are increasing numbers of policy and environmental management and more sustainable agriculture can only be achieved by integrated action at farm, community and national levels.

Agriculture development policies have been remarkably successful at emphasizing external inputs as the means to increase food production. This has produced remarkable growth on global consumption of pesticides, inorganic fertilizer, animal feedstuffs, tractors and other machinery (Maizels, 1968).

These external inputs have, however, substituted for natural control processes and resources, rendering them more vulnerable. Pesticides have replaced biological, cultural and mechanized methods for controlling pests. Weeds and diseases, inorganic fertilizers have substituted for livestock manures, composts and nitrogen-fixing crops, information for management decisions comes from input suppliers, researchers and extensions rather

than from local sources and fossil fuels have substituted for locally generated energy sources (Hubbard, 1991). The specialization of agricultural production and associated decline of the mixed farm has also contributed to this situation. What were once valued internal resources have often now become waste products.

The basic challenge for sustainable agriculture is to make better use of these internal resources. This can be done by minimizing the external inputs used, by regenerating internal resources more effectively or by combinations of both.

5.2 Types of Support for Agriculture

Governments have long provided public support to their domestic agricultural sectors. Through a wide range of direct and indirect monetary transfer from consumers and taxpayers to farmers and other producers, they have sought to ensure that agriculture provides the food and other products needed by the non-farming population. There are five main categories of agricultural policy measures (Pretty, 1995):

Market price support, in which producer and consumer prices are influenced by a range of policies that include levies or tariffs on goods entering the country, so raising the price of imports; guaranteed prices for domestic produce, usually at level above world prices and/or those paid by domestic consumers, quotas on imports, and the subsidization of exports to ensure sales in international markets.

Direct payment, in which money is transferred directly from taxpayers to farmers without raising prices to consumers. These include payments to encourage both production and conservation oriented technologies, and can be monetary, or in kind, such as food markets.

Input cost reduction, in which measure are taken to lower input costs, so encouraging their greater use. These include subsidies for pesticides, fertilizers, water, electricity and credit.

Provision of general services, in which measures are taken to lower the long-term costs of research, extension, education and planning services, so ensuring that farmers have access to new technologies as well as the capacity to adapt them to their own conditions.

Other indirect support, in which regions receive rural development support or tax concessions are granted for farmers using particular activities or measures.

5.2.1 Agricultural pricing policy

Pricing policy is a powerful prime mover of agricultural development. There is evidence to suggest that farmers in Ivory

Coast are highly responsive to price changes and that structure of agricultural product is also determined to a large extent by the relative prices of crop and livestock. The government intervenes considerably in the agricultural sector. The bulk of the most important crops and livestock products – wheat, maize, cotton, and beef.

Pricing policy objectives are primarily commodity. Producer prices of each commodity are reviewed annually and determined a case by case basic. The producer price formulation process is complex and it is governed by numerous factors, including the cost of production, inflation, stock levels, marketing board's trading accounts, levels of parity prices, substitution effects and demand patterns (Eicher, 1998).

Pricing policy is one of the policy decisions that are at the Ivory Coast agricultural stagnation. Failure to provide incentive prices has constrained agricultural growth. It is recognized that attractive producer prices alone are not the panacea for solving production problems. Supply response is a function of infrastructure, adequate and timely availability of inputs, relative prices, technology, credit and extension and market opportunities (Eicher, 1991).

Agricultural prices are unstable both within and between seasons and may involve cycles with move away from, rather than towards, equilibrium, even under conditions of perfect competition. The situation is aggravated by the fact, because most agricultural commodities are necessities, they have a relativity inelastic demand. The existence of different agro-ecological systems and variations in rainfall causes significant variability in production from year to year (Eicher, 1991). Much of the interventions are thus aimed at stabilizing domestic supplies and prices. In addition, food security, income redistribution and reallocation of resources are some of the major objectives pursued in price policy.

Government intervention in agricultural pricing is essentially producer and consumer oriented. In the case of producers, agricultural prices are increased by governments in order to increase farm incomes. For consumers, the aim of government is to moderate the rise of food prices because food is a wage good and it represents 40 and 60 percent of the budget of the poor.

The financial institutions play a dominate role in mobilizing saving and then canalizing those savings for investments in to productive economic activities. Therefore the role of financial institutions is crucial in the development of any sector and agriculture is no exception to it. Rather the agriculture sector is more dependent on banking sector because most of the farmers are small and marginal farmers, who are unable to save and invest due to their low levels of finance (Thorat, 2006).

5.2.2 Local Groups and Institutions

A sustainable agriculture cannot be generalized without the full participation and collective action of farming. This is for two reasons: first, the external costs of resource degradation are often transferred from the conventional farmer to the sustainable farmers; second, one sustainable farm situated in a landscape of high input, resource-degrading farms may produce environmental goods which are undermined or diminished by the lack of support from neighboring farmers.

A necessary condition for sustainable agriculture is, therefore, the motivation of large numbers of farming households for coordinated resource management. This could be for pest and predator management, nutrient management, controlling the contamination of aquifers and surface water resources, coordinated livestock management, conserving soil and water resources, and seek stock management. The problem is that, in most places, platforms for collective decision making have not been established to manage such resources (Eicher, 1991).

The success of sustainable agriculture depends, therefore, not just on the motivations, skills and knowledge of individual farmers, but on action taken by groups or communities as a whole. This makes the task more challenging. Simple extension of the message that sustainable producing extra benefits for society as a whole, will not suffice. What will also be required is increased attention to community-based action through local institutions and users' groups.

Five types of local group or institution are directly relevant to the needs for a sustainable agriculture:

1. Community organizations,

2. Natural resource management groups,

3. Farmer research groups,

4. Farmer to farmer extension groups,

5. Credit management groups consumer groups.

5.3 Empowerment of farmers

Farming is carried out mainly hundreds of smallholders who make their own managerial decisions, the skill and diligence with which they apply themselves to the task of farming are the immediate determines of the level of agricultural output and its growth. Output levels actually achieved, however, will also depend on factors beyond the control of the individual farmer which influence both his production possibilities and his incentives. The interactions between the factors operating at the farm level and

socially determined conditioning factor are complex. Research and agricultural extension programs aimed at making more productive technologies available to farmers operating under diverse conditions face major problems, thee is bound to be uncertainty as to how farmers will respond to technical innovations and to price incentives.

In past year it was commonly alleged that traditional farmers would respond perversely of feebly to economic incentives. Hence, the argument ran, traditional agriculture should be largely by passed as an unreliable, inelastic source of increased supply. At present, however, there seems to be fairly general recognition that this contention was based on incomplete understanding of the context in which traditional farmers made their decisions. The field surveys carried out in connection with this study provided further support for the view that farmers are, by and large, rational in their behavior and in their response to economic opportunities.

The beginning of the process of modern economic growth in this country is very recent. A remarkable expansion of agricultural exports during the pas half-century has been principal stimulus to the process of transforming collections of isolated communities that were engaged predominantly in production to satisfy their own needs into national market-oriented economies. Substantial progress has been achieved in creating a network of transportation, communications and marketing institutions to link together previously isolated communities. Nonetheless, the change in economic structure has been distinctly limited. The bilk of the population and labor force in still rural and engaged in agricultural production, although village crafts, trading or other activities are often carried on concurrently.

A varying but substantial fraction of agricultural output is now produced for sale. As would be expected a large of this commercialized output is destined for export markets because the non-farm population dependent on purchase food remains small. A part from some exceptions noted later, food purchases by the farm population are limited.

That agriculture in development has recorded high rates of growth when six conditions:

1. Effective land reforms and water management,

2. Expansion of productive technology, mechanization, extension and marketing services,

3. High investment in infrastructure,

4. Low level of direct and indirect taxation on farmers,

5. Encouragement to farm exports,

6. Competitive trade environment through low duties on agricultural imports

5.4 Women agriculture

Women constitute 49% of the labor force in livestock sector as against 31% in crop farming in the Ivory Coast. In some areas there are a high percentage of female-headed households. Women play a vital role in many aspects of farming systems, including production, processing, marketing and domestic responsibilities, and their contribution to the evolution of these systems is of the greatest importance (FAO, 2006).

Women in the Ivory Coast are not homogenous social group, but are differentiated according to vase, caste, age, household composition (e.g. whether male or female headed), relation to land (e.g. tenants and land owners), belonging to and indigenous community. In the Ivory Coast, women are the most vulnerable and marginalize group.

They often face obstacles in access to land other natural resources to formal employment and to credit, training and extension services. These obstacles may stem from directly or indirectly discriminatory norms and from entrenched socio-cultural practices and entail negative consequences not only for women themselves (Cotua, 2002).

Women play a critical role within the community and in productive and reproductive life, engaging in agriculture and establishing business enterprises, as well as providing health care and education.

Unfortunately, women farmers have been neglected in extension efforts. It has been found that no less than 60% of operations in farming are carried out by women (daily tend sheep, goats and chickens, milk cows, buy and prepare food, plant and harvest crops, weed their plots). Hence, it is very essential that women should be mainstreamed in all efforts to develop agriculture. Women should receive information relevant to their work in crops and livestock husbandry, so that they can make right decisions in the context of farm and home management. Efforts should be made to increase the proportion of female extension workers to one-third of the force, through incentives like scholarships and stipends. It is also essential to sensitive male extension workers to the needs, approaches and perspectives of women, through appropriate training and orientation programmers, taking into account women's time, mobility and cultural situation.

Women carry the primary responsibility for food security yet development agencies have devoted minimal resources to researching the impact of their agricultural policies and new techniques on the well being women farmers. The dominant focus has been on the cash crop activities of men farmers and

agricultural research and investment has largely been confined to this domain. There is clear evidence that in many parts, women, and men operate separate income and expenditure streams, with women carrying the primary burden for the financing of children's welfare. Whilst local practice is to separate male, female economic accounts, women and children are rarely the beneficiaries of the income generated by cash crops, their present well being is founded rather in subsistence farming. The external expert perspective of the key development agencies, despite the abundant evidence to the contrary, continues to assume a unified household where income earned by males is shared with and distributed amongst their wife/wives and children. As a consequence, gender appropriate agricultural policies and services have failed to develop. (Eicher, 1991).

5.5 Animals

The animal husbandry presents 2, 3 % coarse agricultural product (HZP) and 0, 7 % coarse native product (HDP). In 2004 there were approximately 1 500 000 cattle, most of which were of the small, hump less N'dama breed. There were also 2 715 000 sheep, 620 000 swine, 1.1 million goats, and 8 million poultry (Business Info, 2006).

This branches covers only from 44 % needs population. The animal performance comes short of supply and demand, mainly after meat. The development contributes to indemnity sustenance of inhabitant and to improvement innovation a balance of payments, further to diversification and escalation incomes farmers.

Table 3 - Livestock resources (values expressed in 1 000)

Species	Year				Annual growth rate (%)	
	1980	1990	2000	2002	1980-1990	1990-2000
Cattle	666	1108	1409	1341	5.2	2.4
Sheep, goats	1920	2022	2585	2713	0.5	2.5
Pigs	315	360	336	350	1.3	-0.7
Poultry	17000	24120	29400	32625	3.6	2.0
Total	758	1069	1324	1338	3.5	2.2

Source: FAO 2006

Animal husbandry is functions not only from the point of view of production, but also in the use of their products. Thus animal husbandry provides bullock power and organic manure for the farming operations and crop production provides fodder and other food items for the animals. In this process, the economics of both these operations are improved. Animal husbandry does not require much land and they can be profitably combined with crop production. They can provide gainful employment for the farm families practically throughout the year, particularly for small and marginal farmers and landless laborers.

