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Agriculture Education and Market Improvement Program (AEMIP)

Climate Change Adaptation in Guinea: Situational Analysis for AET Institutional Capacity

April 30, 2014

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PURDUE UNIVERSITY

INSTITUT SUPERIEUR AGRONOMIQUE ET VETERINAIRE DE FARANAH

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■ **Local produce markets, such as this market in Kindia, are likely to offer a narrower selection of products, and less consistent quantities and quality of products, due to the increased variability of daily and seasonal temperatures and rainfall predicted for Guinea.**

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■ At the FABIK cooperative farm, farmers are establishing a vegetable seedling nursery. Identifying and facilitating linkages between producer groups like FABIK with AET institutions and researchers will rapidly accelerate the development, testing, dissemination and adoption of climate-smart seed varieties.

I. Introduction

a) The Agriculture Education and Market Improvement Program (AEMIP)

In This publication is an excerpt of the Baseline Study for the AEMIP Global Climate Change Integration Pilot, conducted by the Agriculture Education and Market Improvement Program (AEMIP) and funded by the United States Agency for International Development/Guinea (USAID). In collaboration with AEMIP staff, a team of four consultants conducted the Baseline Study from February to April 2014. They collected nationwide data to assess the situational context in Guinea for building the capacity of agriculture education and training (AET) institutions to implement climate change adaptation programs and initiatives. The purpose of this report is to summarize the results of the Baseline Study for interested public sector, private sector, and civil society institutions.

AEMIP is a four-year (2013-2017) USAID/Guinea-funded program implemented by Winrock International with the support of Purdue University. AEMIP aims to strengthen AET within Guinea, focusing primarily on the institutional and organizational capacity of Guinea's only agriculture university, the Institut Supérieur Agronomique et Vétérinaire de Faranah (ISAVF). AEMIP's goal is reflected in the statement: "AET institutions and graduates demonstrate leadership to develop market-driven, gender-transformative, and climate-smart agriculture in Guinea." Toward this goal, AEMIP implements four inter-related activities:

Activity 1: Curriculum strengthening – to increase experiential learning opportunities (and develop the resources necessary for experiential learning, such as labs, demonstrations, and research grants) and introduce new technical content (including climate change adaptation).

Activity 2: Faculty strengthening – to integrate experiential learning into existing coursework and introduce new technical content (including climate change adaptation).

Activity 3: The AEMIP Innovations Grants Program – to strengthen applied research (including that focused on climate change adaptation) and integrate it into national and regional research networks.

Activity 4: Management strengthening – to increase collaboration and partnership with external partners in the agriculture sector in Guinea and regionally, strengthen gender equity in AET, and mobilize sustainable institutional resources to maintain the continuous relevance of AET in Guinea's agriculture sector.

AEMIP Global Climate Change (GCC) Integration Pilot

Fully integrated into AEMIP's four activities is a pilot component funded by the USAID/Washington GCC Initiative. The purpose of this program, the GCC Integration Pilot, is to incorporate climate change adaptation into AET institutions in Guinea. The Baseline Study was conducted to examine the current capacity of AET institutions to deliver climate-smart AET and to provide recommendations for implementing the pilot program.

b) About the Baseline Study

The baseline study was carried out from February to April 2014 by a team of four specialists and the AEMIP staff. The study's four main objectives are summarized as follows:

1. Define the baseline and benchmark for success of the AEMIP GCC Integration Pilot
2. Assess current AET institutional capacity for integrating climate change adaptation, biodiversity, and NRM into curriculum and research agendas
3. Determine the nature and effectiveness of cross-sectoral cooperation and coordination among Government of Guinea (GOG) agencies, the private sector, civil society, and AET institutions on the development and dissemination of climate-smart technologies
4. Provide recommendations for AEMIP's implementation of the GCC Integration Pilot.

To realize these objectives, the study used three primary data collection methods:

Literature review. The team conducted a literature review to establish the current global, regional, and national context for integrating climate change into agriculture. The review included examination of reports from global climate change forums and governing bodies; identification of regional and national institutions' engagement in – and resources for – development of climate-smart AET; and analysis of current GOG policies and initiatives relevant to climate change adaptation in the agriculture sector.

Stakeholder survey. The team administered a multiple choice questionnaire to 163 respondents to assess current capacities in climate change adaptation. Respondents included faculty, students, and researchers in eight AET institutions and research bodies. In the private sector, they included six agribusinesses in the poultry, oil palm, rubber, cotton, grains, and fruit sub-sectors. In civil society, they included 10 national-level farmer organization networks and members of 26 grassroots farmer organizations. The team also surveyed six rural radio stations to assess current broadcasting of agriculture and climate-related data. The survey focused on current understanding of climate change, access to information and training on climate change-related topics, and available collaboration mechanisms.

Key informant interviews. The team conducted structured interviews with 16 national agriculture and environment stakeholders from the donor and public sector. Interviewees included representatives of GOG agencies, ministries, and institutions involved in food security, agriculture and livestock, environment,

forestry and natural resource management, higher education and professional development and training, and research, as well as three donors engaged in these sectors. Key informant interviews were also held with managers at AET stakeholder institutions that participated in the multiple choice surveys. The interviews assessed the current status of policy implementation, current understanding of climate change, access to information and training on climate change-related topics, and available collaboration mechanisms.

Data were collected at the national and sub-national level across all four natural regions of Guinea. The data were analyzed both qualitatively and quantitatively to assess the overall context for the integration of climate change into AET in Guinea.

Fish pond development, particularly within the context of integrated rice cropping and fish farming, is an important area for climate smart adaptation technology research and development. Freshwater fishing has high potential for replacing Guineans protein source from dwindling coastal fishing yields in the face of climate change.

■ **Altering farmer land use toward more off-season high value vegetable production (such as local eggplant as pictured), is a climate change adaptation strategy to protect household income.**

II. Latest Facts on Climate Change: Globally, In West Africa, and In Guinea

Key terms used throughout the report are defined below. The definitions are approved by the Intergovernmental Panel on Climate Change (IPCC[1]):

Vulnerability: the degree to which geophysical, biological, and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change.

Resilience: the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Adaptation: in human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities; in natural systems, adaptation consists of the process of adjustment to actual climate and its effects.

Mitigation: the efforts undertaken to reduce anthropogenic greenhouse gas (GHG) emissions or to enhance natural sinks of GHG.

a) Globally

Published in late 2013 after six years of work and the analysis of 9,200 scientific publications, the Fifth Report, "Climate Change 2013: The Physical Science Basis," from Working Group I of the Intergovernmental Panel on Climate Change (IPCC),[2] demonstrates the likelihood of the link between human activities and rising global temperature.

1 IPCC. Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, Appendix I Glossary. Cambridge University Press, Cambridge, UK, 976 pp

2 IPCC. The Physical Science Basis: Contribution of Working Group I to the Fifth Assessment Report of the IPCC. Cambridge University Press, Cambridge. November 2013. 1552p

Projected impacts of climate change globally

The concentration of atmospheric carbon dioxide (CO2) is the highest in 800,000 years. It has increased by 20% since 1958 and by 40% since 1750;

Each of the past three decades has been successively warmer than any previous decade since 1850. The years 1983-2012 were the 30 warmest years ever in the northern hemisphere in 1,400 years. The ground temperature increased by 1°C between 1901 and 2012;

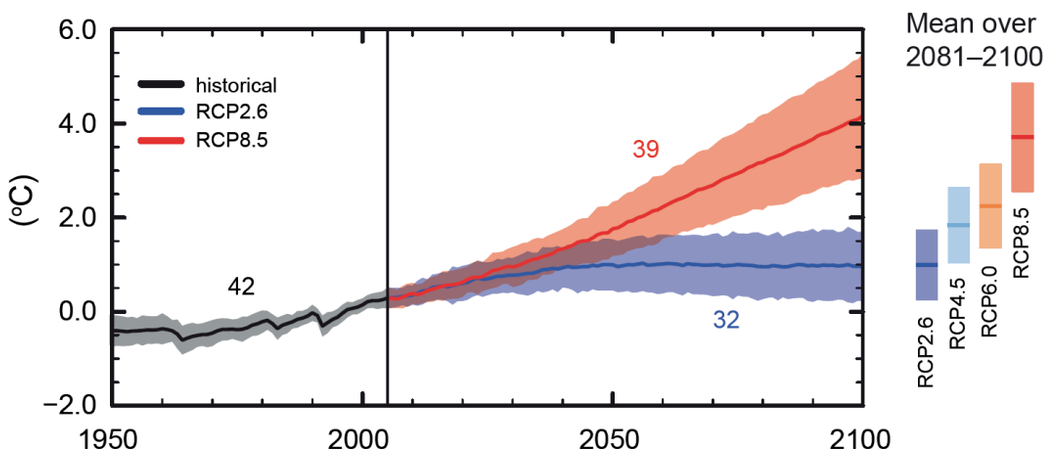
The surface temperature of the oceans (up to 700 m deep) increased between 1971 and 2010, and this temperature had already increased between 1870 and 1971;

Over the past two decades, the ice sheets in Greenland and Antarctica have decreased in mass. The Arctic sea ice and spring snow cover of the northern hemisphere have declined, and glaciers in almost all regions of the globe have decreased in size. Melting has accelerated by 750 million tons per day in the mountains since 1990 and by 990 million tons per day in Greenland and Antarctica since 2000;

The mean sea level has risen at a faster rate since the mid-nineteenth century than in the last two millennia. Between 1901 and 2010, the mean sea level has risen by 0.19 m.

In the Fourth Report of Working Group I of the IPCC,[3] four sets of scenarios (A1, B1, A2, and B2) were analyzed to project temperatures ranging from +1.4°C to +6.4°C for the 2090-2099 period, relative to the 1980-1999 period. In the Fifth Report, new sets of scenarios, called Representative Concentration Pathways (RCPs), were used. Analysis of these scenarios led to the conclusion that the increase in ground temperature for the 2016-2035 period, relative to the 1986-2005 period, is likely to range from +0.3°C and +0.7°C. (Global warming will strongly accelerate). The increase in ground temperature for the 2081-2100 period, relative to the 1986-2005 period, is likely to range from +0.3°C to +4.8°C, and current trends suggest an increase to +4°C, as shown in Figure 1 below:

Figure 1. Predicted increase in ground temperature by 2100 (IPCC, 2013)



3 IPCC. The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge. November 2007. 1007p

Predicted changes in temperature and rainfall are likely to be distributed unequally over the globe, as shown in Figures 2 and 3 below.

Figure 2. Predicted change in temperature (2081-2100 vs. 1986-2005) for RCP2,6 (left) and RCP8,5 (right) (IPCC, 2013)

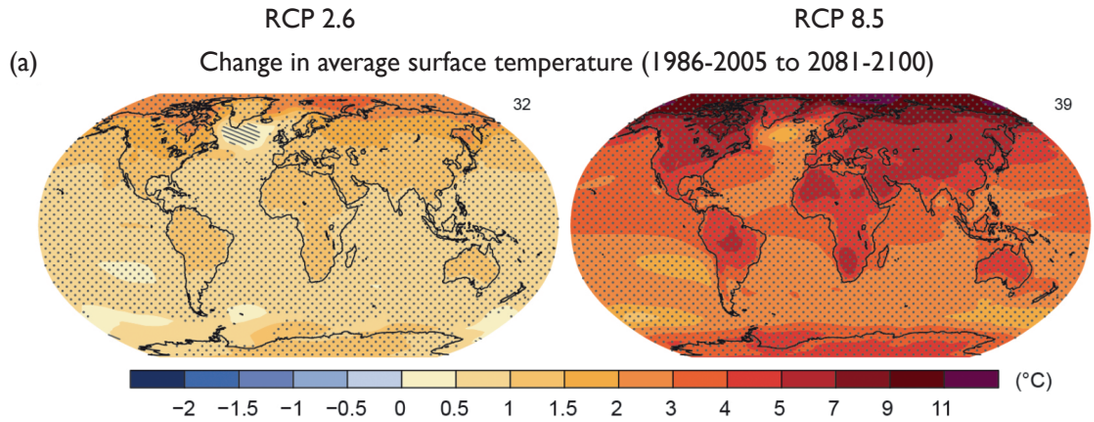
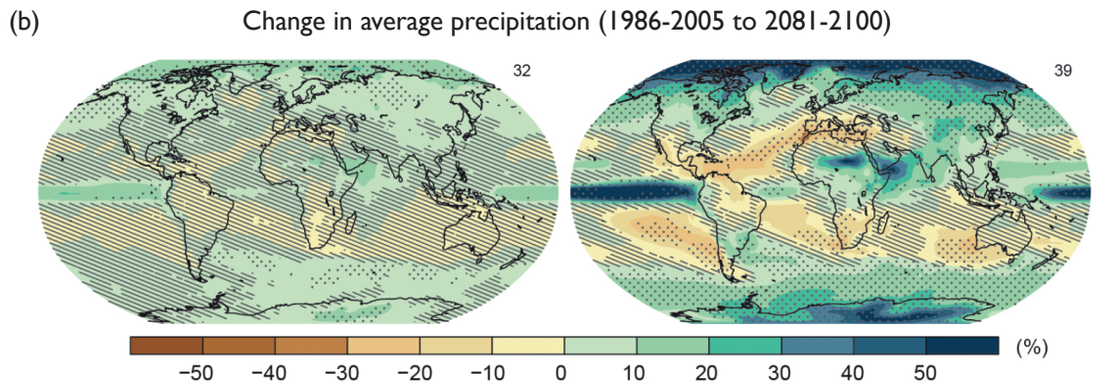


Figure 3. Predicted change in rainfall (2081-2100 vs. 1986-2005) for RCP2,6 (left) and RCP8,5 (right) (IPCC, 2013)



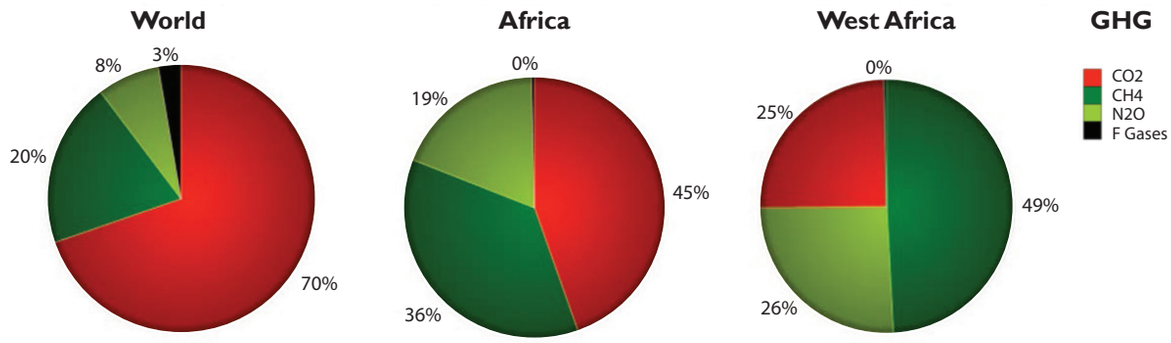
b) In West Africa

Using data compiled by the Carbon Dioxide Information Analysis Center, the Global Carbon Atlas[4] estimates that greenhouse gas (GHG) emissions for the African continent as a whole represent only 3.4% of global emissions. Data compiled by the Shift Project[5] clearly differentiate the GHG emissions profile of the African continent from that of other regions of the globe. Methane (CH4) and nitrous oxide (N2O) are proportionally greater in Africa due to the importance of agriculture in most African countries, with the highest concentrations in countries of the Economic Community of West African States (ECOWAS), as shown in Figure 4 below.

4 The Global Carbon Atlas is a platform to explore and visualize the most up-to-date data on carbon fluxes resulting from human activities and natural processes found at www.globalcarbonatlas.org.

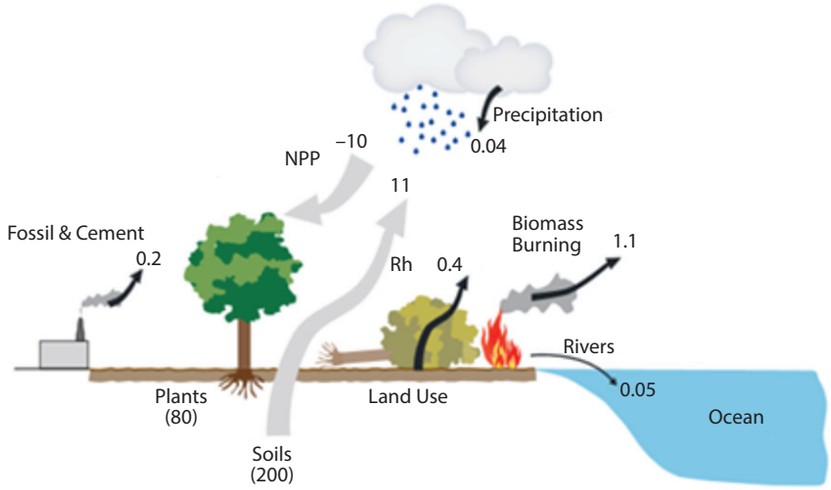
5 The Shift Project, http://theshiftproject.org, hosts a data portal at http://www.tsp-data-portal.org/. TSP data portal is an information platform that provides immediate and free access to a wide range of global energy and climate statistics, using enhanced navigation and graphic tools.

Figure 4. GHG profile (CO2, CH4, N20, F gases) in the world, in Africa, in ECOWAS area (Shift Project, 2010)



According to the CarboAfrica Project,[6] the Land Use, Land Use Change, and Forestry sector is a net source of carbon dioxide, contrary to the global situation, as shown in Figure 5 below *(Note: NPP = Net Primary Production and Rh = Heterotrophic Respiration)*.

