CLIMATE CHANGE AND DEVELOPMENT

CONSULTATION ON KEY RESEARCHABLE ISSUES

SECTION 6: WEST AFRICA REGION
SECTION 6.1. WEST AFRICA SCOPING STUDY
ENDA - NOGOYE THIAM AND OTHERS

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CLIMATE CHANGE AND DEVELOPMENT IN WEST AFRICA

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West Africa experiences very contrasting levels of rainfall, with some regions being heavily watered and other entirely arid. There are two broad eco-geographic areas in the region: the countries of the Sahel[1] and the Gulf of Guinea countries[2]. Though rainfall is not the only indicator of climate, it is, in tropical zones in general and West Africa in particular, a decisive element because of its variability in terms of space and time. Rainfall levels also exert an obvious influence on rain-based agriculture, which forms the basis of the region's economy.

Rain in West Africa falls mainly in the Inter-tropical Convergence Zone (ITCZ). Atmospheric circulation in West Africa is dominated by the year on year movement of the equatorial depression, which is linked to both the thermal contrast between the continental mass and the huge maritime area and the variation of pressure between boreal subtropical anti-cyclones (Azores and Libya) and southern anti-cyclones (Saint-Helena). The ICTZ (still called the inter-tropical front - ITF), in the middle of the depression, splits the Northern and Southern trade winds blowing from these anti-cyclones.

The inter-annual migration of the equatorial depression explains the alternation of dry and wet seasons. In the Sahel, rain falls exclusively in one season, for a period of 2 to 5 months, while the Gulf of Guinea countries have two rainy seasons.

There are four types of climate in West Africa:

- Sahelian climate, which has a single rainy season lasting not more than 3 months and irregular rainfall that does not reach more than 500 mm;
- A Sudanese climate, with precipitation of less than 800 mm in the north of Nigeria and less than 1,000 mm in southern Mali;
- A tropical humid climate with bimodal rainfall. This is the climate from The Gambia to Ghana. Average annual rainfall is 1,500 mm;

[1] ***Burkina Faso, Cape Verde, Gambia, Guinea Bissau, Mali, Mauritania, Niger, Chad, Senegal***
[2] ***Benin, Ivory Coast, Ghana, Guieae, Liberia, Nigeria, Sierra Leone, Togo***

- The Gulf of Guinea is for the most part subject to an equatorial climate, with average annual rainfall seldom exceeding 2,000 mm.

Rainfall in most countries in the region is affected by local eco-geographical factors. Regardless of rainfall patterns, it is safe to say that the main traits of West African agriculture is the year-on-year unpredictability of rainfall, recurring droughts and, worse, the persistence of droughts over several years up to a decade in the Sahel. The most immediate effects of climate variation is that it engenders food insecurity, which spreads as urban centres increase demographically. Judging by the UNDP study on the environment in Africa, the continent has two major characteristics: poverty levels are rising and environmental conditions are deteriorating. West Africa is a very rural area and one of the poorest in the world.

The region is currently home to roughly one third of the total population of Africa. One of the biggest challenges facing African governments is to factor this urbanisation and rapid demographic growth into effective development plans. Most of this population is made up of indigenous rural people, with the region not receiving many foreign migrants who would, of course, bring skills and savings with them.

According to forecasts, the population of this part of the continent will climb from 230 million in 2002 to almost 300 million in 2015 and it is expected to double by 2020, meaning that needs for food, housing and basic services will all increase. Carrying such a large capacity will also intensify pressure on natural resources.

At the moment, 44% of the region's population lives below the poverty line, with more and more sinking beneath it as the years go on - per capita income declined by an average of 0.9% between 1990 and 2000. Several factors explain this spread of poverty: the fragility of the agriculture sector, especially when it comes to subsistence crops, little diversification of productive activities, employment shortages and difficulty of meeting basic needs, dwindling income and competitiveness, etc. In addition, the economic policies that have been applied so far have done little to help the most disadvantaged populations as they have tended to perpetuate highly unequal distribution of wealth.

The economic performances of West African countries have varied greatly. There are also wide social and economic disparities even within countries. The richest 20% in the region have 55% of the income, while the poorest 20% have less than 6% (Mellali et al., 2003)[3]. Per capita GDP for the whole region stands at US$303. Almost every country in the region is ranked among the lowest income countries in the world and 11 of them have average daily per capita income of less than – or just slightly more than - US$1. Poverty is particularly prevalent in rural areas and renders populations who depend on natural resources to satisfy their needs even more vulnerable as they are hit hard by environmental degradation, which takes the form of (i) soil degradation, (ii) deforestation, (iii) lack of availability of water resources and (iv) the loss of biodiversity.

Deteriorating environmental conditions hamper economic growth and impede sustainable development in Africa. Soil degradation is responsible for an annual 3% drop in agricultural GDP in sub-Saharan Africa (Terra Africa, 2004). The World Bank estimates that by 2025 Africa will have lost two third of its arable land. Some parts of West Africa, notably the Sahel, are afflicted by environmental degradation, droughts and desertification.

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[3] ***Mellali S., et al., 2003. West Africa and the Millennium Development Goals. UNDP, Dakar.***

This combination of debilitating factors jeopardises food production and, therefore, lessens food security. In a study published in 2003, the FAO suggested that there has been no reduction in incidence of famine in Benin, the Ivory Coast and Mauritania nor has the absolute number of under-nourished people been cut. Over the same period, The Gambia, Liberia, Mali, Niger, Senegal and Sierra Leone has suffered increased incidence of famine – some only slight, but in some countries the increase has been dramatic[4]. Only Burkina Faso, Ghana, Guinea, Nigeria and Togo have reduced their levels of food insecurity.

Bolstering food security is at the heart of the strategies adopted by West African countries. Several players agree that food security is to a large extent a function of people's socio-economic condition; they also believe that poverty exacerbates the ill effects of harmful occurrences such as extreme climate phenomena (drought, floods, etc.). The potential impact of climate change therefore poses a serious threat to poor countries, especially those in West Africa since it worsens the fragility of basic resources, the recurrence of droughts, soil degradation, desertification and dependence on natural resources. Though the importance of all these factors is recognised in the various environmental assessments, until recently very little attention has been paid to the issue of climate change.