In 1998 the livestock sector contributed about 6 percent of agricultural output. About half of that total came from poultry and egg production, about one-quarter came from cattle and the remainder came from sheep and goats. Although virtually all poultry consumed in Côte d'Ivoire was produced locally, domestic beef production met only about 40 percent of demand.

With the growth of the economy and increasing purchasing power, the citizens tend to eat more and more of animal and fishery products, which have higher nutritive value. Livestock sector produced 25.9 million tones of milk, 31.2 eggs, 173.5 of meat (1 000 metric tones) in 2002-03 (FAO, 2005).

In last years the contribution of livestock to GDP is probably less than 2 percent and no significant growth taken place during the past decade. Livestock development in the Ivory Coast is constrained by ecological and human factors. In the view of officials of the Ministry of Animal Production, the chief obstacle to development is disease. With some exceptions, tsetse fly infestation limited livestock production in savanna regions as did the absence of forage in the forest zone. Consequently, there were few pastoral groups in Côte d'Ivoire and the country's livestock population was unable to meet domestic needs (FAO, 2005). The human constraint to development is the almost total lack of any tradition of animal husbandry. This is true even of the savannah areas, where most of the cattle population is found. To some observers, this lack of livestock tradition is the most difficult constraint to deal with. It can be overcome only through a comprehensive and well-executed education program, which should lay a solid basis for genuine and sustained livestock development. Government ranching schemes have existed for many years, but the results have been poor. Excessive reliance on excessive expatriate personnel has made operating cost high, while the spin-off in terms of training the local population has been low. The success of livestock projects, therefore, will rest largely on their close integration with ongoing agricultural operations that include animal traction, fattening operations, introduction of fodder crops in the rotation and utilization of crop by-products as livestock feed.

5.5.1 Fisheries

In 2001 fish production in Côte d'Ivoire was estimated to 5100 tones and its share in net agricultural value added was about 1.2 percent. Contributing about equally to the total were the tuna industry, low technology coastal and freshwater fishing, including a large smoked fish industry and a fleet of privately owned trawling, sardine seining, and scrimping vessels. In the 1980s, canned fish was the country's seventh largest export commodity in revenue generated (behind cocoa, coffee, fuels and chemicals, timber, cotton, and palm oil), amounting to about 20,000 tons a year. Nevertheless, export revenues from fish exports only slightly exceeded foreign exchange payouts for the approximately 100,000 tons of frozen fish imported each year. The imports supplemented the canoe and fleet catches, which met about half of domestic demand.

Insofar as Ivorian coastal waters had probably reached their maximum sustained yield in 1988, possibilities for growth in the fishing sector were limited without costly research and development, which the country could ill afford. The areas offering the greatest potential for growth were the tuna industry and domestic freshwater production in artificial lakes and ponds.

The potential for marine fishery realization has been assessed about 20% higher than the present output. Marine fishing activities in Ivory Coast have unfortunately witnessed uncontrolled exploitation followed by inefficient management. The present system of free access to the sea needs to be moderated with the regulation of common property rights and introduction of the concept of responsible fishing. There has been massive overcapitalization in fishing capacity. The per capita production of fish has declined as each fisherman continues fishing till his average cost equals average returns. The active population in fishing has increased four-fold in the last 40 years, without any scientific method of exploitation of common fishing grounds, resulting in decline in catch rates, higher fishing mortality and dominance of juvenile fish in the catch.

Marine fisheries

The following strategies are needed for the exploitation of marine fishery resources in an environment friendly and efficient manner:

1. Effective implementation of the regulatory measures for optimizing the exploitation of the fishery resources in the inshore waters,

2. Exploitation of the deep sea and oceanic resources,

3. Increasing the place of motorization of the artisan craft to improve their capabilities,

4. Monitoring and regulating fishing effort in the inshore waters,

5. Protection, conservation and sustainable utilization of marine biodiversity,

6. Manpower development, fishing and processing sectors,

7. Development of infrastructure like fishing harbors, berthing facilities, capacity utilization of post harvest infrastructure,

5.6 Crop

Agriculture forms over most 30 – 40 % HDP and more than 60 % export. Agriculture forms most working seats receipts, because 60 % population lives middle agriculture.

Ivory Coast is among the world's largest producers and exporters of coffee, cocoa, beans and palm oil. Consequently, the economy is highly sensitive to weather conditions and to fluctuations in international prices for these products. Despite government attempts to diversify the economy, it is still heavily dependent on agriculture and related activities, engaging roughly 68% of the population. Growth was negative in 2000-03 because of the difficulty of meeting the conditions of international donors, continued low prices of key exports, foreign divestment and civil war. Political turmoil has continued to damage the economy since 2004, with a rising risk premium associated with doing business in the country, foreign investment shriveling, transportation costs increasing. The government continue to survive financially off of the sale of cocoa, which represents 90% of foreign exchange earnings, but the government probably has lost between 10% and 20% of its cocoa harvest to northern rebels who smuggle the cocoa they control to neighboring countries where cocoa prices are higher. The government remains hopeful that ongoing exploration of Ivory Coast's offshore oil reserves will result in significant production that could boost daily crude output.

5.6.1 Crop protection

The agriculture policy underlines the importance of integrated pest management, including the use of biotic agents, in order to avoid indiscriminate use of chemical pesticides, since the latter can reduce the biodiversity of the natural enemy and can promote outbreak of secondary pests, as well as plant resistance to pesticides and contamination of food and eco-system. However, a judicious mixture of chemical and biological approaches has to be followed to reduce the annual crop loss, estimated at intensive integrated pest management needs to be promoted, involving the conservation and augmentation of natural enemies of crop pests, as well as adoption of all compatible cultural, mechanical, physical and genetic approaches, selective chemical pesticides, tolerant varieties. Modern genetic engineering tools should be utilized to transfer desired genes from wild plant relatives to enhance

resistance to pests and diseases. Research system should increasingly target cultural practices in crop production, for making the environment less favorable for survival, growth, reproduction of several pests.

In the future century, greater emphasis is needed on regulated chemical and biological measures for dealing with the pest problem. Some of these measures include training of farmers for judicious use of such chemicals, greater focus on botanical pesticides and biological measures such as natural enemies of pests.

The legal framework for enhancing plant protection includes better focused laws on destructive insects and pests, as well as on insecticides, it needs constant upgrading to meet evolving challenges. The regulations on manufacture, sale, transport, use of other activities under the Insecticides act need to be regularly reviewed to upgrade their effectiveness and to efficiently fight adulteration of pesticides.

5.7 New technologies

The notable advances during the past century in perfecting experimental methods and in scientific understanding of soil science, plant nutrition, genetics, plant breeding, and other branches of agricultural science have thus far had relatively little impact on farm practices. Although enormous resources have been devoted to agricultural research in the country of the temperate regions, agricultural research in Ivory Coast has been limited and, until recently, confined mainly to the export crops. The special problems involved in the management of soils and the associated problems of high insulation and torrential but erratic rainfall have received relatively little attention. Among food crops, some advances have been made in developing high-yielding varieties that are suited to conditions in part of Ivory Coast, and programs for their development and introduction in Ivory Coast indicate the potential contribution that well-designed research can make to increasing farm output.

The principal change to date in Ivory Coast farming systems has been the spread of production of a variety of export crops, apart from learning how to grow the new crops; farmers have changed the methods of production very little. For the most part, soil fertility is maintained by some system of bush fallowing, although in many areas fallow periods have been reduced considerably and a substantial number of farmers are now engaged in more or less continuous cultivation. Traditional systems of land tenure in most areas were geared to a land surplus economy based on bush fallowing. But the planting of perennial crops and other economic forces have led to important changes in the context tenure systems, and in some areas, the individualization of land tenure has been formalized by legal procedures for registering land titles.

Use of purchased inputs obtained from outside the agricultural sector remains distinctly limited. This result is to a considerable extent a reflection of the very low level of cash income. It is also related to high transport and distribution cost that make such inputs expensive. And in some areas the increased use of fertilizers is limited because research has not developed crop varieties with the genetic capacity to give a strong response to heavy fertilization. In spite of these problems, however, a growing number of farmers are now buying fertilizers, insecticides, plows, and other implements, and some are buying tractors or hiring them.

Expertise can have a role in this effort. This section explores the types of technology needed to face this future growth, including the role agricultural research plays in developing suitable technologies. In particular, it looks at what types of technology are suitable for cultures and environments. Later sections of this report focus on issues in technology transfer, technical assistance, and the responsibilities of the governments themselves.

The issues examined here include the suitability of existing technologies and their appropriateness for conditions likely in future, the indirect role that nonagricultural technologies can serve to increase food production and can best share their scientific and research expertise, how current research information can be shared most effectively, and the need for food producers to have an expanded role in planning and implementing agricultural research (Eicher, 1991).

New technologies have contributed to increased productivity, larger farms, and specialization in one or two commodities on many farms. Increased use of pesticides and other agricultural chemicals has significantly raised crop production. Further improvements, especially for pest control, should be important in the future. Improved management techniques for crop production also have been an important factor. Livestock also has benefited from improved technology.

5.7.1 Technological innovations

Technological advances will continue to have significant impacts on agriculture. More efficient and sophistical irrigation equipment, harvesting and processing methods and equipment, and controlled-atmosphere storage procedures are extremely important production. Others harvesting innovations for especially crops have reduced the amount of labor input required.

Thousand of agricultural research projects are under way in the directed toward discovering new and better ways to grow crops, to manufacture more efficient tractors and farm machinery, to produce superior livestock and poultry, and to more affectivity communicate and manage agricultural information.

Future fertilizer consumption will be affected by the ability of genetic engineers to create crop varieties that fix their own nitrogen form the atmosphere. Also, less fertilizer will be needed when water conservation technologies save nitrogen by reducing leaching and runoff. Similarly, there is a relationship between potential developments in seed treatment and fertilizer use, since seeds may be treated with nitrogen fixing bacteria in addition to using the techniques of genetic engineering, also the potential use of nitrogen fertilizer will involve other factors beyond nitrogen fixation and water conserving technologies, such as controlled nutrient release mechanisms and nitrification inhibitors.

Thus, it is impossible to take one specific technology, such as genetic engineering, and determine its potential implications on agriculture since its commercialization will be closely related to developments in seed treatment, water conservation, plant growth regulators, etc Meinzen-Dick, 2005).

5.8 Watershed management

Major steps are needed to improve efficiency in sustainable use of land and water, through sensible watershed development and agro-climatic regional planning. State land use boards should be strengthened to achieve better coordination. Water use charges in major and medium irrigation projects should be revised to reflect the cost of operations and maintenance as well as the benefits from water use. Greater participation by water-users is essential in managing public irrigation systems.

Water is the most valuable resource in most areas with reasonably good soils. Development of the watershed to optimize water use can yield large benefits in un-irrigated areas, provided emphasis is laid on flexibility, participatory processes and institution building. The pre-requisites for the success of this programme are: 1. liberal devolution of decision-making power, backed up by financial allocation directly to the district level and further to the village level, 2. creation of partnership between government, non-government organizations and the beneficiary farmers, and 3. flexibility in terms of technical as well as financial norms for watershed treatments (Eicher, 1991).