Figure 5. African carbon cycle, in billions of tC (FAO—CarboAfrica project, 2011)



The Fourth Report, "Impacts, Adaptation and Vulnerability," of Working Group II of the IPCC[7] (IPCC 2007) and "The Stern Review: The Economics of Climate Change"[8] (Stern 2007) projected the key impacts of climate change in West Africa:

Reduced rainfall: 75 to 250 million people will be affected by a higher water stress in 2020, and these numbers will double in 2050. Reduced rainfall will impact the availability and accessibility of water for human consumption and livestock (IPCC 2007). Rainfall in Africa will decline by 30% by 2050, resulting in lower crop yields and migration, beginning with the marginal regions of the Sahel and potentially inducing conflicts (Stern 2007);

6 FAO. Africa and the Carbon Cycle - Proceedings of the Open Science Conference held in Accra (Ghana) 25-27 November 2008 on "Africa and Carbon Cycle: the CarboAfrica project."FAO.2011. 208p

7 IPCC. Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Cambridge University Press, Cambridge. November 2007. 976p

8 Sir Nicholas Stern. The Stern Review: The Economics of Climate Change. Cambridge University Press, Cambridge. January 2007. 712p

Sea level rise: Floods from rising sea levels will lead to migration; mangrove areas will become degraded, reducing fish stocks (Stern 2007);

Extreme weather events: Storms, forest fires, droughts, severe flooding, and heat waves will increase in frequency and magnitude (IPCC 2007);

Agriculture productivity: Yields of rain-fed agriculture will fall by 50% by 2050 in some countries. Small farmers will be the most affected, their net income falling by as much as 90% by 2100 (Stern 2007). Arid and semi-arid areas will range from 5% to 8% by 2080, reducing agricultural productivity in marginal areas, slowing growth, and heightening water stress, among other consequences (IPCC 2007).

c) In Guinea

The main findings of the Climate Change Country Profile for Guinea[9] (McSweeney et al. 2012) are as follows:

Temperature: Mean annual temperature has increased by 0.8°C since 1960, an average increase of 0.18°C per decade. It is projected to increase by 1.1°C to 3.0°C by the 2060s, and by 1.6°C to 5.3°C by the 2090s. Rates of warming are expected to increase most rapidly in the northern regions of Guinea;

Rainfall: Mean annual rainfall in Guinea has decreased since 1960 following a period of particularly high wet-season rainfall in the 1960s. April-May-June rainfall has declined around 5.3mm per month (3.0%) per decade. Projections of mean annual rainfall across the country using different models show a wide range of changes in precipitation for Guinea. Projections indicate decreases in the north of Guinea and increases in the south. Despite the projected decreases in total rainfall, the proportion of total annual rainfall that falls in heavy events increases in the overall projections;

Hot days: All projections indicate substantial increases in the frequency of days and nights that are considered "hot" in the current climate. Annually, projections indicate that "hot" days will occur on 21-52% of days by the 2060s, and 27-78% of days by the 2090s;

Sea level rise: Projected scenarios show coastal rice field losses of 17-30% by 2050 and as much as 60% by 2100. With more than a third of the population living in coastal areas, pressure from erosion – compounded by an increased incidence of salinization and flooding in coastal zones, changes in temperature and rainfall, as well as sea level rise – will have serious effects on Guinean livelihoods.

The heterogeneity of past and projected rainfall in Guinea is corroborated by the historical data series 1961-2004 mentioned in the National Plan of Action for Adaptation (NAPA)[10] for four synoptic stations (see Table 1), with standard rainfall (ratio: rainfall in a given year/average rainfall per year from 1961 to 2004) in abscissa axe and year (from 1961 to 2004) in ordinate axes.

9 McSweeney et al. Climate Change Country Profile of Guinea. UNDP. February 2012. 26p

10 Minister of Agriculture, Livestock, Environment, Water, and Forestry (MAEEEF). National Adaptation Plan of Action of Guinea. GOG. July 2007. 118p

Table 1. Change in annual rainfall from 1961 to 2004 in the four regions of Guinea (NAPA2007)

Synoptic station	**Starting point in 1961** (in % of average rainfall from 1961 to 2004)	**Change of rainfall** (% per year, compared to average)
Labé (Moyenne–Guinée)	Positive: 146%	Decrease of around 2%
Kindia (Basse-Guinée)	Slightly negative: 95%	Decrease of around 0.2%
Siguiri (Haute-Guinée)	Positive: 155%	Decrease of around 2.6%
N'Zérékoré (Guinéeforestière)	Negative: 79%	Increase of around 0.9%

Projected climate-related impacts in Guinea

Guinea, as well as other West African countries, is likely to suffer from changes and variations in rainfall, increased temperature, and greater number of hot days. In addition to that, the coastline of Guinea will suffer from sea level rise and correlative effects, salinization in particular.

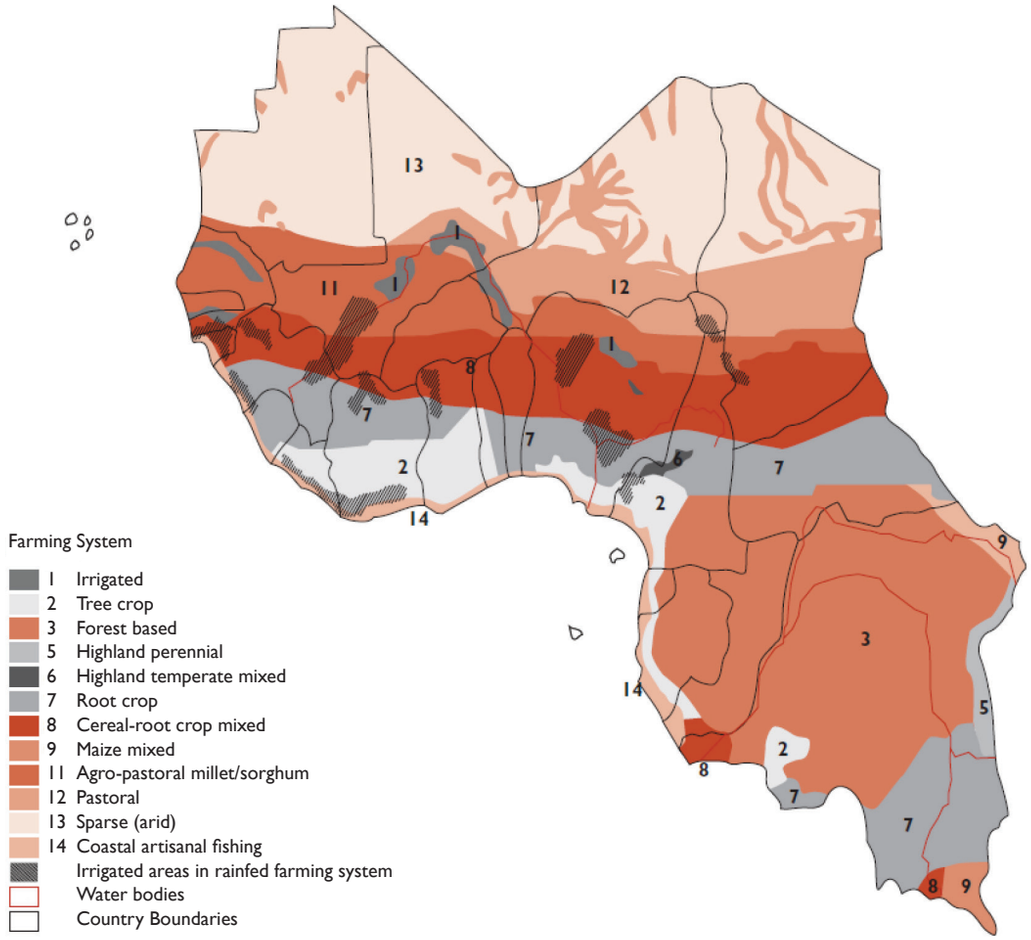
These impacts will be aggravated by the already significant degradation of natural resources by human activity, as well as by existing human and economic factors of vulnerability. Some specifics of Guinea compared to the neighboring countries are worth noting: Guinea has the highest share of employment in the agriculture sector (76% in 2011); average grain yield has fallen by 2% from 1990 to 2011 (while increasing in all neighboring countries, from +2% in Guinea Bissau to +122% in Mali); Guinea's rate of gross deforestation is among the highest (0.5% for the 2005-2010 period); and it has the highest number of forest fires (25 fires/100km^2/year in 2000-2010).

d) Vulnerability and impacts in terms of agriculture productivity and food security in West Africa

According to the FAO and the International Fund for Agriculture Development (IFAD) classifications of Sub-Saharan farming systems,[11] Guinea is covered by two farming systems, as can be observed below: one is based mainly on cereals and tubers (#8) in the northern part of the country, and the other based mainly on tubers (#7) in the southern part of the country.

11 DIXON et al. Farming Systems and Poverty - Improving farmer's livelihoods in a changing world. FAO - World Bank. 2001. 407p and Assessment of Rural Poverty – Western and Central Africa. IFAD. 2001

Figure 6. Major Sub-Saharan farming systems in Sub-Saharan Africa (IFAD, 2001)



A recent program, the Household Economy Approach in Sahel,[12] assessed the socio-economic vulnerability of Sub-Saharan farming systems. The main conclusions of the assessment for farming systems based on tuber and tuber and cereals were as follows:

Uneven rainfall distribution, flood, and drought constrain both agriculture, which is mostly rain-fed, and livestock, which is fully dependent on pasture land;

Lack of investment capacity limits use of inputs and area cropped per household; it restricts the ability of households to be self-sufficient and exposes them to market fluctuations;

Diseases and pests (such as locusts, grasshoppers, and bird), wandering livestock, and uncontrolled bushfires exert additional pressure on cropping systems;

Livestock are vulnerable to infectious animal diseases such as foot and mouth disease, sheep and goat plague, and Newcastle disease, among others;

Cattle rustling, degradation of grazing areas, lack of harvest residues in dry years, and farmer/rancher conflicts place additional pressure on livestock systems;

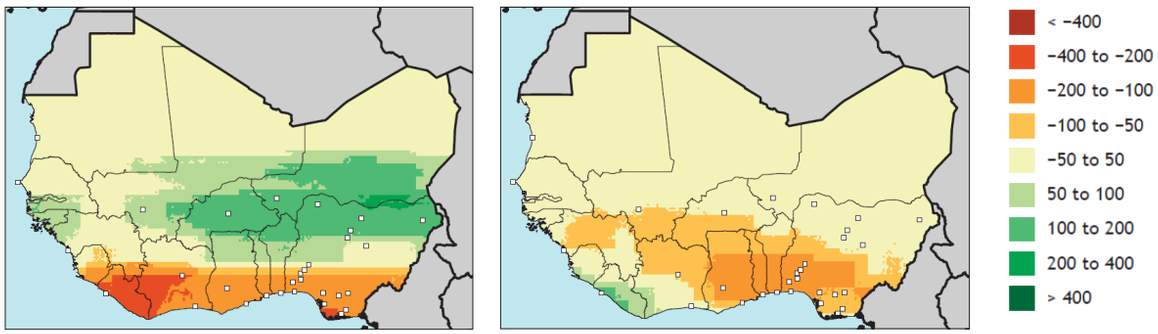
12 http://www.hea-sahel.org/HEA-Sahel-The-Household-Economy-Analysis, initiative supported by the European Union (EU), the Famine Early Warning System Network (FEWS-NET) of USAID, the Permanent Interstates Committee for Drought Control in the Sahel (Comité permanent inter-Etats de luttecontre la sécheressedans le Sahel– CILSS), OXFAM, and Action against Hunger.

Finally, isolation and the weakening of solidarity mechanisms (in the context of urban exodus) further aggravate these vulnerabilities.

The high level of rural household vulnerability in these farming systems will be further aggravated by the impacts of climate change on agriculture productivity. A recent study carried out by the International Food Policy Research Institute (IFPRI) on the impact of climate change on West African agriculture[13] projects changes by 2050 in average annual rainfall and yields. These projections are generated by two models: 1) Commonwealth Scientific and Industrial Research Organization (CSIRO) and 2) Model for Interdisciplinary Research on Climate (MIROC). They are based on the same projections as global climatic scenario A1B from the Fourth Report of the IPCC.

Figure 7 shows the projections for each model. Both models project a decrease in average annual rainfall in the coastal areas of West Africa. *(Note: the MIROC model predicts a slight increase in the northwest, but a slight decrease in the south of Guinea)*:

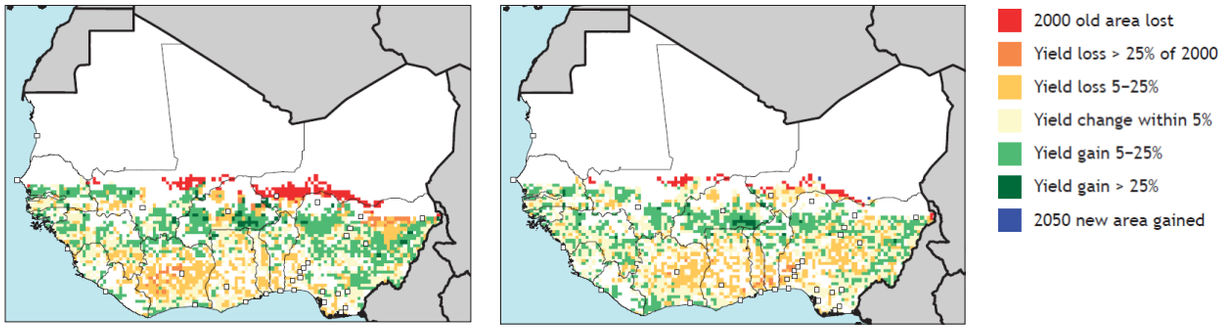
Figure 7. Projections of changes of average rainfall (mm/year) by 2050 with MIROC and CSIRO (IFPRI, 2013)



MIROC **CSIRO**

The two models also predict changes in yield for the major food crops in West Africa, including rain-fed rice, maize, millet, and groundnut). Figure 8 below presents the projections for rain-fed rice; Figure 9 presents the projections for maize.

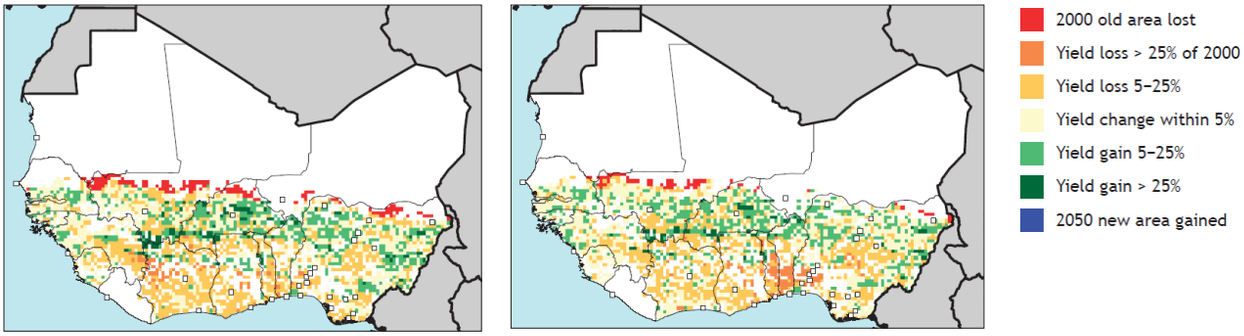
Figure 8. Projections of changes of rain-fed rice yields (%) by 2050 with MIROC and CSIRO (IFPRI, 2013)



MIROC **CSIRO**

13 JALLOH et al. West African Agriculture and Climate Change: a Comprehensive Analysis. IFPRI. 2013. 444p.

Figure 9. Projections of changes of maize yields (%) by 2050 with MIROC and CSIRO (IFPRI, 2013)



MIROC **CSIRO**

As the mosaic of green and yellow dots shows, no clear trend exists for these two crops in Guinea (although the data do indicate some of the biggest losses in yield in Guinea Forestière). However, these maps highlight the fact that changes in food crop yields will occur, requiring more analysis at national level based on the new RCPs used in the Fifth Report of the IPCC.

Located in the basin of the Niger River, ISAVF conducts for field trials for lowland rice production. With the majority of this farm land resource currently unused, ISAVF has the opportunity to accelerate the testing of climate smart lowland rice production technologies.

■ **Field trials on contributing factors related to yield of a Chinese Maize variety. There is a need to substantially increase the quality and quantity of AET-led field trials such as these as a part of any climate change adaptation strategy.**

III. Climate Smart Agriculture: International Benchmarks

a) Adaptation and agriculture under the UNFCCC

1. Overview of UNFCCC decisions in terms of adaptation: NAPAs, NAPs and LEG

Decision 5/CP.7 of the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC)[14] recognized that Least Developed Countries (LDC) are the most vulnerable to climate change and the least able to cope with it. This decision provides a framework for identifying activities that need to be implemented without delay to avoid increases in the vulnerability of LDCs or in their costs of adaptation.

To implement Decision 5/CP.7, LDCs were invited to elaborate a National Action Plan for Adaptation (NAPA) that would include: (i) participatory spatial and sectoral assessment of vulnerability to current and future climate variability, (ii) identification of potential adaptation measures, and (iii) prioritization of these measures and selection of urgent activities.

NAPAs are published on the UNFCCC website and the Global Environment Facility (GEF) website. Identified priorities and their estimated costs are reported in the UNFCCC NAPA database.[15] So far, 50 countries have developed NAPAs and identified 510 priority projects totaling $1 billion. In Africa, 34 countries, including Guinea, have developed NAPAs that identify 350 priority projects at a cost of more than $630 million.

Decision 1/CP.16[16] defined National Adaptation Plans (NAPs) as a process for enabling LDCs to plan and respond to "medium- and long-term adaptation needs." To create the NAPs, LDCs would build on their experience having addressed short-term "urgent and immediate adaptation needs" identified through the NAPAs.

Decision 5/CP.17[17] further defines the objectives of the NAP process: (i) to reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience; and (ii) to facilitate integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programs, and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate.