The fact is that the sheer scale of social problems facing countries in the region leads political decision-makers to just draw up short-term strategies – this means that they overlook climate change issues, whose effects are only apparent over the longer term. As far as these policy-makers are concerned, the most important task at the moment is to halt the process of degradation of eco-systems, which severely hampers development potential. Current climatic conditions mean that the natural resources from which populations draw their living and their income are in many cases limited in quantitative terms and precarious in qualitative terms. Hence, development policies focus on soil restoration, reforestation, preventing forest fires and drawing up actions that preserve resources and combat degradation. The big challenge is reconciling these aims with the demands of longer-term environmental preservation. West African countries are aware of the harmful effects of environmental degradation, but they believe that environmental protection should not be imposed as a condition for economic development by financial institutions and donors.

Regardless of the attitude of donors, the fact is that it is necessary to incorporate a climate dimension into development strategies, in particular by looking at the human aspect and how extreme meteorological and climatic conditions influence peoples' livelihoods (health, water availability, food, fuel production, habitat and environment).

This issue is vital not just because of the strong demographic growth (3% per annum) but also in view of the fact that West Africa's capacity to adapt to the effects of climate change is weakened by the lack of human, material and financial resources. Furthermore, knowledge of climate change, its impact and adaptation strategies is limited because of the dearth of regional expertise and the low amount of research carried out in the region.

The little research conducted to date has tended to be quite compartmentalised, meaning the relationship between the various effects of climate change and the process of economic and social development has not been adequately explored.

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[4] Seven countries in the sub-region have more under-nourished people now than they did in 1990. They are Guinea, the Ivory Coast, Liberia, Nigeria, Senegal, Sierra Leone and Togo.

3. IMPACTS OF CLIMATE CHANGE: VULNERABILITY AND ADAPTATION

With a surface area of some 7,500,000 km^2 and a population of around 250 million, West Africa is a diverse region. Its economy is mainly rural-based and is heavily dependent on its bio-physical environment. Two thirds of the active population in the region is involved in agriculture, which accounts for 30% of its GDP. For the most part, agriculture is rain-based and is therefore very vulnerable to climate change. Even though the region has significant hydro potential, a lack of available water shackles the development of agriculture in the region. A succession of droughts, particularly in the Sahel, has reduced the volume of most water ways[5] and narrowed flood plains. The volume of water ways has dropped by 30 to 50% over the last 25 years.

Consecutive droughts have also reduced the number of wet zones in several countries. The surface area of the Niger river delta fell from 37.000 km² in 1950 to nearly 15,000 km² in 1990. Similarly, the surface area of Lake Chad Was just 7,000 km² in 1990, where as it had been more than 20,000 km² during the wet years before the 1970s. Though there have been a few instances of heavy rainfall since 1994, average rainfall is still declining. Droughts affect river patterns, agricultural production, drinking water supply and hydro-electrical generation. In 1998, Ghana suffered a fuel crises triggered by the drop in the water level of Lake Volta. In 2002 and 2003, drought meant the city of Ouagadougou suffered serious water shortages[6].

Extreme climatic events are an inevitable consequence of climate irregularity and they wring considerable environmental and socio-economic damage. In 1999, floods on the Ghanaian side of the White Volta destroyed many homes and killed tens of people. In 2001, the flooding of Komadugu valley in northern Nigeria caused over 200 deaths and displaced some 35,000 people. In 2002, southern Mauritania and northern Senegal were hit by exceptional rain that was followed by an unprecedented cold wave[7] (UN, 2002) – this has a positive effect insofar as it partially replenished groundwater tables, however it also had a slew of harmful effects on people, cattle, harvests and plant coverage (ten people died, 200,000 homes were obliterated, 50,000 cows were lost as were 500,000 small ruminants). Though it has not been possible to say for certain that this was caused by climate change, such events now have to be taken into account when looking at how West Africa's climate could evolve.

Beyond scientific uncertainties, most climate change scenarios foresee a drop in rainfall by between 0.5 to 40% by 2025, along with reduced surface flows, dwindling groundwater tables, more extreme climate events and rising sea water level (by 0.5 to 1 m in one century). The 2001 GIEC report expressed the view that many eco-systems and organisms *"will not be able to adapt"* to hotter conditions in desertic, arid or semi-arid areas in Africa[8]. This water imbalance will hinder many economic activities. Hydro-electrical generation will also be hit. Increased temperatures and droughts will hamper agriculture, possibly leading to famine and food shortages. Agricultural yields could fall by up to 30%. Change in sea currents will cause many fish species to migrate, meaning West African fishermen's haul will drop. Parts of the coastlines of Senegal, Sierra Leone and Nigeria could be submerged. Malaria, dengue fever

[5] Most West African water ways have their source in wet areas and then cross the Sahel, where very little water is added.

[6] In 2002, the volume of the Niger river going through Koulikorowas 14% lower than during the period from 1971-2001 and 40% lower than during the period up to 1970. In Senegal, cereal production fell from 1.2 billion tons of millet, sorghum, rice and maize in 1999/2000 to 8350,000 in 2002/03 – this was due almost entirely to dwindling rainfall.

[7] The town of Podor in Senegal received more than 115 mm of water in two days, while the inter-0annual average is 214mm ?? pluie en deux jours, alors que la moyenne pluviométrique interannuelle de cette localité s'élève à 214 mm.

[8] Grazing areas and fields in the west, eat and south of the continent risk be hit even harder because rainfall in the areas is expected to decrease.

and yellow fever will spread to new regions. There is likely to be a big regression in tourism to these areas.

3.1 Agriculture, food security and climate change

Agriculture is the main source of income and food for 70-80% of the West African population. This economic sector is dominated by small family holdings, who produce almost all of the region's cereals, oleaginous crops, cotton, cocoa and coffee. Production methods are not very intensive. In total, 11% of emerged land in the region is used for agriculture, though this figure varies greatly between countries. For example, 23% of land in Ghana and the Ivory Coast is so used, where as in Nigeria it is 32% and in Togo 42% (FAOSTAT, 2001). Due to climate changes and the effects of national policies and the international environment, agricultural performances have been very weak recently, leading to drops in income and a lack of subsistence crops. (Dia et al., 2005). This increases peoples' vulnerability since it inhibits the agricultural sector's capacity to meet growing demand for food.