5.8.1 Dryland farming technologies

Developed productive techniques for enhancing yields under un-irrigated conditions. These include:

1. Choice of crops varieties in cropping systems to match the availability of moisture,

2. Contingency crop planning for weather aberrations,

3. cultural practices like timely sowing, deep tillage, mulching, integrated nutrient management, integrated pest management, improved farm implements, rain water harvesting and recycling,

4. Alternative land use systems including trees, pastures, grass lands

5.8.2 Irrigation

Regularly rotation of various long raining seasons and dry spells is a phenomenon that influences life all over the territory, which leads to a lack of water for agricultural production.

Table 4 - Irrigation (1 000 ha)

1999	2000	2001	2002	2003	2004	2005
73F	73F	73F	73F	73F	73F	73F

Source: FAO, Quarterly Bulletin of Statistics 2003

Note: F – odhad FAO

Water plays the crucial role in development of whole society, living standard and mainly rural people and in further development of agricultural production. Agricultural production is dependent on irrigation and irrigation accounts of compulsive water use, irrigation scheme that can enhance agricultural productivity, assume special importance. Because the irrigation represents essentials prerequisite, which enabled expansion of high yielding varieties and fertilizers?

Most of the cost-effective major irrigation projects have already been taken up. In some of the major irrigation projects, doubts are emerging about the validity of the cost-benefit calculations, on the basis of which they were built, the net benefits are found to be smaller than the levels envisaged, due to falling quantity of water harvested and damages to beneficiary land, due to floods and salinity. In the circumstances an important aspect of future moisture management lies in "watershed management", particularly in un-irrigated areas.

Irrigated agriculture is also affected by precipitation variability, as this will control the total volume of water available for agricultural production. In such circumstances, what tends to happen during drought conditions is that water use/unit area is reduced, but if the drought worsens areas of cropland will be left unwatered so that successful crop growth can be maintained over at least part of the agricultural lands. Once again it is a matter of local experience which determines when watering of land ceases and what sort of area is involved. In some cases where new dams have been constructed or new wells sunk to tap deep aquifers it might appear

for a few years that water resources are unlimited and therefore, that water poses no constraint on crop growth. This however, is an erroneous view as it pays no attention to the fact that all fresh water resources are finite in nature. All that is happening in such cases is that water is being withdrawn from storage, whether from reservoirs or from aquifers, and once the storage is depleted it can take considerable time for the water levels to be replenished (Eicher, 1991).

The agricultural strategy is the promotion of irrigation, where cost effective and support to moisture conservation in other areas. Most of the recent advances in crop development call for higher use of moisture to support high-yielding varieties of crops, while increasing cropping intensity and reducing vulnerability to weather risks. Such intensive agriculture has also increased employment and incomes in rural areas.

This growth in irrigation has its downsides as well. While dams can cause large-scale displacement of communities and can destroy the ecology, canals, if not properly managed, can lead to salinity and water-logging. Continuous use of wells and tube-wells also lead to groundwater depletion (Eicher, 1998). Irrigation is also, to a large extent, dependant on the vagaries of nature and a couple of years of draught can wreak havoc with the system.

To solve this problem, numerous government and voluntary agencies have initiated community rainwater harvesting programmers. Instead of depending on government made dams and water supply programmers, numerous communities are reviving traditional water-harvesting structures through local initiative and participation.

There is considerable diversity in the system of levying irrigation. As a rule, these rates ale levied on the area actually irrigated, they are invariably differentiated by season and crop. The rates are further differentiated by categories of irrigation projects to allow for differences in the quality of irrigation as reflected in the quantum, duration and assurance of water supplies (Meinzen-Dick, 2005).

5.8.2.1 Types of irrigation

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs.

Traditional field-to-field irrigation system

Continuous irrigation flows are provided, passing form field to field, generally without watercourses or toled channels. Operating rules have often evolved and been agreed through local tradition (FAO, 1997).

Localized irrigation

Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods (FAO, 1997).

Sprinkler irrigation

In sprinkler or overhead irrigation, water is piped to one or more central locations within the tolled and distributed by overhead high–pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system.

Sprinklers may also be mounted on platforms connected to the water source by a hose. Automatically wheeled system known as traveling sprinklers may irrigate areas such as small farms (FAO, 1997).

Center pivot irrigation

Center pivot irrigation is a form if sprinkler irrigation consisting of several segment of pipe joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along its length. The system moves in a circular pattern and is fed with water from the pivot point at the centre of the arc (FAO, 1997).

Advanced irrigation methods

Surge-flow irrigation is a less energy intensive approach which could be competitive with sprinkler irrigation. It basically involves interrupting the water flow through the soil furrows so as to speed the next wave to specific areas of the plant root zone, while avoiding water runoff losses. Surge-flow irrigation might reduce water application by about 10 percent compared to conventional flood irrigation. Nitrogen should also be developed of the soil. On the negative side, more hardware needs to be developed to automate the system. The system is still labor intensive, requiring repeated opening and closing of the water-control gates.

Potential impact

Advanced irrigation technologies will not solve all water supply problems and are not even a substitute for other systems in all cases. However, the new methods will become widely used to conserve water, particularly in vegetable and fruit production and filed-crop production where water is scarce. The success of various governmental programs designed to better allocate scarce water resources will influence the need for efficient irrigation techniques like these. Similarly, government-sponsored financial incentives to

use water-conserving devices would encourage use of advanced irrigation technology. Improvements allowing drip irrigation to be used economically in row crops also would expand its application (Eicher, 1991).

5.9 Seed technology

Agricultural revolution in crops is mostly a genetic revolution seeds of different crops were developed incorporating all desirable traits, through crossing of varieties which abound in those traits and further re-crossing with others, till a more perfect seed with the desired improvements is developed. These desirable traits include high yield, better quality of grain, fibre, flower or fruit, moisture economy, optimal period of growth coinciding with or moisture availability, tolerance to acidic/alkaline soil, resistance to diseases and pests, higher nutritional value, better cooking and keeping qualities. In a sense, there is no perfect seed since further genetic crossing can always bring a better seed to meet the requirements of microclimates and other farming conditions.

Seed technology has undergone a revolution, through genetically modified seeds. Ivory Coast should seriously engage in the debate and take advantage of the evolving technology. The seed certification system should be reformed to encourage seed producers with integrity. The unfolding powers of biotechnology should be harnessed to enhance yields, protect for crops from biotic and abiotic stresses. We should adopt a sensible patent system which can help harness globally developed seeds with potential benefits for Ivorian farming. Laws should be upgraded to protect legitimate patents, plant varieties, farmers' rights and biological diversity (Conyers, 1984).

The Agricultural policy has made several recommendations for the development of seed industry:

1. Survey and evaluation of genetic resources,

2. Safe conservation of both indigenous and exogenously introduced genetic variability in crop plants, animals and their wild relatives,

3. promotion of bio-technologies for evolving plants which consume less water, or are drought and pest resistant, contain more nutrition, give higher yields and are environmentally safe,

4. Conservation of bio-resources through their ex-situ preservation in Gene banks as also in-situ conservation in their natural habitats through bio-diversity parks,

5. Strengthening of seed quality control system through training and other activities,

6. Strengthening seed and plant certification system with private sector participation,

7. Strengthening of seeds development agencies like certification agencies and testing laboratorial,

8. Encouragement to research and breeding of new varieties particularly through an appropriate law in line, energetic steps need to be taken both in the public and private sectors, through appropriate incentives from government.

5.9.1 Importace of seeds

In the grain sector, which accounts for a major part of Ivory Coast farm economy, there were few scientific breakthroughs and the additional output from the use of better seed was not very significant.

With the evolution of high yielding varieties of seeds in horticultural crops of fruit and flowers in addition to those in cereals and oilseeds, the private sector began taking greater initiatives. A new seeds policy was announced encourage seed producers in both public and private sectors. The private sector focused mostly on hybrids, vegetables and floriculture, while the public sector units generally tended to produce the seeds in the cereals, pulses, oil seeds and fiber sectors with high volume and low profit margins.

5.9.2 Seed Protection

The use of seed treatment to protect seeds form disease and pests. Most materials used before 1960 were inorganic compounds (such as mercuric chloride and copper sulfate) applied as fungicides to wheat seeds with only limited reliability. Mechanized seed treatment improved and organic pesticides were developed in the mid-twentieth century. By the 1980s, the use of seed treatment had expanded, but results were still unreliable. Application mechanisms, formulations, and chemicals have improved in the past decade, a wider range of pests can be controlled and more kinds of crop seeds can be treated.

5.9.3 Seed treatment

Seed treatment is traditionally used to protect seeds from three basic types of organisms-seed borne, soil borne and mobile organisms affecting the plant emergence. Seed borne-organisms include pathogenic fungi. Soil borne organisms include pathogenic fungi and in addition, soil-borne insects which affect the early stages of plan growth, such as wireworm and wheat bulb fly in cereals. Mobile organisms include both disease organisms and insect pests which attack plant foliage.

Treatment of seed and oil borne organisms has been fairly successful. Control of mobile organisms requires longer term protection and therefore maintenance of an effective concentration of the chemical in the plant issues. Although exceptional cases of effective control for 3 months or longer are reported, relatively high chemical doses are required. Long-term protection also is deterred by the low mobility of most pesticides in the soil and plant roots.

Augers, revolving drums, and spinning discs are used to apply powders to simple seed mixtures. More accurate dosing may be achieved by using more specialized techniques such as pelleting, used to coat sugar beet and vegetable seeds. Pelleting involves placing seeds into a revolving drum where they are sprayed with a mixture such as clay or fiber. The mixture, which includes a chemical insecticide, fungicide, or other materials, forms a coat around the seed. After planting, water penetrates the seed and normal germination occurs. Another method is seed coating (Roy, 1994).

5.9.4 Potential impact

Seed treatment simplifies, reduces the cost of the application of chemicals to field crops and promotes good seedling establishment and higher yields. The reliability of seed treatment has been a major drawback to widespread use. As a result, more research is needed before any major increases in commercial use. Active ingredients which are effective under various environmental conditions prove adequate protection in small quantities and are environmentally sound must be developed. More sophisticated formulations which adhere strongly to the seed and provide longer term protection of the seed and seedlings are needed. The fate of the applied chemical in the soil, and the influence of soil type and conditions on absorption, degradation, movement, and update of the chemical, must be assessed. Reduction of seedling rates facilitated by precision sowings, higher seed quality, etc., would lessen the total expense of seed treatment per unit area of land.

5.9.5 Salt-tolerant

Agriculture faces a serious challenge it must improve upon, or at least maintain, crop productivity while coping with ever more saline soils and water resources. On a world-wide basis acres irrigated are affected adversely by salt. Two main factors contributing to the salinity problem are the arid to semi-arid climate and salt load in the water used for irrigation. Seed does not germinate well in salty soil, and plant growth is repressed. Researchers are looking for salt-tolerant plants which will produce an acceptable yield of plant parts or products. So far, more than 50 crop species have been evaluated for cultivars that exhibit salt tolerance. These include cereal crops, fiber crops, and legumes, fruits, oilseed crops, sugar crops, vegetable crops and trees.

The development of salt-tolerant crops will have a great impact on agricultural production. With salt-tolerant crops, morel and can be put into intensive production using lower quality resource. In addition, the geographic range of commercial crops may be expanded.