14 UNFCCC. Decision 5/CP.7 on NAPA, from the Marrakech Climate Conference. UNFCCC. 2001. 8p

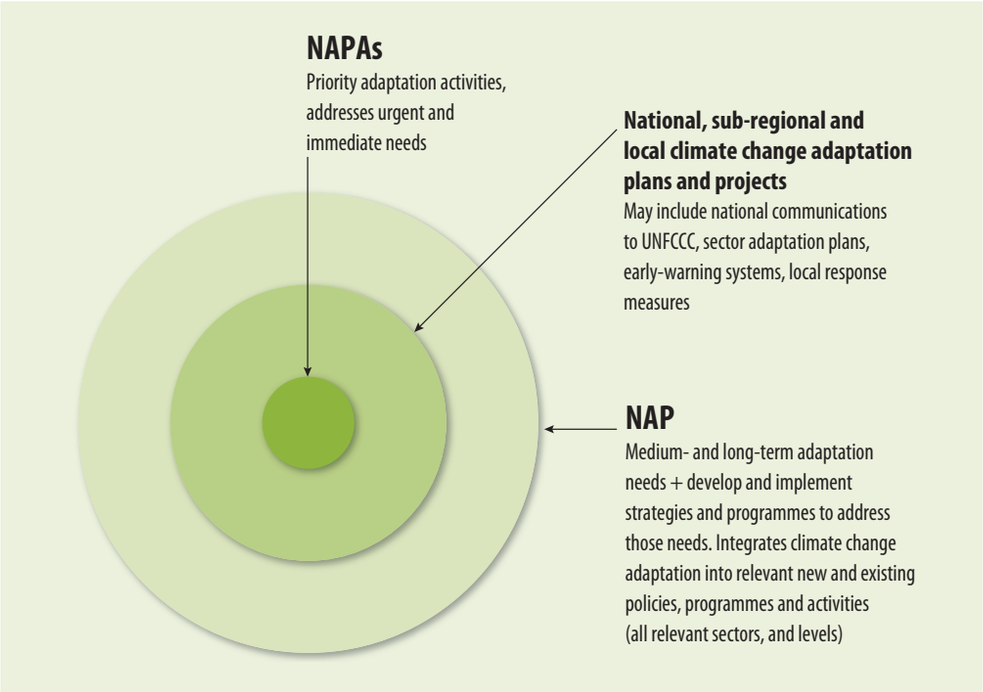
15 http://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4583.php

16 UNFCCC. Decision 1/CP.16 on the Cancun Agreement and the Cancun Adaptation Framework, from the Cancun Climate Conference. UNFCCC. 2010. 31p

17 UNFCCC. Decision 5/CP.17 on the NAPs, from the Durban Climate Conference. UNFCCC. 2011. 7p

The NAPA and NAP processes are illustrated in Figure 10:[18]

Figure 10. NAPA and NAP processes (Kissinger and Namgyel 2014)



The LDC Experts Group (LEG) prepared technical guidelines for the NAP process in 2012, based on the Conference of Parties's (COP) initial guidelines. The review of the guidelines planned for November 2013 at COP19 in Warsaw was postponed to December 2014 at COP20 in Peru to allow the LDCs more time to try out the existing guidelines. To inform this review, parties were invited to submit comments by March 2014 on their experience with the application of the initial NAP guidelines.

At COP20, guidelines for concrete design and implementation of the NAPs will be adopted. In that context, some key issues will need to be addressed:

Based on the NAPA experience, of great concern to LDCs is the availability of adequate levels of financing for NAPs (and pre-existing NAPAs), the timing of finance delivery, and the modalities for accessing financing. The GEF Council has affirmed support via the LDC Fund and the Special Climate Change Fund (SCCF) for both planning and preparatory activities. However, it is unclear whether funding levels will be sufficient, and how these sources will relate to the Green Climate Fund;

A critical objective of NAPs is to facilitate the integration of climate change adaptation into development policies and activities. Meeting this objective is a challenge for the following reasons: (i) LDCs often have multiple sector policies that are "coordinated" and "mainstreamed" in theory but not necessarily in practice, (ii) few examples exist of how LDCs have mainstreamed climate plans into national development and sector plans; such examples could provide models for NAP processes and interventions;

Clear guidance from the COP is needed to support "country-driven" approaches and define measurement, reporting, and verification systems for climate financing to differentiate adaptation support from official development assistance.

18 KISSINGER G. and NAMGYEL V. LDC paper Series – NAPAs and NAPs in LDCs. March 2014. 26p.

2. Overview of international financing for adaptation

Table 2 provides information on four multilateral funds, supervised by the UNFCCC, which are financing adaptation to climate change.[19]

Table 2. Multilateral financing mechanisms for adaptation

Multilateral financing mechanisms for adaptation	
LDC Fund (LDCF) *Managed by the GEF (grant)*	■ Support for NAPA preparation and NAPA projects (following the GEF project cycle); ■ "Balanced access": a ceiling per country ensures that all countries have access to the Fund; ■ Full cost financing of priority activities, co-financing for non-priority actions (Decision 3/CP11); ■ Awarded $537 million by mid-2012, of which $346 million was allocated to the financing of 49 NAPA and 82 projects in 44 countries. Fifty-six percent (56%) of funding was allocated to Africa. Funding to Sub-Saharan LDCs totaled $130 million from 2003 to 2012.
Adaptation Fund *Managed by the World Bank (grant)*	■ Focus on the most vulnerable areas; ■ Specific criteria: vulnerability, emergency, up-scalability, and co-benefits; priority given to LDCs unable to access the LDCF; ■ Direct access by accredited National Implementation Entities (NIEs). *Note: for now, only two NIEs are among the Sub-Saharan LDCs: Ecological Monitoring Centre in Senegal and the National Fund for Environment in Benin;* ■ Awarded $283 million by mid-2012, of which $180 million was allocated to 27 countries (including Mauritania and Senegal in West Africa).
Special Climate Change Fund *Managed by the GEF (grant)*	■ Two funding windows: "adaptation" and "technology transfer"; ■ Accessible by all developing countries, with priority to the most vulnerable countries in Africa and Asia and to small island developing countries; ■ $241 million was awarded by mid-2012, of which $162 million was allocated for the financing of 39 projects. Twenty-six percent (26%) of funding is allocated to Africa.
Green Climate Fund	Created by Decision 1/CP16 and qualified as a financial mechanism of the UNFCCC (together with the GEF). Expected to be operational in 2014; $6 million in pledges received so far.

Table 3 lists other multilateral and bilateral sources of financing for climate change adaptation in West Africa.

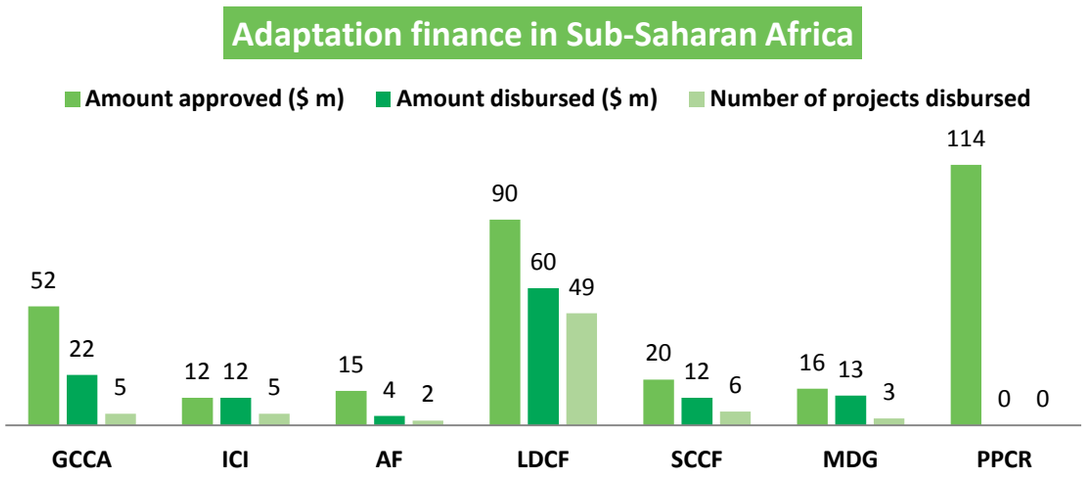
19 Salva Terra. Training manual for the Workshop of preparation of West African negotiators to the COP19 in Warsaw. CILSS. October 2013. 165p

Table 3. Additional financing mechanisms for climate change adaptation

Multilateral and Bilateral financing mechanisms for adaptation	
US Government's Global Climate Change Initiative's Integration Pilots	Focus on integrating climate change adaptation into other sector development programs. Launched in 2012, current African pilot projects are being implemented in Ethiopia, Democratic Republic of Congo, and Guinea (AEMIP's pilot).
Global Climate Change Alliance	Focus on LDCs and small island developing countries. In 2012-2013: budget of $85 million. In 2008-2012: 60% of funding was allocated in Sub-Saharan Africa for four projects in Benin, Ethiopia, Gambia, and Senegal ($40 million).
German International Climate Initiative	Worldwide. By late 2012 had a budget of $851 million, $770 million had already been allocated, including $9.1 million for four projects in Central Africa Republic, Ethiopia, and Mali (two projects).
Japan's Fast Start Finance	Grants and loans for public or private initiatives worldwide. In 2012, $1.6 billion was allocated, including $60 million for five projects in Benin, Burkina-Faso, Djibouti, Ethiopia, and Sudan.
Pilot Program for Climate Resilience	Grants and loans with a focus on vulnerable countries (LDCs and small island developing countries). $1.12 billion has been pledged and 13 programs approved for $800 million (including four in Niger for $100 million).

Despite these mechanisms, many challenges remain to realizing implementation for Sub-Saharan countries. A 2011 review of climate finance in Sub-Saharan Africa20 highlighted how few of the financing pledges were approved and how little of the approved financing was disbursed, as shown in Figure 11 below.

Figure 11. Funding disbursed and approved for adaptation in Sub-Saharan Africa in 2004-2011 (ODI & HBS, 2011)



20 Overseas Development Institute (ODI) & Heinrich Böll Stiftung (HBS). Climate Finance Policy Brief - Climate Finance in Sub-Saharan Africa. ODI & HBS. November 2011. 8p

The "agriculture item" in UNFCCC negotiations

The lack of progress on the agriculture agenda item (in the UNFCCC negotiations is unfortunate for Africa. In the Gaborone Declaration on Climate Change towards 2015, African Ministers of Environment made clear they wanted swift and ambitious progress on this item: "*Since agriculture is the backbone of African economies and livelihoods for people, we must create a special working group on the subject of adaptation of agriculture and may process this item […] In this context, the Africa Group has also supported the establishment of a platform for dialogue on food security and adaptation to climate change based on ecosystems.*" [21]

b) Internationally accepted definition of CSA and climate-smart AET in West Africa

1. Determining an internationally accepted definition of CSA

Given the lack of progress at the UNFCCC on the agriculture item, the concept of climate-smart agriculture (CSA) has been primarily discussed and "agreed upon" (but not officially endorsed by a COP Decision) through papers and international meetings supervised by the Food and Agriculture Organization (FAO). The first meeting was the Hague Conference on Agriculture, Food Security, and Climate Change held from October 31 to November 5, 2010, just before the Cancun Climate Conference.[22] FAO produced a paper one year later, focusing on investment opportunities for CSA in Africa.[23] Soon afterwards, in April 2012, the FAO and Organization for Economic Cooperation and Development (OECD) held a workshop entitled, "Building Resilience for Adaptation to Climate Change in the Agriculture Sector" in Rome.[24] Finally, in June 2013, the FAO published a CSA Sourcebook[25] summarizing common knowledge and best practices with regard to CSA. This sourcebook is organized in modules on specific issues (landscape, water, soils, energy, genetic resources, crop production, livestock, forestry, fisheries, and aquaculture), as well as cross-cutting issues (food value chains, local institutions, mainstreaming into national policies, finance, disaster risk prevention, safety net, capacity development, and monitoring and evaluation). Roughly summarized, the concept of CSA is encompassed by three pillars: adaptation, mitigation, and livelihoods.

21 African Ministerial Conference on the Environment. Gaborone Declaration on climate change towards 2015. Fifth Session of the African Ministerial Conference on the Environment. October 2013. 6p

22 FAO. CSA – Policies, practices, and financing for food security, adaptation, and mitigation. Input to the Hague Conference on Agriculture, Food Security, and Climate Change held from October 31 to November 5, 2010. FAO. October 2010. 41p

23 FAO. Identifying opportunities for CSA investments in Africa. FAO. December 2011. 129p

24 FAO/OECD. Proceedings of a joint FAO/OECD workshop: Building Resilience for Adaptation to Climate Change in the Agriculture Sector, held in Rome in April 23-24, 2012. FAO/OECD. April 2012. 346p

25 FAO. CSA Sourcebook. FAO. June 2013. 570p

Pillars of climate-smart agriculture

Adaptation: To reduce farmer vulnerability to climate change (climate variability and extreme events, as well as slow onset changes). Adaptation of agriculture to climate change is a must, as underscored by the previsions of the Stern Review: yields of rain-fed agriculture will fall by 50% by 2050 in some countries. Small farmers will be the most affected; their net income may fall by 90% by 2100 (Stern 2007).

Mitigation: To reduce GHG emissions from agriculture and land use changes. According to the FAO,[26] the agriculture sector directly accounts for 14% of GHG emissions,[27] and deforestation, forest degradation, and land use changes account for an additional 17% of GHG emissions. Even though the absolute contribution to global GHG emissions of Africa's agriculture sector is comparably low (3.4% according to the Global Carbon Atlas, 2014), its relative contribution is much higher than the global average: 75% of West African GHG emissions are comprised of CH4 and N2O, compared with 31% at global level.

In short, "considering the necessary increase in production needed, staying within planetary boundaries will require reducing emissions per kg of output and enhancing carbon sinks" (Meybeck et al. 2012).[28] Reducing emissions in turn requires (i) limiting the land use changes that bring more surface under cultivation through deforestation or conversion of grasslands to croplands, (ii) limiting the use of chemical fertilizers, whose production is an important source of CO2 and which at the field level translate into N2O emissions, (iii) innovations in livestock management, which is an important source of CH4 and N2O (*Ibid*).

Livelihoods: To increase food production and farmer income. The development needs of LDCs, including most Sub-Saharan countries, are well known and recognized in the Millennium Development Goals (MDGs). The target of MDG, Eliminate Poverty and Hunger, has been revised upwards to reflect the latest world population estimates[29] of 33% growth by 2050 (from the current 7.2 billion to 9.6 billion people). Africans are expected to account for 25% (2.4 billion) of the world population by 2050. In that context, the High Level Panel on Food Security and Nutrition (HLPFSN) foresees the need to produce 70% more food by 2050.[30]

The concept of CSA is fully in line with the Millennium Development Goals (MDGs) and objectives of the three Rio Conventions, as well as the World Food Summit. The implementation of CSA strategies and techniques involves three main challenges:

Need to integrate "CSA techniques" into "CSA strategies." As stated by the Rural Hub,[31] ***CSA techniques*** are usually used at the farm level to increase farming revenue. They include water harvesting techniques, soil management techniques, seed selection, and cropping-livestock integration, among others. Many of these techniques have been used for decades and were not specifically designed to address adaptation needs. They were, and still are, called "good practices."

26 FAO. CSA: Managing Ecosystems for Sustainable Livelihoods. FAO. 2014. 14p

27 e.g. CO2 emissions from fossil fuel and cultivated soils, CH4 from anaerobic fermentation (incl. enteric fermentation) and biomass burning, N2O from aerobic fermentation and chemical fertilizers, etc.

28 MEYBECK A. et al. CSA, presented at the Workshop "Planet Under Pressure, New Knowledge Towards Solutions", March 26-29, 2012. FAO. 4p

29 UN. World Population Prospects: The 2012 Revision – Key Findings and Advance Tables. UN. August 2013. 54p

30 HLPFSN. Food Security and Climate Change. June 2012. 119p

31 Rural Hub. Preparatory Note for the Forum of National and Regional Stakeholders on CSA in West Africa for the setting of an ECOWAS intervention, funding, monitoring and evaluation framework on CSA, associated with an Alliance for the consistency and coordination of CSA initiatives, as part of ECOWAS Agriculture Policy/CAADP implementation. Rural Hub. March 2014. 27p

With the potential for decreasing yields because of climate change, adaptation strategies need a stronger emphasis on efficient post-harvest handling, processing, and marketing of staple crops like maize.

Two examples are the Zaï and Stone Barrier (*cordon pierreux*) techniques to increase water retention in the soils. These two techniques appeared in the 1960s as "soil fertility improvement techniques" and were successively labeled as "agriculture development techniques" in the 1970s, "water harvesting techniques" in the 1980s, "soil fertility improvement techniques" (again) in the 1990s, "integrated water management techniques" in the 2000s, "CSA techniques" now, and are likely to become "green agriculture techniques" in the future. Many CSA techniques therefore already exist as "good agricultural practices."

CSA strategies, on the other hand, are set up according to forecasted agro-ecological conditions, at short, medium, and long-term, taking into account local, sub-national, and national levels of vulnerability and resilience with regard to climate change. CSA strategies are meant to accelerate and rationalize the deployment, in space and time, of already existing (for most of them) "good agricultural practices." CSA techniques may not be new, but the concept of CSA strategies is.

Need to define "farming-system specific" CSA strategies and techniques. Many opportunities exist for capturing synergies between the three pillars of CSA, leading to "triple win" solutions, but trade-offs are also inevitable in some situations. For example, converting wooded lands for cropping to achieve food security locally and support vulnerable rural populations will lead to increasing GHG emissions. A trade-off in one community, however, can often be mitigated in another community within a farming system. Therefore, CSA has to be adapted to the local context, be "farming-system specific," and implemented with flexibility to take trade-offs into account; for example, if the triple-win solution is not possible, the second-best option is a win-win solution that addresses adaptation and livelihood needs.

Need for closer integration of NRM and agricultural outreach efforts to promote CSA. The individual country assessments carried out by the USAID-funded Modernizing Extension and Advisory Services (MEAS) project,[32] and the Worldwide Extension Study[33] carried out by IFPRI (supported by USAID, the FAO, and the Inter-American Institute for Cooperation on Agriculture) show that, in most countries, agriculture and NRM extension efforts are carried out by separate structures. Each has its own staff working in different geographic areas and employs different methods to pursue its objectives. In Sub-Saharan Africa in particular, the provision of extension services tends to be divided among crop, livestock, fisheries, and forestry line ministries, often with weak or no cross-ministerial communication.

A review of the literature under the same MEAS project[34] further emphasizes that "few national extension and advisory service programs have launched initiatives aimed specifically at assisting farmers in adapting to climate change. It is unclear whether this is an indication that conditions have not yet reached a management switching point where change is required, an indication of the time lag in accepting, understanding, and preparing responsive measures, or simply confirmation that many of the early adaptive responses are not sufficiently different from many ongoing development interventions targeting natural resource-dependent smallholder farmers and thus are not being recognized for their climate change adaptive qualities."

