UNITED NATIONS
ECONOMIC COMMISSION
FOR AFRICA

NATIONS UNIES
COMMISSION ECONOMIQUE
POUR L'AFRIQUE

BUREAU SOUS REGIONAL POUR L'AFRIQUE DE L'OUEST

Distr.: LIMITED
CEA-AO/CIE.11/2008/4b
Original: FRENCH

Biofuels: What strategies for developing the sector in West Africa?

« Making climatic change a factor of progress than risk"

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INTRODUCTION

Background and rationale

1.Biofuels are fuels from biomass origin (and that is why they are called « green fuels »). They belong to the general category of renewable energies. Although their industrial popularity is a recent phenomenon, biofuels have existed for a very long time. The diesel engine prototype invented by Rudolf Diesel ran on vegetable oil, ancestor to biofuel. Similarly, the Ford model T engine was designed to run on bioethanol. However, oil-based fuels became popular in the road transport sector in the 1930s. After the first oil shock in 1973, Brazil and then the United States started to look for ways of diversifying their energy sources and launched ambitious bioethanol production programmes to blend bioethanol with petrol used in the transport industry.

2.At the beginning of this 21st century, climate change has become a worldwide concern, but it offers some opportunities for Africa as a whole and West Africa in particular. The lecture-discussion organized by the Sub-regional Office for West Africa of the United Nations Economic Commission for Africa (ECA/SRO-WA), during the 10th Intergovernmental Committee of Experts (ICE) in Niamey (Niger) in June 2007 emphasized the point that Africans should consider climate change as a development factor than only risk. One of the opportunities offered by climate change is substitution of biofuels (bioethanol and biodiesel) for fossil fuels that emit greenhouse gases.

3.At a time when the price of oil has been spiraling out of control (more than 130US $ at New York, May, 2008) for four years unabated without any sign of going down, biofuels production is becoming increasingly interesting throughout the world. The quantity of bioethanol and biodiesel produced has been increasing steadily over the years and demand has continued to rise. The United States is the world leader in bioethanol production and accounts for 37% of total world production based mainly on maize, followed by Brazil, second major world producer with 35% of world ethanol production from sugar cane. Biodiesel, another biofuel, is produced mainly by the United States, Germany, France, Malaysia, Indonesia, and Argentina, is extracted from fats and from vegetable oils (rapeseed, sunflower, Soya, Jatropha or even algae. Many industrialized and developing countries such as Spain, Australia, Sweden, China, India and Latin American countries are striving to increase their production of biofuels. In Africa, South Africa, Mauritius, Mali, Senegal, Ghana, Nigeria, and others are also gradually embracing biofuels. The question one might ask is whether all West African countries have an interest in jumping on the biofuels bandwagon and if so, what should be the strategy?

4.The aim of this study is to answer this question by reviewing the exponential increase in the production and marketing of biofuels worldwide, emphasizing what is at stake for Africa in a context of spiraling oil prices before addressing the strategies that West Africa, in particular, can adopt to develop the biofuels sector, taking into account its

potential in terms of cultivable land and abundant labour, even though it is still hamstrung by the problem of financing and lack of technology.

Objective

5.This study is an attempt to propose some solutions to the above mentioned problems in order to lay upstream a good foundation for the development of the biofuels sector. These solutions aim at taking advantage of the opportunities offered by regionalization and globalization so as to promote a biofuels agro-business that will benefit the populations and the country's economies. They are also based on the vision supported by the Sub-regional Office for West Africa of the United Nations Economic Commission for Africa, which gives priority to strategies aimed at retaining optimum wealth generated by the sector through the active involvement of private nationals and West African private sectors in the production and marketing of biofuels.

6.The overall objective of the study is to harness the collective will of the sub-region to help laying a firm foundation on which to build a viable biofuels-based agro-business in West African countries, in order to reduce fossil fuels imports which constitutes a drain on their oil bills, create jobs and value-added to increase their capacity to meet the needs of populations and take part in the world effort to combat global warming.

7.More specifically, the study aims at: (i) drawing the attention of West African countries to the present and future promising economic outlook for biofuels in the world; (ii) Proposing to West African countries and economic operators the adoption of a strategic approach that pools their comparative advantages for the development of the biofuels sector; (iii) Encouraging private sector operators to forge partnerships to create one or more West African multinational societies of commendable size to produce and market biofuels and, to effectively contribute to growth in the sub-region that will make it capable of participating in the world carbon trade and in the Clean Development Mechanism (CDM) Funds of the Kyoto protocol.

Methodology

8.This study comprises two phases. Phase one is conceptual in nature and is based on documentary research using existing written papers and analyses made by specialists, operators/promoters, researchers and international organizations. The information is available on the Internet, in newspapers and in all publications of interest. Phase two is based on the expected comments and experiences to be shared during presentations on the theme at the Eleventh Intergovernmental Committee of Experts (ICE) meeting organized by the Sub-regional Office for West Africa of the United Nations Economic Commission for Africa, 25-26 June, 2008, Niamey, Niger. The theme of this paper, "Harnessing Africa's resources: What strategies for developing the biofuel sector in West Africa?" is one of the key topics to be discussed by the ICE.

Structure

9.Besides the introduction and the conclusion, this paper is composed of three sections. The first section highlights biofuels and their use. The second analyzes the challenge of biofuels in the world and its prospects for West Africa. The third examines current developments in biofuels production in the West African sub-region and attempts to propose a best strategy for tapping the potential and comparative advantages of all member states in order to build a viable and sustainable biofuels sector.

1. BIOFUELS AND THEIR USE

10. The renewable energies family which comprises biofuels is also made up of wind energy, wave energy and swells, tidal energy, ocean thermal energy, hydraulic energy (water gravitational energy), geothermal energy (subsoil heat), and solar energy (photovoltaic and heat)

11. Sometimes called agro-fuels, biofuels are nowadays obtained from land crops. The most widely commercialized biofuels are obtained from two main feedstock: oils (rapeseed, palm, sunflower, cotton, Jatropha, etc) of which the end product is biodiesel; and the alcohol feedstock from the fermentation of sugar produced from beet, wheat, sugarcane, maize, cashew, etc. of which bioethanol is the end product. These biofuels are said to be first generation ones. Research is underway to market production technologies for "second generation biofuels" which will make it possible to produce them from ligneous substances, gramineae, algae, and other types of natural waste (wood, straw, etc.) It is estimated that the production processes for these second generation biofuels will lead to a reduction of greenhouse gas emissions by about 90%.

12. Biofuels have properties that are similar to those of oil products and can be used in petrol or diesel engines as a total or partial substitute for oil fuel. They can be used in ordinary engines (unmodified) for low content mixtures up to 10%, or subject to inexpensive modifications for mixtures with a high content of biofuels. Research throughout the world has revealed the existence of other biofuels: biogas, pure vegetable oils, biodimethylether (dimethylether produced from biomass), and biohydrogen (hydrogen produced from biomass and/or from the biodegradable waste). All these biofuels hold some promise but this study will deal mainly with the two most widely produced and marketed types in the world, namely bioethanol and biodiesel which can be produced in West Africa.

1.1 Bioethanol

1.1.1 Production

13. Bioethanol is an alcohol produced from the fermentation of sugars contained in plants that are rich in sugar (beets, sugarcane, etc.) or in starch (cereals, cassava) through the

action of micro-organisms, yeast and bacteria. In Europe bioethanol is produced from cereals (wheat, maize, etc.) or beets. In Brazil, bioethanol is produced from sugar cane while in the United States bioethanol is produced mainly through the processing of corn. By using an industrial fermentation process, the sugar contained in these plants is transformed into alcohol. This alcohol (called ethanol) is concentrated and then dehydrated to obtain bioethanol.

1.1.2 Use

14. There are two ways to use bioethanol in vehicles:

a) In a pure state for all petrol vehicles when it is added directly to the fuel.

Mixing bioethanol directly with petrol can be done easily and immediately since every car engine can operate on a blend of biodiesel-petrol of less than 10% without any modification. The regulatory blend rate of bioethanol in petrol varies according to country. The French government, for example, set a blend target of 5,7% in 2008 and 7% in 2010.

b) Transformed into ETBE (ethyl-tertio-butyl-ether), into MTBE (methyl-tertio-butyl-ether) or into Super ethanol E85.

ETBE (ethyl-tertio-butyl-ether) is the result of a synthesis between 49% of bioethanol and 51% isobutylene, an oil base obtained from refineries. In Europe, ETBE can be added to petrol at the rate of 51%. Today, 80% of French bioethanol production is reserved for the production of ETBE but for some time now the addition of bioethanol directly to petrol is authorized in the country. MTBE (methyl-tertio-butyl-ether) is another form that can be used. It is a biofuel produced from bio methanol. Super ethanol E85 is composed of 85% bioethanol and 15% petrol.

1.1.3 Advantages and disadvantages of bioethanol

15. Spurred by its incredible development in Brazil and the United States and also by its environmental qualities, bioethanol is today the most widely produced and marketed biofuel in the world. Bioethanol has been gaining more and more ground in the world for several reasons. It is a clean energy that produces during combustion 75% less carbon dioxide than fossil fuels and thus contributes to combat greenhouse gas emissions that are responsible for global warming. At the same time, it can now be produced at a competitive cost compared to the current price of petrol. Moreover, it can be blended with petrol up to 10% in traditional engines without modifying them.