As salt-tolerant cultivars of crops are developed, many castors of the agricultural production system will be affected. Seed companies and irrigation system manufacturers should be affected beneficially. Land not currently in production may be utilized if salt-tolerant crops are developed. Furthermore, producers will have the opportunity to in crease production on underexploited marginal land.

A number of internal and external factors affect the use and rate of adoption of breeding of salt-tolerant crops. Of primary importance are the availability, quality, and cost of irrigation water. The yields levels of salt-tolerant crops relative to their production costs will also affect commercialization (Roy, 1994).

The environmental impacts of increased salt concentrations in both water and soils must be investigated. Saline irrigation water could have negative impacts of adding additional salts to the soils.

5.10 Biotechnology

Breeding has been a cornerstone of agricultural development since explained the principles of plant genetics. Almost half of increased crop yields have come about through genetic improvement. Crop improvement conventionally involves the use of one or more traditional techniques, such as bulk breeding and selection, pedigree breeding and selection, backcross breeding, recurrent selection, hybrid breeding, mutation breeding, and chromosome breeding, none of which are discussed here (Roy, 1994). However, significant advancement in the field of molecular biology in the last decade widened the range of crop improvement techniques potentially available to the crop breeder. These techniques fall into a class collectivity referred to as biotechnology. Biotechnology may be applied to microorganisms, higher animals and plants. The technique with the most promise for use in crop breeding is plant tissue culture (Eicher, 1998).

5.10.1 Tissue culture

Plant tissue culture involves the growth of plant cells, tissues or immature seeds under carefully controlled laboratory conditions. Plant tissue culture traditionally has been used in research regarding various biochemicals, physiological, genetic and anatomical aspects of plants.

Plant cell and tissue culture appears particularly promising as a breeding tool. The technique is relatively uncomplicated. Tissue is cut from a plant and placed on a solidified medium containing

nutrients to facilitate growth of the tissue. The tissue culture is incubated under proper light and temperature conditions for 3 to 4 weeks. This culture, which is about five times the size of the original tissue, is called callus. The callus is transferred into liquid nutrient media in a flask, and then is incubated for 5 more weeks under proper light and temperature conditions. And this time, individual cells, or groups of cells, are removed, and either further culture or, for use in crop breeding, regenerated into whole plants. Regeneration entails the incubation of individual cells in nutrient media under proper environmental conditions. Upon adequate development, rooted plants then are grown under greenhouse conditions.

Plant cell tissue culture opens the way to crop breeding through recovery of desirable plant genotypes culture, protoplast fusion, anther culture, and cloning. Recovery of desirable plant genotypes involves the application of artificial selection to the culture (Eicher, 1998).

5.10.2 Break-through in biotechnology

Biotechnology offers a powerful tool for enhancing productivity by removing constraints and protecting crops against biotic and abiotic stresses that destabilize production. The new advances recombinant-DNA technology now enable transfer of genes across species barriers, also tailor-make genes and their controlling elements, to achieve expression at a specially selected time and in the desired organ. Moreover, exploitation of heterosis or hybrid vigour enables efficient production of large quantities of hybrid seed efficiently and economically, since fresh seed has to be used for each planting (Roy, 1994).

For harvesting the benefits of biotechnology for the common farmer, urgent and designed steps are necessary for orienting research programmers on rational basis and developing appropriate policy framework for implementation. Biotechnology research is extremely rostly and hence careful selection of objectives and monitoring of results are needed. Public-funded research in agricultural biotechnology would need to make careful appraisal of public benefits. The commercialization of biotechnology products also needs efficient and sound regulatory process to ensure that public interest is served in terms of bio-safety, bio-diversity, ecology as well as environmental, social and ethical concerns.

Future efforts for improving the productivity of high duality seeds will require greater investment in research in the private sector, which can take place only if there would be adequate financial returns for such risk investment (Eicher, 1998).

5.10.3 Benefits from bio-technology applications

Seed industry, identifies four broad areas, which offer maximum potential for the application of biotechnology for increasing yields and benefits for the farmers.

The first is the exploitation of hybrid vigour in rice, wheat, and etc. Successfully harnessed hybrid technology with the result that an area of over hectares has been sown to hybrid with higher yields.

Secondly, biotic stresses like pests, pathogens and weeds cause damage, ranging between 10 to 30% or even more. Among the strategies suggested here are the use of gene technology to deal with pests, coat-protein technology to deal with viruses and use of genes for building resistance against herbicides (Eicher, 1998).

5.11 Fertilizer

The consumption of fertilizers on soil is about 20 kg/ha, which is relatively little and has a lot to do with the low yield per hectare. Apart from this it is possible to say that in the Ivory Coast what predominates is the export above supply industrial fertilizers.

Table 5 - Consumption of fertilizer

Consumption (1000 t)	1996	1998	2000	2001	2002	2003	2004	2005
Nitrogen	36	60	41	40	30	53	53	53
Phosphate	16	25	14	11	22	30	30	30
Potassium	14	25	15	16	16	16	16	16

Source: FAO, Quarterly Bulletin of Statistics 2003

Modem high yielding seeds also happen to need high doses of plant food like nitrogen, phosphates, potash and micro-nutrients. It is necessary to have fertilizer products, which are suitable for different kinds of soils like acidic, alkaline, clayey and sandy soils. Plants also need micro-nutrients like sulphur and potassium for optimum growth. Over time, the cost component of these plant foods has reached a percent of the total recurring cost.

The Ministry of Agriculture computed the cost of production of each fertilizer factory and paid a subsidy that would be needed to sell the fertilizer at the government-declared price. A flat rate of subsidy was given for imported phosphatic and potassic fertilizers. Expert analysis shows that the benefit of the subsidy went to the farmers to the extent of 2/3 and to the industry to the extent of

1/3. With the removal of subsidy for phosphatic and potassic fertilizers and increased costs there of, there has been a harmful distortion in the N, P and K balance the relative higher application of N and lower application P and K have tended to damage soil fertility.

The problem of over-fertilizer is primarily associated with the use of artificial fertilizers, because of the massive quantities applied and the destructive nature of chemical fertilizers on soil nutrient holding structures. The high solubility's of chemical fertilizers also exacerbate their tendency to regrade ecosystems.

Storage and application of some nitrogen fertilizers in some weather or soil conditions can cause emissions of the greenhouse gas nitrous oxide (N2O). Amonia gas (NH3) may be emitted following application of inorganic fertilizers, or manure or slurry. Besides supplying nitrogen, amonia can also increase soil acidity. Excessive nitrogen fertilizer applications can also led to pest problems by increasing the birth rate, longevity and overall fitness of certain pests (Antony, 1979).

For these reasons, it is recommended that knowledge of the nutrient content of the soil and nutrient requirements of the crop are carefully balanced with application of nutrition's in inorganic fertilizer especially. This process is called nutrient budgeting. By careful monitoring of soil conditions, farmers can avoid wasting expensive fertilizers, and also avoid the potential costs of cleaning up any pollution created as a by product of their farming.

The Agricultural policy emphasizes environmentally safe and productive use of fertilizers. The policy calls for a growth strategy that is based on efficient use of resources, which conserves our soil, water and bio-diversity, seeks to promote technically sound, economically viable, environmentally non-degrading and socially acceptable use of natural resources including land. Emphasizes the importance of adequate and timely supply of quality inputs like fertilizers at reasonable rates, as well as soil testing and quality testing of fertilizers. It emphasizes balanced and optimum use of fertilizers together with the use of organic manures and bio-fertilizers to optimize the efficiency of nutrient use (Antony, 1979).

5.11.1 Bio-fertilizers

To find bio-fertilizers such as rhizobium culture, as an effective source of nitrogen supply to pulse crop. Azotobacter and azospirillum help in nitrogen fixation, particularly in wheat, maize, cotton, fruit crops and vegetables. Likewise, the crops can get phosphorus from phosphate solubilizing bacteria (PSB). The use of blue-green algae in low-land rice has been found to be useful(Eicher, 1998).

5.12 Plan protection

The long term objective of protection is to evolve and strengthen institutions and resources for services like research, training, extension, quarantine as well as production, quality control and marketing of pesticides and equipment in order to promote the protection of plants against pests and diseases on a cost effective basis. The short-term objective is to deploy the prevailing institutions and resources for preventing if possible pests and diseases and fighting them where they occur. With progressively increasing investment in costly inputs, the stakes for protecting the crops have risen. The risks include seed-borne and fungi-caused diseases, soil and surface insects, weeds, rodents and non-insect pests (Antony, 1979). The strategies employed for protecting plants include pest surveillance, observation stations, forecasting and warning, demonstration of plant protection methods, training of staff and farmers, laboratories to test chemicals and equipment, development of suitable pesticides, chemicals and equipments and finally a supportive social and legal frame work.

5.12.1 Eco-friendly approach

The biological control sounds a warning that the indiscriminate use of hazardous plant chemicals has resulted in a reduction in the bio-diversity of natural enemy, outbreak of secondary pests, development of plant resistance to pesticides and contamination of food and eco-system. This warning comes in the face of sharply increasing demand for chemical pesticides.

Unfortunately, Ivorian's consumption of environment-friendly bio-agents like entomophages, botanical and microbial pesticides, pheromones, etc.

Agricultural research should in future increasingly focus on cultural practices associated with crop production for making the environment less favorable for survival, growth or reproduction of several pests. These measures include careful selection of sites/crops, deep ploughing with or without tractors, use of healthy seeds and seedlings duly treated with chemicals, appropriate planting dates and crop duration, destruction of off-type and volunteer plants, thinning and cropping, pruning, defoliation and destruction of crop refuse. Other environment friendly plant protection methods include mechanical and physical measures like hand-picking and destruction of eggs, larvae, etc. (Antony, 1979).

5.12.2 Chemical, biological measures

The risk of introduction of alien pests has increased tremendously with the increased exchange of seed and planting material between nations.

At present, the most common method of pest management is the use of chemical pesticides. It is necessary to train farmers in the judicious use of such chemicals, including avoidance of prophylactic sprays, adopting strip treatment, spot application to only those areas with heavy incidence of pests, applying to the soil to avoid direct contact with natural enemies and the use of selective or non-persistent pesticides.

Greater research is now being focused on botanical pesticides, species of plants exhibiting insecticidal properties. Another recent development is the arrival of insect growth regulators, which can prevent normal reproduction of the insects.

Biological measures recommended include encouragement to natural enemies of pests, which can reduce the population of crop pests, these include aphid-uons, ground beetles, spiders, frogs, etc. (Antony, 1979).

5.13 Agricultural machinery

The mechanization in the Ivory Coast is on the low-level. Predominate the needlework, only on bigger farms are exploited the techniques of mechanization. The amelioration of mechanization supposes except technological aspects also development of infrastructure.

Table 6 - Mechanization

Mechanization	1999	2001	2002	2003	2004	2005
Tractors	3 800	3 800	3 800	3 800	3 800	3 800
Harvesters	70	70	70	70	70	70

Source: FAO, Quarterly Bulletin of Statistics 2003

Increased agricultural production is most often brought about by the introduction of improved crop varieties and by creating an optimal environment such that the plants and animals can grow at their potential. Planting, tending and harvesting a crop requires both a significant amount of power and a range of tools and equipment. Mechanization of farming fully increased the area that could be planted and contributed to increased yields.