The work of the IPSS has shown that agriculture, especially in less developed nations, is likely to be one of the economic sector worst hit by climate change. Climate change risks severely jeopardising efforts to increase agricultural production in West Africa and, indeed, in many areas even threatens to curtail farming activity completely. Though the global models used to predict climate change in the region are not foolproof, all signs are that temperature is set to rise and lead to evapo-transpiration phenomena that will hit agriculture hard.

CO2 concentration is predicted to double between now and 2050 (judging by the average figure put forward by most models). This is expected to have a major impact on crops: firstly, they will consume more water and yields (of cereals such as rice) will rise and, secondly, the nutritional quality of these cereals will fall[9].

The predicted temperature increase could lead to drops in yields and production (IPPC TAR Synthesis Report). According to Burke et al. (19..), most crops (including maize, sorghum and sugar cane) could handle the resultant heat stress provided they have an abundant supply of water. However, water is already a limiting factor in the region. Consequently, a rise in temperature will lead to a drop in cereal yields, especially around the Sahel.

Upon close examination, it is clear that outlooks for change are very different form country to country. Regardless of emission outlook, the models (HadCm3, CSIRO and CGCM2) foresee a drop in cereal production potential in Nigeria, Mali, Burkina Faso, Niger, Chad and Sierra Leone. Other countries use the same models to find that their cereal production potential will increase by 2080 – these countries include the Ivory Coast, Benin, Togo and Guinea.

Any drop in productivity arising from climate change could aggravate hunger in the region and this would, of course, impact most of all on the most vulnerable sections of society, those that have trouble accessing land and other factors of production. Moreover, countries would be compelled to import food products, and the repercussions of climate change on world cereal supply are not yet well known.

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[9] ***Hare, W. et al., Assessment of knowledge on impacts of climate change, IPCC site. IT should be pointed out that very few studies have been done to quantity this drop.***

Even in countries where increased agricultural yields are forecast, this does not necessarily mean that agricultural production will rise since extreme phenomena such as droughts and flood could counteract it. The models forecast increased frequency, intensity and duration of these phenomena. In addition, changes in rainfall and the location of savannah could alter the processes by which crickets descend on West Africa (Mabbutt, 1989). Given this, it is worth recalling that in 2004 West Africa fell victim to swarms of crickets who invaded several thousands square kilometres of land, devouring hundreds of acres of subsistence crops and thereby throwing the futures of thousands of farmer into doubt in an already-fragile environment. These were the most devastating invasions of the past decade (OMM, 2004).

Inset 1: Trends and outlooks for the agricultural sector

In Burkina Faso, agricultural forecasts for 2025 were made on the basis of probable trends and climatic, socio-economic and political conditions. Analyses of potential impact on agriculture focused on cotton in the western part of the country. The forecast model used was devised by the Japanese Meteorological Agency. The findings of the simulations indicate that temperature will climb by 2.5C by 2025 and average rainfall will also rise but will vary greatly from one year to another (with differences of up to 180 mm). Sown areas will increase by about 30,000 ha and cotton production will rise by 600,000 tons, giving yields of around 1,300 kg/ha. However, in spite of the performances, the socio-economic conditions of producers are expected to deteriorate and the country's export revenue will also drop as a result of decreased prices on international cotton market.

In Niger, the MAGICC (Model for the Assessment of Greenhouse-gas Induced Climate Change), combined with the SCENGEN (SCEnario GENerator) software were used along with the IS92A (Reference Scenario) and IS92D (Policy Scenario). Les paramètres de sortie (precipitation and temperatures) were estimated with HadCM2 (Hadley Centre Unified Model 2 Transient, UK) and GFDLLO (Geophysical Fluid Dynamics Laboratory, USA). Together, these found that precipitation is expected to drop by 10 to 20% by 2025 compared to the average during the period from 1968 to 1997 and temperature will increase by the same amount. The selected unit of exposure is formed by the most consumed cereals and crops that yield income for rural producers (millet, sorghum, maize, niébé beans, rice, groundnuts, etc.). The geographical area considered is that lying between the isohyets of 200 of 600 mm, accounting for about 35% of the country and the main agricultural and pastoral land. The simulations showed that the crop-growing season in the Maradi region will narrow by 13 to 24%, millet production will drop by about 11% and niébé yields will fall by 13 to 29%. As for pastoral farming, UBT load capacity will fall from 40 to 18%.

In Mali, a biophysical model for SORGHO (SORGEF) was developed in tandem with The Dutch Centre for Agro-biological Research (CABO) and used to make simulations on the basis of temperature rises of between 1°C and 4°C. Results suggest sorghum yields will plummet by 2 to 16%. The DSSAT model (Decision Support System for Agrotechnology Transfer) predicts that yields around Bamako, Bougouni, Ségou and San will decline by 10 to 26% assuming the CO2 concentration in the atmosphere doubles. The deficit of subsistence crops by 2025 is estimated at 18 to 33%.

Temperature change scenarios in Benin are based on the findings of simulations done with the GCM MAGICC SCENGEN model. Similar scenarios were used to determine rainfall changes. Simulations with the GCM model indicate temperature rises ranging between 1°C and 2°5C. The regions considered are those with production surpluses (Natitingou, Parakou,

Djougou Savè and Pobè) and also the Bohicon which, though it has a deficit rather than a surplus, boasts enormous agriculture potential that could be harnessed in suitable climate conditions. The outlook for 2025 suggests yields of the main crops (manioc, beans, cotton, sorghum, rice and groundnuts) will fall by 3 to 18% due to a series of factors (worsening humidity index, increased evapo-transpiration and lack of useful rain). During the same period, the crop-growing season will narrow, the number of wet days will decrease and the second crop season will shorten and possibly even disappear. These changes will mean that feeding the population will require increasing the amount of cultivated land by 2.2 to 2.9 million hectares per year.

Analysis of the assessments made in the different countries through various models shows that climate change is likely to have the following effects:

- The amount of cultivated land will increase at the expense of forest coverage, protected areas, marginal land and wood and pastoral farming land;
- There will be more conflicts between crop grower and pastoral farmers;
- There will be more migration;
- People and, as a result, governments, will lose income;
- There will be acute food insecurity.

