

Climate Learning for African Agriculture: Working Paper No.3

Innovation Systems for Agriculture and Climate in Benin: an Inventory

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January 2013

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Translated from the French by John Morton in consultation with the authors

Climate learning
for African agriculture



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Foreword

The project “Climate Learning for African Agriculture”, funded by the Climate and Development Knowledge Network, and led by the Natural Resources Institute (NRI) of the University of Greenwich, the African Forum for Agricultural Advisory Services (AFAAS) and the Forum for Agricultural Research in Africa (FARA), is very pleased to present this preliminary output of ongoing action-research in Benin led by Dr Ismail Moumouni.

Dr Moumouni and his collaborator Latifou Idrissou present here a systematic tour of the policies and institutions which form the context for agricultural adaptation to climate change in Benin. Dr Moumouni demonstrates the gap between ministries and institutions concerned with climate change on the one hand and agriculture on the other, and the lack of *policies* that are specifically and realistically oriented to helping small farmers adapt to climate change. On the other hand, he surveys a range of *projects*, along a spectrum between research and development, and funded and implemented by a variety of organisations that are actively assisting farmers, in ways which demand further study and documentation.

Some of these projects are explicitly designed in response to climate change, others are of more general relevance in that they address some of the impacts of climate change, or lay the ground for adaptation by building small farmers’ capacity to adapt. We look forward to the next phase of work in which some of these projects will be studied in greater depth, and dialogues and learning between them and other stakeholders facilitated, to stimulate new forms and processes of agricultural innovation in the face of climate change, in Benin and beyond.

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List of Acronyms and Abbreviations

ABE	Agence Béninoise pour l'Environnement	Benin Agency for the Environment
AFD	Agence Française de Développement	French Agency for Development
AquaDeD	Aquaculture et Développement Durable	Aquaculture and Sustainable Development
CADG	Cellule d'Appui au Développement du Conseil de Gestion	Unit for Support to the Development of Management Advisory Services
CNCC	Comité National sur les Changements Climatiques	National Committee on Climate Change
CEF	Conseil à l'Exploitation Familiale	Advisory Services for Family Farms
UNFCCC		United Nations Framework Convention on Climate Change
DE	Direction de l'Environnement	Directorate of the Environment
DPDR	Déclaration de Politique du Développement Durable	Policy Statement on Sustainable Development
FUPRO	Fédération des Unions de Producteurs	Federation of Producers' Unions
GERME	Groupe d'Appui, d'Encadrement et de Recherche sur l'Environnement et le Développement	Support Group for Management and Research on Environment and Development
IAMD	Institut Africain d'Application des Méthode de Développement	African Institute for Application of Development Methods
IDID	Initiatives pour le Développement Intégré Durable	Initiatives for Sustainable Integrated Development
InuWaM	Projet de Gestion Intégrée de l'Eau et des Nutriments	Project on Integrated Management of Water and Nutrients
IDRC		International Development Research Centre
LBCA	Livre Blanc sur le Conseil Agricole	White Paper on Agricultural

		Advisory Services
LDPDR	Lettre de Déclaration de Politique du Développement Rural	Policy Statement for Rural Development
MAEP	Ministère de l'Agriculture, de l'Élevage et de la Pêche	Ministry of Agriculture, Livestock Production and Fisheries
MEHU	Ministère de l'Environnement, de l'Habitat et de l'Urbanisme	Ministry of the Environment, Housing and Town Planning
MEPN	Ministère de l'Environnement et de la Protection de la Nature	Ministry of the Environment and Nature Conservation
NAPA		National Action Programme on Adaptation
OBEPAB	Organisation Béninoise pour la Promotion de l'Agriculture Biologique	Organisation for the Promotion of Organic Agriculture in Benin
PROCOTON	Programme de Renforcement des Capacités des Organisations de Producteurs de Coton	Programme for Capacity-Building of Cotton Producers' Organisations
PADYP	Projet d'Appui aux Dynamiques Paysannes	Project to Support Farming Dynamics
PARBCC	Projet de Renforcement des Capacités d'Adaptation des Acteurs Ruraux Béninois face aux Changements Climatiques	Project for Strengthening Rural Adaptive Capacity for Climate Change in Benin
PAPA	Programme d'Analyse de Politiques Agricoles	Programme for Agricultural Policy Analysis
PRECAB	Projet de Renforcement des Connaissances Économiques et de la Capacité d'Adaptation face aux changements climatiques au Bénin	Project to Strengthen Economic Knowledge and Adaptive Capacity in the face of Climate Change in Benin
PTA	Programme de Technologies Alimentaires	Food Technology Programme
RIPIECSA	Recherches Interdisciplinaires et Participatives sur les Interactions entre les Écosystèmes, le Climat et les Sociétés en Afrique de l'Ouest	Interdisciplinary and Participatory Research Project on Interactions between Ecosystems, Climate and Society in West Africa

SNCA	Stratégie Nationale de mise en œuvre du Conseil Agricole	National Strategy for Implementation of Agricultural Advisory Services
SNV		Netherlands Development Organisation

NB: acronyms for projects and organisations used only once in the text are not generally included here.

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1. Introduction

1.1. Background and Objective

Climate change is now considered one of the main threats to the global environment in the 21st century (Acacha Akoha, 2003). Climate change is the result of global warming induced by an enhanced greenhouse effect resulting from the increase in the atmospheric concentration of greenhouse gases produced by human activities such as burning of fossil fuels, deforestation, land use and land use change, agriculture, waste management, industrial processes etc. (Acacha Akoha, 2003). Among the greenhouse gases, six are targeted because of their significant greenhouse effect, namely carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

The international community has formulated a global response to climate change that involves the development of policies to anticipate the consequences and prepare appropriate responses. To do this, international agreements to combat climate change have been prepared and submitted for signature by governments, the most important being the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol on greenhouse gas emissions, the National Action Programmes for Adaptation (NAPAs) etc.. The implementation of these international policies at the country level involves various stakeholders who interact, developing innovations to serve this purpose.