Through the last century crop production systems evolved rapidly and achieved significantly increased yields. Unfortunately, on some occasions the production systems created unwanted environmental side-effects. Matters such as soil degradation and erosion, pollution from chemical fertilizers and agrochemicals and a loss of bio-diversity have been highlighted for a number of years. Furthermore, not only were some crop production systems

found to be unsustainable in an environmental sense, in some locations they were not sustainable in an economic sense. Of equal concern was the discovery that in some cases it was only the work undertaken by men that was mechanized.

It is against this background that an emphasis on the following has arisen:

- All aspects of farm power (human, animal and mechanical) including related social, economic and environmental dimensions,

- Standards for farm tools, farm machinery and equipment, together with codes of conduct for their safe use (implemented in close collaboration with the plant production and protection division),

- Technical, policy and strategy issues concerning.

Most cultivation in the Ivory Coast is still carried out with hand tools. Seasonal shortages of labor- particularly at the time of crop – establishment, early weeding and harvest – limit the areas of crop grown and the quality of crop husbandry. Inadequate weeding is a common cause of low yield. A farmer's ability to adopt new techniques often depends on the possibilities open to him overcoming labor shortages. The use of mechanization to reduce labor needs at critical periods can be a key factor in development. Within each farming area there is a range of farm size and farmer prosperity. This creates corresponding needs for a range of cultivation equipment from hand seeders and push-type weeders to relatively sophisticated ox-drawn multipurpose tool bars, as well as a demand for contact plowing services.

Wide range machinery is available for small farms, particularly ox-drawn and light spraying equipment. But information is not readily accessible to extension services on the types of equipment that an available and on the suitability of equipment for specific tasks and conditions. It is best supplied by government testing centers, working in cooperation with manufactures, responsible for development work and in contact with traditional advisory services.

Tractor mechanization will play an increasingly important role in the agricultural development as the predominantly agrarian structure of their economies is transformed. The rate at which such equipment is introduced should, however, be geared to a real need. It must be supported by the provision of adequate servicing facilities and the means for farmers to acquit the necessary expertise to enable them to manage their machinery to the best advantage. Sharply increased fuel costs and higher prices for tractors equipment underscore the necessity of a cautious approach to tractor mechanization and may well help to focus more attention on ox-drawn implements.

The agricultural policy emphasizes the need for adequate and timely supply of quality agricultural machinery. It also calls for review and rationalization of the excise duty on farm machinery and implements, in order to reduce the burden on the farmers. Rural electrification would be given a high priority as a prime mover for agricultural development.

With its abundant farm labor, Ivorian's farm mechanization has been oriented to the use of efficient tools, implements and machines, which raise farm productivity and reduce unit cost of production, without large-scale replacement of human labor. This has led to the selective use of farm machines like tractors, power tillers, combine harvesters, irrigation equipment, plant protection equipment, threshers, other improved implements and hand tools (Schultz, 1963).

5.13.1 Agricultural Mechanization Policy and Strategy

Of all the modern agricultural technologies introduced in development in the Ivory Coast, mechanization has probably proved the most controversial. Mechanization has been blamed for exacerbating rural unemployment and contributing to other social ills.

In the 1970s and early '80s, numbers of tractors were supplied as gifts from donors or on advantageous loan terms to development. Projects designed to provide tractor services through government agencies produced a miserable track record. These public sector tractor-hire schemes collapsed because of the distorted cost of capital as compared to labor and draft animals, chronic mismanagement and the intrinsic inefficiencies of any government-run machinery service.

But development still needs labor-saving technology. The demand will rise naturally with a growing population's demand for food, particularly in industrialized where rural labor is becoming scarce. Concerns about rural unemployment and other social problems will no longer be issues if earlier mistakes are not repeated. What will be important will be to encourage sustainable private sector development that will offer farmers the right choice of technology at the right price to increase agricultural productivity, provide food security and reduce post-harvest losses.

Benefits from mechanization

The benefits from efficient agricultural mechanization in terms of increased production, productivity and profitability, by achieving timeliness in farm operation, bringing precision in metering and placement of inputs, reducing avoidable input losses and increasing utilization efficiency of costly inputs like seeds, chemical fertilizers, irrigation, etc. It also helps efficient use of animal and commercial energy for increased productivity, at the same reducing unit cost of produce, enhancing profitability and

competitiveness. Its other benefits include conservation of produce and bi-products from both qualitative and quantitative damage, as well as reduction of drudgery in production and post-harvest operations.

The advent has seen a swift increase in the demand for agricultural machinery to the present level. The entire demand is met through domestic production. Tie pressure for greater efficiency has led to larger engineering inputs involving high capacity, precision, reliability and energy efficiency, not only to increase productivity but also to save time (Schultz, 1963).

5.13.2 Mechanization technologies

The trend toward increased farm mechanization will have increased in all these areas: tractors and engines, tillage and planting, crop harvesting and storage, remote sensing, and robots.

Combines may have taken the harvesting job away from tractors, but tractors still do the majority of work on a farm. They are used to pull implements (machines that till the ground, plant seed, or perform a number of other tasks).

Tillage implements prepare the soil for planting by loosening the soil and killing weeds or competing plants. Plows are actually used, with offset disks used instead to turn over the soil and chisels used to gain the depth needed to retain moisture.

The most common type of seeder is called a planter and spaces seeds out equally in long rows, which are usually 2 to 3 feet apart. Some crops are planted by drills, which put out much more seed in row less than a foot apart, blanketing the field with crops.

After planting, other implements can be used to cultivate weeds from between rows, or to spread fertilizer and pesticides. Modern irrigation also relies on a great deal of machinery. A variety of engines, pumps and other specialized is used to provide water quickly and in high volumes to large areas of land.

Besides the tractor, a variety of vehicles have been adapted for use in various aspects of farming, including trucks, airplanes, for everything from transporting crops and making equipment mobile, livestock management.

5.13.3 Tractor Mechanization

Tractors have provided the muscle necessary for increased productivity farms. New development in tractors and engines result mostly from research by the tractor and engine manufactures.

The use of tractors has frequently been regarded as the universal panacea for the problems of increasing farm productivity.

Mechanization has often seemed the simplest and quickest way of modernizing traditional farming, and several costly programs for large-scale mechanization were put into effect, with little preparation. These schemes follow an all too familiar pattern, beginning with the purchase of large quantities of expensive equipment and a crash training program to provide drivers and maintenance staff. Running cost were heavy are not accompanied by correspondingly large increase in production.

To obtain an efficient sequence of operations, mechanization must alleviate and not accentuate labor shortages in the farming system. Selective mechanization has been used to advantage in the irrigation scheme. In the early days of the scheme, land preparation for cultivation was carried out with work oxen. It was difficult to complete the operation on time over a large area and the timetable for other operations suffered accordingly. The subsequent introduction of tractor-drawn equipment made for more thorough land preparation and it became possible to ensure that planting and field operations were carried out.

Tractor services have been accessible and charges to farmers are frequently heavily subsidized. Low costs result partly form the supply of services on a national basis to small, dispersed fields and from very seasonal work. The provision of service facilities to small dispersed units adds to maintenance and repair costs, as does the operation of tractor services within the administrative framework of the civil service.

Private sector owners have been more successful and often provide a cheap and efficient service. Costs are kept down by working long hours, by the greater care taken of equipment, and by the greater freedom owners have to choose their customers. It has proved advantages to leave development of tractor-hire services in the hands of entrepreneurs, who cam call on government extension services for advice on the types of equipment to use (Anthony, 1979).

Rate of adoption

A with tractors, the main factor affecting the rate of technology adoption will be the pressure to continually increase the efficiency of farming operations. The integrated control of variables on grain harvesters will allow the machine to operate much faster with less operator fatigue. As the cost of labor increases, the pressure to decrease the amount of labor used in vegetable and fruit production will increase (Anthony, 1979). The agriculture community must develop, or adopt from other industries, the algorithms and sensors necessary for computer control of the above technologies. Even though agricultural output in terms of dollars and production is high, the number of units of machinery used is actually very small compared to the number of units required to produce.

5.13.4 Tillage and Planting

Preparation of the soil planting and other tillage operations are some of the most important farm operations. Soil tillage is also the single largest user of power on the farm. The trend of increasing tractor horsepower is a direct result of the desire of the farmer for larger, more productive field crop tillage.

Revolutionary mechanisms for accurate seed placement have been developed because of its importance to plant productivity. Increasingly better ways to plant crops will continue to be developed.

The most important tillage toll of the last several hundred years the plow is being used less for several reasons. One of the most important is the fact that moldboard plowing is the most energy intensive tillage operation and fuel costs have increased dramatically. The moldboard plow will probably never be completely eliminated. It buries plant residue better than other tillage systems and helps control soil insects. Much of the moldboard plowing done in the past has been replaced by chisel plowing or the use of heavy disks for primary tillage.

One problem with tillage equipment today is the difficulty of transporting wide equipment down public roads. To help alleviate this problem, machinery designers have used ingenious methods to fold implements or otherwise reduce their width for transporting. Another trend is to increase the speed at which the implements are pulled in the filed, giving a smaller implement the same productivity rate as a larger, slower one. Unfortunately, increased speeds often mean increased power requirements.

Current planters have become sophisticated in their ability place seeds in the proper depth at the right spacing, using a variety of mechanisms. Some commercial planters use air pressure or air suction to meter the seeds, fingers to capture and hold the seed until the proper release time, or edge drop plates. To plant wheat and other grain crops, continuous flow seed-feeding devices are used. Many different methods are used to open the soil and cover the seed after seed placement (Agriculture, 2000).

One of the major production costs for field crops is the cost of the equipment, fuel and maintenance for tillage and planting. If the power per acre tilled could be reduced, obviously, smaller tractor with lower price tags and fuel bills could be used. Also, if fewer passes could be made through the fields, the fuel and maintenance production costs could be reduced.

5.13.5 Crop Harvesting and Storage

The speed made possible by mechanized harvesting equipment has done much to reduce drop losses caused by weather, insects and rodents. At the same time, much of the human labor for harvest

has been eliminated, especially in grain crop. Mechanization has developed more slowly in fruit and vegetable harvesting.

Grain harvesting is almost exclusively performed by large self-propelled grain combines. These machines cut and convey the plant material to the threshing mechanism, thresh the seeds from the other parts of the plant, separate the seed, chaff and other debris from seeds.

Most vegetables are harvested by hand. Vegetable harvesting is not mechanized for a number of reasons. Many vegetables for the fresh market are too delicate to be handled by any of the mechanical means devised to date. Vegetables are to be processed in some way after harvest may be mechanically harvested because the effects of mechanical handling are not noticeable. Many vegetable crops do not ripen at the same time, thus making selective harvesting a necessity. Because most vegetables are grown on relatively small acreages, there is less incentive to develop mechanized harvesting equipment.

Fruit harvesting has many of the same problems as vegetable harvesting. The product usually is damaged by the rough treatment that mechanical harvesting usually requires. Also, fruits usually do not ripen at the same time on the same plant, creating problems for selection of ripe fruit. Machines and techniques for harvesting different crops have been developed. Shaking devices that hold the tree trunk and vibrate it to remove the fruit have been developed for deciduous fruits and citrus fruits.

Crop harvesting will be affected in the next decades by several technological advances. They are integrated control of grain combine variable, automated guidance, increased mechanization of labor intensive specialty crops, in-field processing, and new methods for separating and cleaning grain crops (Roy, 1994).