2. International and sub-regional institutions active in the field of climate-smart AET

Many universities, research centers, and NGOs are active worldwide in the adaptation of agriculture and NRM to climate change (and sometimes CSA). Considering the action-oriented nature of the terms of reference for the Baseline Study, we focused on (i) regional and sub-regional AET institutions and research centers that are more easily linked with the Guinean AET, (ii) those that deliver information/training courses in French, as many AET faculty/students do not know English, (iii) those that provide "on-the-job oriented"

32 www.meas-extension.org/meas-offers/country_studies

33 www.worldwide-extension.org and www.g-fras.org/en/world-wide-extension-study

34 SIMPSON B. M and BURPEE.C G. Modernizing Extension and Advisory Services (MEAS) Discussion paper 3 – Adaptation under the "New Normal" of climate change: the future of agricultural extension and advisory services. January 2014. 40 p

curricula or curricula elements, rather than "academic oriented" ones, in light of the fact that Guinean AET students lack on-the-job training experience (ISAVF institutional assessment, 2013).

The study identified 12 institutions with different levels of relevance for "serving as appropriate models/ benchmarks for Guinea on the integration of climate change adaptation, biodiversity, and NRM into AET." A consideration is that only two of the institutions offer curricula that would respond to this objective. However, some institutions provide useful information or materials that could be used in an AET training course about environmental issues or to develop AET curricula on environmental issues.

The 10 most important institutions are presented below, classified by level of relevance. Those most relevant for AEMIP and ISAVF are listed first.

1. WASCAL - West African Science Service Centre on Climate Change and Adapted Land Use[35]

Created in 2010 and based in Accra, WASCAL is a large-scale research-focused program designed to tackle the climate change challenge and thereby enhance the resilience of human and environmental systems to climate change and increased variability. It does so by strengthening the research structure and capacity in West Africa related to climate change and by pooling the expertise of ten West African countries (Benin, Burkina-Faso, Gambia, Ghana, Ivory Coast, Mali, Niger, Nigeria, Senegal, and Togo) and Germany. WASCAL has three principal components: (i) Competence Centre, (ii) Core Research Program, (iii) Graduate Studies Program.

The third component is of particular interest for our study. It involves the creation of seven graduate schools in West Africa and aims to contribute to the education of the next generation of African scientists and policy makers in the field of climate change and land management. It consists of six doctoral programs and four master's programs.

WASCAL resources of interest to AEMIP

Doctoral programs: (i) West African Climate System (*Federal University of Technology, Akure, Nigeria*), (ii) Climate Change and Water Resources *(Université d'Abomey-Calavi*, Benin), (iii) Climate Change Economics *(Université Cheikh Anta DIOP de Dakar*, Senegal), (iv) Climate Change and Land Use *(Kwame NKRUMAH University of Science and Technology,* Ghana), (v) Climate Change and Agriculture (*Institut polytechnique rural de formation et de recherché appliquée*, Mali, and *University of Cape Coast,* Ghana), (vi) Climate Change and Biodiversity (*Université Felix H. BOIGNY*, Ivory Coast);

Master's programs: (i) Climate Change and Human Security (*Université de Lomé*), Togo), (ii) Climate Change and Adapted Land Use *(Federal University of Technology, Minna*), Nigeria), (iii) Climate Change and Energy (*Université Abdou MOUMOUNI de Niamey*, Niger), (iv) Climate Change and Education (University of The Gambia, the Gambia).

35 https://icg4wascal.icg.kfa-juelich.de/

2. CILSS - Permanent Interstate Committee for Drought Control in the Sahel (Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel)[36]

CILSS was established on September 1973 in the aftermath of major droughts in the Sahel in the 70s. Its 13 member states include eight coastal states (Benin, Bissau Guinea Gambia, Guinea, Mauritania, Senegal, and Togo), four landlocked countries (Burkina-Faso, Chad, Mali, and Niger), and one island state (Cape Verde). Its headquarters are in Ouagadougou, its scientific research center (Agrhymet[37]) is in Niamey, and its expansion center (Sahel Institute) is in Bamako.

CILSS has five areas of work: (i) support the definition and implementation of sectoral strategies and policies related to food security, desertification, and domestic energy; since 2012, the CILSS scope includes climate change mitigation and adaptation, (ii) provide initial and continuous short, medium and long term training via Agrhymet, primarily for the technical services of the member states, (iii) information sharing, (iv) research and development, and (v) design and implementation of multi-country pilot projects.

CILSS resources of interest to AEMIP

Master's on adaptation of agriculture to climate change: the curriculum is ready and expected to be implemented for the first time this year. Applicants require a basic understanding of agronomy, rural economics, and food security. The program includes seven modules: (i) scientific basis of climate change and climate variability, (ii) vulnerability, impact and adaptation, (iii) statistics and geomatics, (iv) mitigation in the agriculture, forestry, and land use sector, (v) communication and management, (vi) global governance and international climate negotiations, (vii) master's thesis.

Master's on agro meteorology: This program has been offered for some years. Applicants require a basic understanding of agronomy, rural economics, and food security. The program is not organized in modules, but consists of various courses in agronomy, animal production, ecology and NRM (soil and water), rural economics, agriculture machinery, meteorology (general, agro meteorology, tropical, dynamic, physical, synoptic, and satellite), cartography, remote sensing and Geographic Information Systems (GIS), and statistics and biometrics. Additional courses are related to climate change and include climatology, climate change and agriculture, and early warning systems.

Short-term training through the Agrhymet.

3. ANAFE - African Network for Agriculture, Agroforestry and Natural Resources Education[38]

ANAFE is a network of 132 educational institutions in 37 African countries (Guinea is not among them), whose objective is to strengthen the teaching of multi-disciplinary approaches to land management. The ANAFE Secretariat is hosted at the headquarters of the World Agroforestry Centre (ICRAF) in Nairobi.

36 http://www.cilss.bf/
37 http://www.agrhymet.ne/
38 http://anafe-africa.org

ANAFE resources of interest to AEMIP

ANAFE published a Working Paper on "Mainstreaming Climate Change into Agricultural Education: Challenges and Perspectives,"[39] which emphasized that "Climate Change should be integrated into the curricula of tertiary agricultural institutions as a matter of urgency. There is need for concrete scientific data based on African experiences to be infused into the curricula [….] The curricula can be handled as a separate subject or infused and integrated into the various agricultural and NRM subjects."

Possible elements of such a curricula were also presented: (i) introduction to climate change (causes, projections, impacts on livelihood), (ii) agro biodiversity (impacts of climate change on agro biodiversity at ecosystems, species and within-species levels and facilitating adaptation to climate change through agro biodiversity), (iii) biofuels (alternative sources of energy, socio-economic implications), (iv) adaptation strategies (options available), (v) mitigation strategies (current thinking, geo-engineering concepts and practices), and (vi) global policy issues (UNFCCC, Kyoto Protocol, CDM, NAPA).

In addition to a Working Paper published by ANAFE, the ANAFE 2013-2017 Strategic Plan40 also touches of the importance of considering climate change and NRM when implementing Strategic Objective #1 - Review and Reform Curricula: "The increasing recognition of the complex interdependence of agriculture and NRM is a critical dimension for consideration in curriculum architecture [….] ANAFE will support universities to develop teaching and research programs that expose students to climate change adaptation and mitigation options in different agro-ecological zones, with a special focus on sustainable agriculture, forestry, water management, energy, etc."

Potato production dominates in Moyenne Guinea, benefiting from 14 river sources in the region. Climate change adaptation strategies must introduce improved water resource management for potato production.

39 CHAKEREDZA S. et al. Working Paper: Mainstreaming Climate Change into Agricultural Education: Challenges and Perspectives. ANAFE and ICRAF. 2009. 30p

40 ANAFE. Strategic Plan 2013-2017. ICRAF. 36p

Unfortunately, the envisioned strategic orientations have not yet materialized: there are no curricula documents online with regard to adaptation to climate change.41 Although both the ANAFE Strategic Plan 2013-2017 and Working Paper #82 include interesting ideas and elements, they remain too vague as an input for facilitating the introduction of CSA AET in Guinea.

4. Inter-Network (Inter-réseaux)[42]

Established in the 1980s and formalized in 1996, Inter-réseaux is led by 20 NGOs active in the rural sector in Africa, including Network of Farmer and Agricultural Producers' Organizations of West Africa/Réseau des organizations paysannes et de producteurs de l'Afrique de l'Ouest (ROPPA); Green Africa International; and SOS hunger Belgium. Its 6,000 members from the north and south include farmer organizations, universities, research centers, NGOs, and projects. Inter-Network shares information and good practices on rural development with a special focus on farmer organizations.

Inter-Network resources of interest to AEMIP

Inter-Network has five online forums: agricultural policies, value chains and market access, rural extension, rural financing, and family farms. Climate change will likely be included under agricultural policies, pending revision of this forum's terms of reference. In addition, Inter-Network could provide valuable inputs to development of curricula on climate change through the following resources:

A 40-page quarterly review called Grain of Salt (*Grain de sel*) regularly provides information on climate change and CSA. A special issue on "Agriculture and Climatic Risks: from the Field to the Policies"[43] was published in the first quarter of 2010;

A 10-page biweekly warning bulletin provides summary information, including on climate change. For instance, the February 21, 2014, bulletin[44] gave an overview of climate finance in West Africa;

Various other publications have addressed vulnerability, resilience, and adaptation of agriculture issues, including vulnerability and the fight against hunger at the regional level[45] and strengthening the resilience of pastoralism.[46]

5. Rural Hub[47]

The Rural Hub was created in 2004 and is an information sharing platform to support rural development and food security in 21 countries of West Africa and Central Africa. It is chaired by ROPPA, and its board includes six regional organizations (ECOWAS, CILSS, etc.) and 21 technical and financial partners (e.g. USAID, EU, IFAD, IFPRI, CORAF, etc.).

41 http://anafe-africa.org/?page_id=54
42 http://www.inter-reseaux.org
43 http://www.inter-reseaux.org/revue-grain-de-sel/
44 http://www.inter-reseaux.org/bulletin-de-veille/
45 http://www.inter-reseaux.org/IMG/pdf/GDS59_cedeao2.pdf
46 http://www.inter-reseaux.org/IMG/pdf/GDS59_Pastoralisme.pdf
47 http://www.hubrural.org

Rural Hub resources of interest to AEMIP

Rural Hub has five online forums: agricultural policies, land tenure policies, rural financing, bioenergy, and climate change. Other resources that may be useful in developing curricula on climate change include (i) an online database with 1,187 referenced documents related to climate change and environment, (ii) a regular bulletin, "Adaptation of Agriculture to Climate Change in West and Central Africa;" 11 bulletins have been published since July 2012. Rural Hub is also a key partner with USAID supporting ECOWAS countries, including Guinea, to integrate CSA into the NAIPS under CAADP.

The organization hosted a West African Forum on CSA, May 27-30, 2014, in Bamako.[48] It was sponsored by many donors (e.g. USAID, ECOWAS, GIZ, etc.) and supported by 19 technical and financial partners (e.g. CORAF, IFPRI, AfricaRice, FAO, IUCN, ROPPA, etc.). Based on the concept note describing the forum's rationale, objectives, and planned key-note speakers, there is no doubt this forum could be extremely useful to the AEMIP/GCC Integration Project. For example, a group of AET faculty and students could be sent to the forum with the mandate to report back to other AET faculty and students.

6. IFPRI - International Food Policy Research Institute[49]

Created in 1975, IFPRI seeks to provide research-based policy solutions that sustainably reduce poverty and end hunger and malnutrition. It is based in Washington, D.C., with a sub-regional office in Dakar. IFPRI is a member of the Consultative Group on International Agricultural Research (CGIAR).[50]

IFPRI's 2013-2018 Strategy[51] highlights six strategic research areas, one of which is entitled "building resilience" and focuses on adaptation of agriculture to climate change. Of particular interest is its research sub-theme #1.2 on climate change,[52] which has four areas of work: (i) adaptation to progressive climate change, (ii) adaptation pathways for current climate risk, (iii) pro-poor climate change mitigation, and (iv) integration for decision making.

IFPRI's 2013-2018 Strategy reads, "Researchers at IFPRI are dedicated to helping farmers achieve the triple win of adapting to climate change, increasing crop yields, and mitigating greenhouse gas emissions."

48 Rural Hub. Preparatory Note for the Forum of National and Regional Stakeholders on CSA in West Africa for the setting of an ECOWAS intervention, funding, monitoring and evaluation framework on CSA, associated with an Alliance for the consistency and coordination of CSA initiatives, as part of ECOWAS Agriculture Policy/CAADP implementation. Rural Hub. March 2014. 27p.

49 http://www.ifpri.org/

50 www.cgiar.org

51 IFPRI. IFPRI Strategy 2013–2018: Food Policy Research in a Time of Unprecedented Challenges. IFPRI. 2013. 34p

52 http://cgmap.cgiar.org/factsheets/2011-2013/IFPRI/Subtheme+1.2/Subtheme+1.2:++Climate+Change+%28GRP+43%29.htm

IFPRI resources of interest to AEMIP

Even though IFPRI does not develop curricula on climate change and CSA, it produces valuable materials that could be integrated into curricula, such as yield projections produced by sophisticated climate, crop and economic models to simulate the impact of climate change on agricultural activities.

An ongoing study to model future food crop production (beginning with rice) under different climate change scenarios, carried out under the supervision of IFPRI Dakar, might be useful in raising awareness among Guinean decision-makers. The results are expected at the end of 2014. The AEMIP/GCC project could explore collaboration with IFPRI/Dakar to broadly communicate the results and use them to help mobilize Guinean stakeholders on issues related to the adaptation of agriculture to climate change.

Guinean farmers cite slash-and-burn as the only approach available for land clearance and short-term soil fertility management. Increased dissemination and training in proper techniques is needed to mitigate long-term soil infertility and deforestation that can result from improper techniques.

7. CTA - Technical Centre for Agricultural and Rural Cooperation[53]

CTA is a joint international institution of the Africa, Caribbean, and Pacific Group of States (ACP) and the European Union (EU). Financed by the EU, CTA operates in ACP countries under the Cotonou Agreement to improve food and nutritional security, increase prosperity in rural areas, and ensure proper management of natural resources. It facilitates access to information and promotes the development of agricultural policies. Created in 1983, it has 79 member states, including Guinea.

53 http://www.cta.int/fr/

CTA resources of interest to AEMIP

CTA publishes a bimonthly review called "CTA Spore." This review includes a section dedicated to climate change[54] that offers useful information on CSA techniques. For instance, recent issues featured articles on genetic improvement of dairy cattle in Senegal, a polyvalent craft mill to produce food supplements in Burkina Faso, and improved fishing techniques to protect fry in South Sudan. The CTA website also offers many publications online, but has no specific section on climate change.

8. GTD - Desertification Working Group (Groupe travail desertification)[55]

Created in 2001, GTD is a network of 16 French NGOs active in the Sahel in the fight against desertification (e.g., SOS Sahel and Agronomes et Vétérinaires Sans Frontières). It has three areas of work: (i): advocacy, (ii) knowledge transmission to the general public, and (iii) capacity building.

GTD resources of interest to AEMIP

GTD does not produce materials for a basic curriculum, but prepares and distributes highly technical, focused leaflets appropriate for continuous short-term training on topics related to NRM, the fight against desertification, and agro-ecology. Sixteen leaflets are available online (e.g., living fence, zaï, conservation tillage, fodder conservation, turning pastures, and grass strips)[56]and could be useful for enriching AET curricula with examples of CSA techniques. GTD also has an online database of successful NRM projects in the subregion.[57]

9. 2iE - International Institute for Water and Environmental Engineering[58]

Created in 1968 and formerly known as the Rural Equipment Engineering School/Rural Equipment and Hydraulic Technicians' School, 2iE is based in Ouagadougou and trains students from across Africa. Because water management is a key challenge for CSA in Sub-Saharan countries and a key component of any AET curricula in CSA and NRM, some of 2iE's curricula could be of interest to Guinean AETs: (i) bachelor's degree in water and environmental engineering (three-year courses; thus of interest to both the vocational/professional level AETs and ISAVF), (ii) master's degree in water and environmental engineering (five/six-year training; of interest only to ISAVF), (iii) doctoral program in water and environmental sciences (eight-year training; of interest only to ISAVF).

10. GWP - Global Water Partnership[59]

The GWP was created in 1996 following the International Conference on Water and the Environment held in Dublin in 1992. It seeks to promote the principles of integrated water resource management and water efficiency to achieve equitable and efficient management and sustainable use of water. It encompasses 84

54 http://spore.cta.int/fr/component/content/article/37-spore/31/8420-changement-climatique-168
55 http://www.gtdesertification.org
56 http://www.gtdesertification.org/rubrique61.html
57 http://www.gtdesertification.org/rubrique58.html
58 http://www.2ie-edu.org
59 http://www.gwp.org

member states, including Guinea, and has 13 Regional Water Partnerships, including one for West Africa, headquartered in Ouagadougou.

The 2014-2019 GWP Strategy includes six thematic areas of work,[60] including one on climate resilience and water security. The GWP does not provide training as such, but, in the frame of its Water, Climate, and Development Programme (WACDEP), has set up a Young Professional Development Initiative.

Under this initiative, nine youth professionals will serve as interns in each of the eight WACDEP countries, including Ghana and Burkina Faso in West-Africa, and in the WACDEP Coordination Unit in Pretoria, for six to twelve months. During their internships, the young professionals will receive mentoring, technical support, and training from the WACDEP Country and Regional Managers.

c) Implementation of adaptation in agriculture in West Africa

1. Mainstreaming adaptation to climate change into public policies

As outlined earlier, since 2000, adaptation to climate change policies and measures have been developed mainly under UNFCCC guidance and implemented under the supervision of Ministries of Environment. In this context, NAPAs were set up with priority to agriculture in the broad sense of cropping, livestock farming, forestry, fisheries, and other rural activities.

By the end of the decade, came the launching of (i) the Comprehensive Africa Agriculture Development Programme (CAADP) under the joint auspices of the African Union (AU) and New Partnership for Africa's Development and (ii) the ECOWAS Agricultural Policy.

Regional Agricultural Investment Programs (RAIPs) and National Agricultural Investment Programmes (NAIPs) were developed around the same time. In West Africa, climate change received little, if any, consideration in the RAIP and the NAIPs, though USAID and Rural Hub are actively supporting ECOWAS to address this. Therefore, below we summarize key findings of a meta-analysis of 18 Sub-Saharan NAPAs[61] in terms of: (i) key aspects of vulnerability and resilience to climate change, (ii) key adaptation measures planned and sometimes implemented in the agriculture sector. The 18 countries included are LDCs: Benin, Burkina-Faso, Central African Republic, Chad, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Senegal, Sierra Leone, Sudan (Note: now split into Sudan and South Sudan), and Togo.

