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A report on EU-Africa joint requirements for cooperation and capacity building (including human capital development) for research on food and nutrition security and greenhouse gas observations under a changing climate.



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SEACRIFOG Deliverable 1.2

List of acronyms

Africa Rice Center
Centre Régional AGHRYMET
African Union
Climate Change
Consultative Group on International Agricultural Research
Methane
Euro-Mediterranean Center on Climate Change
carbon monoxide
Carbon Dioxide
Conference of Partis
Directorate-General for International Cooperation and Development
European Commission
European Union
Green Climate fund
Greenhouse Gas Observations
International Crops Research Institute for the Semi-Arid Tropics
Intended Nationally Determined Contributions
Joint Africa-EU Strategy
National Agricultural Research Systems
Nationally Determined Contributions
Nitrous oxide
Numerical Weather Prediction
Partnership on Climate Change
Paris Committee in Capacity Building
Research Infrastructure
Southern African Development Community
Supporting EU-African Cooperation on Research Infrastructures for Food
Security and Greenhouse Gas Observations
United Nations Development Programme
United Nations Framework Convention on Climate Change
Vulnerability Assessments
West African Science Service Center on Climate Change and Adapted
Land Use,
Work Package



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Summary

In Africa policymakers, scientists and land-use decision makers are increasingly dependent on knowledge on the state of the environment. Long-term observational systems and research infrastructures have been identified to be indispensable elements of knowledge generation to serve climate change adaptation, food security, and climate change mitigation.

Inside this WP1 "User needs and knowledge gaps" under the lead of CMCC and the responsibility of WASCAL for submitting deliverable D1.2, we provide a pioneering approach to underline key information on EU-Africa joint requirements for cooperation and capacity building (including human capital development) for research on food and nutrition security and greenhouse gas observations under a changing climate. The key requirements for cooperation and capacity building between Europe and Africa emphasis by several authors in the identified thematic themes gathered from journal's review, online surveys and face to face interviews were summarized and presented in the form of flowcharts, figures and tables. In addition to this, information were collected based on expert's judgments with regards to crop yield models through a designed questionnaire.

The most supporting actions from Europe to Africa in adaptations strategies to climate change were focused at the regional and national level. For this purpose according to the underlined various sources above, there is a need:

➢ for prioritizing adaptation and mitigation efforts at the local level,

 \succ to strengthen the capacity of the local government officers who were most concerned by the implementation of various projects in the field. In this context, human development or the capacity building is crucial to target development at the local and household level. In addition climate adaptation was widely accepted as an important issue for planning conducted by local governments. There is a need to go beyond the individual level, and to plan and provide support for appropriate technologies and strategies and in addition considerable efforts should be made to increase the initial likelihood of adoption,

 \succ for cooperation between African and European scientists for research development for updating of the sowing date in African Agro-Ecological Zones. This cooperation must involve the technology transfer process and the way to strengthen capacity of technical officers of various institutions in Africa for the acquisition and the maintenance of these technologies related to rainfall stations,

> priority needs to be given to adaptation and implementation of comprehensive programs on water management and irrigation, desertification control, development of alternative sources of energy and the promotion of sustainable agricultural practices by farmers. In addition the predominant approach to analyzing climate change and food security in sub-Saharan Africa has been to couple EU-African scientists to model the effects of future climate change scenarios on food production.

> Even if mitigation is not a priority for Africa, it is urgent to underline some few key requirements (modernization of bio-energy, replace slash-and-burn to slash-and-char, great interest in microalgae as source of renewable energy, focus a new appraisal on CO_2 mitigation and renewable oil from photosynthetic microbes, research and field demonstration of synergy between mitigation and adaptation) for EU-Africa cooperation and capacity building. These requirements can be involved or coupled together with adaptation initiatives when defining the ways for cooperation between Europe and Africa in a multi stakeholder's panel's engagement for research and capacity building.

 \succ Speaking about uncertainties in crop yield models experts think that it can be reduced by using local agronomy data and sharing these through a global platform which must follow the data sharing protocol rule. Another approach to reducing uncertainties in crop yield predictions is ensemble modelling. For this purpose, there is a need for a strong cooperation between



African and European's modelers to set out the strength and weakness of most frequent used models by users and to find the way to build these ensemble models. In addition, strong cooperation between South and Northern scientists must conduct to a platform on which data format protocol will be designed.