16. In particular, bioethanol produced from sugar cane presents most advantages. Certain experts hold that sugar cane bioethanol has a very interesting energy balance which far exceeds that of any other biofuel, particularly those produced in temperate regions. The production of ethanol from sugar cane in Brazil can reduce greenhouse gas emissions by

about 90%. On the other hand, producing biodiesel from palm oil or Soya bean oil can reduce greenhouse gas emissions by about 50% and 30% respectively.

17. Another advantage of sugar cane ethanol is attributable to the fact that sugar cane grows prodigiously in the tropical regions of Brazil and that it is produced in a closed cycle in that the energy needed for refining and distilling the raw product comes from the combustion of the by-products and as a result no combustible fuel is needed for these operations. Finally, as a result of successive improvements since the 1970s, Brazil has succeeded in producing sugar cane bioethanol today at a competitive price compared to the price of a barrel of oil which is $35 U.S.; this makes sugar cane bioethanol very attractive compared to petrol which has become very expensive.

18. The main disadvantage of bioethanol, besides those related to the fact that it competes with food products (maize, wheat, cassava, etc.) used in its production in certain countries, is that the eco-balance of ethanol produced from certain feedstock is not very good because of the low performance of alcohol fermentation which produces much carbon dioxide. West Africa can take these disadvantages into account and produce bioethanol from sugar cane which grows in all its member countries, and thus benefit from Brazil's experience.

1.2 Biodiesel

1.2.1 Production

19. Biodiesel is an ester extracted from fats and vegetable oils (rapeseed, sunflower, Soya, Jatropha) using a reaction process with an alcohol, methanol (process called transesterification). The reaction obtained produces ester and glycerine. This ester is also called diester (trade name) by contracting the words diesel and ester, and finally biodiesel because of its biomass origin.

20. In the future, with the development of second generation biofuels, maybe oils will be produced from algae with better yields making it possible to produce biodiesel on a wide scale within 5 to 8 years.

1.2.2 Use

21. In general, biodiesel is blended with oil diesel in varying proportions depending on the country. Thus B20 designates a mixture containing 20% biodiesel and B100 designates pure biodiesel.

1.2.3 Advantages and disadvantages of biodiesel

22. The main advantage of biodiesel is that it is a renewable energy which does not increase the rate of carbon dioxide in the atmosphere. It only releases into the atmosphere the carbon dioxide that the plant producing its absorbed through photosynthesis.

23. Nevertheless, in understanding the ecological quality of a fuel, its eco-balance should be considered, and consequently its entire production process, including the cultivation of the feedstock, inputs, energy efficiency and the ecological footprint of the transformation process and transportation from the producer to the end consumer. But then biodiesel needs energy supply to accelerate the etherification process and should be processed in specialized refineries before being delivered to consumers; this of course greatly affects its energy efficiency, in particular, when compared to vegetable oil fuel.

24. Biodiesel has been accused of having other real or imagined negative effects. Some say that the vegetable oil crops (rapeseed, in particular) used in the production of biodiesel are grown intensively using fertilizer and pesticides and therefore conclude that the eco-balance is negative as compared to petrol. Others hold that instead of using biodiesel, pure or crude vegetable oil (PVO-CVO) should be used because it has a better environmental balance. A few years ago biodiesel was also accused of costing more than diesel fuel but the recent surges in the price of a barrel of crude and the growth of the biodiesel market are tending to reverse this situation.

25. In general the environmental balance of biofuels depends on the type (alcohol, pure vegetable oil, biodiesel, etc.) and their feedstock growing (intensive agriculture, biological agriculture, etc.) It also takes into account the energy needed in producing the fertilizer, the fuel used in the farm machinery for sowing and harvesting, transporting the produce and finally the energy consumed throughout the entire process that culminated in obtaining the desired biofuel. Thus it is certain that the so called disadvantages of each biofuel depend both on the cultivation mode, the nature of the feed and the production process.

26. At the social level many analysts believe that the development of biofuels will cause untold food hardship in the world by threatening the livelihood of the poor. They believe that the great interest shown in biofuels is the cause of the steep increase in cereals prices. However, these concerns are only justified to the extent that biofuels are obtained from the processing of food products such as maize, wheat, or sweet sorghum, cereals already widely used in other industries (brewing) and especially for animal feed. On the other hand biofuels made from sugar cane or Jatropha should be encouraged in tropical countries like those of West Africa as long as there is good farm land management policy that preserves the environment and safeguards food crop zones.

2. BIOFUELS IN THE WORLD AND THE CHALLENGE FOR WEST AFRICA

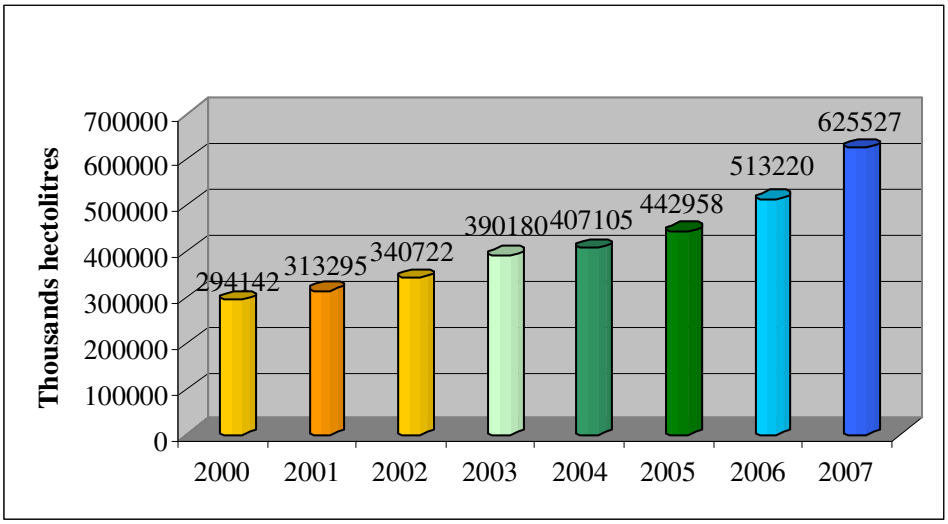
27. Since 2000 the price of oil has continued to rise rapidly. Analysts have estimated that the current oil deposits will be exhausted in some 30 years and this has revived interest in biofuels. Unlike in the 1970s when only Brazil and the United States undertook research to diversify their energy sources following the first oil shock of 1973, almost all developed countries and the majority of developing countries have taken or are taking measures to produce biofuel in order to gradually reduce their consumption of fossil fuels and diversify their supply sources by giving priority to local production. Countries of the

North, especially those within the European Union and all those who have ratified the Kyoto Protocol have the additional responsibility of respecting their obligation to reduce greenhouse gas emissions. To this end, the production and consumption of biofuels is one way of achieving this goal and this is in part the reason for their great interest in biofuels.

2.1 Biofuels in the world

28. During this decade (2000-2010), biofuels (bioethanol et biodiesel) production has increased to an unprecedented high level fuelled mainly by the increase in oil prices, the great demand of emerging countries, speculations, and the combat against climate change. Quantities produced have soared. As Graph 1 below shows, world bioethanol production jumped from 294 MHL (millions hectolitres) in 2000 to more than 513 MHL in 2006, representing an overall increase of about 74% at an annual rate of about 10%. Brazil and the United States alone accounted for about three-quarters of this world production.

Graph 1: Trends in world bioethanol production



Source: Taken from internet website: http://www.bioethanolcarburant.com/

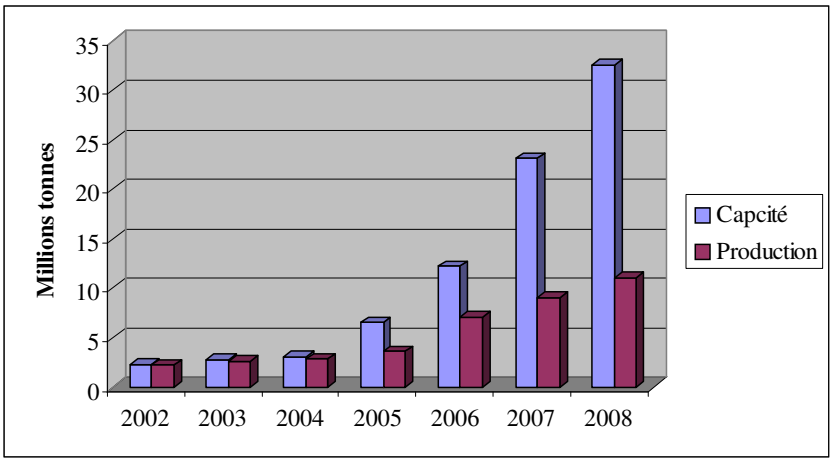
29. The production of biodiesel follows the same trajectory as that of bioethanol. A study entitled « Global Market Survey, Feedstock Trends and Market Forecasts » (Emerging-Markets Online, 2008) acknowledges that Europe represents about 80% of the biodiesel market in terms of production and consumption but that the United States is developing its production more rapidly. In the United States production increased 18 fold in three years between 2004 and 2007, from 25 millions gallons[1] to more than 450 million

[1] One Gallon is 3.785 l litres

gallons, which so far represents only less than 1% of total diesel sold in the country. Brazil for its part is accelerating its production and hopes to increase its biodiesel production to 20% of its transport fuels around 2015.