2. Key aspects in terms of vulnerability and resilience to climate change

Sub-Saharan agriculture is considered vulnerable to climate change due to the following factors:

- Capital and labor are the "historical" limiting factors, but a new one now appears with population growth in many places: land;
- Productivity gains are low;
- Slash-and-burn practices are commonly used to ensure the restoration of fertility;
- Rates of use of chemical fertilizers and improved seeds are the lowest in the world;
- The level of mechanization is low and motorization is almost zero;

60 GWP. Summary of the 2014-2019 GWP Strategy. GWP. 2014. 2p

61 SalvaTerra. Meta-Analysis of 18 Sub-Saharan Countries, with Focus on Adaptation of Agriculture to Climate Change. FAO (underpress). 2013. 120p

- Almost no access to "formal" agricultural credit exists, and access to micro-finance is limited;
- AET (initial and continuous) and agriculture extension are often deficient. Agriculture extension in particular is undermined by the "training and visit" approach promoted in the 1990s[62];
- Farmer organizations are emerging, with large disparities in countries and sectors. They struggle to organize collective services formerly provided by the state;
- Public investments are inadequate with regard to the importance of agriculture in terms of GDP and jobs[63];
- Laissez-faire and open market principles, exacerbated by globalization and the Economic Partnership Agreements, accelerate the decapitalization of small farms;
- Crop production is season-dependent (especially to rainfalls), and the level of dependence increases from south to north (Guinean zone > Sudanese zone > Sahel).

But small farms also have resilience capacity that has allowed them to survive past crises:

- Small-scale farmers are generally "risk-adverse" and use risk-management practices (e.g., crop associations: cowpea/millet, rice/maize, Bambara bean/peanut/yam);
- Rural activities are generally diversified: agriculture, forestry, livestock, NTFP harvesting, hunting, fishing;
- Other activities are also common: small commercial business, craft, etc.;
- Money transfers are common, either domestically (urban/rural) or internationally (south/south, e.g. Sahel migrants working in the coastal countries or north/south for most countries. Transfers are very developed in some areas: Sarakolés of the Kayes Region in Mali, Peulhs in Fouta Djallon in Guinea, etc.).

West African smallholders' vulnerabilities and resiliencies

In short, family farms are highly vulnerable to the impacts of climate change because of the socio-economic and physical environments in which they operate. They have demonstrated significant capacity for resilience, however, during past crises: (e.g., conflicts and wars, the disruption European colonization, significant droughts of the 1970s, etc.)

3. The nine main types of adaptation measures in the agriculture sector

Of 217 NAPA projects examined across 18 countries, 195 (90%) can be considered agriculture adaptation projects. These projects represent about 97% of the total NAPA budgets. Using weighting criteria, the main types of adaptation measures can be identified as follow: cross-cutting (27%), water (23%), crops (11%), forestry (9%), livestock (8.5%), coastline (6%), energy (6%), food (5%), and fishing (3%).

The rationale and measures for each type are described below with three examples of NAPA projects (identified by host country and its NAPA project number):

62 The Training and Visit (T&V) extension system was promoted by the World Bank in 1975-98 in over 50 developing countries.

63 African Union (AU). Maputo Declaration on Agriculture and Food Security in Africa. AU. July 2003. 2p

CROSS-CUTTING

Rationale: These projects seek to overcome the following cross-cutting challenges: (i) Observation/warning systems on climate change and natural resources (monitoring of sea level, rice yields, rainfall, etc.) are non-functional because of the lack of equipment, funding, and qualified human resources; (ii) Capacity for prevention of and response to extreme weather events is low due to factors such as the lack of NICTs and IEC; (iii) Capacity for planning/implementation of adaptation strategies is low at the household level (due to lack of capacity-building training, alternative income generating activities), community level, and state level. **Measures:** (i) observation of climate, water resources, sea level, (ii) strengthening of institutional capacity (government and local institutions), (iii) capacity building and technical training of farmers, and rural populations in general, (iv) IEC for the general public, (v) development of alternative income generating activities (to compensate for declines in production and/or income in the agricultural sectors). **Examples:** Promotion of community-level NRM (Mali, #12); Large-scale diffusion of UNFCCC objectives and IPCC findings (Senegal #8); Support to women farmer groups in accessing land titles (Niger #6).

WATER

Rationale: Droughts have been observed in the Sahel since the 1970s. Agricultural activities take place at the limits of of possibility in Sahel and Sahara zones. Water shortages are worse in these areas, and water problems are now spreading to the coastal countries: (i) erratic rainfall and lower rainfalls, more frequent droughts or floods, rising evapotranspiration) and/or insufficient or degraded hillside storage reservoirs, (ii) decreased water availability and/or fluctuating availability in time, (iii) declining productivity/plant production: shift of growth period or shorter periods of growth, opportunistic diseases because of bad growth, production is impossible for some photoperiodic varieties (often dominant on-farm). **Measures:** Maintenance of the availability of agricultural water, needed to maintain rain-fed agriculture, and development of irrigated agriculture(in rainy-season or even dry-season): (i) hydro-agriculture facilities: construction of very simple structures (e.g.zaïor hillside storage reservoir) to more elaborate ones (e.g. dams/irrigated areas with full water management, drip), (ii) capacity-building in water management: promotion of irrigated agricultural systems. **Examples:** Trapping runoff water by planting fodder trees or shrubs, e.g. Acacia Senegal (Sudan #2), Supporting community water management Committees (Eritrea #4), developing flood recession agriculture, with river diversion structures and/or mounds of earth retaining water a little longer at the end of the wet season (Eritrea #2 and #5).

CROPS

Rationale: Weather conditions are harsh and aggravated by climate change: strong sunlight, high temperatures, low or erratic rainfalls, causing disruption of vegetative cycles, water stress, depletion of groundwater and emergence of diseases (rust, whitefly, etc.). It is sometimes aggravated by the erosion of genetic resources and, in coastal areas, sea level rise causing salinization, mangrove degradation and loss of agricultural land. It is often aggravated by unsustainable farming techniques: slash-and-burn practices with shorter fallow, use of poor quality seed, export of straws that deplete the soil organic matter, etc. Techniques and adapted species exist but are not widely distributed. Farm inputs (seeds, tools, etc.) are poorly accessible. Water and wind erosion result in soil stripping, declining fertility and siltation of irrigation canals. As a result of all these factors, crop/fodder production decrease, leading to food insecurity, poverty, and displacement of population. **Measures:** Maintenance of "traditional" slash-and-burn/extensive livestock farming systems with the (i) promotion of agroforestry or the (ii) promotion of soil management techniques (seeding under crop cover, mulching, etc.), or (iii) promotion of new farming systems with the diffusion of new species and/or

Traditional cultivation practices using flood irrigation are widely applied in Guinean for water and nutrient management, such as the elevated cabbage mounds shown here.

varieties and/or rotations and/or associations. **Examples:** Recovery of salty soils ("tannes") with anti-salt dikes and salt-tolerant plants (Senegal #2 and #3), Promotion of farming systems (e.g. lowland rice, rain-fed soya) alternative to slash-and-burn (Liberia #1), Promotion of drought resistant crops, like pearl millet (Guinea #8).

FORESTRY

Rationale: Forest and woodland ecosystems are under increasing pressures: (i) anthropogenic ones: slash-and-burn farming, overgrazing, harvesting of firewood and timber, forest fires (favored by climatic conditions), etc. accelerating with population growth, (ii) climatic ones: droughts and high temperatures increasing water stress and the spread of forest fires, degradation of mangroves with sea level rise and salinization, fungal attack favored by climate change. These pressures are aggravated in savannah dry forest by the low forest growth. Overall, for all types of forest, laws are often not well designed or enforced. **Measures:** Maintenance of forest soil fertility, firewood and timber supply, NTFP production through: (i) promotion of sustainable forest management, (ii) afforestation/reforestation, (iii) forest fire fighting techniques. **Examples:** Community afforestation (Sierra Leone #18), Hedgerows with tree fodder species (Senegal #1), Creation and training of community-level forest fire fighting committees (Guinea #12)

LIVESTOCK

Rationale: Climate change, together with the population growth, lead to lower crop and fodder yields and/or the reduction of grazing land areas. This lead to insufficient feed, especially during the dry season, for the meat production, sometimes even for the simple maintenance of animals. In reaction, there are overgrazing and/or pruning of trees and/or transhumance (from the Sahel strip to the Sudanese strip) and/or concentration and trampling around water points and/or livestock inadequately fed and subject to diseases and/or collection of straw and/or decreased production of manure. These factors can also lead to breeders/farmers conflicts and/or degradation of natural resources (grazing land, soils, pastures, forests, water) and/or invasion of opportunistic species (e.g. Prosopis juliflora). **Measures:** Maintenance of animal feeding through: (i) promotion of fodder or (ii) promotion of food supplements, and (iii) adaptation of domestic animal breeds to climate change. **Examples:** Creation of improved grassland with selected seeds, e.g. bourgou, cowpea, pigeon pea (Mauritania #1, Mali #2), Creation of secured transhumance corridors (Mauritania #3), Creation of food banks to distribute cottonseed, groundnut cake, bagasse, brewer's spent grains (Chad #9, Mali #17, Niger #2).

COASTLINE

Rationale: Sub-Saharan populations have settled on the coastlines for centuries, progressively degrading marine and terrestrial ecosystems, as a result of multiple human activities: overfishing; deforestation for firewood harvesting, rice cropping, fish smoking, fuel-based evaporation for salt production, etc.; extraction of sand/gravel; creation of structure; chemical pollution (agricultural or industrial waste), etc. These effects are now worsening with climate change: sea level rise, salinization, etc. leading to the degradation or destruction of structure and ecosystems, including mangroves, a decline in fishing (fish, shellfish, etc.) and cropping, themselves leading to increasing poverty and/or food insecurity and/or rural exodus. **Measures:** Protection of the coastline and its ecosystems (dunes, mangroves, mangrove rice fields, etc.) against sea level rice and salinization. There are no subcategories here, because all the projects are integrated (with most of the time: alert system/IEC/IGAs/reforestation). **Examples:** Design/implementation of integrated management plans for coastal areas (Senegal #17, Benin #5), Stabilization of coastline with groin systems and afforesta-

tion with casuarina, eucalyptus, coconut, etc. (Gambia #9, Guinea Bissau #3, Senegal #7), Improvement of wood energy supply (supply schemes, dissemination of improved cook stoves, solar fish smoking techniques, solar salt production techniques. (Benin #5, Senegal #7).

ENERGY

Rationale: Pressures on forest and woodland ecosystems are increasing because of (i) human activities: slash-and-burn farming, harvesting of firewood for cooking, fish smoking, brick cooking, salt production (boiling salted water…with low energy efficiency rates, etc. exacerbated by population growth, (ii) climate change: droughts and high temperatures increasing water stress, sea level rise, and salinization in mangroves areas. Wood energy supply is threatened, time spent for firewood harvesting is increasing, and unsustainable firewood harvesting aggravates environmental damages: local climate disruption, loss of soil fertility, coastal erosion, loss of income sources (timber and NTFPs). **Measures:** (i) Demand-side: increase energy efficiency (for charcoal production, for cooking, etc.), (ii) Supply-side: increase biomass production through afforestation or promote alternative sources of energy to firewood. **Examples:** Fast-growing species plantations for energy production (Benin #2, Mauritania €22), Promotion of solar energy: water heater, pressure cookers, dryers (Benin J2, Burkina-Faso #12, Senegal #8, Mali #10), Promotion of compressed earth brick to replaced cooked brick (Guinea #7).

FOOD

Rationale: Sahelo-Sahara and Sahara fringes are structurally deficient in cereals. The high growth of population and the slow growth of productivity gains exacerbate this problem for the past decades. Climate change now adds to the food insecurity: slow onset events (sea level rise, reduced rainfall and increased variability, increased temperature, etc.) and extreme weather events (floods, droughts, etc.) leads to lower productivity/production of livestock and/or crops. Food crises are not mitigated, because food security policies are often built on two (2) weak pillars: (i) inefficient agricultural market information systems, (ii) inadequate, or even inexistent, emergency food stocks. This leads to increased poverty and/or food insecurity and/or rural exodus, and sometimes to loss of human life. **Measures:** (i) Design/implementation of food warning system, (ii) creation of emergency food stocks, (iii) food diversification. **Examples:** Promotion of tubers (cassava, yam, sweet potato) in substitution of mangrove rice (Guinea Bissau #1), Promotion of poultry farming/fish farming integrated systems (Togo #6), Creation of cereal banks (Burkina-Faso #1, Mali #5, Niger #9).

FISHERIES

Rationale: Marine coastal areas are rich in fish, attracting many fishers, who are often not respecting environmentally-friendly fishing rules (regulatory net, ban on certain species, etc.). This is further aggravated by pressure on spawning areas (mangroves and other wetlands), either due to human activities (firewood harvesting, use of pesticides, etc.) or climate change (sea level rise, salinization, etc.). In deep sea, the increased atmospheric CO2 concentration leads to acidification of seawater, change of laminar flows, disruption of upwelling, and finally decreasing of plankton. Climate change also impacts inland fisheries (drought, eutrophication, etc.) resulting in decreasing fish production, lower incomes and food insecurity. **Measures:** (i) Strengthening evaluation, monitoring, and control of fish stocks in coastal areas or in the deep sea, (ii) strengthening evaluation, monitoring, and control of natural fish stocks in inland fisheries, and promoting fish farming. **Examples**: Evaluation and monitoring of fish stocks in the coastal area (Sierra Leone #5), Construction of aquaculture ponds (Togo #7).

4. Have Sub-Saharan NAPAs promoted the deployment of CSA practices?

According to the Concept note presenting the rationale for the CSA Forum held in May 2014, four conclusions can be drawn from the implementation of Sub-Saharan NAPAs, which suggests NAPAs are not actively promoting the deployment of CSA practices (Rural Hub, 2014):

The landscape of climate finance in Sub-Saharan Africa is changing: Funding for mitigation is gradually climbing (61%, including 14% for REDD+), at the expense of funding for adaptation (39%) (ODI & HBS, 2011).

Early warning systems are a focus: Field activities tend to receive less funding than activities focused on early warning systems, which have recently become dominant in projects approved by climate funds.

The NAPA process follows a project approach: Countries are struggling to build on the achievements of their projects, contributing to the isolated nature of the actions.

Project efficiency: The projects related to agriculture have not been sufficiently effective and efficient, considering their results and impacts.

Status of NAPAs in Africa

In short, NAPAs are underfinanced, especially in terms of field activities, and they are difficult to upscale. And, first and foremost, projects are not really successful: much is still to be done to promote CSA activities in West Africa.

d) Adaptation to climate change and CSA in Guinea

Below we review the different strategies and policies of the GOG related to adaptation to climate change, on the one hand, and to agriculture, on the other, to assess where Guinea stands in terms of adaptation of agriculture to climate change.

1. Guinea's NAPA[64]

Guinea's NAPA was developed in 2006 and 2007. The selection of priorities was a complex process. Public consultations were held, and 53 project ideas were identified as follows: water–5; livestock–10, forestry–11, coastline–13, crops–14.

A synthesis report of the public consultations proposed to group similar project ideas into 13 main projects. Then, four successive multi-criteria analyses took place, using seven weighted criteria. The final classification was based on average scores resulting from the analyses. The first six criteria and their relative weights were determined during stakeholder workshops: (i) ability to ensure adaptation to climate change (weight = 23%, scoring from 1 to 5), (ii) local conditions favorable to the realization of the project (weight = 21%, scoring in %), (iii) environmental impact (weight = 12%, scoring from 1 to 5), (iv) socio-economic impact (weight = 14%, scoring in %), (v) consistency with GOG strategies and policies (weight = 12%, scoring from 1 to 5), (vi) cost (weight = 8%, scoring in US$). A seventh criterion, (vii) synergy with multilateral

64 Minister of Agriculture, Livestock, Environment, Water, and Forestry (MAEEEF). National Adaptation Plan of Action of Guinea. GOG. July 2007. 118p

environmental agreements (weight = 10%, scoring from 1 to 5), was identified by NAPA experts. Ten project ideas were retained with limited explanation: "the NAPA team, after consultation, deems it possible to develop NAPA project profiles for the first ten options." Nevertheless, for reasons that were unclear, 25 project ideas were presented in the NAPA.

Of the 25 projects, 22 can be classified as adaptation of agriculture to climate change. The other three are related to the provision of drinkable water (#18 - Creation of improved wells, #19 - Purification of surface water by Hydropur, and #20 – Creation of impluviums). The 22 projects total $7,335,000, which is 89% of the total NAPA budget.

The level of implementation of the NAPA has been slow. The 22 agriculture-related projects include projects in each of the nine categories, as shown in Table 4:

Table 4. Guinea NAPA adaptation projects related to agriculture (NAPA, 2007)

#	Project Title	Type	Budget (US$)
#1	Support to the development of private and community-based cashew nut plantations (pp. 41-42)	Forestry	600,000
#2	Support to the creation of community-forest management plans (pp. 42-43)	Forestry	600,000
#3	Promotion of indigenous knowledge and practices in terms of adaptation (pp. 44-45)	Transversal	300,000
#4	Initiation of coastal populations to the technique of oyster farming mangrove (pp. 45-46)	Coastline	250,000
#5	Extension of anti-erosion techniques (pp. 46-47)	Crops	300,000
#6	Promotion of solar energy to reduce firewood consumption (pp. 48-49)	Energy	300,000
#7	Promotion of compressed brick to replace cooked bricks (pp. 49-50)	Energy	600,000
#8	Promotion of pearl millet cropping in the Northern areas (p. 51)	Crops	350,000
#9	Promotion of solar salt production to reduce firewood consumptions (p. 52)	Energy	200,000
#10	Promotion of chainlink fencing and hedgerows in Moyenne Guinée (pp. 53-54)	Livestock	350,000
#11	Setting up an early warning system to secure food production (pp. 54-55)	Transversal	150,000
#12	Promoting forest fire fighting techniques and forest reservation measures (pp. 55-56)	Forestry	300,000
#13	Protecting cropping areas on the coastline (pp. 57-58)	Coastline	350,000
#14	Public outreach on international and national environmental regulations (pp. 58-59)	Transversal	300,000
#15	Information, Education and Communication for rural populations on the coastline (pp. 59-60)	Coastline	200,000
#16	Creation of multi-functionnal wells (pp. 61-62)	Water	600,000
#17	Creation of hillside storage reservoir (pp. 62-63)	Water	180,000
#21	Protection of spawning areas in the Fatala, Konkouré and Méllacoré estuaries (p. 66)	Fisheries	250,000
#22	Promotion of irrigated rice cropping in Moyenne-Guinée and Haute-Guinée (pp. 67-68)	Water	300,000
#23	Promotion of small ruminants rearing (pp. 68-69)	Food	325,000
#24	Promotion of vegetable gardening (pp. 69-70)	Food	250,000
#25	Creation of grasscutter ranches to limit forest fires and improve rural livelihood (pp. 71-72)	Forestry	300,000

NAPA projects in Guinea

Three projects each in forestry and energy: Because most of six projects of these two types aim to reduce firewood consumption and deforestation, they might seem more related to mitigation than adaptation. This corroborates the idea that confusion about the causes and consequences of climate change exists among key stakeholders, as well as the belief that stopping deforestation in Guinea could bring the global climate system back into balance.