Although Benin is not one of the countries covered by the Kyoto Protocol on reducing GHGs because of its low emissions, its contribution is still not negligible. Agriculture is the main source of GHG emissions in Benin (BEN/98/G31 Project, 2001; MEHU, 2011). Benin's agricultural sector both contributes to greenhouse gas emissions and is also vulnerable to the effects of those emissions, namely climate change. The 2nd National Communication on Climate Change shows that total GHG emissions attributable to the agriculture sector in 2000 amounted to approximately 4239.00 million tonnes of CO₂ equivalent, or 68% of total national GHG emissions (MEHU, 2011). The main sources of these GHGs, both attributable to the agricultural sector, are cultivated soils and enteric fermentation contributing 53% and 29% respectively of GHG emissions within the agriculture sector, followed by the managed burning of savannas (8%), rice cultivation (4%), burning of crop residues (3%) and manure management (3%) (MEHU, 2011).

In addition, Benin's Initial National Communication on Climate Change has identified two areas where vulnerability to climate change will be more pronounced (BEN/98/G31 Project, 2001): the agriculture sector and the coastal areas. The inclusion of the agriculture sector is justified by its importance for the national economy and its sensitivity to global climate change. Benin's economy depends mainly on agriculture, which employs about 60% of the workforce, contributes about 40% of GDP, provides around 80% of exports and is still the

mainstay of growth of the national economy. Agriculture in Benin remains vulnerable due to the use of crops, varieties and production systems that are not adapted to conditions of climate change (MEHU, 2011; BEN/98/G31 Project, 2001; Acha Akoha, 2003).

To respond to these threats of climate change, Benin has joined the international community in the development and implementation of climate policies. Thus, policies have been developed and implemented at the national level to address the negative effects of climate change, both inferred and projected, across all sectors. Within the framework of policies aimed either at supporting agricultural producers, or at managing climate change, several organisations are developing activities at field level. As well as government ministries, these include programmes and projects, non-governmental organisations (NGOs), agricultural producers' organisations and the two national universities of Benin.

The objective of this report is to:

- Present the institutional environment for management of climate change in Benin by surveying the institutions, policies and projects implemented by government, generally and specifically in the agricultural sector;
- Briefly present the main organisations involved in agricultural advisory services, and highlight those actions carried out by them that address the management of climate change - mitigation or adaptation;
- Identify case studies for in-depth study.

1.2. Methodology

The data presented in this report come from review of documents (reports and websites), and semi-structured interviews with key stakeholders in the management of climate change in the agricultural sector - specifically:

- Government departments and agencies - the Environment Directorate, the National Committee on Climate Change, the Directorate of Agricultural Advisory Services and Operational Training, the Benin National Institute for Agricultural Research, Regional and Communal Centres for Agricultural Promotion;
- Government projects - the Project to Support Farming Dynamics (PADYP), the Programme for Capacity Building of Cotton Producers' Organisations (PROCOTON), and the Project for Integrated Management of Water and Nutrients (INuWaM);
- NGOs - Initiatives for Integrated Sustainable Development (IDID), Organisation for the Promotion of Organic Agriculture in Benin (OBEPAB), Unit for Support to Development of Management Advisory Services (CADG), Aquaculture and

Sustainable Development (AquaDeD), Group for Management and Research on Environment and Development (GERME) and the African Institute for Application of Development Methods (IAMD);

- Agricultural producers' organisations – the Federation of Producers' Unions (FUPRO);
- The national universities – the Faculty of Agricultural Sciences of the University of Abomey-Calavi, and the Faculty of Agronomy of the University of Parakou.

2. Institutions, policies and projects for management of climate change

In Benin, the development and implementation of policy on climate change in relation to the agricultural sector is the responsibility of two main actors: the Ministry of the Environment and Protection of Nature (MEPN)¹ and the Ministry of Agriculture, Livestock and Fisheries (MAEP). They are supported in their work by other state institutions, namely decentralized organisations for research, advisory services/extension and support to producers, producer organisations, national and international NGOs and international organisations providing technical and financial support.

2.1. Ministry of the Environment and Protection of Nature (MEPN)

2.1.1. Departments and agencies of MEPN involved in management of climate change

Several structures of departments and agencies of MEPN are involved in the implementation of climate change adaptation policy, primarily the Directorate of the Environment (DE), the Benin Environmental Agency (ABE) and the National Committee on Climate Change (CNCC). The DE and the ABE are concerned with the protection of the environment in general. The CNCC, of which they are key members, has been specifically created to address challenges linked to climate change.

Directorate of the Environment

The Directorate of the Environment is responsible among other tasks for:

- The development of national policy, draft legislation and environment regulation;
- Coordination of programmes and projects at the national and regional levels, in collaboration with the competent departments;

¹ Formerly known as the Ministry for Environment, Housing and Town Planning

² In the original documents from MEPN, the terms “endogène” and “moderne” are used, but “autonomous” 3

- The enforcement of environmental laws and regulations through appropriate mechanisms and procedures, including Environmental Impact Assessments, and inspection and control of protected areas;
- Negotiation, in collaboration with the concerned departments, of international conventions in its areas of expertise, their monitoring and implementation, and the establishment of National Focal Points for the international conventions and agreements on the environment; and
- The design, development, implementation and monitoring of national policies on the environment, regional planning, remote sensing, cartography and combatting desertification, with the participation of all relevant national departments and agencies.