30. In Europe, biodiesel currently represents 2 to 3% of transport fuels and it is planned to increase this figure to 6% in 2010. China and India have similar prospects and hope to produce from 5% to 20% by 2020. Graph 2 below shows that world biodiesel production increased from 2.2 millions tonnes in 2002 to 9 millions tonnes in 2007, which is an very big increase of 300% in five years. Production in 2008 is estimated at 11.1 millions tonnes, but this represents hardly one third of production capacity (32.8 million tonnes). The wide gap between production and capacity reflects in some way world requirements in the importation of raw materials and/or finished products which offer new opportunities for developing countries, in particular those in tropical zones.

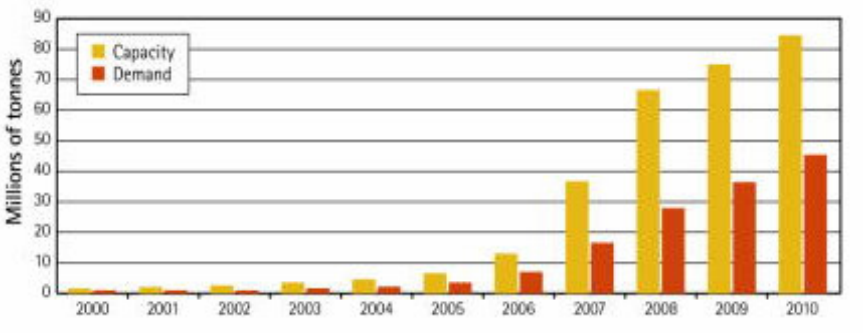
Graph 2: World biodiesel production and capacity



Source: Biodiesel 2020-Global Market Survey, Emerging - Markets Online

31. The trend in global demand is rising steeply. Graph 3 below shows the surge in biodiesel demand which increased from less than 2 million tonnes in 2000 to about 27 million tonnes (estimated) in 2008 and will reach 45 million tonnes in 2010. In the meantime consumer countries already have estimated a capacity of 65 million tonnes in 2008 and this may increase to 85 million tonnes in two years.

Graph 3: Trends in world biodiesel demand



Source: Ralf Gubler, March 1, 2007. *Subsidies and regulations keep biodiesel markets growing.* Industrial Biotechnology

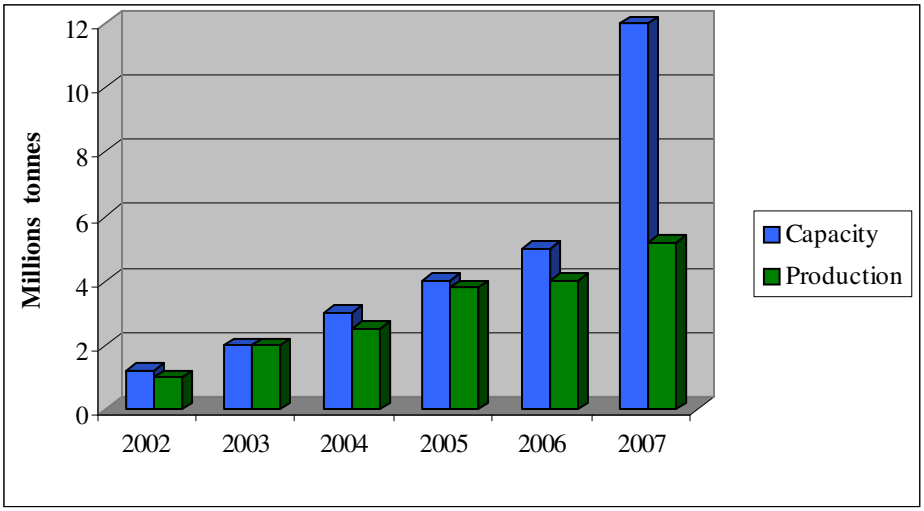
32. This steep increase in the world production of biofuels is yet far from meeting global demand, taking into account the obligations of the countries that signed the Kyoto Protocol and/or national objectives to diversify energy supply sources and energy security policies. There are therefore great export opportunities for countries that can produce biofuels.

2.1.1 Europe is banking on biofuels to ensure its energy security and to meet its commitment to reduce greenhouse gas emissions (GHG)

33. In its status report on biofuels (European Commission, 2007) tabled before the Council and the European Parliament, the European Union Commission maintained that biofuels have a special role to play in Europe's energy policy because today they are the only substitute that are readily available on a large scale to replace oil as transport fuel. With this in mind, the European Union has since 2003 taken a series of measures to promote the use of biofuels and other renewable energies. The Directive 2003/30/CE, 08 May, 2003, was aimed at promoting the use of biofuels and other renewable energies in transports. The Biofuels Directive JO L 123, 17 May, 2003, set the reference values for a market share of 2% for biofuels in 2005 and 5.75% in 2010. The Directive 2003/96/CE of the Council, 27 October, 2003, restructured the Community's tax scheme for energy and electricity products. These institutional provisions have helped accelerate production and consumption in all the countries of the Union.

34. Graph 4 below shows that biodiesel production increased from about 1.25 million tonnes in 2002 to about 5 million tonnes in 2007, representing a jump in increase of 300% in 5 years. The capacity in 2007 was double actual production which, as in the case of bioethanol mentioned earlier, shows the vegetable oil import requirements needed to produce biodiesel, thus opening a window of opportunity for countries that can produce vegetable oil.

Graph 4: European biodiesel production and capacity



Source: Biodiesel 2020-Global Market Survey, 2nd Edition

35. Last year Europe went a step further in biofuels development. During the March 2007 Summit, European leaders agreed to increase the share of renewable energies in total European energy production and decided to set new legally binding targets to reduce greenhouse gas emissions by 20% by 2020 as compared to the 1990 level and to use 20% renewable energies in total European Union energy consumption by 2020. In order to achieve these goals, the European Union is already importing biofuels from Brazil and Asia, and will do so under more advantageous terms from Africa which is closer to Europe.

2.1.2 The United States is increasing its production/consumption of biofuels to ensure its energy security

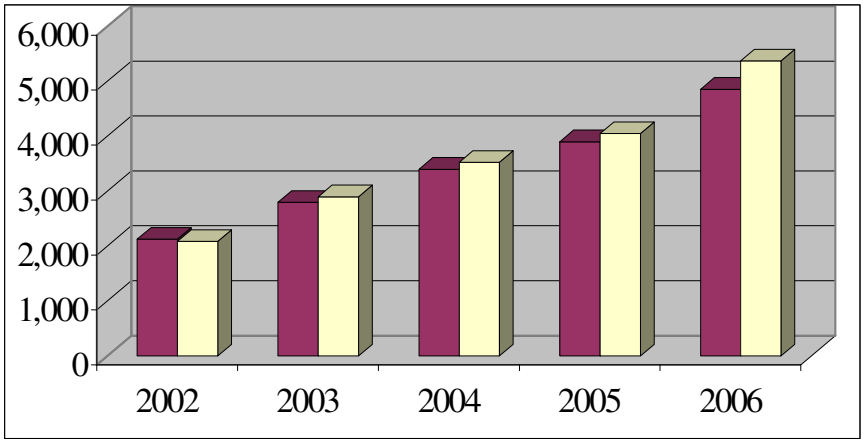
36. According to an analysis by Gulf Ethanol Inc, the four factors that have motivated the United States to embark on rapid development of alternative energies including biofuels are : security and the reduction of energy dependence, increase of farmers' incomes, availability of production technologies and biofuels consumption (production capacity and adaptation of new vehicles) (fuel flex vehicles).

37. The House of Representatives voted a new law on energy at the end of 2007 aimed at increasing the share of renewable energies in total energy consumption. The law sets the ratio of renewable energies to total energy consumption by 2020 at 15% and announces tax exemption reductions for oil and natural gas production by $21 billion. To be able to achieve the 15% renewable energies target, a new production objective of 36 billion gallons (136.3 billion litres) has been set for ethanol production by 2022. This provision reinforces the country's resolve to achieve a 20 billion gallons target (75.7 billion litres) by 2015 as stated in the same law.

38. These binding institutional provisions have resulted in the fact that although the United States is the world's largest bioethanol producer, it still has a major consumption

deficit as shown in graph 5 below since its production cannot meet its needs. As a result, the United States imported 653 million Gallons (2471 million litres) of bioethanol in 2006, mainly from Brazil and other Latin American countries (table below). Furthermore, according to the U.S. National Biodiesel Board (NBB News, 2008), biodiesel production (80% from Soya) more than doubled in 2006 to reach 225 million gallons. The NBB points out that since 2007, producers have been greatly affected by the increase in the price of soya and other vegetable oils and this explains in part the wide gap between installed capacity and actual production.