One livestock project: Guinea is a country of highly developed animal husbandry, mainly dependent on rain-fed grazing land. During the dry season, herds located mainly in Moyenne-Guinée and Haute-Guinée are more often displaced to the southern part of Moyenne-Guinée or Haute-Guinée, or even to Guinée forestière and Basse-Guinée. Fodder availability is an issue, as are water availability and increasing animal pests. It is surprising that adaptation of livestock farming to climate change is not higher on the agenda.

Two crops projects: Most food crop production in Guinea is rain-fed and based on slash-and-burn techniques. Most important in terms of volume is rain-fed rice, followed by maize (especially in Haute-Guinée and Guinée forestière), fonio (especially in Moyenne-Guinée and Haute-Guinée), and cassava (everywhere, especially on degraded soils). These farming systems are vulnerable to (i) water shortages (erratic and/or insufficient rainfall) and (ii) soil degradation (reduction of fallow period, loss of fertility, degradation of the soil texture, and erosion). No project addresses these two issues.

2. Agriculture strategies and policies: NLPDA, SNDR, and PNIASA

The GOG has three primary ongoing agriculture strategies and policies:

NLPDA[65]: The 2006-2015 New Policy Letter on Agricultural Development (*Nouvelle lettre de politique de développement agricole 2006-2015*– NLPDA) is a logical follow-up to the 1991-1997 Policy Letter on Agricultural Development (*Lettre de politique de développement agricole 1991-1997* – LPDA1) and the 1998-2005 Policy Letter on Agricultural Development (*Lettre de politique de développement agricole 1998-2005* – LPDA2);

SNDR[66]: The 2009-2018 National Rice Development Strategy (*Stratégie nationale de développement de la riziculture 2009-2018* – SNDR);

PNIASA[67]: The 2012-2016 National Agriculture Investment and Food Security Plan (*Plan national d'investissement agricole et de sécurité alimentaire*- PNIASA) fits into the framework of the ECOWAS Agricultural Policy and the CAADP adopted at the 2003 Summit of the African Union in Maputo (Mozambique).

DSRP3 2013-2015[68]: The Third Poverty Reduction Strategy Document (*Document stratégique de réduction de la pauvreté*).

Below we assess how each policy or strategy addresses the issue of agriculture adaptation to climate change.

65 Ministry of Agriculture, Livestock, Environment, Water, and Forestry (MAEEEF). 2006-2015 New Policy Letter on Agricultural Development. GOG. May 2007. 56p

66 Ministry of Agriculture and Livestock. 2009-2018 National Rice Development Strategy. GOG. May 2009. 27p

67 Ministry of Agriculture. 2012-2016 National Agriculture Investment and Food Security Plan. GOG. September 2011. 104p

68 Ministry of Economy and Finance. 2013-2015 Poverty Reduction Strategy Document. GOG. May 2013. 170p

2006-2015 NLPDA

The NLPDA is composed of three main strategic axes: (i) support food security through the diversification and increase of food production, (ii) increase agriculture revenue through agriculture exports, and (iii) support cross-cutting measures to secure agriculture investments.

As part of the third axis, activity 6.3.1 is about the "*improvement of NRM*" but mentions neither climate change nor adaptation to climate change and focuses mainly on the protection of forests. Still in the same axis, activity 6.3.5.4 is about the "*prevention and management of major agricultural risks*." It mentions the creation of early warning systems and insurance mechanisms, but not climate change or adaptation to climate change.

2009-2018 SNDR

The SNDR reviews the importance of the rice sector in Guinea: It is a main food crop (61% to 69% of daily consumption in 2008, depending on the agro-ecological regions), with an increasing level of consumption (from 92 kg/capita in 1992 to 100 kg/capita in 2008) and an increasing share of the total value of imports (from 5.4% in 2000 to 11.3% in 2008; in 2008, 0.30 Mt/year of rice were imported, which is 26% of domestic consumption of 1.15 Mt/year). The SNDR also details the main rice farming systems, summarized in Table 5.

Table 5. Average yield, surface, production, and main locations per rice farming system in 2008 (SNDR, 2009)

Rice farming systems	Aver. yield (t/ha)	Surface		Production		Main locations
		ha	%	t	%	
Irrigated plains	1.5	74,912	9%	112,368	9%	Haute-Guinée, Gaoul & Koundara
Mangrove	2.5	133,177	16%	332,942	28%	Coastline
Lowland	2	83,236	10%	166,471	14%	Everywhere, mostly Guinée Forestière
Rain-fed	1.1	541,031	65%	595,134	49%	Everywhere
Total (paddy)	**1.45**	**832,355**	100%	1,206,915	100%	

The table highlights the fact that most of the production (more than 3/4) takes place in two vulnerable farming systems: mangrove rice (sea level rice, salinization, acidification, iron toxicity, etc.) and rain-fed rice (erratic and/or reduced rainfalls, soil degradation, etc.). The SNDR forecasts an increase in domestic need (expressed in tons of white rice) from 1.20 Mt/year in 2013 (for 12 million inhabitants) to 1.43 Mt/year in 2018 (for 14 million inhabitants). It therefore sets an ambitious goal for achievement by 2018: meet domestic need and produce a surplus of 0.45 Mt/year (domestic production = 132% of domestic need), which implies nearly doubling average rice yields of 1.43 t/year/ha in 2008 to 2.75 t/year/ha in 2018.

To achieve this goal, the SNDR has four main strategic objectives: (i) create 160,000 ha of irrigated rice fields, with full water control, in Basse-Guinée (40% of existing lowland in mangrove and inland areas) and Haute-Guinée (40% of the alluvial plains along the Niger and its tributaries), (ii) rehabilitate 20,000 ha of lowland with a diversification aim (rice cropping, vegetable gardening, fish farming), (iii) promote rain-fed rice through the wide dissemination of NERICA, and (iv) improve access to agricultural inputs and equipment.

Climate change issues are not mentioned in this SNDR, yet climate change impacts are major threats to it achievement. Indeed, as mentioned earlier, the mangrove area is already subject to sea level rise, salinization, acidification, iron toxicity, and more. Creating hydro-agriculture facilities is not enough; rice breeds have

to be selected according to their resistance to salt, acidity, and iron toxicity, and the cropping calendar has to be revised according to the late appearance and early disappearance of rainfalls. Rain-fed rice is highly vulnerable to erratic and/or limited rainfall. Using NERICA seed, known to be more drought-resistant, is not a silver bullet; these rice seeds have the ability to produce a minimum yield, but the yield might decrease sharply in water stress conditions. Practically, the use of NERICA seed should come with other measures to increase water harvest and limit evapotranspiration (e.g., agroforestry practices, seeding under crop cover, etc.), as well as to increase the efficiency of chemical fertilizers (e.g., measures to increase organic matter content, such as mulching, rotations with grain legumes, and crop associations).

DSRP3 2013-2015[69]

Climate change is seldom mentioned across the 170 pages of the Poverty Reduction Strategy Document (*Document stratégique de réduction de la pauvreté* - DSRP3):

"Major challenges for the economic take-off and progress towards the MDGs relate to [...] (viii) the adaptation to/mitigation of climate change." Adaptation and mitigation are placed at the same level, unlike in many LDCs where mitigation is far behind in terms of priority.

Also, "It will be important, among other things: (i) to enforce strict application of the rules on restoration of degraded areas, (ii) to promote intensive agriculture and the use of renewable energy (gas, electricity, and photovoltaic), and (iii) to increase the involvement of women in decision-making regarding the protection of environment." The first two measures proposed implicitly refer to the reduction of deforestation and forest degradation: (i) reforestation and revegetation on former mining sites, (ii) limiting of slash-and-burn farming and unsustainable firewood harvesting.

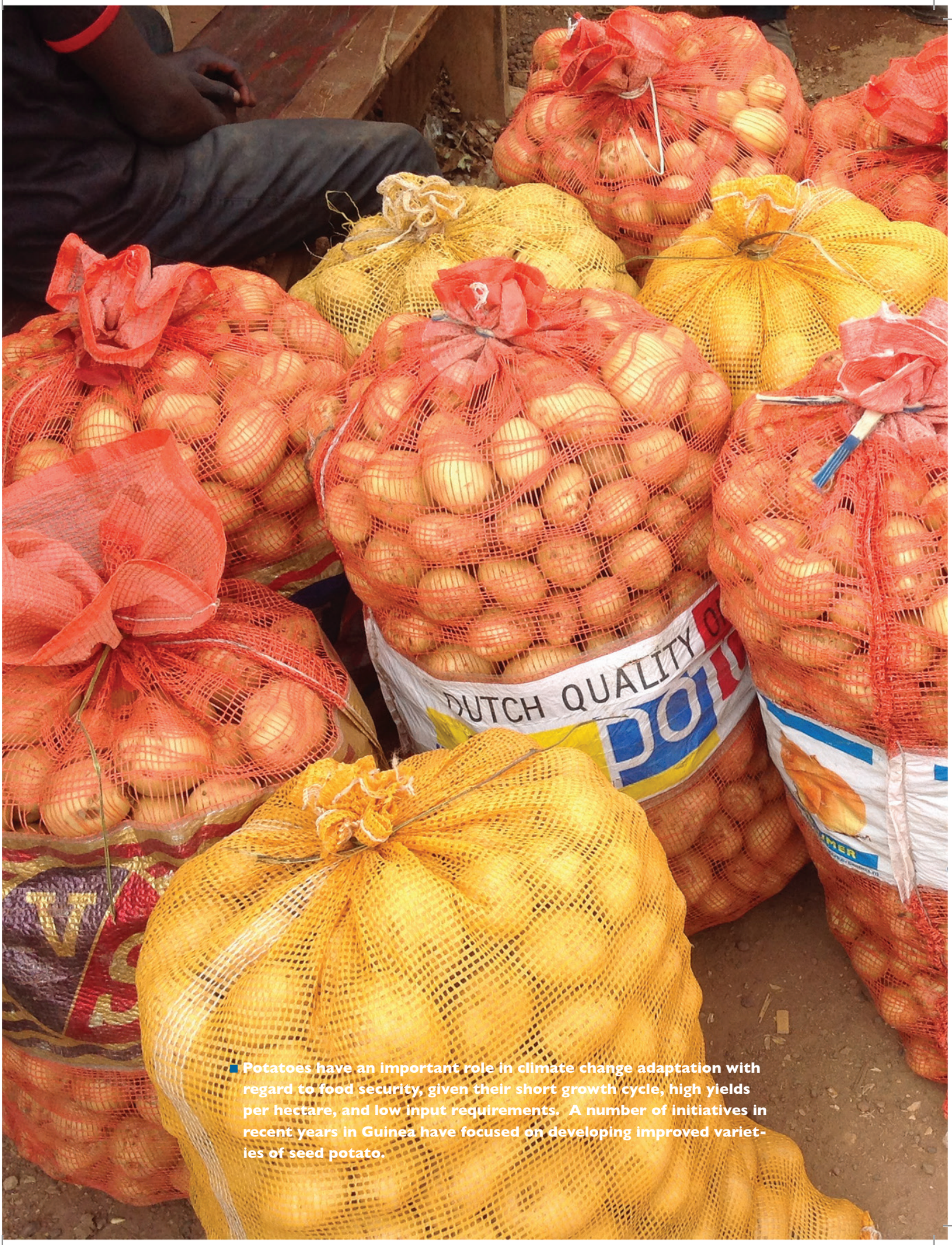
"The foreseen adaptation programmes are under-financed and a small number of farmers adopt intensive agriculture practices (use of chemical fertilizers, improved seed, and mechanization)." This sentence clearly demonstrates the confusion between two very different concepts: CSA and input-intensive agriculture. CSA aims at:

- Increasing agriculture revenue (producing as much or more while stabilizing or decreasing production costs);
- Mitigating climate change (minimizing N2O emissions from the use of chemical fertilizers, and minimizing CO2 emissions from agricultural engines, soils or forests degradation);
- Adapting practices to climate change (using robust and resilient seed, water harvest techniques, soil fertility management techniques, etc.).

On the other hand, input-intensive agriculture may lead to contrary results:

- Agriculture revenue: using chemical fertilizers and mechanization are often not possible for farmers (lack of suppliers, high cost of inputs, especially for chemical fertilizers in a context of rising oil price) or advisable if production costs have to be kept under control;
- Mitigating climate change: the use of chemical fertilizer alone, without appropriate water and organic matter management, does not sustain soil fertility in the long term and leads, sooner or later, to a shift back to slash-and-burn practices. Chemical fertilizers and mechanization lead to increased N2O and CO2 emissions *(Note: even if marginal compared to CO2 emissions from soils and forests degradation);*
- Adapting to climate change: input-intensive farming techniques do not necessarily lead to sustainable NRM (i.e., soil fertility degradation in the absence of supply of organic matter) and are dependent on foreign exports, which is a problem in countries like Guinea that are politically unstable and have a degraded business climate.

69 Ministry of Economy and Finance. 2013-2015 Poverty Reduction Strategy Document. GOG. May 2013. 170p



Potatoes have an important role in climate change adaptation with regard to food security, given their short growth cycle, high yields per hectare, and low input requirements. A number of initiatives in recent years in Guinea have focused on developing improved varieties of seed potato.

2012-2016 PNIASA

The PNIASA merges elements from the 2006-2015 NLPDA and the 2009-2018 SNDR and also takes into account regional and sub-regional guidance provided by the CAADP and the ECOWAS Agriculture Policy. The PNIASA has six main strategic programs: (i) sustainable development of the rice sector, (ii) food crop diversification and increase of food security, (iii) promotion of agriculture exportation, (iv) promotion of sustainable NRM, (v) strengthening of agriculture support services and farmer organizations, and (vi) coordination and implementation of the PNIASA.

Under Program 4 - Promotion of sustainable NRM, two sub-programs are relevant in terms of adaptation to climate change:

- 4.5 - Soil fertility improvement. Explanations are limited to a statement that the GOG has a "Plan for Soil Fertility Management" approved since 2001, but never implemented;
- 4.7 - Climate change. Various activities are planned: (i) determine the most appropriate soil moisture management techniques, (ii) improve soil fertility by improving fallow and planting legumes, (iii) select drought-resistant breeds and develop irrigated crops in areas north of the 10th parallel, (iv) intensify cereal production in Guinée Forestière and Basse-Guinée, where climatic conditions are still favorable, (v) use agro-meteorological forecasting to plan agricultural operations and better adapt to changing climatic conditions.

Sub-program 4.7 is interesting because, unlike NLPDA and SNDR, it provides clear (if limited) guidance in terms of adaptation of agriculture. However, as demonstrated during interviews with key stakeholders, these planned activities are not yet implemented or even known or understood by the stakeholders in charge of their implementation.

Climate Change Adaptation in Current Guinean Agriculture Strategies

Of the four documents reviewed, only the PNIASA and the DSRP3 address climate change in a substantive way. The DSRP3 addresses it in a counter-productive way, however, by merging adaptation with input-intensive agriculture, approaches that are in direct contradiction with each other. On the other hand, although the PNIASA addresses the absence of climate change in previous strategies, key stakeholders responsible for implementing the PNIASA strategy through climate change adaptation-related Program 4 have not received adequate guidance to do so. Thus, little has happened to date.

3. Towards a national definition of CSA and climate-smart AET?

Designing and implementing CSA must overcome challenges by: being "farming-system" specific, optimizing the three pillars of mitigation, adaptation, and livelihood and taking into account inevitable trade-offs, and integrating agriculture/NRM outreach activities to guide farmers. Thus it might be more relevant to adapt the internationally accepted definition of CSA at the "farming-system" level, rather than the national level. "Farming-system" specific CSA strategies and the corresponding CSA AET could be defined in four steps as follows.

Defining climate-smart AET in Guinea

Step One: Identify farming system per agro-ecological areas. As discussed earlier, FAO provides a classification of the main farming systems in Sub-Saharan Africa. Two of them cover most of Guinea: cereals and tubers (#8) in northern Guinea, and tubers (#7) in southern Guinea.

However, the definitions of these farming systems are too broad: Defining more specific farming systems for each agro-ecological region would be worthwhile (e.g., savannah in Haute-Guinée, moist forest and savannah/moist forest mosaic in Guinée Forestière, hilly savannah and rangeland in Moyenne-Guinée, and mangrove/savannah in Basse-Guinée). Two or three of the most representative farming systems in each agro-ecological area could be identified, e.g. in Basse-Guinée: mangrove rice based farming system (with fishing and/or small ruminant rearing and/or salt production), rain-fed rice based farming system (with dry-season gardening in lowland and/or small ruminant rearing and/or fruit tree production: cashew, banana, etc.)

Step Two: Assess vulnerability and resilience of each specific farming system. The assessment would draw on the most up-to-date climate projections (UNDP projections, IFPRI, projections, etc.), as well as information on current levels of vulnerability (determined through a field assessment), to forecast the levels of vulnerability and resilience of each farming system.

Step Three: Design appropriate CSA strategies and techniques. Design optional CSA strategies and related CSA techniques to address each of the three pillars. The designs would be based on the forecast of vulnerability and resilience, and knowledge of CSA techniques available for farmers, (e.g. simple enough, technically sound, cost-efficient, etc.). Optional CSA strategies, incorporating current good practices, are assessed, tested, evaluated and adopted with existing farmers/producers that are managing variability and adaptation.

Step Four: Design/implement climate-smart AET. Once two to three specific farming-system CSA strategies are identified per agro-ecological area, the corresponding AET curricula could be designed and implemented. AET training must include capacity to quickly analyze and address constraints at the community/producer level within each strategy.