3.2 Impacts of climate change on water resources

West African rainfall data reveals a succession of dry and humid periods. The most significant finding is the extent of rain deficits and extreme climate phenomena. Low rainfall through the 1970s and 80s wrought severe consequences in the northern Sahel and disturbed the water cycle, impacting heavily on agricultural production and food security. All of the countries in the sub-region are, to varying degrees, suffering from rainfall shortages whereby isohyets have slid south by some 200 km (Lebel et al. 1999). Evaluation of the potential impact of climate change showed the extent of the region's water resources vulnerability to climate change.

In terms of hydrography, West Africa has several basins: those of the Niger, Senegal, Gambia, Bandama, Comoé and the Volta[10]. These water resources are unevenly distributed. Water is the sector that consumes the most amount of water, with a regional average of 76%, as opposed to 17% for domestic use and just 7% by industry. Even still, however, the rate of water exploitation is low: just 3% (Dièye, 2003).

The droughts reduced the volume of most waterways[11] and shortened flood plains. Over the last twenty five years, average waterway volume has been lowered by 30 to 50%. Most scenarios also suggest a reduction of stream flows and replenishment of underground water in

[10] On the basis of the critical threshold below which countries are considered to suffer hydro stress, all countries in the sub-region, except for Cape Verde, (800 m3 per capita per annum) have renewable water resources in excess of 1000 m3 per capita per annum. However, this situation changes if we only take account of resources produced in the country, in which case Niger, Mauritania and Cape Verde all fall below the threshold of 1000 m3 per capita per annum. This means that the dependency index (i.e. the percentage of water resources coming from external sources) is high, with Niger and Mauritania having indices of around 90%. More than half the countries in the region have dependency indices of above 40%.

[11] Most West African water ways have their source in wet areas and then cross the Sahel, where very little water is added.

arid and semi-arid areas. Rainfall changes will also affect lakes' and dams' storage capacities. River flow rates will fall by 5 to 34%. Groundwater tables and the number of surface water points will drop. Some forecasts (West African Water Vision) suggest water consumption will have to increase by almost five times its current level by 2025 to keep pace with needs. Some countries, such as Burkina Faso, Cape Verde and Niger could find themselves suffering chronic water shortages. West African water ways are very sensitive to changes in rainfall. Even the slightest changes can lead to major changes in stream flows. The runoff rate from the river Gambia, for example, faces a drop of up to 50% due to climate change.

Inset 2: Forecasted water resource changes

In Burkina Faso, water availability is measured from the stream flow of the Massili, in Loumbila. Forecasts suggest that if precipitation rises, surface water resources will increase by 15% (optimistic outlook). However, if precipitation decreases by 2025, the flow deficit will be around 30%.

In Niger, the trend suggests the volume of water ways and the levels of alluvial sheets will change by 2025. If precipitation is lower by 20% and temperatures rise by 20%, the volume of the river Niger through Niamey will drop by 25%. Similarly, if precipitation only decreases by 10% and temperatures rises by the same amount, volume will fall by 11%.

In Mali, forecasts focused on stream flows from the Biger basin in Mopti. Two scenarios were envisaged: the trend detected between 1961 and 1990 continues (scenario 1); and CO2 atmospheric concentration doubles and temperature is hence driven up by 1.5°C and precipitation increases by 15% by 2025 (scenario 2). In scenario 1, surface water would fall by 35% and aquifers' renewable water resources would rise by 13%. In the case of scenario 2, surface water volume would swell by 18% while renewable underwater resources would increase by 9%. Neither scenario suggests any risk of the country permanently running out of water for the satisfaction of its needs. However, scenario 1 does admit seasonal shortages due to the seasonal nature of stream flows.

In the Ivory Coast, a variety of models were applied in the Bandama and Sassandra basins. It was found that if CO2 atmospheric concentration doubles, temperatures would rise by between 2.28 and 4.1°C. Declining rainfall is predicted for savannah areas. Different models found different results for pre-forested and densely forested areas: the UK89 model envisages more rainfall, while the GFD3 reckoned it would decrease. The decline in water resources will be more severe in traditionally dry regions (according to the WATBAL model). This decline will range from 21 and 22% in Marabadiassa to 6.4 and 8.4% in Piebly.

In Chad, the most significant effects of reduced precipitation will be in Saharan and Sahelian areas. In the Saharan part of the country, lakes and temporary tides could dry up. In Sahelian areas, the drastic reduction that has already been recorded in the volume and surface area of Lake Chad will continue – consecutive droughts cut the lake's volume from 33 billion m3 in 1963 to 18 billion m3 in 1992. By 2025, water resources right across the Sahelian area will have decreased, and even the Sudano parts will not be spared, since tides, marshes and even lakes could dry up due to the infrequent rainfall and the rising temperature predicted for 2025.

The drop in water resources will have significant impacts on a host of sector. Not only will it slash agricultural yields and lead to certain crops having to be cultivated elsewhere, but it

could also lead to (i) drying up of bottom lands and river plains, traditional crop-growing araes, (ii) reduced productivity of lacustrine ecosystems, (iii) reduced hydro-electrical production from dam, (iv) peizometric levels of underground tables will drop, (v) surface water will dry up, (vi) water beds will become more sandy and, (vii) mangroves will disappear.

The evaporation of flood areas will make mean less land is available for fall crops and pasture lands could disappear. At the same time, water tables along coastal zones will become salinated. Also, the reduced speed of water flows and the rising temperatures and degraded water resources could result in proliferation of floating plants, which would impede navigation, disrupt hydro-electrical and hydro-agricultural facilities and pave the way for more hydric diseases. In area where water is already a rare resource, any reduction of water resources will lead to cost increases that populations will have great difficulty bearing. Reduced water resources could also aggravate conflicts between different sets of users. Similarly, it could give rise to conflicts between countries, since so many of them depend on shared resources.

3. 3 Impacts of climate change on forestry resources

Most forest resources are located in the extreme south of West Africa (Benin, Ivory Coast, Guinea, Gambia, Senegal, Sierra Leone, Liberia, Togo and Ghana). The region has a wide variety of inhabitants and eco-systems featuring a wealth of biodiversity that is now under threat from human actions. Dense tropical forests play a crucial role in the carbon sequestration and in regulating the planet's climate.

Natural forest coverage is the main domestic fuel source, providing both timber and wood for rural constructions and fencing. Forests also provide non-ligneous products (fruit, leaves, etc.). The deforestation process represents a huge risk to all countries in the region. The abusive exploitation of wood and increasing tree clearance for agricultural purposes have, for example, stripped the Ivory Coast of nearly 7.7% of its forestry coverage from just 1980 to 1990.