Graph 5: Bioethanol production and demand in the United States
(in millions of Gallons, Gallon= 3,785 l)



Source: Renewable Fuels Association, Ethanol Industry Statistics, Washington, Dc 20001

Table 1: Bioethanol imports by the United States by country of origin
(Gallons)

Country	Year				
	2002	**2003**	**2004**	**2005**	**2006**
Brazil	0	0	90.3	31.2	433.7
Costa Rica	12	14.7	25.4	33.4	35.9
El Salvador	4.5	6.9	5.7	23.7	38.5
Jamaica	29	39.3	36.6	36.3	66.8
Trinidad & Tobago	0	0	0	10	24.8
Total	45.5	60.9	159.9	135	653.3

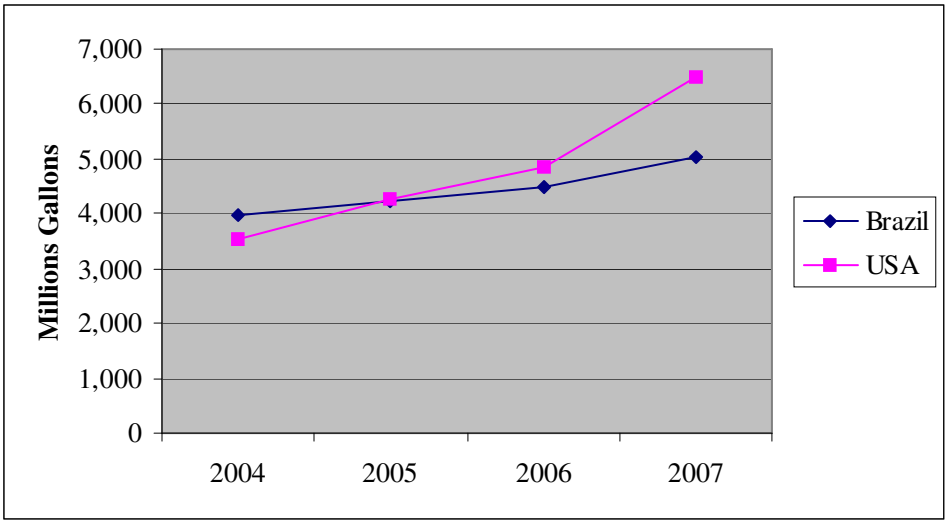
Source: Renewable Fuels Association, Ethanol Industry Statistics, Washington, DC 20001

2.1.3 Bioethanol in Brazil: a flourishing business

39. Bioethanol has been used as a fuel in Brazil since 1970 when the world faced the first oil crisis. Brazil's bioethanol is produced from sugar cane and is the first large scale biofuel programme which can develop on its own without government subsidies, It scores the best environmental balance among first generation biofuels. On the other hand, bioethanol produced in the United States from maize is highly subsidized and exerts tremendous pressure on world cereals prices.

40. Nowadays, 30% of the 19 million vehicles in circulation in Brazil have been designed to use bioethanol. Most of them are equipped with fuel flex engines making it possible for them to use both ethanol and petrol at any chosen rate. It is estimated that by 2015, the vehicle fleet will reach 30 million vehicles of which 19 million will be fuel flex; About 85% of cars manufactured in Brazil today are equipped with flex technology. Notwithstanding this strong local consumption, Brazil which is the only country that produces more than it needs, dominates world bioethanol exports. Up to the year 2005, Brazil was the largest producer of bioethanol before slipping to second place behind the United States (graph 6 below). It nevertheless is still the world's leading exporter.

Graph 6: Trends in bioethanol production in Brazil and the United States



Source: Ethanol Industry Statistics

41. Brazil exports ethanol to some ten countries as table 2 below shows, especially India, United States, South Korea, and the European Union. In 2006, it exported 433.7 million gallons (1642 million litres) to the United States, and this represents two-thirds of U.S. ethanol imports (Table 1 above). In 2007 it exported 3.84 billion litres, but intends to reduce this figure to 3.46 billion in 2008 (Thomas Kutty Abraham, 2008) to meet its domestic market needs first and may be to benefit from an increase in the world price of sugar.

Table 2: Brazil's exports of bioethanol by country of destination

	Exports in million US Dollars	
Country	2003	**2**004
India	3.9	92.9
United States	9.7	80.4
South Korea	11.7	56
Sweden	21.4	46.2
Japan	18.9	44.3
Netherlands	18.4	36.4
Jamaica	17.2	27.2
Nigeria	11.4	23.8
Costa Rica	5.4	23.2
Mexico	8.7	18.3
Others	31.2	49
Total	**157.9**	**497.7**

Source: Análise das Informações de Comércio Exterior–ALICE
(Analysis of information on external trade _- ALICE)

42. It should be pointed out that in spite of Brazil's reputation as a major bioethanol producer; the country was one of the pioneers in the biodiesel field. The first research programme was launched in 1977 and professor Expedito of Tecbio du Ceara Company in the North East of Brazil obtained the first world patent for biodiesel. Yet it was not, until a Ministerial Order was issued on 6 December 2004, that the National Oil Agency in charge of regulating fuels in the country, authorized the optional blend of 2% biodiesel with diesel. Brazil unveiled its first biodiesel factory using Soya in 2005. This factory is located in the State of Minas Gerais in outh East Brazil and produces about 12 million litres of biodiesel per year.

2.1.4 Asia is imposing itself more and more as the greatest producer of « controversial » biodiesel

43. In Asia, increasing reliance on biodiesel is mainly due to the skyrocketing price of oil. As a result, Malaysia which is the leading world producer of palm oil (15.9 million tonnes in 2006) and leading world exporter (14.4 million tonnes in 2006) considerably strengthened its biodiesel production position. Its major client is Germany which, given its fiscal policy that encourages biofuels, has become the European leader with more than 1,500 biodiesel distribution stations. For its part, India, which is among the four leading world producers/consumers of bioethanol, has for some time been emphasizing biodiesel production from Jatropha oil , a plant that has been the focus of research. India which has already authorized the blending of bioethanol to 5% of petrol, has over the last few years championed the production of biodiesel from Jatropha oil based on successful results

obtained from major research and extension centres such as the Centre for Jatropha Promotion & Biodiesel (CJP). China, Thailand, Indonesia and almost all South East Asian countries are following in India's footsteps.

44. Nevertheless, the biofuels from Asia, in particular, the biodiesel from Malaysia obtained from palm oil is the subject of great controversy notably in the European Union. Ecologists, in particular, believe that the development of oil palm plantations accounts for 87% of deforestation in Malaysia and that the country's biodiversity is threatened. Accordingly, they say that the orang-utans in the wild will disappear as well as the Sumatra rhinoceros, tigers, gibbons and thousands of other species. Farmers are also accused of drying up forest marshland by growing palm oil plantations although when peat dries up they oxidize and release more carbon dioxide than that contained in trees. In Indonesia (Malaysia's neighbour), the continued rise in the price of palm oil has produced a negative effect. Farmers are now attracted to growing palm oil trees which are yielding such profits they never had before, with the result that the farmers are destroying pristine forests of thousand years old which are the natural habitat of orang-utans and other inhabitants of an ecosystem that is already being destroyed by the trade in timber.

2.1.5 Africa is slowly jumping on the biofuels bandwagon

45. Faced with the skyrocketing price of oil, African countries are becoming increasingly interested in biofuels as a palliative. Southern Africa and the Indian Ocean islands are slightly ahead in this area. In South Africa, the Industrial Development Corporation (IDC) has invested heavily over the past five years in 5 bioethanol production projects. The most advanced project is a 174 millions Euros project conversion unit in KwaZulu Natal, a sugar cane producing region. The others are in the Free State, Northern Cape, Eastern Cape and Mpumalanga. All these projects are expected to produce 1.1 billion litres/year, which is 10% of the country's fuel consumption. Clearly these projects will affect the place of biofuels in South Africa's economy and make the country Africa's top producer. Other projects such as Ethanol Africa are encouraged by the government's commitment to make the blending of bioethanol with car fuels mandatory. In Mozambique, some ten foreign companies are involved in improving the yield of Jatropha to produce biodiesel. Jatropha is a plant that also grows in Zimbabwe and Zambia. According to Mr. Mitsuo Hayashi, executive director of Biwako Bio-Laboratory Inc., a Japanese company, biodiesel production in Kenya could soon begin on a 30, 000 hectares concession used for Jatropha cultivation. The area is expected to increase to 100,000 hectares in 10 years and will generate about 10,000 jobs.

46. In Madagascar, production of biodiesel (called « green gas oil») from Jatropha is increasing and could meet 5% of the country's fuel consumption needs as from 2008. The largest producer is D1 Oil Company which will soon have four refineries. The sale of Jatropha oil to the company represents additional income for the farmers working with the project. In Mauritius, bioethanol is helping to attenuate the difficulties faced by sugar companies as a result of the reform of the sugar sector in Europe. Sugar cane production covers 70,000 hectares, which is 42% of the island's land area, and generates 60,000 jobs. In addition to producing sugar, sugar cane prevents soil erosion and preserves the lagoon which is a great tourist destination. On account of the sugar reforms in Europe,

Mauritius has decided to exploit to the full sugar cane biomass by producing bioethanol with the 160,000 tonnes of molasses produced annually (Marie Bruneau, 2007). The Savannah factory plans to build a 30 million litres distillery in 2008.

47. In West Africa (CF 3.1 below), the agro-business industry in biofuels is still in its infancy. Since 2007, some countries such as Benin, Cote d'Ivoire, Ghana, Mali, Nigeria and Senegal have embarked on it timidly. In Central Africa, certain institutional measures have been taken as in the Central African Republic where a law on biofuels has just been voted.