Presented below are two concrete examples of CSA strategies (and the corresponding techniques) identified in the northern Ivory Coast for two farming-systems: the rain-fed rice based farming system and yam based farming system. The identification took place after the two first steps of identifying farming systems with the National Agriculture Research Centre of Ivory Coast, and forecasting vulnerability/resilience based on climatic projections issued by the International Centre for Tropical Agronomy in Cali, Colombia.[70]

Example 1: Rain-fed rice based farming system. The main features of the farming systems are as follows:

Traditional rain-fed rice cropping: slash-and-burn on degraded savannah with reduced fallow (low fertility), use of local seed (often mixed, average cycle of 5 months), broadcast seeding, no fertilizer (organic or chemical), and one weeding. The average yield is around 0.8 t/ha/year.

Strategy for climate smart rain-fed rice cropping system: limited slash-and-burn with longer fallow, use of selected seeds (IDSA 6or10 or 78 or 85, NERICA1 or 2/pure/cycle of 3 months), dibbling (for better tilling and easier weeding) under N-fixing crop cover (pueraria), fertilizer (50 Kg/ha of NPK, in addition to the pueraria organic matter), and three weedings. The yield ranges from 2 to 3.5t/ha/year, but the lower range is used in our calculation below.

70 SalvaTerra. Cost-Benefit Assessment of REDD+ Activities implemented for the main Food Crops and Cash Crops in Ivory Coast. European Forest Institute. January 2014. 139p

Valuing the labor force at 800 FCFA/man-day ($1.5/man-day), the net margin is -10,300 FCFA/ha/year (-$22/ha/year, which can be explained by the fact that farmers do not usually value their labor costs) for traditional rain-fed rice cropping, and 62,150 FCFA/ha/year ($130/ha/year) for climate smart rain-fed rice cropping. In terms of livelihood, the difference is substantial: around +$150/ha/year and +$1.2 t/ha/year.

In terms of adaptation, the climate smart rain-fed rice cropping system has many advantages, including: (i) the use of crop cover optimizes the use of water and chemical fertilizer (strengthened clay-humus complex) by the plant, and (ii) the use of short-cycle and drought-resistant rice seed allows avoidance of water stress in case of earlier end of rainfalls and/or reduced rainfalls during the whole cycle.

In terms of mitigation, the improvement of soil fertility leads to decreased slash-and-burn, which in turn allows avoidance of GHG emissions from soils and forests.

Example 2: Yam based farming system. The main features of the farming systems are as follows:

Traditional yam cropping: slash-and-burn on degraded savannah with reduced fallow (low fertility flash), use of local varieties (and degeneration due to reversed mass selection: large tubers are eaten and small ones replanted), no stake, no fertilizer (organic or chemical), and one weeding. The average yield is around 6.5 t/ha (including 20% in post-harvest losses because of inadequate harvest and storage practices).

Strategy for climate smart yam cropping system: limited slash-and-burn with longer fallow, use of selected varieties (from Nigeria or Ivory Coast, mass selection: some large tubers are planted, large and medium tubers are sold or eaten, small tubers are processed in yam chips), stakes, N-fixing crop cover (pueraria), fertilizer (290 Kg/ha of NPK, in addition to the pueraria organic matter), and three weedings. The yield ranges from 20 to 25 t/ha/year (including reducing post-harvest losses to10% through appropriate harvest techniques to avoid damaging tubers, storing in underground pits covered with leaves and earth rather than outdoors, regularly removing sprouts during storage, transforming damaged tubers into chips just after harvest).

Valuing the labor force at 800 FCFA/man-day ($1.5/man-day), the net margin is -597,000 FCFA/ha/year (-$1,250/ha/year, which can be explained by the fact that farmers do not usually value their labor costs) for traditional yam cropping and 1,564,000 FCFA/ha/year ($3,270/ha/year) for climate smart yam cropping. In terms of livelihood, the difference is substantial: around +$4,520/ha/year and +13.5 t/ha.

In terms of adaptation, the main advantage of the climate smart yam cropping system is to optimize the use of water and chemical fertilizer (strengthened clay-humus complex) by the plant, thanks to the crop cover. In terms of mitigation, the improvement in soil fertility leads to decreased slash-and-burn, which in turn allows avoidance of GHG emissions from soils and forests.

IV. Institutional Capacity to Integrate Climate Change Into AET

The section below summarizes data collected by the Baseline Study team through a survey of AET stakeholders and key informant interviews.

a) GOG institutions and donors

Extension agencies responsible for providing information, technologies, and good practices to farmers are delivering technical packages that have not been upgraded and updated within the context of climate-smart AET. Furthermore, the agencies lack institutional linkages with those who would be expected to develop the information, technologies and good practices: AET institutions.

The ministries involved in rural agricultural development and food security generally lack a substantive awareness of the possible impacts of climate change on their respective sub-sectors, and have not prepared actionable adaptation measures to date. They lack basic data on reserves of food, fodder, inputs, fertilizer, and animal health supplies that are necessary to undertake adaptation planning.

The ministries involved in environmental management suffer from unclear lines of responsibility for climate change among departments, creating bureaucratic delays in designing and implementing strategies, policies, and projects. The staff has a low level of technical understanding of adaptation with regard to agriculture. Adaptation/mitigation measures are scarce and now outdated. Sustainable management of forests is not yet fully realized, even in Guinée Forestière, where mobile and industrial sawmills are active. In a number of cases, staff members are conflating causes and consequences of climate change and do not grasp the universal nature and irreversibility (in the short to medium term, at least) of climate change, and reforestation is viewed as an adequate solution to bring the system back to equilibrium in the short term. In that context, the need for long-term adaptation is not identified.

The National Directorate of Meteorology has valuable meteorological data dating back to 1897, but the old data have deteriorated and have never been compiled or analyzed. Data for 1961-1990 were compiled and analyzed with ClimCom, and data for 2001-2010 were compiled and analyzed with Excel. To have a complete and coherent historical data record, there is an need to collect and compile the data into a single software. In terms of climate projections, the directorate uses the ENSEMBLE and CORDEX Programs, but has not yet been able to produce a country-specific scenario. In terms of data collection, most of the "agro-meteorological" stations appear to be off duty, and only basic meteorological data are recorded with "synoptic" stations.

Donor and bilateral agencies in Guinea rarely fund projects in the environmental sector, let alone adaptation in agriculture. "Loss of interest" challenges seem to be the culprit because of lackluster impacts and results from previous efforts.

b) AET institutions (faculty and students) and research centers

AET governing agencies. Within agencies responsible for rural training, the climate change phenomenon itself is not understood, and confusion between causes and consequences is common. As a result, the universal nature and irreversibility of climate change (in the short to medium term at least) are not well known, and reforestation is seen as the adequate solution to address the issue and bring the system back to equilibrium in the short term. In that context, the need for long-term adaptation is not recognized. Collaboration among technical training institutions, research institutions, and extension agencies is entirely informal. There is a great missed opportunity given the geographical proximity between technical training institutions and research institutions. The interviewees recognize the low academic level and lack of practical know-how among AET students.

AET faculty. Seventy-five percent (75%) of AET faculty interviewed have a low level of knowledge of the climate change phenomenon, linking it mainly to local deforestation and thus not understanding that it is irreversible in the short to medium term and of the urgent need to adapt to it. They also have a low level of knowledge of the progress of international talks/actions on NRM (climate change, biodiversity, and desertification). The remaining 25% have slightly higher but still very limited knowledge. Only 25% of the faculty interviewed say they have frequent access (more than once a month) to information on climate change, biodiversity, and soil management. They access it mostly through the radio or internet. Very few faculty interviewed – less than 10% in the past five years – have received recent training on climate change, biodiversity or soil management. Those who did so generally received short-term training provided by projects or donors.

AET students. Eighty-five percent (85%) of the AET students interviewed have a low level of knowledge of the climate change phenomenon, linking it mainly to local deforestation and thus unaware of its irreversibility in the short to medium term and of the urgent need to adapt to it. They also have low levels of knowledge on the progress of international talks/actions on NRM (climate change, biodiversity, and desertification). The remaining 15% have limited knowledge. Only 15% of the students interviewed say they have frequent access (more than once a month) to information on climate change, biodiversity, and soil management, and a little more than 30% say they rarely receive information (less than once a month). Seventy-five percent (75%) of the students receiving information, frequently or rarely, mention a training course as the source of information. Other sources of information are rarely mentioned, apart from the radio, mentioned by 10% of the students receiving information. Internet, reviews/newspapers, TV, workshops, NGOs, and projects are almost never mentioned. The information received appears to be of low quality: most of time they are not able to recall the key messages. Only 20% of the AET students interviewed say they received training about climate change, biodiversity or soil management. This training always took place at school, generally as part of a broader training course (agronomy, animal science, forestry, etc.) as there is no specific training course on NRM. Most of the students who received training that addressed climate and biodiversity do not recall the main messages. The situation is different for soil management: 11 of the 15 who received training that addressed soil management can recall key messages.

AET researchers. National research institutions appear to have limited knowledge of climate change issues. The most closely related research is focused on the cropping system (e.g. designing new crop association/rotation farming system with sowing under crop cover, shortening of the rice breed cycle, identification of drought-resistant and/or salt-resistant rice breed, etc.). Essentially no research that could be considered related to climate change takes place in livestock and fisheries. While research institutions appear to have stronger regional networks than educational institutions, adaptation to climate change is not specifically addressed in the framework of their collaboration. More than 80% of the IRAG researchers interviewed tend to link the climate change phenomenon to local deforestation and thus do not understand that climate

change is irreversible in the short to medium term and that there is an urgent need to adapt to it. They also have little knowledge of the progress of international talks/actions on NRM (climate change, biodiversity, and desertification). This is all the more striking given that their research programs are highly dependent on these global changes and they should be the best informed about them in Guinea. Only 20% of the researchers interviewed say they have a frequent access (more than once a month) to information on climate change, biodiversity, and soil management, and a little over 60% say they rarely receive information (less than once a month). Thirty percent (30%) of the researchers receiving information, frequently or rarely, mention internet and the CTA/Spore bimonthly review. Other sources of information are marginal, apart from radio, mentioned by 10% of the researchers receiving information. Books, reviews/newspapers (apart from the CTA/Spore), TV, conferences/workshops, and NGOs and projects are almost never mentioned. Very few researchers interviewed – less than ten percent in the last five years – have received recent training on climate change, biodiversity or soil management. When they have received it, they generally received short-term training provided by projects or donors. Around 60% of the researchers interviewed say they do not address climate change, biodiversity, or soil management in their research. The others mention the following topics of research: (i) in relation to climate change and biodiversity: mostly seed selection (photoperiodism, length of the cycle, drought-resistance, salt-resistance, etc.) and seed classification, (ii) in relation to soil management: trials of different fertilizers (organic: manure or crop cover, chemical, mix of the two), iron-toxicity resistance of seed (therefore indirectly related to soil management). In short, most of the research programs related to NRM are focused on genetic selection/improvement of food crops.

Field trials at AET institutions

Field trials can be classified into six main topics (in case of overlap, the major one was retained):

Nine are about **seed**; resistance to drought (for rice and bean), to salinity (for mangrove rice), plasticity to adapt to poor fertile soils (for yam and cassava), adaptation to flooding (for rice: selection of high stem rice), adaptation to storms/lodging (for maize: selection of short stem maize), shortening of the cycle (for rice and bean), protein rich maize;

Eight are about **soil fertility**: use of compost, manure, mulching, termite mounds, or a mix of chemical and organic fertilizer;

Six are about **fodder**; Five are mostly about fodder/groundnut hay/rice straw conservation, and one is also about enrichment of natural grazing land;

Six are about **soil erosion**; use of cover crop, like cowpea/rice association in sloppy area or sweet potato in vegetable gardens, zero tillage, physical barriers to soil erosion;

Six are about **cropping systems**; shortening of the rice nursery period and early planting (to shorten the cycle and avoid water stress), broadcast sowing instead of dibbling, rice cropping and fish farming association (diversification of revenue), maize and bean association (to increase N-fixation), improved rubber and palm oil farming system (agroforestry);

Four are about **reforestation**; on degraded soils or catchment area, using fast growing species (esp. Gmelina)

Generally, the objective of the trials is to identify three types of technology development/transfer, the basic one being "transfer" (to implement a technology already successfully implemented elsewhere). A bit more elaborate objective is the trial in station to design a technology in a controlled environment, without involving farmers. The most elaborate one (and the most complex, but also most interesting in terms of local ownership) is the farmer trial to design a technology in a partially controlled environment, the farmers managing the plot trials. In total, 11 transfers, 16 trials in station and 12 farmer trials, were mentioned, but

most of the trials in station seem to be simple transfer, and most of the farmer trials seem to be trials in station. Forty (40%) of the transfer or trials are not subject to dissemination. When dissemination is carried out, it is usually with the support of formal extension services, mentioned 13 times out of 22, and more rarely through the farmer organizations, mentioned by nine of the 22, or through the IRAG "open houses," mentioned by three of the 22, or rarely through the radio, mentioned by one of 22. The answers to the question about the number of visitors does not appear significant, most of the interviewees found it difficult to answer the question.

The tables below list the research related to climate change carried out by AET faculty (Table 6), students (Table 7), and IRAG researchers (Table 8).

Table 6. Trials/transfer on adaptation of agriculture to CC carried out by AET faculty (Baseline study, 2014)

Description of the trial	Type of trial	Dissemination	Visitors
Production of 20,000 seedlings of Gmelina et Acacia to restore degraded soils	Farmer trial	No	10 nursery gardeners
Trials of more drought-resistant seed	Farmer trial	ANPROCA	>1000
Biological and physical protection against soil erosion	Farmer trial	CNOP-G + Federation	<100
Anti-erosion practices (no detail given)	Farmer trial	CNOP-G + Federation	<100
Use of termite mounds to enrich the soils	Farmer trial	ANPROCA	<100
Use of sweet potato as cover crop to avoid soil leaching	Testing station	No	Few Students
Shortening of period in rice nursery (18-21 days vs of 30) and fast planting (May-June vs July)	Testing station	No	Few Students
Enrichment of grazing land with selected fodder species	Testing station	Rural radio	1000>x>100
Mulching of vegetable gardens and improved crop rotation	Testing station	Federation	<100
Trials of maize/bean association, together with compost	Testing station	SNPRV (ANPROCA now)	>1000
Identification of climate change resistant seeds (no detail given)	Testing station	ANPROCA	>1000
Zero tillage and use of organic manure	Testing station	ANPROCA	>1000
Reforestation of degraded soils	Testing station	ANPROCA + Federation	<100
Comparative trial of aboveground conservation (silo) of fonio straw vs groundnut hay	Transfer	No	25 Students
Preparation of 2 buried maize silos (2 m x 1 m) to increase grain conservation	Transfer	No	38 Students
Reforestaton of catchment areas	Transfer	No	<100

Table 7. Trials/transfer on adaptation of agriculture to CC carried out by AET students (Baseline study, 2014)

Description of the trial	Type of trial	Dissemination	Visitors
Trial of different maize seeds	Testing station	No	Do not know
Trial of different crop associations	Testing station	No	Do not know
Integration rice cropping and fish farming	Testing station	CNOP-G + Federation	Do not know
Improved fallow	Testing station	No	Do not know
Trial of different cultivation cycles for rubber and palm oil plantations	Testing station	IRAG Sérédou	Do not know
Conservation (silo) of groundnut hay	Transfer	No	25 students
Conservation (silo) of rice straw	Transfer	No	20 students
Conservation (silo) of rice straw	Transfer	No	18 students
conservation (silo) of gramineous hay	Transfer	No	18 students
Use of organic manure on coffee plantation	Transfer	No	<100
Reforestation with Gmelina	Transfer	No	Few students
Early planting of rice taken from the nursery	Transfer	Rice farmers'group	<100
Use of compost on vegetable gardens	Transfer	No	1000>x>100

Table 8. Trials/transfer on adaptation of agriculture to CC carried out by IRAG researchers (Baseline study, 2014)

Description of the trial	Type of trial	Dissemination	Visitors
Association of cowpea and rice in sloppy areas (to reduce erosion and increase N-fixation)	Farmer trial	ANPROCA	>1000
Identification of yam and cassava breeds adapted to degraded soils	Farmer trial	ANPROCA + Federation	1000>x>100
Multi-sites participatory trials to identify rice seeds (mangrove, irrigated, and lowland areas)	Farmer trial	ANPROCA	60
Trials of different association of chemical and organic fertilisers to maintain soil fertility	Farmer trial	ANPROCA	Bit more than 100
Participative selection of rice seeds, with resistance to drought, salinity, flooding (high stem)	Farmer trial	ANPROCA	Around 270
Comparative trial of 2 high protein maize varieties	Farmer trial	ANPROCA	15-20
Comparative trials of 6 rice breed: broadcast sowing vs drilling (to shorten the production cycle)	Farmer trial	ANPROCA	Around 400
Shortening of bean production cycle (to avoid heavy rains in October and fungal diesases)	Testing station	"open house"	100 to 200
Improvement of a local maize seed to reduce its stem (to reduce lodging) and increase yield	Testing station	No	No
Comparative trials of different chemical fertilisers inputs (urea and NPK)	Testing station	"open house"	Around 50

c) Private sector: farmer organizations, agribusiness firms, rural radio

Networks of farmer organizations. Generally the network institution itself (representing hundreds of thousands of farmers) is well aware of the current impacts of climate change, especially the lack of water ("*the water tower is drilled!*") and effects on animal behavior, but does not address this issue in its strategic plan. However, the strongest Guinean federation, FPFD, is active in the field and has started implementing adaptation measures, such as (i) building hill dams in the central plateau of the Fouta Djallon, (ii) promoting the use of compost, (iii) diversifying activities (fish farming, small ruminants holding, etc.). FPFD also intends to carry out a water balance analysis of its Sub-Prefectures (with support from the International Centre for Agricultural Research for Development) and to include climate change in its next strategic plan. The National Association of Poultry Farmers (ANAVIG) is one of the few members of a large network of livestock organizations. It feels the impacts of climate change: decrease of feed consumption and rate-of-lay, increase of panting, acidosis, attacks, mortality, etc. Using the internet and exchanges with its Ivorian colleagues, ANAVIG has already started implementing adaptation measures: decreasing the density in the henhouse, increasing the number of watering spots, covering the water tanks, replacing the brick wall by wire grid, introducing vitamins during the hot season, etc. Generally these networks feel AET institutions could better serve farmer organization by developing the capacity of their graduates to provide up to date adaptation techniques that can be easily communicated and adopted by farmers. They also feel that government efforts to provide improved seed and inputs should be refocused on regionally appropriate extension programs to use those improved inputs within the framework of broader CSA strategies. In terms of adaptation, their two main priorities are (i) to put in place an early weather warning system at a national scale, and (ii) to launch local studies on water balance, to assess the water availability/need/gap, month by month.