5.13.6 Integrated control of variable

Grain combines require a skilled and attentive person for proper operation. The operator is responsible for controlling the highest of the gathering platform, speed, settings and for recognizing and diagnosing fault. In fact, the operator is one of the limiting factors in the speed and capabilities of the combine.

Future grain combines will relieve the operator of most control functions, leaving the responsibility of monitoring the cutting, threshing, separating, cleaning processes and diagnosing failures. Sensors in front of the machine will determine the grain moisture content and condition and adjust the settings for the best harvesting with the least damage. Sensors on the gathering platform will sense the distance from the bottom of the platform to the ground and automatically maintain the correct cutting height. Others will locate the cut edge of the grain or the next uncut row of the row crop and automatically steer the combine. The ground

speed of the combine will adjust automatically for maximum production with the least loss. The combine may record the volume of grain harvested, including where it was harvested. The farmer could use this information later to decide what parts of a farm are most and least productive and where additional fertilizer or herbicides are needed.

Probably the first use of automatic guidance will be on harvesting equipment, because sensors in the guidance system could easily follow either row crop or the cut edge of grain crops. Controlled traffic systems with buried wires also could be used (Eicher, 1998).

5.13.7 Increased mechanization of labor intensive crops

The high production cost of fruits and vegetables reflects the large amounts of labor used. Mechanical methods developed to date for handling these crops inflict more damage than can be tolerated fro the fresh market. By many fruits and vegetables will be harvested using new sensors and harvesting mechanisms. Computers on these harvesting machines will control picking, sorting, and packaging. Reduction of labor costs is one advantage of mechanizing these harvesting operations. In addition, labor is not always available when needed.

An obstacle to the development of these technologies is resistance from people in the farm labor unions and from other people concerned about the effect of mechanization on the rural way of life. Concern has also been indicated about using state and federal funds to develop labor-saving devices. Such policies reflect the conflict that often arises between innovative technology and potential job displacement (Roy, 1994).

5.13.8 New methods for separation and cleaning crops

One of the first threshing machines patented, the ground hog and or bull thresher, used teeth on a rotating cylinder to tear the plant apart and beat the grain out of the head. The threshing portion of modern combines is based on exactly the same concept. In the last years, grain was separated and cleaned by shaking and air blasts from a large farm, again modern combines use the same principle. These methods have worked well for many years. Higher productivity was achieved by increasing the size and power of the combines without using any radically new technology. Some experts think that this policy may not work in the future. Combines may be reaching limits in physical size because of shipping and transportation problems. To get higher productivity a new design approach must be used. Future machines may be able to discriminate between the grain and the other plant material to separate (Roy, 1994).

5.13.9 Saving post-harvest losses

Post-harvest losses continue at a high 10% level in food grains, 20-40% in fruits and vegetables, 10-12% in animal products and fishery, estimated. Post-harvest losses can be reduced by half through scientific use of different kinds of agricultural machinery. Losses in field crops can be minimized if harvested at optimum moisture, threshed in time and without undue losses, cleaned, dried and stored safely. Grain dryers are extremely useful here. In particular, the currently huge losses in horticultural crops can be prevented through a chain of cold stores as well as modified and controlled-atmosphere storage (Agriculture, 2000).

The experience of growth of agricultural mechanization has disproved the following three myths:

1. Tractors combines and other heavy machinery displace labor,

2. Heavy machines are not suitable for small and medium farmers,

3. Small farmers will not adopt hi-tech technologies for production and processing of their produce

5.14 Agricultural export

The structure of economy that is based largely on agriculture reflects particularly in the character of external business. At the end of the ninetieth accrued more than 75 % income from export of agriculture and forestry. This result was especially the cause of coffee and cocoa production, because these represent the two key products and create pillar of the national economy. In the consequence crisis in the world's economy in years 1980- 1983 put prices of coffee and cocoa considerably down - thereby came to import debit balance. Despite of the strong dependence on coffee and cocoa the government accepted measures concerning diversification of performance so that the shares of two dominant products are reduced and that should lead to better balance in export. It is concerned support of pineapple, bananas, palm oils, cottons, sugar reed, and rubber tree production.

Devaluation of African currency FCFA that happened in beginning of year 1994, enable the external business to obtain a good position among African countries. Currently coffee and cocoa constitute about 45 % and the others products about 20 % receipts from the total export. In the structure of supply of agricultural commodities dominate cereals, mainly wheat and rice, then meat, milk, agriculture machinery and tools. Except the agricultural products Ivory Coast imports machinery and devices, particularly electronic and traffic, also paper and papermaking products, yarn and goods, construction material, pharmaceuticals.

The trade is oriented on develop countries, particularly the advanced countries from Europe. In between the main business

partners belong France, Italy, Germany, Netherlands, Spain, Great Britain, Ireland, Denmark, Belgium and Portugal. To other significant partner is the USA. Among African states it is: Nigeria, Senegal, Ghana, Mali, Burkina Faso and Mauritania. Among Asian partners belong Japan, China and others.

The agriculture produces some of the finest products in grains, fruits and vegetables, whose consumption can be promoted. Should be in a position to maintain quality, adopt best packing practices and follow efficient export systems. The measures needed to boost agricultural exports are:

1. Free exportability of all agricultural products, without creating obstacles through mechanization and restriction,

2. Removal of procedural restrictions like requirement for registration, packaging,

3. Establishment of agricultural export zones to enhance international market access and improvement of infrastructural facilities and provision of adequate credit,

4. Encouragement to business houses through tax sops and investment credit to enter export business, particularly of fruits and vegetables for which there is high overseas demand,

5. Financial assistance for improved packaging, strengthening of quality control mechanisms and modernization of processing units,

6. Promotion campaigns such as buyer-seller meetings and participation in important fairs and exhibitions.

Table 7 – Export (2000 – 2004)

	Export							
Product	2001		2002		2003		2004	
	Quantity (t)	Price (1000$)	Quantity (t)	Price (1000$)	Quantity (t)	Price (1000$)	Quantity (t)	Price (1000$)
Cocoa	1 025 954	1 006 452	1 004 283	1 766 575	947 858	1 733 079	947 858	1 500 000
Coffee	215 483	101 521	144 276	72 516	118 35	77 728	77 825	138 573
Oil palm	74 535	35 816	65 022	35 545	78 200	52 396	34 511	18 834
Cotton	112 626	124 092	137 528	134 537	144 155	177 406	112 712	154 651
Banana tree	255 582	70 202	256	74 012	242 446	87 708	227 225	170 418
Pineapple	195 236	45 201	173 829	43 534	173 518	49 822	153 860	115 383

Source: Faostat.fao.org

Table 8 - Business indicator (1999 – 2001)

Agricultural export (million US$)	Agricultural import (million US$)	Agricultural export (share export of products)	Agricultural import (share import of products)	Clean supply food	Agricultural export
				(1000 $)	Relative to agricultural HDP
2027	617	49.1	15.1	-11635 84	77.5

Source: The state of food agriculture, FAO 2003-2004

5.15 Estimation

Table 9 - Present and suppose situation (livestock)

Product	Goal (1000)				Average annual increasing
	1995	2000	2005	2010	
Bovine	30,14	40,65	50	60	3,8 %
Mutton	7,50	19,30	25	30	3,8 %
Pork	11,30	23,70	30	55	3,8 %
Poultry	42,45	63,00	70	80	3,8 %
Egg	34,10	50,30	65	75	3,8 %
Fish	86,00	100	100	120	2 %

Source: REPUBLIQUE DE COTES D´IVOIRE, Plan director due développement agricole 1991

Table 10 – Present and suppose situation (plant)

Product	Goal (1000)				Average annual increasing
	1995	2000	2005	2010	
Coffee	250	320	360	400	2,2 %
Cocoa	800	820	850	900	0,4 %
Sugar	190	210	260	320	3,2 %
Cotton	348	450	560	645	4,9 %
Pineapple	269	481	601	751	6,5 %
Maize	553	654	737	875	3,0 %
Manioc	1 678	1 710	2 050	2 420	2,8 %
Peanuts	162	195	224	255	3,3 %

Source: REPUBLIQUE DE COTE D´IVOIRE, Plan director due développement agricole 1991

5.15.1 Factors Influencing the Growth of Exports

By and large the expansion of agricultural exports in the Ivory Coast appears to have been of the variety, in which country having large quantities of labor or natural resources available at low opportunity costs can increase output rapidly by employing these factors to produce commodities for export.

Several threads of common experience: 1. demand increased very rapidly and suddenly for all the commodities, 2. labor, land, constrained production and shortages were made good by slaves and migrants, 3.in all instances, imported goods were important incentives for expanding production for export, 4. improved transport was important for cocoa and coffee, 5. indigenous capital formation was important, 6. indigenous initiative was of critical importance in numerous ways (Anthony, 1979).

Prior to the improvements in transportation and communication that enabled export-import firms to link cultivators with the market, the commercial demand for agricultural output was severely limited and "effective demand" consisted overwhelmingly of the "reservation demand" of rural households for their own substance. Given such a restricted market and inelastic demand, much of the land was left idle or used only for hunting, and a relatively small amount of total available labor time was devoted to agricultural production (Anthony, 1979). Introduction of a market for cocoa, coffee, or some other "cash crop" - a term that has been virtually synonymous with "export crop" in the literature- abruptly increased the value of the additional output that could be produced by putting more land under cultivation and increasing the amount of labor employed farming.

Export-crop industries that resulted from the opening of markets to producers had some important features. Rapid increases in crop production were possible and could be sustained over long periods with only a minimal investment of outside resources and with little change in agricultural technology other than learning how to grow a new crop using techniques which (like the traditional food crop) employed virtually no inputs aside from traditional ones of land and labor. Moreover, the release of labor from craft manufactures and other nonagricultural activities meant that the family's needs. Thus cultivators could, as Myint said, "hedge their position completely and secure their subsistence minimum before entering into the risks of trading " and look upon the goods purchased with the cash receipts from their new crop as "a clear net gain obtainable merely for the effort of the extra labor in growing the export crop." The traditional income from production of the new crop was not, of course, costless, the labor employed had an opportunity cost in terms of other economic production or leisure foregone. Much of the available labor time was apparently

perceived as having a low opportunity cost, and the new farming opportunities were sufficient to induce significant changes in labor's allocation. But the opportunity cost of labor and shortages of labor may limit farm output even though the farm labor force is not fully utilized according to some accepts. Up to the present it seems to have been mainly new export opportunities that have led to increases in the allocation of labor to farming, but in the future new technologies or market opportunities associated with the growth of domestic demand no doubt play a similar role in many areas (Anthony, 1979).

Substantial and continuing expansion has been possible primarily because the spread of transportation links and knowledge of the income-earning opportunities of export crops has meant that new cultivators continued to join the ranks of the earlier producers until the supply of land available for enlarged production became a limiting factor. The supply of labor available in areas well suited to high-value crops such as cocoa or coffee has typically been augmented by migration of workers from less favored regions.

There have, of course, been numerous variations in the way in which this process unfolded. In many areas the peak seasonal labor requirement for the export crop occurred during the slack season for traditional crops. In such areas, the main effect of the new crop enterprise was to reduce the time devoted to nonagricultural activities. Elsewhere, seasonal labor bottlenecks resulting form introducing a new crop led to a shift in the major staple food.