Benin Environmental Agency

MEPN also includes the Benin Agency for the Environment (ABE), which is also involved in the implementation of the national environment policy. The ABE is charged by law to develop Environmental Impact Assessment studies at the level of both policies and project strategies.

National Committee on Climate Change

Created by Decree No. 2003-142 of 30 April 2003, the National Committee on Climate Change (CNCC) is placed under the authority of MEPN. The CNCC is a multidisciplinary body set up to monitor and support the implementation of the UN Framework Convention on Climate Change (UNFCCC) and all the legal instruments related to this Agreement (including the Kyoto Protocol), and of scientific, technological and other studies related to climate change in Benin (Acacha Akoha, 2003). It has the following functions:

- Dissemination of information and awareness-creation on climate change and its impacts;
- Monitoring and evaluation of the implementation of the UNFCCC and its subsequent legal instruments;
- Support to the preparation for Benin's participation in the sessions of the Conference of the Parties (COP – the supreme body of the UNFCCC), and the subsidiary organs;
- The effective implementation of COP decisions;
- Monitoring and control of the process of developing Benin's National

Communications on Climate Change, as required under the provisions of Article 12.5 of the Convention;

- Monitoring and control of the process of developing and implementing the National Strategy on Climate Change;
- Support to the coordination of studies and research on inventories of greenhouse gas emissions, vulnerability and adaptation to climate change, and mitigation options;
- Participation in needs assessment of technologies necessary for the implementation of the UNFCCC and in capacity-building;
- Support to the preparation and organisation of conferences, seminars, workshops, symposia, and roundtables on topics related to climate change;
- The issuing of opinions on the legal, scientific, technological, methodological and other issues relating to climate change;
- The identification of indicators necessary for the projection of climate change;
- Support to the design and formulation of projects or programmes of action to be submitted to the Global Environment Facility and other financing mechanisms, as foreseen by the implementation of the UNFCCC and its subsequent legal instruments.

The CNCC is therefore a central body in the management of climate change in Benin. Its activities extend from research and policy formulation to implementation of various projects (information dissemination, awareness-creation, reflection, etc.). The CNCC is composed of representatives of the government departments and non-state actors as below:

MEPN including DE and ABE;

- Ministry of Transport (Department of Meteorology, Directorate of Land Transport, Autonomous Port of Cotonou);
- Ministry of Agriculture, Livestock and Fisheries (Directorate of Agriculture, Directorate of Forestry and Natural Resources, Directorate of Fisheries, Benin National Institute of Agricultural Research, National Centre for Agro-Pedology);
- Ministry of Industry (Directorate of Industry);

- Ministry of Trade;
- Ministry of Higher Education and Scientific Research (the Department of Geography and Regional Development, and the Department of Chemistry and Physics in the University of Abomey-Calavi, the Benin Centre for Scientific and Technical Research, the Faculty of Agricultural Sciences of the Polytechnic University College, the Faculty of Agriculture, the Department of Geography and Regional Planning, and the Faculty of Science and Technology of the University of Parakou);
- Ministry of Water and Energy (Directorate of Water, Directorate of Energy);
- Ministry of Health;
- Ministry of Foreign Affairs and African Integration (Directorate of International Organisations);
- Ministry of Planning (Directorate for Coordination of External Resources, Unit for Monitoring and Evaluation of Nationally-Executed Projects and Programmes, Benin Centre for Sustainable Development);
- Ministry of the Interior (Directorate of Preparedness and Civil Protection);
- Ministry of Communications;
- Ministry of Justice and Legislation;
- Ministry of Finance (Directorate-General of the Budget);
- NGOs (BENIN 21, OFEDI, ABFEM-NGO, GRAIB, representing the network of NGOs at the local level);
- The private sector (Benin Chamber of Commerce and Industry).

The implementing authority for the decisions of the National Committee is the Executive Board. The National Focal Point for the UNFCCC is the Chairman of the Executive Board.

The CNSC is therefore a multi-actor, multi-institutional, multi-sectoral and multidisciplinary platform, as it assembles a large number of institutions from various ministries directly or indirectly concerned with climate change issues. However, it does not seem to give sufficient space to farmers and farmers' organisations - those who most directly experience the effects of climate change. The involvement of various institutions involved in or concerned with in

climate change is an important asset for the development of systemic and interdisciplinary perspectives. However, the inertia and the exorbitant costs associated with the operation of such a body are factors that inhibit and reduce its effectiveness.

2.1.2. Policies on climate change

Benin signed the UNFCCC on June 13, 1992 and ratified it on June 30 1994. It also signed the Kyoto Protocol and ratified it on 17 December 2001. These actions show a willingness to adapt to climate change through complying with international recommendations in the field. Compliance with these commitments involves actions to protect the environment and agriculture at national level.

MEPN is responsible for the design and implementation of policies for management and protection of the environment, including the management of climate change in all sectors. So to meet international requirements in terms of adaptation to climate change, the department has drafted a number of documents and undertaken certain actions. Among the documents produced include the Initial National Communication on Climate Change, the National Strategy for Implementation of the UNFCCC, the Second National Communication on Climate Change, and the National Action Programme for Adaptation (NAPA).

The documents developed in the field of climate change have explored all sectors that contribute to global warming. With regard to agriculture and forestry, these documents show the sectors' emissions, but also their vulnerability, and the adaptation strategies proposed for them (BEN/98/G31 Project, 2001; MEHU, 2011; Acacha Akoha, 2003). The direct and indirect impacts of climate change have been well identified for forestry and agriculture (Acacha Akoha, 2003).