Farmers involved in grassroots farmer organizations. All the farmers interviewed observe climate change, especially erratic/reduced rainfall and increasing heat, and most of them explain it by deforestation (that would locally reduce the rain and increase the temperature). Thirty-three percent (33%) say they do not change their farming practices, some explaining they are ancestral or that they do not know how to adapt. Sixty-six percent (66%) say they have changed their farming practices, mainly by shifting the farming cycle to adapt to the rainy season. Nearly all the farmers say they observe a loss of biodiversity, mostly loss of forest, for 50% of them, and a degradation of the soils, mostly loss of fertility, for 66% of them. These farmers and associated groups have poor access to information/advice on environmental issues (climate change, biodiversity, soil): 50% of them do not have such information and 33% receive it rarely (less than once a month). The main sources of information are the radio, ANPROCA, Forest Service, and their federation. Reviews/newspapers, internet, and TV are never mentioned. The main key message relates to the protection of forest (avoiding slash-and-burn and bushfires, reforesting), and very few specific messages are related to adaptation to climate change, protection of biodiversity, and sustainable soil management. Farmers expressed that climate change-related extension and support needs to insure that the needs and conditions of farmers/producers are taken into account by ensuring that proposed CSA techniques: improve production and profitability; provide alternatives to existing production systems; are clear and easily understood; and, address root causes and bottlenecks.

Agribusinesses. The level of awareness and information about environmental issues is lower for the high level representatives from agribusiness firms than for farmer group representatives. A majority of them say they do not adapt to climate change and they have never seen information on climate change/NRM.

Rural radio. Rural radio is often mentioned as a key source of information on climate change and NRM. But, the interviewees do not understand the climate change phenomenon, lack knowledge about international talks/actions on NRM, and do not seem to have information/training on climate change/NRM. Therefore, their key messages are focused on limiting slash-and-burn and bushfires.

V. Conclusions and Recommendations for the AEMIP GCC Integration Pilot

a) Current and projected impacts of climate change in Guinea

Guinea, as well as other West African countries, is likely to suffer from reduced rainfall (but more frequent heavy rainfall events), increased temperatures, higher number of hot days, and more storm events as a result of climate change. In addition, the Guinea's coastline will suffer from sea level rise and related effects, salinization in particular. These impacts will be aggravated by the already significant degradation of natural resources by human activity, as well as existing human and economic factors of vulnerability. The prognosis for maintaining agriculture productivity, let alone increasing it, is dim.

The need for development of human and institutional capacity for climate change adaptation in Guinea is urgent. The AEMIP GCC Integration Pilot is a significant effort to address this urgent need in both the short and long terms.

b) Institutional benchmark for climate-smart agriculture

The UNFCCC framework does not yet offer an agreed-upon definition of climate smart agriculture. However, FAO has consolidated the experience and expertise of a wide range of specialists and organizations to produce a framework that relies on three pillars to achieve climate-smart agriculture: programs that address adaptation, mitigation, and livelihoods. Implementation of this approach faces three main challenges: (i) Current efforts often focus on CSA promoting techniques farmer by farmer according to current conditions, rather than predicted conditions; (ii) Often a farmer or community cannot achieve the three pillars, but at best perhaps two; (iii) A disconnect exists among extension agencies in agriculture, forestry, livestock, and fisheries, and it is not uncommon for agencies to promote CSA techniques that are at cross-purposes.

■ ***Recommendation #1:*** *AEMIP, through Activity 2: Faculty Strengthening and Activity 3: Innovations Grants, should promote an approach to CSA that (i) consolidates known CSA techniques into CSA strategies based on agro-meteorological conditions for the short, medium, and long terms; (ii) Assesses CSA from a "farming system" perspective rather than a farm or national level perspective. Additionally, AEMIP could facilitate increased communication and collaboration among extension agencies through Activity 3 and Activity 4: Management Strengthening in the establishment of the Guinean Agriculture Institutions Network (GAIN).*

c) Policy environment for CSA in Guinea

The GOG developed a NAPA with selected projects that neglect major areas of climate change vulnerability (livestock, for example) and are slow to be implemented. A NAP has not yet been developed. Of the current agriculture policies and strategies, only the PNIASA addresses climate change, but it provides unclear guidance to government agencies for executing those efforts.

Further, the Baseline Study team found a recurring theme in written GOG policies and strategies and among policymakers, AET institutions, and other stakeholders: A fundamental misunderstanding exists about the causes of climate change and the necessary remedies. Most interviewees and survey respondents described climate change as a result of deforestation. They did not understand its global nature and believed that reforestation was an adequate response.

The Ministry of Environment is tasked with coordinating all domestic policies and measures related to climate change, which would include the present AEMIP/GCC Integration Pilot. Thus, it is necessary to have a clear understanding of who is doing what in the Ministry. The delays in preparing the 1CN and 2CN and in implementing the NAPA projects demonstrate that a shared vision is crucial for the successful deployment of AEMIP's efforts and a pre-requisite for the launch of any inter-sectoral initiative about CSA.

■ ***Recommendation #2:*** *A high-level meeting between AEMIP and the Ministry of Environment should take place for better understanding of the Ministry's overall leadership and coordination role in climate change among agencies and of the status of progress of the NAPA.*

■ ***Recommendation #3:*** *AEMIP's GCC Integration Pilot should carry out basic climate change awareness campaigns not only among AET institutions, but also among other AET stakeholders (policymakers, private sector, civil society, etc.). This will ultimately strengthen the demand for expertise in climate sciences, which ISAVF would be able to meet in the future. Such campaigns could be part of Activity 3: Innovations Grants or Activity 4: Management Strengthening's Support of the GAIN.*

d) AET institutional capacity to integrate climate change adaptation

Exposure to information and concepts on climate change adaptation, biodiversity, or NRM topics is low among AET faculty, students, and researchers. Faculty and researchers do not have access to short- or long-term training in climate sciences, and they cannot or do not access information on climate change on a regular basis. Retention of information among the few that have accessed training or information is weak. While some field trials being conducted can be considered related to adaptation, the systems for disseminating and commercializing the resulting technologies are virtually non-existent, due to generally poor or absent collaboration among various AET stakeholders.

■ ***Recommendation #4:*** *Given the very low levels of capacity in climate sciences, AEMIP should provide high-quality short-term training to AET faculty and students and other stakeholders through Activity 2: Faculty Strengthening, Activity 3: Innovations Grants, and Activity 4: Management Strengthening (the GAIN). Training should negate counter-productive explanations (e.g. climate change = local deforestation/back to normal = reforestation), and present three main modules: (i) the climate change phenomenon (greenhouse effect, GHG in general, GHG from agriculture and land use, etc.), (ii) projections (by 2050: globally, in West Africa, and in Guinea, impacts on agriculture and livelihood, etc.), and (iii) actions (mitigation in the rural sector, adaptation in the rural sector, concept of CSA, etc.). The Innovations Grants and GAIN mechanism should be used to develop, test, and promote the CSA farming system strategy options among farmers and farming organizations. This development of CSA farming system strategies is a critical first step before formal revision of AET curriculum.*

AEMIP must first build up momentum, interest, and basic understanding of climate change and CSA so that curriculum development is Guinean-led. It should also take place after AEMIP has supported increased collaboration with external networks and farmer organizations in order to understand their comparative advantage and potential unique contribution to the field of study as well as to gain consensus on the most appropriate CSA farming system strategies.

■ ***Recommendation #5**: AEMIP-supported training, whether short or long term, must take into consideration the significant challenge of trainee retention of information.*

e) Current resources available for climate-smart AET

Currently, none of the Guinean AET institutions have training modules on distinct climate change adaptation topics. They sometimes touch upon environmental issues during technical training (e.g., soil biodiversity during soil science courses) but do not deal with them specifically, and AET students do not generally recall key messages about these environmental issues except that slash-and-burn and bushfires should be avoided, especially in water catchment areas.

■ ***Recommendation #6**: AEMIP should reach out as soon as possible to regional networks WESCAL and CILSS, which appear to have the most relevance for Guinea with the availability of short- and long-term training in French. Other efforts should be undertaken to establish linkages between ISAVF and particularly WESCAL and CILSS. These linkages could take place through AEMIP Activity 2: Faculty Strengthening, through support for long-term degree training for ISAVF faculty or by bringing specialists to ISAVF for short-term training or seminars; through Activity 3: Innovations Grants, by supporting peer networking among researchers; or through regional study tours in Activity 4: Management Strengthening. AEMIP should also conduct a thorough review, with ISAVF and possibly the GAIN, of ANAFE's publication on mainstreaming climate change into AET.*

■ ***Recommendation #7:** The ISAVF Cyber Café (within Activity 1: Curriculum Strengthening) will be vital to accessing teaching and learning materials for ISAVF faculty and students. AEMIP should facilitate the downloading and printing of materials from other mentioned regional networks like Inter-Network, Rural Hub, CTA, IFPRI, and GTD to build a library of information for faculty and students. Training modules should reference the key periodicals these organizations produce.*

f) Levels of collaboration among AET institutions and external stakeholders, to support climate-smart AET

At the policy level, while some collaborative bodies have been launched that could be utilized for climate change collaboration, these bodies have been unable to reach functionality and sustainability.

At the policy execution level, virtually no cross-institutional collaboration exists among extension agencies, research institutions, AET institutions, and other sub-national line ministry representatives.

At the enterprise level (farmer organizations, agribusinesses, and farmers), little collaboration takes place with AET institutions and research institutions. Moreover, based on the interviews carried out, some enterprise level institutions do not share the vision of the GOG (promoting improved seeds, chemicals fertilizers, and pesticides) and do not trust AET institutions and IRAG to support them in designing and implementing CSA (because of a lack of capacity). In short, no mechanism or platform exists for civil society to coordinate with GOG and AET institutions on CSA; even worse, mutual trust is lacking for advancing CSA development.

■ ***Recommendation #8:*** *AEMIP should facilitate a GAIN meeting to share information about adaptation of agriculture to climate change and foster a common understanding of CSA and climate-smart AET. At meeting, the four-step work plan to establish Guinean CSA strategies could be presented and discussed. Later, GAIN could launch a restricted working group to implement the four-step work plan to identify the main farming systems and design/implement ad hoc CSA and climate-smart AET. The working group would ideally include the National Directorate of Meteorology, ANPROCA, and CNOP-G. If pilot sites are selected for implementing CSA activities, AEMIP could provide dedicated support to the National Directorate of Meteorology to rehabilitate agro-meteorological stations nearby and assist in the monitoring and evaluation.*

The first CSA strategies to be produced could address the rice sector, by far the main food crop in Guinea, and focus on the following vulnerable farming system: recession rice in the Niger valley and its tributaries (Haute-Guinée), lowland rice (without bundling/water control) in Guinée Forestière, mangrove rice (without bundling/water control) in Basse-Guinée, and rain-fed rice in the hillsides of Fouta Djallon (Moyenne-Guinée). Assistance could help AET stakeholders to understand the process in practical terms and, later, start working on other farming systems.

■ ***Recommendation #9:*** *Facilitating collaboration among Guinean AET institutions that are (or should be) engaged in climate change adaptation in agriculture should be a priority for AEMIP. Coordination will be critical in developing CSA strategies and farming system strategies as recommended above. The GAIN, supported by AEMIP's Activity 4: Management Strengthening, is a potential mechanism for such collaboration.*

g) Private sector (and farmer) engagement in climate-smart agriculture

All farmer organizations interviewed are aware of the current impacts of climate change, especially erratic/reduced rainfall and increasing heat, but most explain the impacts in terms of deforestation (reduction of rainfall locally and increased temperatures). Most say they do not change their farming practices, some explaining that the practices are ancestral or they do not know how to adapt them. Others say they have changed their farming practices, mainly by shifting the farming cycle to adapt to the rainy season. Nearly all the farmers say they observe a loss of biodiversity, half of them as a loss of forest, and most also observe soil degradation, two-thirds of them as a loss of fertility.

About half of those interviewed say they have poor access to information/advice on environmental issues. If they do receive such information, it is from extension agencies and rarely from the media. The key message they receive from extension agencies relates to the protection of forest (avoiding slash-and-burn and bush-fires, reforesting) and few messages are specific. The information is generally considered unhelpful, with little or no improvement in terms of production: farmers say they do not have alternatives to slash-and-burn, no means to implement the advice, or the advice is too vague or does not address the real issues.

■ ***Recommendation #10:*** *AEMIP should support AET institutions with outreach to the private sector and enterprise-level bodies, perhaps through Activity 3: Innovations Grants or Activity 4: Management Strengthening. Not only is such outreach necessary to change the negative perception of AET by these bodies (and thus increase demand for their graduates), but private sector entities are on the front lines of the effects of climate change and have already begun adaptation measures. AET institutions and the private sector have much to learn from each other.*

The AEMIP GCC Integration Pilot aims to strengthen linkages between AET institutions and researchers and farmers, to merge widely used good agriculture practices with new climate smart technologies to enhance the resilience of Guinean agriculture to climate change.

> *"There will be no return to prior conditions over the course of individual lifetimes […] even if we reach a peak of GHG emissions in the coming decades, climate change will continue for hundreds of years, because of the "lifetime" of the GHG in the atmosphere"*
>
> —IPCC, 2013

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Acronyms

2iE	International Institute for Water and Environmental Engineering
ACP	Africa, Caribbean and Pacific Group of States
AEMIP	Agriculture Education and Market Improvement Program
AET	Agriculture Education and Training
ANAFE	African Network for Agriculture, Agroforestry and Natural Resources Education
ANAVIG	National Association of Poultry Farmers of Guinea (Association nationale des aviculteurs de Guinée)
ANPROCA	National Agency for Rural Promotion and Farm Advisory (Agence nationale de la promotion rurale et du conseil agricole)
AU	African Union
C	Celsius
CAADP	Comprehensive Africa Agriculture Development Programme
CC	Climate Change
CDM	Clean Development Mechanism
CERAAS	Regional Research Centre for the Improvement of Adaptation to Drought (Centre d'étude régionale pour l'amélioration de l'adaptation à la sècheresse)
CGIAR	Consultative Group on International Agricultural Research
CH4	Methane
CILSS	Permanent Interstates Committee for Drought Control in the Sahel (Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel)
CNOP-G	National Confederation of Farmer Organizations of Guinea (Confédération nationale des organizations professionnelles de Guinée)
COP	Conference of Parties
CORDEX	Coordinated Regional Climate Downscaling Experiment
CO2	Carbon Dioxide
CSA	Climate-Smart Agriculture
CSIRO	Commonwealth Scientific and Industrial Research Organization
CTA	Technical Centre for Agricultural and Rural Cooperation
DSRP3	Poverty Reduction Strategy Document (Document stratégique de reduction de la pauvreté)
ECOWAS	Economic Community of West African States
EU	European Union
FAO	Food and Agriculture Organization
FAPI	Federation of Bee-keepers of Guinea (Fédération des Apiculteurs de Guinée)
FAR	Network on Agricultural and Rural Training (Réseau formation agricole et rurale)
FCFA	CFA franc
FPFD	Federation of Fouta Djallon Farmers (Fédération des paysans du Fouta Djallon)
GAIN	Guinean Agriculture Institutions Network
GCC	Global Climate Change
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	German Society for International Cooperation
GOG	Government of Guinea
GTD	Desertification Working Group (Groupe travail desertification)
GWP	Global Water Partnership
ha	Hectare
HBS	Heinrich Böll Stiftung
HLPFSN	High Level Panel on Food Security and Nutrition
ICRAF	World Agroforestry Centre
IEC	Information-Education-Communication

Acronyms (continued)

IFAD	International Fund for Agriculture Development
IFPRI	International Food Policy Research Institute
IGA	Income Generating Activities
IPCC	Intergovernmental Panel on Climate Change
IRAG	National Agriculture Research Institute of Guinea (Institut de recherche agronomique de Guinée)
ISAVF	Institut Supérieur Agronomique et Vétérinaire de Faranah
kg	Kilograms
IUCN	International Union for Conservation of Nature
LDC	Least Developed Country
LDCF	LDCs' Fund
LEG	Least Developed Countries' Experts groups
MAEEEF	Ministry of Agriculture, Livestock, Water and Forestry (Ministère de l'agriculture, de l'élevage, des eaux et forêts)
MDGs	Millennium Development Goals
MEAS	Modernizing Extension and Advisory Services
MIROC	Model for Interdisciplinary Research on Climate
mm	Millimeters
m/t	Metric tons
NAIPs	National Agricultural Investment Programmes
NAP	National Plans of Adaptation
NAPA	National Plan of Action for Adaptation
NERICA	New Rice for Africa
NGO	Non-Governmental Organization
NLPDA	New Agricultural Development Policy Letter 2006-2015 (Nouvelle lettre de politique de développement agricole)
NRM	Natural Resource Management
NTFP	Non Timber Forest Product
N2O	Nitrous oxide
ODI	Overseas Development Institute
OECD	Organization for Economic Co-operation and Development
PIF	Project Identification Form
PNIASA	National Agricultural Investment and Food Security Plan 2012-2016 (Plan national d'investissement agricole et de sécurité alimentaire 2012-2016)
RAFARGUI	Network of Stakeholders on Agricultural and Rural Formations of Guinea (Réseau des acteurs des formations agricoles et rurales de Guinée)
RAIPs	Regional Agricultural Investment Programs
RCPs	Representative Concentration Pathways
REDD+	Reduction of GHG Emissions due do Deforestation and Forest Degradation, and Conservation or Enhancement of Forest Carbon Stock
ROPPA	Network of Farmer and Agricultural Producers' Organizations of West Africa (Réseau des organizations paysannes et de producteurs de l'Afrique de l'Ouest)
SOBRAGUI	Guinea Brewery Company (Société de brasserie guinéenne)
SOGUIPAH	Guinea Palm Oil and Rubber Company (Société guinéenne de palmier à huile et d'hévéa)
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WACDEP	Water, Climate and Development Programme
WASCAL	West African Science Service Centre on Climate Change and Adapted Land Use
WECARD	West and Central African Council for Agricultural Development (Conseil Ouest et Centre africain pour la recherche et le développement agricoles - CORAF)

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