The scope for increasing labor inputs in farming was substantial because of the traditional division of labor by sex, which left men a good deal of time to spend on activities that were no longer possible or needed as influence spread, or on activities that were readily compressible when more attractive alternatives became available. Women and children were responsible for most of the work of producing and preparing food crops, the farm work of men being limited to the heavy task of feeling trees and clearing bush plots. Where export-crop production has been initiated, the traditional restrictions related to the division of labor by the sex have generally been modified and the new cash crop has most often been a "man's". The sharp curtailment in tribunal warfare with the spread of law and order has increased the time that could be allocated to farming. The time devoted to hunting has declined as game has become less abundant. The time available for farming was also increased when porter age was replaced by transportation by rail, truc. Moreover, the new imported goods hat provided an incentive for export-crop production also led to a decline in traditional activities such as basketry, spinning and weaving, pottery making (Anthony, 1979).

Emphasized the importance of agricultural exports and announced several policy measures to boost them:

1. Free exportability of all agricultural products, export of which is canalized through approved agencies.

2. Removal of procedural restrictions like requirement for registration, packaging,

3. Setting up of agro-export zones to enhance international market access and improve infrastructural facilities and ensure better flow of credit,

4. Assistance for reducing the marketing cost such as transportation, handling and processing, of export of selected agricultural commodities,

5. Financial assistance for improved packaging, strengthening of quality control mechanism and modernization of processing units,

6. Arranging promotion campaign such as buyer-seller meetings and participation in important International fares and exhibitions.

5.16 Agricultural marketing

Marketing has been and will continue to be an art in search of a structural framework. The key to a practical structure is to possess not only an understanding of the marketing process but also a set of flexible decision guidelines that can be adapted to different situations. The increasing constraints under which marketers must work limit many potentially profitable operations. Legal rulings plus technological and social pressures have forced marketers to adopt stringent, goal-oriented outlook. Marketing is business and the themes of the following readings represent a calculated, analytical thought process.

Agricultural markets play a crucial role in the process of economic development. Yet, by

Virtue of the spatial dispersion of producers and consumers, the temporal lags between input application and harvest, the variable perish ability and storability of commodities and the political sensitivity of basic food staples, agricultural markets are prone to high transactions costs, significant risks and frequent government interference. The relative power of develop government and private domestic or firms in agricultural markets has varied over time. But the fundamental functions of input, output distribution, post-harvest processing and storage, as well as the persistent challenges of liquidity constraints, contract enforcement and imperfect information; have characterized agricultural markets under all forms of organization (Farries, 1983).

Efficient agricultural marketing is indispensable for encouraging farmers to invest in costly current inputs. The price support system should strike a healthy balance between economic viability and protection of farmers' interests.

Changes in agricultural marketing practices will be equally as important as development of new technologies for producing crops and livestock. Many of these changes will be extensions and increased acceptance of current trends. For example, more emphasis will be placed on developing branded differentiated products tailored to consumer tastes, as a means of stimulating product demand, increasing product value, and raising farmer income. Forward integration into food processing by agricultural marketing cooperatives is one way to accomplish product differentiation (Edith, 1972).

An important constraint faced by a majority of farmers, who have small and marginal holdings, is the price depression in the market for their produce soon after first week of harvest. The spread between the market prices in the harvest season and the lean season can be as much as 20%. In the circumstances, the small and marginal farmers need institutional support to sell their produce at a fair and equitable price after harvest. To protect the interest of such farmers. Government has promoted organized marketing of agricultural commodities through a network of regulated markets, where there would be open and fair auction of produce at the best prices. However, the regulated markets have been found, in several decades of experience, to achieve limited success in their mission of direct and free marketing, smooth raw material supplies to agro processors, information exchange and adoption of innovative marketing system (Farries, 1983).

After a thorough study has formulated a model law on agricultural marketing and contract farming in consultation with the government and the representatives of trade and industry.

Partnership between public and private interests would be promoted in the management and development of agricultural markets. Special markets with appropriate changes in their constitution can be set up for highly perishable commodities like fruits, vegetables and flowers (Edith, 1972). There will be adequate provision to regulate and promote contract-farming arrangements. The market committee would promote alternative marketing system, contract farming, direct marketing as well as farmers/ consumers markets.

5.16.1 Product Differentiation

Agro business engages in two types of agricultural product marketing. First, commodities such as milk, eggs and grain are marketed as the products are obtained directly from farmers. Many of these items proceed through the marketing channel with little change in form. The commodity may be processed to some degree, but it often is retailed in an unbranded, undifferentiated form.

The second type of marketing by agro business is to merchandise differentiated consumer products. This implies transforming raw commodities into finished products such as bread, fruit juices,

mashed potatoes and then merchandising these items as branded products labeled under the company name. Under this type of marketing, an agribusiness controls the raw products through more of the processing and marketing chain, adding to the product's value at each step (Allen, 1959).

5.16.2 Marketing Cooperatives

Marketing cooperatives offer the potential for farmers to obtain better returns from a combination of efficient marketing operations and superior merchandising of farm products. There are numerous examples of successful marketing by cooperatives. Complete flock management should offered by the cooperative to its growers-breeding stock, fertilized eggs, hatcheries, feeding programs.

An integrated food production-marketing system recognizes the interdependence of the various functions of farm production, food marketing and combines them into a single, coordinated program for grater efficiency and economic returns. The farmers-members own and control the system, and share in its earnings along the way.

For the system to operate best, farmers must produce foods for specific consumer demands. The cooperative, through market research, determines what these demands are and provides farmers-members with crop and livestock production programs tailored to meet these demands. The farmers-members are required to exercise discipline and commitment. Their rewards are minimized market surpluses and shortages and stabilized farm income. Consumers benefit by having the desired quantity of products (Farries, 1983).

Cooperatives do not automatically solve farmer's marketing problems. Like other organizations, some cooperatives have failed because they did not live up to member's expectations or satisfy a market need. However, cooperatives do enable farmers to integrate forward into the marketplace and thus offer a means for product differentiation and higher prices for the farmer. Backward integration by no cooperative food companies is practiced by many no farming organizations. These private businesses engage in farming, or contract with family farms to raise the required raw materials. Farmers produce products according to specifications for quantity for quality, often at a predetermined price, but do not share in the company profits (Farries, 1983).

Future trading offers the highly attractive combination of low margin requirements and price fluctuations which are both wide and rapid. Year after year, there have been opportunities in one or more of the commodities traded on organized exchanges for returns of several hundred percent on invested capital. Granting that these were exceptional, it must be underscored that these opportunities continue occur. Needles to say, the chance to make

profits of such magnitude is usually linked with large risks. The knowledge of trading fundamental and methods is the key to reducing those risks (Edith, 1972).

However, described the mechanism of the markets for agricultural products, through which farmers obtain then gross income. Out of this income, they must find each year the cost of the inputs required for the next year's output. Such cost may be quite small for the farmers employing only family labor to grow food crops and perhaps one commodity for market, almost all their gross receipts of cash from the market will be spent on a few purchases for the needs of their families. But commercial farmers may have considerable costs in cash year, and these must be deducted form gross receipts each year before we obtain the net income, representing what farm families can spend on their own needs.

5.16.3 Futures Trading

The use of the commodities futures market as an aid to business planning, and as a means of reducing price uncertainly, certainly is not new.

The futures market can be employed in two ways – as a means of transferring risk, or to serve as a price reference guide to aid in decision making. The futures price is viewed as a consensus of individual price expectations of farmers, processors and merchants participating in the market. Distant contract price reflect the expectations of storage stocks, storage costs, future production, and expected demand. Current, closest month contracts reflect all current market information. An efficiently performing market incorporates all available market information and adjusts to changes in information and market conditions. Therefore, the futures market prices can be assumed to reflect the effects of weather, production, transportation costs, consumption and their proportional impact on prices. The market is characterized by the correlation of the futures price and cash price at contract maturity and will offer accurate reflections of subsequent market prices (Edith, 1972).

Under these assumptions the futures market can be used as a reference price to guide production and marketing decision making. By using futures prices as an indication of the commodity's market value, the farmer can plan production and marketing decisions accordingly.

For example, the futures market will be used more by farmers and processors as a mechanism, for transferring risk. Through hedging, farmers or processors can transfer a portion of their production risks to a speculator, decreasing the impact of any adverse price changes. Farmers always have been confronted with volatile prices for their agricultural goods. Prices are expected to continue to be volatile unless farmers are more successful in coordinating production with marketing. Hedging on the futures

market will help alleviate negative impacts produced by extreme price changes. In many areas of the farm sector, vertical integration has increased the processor's susceptibility to price risk.

5.17 Agricultural research

The agricultural research system needs creative management to overcome several constraints such as excessive centralization, inadequate integration amongst research, extension and education, need to promote quality and excellence and stronger linkages between partner institutions.

Research planning of agricultural research should move from narrow commodity research towards comprehensive research on farming systems. A broader programme approach is needed cutting across disciplines, commodities, divisions and institutions but focusing on maximizing returns from plant-animal-man chain. While continuing efforts towards more cost effective production of crops, greater emphasis is needed on livestock, fisheries and horticulture to respond to the rising demand for these products.

Agricultural research is recognized the world over as one of the most important vehicles for the development of suitable agriculture. Even in highly developed, agricultural research is still considered vitally important to continued progress. Ivory Coast is recognized for its strong agriculture in recent years, the country has been widely praised for pursuing agricultural policies.

The agricultural research system should successfully tackle three challenges: 1. to retain the green-ness of the green areas by tackling non-sustainability factors, 2. turning "grey" area into green through watershed management, hybrid technology, small farm mechanization, integrated plant nutrient and pest management, 3. optimization of valuable soil resource use through correct techniques of irrigation, drainage, soil nutrition (Upton, 1996).

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To should take steps to harvest emerging technologies like biotechnology and information-technology. Future success will come through greater inter-disciplinary teamwork as the research task becomes more complex. These need organizational and management reforms, incentives, rewards, continuous training (Eicher, 1991).

5.17.1 Priorities agricultural research

The limited financial resources available for research in Ivory Coast and shortages of qualified scientific personnel make it important to be able to define lines of investigation that will have the greatest impact in fostering increases in agricultural production in relation to the needs. These needs will be influenced by natural resources and the potential for agricultural production as well as by existing land use, national development policies and the availability of technical knowledge.

Past experience of successful research programs provides indications of the types of research that are likely to yield large returns under the conditions. Mainly factors in the general acceptance of innovations by farmers are the size of the return obtained and the ease with which an innovation can be understood and adopted. Specific priorities can only be determined within the context of particular situation. However, the problems commonly encountered in promoting agricultural development within the region make it suggest some general guidelines (Upton, 1996).

5.17.1.1 Crop research

Research leading to the production of high-yielding hybrid varieties has been the main factor in the considerable increase in yileds.The beneficial effect of the use of hybrids was further enhanced by research by fertilizer recommendations, plant populations, early planting as well as pest and weed control measures.

The first major breakthrough research with the development of effective pest and disease control technology. The major disease and pest problems have been those related to jessed attacks. Research on spraying techniques demonstrated the pest control can be achieved economically by application of insecticides. The breakthrough was followed by research into varieties capable of increasing yield and producing high quality (Eicher, 1991).

5.17.1.2 Livestock research

Livestock production was center in the drier regions of the country and little or no supplementary feeding was practiced. In addition, more detailed research showed that not only did supplementary feeding of cattle with protein-rich foods reduce body-weight loss during the dry season, calving rates of breeding cows and weaning

weights of progeny could be increased considerably by protein supplementation (Eicher, 1991).