There is little available data on the impact of climate change on forestry resources. However, all the signs are that declining rainfall and rising temperatures will decrease forestry coverage and change the composition of forest coverage. Niger's national report estimates that rainfall changes will mean the bush will go from 2,562,200 ha in 1995 to 1,529,000 ha by 2025.

In Togo, climate disturbances could significantly reduce the productivity forests in the sea water region and plateau zones.

Overall, the reduction in forest resources will have an impact on the regulation of the climate in the region. It will also affect the quality of soil and biodiversity in the region. The effects of reduced forest coverage will be made more debilitating by the fact that so many productive activities in the area are fuelled by forests. Wood producing countries will lose income.

3.4 Impact of climate change on coastal areas

West Africa has a seaboard stretching over 15,000 km. The region's population is concentrated in the coastal area (a quarter of West African countries have a seaboard). This is also where most economic infrastructure and economies are concentrated.

Coastal erosion is a major problem in the region. In some places, this erosion has reached 23-30 metres (Smith et al, 1996). Human actions are responsible for some of this (sand and gravel use, construction of ports perpendicular to coastal zones, dam building, etc.) This affects all coastal countries, but to varying degrees. In east Accra, annual erosion has been measured at 6m. In Togo and Benin, meanwhile, the coast has retreated by more than 150 m in the last 20 metres. Of the 50 countries in the world classified as the most vulnerable to coastal erosion, right are in this region: Guinea Bissau, Liberia, Gambia, Sierra Leone, Togo, Benin, Senegal and Ghana. (IPCC/RSWG, 1990).

Forecasts based on rising sea levels suggest that some 18,000 km² of land will be lost along the coast of West Africa. If sea levels rise by 0.5 to 1m by 2100, the most significant impacts will be:

- The lowest coastal zones will be flooded (especially around deltas and estuaries), including in some major cities such as Banjul, Abidjan, Lagos, Lomé and Cotonou;

- Populations will be displaced and infrastructure will be lost (Jallow et al, 1996).

Inset 3: Impacts of climate change on coastal zones

Some studies suggest that in Senegal, The Gambia and Nigeria, tree clusters and mangrove forests will be decimated if the sea level rises by just 1 cm per year (Nicholls et al., 1995). In Senegal, 37% of the surface area covered by mangroves will disappear if the sea level climbs by 0.5m by 2100 (Dennis et al., 1995).

In Niger, a rise of more than one metre would flood more than 15,000 km² of land around the Niger delta and displace 80% of the population. Other consequences could include: loss of productivity of humid eco-systems around the Niger delta, loss of income for populations who live of the oyster trade, drop in oil exports from Nigeria since (90%) most of them come from wells in this area.

In the Ivory Coast, the sea level will rise by 1 m leading to the loss of 54 km² of land, jeopardising the whole coastal zone and its resources. Four million people would be affected and the economic infrastructure of the region, which is concentrated in this area, would be submerged and destroyed. Palm oil, pineapple, banana and coconut plantations would also be lost.

In Benin, studies forecast that the coastline would retreat by 50 m by 2025, then by 100 m by 2050 if nothing is done to protect it. Coastal erosion has already lead to the loss of land and plantations (around 1,400 feet of coconut trees per assume). This is especially worrying as trees such as these help settle soil and serve as windbreakers and a source of income. If the sea level rises as predicted, it will flood land around the mouth of the Mono river, destroying crops and communication infrastructure. The floods will also displace thousands of people.

In Togo, a sea level rise of 0 to 21.42 cm from 2000/2030 would cause alluvial plains (estuaries, mouths and lagoons) to disappear and would also increase river levels, submerge

cords and lead to land and surface water salinification and more coastal erosion. The current rate of coastal erosion in Togo is 5m per year but, if sea levels rise, this would jump to 10m per year. In addition to swallowing land and destroying mangroves in the Volta delta and the mouth of the Mono, this would oversalt the coastal alluvial plain. Fishing would be hit very hard.

3.5 Impact of climate change on health

The issue of how climate change could impact on health was not looked at in systematic fashion in the national reports submitted by West African countries. Nevertheless, several of them did acknowledge that health would be affected. The reports from Niger and Togo alluded to increased incidence of malaria and respiratory diseases and epidemics of meningitis and measles.

The most recent GIEC report says that malaria, dengue fever and yellow fever will infect regions around the world that they have hitherto not reached. The African Development Research Institute reckons that malaria and tick-borne borreliosis are the two tropical diseases whose epidemiology has been most affected by climate change so far (Trape et al). In the case of tick borreliosis, the persistence of rainfall deficits in Senegal since the 1970s is believed to be responsible for the spread of the disease and of the tick that carries it (the *Alectorobius sonrai)*. Currently, this disease is found in Sudano-savannah areas and it is now the second most common vector-borne disease for which people are treated in health centres in Senegal. In terms of malaria, north Sahelian population have lost their immunity, meaning large-scale epidemics c0ould ensue, especially in extreme climatic conditions in areas where water amenities are such that carrying anopheles can survive and breed.

4. ADAPTATION TO THE IMPACTS OF CLIMATE CHANGE

The national reports say that adapting to the impacts of climate change is of paramount importance. West African populations have grown accustomed to the intrinsic variability of their climate, especially in the Sahelian zone and, as such, has acquired a sort of 'culture of adaptation' and a capacity to cope with constantly changing circumstances (Mainguet, 2003). They have devised an array of strategies for adapting to climate change: crop diversification, development of non-agricultural activities in rural areas, emigration, etc. To respond effectively to the challenges posed by climate change, adaptation measures that go beyond individual improvisation must be formulated to support and foster concerted collective initiatives. The national reports indicate the adaptation strategies advocated by countries for each sector of activity.

4.1 Adapting to the impacts of declining water resources

The main actions put forward relate to:

- Planning how water resources are used;
- Devising techniques for preserving water resources;
- Improving water management by introducing a system that minimises waste;

- Combat pollution of all kinds in order to enhance water quality;
- Improve the efficiency of irrigation systems;
- Develop warning systems for extreme climate change phenomena;
- Ensuring rain and runoff water is collected;
- Map areas at risk;
- Fight sand silting in waterways;
- Conduct more experiments with artificial rain.