The direct impacts of climate change on forestry include changes in natural ranges of plant species due to global warming, species tending to move their ranges to higher latitudes and higher altitudes. Thus rare plant species or plants occupying limited areas could be at greater risk of extinction. Indirect impacts are the increased intensity of bushfires that may become widespread in Benin's forest ecosystems and contribute to their degradation.

As for agriculture in Benin, it remains vulnerable to the effects of climate change because of worsening conditions for farming and because of the current use of varieties ill-adapted to these conditions (Project BEN/98/G31, 2001). Thus yields are below the potential for the varieties cultivated. The direct impacts of climate change on the agriculture sector relate to the plant responses, changes in soils and lower yields. Phenomena of early flowering and premature drying of fruit can be observed in plants. Also, as a result of declines in rainfall and disturbances in rainfall regimes, agricultural yields will be severely affected. The ability to make seasonal forecasts of production will be disrupted, increasing risks of food insecurity.

Categories of indirect impact include the following (Acacha Akoha, 2003):

- Lack of agricultural labour: in a context of climate change, if real technological improvements are not made to the agricultural production process, shortage of labour may become a major limiting factor for agriculture in Benin due to rural-urban migration that is reaching a significant threshold;
- Increasing agricultural commodity prices: in a situation of climate change where agricultural yields are low, rising prices of agricultural products as farmers seek to maintain their standard of living;
- Poor functioning of agro-processing industries: processing plants will run at low capacity and some may close, as they are dependent on a flow of agricultural products;
- Threats to livestock production: in the context of global warming, where temperatures will remain high for several months and rainfall will be low, we will witness the development of various parasites that will decimate livestock holdings, especially poultry;
- The threat to fisheries production: studies have shown that the effects of a rise in sea level will be severe for small island states and countries like Benin, where low-lying coastal plains occupy large areas with large concentrations of population. Under these conditions, inland waters will suffer intrusion of salt water, resulting in a change of habitat and a loss of biodiversity, possibly leading to a drop in freshwater fish production.

These impacts will require adaptation. Producers make use of use autonomous adaptation strategies. In addition, documents produced by the MEPN propose planned adaptation strategies to meet the estimated negative effects of climate change.² The autonomous strategies are already used by people to alleviate the effects already being experienced by them and attributed to climate change. The autonomous strategies used by rural communities include (Project BEN/98/G31, 2001):

- Environmental migration to more humid areas;
- The occupation of lower-lying lands, especially seasonally-flooded areas;

² In the original documents from MEPN, the terms “endogène” and “moderne” are used, but “autonomous” and “planned” are used here as more familiar in English-language literature

- Staggered and repeated sowings, and;
- Flexibility in the practice of agricultural calendars.

As for the proposed planned adaptation strategies, they consist of new options for adaptation to the adverse effects of climate change. These options include improving the assessment of available water resources through capacity-building of the government services responsible, including regular monitoring and evaluation, and the promotion of integrated and rational water resource management. They also include promotion of, and training farmers in, sustainable and viable farming practices, such as (Acacha Akoha, 2003: 40):

- Developing effective measures to combat soil erosion;
- Developing farming systems using only organic inputs;
- Increasing the use of agroforestry techniques for the protection and restoration of fertility;
- Intensifying the management of existing pastures to increase their productivity through the introduction of improved feeding strategies, fertilisation, mechanisation and improved management of livestock;
- Increasing the use of organic manure in farming systems through the effective integration of livestock and crop agriculture; and
- Developing production methods adapted to fragile areas.

MEHU (2011) summarises available options that can help communities better adapt to climate change:

- Establishment of a system of early warning and disaster management;
- Developing systems for crop and livestock production adapted to climate change;
- Improved water management in agricultural systems;
- Promotion of aquaculture in appropriate areas.

2.1.3. Projects and activities implemented in the context of climate change management

In the context of the definition and implementation of policies for managing climate change, MEPN has implemented two projects mainly focused on climate change, namely the Programme CC-Train (Programme for Capacity Building in Climate Change) and Project BEN/98/G31 (National Communication on Climate Change). These projects have helped to: develop knowledge on climate change in Benin; develop a national strategy for the implementation of the UNFCCC; raise awareness among policy-makers in Benin on policies and measures to mitigate the adverse effects of climate change; strengthen the capacity of national actors involved in climate change issues and develop and adopt the National Strategy for Implementation of the Framework Convention of the United Nations on Climate Change and Benin's Initial Communication on Climate Change.

Other projects and activities have also been carried out within the framework of sustainable management of the environment, and still more are in progress, namely the Environmental Management Project (PGE), the Programme of Assistance to Communication and Information on Environmental Protection (PACIPE), the National Ozone Project for Benin, the Environmental Advisory Project (PCE), the Implementation of the Convention on Biological Diversity, the Project for Management of Solid Waste, the Natural Resource Management Project (PGRN), Support for the Implementation of the National Action Programme to Combat Desertification (PAN/LCD), the development of the National Environmental Management Programme (PNGE), the development of the National Strategy to Combat Atmospheric Pollution in Urban Areas, the Programme for Management and Conservation of National Parks (PCGPN), the Programme for Rational Use of Protected and Contiguous Areas and their Zones of Influence in Benin, Burkina Faso and Niger (ECOPAS), the Project for Management of Riverine Forests and Lands (PGFTR), etc. (see MEHU, 2010). Although these projects and initiatives do not fall directly within the framework of the fight against climate change, they help in the management of its impacts in terms of adaptation or mitigation.

In the implementation of the policy on climate change in the agricultural sector, MEPN is accompanied by other structures, namely the Ministry of Agriculture, Livestock and Fisheries (MAEP).