48. At the global level, a study published in July 2007 by Global Insight, an economic analysis firm, posits that biofuels will cover approximately 15% of world fuel demand for vehicles in the next twenty years. According to the study, "The boom in biofuels: Implications for the automobile industry, agriculture and energy", the automobile industry is ready to adapt its products to biofuels and will not need a technological revolution. The report states that all current vehicles are ready to function with 5% of biofuels while new vehicles can already tolerate a blend comprising up to 30% of biofuels subject to some technological adaptations.

2.2 The challenge of biofuels for West Africa

49. Meeting the biofuels needs of industrialized countries will be constrained by the lack of cultivable land in many countries, in particular, in Europe. Indeed, the production of biofuels requires much farm land which all the countries do not have in sufficient quantity. What this means is that the search for land to grow biofuels in the future could become a major concern especially for countries which are not able to produce their biofuels from the most suitable and high yielding plants such as Jatropha or sugar cane. If these plants cannot be grown locally, these countries will be compelled to import.

50. Furthermore, for various reasons, the high cost of biofuels produced in the European Union will make it harder for member countries to compete for fossil fuels. Most of them are obliged to give tax breaks or subsidize retail biofuels at the pump in order to develop biofuel production in spite of the high cost. Taking into account current available technologies, biofuels produced in the European Union are only profitable if the price per barrel of oil is below 60 Euros, whereas European bioethanol made from beet, wheat or maize is only competitive if the price of petrol is 90 Euros per barrel (European Union Commission, 2006). Notwithstanding these measures, the status report on biofuels in 2005 (EU Commission, 2007) concluded that on the average, member states were able to meet only 52% of their target and that the European Union will achieve only a market share of 4.2% of biofuels in 2010 compared to its 5.75% target objective.

51. On the other hand, bioethanol produced from sugar cane is currently competitive as compared to fossil fuels in Brazil which is the second world ethanol producer as long as the price per barrel remains below $35 U.S. In addition, the fossil energy required to produce bioethanol from sugar cane is far less than that needed for bioethanol produced from beet, wheat, or maize in Europe. Accordingly, the corresponding eco-balance is better.

52. Like Brazil, tropical countries like those of West Africa have a real comparative advantage in the production and consumption of biofuels obtained from tropical plants such as sugar cane and Jatropha. These crops are different from those in the other regions by their particularly high energy efficiency, their yield and their relatively low production cost. Besides, the sub-region has wide expanses of undeveloped cultivable land, abundant water resources and labour force. In short, they have what it takes for them to become some of the largest biofuels producers/exporters. However, if the sub-region does not avail itself of the opportunities upstream to tap these potential resources in a sustainable manner for its development, there is no doubt that others will supersede them in growing the feedstock and/or producing cheaper biofuels for export on international markets. The presence of American and Italian companies which have recently obtained concessions of 200 hectares in Cote d'Ivoire and 250 hectares in Benin respectively for the production of biofuels is a pointer to what will happen (see 3.1 below).

53. Indeed numerous challenges face biofuels production in West Africa: reduction of energy dependence, reduction of oil bill, development of agricultural land, rural and urban job creation, combating rural exodus, desertification control through cultivating plants such as Jatropha, creating value added and improving the trade balance, fighting against climate change, integrating in a globalized world, etc. Biofuels can be used in different forms in the sub-region. Jatropha oil can be used to produce at least cost (about 250 FCFA/litre) to serve in multi-functional platforms to produce energy in rural areas and rural electrification, and in agricultural mechanization (farm machinery, motor pumps). Bioethanol, in addition to its use as a fuel, can be used in "gel fuel" for cooking. However, biofuels (bioethanol and biodiesel) processed in West Africa will be used mainly as transport fuel. If the sub-region can meet its domestic demand and generate surplus production, the Europe will remain a demanding market in the short, medium and long term for the reasons already adduced.

2.2.1 Seizing the opportunity offered by the global carbon market

54. Opportunities for climate change depend in the main on the respect of the Kyoto Protocol according to which the main industrialized signatory countries, with the exception of the United States, committed to reduce their greenhouse gas emissions by an average of 5.2% by latest 2012 as compared to the situation in 1990. In 2007, in view of the Bali negotiations on climate, the European Council adopted, in addition to the Kyoto Protocol, a "climate-energy package" on future emissions and gave 2020 as the target date for a 20% reduction in GHG emissions or a 30% reduction if other industrialized countries undertook to make similar reductions. In order to honour their commitments or simply to ensure their energy security, the industrialized countries which are the main polluters, are using cereals such as wheat, maize, and soya to produce biofuels. This has resulted in an inflationary trend on the world cereals market and threatens global food security. Thus, the price of wheat and rice has skyrocketed while galloping inflation has seriously affected these products in the West African sub-region, leading in the last few months to strikes and demonstrations against « the high cost of living » that spared no country. This crisis may likely compel countries of the North to reduce the use of food products in producing biofuels because these countries are being criticized more and

more for starving the world, in particular poor countries by « feeding their vehicles » with food products.

55. Africa in general and the West African sub-region in particular have a golden opportunity before them to react to the food shortage by producing not only the cereals already mentioned to meet their self-sufficiency needs, but also biofuels for their consumption and even for exporting the surplus. As regards biofuels in particular, the sub-region also has the opportunity of selling its accumulated carbon credit on the global carbon market to industrialized countries which produce more carbon than authorized. In fact, in view of the Kyoto Clean Development Mechanism (CDM) (Inset 1 below), projects that reduce greenhouse gas emissions in developing countries and which advocate sustainable development, can generate Certified Emission Reductions (CERs) credits. This can apply to biofuels such as biodiesel from Jatropha as long as the CERs generated can be proven and quantified. This is a difficult task which requires the intervention of specialists. Countries that have made commitments under the Kyoto Protocol can procure these CERs to honour part of their obligation to reduce greenhouse gas emissions by participating in the financing of these projects or by compensating in part for the investments.

Insert 1: Kyoto Protocol Clean Development Mechanism (CDM)

The CDM is an important mechanism enshrined in the Kyoto Protocol. The 1997 Treaty enjoins industrialized countries to reduce their greenhouse gas emissions which are causing global warming and to bring the level of the emissions down to the 1990 levels. The CDM allows developed countries to meet the reduction of their greenhouse gas emissions in part by investing in projects that reduce the quantity of carbon dioxide and other GHG emissions produced by developing countries. Each tonne of non emitted GHG by a project approved within the framework of the CDM in a developing country is credited with a Certified Emissions Reduction credit, called simply a « carbon credit ». These "carbon credits" can then be purchased and sold like company shares and can be used by developed countries to meet their GHG emission reduction target.

Source : Afrique Renouveau/ONU, www.un.org/AR

56. It is estimated that the CDM will earn more than 2.5 billion CERs by the end of the first commitment period of the Kyoto Protocol in 2012, with each unit corresponding to a tonne of carbon dioxide. So far the European Union Emissions Trading Scheme (EU-ETS) is the most important mechanism for the trade in emissions rights and it is very promising. The value of world carbon increased by 80% in 2007 and trade was about 2.7 billion tonnes of carbon dioxide credits, representing 40.4 billion Euros. According to a study by Point Carbonexternal, an independent consulting firm (Infos de la planète, 19 February, 2008), this is a very encouraging sign for the growth of trade in carbon for world companies and investors. However, the enthusiasm is tapering off because of the

decline in the value of carbon credits between 2006 and 2007 although it is hoped that the situation will stabilize by 2012.

2.2.2 Creating favourable conditions to profit from global financing for climate change

57. The global combat against climate change has resulted in the creation of some funds for financing activities to reduce greenhouse gas emissions in developing countries. One of these funds is the Global Environment Fund (GEF) associated with CDM which is made up of 178 countries in partnership with 10 major organizations, the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Industrial Development Organization (UNIDO), the World Bank and the African Development Bank (ADB). Unfortunately African countries are not benefiting very much from these funds (see insert 2 below) because they lack the requisite expertise and do not present projects with the required size to meet the eligibility conditions. The launching of major biofuels production/consumption projects could reverse this trend as long as the projects have an acceptable eco-balance and meet the other conditions.

Insert 2: Global Environment Fund (GEF) financing

According to experts working on the United Nations Framework agreement on climate change and supervising CDM, Africa accounts for less than 3% of about 1000 projects approved worldwide within the framework of CDM. On the other hand, Mexico alone obtained 3.56% of total carbon credits; South Korea, 7.28%; Brazil, 8.97%, India, 14.75% and China, 48.9%.

Most of Africa's projects are in South Africa which has the adequate industrial and financial infrastructure that meets the stringent accreditation requirements of CDM. Excluding South Africa, sub-Saharan Africa accounts for less than 1% of projects accredited within the framework of CDM. The region is therefore really excluded from the carbon credits market which in barely a few years has attracted about 30 billion $U.S. in investments in the combat climate change. The reasons that have made it difficult for Africa to attract investors interested in CDM have to do, among others, with limited financial and economic resources, shortage of trained personnel with technical and management skills to set up projects that meet CDM standards, and weak economic institutions.

Source : Michael Fleshman, 2007. Afrique Renouveau, ONU.