The success of agricultural research programs must be judged by the extent to which recommended innovations are adopted by the farming community and by their effect on farm production (Eicher, 1991). Attention has to be paid to the difficulties experienced by small-scale farmers in adopting new farming practices under constraints imposed by limited resources. There is as much need for a flow of information from farmer to scientist as from scientist to farmer.

5.18 Agricultural extension

Agricultural extension in the process of transferring information and technology to farmers for use in the production process and similarly transferring information from farmers to researchs to solve the problems of farmers (Swanson, 1984). It is essentially a two-way link where extension agents transfer knowledge and ideas to farmers and their similes within advisory role. By the same taken, extension agents should be receptive to farmer's ideas, suggestions and problems so they can be incorporated in to the extension message and passed on to researchers.

For enhancing the effectiveness of agricultural system, several managerial measures are needed. The extension system should be able to enhance food security, nutrition, sustainability, risk minimization. Private and community-driven extension should be allowed to compete with government extension services. Farmer groups like self-help groups and community associations should be enthused to participate in propagation of better technology.

Research extension linkages should be strengthened so that the farmers can get the best and latest cost effective technology. Continuous efforts need to be made to build the capacity of extension functionaries to reach out to the farmers and effectively transfer the latest techniques to enhance productivity. The skills of extension personnel should be built up with strategies like participatory rural appraisal, group dynamics, leadership skills, conflict resolution, communication skills, data collection analysis and documentation (Antony, 1979).

A sound extension system would empower farmer's community through consultations on all important matters affecting their interests and through their primacy in groups like watershed associations, cooperatives, etc.

Considering that farm operations are carried out by women, special efforts must be made to sensitize male extension workers to the needs, approaches and perspectives of women through appropriate.

The first place governments can have an impact is on their own national research and extension systems. Many of these systems are under financial pressure, with governments short of resources and often unable to find adequate facilities or ensure that they hold on to quality professionals. Most are also oriented towards modernized agriculture and there are deeply ingrained structures that bias research and extension.

There is growing acceptable that participatory approaches are essential for the development of a more sustainable agriculture. But most government and state institutions are currently limited in their capacity to conduct such research and extension. This is partly because they are organized according to the principles of the positivist paradigm (Antony, 1979). Researchers have the prestigious role of being the source of new technologies and extensions pass knowledge from centers of leading to farmers who are assumed to be passive recipients.

Another problem is that many state institutions have narrow mandates. Often crop production is the responsibility of one department in a ministry, while livestock may be in another department or ministry altogether, tree crops fall in to the responsibility of a forestry department, water resources into another, and soil and water conservation in perhaps yet another. This is in stark contrast to the diversity needed on farms and in communities for sustainability. Division of responsibility among external agencies hinders the ability of their professionals to support mixed livelihood systems if they are working alone. However, if individuals and institutions work more closely together in alliances and networks, including with non-government organizations, then this need not be an insurmountable problem. Better alliances and linkages are widely recognized to be a better option than putting all services into one single, multi-sectional institution. It encourages the development of a better capacity or learning and for responding to the changing needs of farmers and rural people (Antony, 1979).

Despite the widespread problems, there are a growing number of successful innovations in national agricultural research and extension systems. There are some similarities. In many there was recognition that past approaches had failed both farmers and researchers.

5.18.1 Agricultural extension services

In an important sense, agricultural development is a major learning experience. Factors in the sociocultural environment that improve the farmer’s knowledge and technical competence include experiences as migrant laborers, farmer education programs that teach specialized functional skills, the methods, employed by more successful local farmers who serve as models for the community and the opportunity provided by the sociocultural system for the

demonstration of achievement and prestige in both traditional and modern forms.

Ivorian farmers who are able to recognize that their traditional farming techniques and present level of knowledge impose a limitation on their farm enterprises seem to be on the road to success.

One of the cultural falls in extension education is the false assumption that the "farmer" and the male "head of the household" are always the same. Making the male head the target for all extension education and training ignores the fact that on many farms, women are responsible for sowing the seed, weeding the growing crop and storing the harvest. It is not enough to tell the man that planting crops in rows and early weeding to increase yields, the wife must be equally involved and provided with an incentive to do the work required. Decision-making in agriculture can be highly fragmented and since the husband and wife are not necessarily one economic unit, innovations which require that a husband make the decisions for his wife o wives as well as for himself are likely to fail (Eicher, 1991).

Extension programs are not worth the name if there are no profitable innovations to extend or if the innovations that exist are of doubtful or marginal profitability. Nevertheless, it is clear that as an agricultural system expands its technical base, the need for sound extension advice, supported with profitable inputs, tends to be a critical limiting factor (Eicher, 1991).The challenge for each specific program is to determine when this point has been reached. Like research and other institutional infrastructures that serve agriculture, expansion emphasis in Ivory Coast has tended to be uneven.

5.18.2 Evolution of Extension Services

Considerable differences in approach and organization mark extension work in Ivory Coast today. These differences notwithstanding, it is possible to distinguish phases in the development of extension programs: 1. the phase of limited assistance, 2. the phase of essentially regulatory activities, 3. the phase of development programs, characterized by active educational and service functions. The first two phases coincide with the colonial period, while the third is more characteristic of the preindependance and the postcolonial period.

Phase 1 – Limited Assistance to Farmers

The major concern of colonial governments prior was administration, not social and economic development. Early extension activities grew out of colonial administration and reflected the dominant government priority – the maintenance of political peace.

Early extension to farmers was limited in scope and in approach. Extension methods were adapted to group instruction in land preparation, seeding, planting, and manuring techniques, soil conservation measures and in most marginal areas, the enforcement of target food crop acreages of the so-called famine reserve foods (Eicher, 1991).

Phase 2 – Regulatory Activities

In this period, the central axis of colonial government extension programs continued to be crop and livestock production, within a strong framework of soil and water conservation. The extension approach was changed from the stern paternalism of the earlier period to a benevolent paternalism in which farmers were not merely told to do what the extension officers considered to be good for them, but were told why it was good for them (Making 1967;63).

The expansion of an export agriculture in a competitive world market demanded that the quality of the products be made acceptable to consumers. Major emphasis on quality strengthened the regulatory character of the colonial extension service. Regulation of the quality of export crop and control of animal disease may have been necessary, other regulations, like the requirement of self-sufficiency in food staples in each district and of tie-ridging even when land was plentiful, probably were not and their enforcement was almost hopeless (Eicher, 1991).

Mass immunization of livestock and the control of cattle movement are largely services, so also are phytosanitary regulation that govern the introduction of new crop and their protection from pests and diseases. In animal industry, a large body of extension activities is rightly regulatory. The control of epizootic disease was a necessary precondition to the establishment of improved and high-yielding stock. The "command" approach failed on a number of extension activities, whether they were technically impeccable regulations like those cited above or less defensible goals such as commodity "target drives" soil-erosion control measure, and the selling of farm produce to an inefficient government monopoly. Compulsory measures for agricultural improvement were openly rejected before independence, and many technically sound programs fell into disuse once the pressure from government staff was removed (Eicher, 1991).

Phase 3 – Development program

Extension work is fundamentally educational. It is based on time belief that new skills and techniques exist that will increase agricultural productivity of farmers will learn them. The expanding governmental-sponsored development programs which started before independence have tended to increase the hortatory and service activities of the extension service. Whether in an out grower's system, in group farming, in ranching, or in settlement

schemes, the extension service has work of educating to do (Eicher, 1991).

6 Conclusion

Agricultural sector is the most crucial sector of the Ivory Cost economy because the main objectives of economic policy of output growth, price stability and poverty alleviation are best sub-served in this sector. Agriculture Ivory Coast partakes on production coarse native product and export forms over most 30 – 40 % HDP and more than 60 % export.

Agriculture forms most working seats, receipts, because 60 % population lives middle agriculture. There is thus a need to increase the credit of cash flow to agriculture, raise productive capacity of land and enhance the potential of water resources as well as its use efficiency for agricultural development. The productive requires investments in complementary assets like irrigation, land development, farm livestock machinery. (Gill, 2000).

Agriculture is nearly adherent with natural and economic conditions throughout the country, whose favorable temperature, sufficient rainfall, working coming and development infrastructure, especially the public road system and ports in Abidjan and San Pedro, makes it possible for faster transport of agricultural performance and achieves a higher gross average.

The SWOT analyses conclude that the agricultural obstacles in the Ivory Coast are gigantic despite its important role in national economy. To align these inadequacies, it should receive definite procreation that would effected agriculture more productively and make it able to compete.

- have to strengthen range agriculture and skill
- should ensure access to the production factor at reasonable prices
- the introduction of new progress above all on a small and middle gauge
- the development of infrastructure in provincial regions, so products easily get on the market

In the business of agricultural products it is necessary to search for ways for farmers and producers, so that they can sell their products through cooperative or special organizations. This especially involves joining financial resources for the construction of irrigation systems, the storage of agricultural products, and the development of mutual help in a mechanical environment.

The deposits of agriculture make one of the decisive conditions for the development of agriculture, it is necessary to pay appropriate

attention to increasing agricultural performance. This concerns the reservation of soil, capital and work.

A dynamic contribution to economic development from the agricultural sector improvement in rural welfare depends upon the modernization of agriculture through technological changes. A series of technological changes – mechanization, the effective use of chemicals, the breeding of new plant and animal.

To support agricultural sector Ivorian government must finance further expansion of irrigated areas, help to build up the feeling of responsibility for reasonable and economical use of water by farmers and agricultural companies. Also production chain (weak irrigation system and water supply) continuing with obstacles concerning affordability of planting material, fertilizers, etc. Therefore, processing, value addition, granding, standardization, efficient and modern transportation, modern storage, contract farming are going to step up the financing requirements in the agricultural sector to drive benefits. Is necessary joint economic development reservation fair standard of living, sustainable development, ablation poverty, fair behavior market and limitation counter.

It is clear that accelerating the increase in agricultural production will not in itself permit in the Ivory Coast to achieve their national development goals. Development involves transformation of the predominantly rural structure of Ivorian economic and the emergence of new institutions, values, attitudes, and behavior.

The progressive modernization of country rural households will affect attitudes and behavior more favorably than relying primarily on large mechanized farming units that more or less bypass farm households. Widely shared increases in farm incomes, resulting from progressive modernization, generate increased demand for inexpensive mass produced goods that can be provided by local manufactures. This kind of agricultural development is less likely to be constrained by shortages and foreign exchange and by strengthening and diffusing entrepreneurial and technical competence among country's firms. It facilitates the production of many other products and contributes to the development of capital goods industries.

As written, much more must be done. Since the conditions for agricultural production differ. According to variable infrastructure (roads, electricity, irrigation), processing services, natural conditions, land rights, used technology, socio-economic status, vary the productivity of highly potential agricultural sector.

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APPENDIXES

Appendix 1 - PNUD – Courrier No.166, září – říjen 1997

(Ministère des Affaires Entrangères de la Côte d´Ivoire)

Appendix 2 Socioeconomic indicators (The World Bank Group 2007)

Appendix 3 Rainfall (L´agriculture ivoirienne aujourd´hui 1982)

Appendix 4 Sunshine (L´agriculture ivoirienne aujourd´hui 1982)

Appendix 5 Vegetation zone (L´agriculture ivoirienne aujourd´hui 1982)

Appendix 6 Regionalization plantáží kakaovníku, kávovníku a bavlníku (L´agriculture ivoirienne aujourd´hui 1982)