2.2. Ministry of Agriculture, Livestock and Fisheries (MAEP)

The Ministry of Agriculture, Livestock and Fisheries (MAEP) is the department responsible for the design and implementation of agricultural policy in Benin. MAEP implements its agricultural policies on the ground through decentralised operational arms, which are responsible for research, extension/advisory services, and support to producers. These structures are assisted by international research institutions, universities, national and international NGOs, international organisations providing technical and financial support,

and producer organisations.

2.2.1. MAEP institutions involved in the management of climate change

Benin National Institute of Agricultural Research

The Benin National Institute of Agricultural Research (INRAB) is the public agency responsible for the implementation of the agricultural research policy as defined by MAEP. INRAB is composed of: several Regional Research Centres (Centre for Agricultural Research - North, Centre for Agricultural Research - Central, Centre for Agricultural Research - Niaouli, Centre for Agricultural Research – Agonkanmey); Research Centres with commodity mandates (Centre for Agricultural Research - Cotton and Fibre, Centre for Agricultural Research - Perennial Crops, Centre for Agricultural Research - Oil Palm); and research centres dedicated to specific research programmes (Food Technology Programme (PTA) and Programme for Agricultural Policy Analysis (PAPA).

INRAB is also conducting several research programs in collaboration with some international partners. For example, INRAB is a partner in the research project on drought tolerant maize (Drought Tolerant Maize for Africa), led by CIMMYT (International Maize and Wheat Improvement Center) and IITA (International Institute of Tropical Agriculture) and funded by the Bill and Melissa Gates Foundation. The objective of this project, which also involves other countries throughout Africa, is to reduce hunger and increase food and income security of the rural poor through the development and dissemination of maize varieties. So since 2007 new technologies (improved varieties, etc.) are the subject of trials and evaluations, on-station and on-farm.

Regional and Communal Centres for Agricultural Promotion

Regional and Communal Centres for Agricultural Promotion are decentralised organs of MAEP which are in charge of the implementation of the agricultural advisory policy at levels of Départements and Communes³ respectively.

2.2.2. Development of policies on climate change

MAEP is not responsible for the drafting of the policy against climate change, but it incorporates the recommendations of MEPN for the agricultural sector in its design and implementation of agricultural policy. In agriculture, several agricultural policy documents have been developed and actions implemented, and others are in progress in order to develop the agricultural sector in Benin in environmentally-sustainable ways. The main agricultural policy documents prepared by MAEP from the early 90s to the present day are

³ These are local government units : Benin is divided into 12 Départements and 77 Communes

the Policy Statement for Rural Development (LDPDR), the Programme for Restructuring the Agricultural Sector (PRSA), the Policy Statement on Sustainable Development (DPDR), the Master Plan for Agricultural and Rural Development (SDDAR), the Policy for the Promotion of Women in the Agricultural Sector and Rural Development (PPFR) which is an offshoot of the National Policy for the Advancement of Women (PNPF), the White Paper on Agricultural Advisory Services (LBCA), the National Strategy for Implementation of Agricultural Advisory Services (SNCA), the Strategic Plan for Revival of the Agricultural Sector (PSRSA), and the National Agricultural Investment Plan (PNIA) 2010-2015. These documents show that unlike MEPN, MAEP has not developed policy documents narrowly focused on climate change. This shows that MAEP does not have a specific strategy against the negative effects of climate change on the agricultural sector. Nevertheless, the issue of climate change has in some way been taken into account in the above-mentioned documents.

Consideration of climate change in the agricultural sector within agricultural policy documents has evolved over time. Indeed, the first documents developed in the 90s were much more focused on the sustainability of agriculture, aiming for conservation and wise use of natural resources in production systems. Thus, recommendations include the intensive management of water and of soil fertility, taking into account the agro-ecological and socio-economic conditions, and the promotion of a set of technologies and organisational and socio-economic measures within agriculture (MDR, 1991). The State should ensure the rational use of natural resources, respect the relevant laws in force, and mobilise research for the development of appropriate responses to the problems of resource degradation (reduced fertility, loss of forests, depletion of fisheries resources, etc.).

Recent agricultural policy documents have explicitly recognised the threats of climate change to the agricultural sector in Benin (MAEP, 2010; MAEP and MEF, 2010). It is recognised in these documents that the productive agricultural sector in Benin is characterised by the predominance of small farms and the sector's vulnerability to climate variability and extreme weather events. Current climate challenges (climate variability, extreme weather events, climate change) could further exacerbate the difficulties, delay the relaunch of the agricultural sector, and hamper efforts to reduce poverty (MAEP, 2010). The following threats of climate change to agriculture have been identified (MAEP, 2010; MAEP and MEF, 2010; Houndénou, 2005):

- Decline in average rainfall;
- Decline in soil fertility;
- Decreased production and yields;

- Reduction of water resources;
- Changes to the agricultural calendar;
- Risk of food insecurity;
- Reduction of fisheries resources; and
- Deforestation.

Thus, efforts to adapt production systems to climate change are seen to be indispensable: starting from the proper management of land and water to increase agricultural productivity while ensuring the preservation of ecosystems (MAEP, 2010). To this end, efforts have been proposed to adapt agricultural production to climate change, namely (MAEP, 2010: 50):

- The development and implementation of adaptation strategies to climate change for the management of land and water at the level of communes or groups of communes;
- The establishment of an early warning system for food security;
- The adoption of farming practices that limit water losses through evaporation and runoff, and
- The development of short cycle crop varieties resistant to drought.