58. It is clear that climate change risks compel all countries on the globe to take appropriate action to reduce GHG emissions which is the main cause of climate change. The risks are well known: drought, glaciers melting, floods, tornados, etc. Many analysts are of the view that African countries are most prone to these risks even though they are

not responsible for them nor do they have the means to cope with them. Nevertheless, this does not mean that African countries should sit back smugly, wring their hands and do nothing about them. One way of reacting is through active participation in the global combat against climate change by producing/consuming biofuels and taking into consideration all the economic and social benefits that have been discussed, including the possibility of benefiting from the world carbon trade and the global financing of climate change projects. In a nutshell, West Africa can, through the development of biofuels, make climate change more opportunity than risk.

3. WHAT SHOULD BE THE STRATEGY FOR DEVELOPING BIOFUELS IN WEST AFRICA?

59. In spite of the many comparative advantages described earlier, West African countries have been slow to develop biofuels production. So far most countries have relied only on external assistance to experiment with cultivating feedstock and producing biofuels (usually Jatropha oil). This solution is not sustainable and places countries in a situation of continued dependence. Past experiences show that most actors in the biofuels sector considered individually, do not have the financial means nor the required research infrastructure or technology to set up viable biofuels agro-business schemes. Furthermore, very few countries have taken the necessary action upstream to create the enabling environment for the development of biofuels.

60. In order to ensure the sustainable development of biofuels in the sub-region, it is absolutely necessary to address the problems outlined earlier. The best way is for countries to first adopt the appropriate upstream legal, regulatory and fiscal framework to govern the production, the standardization, the quality control and marketing of biofuels, including a tax regime and equipment for distribution stations. Thereafter it will also be necessary to put in place a biofuels financing mechanism and a promotion policy based on public-private partnership throughout the production and marketing chain, involving countries, African or foreign multinational corporations and the local private sector in order to harness maximum resources from the sector.

3.1 Status of biofuels production/consumption in West African countries

61. In West Africa today the production/consumption of biofuels is still at the experimental stage or in some cases it is just being launched. Progress in this sector depends on the steps taken by individual countries. For the moment, there is no general sub-regional strategy as each country adopts its own policy. The production and marketing of biofuels in West Africa is managed mainly by private economic operators who are often individual or family businesses working generally in an informal and traditional manner. These operators are usually inefficient because of the welter of problems they face such as access to financing and to appropriate technologies, organisational and management problems, lack of know-how, etc.

62. Nevertheless, it is obvious that most West African countries are interested in the development of biofuels. In all the countries biofuels development programmes have been launched or are being designed. Nigeria has so far opted for the production of bioethanol from cassava and sugar cane. In addition to these two products, the country is also starting the development of Jatropha and oil palm to produce biodiesel. The Nigerian Federal Government has already prepared a regulatory text for the development of biofuels. Biodiesel production is likely to develop rapidly in the short term because an American research group has recently obtained a concession to grow Jatropha in the northern Nigeria.

63. Ghana is pursuing its Jatropha pilot project with Anuanom Industrial Bio Products Ltd which has launched a large scale Jatropha cultivation project to produce biodiesel in partnership with the public sector. The objective is to produce one million hectares of Jatropha plantation in Ghana in the next 5 to 6 years (Pépin, http://www.riaed.net). The first phase of the project will involve a total area of 40,000 hectares in 30 districts. The project has already received the blessing of district officials and municipal councils.

64. In Benin, the Directorate General of Energy plans, as part of its energy supply project (PFSE), plans to locally produce bioethanol and biodiesel from the biomass component of the project. The associated biofuels development programme is aimed at producing biodiesel from ricin (Ricinus communis) and Jatropha for use in farm machinery, transport, electricity generation, as well as cashew bioethanol for cooking and to substitute petrol. Furthermore, an Italian company, Green Waves, has just obtained the authorization and support of the Benin government to develop 250,000 hectares to produce biofuels (Christophe Gandonou, 2007).

65. In Burkina Faso, two companies, DAGRIS and SN CITEC, have designed a biodiesel production project based on cotton oil to be blended with gas oil and/or to serve as fuel for electricity generators used in the country. However, because it involves oil for food, the project is still in an experimental phase. The largest project is being promoted by Agritech-Faso which plans to produce biodiesel from Jatropha by 2011 (L'Observateur, 9 April 2008).

66. In Cote d'Ivoire, the 21st Century Energy company (Le Patriote, 16 February 2007) intends to invest about 650 billion Francs CFA within 5 years to produce bioethanol for local consumption and export on the sub-regional or international markets. It hopes to produce 3.5 billion litres of biofuel per year from sugar cane and maize. A few private projects have been developed in the past such as the pilot project to produce biofuel from copra oil for use in farm tractors or the SOGB project to produce biofuel from palm oil. Unfortunately these projects failed for several reasons, including lack of financing.

67. In Niger, the IBS Agro-industries company has opted to grow Jatropha and to produce pure vegetable oil and biodiesel. The company has already started experimenting with Jatropha in the Gaya region on a few hectares. It plans to increase the Jatropha plantation to 5,000 hectares in 3 years with the hope of cultivating 50,000 hectares later,

and install a factory to produce 29,000 litres of Jatropha oil per day and process it on the spot into biodiesel.

68. Mali has been growing Jatropha for more than two decades. The plant is widely used as a hedge in the country and is cultivated on dozens of kilometres. In fact, Mali benefited from the support of GTZ in 1987 within the framework of a renewable energy project, to develop Jatropha cultivation. In order to limit the country's dependence on energy and also to develop the country, the Malian government launched a pilot project to assess the energy potential of Jatropha (also called bagani locally) as a substitute fuel for gas oil by setting up the national programme for the assessment of the energy potential of Jatropha ((PNVEP). This has led to the use of pure Jatropha oil in multi-functional platform generators and even in small village electricity mini-power stations. With the current skyrocketing price of oil on the international market, Mali has embarked on the industrial production of biodiesel from Jatropha oil. The first site that has been chosen is in Koulikoro (L'Essor, 19 March 2008). The factory that has been built belongs to Mali Biocarburant SA, a company inaugurated in February 2008. The company had an initial staffing of about 15 persons and will produce 750,000 litres a year. This represents only one thousandth of the estimated 750 million litres of gas oil that the country consumes each year. Mali Biocarburant SA expects to set up 20 similar units in Mali in the next 6 years to produce about one million litres of biodiesel per month and to employ about 120 workers. In the long run, the cultivated area will be increased to 5000 hectares by 2012 and the company plans to invest in other countries in the West African sub-region.

69. Senegal has for some time focused on both bioethanol and biodiesel. In November 2007 the President of Senegal inaugurated a distillery in an industrial complex in Richard-Toll (400 km North of Dakar, the capital), for the production of ethanol from sugar cane. According to the promoters of the project, this was the first such venture in Senegal. This new production unit was funded by the Senegal Sugar Company (CSS) from its own funds. The distillery has been set up in the company's agro-industrial complex which has a sugar cane mill and refinery. It will produce 8 to 12 million litres of bioethanol per year from molasses obtained from the processing of sugar. At the same time, the Senegalese promoters recently announced the launching of an integrated agricultural and biodiesel production project using Jatropha oil in the Tambacounda region in the South East of Senegal where Jatropha grows naturally and is used as hedges. The promoters intend to develop 10,000 hectares of Jatropha along the Gambia River bank from Gouloumbou to Kedougou over a 300 km distance. They also plan to set up the first pilot unit for the transesterification of oils into biodiesel in Tambacounda. The capacity of the unit is 200 litres/hour but it can be increased as and when necessary depending on the need and technological developments.

70. In summary, it can be said that generally speaking West African countries encourage biofuels production but in some cases the necessary legal, regulatory and fiscal framework is lacking. There is also a lack of a policy instruments on biofuels development in most of the West African countries even though private sector initiatives to invest in the biofuels sector are gaining ground. Nevertheless, some countries like Ghana, Mali, Nigeria and Senegal have adopted national strategies to promote biofuels

development. All the same, it is necessary for these strategies, which still have to be well refined, to clearly define the policies to be implemented and to adopt incentive measures for biofuels production and marketing for the durable development of the biofuels sector in the short, medium and long term.

71. Another noteworthy point is that the national strategies have failed to harness regional cooperation synergies. It goes without saying that taking into account the regional dimension, which is necessary, also depends on the involvement of sub-regional organizations in the development of the biofuels sector. In this regard, the West African Economic and Monetary Union (WAEMU) has prepared a document entitled «Regional Vision and Strategy for the Development of Biomass» and established a Regional Biomass Energy Programme (PRBE) to undertake work on biofuels development in member countries. The programme helped organize a workshop for the validation of the study on the development of ethanol-biofuel within the WAEMU sub-region in Dakar from 20 to 22 November 2006, and also created an African Biofuels Producers Association (AAPB). The CILSS is also carrying out other advocacy activities as part of its regional Programme for the Promotion of Domestic and Alternative Energies in the Sahel (PREDAS).

72. Regional integration organizations have another major role to play in biofuels development. It is necessary to standardize the production and consumption of biofuels in all member countries. Since there is already free movement of persons and goods within the ECOWAS sub-region, vehicles need to refuel when they go through each country. These fuels must meet the same standards in all countries. To this end, it is necessary to develop an upstream sub-regional biofuels strategy for production (blend content and distribution modalities) and marketing (product characteristics) for the harmonious development of the biofuels sector.