4.2 Adapting to declining agricultural productivity

The measures advocated emphasise the importance of:

- Promoting sustainable irrigation systems;
- Intensifying agriculture while retaining soil fertility and identifying species resistant to drought;
- Establish a device for monitoring agro-hydro-meterological conditions for crops and pasture lands;
- Provide producers with agro-meterological support;
- Promote integrated agricultural systems;
- Develop agro-forestry.

4.3 Adapting to the impacts of sea level rises

Options for adapting to cope with the impacts of sea level rises centre around two approaches: (i) protecting shore areas and, (ii) increasing sand-retention in dunal areas.

4.4 Adapting to the impacts of declining forest resources

The national reports recommend combining a clutch of options aiming to:

- Ensure sensible selection of species used for reforestation;
- Encouraging the genetic improvement of timber species for reforestation by refining seeds that can resist the different stress factors;

- Promoting the use of renewable energies.

Making these strategies work entails capacity building and valorising research findings. Therefore, it is worth looking at how these are dealt with by the activities underway.

5. RESEARCH & DEVELOPMENT ACTIVITIES RELATING TO CLIMATE CHANGE

The climate change-related activities underway are not solely about research. They also feature more political or technical aspects designed to encourage the integration of climate change issues into macro-economic planning.

5.1 Regional integration

One of West Africa's biggest assets is the fact that is has several cooperation and integration frameworks and arenas in which environmental problems can be tackled in a collective manner. All West African countries except Chad and Mauritania are members of ECOWAS. Eight of the sub-regions 15 countries are members of WAEMU. The Sahelian countries are members of the Interstate Committee for Drought Control in the Sahel (CILSS). In addition, there are other bodies between two or three countries, such as the Niger River Basin Authority, the Organisation for the Valorisation of the River Senegal, the Organisation for the Valorisation of the River Gambia, and the Lake Chad Basin Commission.

The region also boasts some institutions that specialise in environmental forecasts. Through the AGHRYMET centre, the CILSS plays an active role in gathering and managing data relating to agriculture, water and climate, and is also involved in setting up early warning systems and undertaking environmental research and training.

The region also has numerous institutions that work on basin management and oversee development and regulation operations relating to water resources. These organisations can serve as valuable frameworks for offsetting risks of conflict arising from competition for water between neighbouring countries; they can also help with the design of shared dam projects. As these countries adopt environmental conventions (such as the Ramsar convention, a convention on biodiversity and another on shared use of water ways for purposes other than navigation), they could not only bolster the integrity of their river systems but also ensure greater equity between nations sharing the same hydrological resources.

Furthermore, the NEPAD, which aspires to acting as a framework for the coordination of all regional development endeavours, could be used to stimulate the region's efforts to adapt to climate change.

5.2 Capacity building

The first capacity building activities relating to climate change were carried out as part of the preparation of countries' national reports. The projects executed to date have aimed at building African countries capacities so that they may (i) better fulfil their commitments to ratify the Convention and, (ii) take advantage of opportunities offered by the Convention to

achieve development objectives. By giving technical support to national bodies, the NGO Enda Third World has help to forge national skills networks and consolidated, at regional level, skills bases that represent the region in international negotiations. Despite these efforts, West Africa still suffers from a serious lack of scientific and technological capacities for overcoming the effects of climate change.

Other capacity building initiatives are being introduced via research projects undertaken at various levels (national, regional and international).

5.3 Some current research projects in West Africa

There are a host of research projects on the issue of climate change. Most tend to focus on two areas: (i) devising models for assessing climate, and (ii) carbon sequestration. These projects include:

- The Seasonal Rain and Flow Regimes Forecast Project in West Africa (PRESAO);
- The Flow Regimes from International Experimental and Network Data[12], which got underway in 1992;
- The Support Project for Building Climate Change Adaptation Capacities in CILSS-member countries;
- The Global Hydrological Cycle Observation System (HYCOS) ;
- The Multi-disciplinary Programme for Analysing African Monsoon (AMMA) ;
- The project for Assessing the Impacts and Adaptation to Climate Change (AIACC);
- Global Water Partnership;
- Harmonisation of Climate Prediction for Mitigation of Global Change Impact in Sudano-Sahelian West Africa.

These projects and initiatives afford an opportunity to carry out long-term integrated studies and, at the same time, to support the development of West African expertise. It should be stressed that most countries have their own research bodies working on agro-climate and hydrological issues. In some cases these bodies are involved in executing projects in partnership with international institutions, and they also collaborate with the Global Environmental Fund and the instruments arising from the Convention on Climate Change.

In theory, these different projects in progress should lead to the emergence of a critical mass of capacities and strengthen initiatives for fighting poverty. However, the question has to be asked as to whether theses results have actually been achieved – in this regard, some observations can be made on the basis of critical assessments of some of the initiatives.

Firstly, it can be said that the way that countries in the region have allocated credits to projects working on climate modelling, and the fact that these initiatives depend to a large

[12] ***This project deals with flow systems on the basis of data deriving from experiments and networks.***

extent on external backing, poses several problems. Notably, it means that national bodies are not in full control of the direction and topics of research, which in turn means that the projects tend to cater to the concerns of laboratories based in the North[13]. The development of an indigenous capacity for taking charge of climatic concerns is all the more important when we consider that being dependent on funding from external sources means research activities may not be sustainable.

Carbon sequestration projects looking at agricultural systems in Sahelian Africa are quite controversial because carbon sequestered from agriculture is not permanent.

Another limiting factor on the various projects conducted in the countries (and which is also evident in the national reports) arises from the fact that they do not define clearly enough the interface between climate change, biodiversity, the combat against desertification and the combat against poverty.

Broadly speaking, research conducted so far into climate change is compartmentalised and quite scattered in terms of the complexity and exhaustiveness of research tools. Most research programmes are still restricted to looking at scientific and technical aspects and therefore do not pay sufficient heed to questions relating to the economic and institutional aspects of climate change. The absence of linkages between these programmes and economic impact studies makes it impossible to accurately ascertain the costs and benefits of different adaptation options.