2.2.3. Projects and activities implemented in the context of climate change management

Due to the lack of a national policy on climate change and agriculture as defined by MAEP, INRAB's work on climate change is not yet well-coordinated. Thus, individual actions are undertaken by researchers from some research centres attached to INRAB. The Centre for Agricultural Research - Cotton and Fibre is working with producers to develop innovations that will allow producers to adapt to adverse climate change in the production of cotton. The centre is engaged in the study of planting dates in order to adapt to variability and change in the seasons. The objective is to identify the planting dates that are suitable for planting cotton on the due date. The centre also implements trials on Integrated Soil Fertility Management to combat the negative effects of climate change. This involves developing innovations to maintain soil moisture through the use of organic inputs such as manure (collected by corralling animals), the use of powdered nightsoil, and the manufacture and use of compost. Properly using these organic inputs alongside chemical fertiliser will allow the retention of soil moisture for cropping.

In the field of advisory services and extension, although the documents remain at a level of generality by not giving specific attention to climate change (see the LBCA and the SNCA), issues arising in adaptation to climate change are taken into account (again see the LBCA and SNCA). Thus advisory activities and agricultural extension deal with soil fertility management, and sustainable management of the environment and natural resources (land, water, forests, etc.), within the context of advisory activities such as technical advice on agronomy, on land and natural resource management, on agricultural equipment, on aquaculture and fisheries, and on livestock production (DICAF, 2008; MAEP, 2007).

3. Government Projects

In the implementation of agricultural and environmental policy, MAEP develops and implements projects with technical and financial support from donors. These projects and programmes are implemented on the ground, often with the support of NGOs. Among projects or programmes more explicitly engaged in large-scale agricultural advisory services are the Project to Support Farming Dynamics (PADYP) and the Capacity Building Programme for Cotton Producers' Organisations (PROCOTON).

3.1. Project to Support Farming Dynamics

PADYP is a project funded by the French Agency for Development (AFD) and placed under the supervision of MAEP. It aims to help promote sustainable farming to increase and safeguard the incomes of producers. PADYP operates under four components:

- Advisory Services for Family Farms (CEF) in 42 communes over 11 Départements, the objective of which is to increase farmers' incomes through improved management of productivity by a process of decision support and ongoing advice on agronomy and business management.
- Advisory Services on Management of Producer Organisations (CdG-OP) in 18 communes over 5 Départements, the objective of which is to help improve organisational and financial management of grassroots producer organisations.
- Monitoring and Evaluation of the programme, the objective of which is to facilitate the management of the programme, by measuring its impacts and promoting sustainable approaches to advisory services.
- The Development Fund for Specific Services (FDSS), the objective of which is to place CEF methods in the training curricula of agricultural high schools and Faculties of Agronomy, to support and sustain the initiatives of CEF beneficiaries and grassroots

producer organisations, and ultimately to support research and development.

PADYP as a project does not explicitly address climate change, but PADYP's farm advisers, in their role as facilitators, are expected to lead farmers towards appropriate specialists (from public research and extension organisations, but also possibly from climate-related projects).

3.2. Programme for Capacity Building of Cotton Producers' Organisations

PROCOTON is a programme funded by the Netherlands Organisation for Development (SNV) and implemented by NGOs and producer organisations with which the SNV signs contracts to be implemented grassroots level. This programme aims to improve cotton production through support to producer organisations in the cotton and cotton production. PROCOTON, through its NGO partners, supports the proper management of soil fertility by farmers. However, this program does not explicitly address climate change.

3.3. Interdisciplinary and Participatory Research Project on Interactions between Ecosystems, Climate and Societies in West Africa

The Interdisciplinary and Participatory Research Project on Interactions between Ecosystems, Climate and Societies in West Africa (RIPIECSA) was a project funded by AFD in 17 countries in West Africa, including Benin. The programme's goal was to support scientific policy responses to climate change through the promotion of scientific research and capacity building for African researchers. In the context of research, one component was dedicated to climate change and climate variability. Projects implemented under this component aimed to (i) characterise climate variability in West Africa, (ii) improve seasonal forecasting and (iii) provide a more solid basis for climate projection models. Among these projects were:

- Evaluation and improvement of the early warning system in the context of agro-silvo-pastoral production in West Africa;
- Improved weather forecasting over short-term to seasonal timescales;
- Support for meteorological services in West Africa for the development of an agro-climatic atlas;
- Modelling of rainfall and climate in West Africa.

4. Non-Governmental Organisations

NGOs involved in agriculture join with MAEP in implementing national agricultural policy, so some among them are implementing actions that fall within the scope of adaptation to climate change.

4.1. Initiatives for Sustainable Integrated Development (IDID)

The NGO IDID was the implementing agency for the Project for Strengthening Rural Adaptive Capacity for Climate Change in Benin (PARBCC), with financial support from the Climate Change Adaptation in Africa Programme of DFID and the International Development Research Centre (IDRC).

A participatory climate risk assessment identified heavy rainfall events and/or flooding, late rains prolonging the long dry season, violent winds, spatial and temporal variability of rainfall and poor intra-seasonal rainfall distribution, dry spells during the rainy season, and premature ending of the rains as major climate risks. Faced with these risks, farmers develop autonomous adaptation strategies that may be considered as unfounded or of very limited efficacy.

Trials of participatory farmer field schools have been conducted to test and improve technical options for adaptation, alongside farmers. Fact sheets have been developed to assist producers in managing the effects of climate change. These cover:

- Inputs of organic matter and chemical fertiliser to a cowpea/maize rotation to counteract the effect of dry spells in the rainy season;
- Alley cultivation of maize in between pigeon pea, with fertiliser application, to counteract lodging of maize in high winds, and lower yields;
- The use of mucuna as a cover crop to manage the effects of late rains, prolonging of the long dry season, dry spells within the rainy season and premature ending of the rains;
- The digging of *zai* (small pits for planting filled with compost or manure), also against dry spells within the rainy season and premature ending of the rains.