3.2 Need for an appropriate legal, regulatory and fiscal framework

73. National and international investors interested in biofuels development in a given country need to know the conditions for access to farm land, production, control and marketing standards for products, as well as tax and customs incentives and financing opportunities. It is thus incumbent on public authorities to define upstream the legal, regulatory and fiscal framework that clarifies the policy orientation and complementarity of the public and private actors in order to pave the way for the involvement of the private sector which is indispensable for the sustainable development of the biofuels sector. This should include where necessary agrarian and land tenure reforms. It is pointless to emphasize the key role the private sector (national and foreign) should play in the acquisition and transfer of technology and know-how as well as in building the capacity of national operators.

74. At present the necessary institutional mechanisms appear as a necessity in some countries as a condition for the harmonious development of biofuels. At the same time, the land tenure issue appears as one of the preconditions for investments and increasing production. As regards the cultivation of plants for producing biofuels feedstock, land

requirements usually loom large and involve great competition with other food production needs. Addressing this issue requires first that a serious socio-economic analysis be carried out to find a compromise between food security, land tenure problems and the cultivation of feedstock needed for biofuels production. It is also important to point out that the existing natural resources management codes (forestry code, land tenure code, environment code, etc.) need to be revised to adapt them to the biofuels sector which has its own specific needs.

75. The above instruments should address the challenges and define national biofuels priorities: energy security, creation of public and private wealth, rural development, job creation and local income generation, food security, etc. They should also make it possible to manage the project cycle and the marketing of products (choice of the type of blend and control modalities…). Furthermore, they should integrate the sub-regional dimension with the aim of harmonizing the acts governing production and marketing for all the countries, pool experiences, standardize and certify all West African products according to common criteria that are consistent with international standards.

3.3 Establishment of sub-regional biofuels financing mechanism

76. Lack of financing is one of the major impediments to the development of biofuels sector in Africa and the sub-region. Potential promoters/operators must overcome many obstacles such as limited access to traditional financing, complex modalities and procedures for accessing CDM, high transaction costs for specialized services, inadequate knowledge of African CDM financial intermediaries, lack of competent national CDM consultants, lack of structures that can mount viable projects to attract buyers, poor information flow between sellers of carbon credit opportunities who are generally from developed countries and buyers from the developing countries of the sub-region.

77. In this context it is imperative to facilitate the emergence of dedicated financial institutions such as the African Biofuels and Renewable Energies Fund (ABREF) and to urge existing financial institutions to propose loan conditions that are adapted to the biofuels sector. Nonetheless, access to financing can be facilitated through public-private partnership.

3.4 Adopting a biofuels development strategy through public-private partnership

78. The Economic Community of West African States (ECOWAS) covers an area of about 5, 093, 000 km2, with a population estimated to be 269.1 millions inhabitants in 2007, which represents a density of hardly 52.8 inhabitants per km2. Although certain parts of the Sahel countries such as Mali and Niger are desert lands, cultivable areas are immense and suitable for the cultivation of feedstock such as maize, cassava, sugar cane, Jatropha, etc. used in the production of biofuels. Cultivable areas in the Niger basin alone have been estimated to be 2.5 million hectares of which hardly 25% have been exploited. Moreover, the sub-region has abundant water resources and labour. Based on present

yields, just 30 000 hectares of jatropha are needed to produce up to 10% of the total fossil diesel imported by the majority of West African States, except Côte d'Ivoire, Ghana and Nigeria. As it has been pointed out earlier, what is missing is access to financing, technology and know-how. This deficiency can be made up through public-private partnership for production and marketing biofuels (including equipping distribution stations), provided that it is « intelligent at the sub-regional level and strategic at the international level» (ECA/SRO-WA, 2008a).

79. Establishing this public-private partnership is predicated on the firm and collective determination of leaders in member states, economic operators and regional integration institutions. It also assumes that all of them are aware that promoters/operators taken individually, with a few exceptions, have neither the financial means nor the research infrastructure nor the requisite technology to set up viable biofuels agro-industries. Furthermore, marketing should take into account the mobility of people and goods between countries and thus requires some harmonization and standardization. Lastly, it supposes the existence of a shared will to make regionalization a reality by ensuring that the development of each member State of ECOWAS is more dependent on the economic and fiscal bootstraps of the entire sub-region (ECA/SRO-WA, 2008b), rather than continuously relying on the economies of the North and suffering from the attendant consequences.

80. Subject to the conditions outlined above in this paper, establishing public-private partnership for producing and marketing biofuels could be based on either of the following two strategies, both grounded on public-private partnership: (i) The regionalization strategy for producing and marketing biofuels based on transnational corporations and ii) The regionalization strategy of providing support to biofuels development based on sub-regional support networks.

3.4.1 Regionalization strategy for producing and marketing biofuels

81. With the exception of a few major biofuels projects which, from the outset, had integrated access conditions to world and CDM carbon market opportunities such as the production of bioethanol from cassava developed in Nigeria, the production of biodiesel from Jatropha in Ghana, and maybe the production of ethanol in Cote d'Ivoire by 21st Century Energy company, most of the nascent projects in countries of the sub-region are too small to take advantage of such benefits. Only large scale projects can meet the conditions to enable them benefit from the carbon credits traded on the global market. Small individual promoters are unlikely to access the world carbon market unless they are part of well organized and knowledgeable organizations. It is for this reason that a sub-regional strategy should be forged that includes all actors in the biofuels sector to enable all of them benefit from it and also to better distribute the wealth that it will generate.

82. The strategy for the regionalization and marketing of biofuels is based on the setting up of transnational corporations and aimed at globalizing the production and marketing of biofuels throughout the ECOWAS sub-region. The objective is to establish companies that can operate on large expanses of land (that are not necessarily contiguous) and that

can open large factories, and by so doing, place them on the same footing as world multinational companies. The regionalization principle implies that ECOWAS is a single space where cultivable areas can be identified to grow feedstock and where production factories will be located after careful consideration of the site, taking into account the economic return linked to proximity to feedstock and desired inputs.

83. If the chosen feedstock are for example maize and sugar cane for the production of bioethanol, the appropriate areas to be cultivated will be the irrigable basins of the Niger, Mano, Gambia and Senegal rivers or the Lake Volta banks and the coastal areas. If Jatropha has been chosen to produce biodiesel, Jatropha can be grown throughout West Africa, given that it thrives better in the semi arid regions. In any case, processing plants will be judiciously set up in some of these areas and not necessarily in areas where the plants are grown, taking into account processing capacity in relation to the supply of feedstock from a profitable area. This strategy also provides that feedstock produced in industrial plantations by the transnational corporation can be supplemented by those produced by neighboring farmers or cooperatives of small producers so as to create jobs and ensure distribution of the wealth generated from biofuels production.

84. The creation of the transnational corporations will be based on the African Wealth Creation and Retention Strategy (ECA/SRO-WA, 2008b) prepared by the Sub-regional Office for West Africa of the Economic Commission for Africa. The strategy states that establishing a local African transnational feedstock processing corporation requires the assistance of a well known multinational as a strategic partner to hold 30% of the share capital and to provide the required technology, know-how and the bulk of the financing. Furthermore, 60% of the capital would revert to an African private and/or public group and 10% would be controlled by a pool of excellent foreign transnational corporations interested in taking part in the joint-venture. In this regard, the African group of investors would be made up of a majority of private and public operators from West African countries who are willing to concede land to the newly created transnational corporation. The establishment of the African transnational corporation would take place by either creating a completely new corporation or by merging existing companies operating in the biofuels sector.

85. In the case of strategic partnerships, there is reason to believe that these would be forged quite easily as long as the projects are large enough to be attractive. Several such transnational corporations exist in the world. The growing interest in biofuels in recent years has attracted major investments into Brazil, the world's top producer of sugar cane-based bioethanol. Foreign capital investments in agriculture which accounted for 6% of direct foreign investments in 1996 increased to 16% in 2006 and amounted to 3.5 billion $U.S., according to figures released by the Brazilian Ministry of Agriculture. Cargill, the American agro-business group, took control of the ethanol distillery in Brazil, and Tereos the French group which already controls Açucar Guarani, is looking for new acquisitions (LiliAn, 2007). West Africa can stoke similar interest in its biofuels sector if adequate measures are taken especially as the climatic conditions in the sub-region are close to those in Brazil, what explains the foreign interests discussed above (CF § 3.1 above).

86. In the operational phase, transnational corporations can specialize either in production or in marketing or in the complete production and marketing chain for biofuels. The choice will depend on the interest of shareholders. Besides, the size of the companies will enable them to create the necessary support services from within or to procure them more cheaply from specialized services (CF 3.4.2 below). They could also define the production standards, the distribution modalities including the equipment for distribution stations and determine the blend rate in consultation with the relevant authorities in member countries.

3.4.2 Regionalization strategy for providing support to the development of the biofuels sector

87. The aim of this strategy is to facilitate access by all the actors involved in the biofuels sector to services that are needed for the sector's harmonious development. Some of these services such as agricultural research centers, seed producing centers and codification/certification institutions already exist in some countries, and it will simply require including them in a network and coordinating their activities for the benefit of the biofuels sector. Furthermore, in order to cope with the problem of access by local producers to the opportunities offered by CDM and the global carbon market, it will be necessary to make available to the local producers consultancy and advisory services, to help them design viable projects that can attract major investors and to carry out evaluations to justify the eligibility of projects to CDM (carbon balance, eco-balance, energy efficiency, etc.).