Some other projects connected to 'climate change' (to be completed with ENDA projects)

PROJECT	INSTITUTIONS
- Vulnerability Study of the Senegalese Coast	Direction de l'Environnement
- Linking Climate Adaptation (LCA)	Enda Energie, Environment and Development
- Climate Change Capacity Development C3D	Enda Energie, Environment and Development
-Capacity Building on the Clean Development Mechanism (Kyoto protocol)	CECODI /BENIN Ministtry of the Environment /BENIN
-Climate Change Information Programme	Enda Energie, Environment and Development
- Forestry Exploitation Rationalisation Project – Promotion of Wood Substitution Fuels	Direction de l'Energie / PROGEDE
- CC National Implementation Strategy	DGE/BF
- CC National report	DEEC /DCE BF
- CC Reduction Options Economic Assessment Evaluation	DEEC /DCE BF
- CC Train programme	DEEC /CECODI BENIN
- NSCAP I	
- NSCAP II	CSE DGE /BF /ENDA

[13] ***The AMMA has taken a different approach by attempting to harness the involvement of African scientists in setting research objectives and using their methodologies and monitoring/assessment mechanisms.***

-Identification of CC Adaptation Technologies	
- NAPA	CECODI/BENIN
- Inventory Improvement Programme	Round table on Sustainable Modes of Consumption and Production
- Refinement of Adaptation Technologies	ISRA- Senegal
- Study of Carbon Sequestration Potential	ISRA- Senegal
-Impact of Climate Chane on the Agricultural Sector	UCAD- ISRA- Senegal
-CC National Implementation Strategy -NAP Implementation	-Direction de l'Environnement MEHU - ONG OFEDI 04 BP 1530 Cotonou BENIN - CECODI ONG 08 BP 7091 Cotonou
-National NGO projects -CC National Implementation Strategy - NAP Implementation	CNCOD – Niamey- Niger S/C EIP- NIGER, BP 11 867 - Niamey

6. AREA OF RESEARCH: STATE OF PLAY, LIMITATIONS AND PRIORITIES.

The experts who attended the second day of the workshop on climate change at regional level, focused their discussion on the:

1. Research policies at sub-regional level giving the state of play by highlighting the different gaps and
2. How to prioritise research topics in the sectors most affected by climate change and coordinate them with sub-regional development objectives

6. 1 Research policies

Discussions looked at deepening the debate on the states of play of research policies and the identification of paths for bringing research forward.

6.1. 1 State of play in terms of the direction of research policies

a) <u>In policy terms</u>:

- There is a willingness among policy-makers to take account of research findings when shaping their policies
- In sectors such as agriculture, water, health and the environment, research findings are taken on board

- Inventories are available in Africa on the impact of biomass-type emissions (unlike in Europe, where emissions are of fossil fuels)

  The limitations are:

  - This political willingness is for the most part confined to national level and generally fails to consider the regional dimension (an approach that restricts research to single country-level without forging any link with other countries in the sub-region)
  - Research on climate change is still in its teething stages and is not treated as a primary lever to be used for in overall guiding policies
  - Research is heavily dependent on the orientations and funding of external sources
  - Research is not coordinated to mesh with social demand
  - Though some inventories have been compiled, we are still in the initial diagnostic phase.

b) **<u>In institutional terms</u>**:

- Sub-regional West African arenas have been (or in the process of being) created, such as CILSS, the AGRIMET centre, etc.

c) <u>In terms of regional integration mechanisms</u> such as ECOWAS, the NEPAD:

- Climate change was identified as an important issue that should be incorporated
- Sub-regional initiatives have been devised:
  - Countries in the sub-region held a workshop on climate change
  - State of play report on climate change was produced at regional level (analysis and identification of problems)
  - Problems are identified and research is underway in institutions such as UCAD's geography department
  - Regional projects have been put forward (including the West African sub-regional project on rising sea levels, in partnership with UNESCO; the project is at the fund-raising stage)

  There are limitations connected to the following factors:
  - The newness of the climate change issues:
    - There is not enough specialist expertise on the issue
    - Research is not undertaken with a view to supporting development
    - Policy-makers are not sufficiently aware of climate change issues and therefore cannot fully appreciate research results when taking decisions

d) <u>Recommendations for effectively steering research</u>

- Take advantage of existing or emerging opportunities in Africa:
  - The willingness of the Blair administration to back initiatives for implementing and adapting approaches and conclusions identified during the CFA consultations in the sub-region
  - The formulation of action plans in West Africa in the issue of capacity building for the implementation of the convention on climate change (Abuja meeting)
- Avail of the provisions of policy orientation documents in Africa:
  - recommendations for integrating international conventions further into policies, as contained in the Environment Ministries' conference document

6.1.2 Methods/mechanisms by which public policies take account of knowledge generated by research

a) The emergence of a political dialogue through consultation arenas (discussion forums) on the basis of knowledge gleaned from research
b) The effectiveness of a clause demanding the establishment of a states of play report on the GEF provisions relating to project funding and the compilation of a PDF; this clause offers incentives to research and, by extension, makes it more likely that research results will be taken into account
c) The existence within the NEPAD of a capacity building project that will eventually improve the quality of knowledge gained through research and the likelihood of it being harnessed by policy-makers

d) Knowledge gained through research can be disseminated without necessarily going through political channels as long as discoveries are relevant and directly applicable.

However:

- Even where a political dialogue is set in motion (discussion fora on generated knowledge), the right audience has not been chosen
- There is a big time-lag between when research is conduct and when findings become available
- There is little dialogue between researchers and private operators, this is bad because the latter have a crucial role to play in making results known and getting them used
- There is no support and incentivising policy for backing private operators' with the implementation of research-generated knowledge (the case of the platform projects provides ample demonstration of this: no mechanisms or linkage has been put in place to facilitate appropriation and use of research results)
- The presentation format of generated knowledge is too technical or academic and thus discourages policy-makers
- Researchers are still confined in a academic shackles, whereby where and to what extent they are published is the only criteria by which research results are assessed; if researchers want promotion, they usually have to pay more attention to getting published than to systematically applying their findings
- National and sub-regional research expertise on climate change is insufficient
- The absence of funding for research remains a major handicap

Recommendations on methods/mechanisms by which public policies take account of knowledge generated by research

- A support and incentive policy should be introduced to help private operators to implement knowledge generated by research in projects such as the platform projects
- Efforts should be made to upgrade the status of researchers and their research
- Effective political dialogue between all stakeholders (institutional and financial partners, policy makers, researchers, NGOs, CBOs, etc.) should be introduced
- There should be fuller and franker collaboration between researchers at regional level
- Existing research institution should do more to reflect climate change concerns in their work.