IDID has built on the achievements of PARBCC with various successor projects. It implemented two projects within the joint UNEP/UNDP programme CCDARE (Climate Change and Development - Adapting by Reducing Vulnerability), one in the Département of Alibori and one in selected vulnerable communes countrywide. In these projects, the NGO

organised:

- Training of stakeholders involved in the development at commune level (technical staff of communes, commune centres for the promotion of agriculture, commune centres for the protection of the environment, umbrella organisations of producers, civil society organisations, etc.) and, particularly in the second project, elected local representatives;
- Drafting of practical manuals for the mainstreaming of adaptation to climate change in local development planning and contingency plans for climate-related disasters;
- Awareness-creation on climate change

Also based on the results of PARBCC, the Project to Strengthen Economic Knowledge and Adaptive Capacity in the face of Climate Change in Benin (PRECAB), launched in 2011, aims to carry out in-depth economic studies (cost-benefit analyses, Multi-Criteria Analyses) comparing the adaptation options identified in the PARBCC, to identify those that offer the most benefits to producers, while allowing them to cope with climate risks. The overall objective of this project is to improve the adaptive capacity and resilience of communities to climate change in order to counteract its negative impacts on food security and rural poverty in Benin. Specifically, the project aims to:

- Deepen research on adaptation options identified in the farmer field schools through a detailed economic analysis, cost/benefit analysis and feasibility analysis for scaling-up;
- Develop an approach based on Participatory Action Research for integration of adaptation and adaptation assessment in sectoral development plans at various scales (local, regional and national);
- Strengthen the capacity of Commune Committees for Early Warning and Adaptation to Climate Change in management of risk and climate-related disasters, monitoring and evaluation, and local-level implementation of adaptation;
- Assure coordination, monitoring and evaluation, and communication and follow-up of the results and achievements of the project.

The main donor for PRECAB is IDRC, through the African Adaptation Research Centres Initiative.

4.2. Organisation for the Promotion of Organic Agriculture in Benin (OBEPAB)

OBEPAB is a non-political NGO established in 1995. It works for sustainable development by focusing on the development of local resources and the development of sustainable agricultural production systems, the preservation of the health of producers and consumers, and safeguarding of the environment. OBEPAB aims to:

- Promote organic farming and to develop expertise in this area for more environmentally friendly agricultural production;
- Work for the gradual establishment of sustainable – that is to say economically profitable and socially equitable - organic value chains;
- Promote action-research on the issues of the environment and the preservation of the health of producers and consumers;
- Contribute to educate and inform the development community, consumers, producers, processors, researchers, students, policy makers and donors on synthetic chemical pesticides;
- Contribute to raising producers' confidence in their ability to participate in development.

These objectives show that although OBEPAB may not have objectives explicitly related to climate change, however, it addresses topics that implicitly fall within the framework of adaptation to climate change.

4.3. Unit for Support to the Development of Management Advisory Services (CADG)

The NGO CADG was founded in 1997 and is a forum for exchange of experiences, reflection on methodologies and discussion of tools for management advisory services. It is thus an NGO involved in extension and advisory services. It implements the Advisory Services for Family Farms (CEF) as part of PADYP in two northern departments, Atacora and Borgou. This NGO currently has no activities specifically related to climate change. However, in its extension and advisory services, it works on themes implicitly linked to climate change, especially on Integrated Soil Fertility Management in cotton production in Northern and Central Benin.

4.4. Aquaculture and Sustainable Development (AquaDeD ONG)

AquaDeD's main mission is to fight against poverty through the promotion of aquaculture (production of fish, shrimps, crabs, molluscs, etc.) the integration of agriculture and

aquaculture, and the judicious use of natural resources, as an entry point for sustainable management of biodiversity in natural aquatic ecosystems. This NGO is also promoting participatory development at grassroots level, the establishment of sustainable production systems and capacity-building for women, youth and local officials in participatory and sustainable grassroots development. Although AquaDeD is not working explicitly on climate change, it addresses topics that fall within the scope of producers' adaptation to climate change and the counteracting of its negative effects, including the following:

- The restoration of biodiversity through tree planting;
- Restoration of fish spawning areas;
- The promotion of aquaculture; and
- Adaptation of fishing techniques to hydro-climatic changes.

In this context the NGO is in partnership with institutions such as the Dutch section of IUCN, the international NGOs Both ENDS and Wetlands International, the University of Namur, and national NGOs such as Initiatives for Sustainable Integrated Development, OFEDI and Nature Tropical.

4.5. Support Group for Management and Research on Environment and Development (GERME)

GERME is an NGO founded in 1998 that supports farmers and their organisations on technical and economic aspects of agriculture through agricultural advisory services. This NGO has no projects or programmes of activity in the field of climate change. However, it supports producers in the use of techniques forming part of Integrated of Soil Fertility Management (ISFM) in pineapple production in southern Benin.

4.6. African Institute for Application of Development Methods (IAMD-ONG)

IAMD uses the Advisory Services for Family Farms approach (CEF), developed under PADYP, to advise farmers on cotton production techniques and efficient management of their farms as an activity of PROCOTON. Although IAMD has no explicit project or activity on climate change, it still gives advice to producers and rural communities on topics related to climate change such as environmental protection, agro-forestry, and training and awareness-raising on crop rotations and the use of green manures.