88. The regionalization strategy for providing support to the biofuels sector also requires that efforts be made to ensure that each state has easy access to the best available form of assistance and support wherever the project is located in the sub-region, and according to its needs, in implementing its own national strategy for the promotion of biofuels.

89. Support agronomic research programmes should target biofuels feedstock, indispensable field experiments as well as tests on the use of biofuels that can be produced in the sub-region. This research will make it possible to resolve upstream the problem of the choice of plant types for producing biofuels feedstock by soil type and by geographical zone. It will also help address the issue of yield, water requirements, appropriate varieties, resistance to pests, competition between biofuels production and food crops, etc.

90. Codification and certification are aimed mainly at establishing minimum biofuels production and marketing standards in compliance with recognized international practices and, defining quality label and quality assurance for biofuels of West African origin.

91. The consultancy and technical advisory services should have the necessary human and technical means to deal with all problems that can impede access of the sub-region to the global carbon market and to the opportunities offered by the CDM (CF 3.3). One of their functions will be to prepare a carbon balance of West African biofuels projects which means undertaking analysis of the greenhouse gas effects of all activities in order

to quantify direct or indirect emissions as well as the Certified Emissions Reductions (CERs) to which it may have access. This is the first assessment of the chances of a project to access the global carbon market and benefiting from CDM advantages.

92. Networking the seed producing centers in the sub-region will facilitate the sharing of information with actors in the biofuels sector, on the availability of seeds and cuttings in the sub-region, and thus help accelerate the launching of new biofuels projects. The availability of this information is necessary during the generalized launching of projects because it has been noted that the lack of seeds is one of the major obstacles to investing in the biofuels sector in Africa.

3.4.3 Advantages and disadvantages of both strategies

93. Each of both strategies has advantages and disadvantages. The regionalization of support to the development of the biofuels sector is well suited to the current situation in which each country is applying its biofuels development policy. While it enables each country to develop its own biofuels policy, it has the disadvantage that it is also encouraging the development of small projects which will make it very difficult for them to benefit from CDM funding and the world carbon credits market. On the other hand, the strategy for the regionalization of production and marketing of biofuels cannot be implemented unless there is genuine collective will to do so on the part of the various actors: the will on the part of operators from different countries to work hand in hand to set up a solid biofuels sector, and strong political will on the part of the countries to act like a "Union of Nations in a network around their economies and markets", to make the biofuels sector one of the pillars of development of the sub-region. This is the best strategy that can propel West Africa to the rank of one of the world's foremost biofuels producers alongside the United States, Brazil, the European Union and soon Malaysia, China, India, Indonesia and many others who are accelerating their biofuels production.

3.5 What is the position to take on the growing controversy surrounding biofuels

94. There has been a brewing controversy for some time now concerning biofuels. While this was initially confined to ecologists, it has spread recently, especially since the adoption in February 2006 of the European Union's Strategy (European Union, 2006) that promotes biofuels. An OECD study presented in September 2007 strengthened the position of the many analysts who harboured fears about the European Union's strategy. The OECD study pointed out that the EU's policy would lead to food shortages and destroy natural habitats while not really having an impact on climate change. It also stressed that subsidizing or guaranteeing the price of biofuels could encourage landowners to move away from growing food crops to cultivating energy plants, and this would have an impact on the price of food products.

95. Generally speaking, in countries that have made plans to expand the production of biofuels feedstock on a large scale, environmental concerns have been expressed about the increased pressure on eco-sensitive zones such as primary forests that harbour great biodiversity. Other concerns relate to soil fertility, availability and quality of water and

the use of pesticides which could pollute underground water resources. Some of the social consequences have to do with the dislocation of communities and competition between various types of fuel and food production both in terms of cultivable land use and the risk of dramatic increases in the price of food products used as feedstock for biofuels (maize, soya, rapeseed oil, etc.)

96. These concerns are expressed mainly in Europe and do not seem to have caught on in many countries, especially Asian and Latin American countries. While the concerns can be justified, they can become a cause of alarm only in countries with small cultivable land areas, and where the price of biofuels is high and requires government subsidies and also where food crops serve as feedstocks for biofuels. This does not seem to be the case in West Africa where the two main biofuels, bioethanol and biodiesel, may be produced economically from sugar cane and Jatropha respectively. It is therefore the responsibility of each geographical zone and country to manage these concerns by putting in place an adapted legal and regulatory framework that sets out clear orientations upstream on biofuel types and authorized feedstock and, addressing the issue of land use between the different types of agricultural production (food crops and feedstock for biofuels). Any biofuels promotion policy must therefore take into account the specificities of each country and deal with environmental, economic and social aspects.

97. This view is supported by the recent actions undertaken by United Nations agencies and the African Union as well as countries such as South Africa, Nigeria, Ghana and Senegal. Some of the actions that have been taken to promote biofuels production in Africa are the following: (i) The first joint AU/Brazil/UNIDO high-level seminar on biofuels in Africa organized from 30 July to 1 August 2007 at the headquarters of the African Union Commission in Addis Ababa (Ethiopia); During the seminar, the Economic Commission for Africa (ECA) stressed the importance of the policy and the need for a regulatory framework for the biofuels sector; ii) The International Conference on Renewable Energies in Africa (including biofuels) organized jointly by UNIDO and Senegal, 16-18 April, 2008, Dakar, Senegal; iii) The second edition of the MERS-AO (Market for Renewable Energies in the Sahel and West Africa), 26-30 May, 2008, Niamey Niger; iv) Since 2006 South Africa showcases the largest African biofuels promotion event called « Biofuels Markets Africa conference ». The first edition brought together 24 countries and 200 industry executives throughout the world. The 2007 edition was equally successful and the next edition will be held in November 2008. Lastly, it is worth pointing out that the Intergovernmental Panel on Climate Change (PCC) considers that biofuels constitute one of the solutions to greenhouse gas emissions (IPCC, 2007).

98. In any case, notwithstanding the aforementioned controversy, it is noteworthy that the European Commission has not revised its strategic orientation for biofuels promotion. Its position is still that as long as oil prices remain very high, and considering that biofuels are a credible substitute for transport fuel, the legal framework of the European Union's policy only needs to be reshaped (European Commission, 2006). Accordingly, West Africa should not allow itself to be overtaken in this field but should take upstream measures to manage the complete cycle of its biofuels - from the production of feedstock on appropriate land, and without competing with food products - to marketing and final consumption after processing in factory. The sub-region must implement at the same

time, food self sufficiency and biofuels production and consumption policies, because both contribute to mitigate the high cost of living which is the major concern now.

CONCLUSION

99. This paper has emphasized the numerous advantages of producing/consuming biofuels in Africa in general and in West African sub-region in particular. This industry offers three advantages to the country producer: (i) Reduce the oil bill of the country to improve its balance of trade and secure its energy supply; (ii) Take part in the world combat against global warming, and so doing, benefit from the advantages offered by Clean Development Mechanism (CDM) of the Kyoto protocol and; (iii) Exploit agricultural lands to develop rural aerias, create rural jobs and above all, create wealth for growth speeding up. It may also be considered as an investment with a multiplier effect on account of the diversity of economic activities it generates. The advantages that have been advanced in this paper show that the development of a sound biofuels sector will contribute to integrating the West African sub-region in the world economy by giving it a platform from which to stand and combat climate change.

100. The growing controversy over biofuels in the world relates to competition with food products or the negative impact of feedstock cultivation on soils and biodiversity, but indeed, this has to do with biofuels that have a poor environmental balance and/or using food crops to the detriment of human food. This situation can be managed in West Africa where the two main biofuels, bioethanol and biodiesel, can be economically produced from sugar cane and Jatropha respectively. A plant like Jatropha is not edible and so cannot compete with the food sector. Besides, it can be cultivated on arid soils that are not conducive for the cultivation of traditional crops; and thus help combat desertification and deforestation. What the sub-region needs to do therefore is to simply put in place the adapted legal and regulatory framework and give clear guidelines upstream on the type of biofuels and authorized feedstock, and then address the issue of using farmland for various agricultural production activities (food crops and feedstock for biofuels).

101. To be able to develop a viable biofuels sector, the obstacles can be obviated through public-private partnership that is intelligent at the sub-regional level and strategic at the international level[2] , for production and marketing including equipment for biofuels distribution stations. Forging this partnership is firmly rooted first of all in the collective determination of member States' leaders, economic operators, and regional integration institutions. It also assumes that they are all aware that promoters/producers considered individually with a few exceptions, do not have the financial means, research facilities and the technologies to mount viable biofuels agro-industries, and especially that marketing biofuels must take into consideration the mobility of people and goods across borders, which requires some harmonization and standardization. Lastly, it is based on a

[2] ECA/SRO-WA, 2008. Africa Foolproof Wealth Retention Strategy: Act Now and No Time to Waste. Building Capable, Accountable and Responsive States across West Africa.

shared will to make regionalization effective within the ECOWAS zone, by giving each country the opportunity for its economy to depend increasingly on the economic and fiscal bootstraps of the sub-region, rather than on countries of the North and suffering from the attendant consequences.

102. It is in this context that countries of the sub-region, acting as a "Union of Nations", can tear down the barriers and tap their potential and comparative advantages to develop the biofuels sector and benefit from globalization through CDM and the global carbon market. West Africa has the potential to become one of the major biofuels producers/consumers while striving to be self sufficient in food. The sub-region is urged to meet both targets.

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