6.1.3 Lessons learned from experiences of valorising research findings

- It is essential to waste no time in making research results available
- Findings are presented in a format that is too technical or academic (and often hard to understand)
- Knowledge generated by indigenous research is not valorised
- There is no linkage between prototypes made through research and the industrial processes of popularisation and valorisation
- The factors to be taken into account for model-making purposes are very complex (bio-physical, socio– economic, climatic)

Recommendations

- Indigenous knowledge should be valorised
- There should be increased awareness of the limitations of model-making
- Researcher and research bodies capacities' should be bolstered

6.2 . Priorities in terms of research policies

6. **2.1. How to improve the research planning system (increasing research's social usefulness, building forecasting capacity and carrying out scientific monitoring)**

- Research needs to be re-centred on African development priorities African researchers need to be equipped with suitable conditions for undertaking quality research on issues facing the continent, since Africans are more aware of these and therefore more likely to conduct analyses that could prove useful in resolving them in sustainable fashionResearch problems need to be clearly identified, prioritised and considered in coordination with regional development targets; adequate funding must also be provided to research
- Relevant information must be provided on the knowledge generated through research and technological monitoring
- Researchers operational capacities must be built, and the efficiency of research institutions must be improved
- Instruments and mechanisms for promoting findings must be devised (a publicity strategy in tandem with the media should be developed)
- Consultation and planning frameworks should be developed to harness the input of all stakeholders (grassroots organisations, NGOs, CBOs, institutional and financial partners, private operators, etc.)
- There should be better collaboration between researcher and national and sub-regional level

6. 2.2. Conditions to be created to improve dialogue between researchers and policy-makers

- Cf report on the workshop organised by CRDI (the findings and conclusions of this workshop are still relevant)

6. 2.3. Instrument to set up to guarantee the effectiveness of measures taken

- The promotion of policy on climate change via the establishment of consultation frameworks (round tables, exchange forums) on relevant research findings

- The implementation of information and awareness-raising devices for the relevant policy-makers (ministries of environment and of research) to encourage the appropriation of the conclusions of the workshop and their implementation at sub-regional level with the support and involvement of Enda and its partners: one possible strategy for doing this could be to:
    - Produce a document on the workshop (context, objectives, expected results, extent of participation, knowledge gleaned from the preparatory phase, conclusions and recommendations, etc.). Enda would be responsible for leading this,
    - Send this document to the relevant political authorities (ministries of research and the environment, CEMAE, IIED, etc.)
    - Facilitate understanding and appropriate of the conclusions and recommendations through political dialogue
- The setting up of a monitoring mechanism

6. 2.4 Funding research

- African governments have to translate their willingness to stimulate research on climate change into the actual allocation of specific funds for this purpose
- African governments should avail of investment opportunities in the NEPAD, ECOWAS, ADB, CFA, etc.
- All development programmes take account of the need to finance research
- A fund reserved exclusively for research should be set up to help raise funds for the implementation of the Kyoto Protocol that has just been signed
- NEPAD should seek a budget allocation for research as part of the creation of an African Environment Fund in the ADB
- The private sector should be involved in funding research
- Research conducted by NGOs and the private sector should be recognised and valorised

6. 3. At sectoral level: the state of play and priorities

6. 3.1 States of play of existing regional institutions

Agriculture and water

- CERAAS: improvement and adaptation of crops to drought
- CILSS
- ADRAO
- FARA
- DMP (Desert Margin Program): 7 West African countries + Zimbabwe + South Africa
- AGRHYMET
- CERRA

Health

- WAHO (West Africa Health Organisation)

Energy

- Solar energy centres in various countries

Coastal zones

- PRCM
- Adaptation to climate change in West African coastal zones, in tandem with UNESCO

6. 3. 2 Major achievements of research projects

- Selection of certain varieties of short-cycle crops that are resistant to drought (such as rice, groundnuts, millet and sorghum)
- Development of an agro-forestry system (LULUCF)
- Major strides made in energy-efficient technology
- Major advances made in solar drying and heating technology

6.3.3 Identified gaps and inadequacies

- Initiatives are undertaken at national level in relative isolation;
- Findings are not capitalised nor made well known;
- No clarification of roles and responsibilities at institutional level;
- Little inter-disciplinarity;
- Little effective research on climate change at regional level;
- Insufficient reference to climate change issues;
- The regional approach taken to research issues, if there is one, is not effective;
- Insufficient finance for research;
- Climate change is a very new topic;
- Little synergy between the various conventions (on climate change, desertification, etc.)

- The health aspect is not sufficiently taken into account at regional level

6.3.2 Some guidelines for future research priorities

The foundations for climate change research systems are still only embryonic in terms of human capacities, infrastructures and the potential for valorising findings. It is essential to

boost research capacities if West Africa is to devise effective adaptation strategies. Efforts to improve research should be based on the following:

- The identification of the economic sectors most vulnerable to climate change and the definition of framework conditions that could reduce this vulnerability and strengthen adaptation capacities;
- The valorisation of low-cost practices that can reduce vulnerability;
- Assessments of potential value of cloud seeding activities aimed at increasing rainfall and therefore reducing hydric deficits and increasing food security;
- The development of tools for evaluating the effects of particular policies on bolstering the resilience of eco-systems or rendering them more vulnerable;
- The identification of suitable adaptation mechanisms for groups vulnerable to extreme climate changes;
- The evaluation of the effectiveness of risk and disaster management systems relating to climate change;
- The identification of research spheres needing more investment;
- The development of positive social and technical innovations;
- The harmonisation of approaches and methods for assessing climate change;
- The appraisal at regional, local and national level of the possible costs of climate change.

For all climate change-related aspects to be taken into account and reflect local, national and regional concerns, research should also be geared towards:

- Achieving trans-disciplinarity in the formulation and implementation of regional research projects;
- Building capacities of all stakeholders (policy-makers, NGOs, researchers, etc.);
- Embedding a genuine technological monitoring process (hard and soft technologies);
- Raising internal financial resources;
- Speed up the implementation of mitigation strategies;
- Inform and raise the awareness of populations so that they take account of the impacts of climate change

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