5. Agricultural producers' organisations

The Federation of Producers' Unions (FUPRO) is the main national umbrella of all agricultural producers' organisations in Benin. It is represented at the departmental level and even at the municipal level through its decentralised structures that are respectively the

Departmental Producers' Unions and the Commune Producers' Unions. FUPRO implements projects for support and advice to farmers with technical and financial support from partners such as AFD, SNV, Belgian Technical Cooperation etc.. FUPRO is not working on climate change in a strict sense at the moment. However, it works on topics that fall within the scope of adaptation to climate change such as Integrated Soil Fertility Management and Integrated Water Resources Management.

6. The National Universities

The Universities of Abomey-Calavi and Parakou are very active in the field of climate change, indeed are known as centres of excellence in research in the field. Specifically, the Faculty of Agricultural Sciences at the University of Abomey-Calavi and the Faculty of Agronomy of the University of Parakou have carried out studies and have others in progress, in the field of climate change and agriculture. They are also involved in several studies on climate change undertaken by ministries, technical agencies, NGOs and projects. These faculties have addressed topics of vulnerability and adaptation to the adverse effects of climate change. Most of their research on climate change in agriculture focuses on farmer perceptions and farmers' adaptation strategies, assessing the vulnerability of agriculture to climate change and the sustainability of production systems in contributing to food security.

The Project on Integrated Management of Water and Nutrients, INuWaM, is a project funded by IDRC which covers Niger, Mali, Burkina Faso and Niger. INuWaM is a project piloted in Benin by the Faculty of Agriculture at Parakou. INuWaM sets out from the fact that climate change is already a reality, which means action is necessary to mitigate the causes and adapt to its effects. The project aims to provide solutions to the negative impacts including soil erosion and declining soil fertility through loss of soil nutrients, through the integrated management of water resources. The project has developed, with the participation of "contact farmers", innovations that might counteract these problems of climate change.

The Project on Better Management of *Bas-Fonds*⁴ in Southern Benin for Improved Food Security in the Context of Climate Change is funded by the START programme and led jointly by the two University faculties. It has as its project activities: (i) evaluating the adequacy of existing types of management of the *bas-fonds* in the context of climate change, (ii) assessing the vulnerability of farmers to climate change and appropriate adaptation strategies for the *bas-fonds*, and (iii) capacity-building of stakeholders on best management practices.

⁴ Small wetlands used seasonally for agriculture, a term common in francophone Africa

In the context of partnerships between IDID and the two Faculties, studies have also been conducted on the following topics:

- Climate Change and Change in Planting Times of Major Crops in Alibori: case studies of Malanville and Banikoara Communes. Master's thesis in the Faculty of Agronomy of the University of Parakou;
- Vulnerability of Water Resources in the Face of Climate Change and Endogenous Management Strategies Developed in the Agricultural Sector: the case of Banikoara and Malanville Communes. Master's thesis in the Faculty of Agronomy of the University of Parakou;
- Farmers' Water Control Strategies in the Face of Climate Change and Climate Variability: the case of Lalo Commune. Bachelor's Dissertation in the Faculty of Agricultural Sciences at the University of Abomey-Calavi;
- Agriculture and Climate Change in Benin: Climate risks, vulnerability and adaptation strategies of rural people in Couffo Département. Master's thesis in the Faculty of Agricultural Sciences at the University of Abomey-Calavi.

7. Conclusions

Efforts are being made at the national level in Benin to comply with international agreements in relation to climate change. The Ministry of Environment and Protection of Nature holds the mandate for, and works on, the management of climate change in all sectors. Agriculture, as both a factor in and a victim of climate change, needs to be better taken into account in MEPN's programmes. On the other hand, the institutions and policies for agricultural development, insufficiently involved in the activities of MEPN, do not seem either to take climate change into account, either sufficiently explicitly or sufficiently well. Coordination mechanisms between the ministries of environment and agriculture must be strengthened so that high-level policy discourse can result in concrete actions on the ground. In addition to the actions of organisations in charge of the definition and implementation of public policies, several other organisations (NGOs, development projects, producer organisations, research centres and training) mobilise international funding to develop localised activities specifically aimed at adapting to the effects of climate change or improving resilience to climate change of various actors, including farmers.

It appears from the results of our interviews that the institutions organising agricultural advisory services do not systematically or explicitly take climate change into account in their interventions. Similarly, organisations explicitly involved in the management of climate change do not have a strong expertise on agricultural advisory services. Organisations

acting on climate change in the agricultural sector can be classified into two categories, namely those that act directly to mitigate the causes of climate change and adapt to its adverse effects, and those working on topics such as environmental management and protection, Integrated Soil Fertility Management, and management of water resources, which are all issues that relate to climate change. Research and development with rural people on these issues will allow them to adapt to the adverse impacts of climate change.

Finally, promising experiences that can be investigated in more detail are:

- The Project to Strengthen Economic Knowledge and Adaptive Capacity in the face of Climate Change in Benin (PRECAB) and its predecessors, with their experiments in participatory technology development;
- The Project on Integrated Management of Water and Nutrients (InuWaM) with its intervention mechanism based on contact farmers for the development and dissemination of innovations that counteract problems of climate change;
- The Project on Better Management of *Bas-Fonds* in Southern Benin for Improved Food Security in the Context of Climate Change with its approach of building the capacity of stakeholders on best management practices for the *bas-fonds* in a context of climate change.
- The participatory research project on drought tolerant maize (Drought Tolerant Maize for Africa) aiming at participatory development and dissemination of drought tolerant maize, for and with poor farmers.

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This document is an output from a project funded by the UK Department for International Development (DFID) and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries. However, the views expressed and information contained in it are not necessarily those of or endorsed by DFID, DGIS or the entities managing the delivery of the Climate and Development Knowledge Network, which can accept no responsibility or liability for such views, completeness or accuracy of the information or for any reliance placed on them.