> Available observed precipitation products over Africa are limited and station density is too low for comprehensive monitoring of extreme events. Therefore, care should be taken in order to take advantage of the improvements and developments in observational datasets for Africa. To build these chains, the EU-Africa research institutions should work closely together in order to increase the density of the network, adapt the stations to the newest technology and ensure a reliable transfer of observations on the global or regional telecommunication system. In one word, a systematic initiative should be taken in order to improve the quality, value, and training in use of NWP (Numerical Weather Prediction) products for local meteorological agencies in Africa.

> According to official documents, a fundamental motive for the JAES (Joint Africa-EU Strategy) on both sides was to establish a more political and strategic partnership than preceding frameworks for Africa-EU relations. This partnership would be based on common values and interests, pursuing peace, security, human rights, democratic governance, economic and social development, and environmental sustainability on both continents.

➤ The Africa-EU dialogue could help to elaborate an African climate policy framework providing guidance (governance principles, common priorities, and accountability mechanisms) to African countries for their climate policy processes, supporting local initiatives in the context of the multilateral policy framework, ensuring that climate policies are coherent with policies in other sectors, and strengthening their "readiness" for climate finance instruments such as the GCF (Green Climate fund) and those of European bilateral donors,

> A policy dialogue could convene African and European stakeholders in the coming months, bringing together negotiators, policymakers, experts and civil society representatives to share views and jointly elaborate a practical concept of equity in the context of the climate negotiations.

➤ The Africa-EU dialogue could yield balanced contributions to the debate on differentiation in mitigation commitments in the post-2020 climate regime.

> The private sector may also invest more in mitigation than in adaptation, since the latter does not offer an immediate financial return,

Finally, for a real development of African countries under a climate change conditions, care should be taken to these requirements (needs) or priorities when developing projects proposal in the future.



INTRODUCTION

African societies face growing global change risks, with rapidly changing patterns of human settlements and intensity of use of ecosystem services. At the same time, climate variability and climate change trends are intensifying stress on the ecosystems that ensure environmental security, both locally (e.g. ecosystem services), regionally (e.g. sustainable development options) and internationally (e.g. carbon sequestration). Approaches that can address this challenge in an integrated and multidisciplinary way are urgently needed in many places in Africa where there is a close relationship between societal well-being and environmental condition, relating particularly to biomass for energy and food production, and hydrological considerations such as water yields. Policymakers and land-use decision makers are increasingly dependent on knowledge on the state of the environment. Long-term observational systems and research infrastructures have been identified to be indispensable elements of knowledge generation to serve climate change adaptation, food security, and climate change mitigation.

In the setting of the SEACRIFOG project under WP1 (Work Package 1) the deliverable D1:1 and D1:2 aim to:

- ✓ Assess needs and gaps, in terms of data, knowledge, capacities and research infrastructures in Africa (with respect to Europe) in the fields of food and nutrition security as well as greenhouse gas observations under a changing climate.
- Support the other WPs providing them with required information about user needs and gaps.

WASCAL has the responsibility to submit the deliverable D1.2 under the framework of the following tasks, with the collaboration of CMCC.

For this purpose the concerned tasks are:

Task 1.2 Knowledge needs and gaps

Tasks 1.3 Data needs and gaps

The deliverable D 1.2 which will use the results from the above mentioned tasks to formulate appropriate EU-Africa joint requirements for cooperation, capacity building, food security and greenhouses gas observations is structured in four parts as follow.

The first part outlines the objectives and the methodological approaches used to obtain various results.



The second part was focused on the results which outlined keys EU-Africa joint requirements for cooperation and capacity building (including human capital development), for research on food and nutrition security and greenhouse gas observations under a changing climate. The third part mentioned difficulties met during this research. The fourth part of the document presented the conclusion.

1. Objectives and methodology

1.1 Objectives

The specific objectives of the deliverable D 1.2 in combination with the deliverable D 1.1are:

- ✓ Assess needs and gaps, in terms of data, knowledge, capacities and research infrastructures in Africa (with respect to Europe) in the fields of food and nutrition security as well as greenhouse gas observations under a changing climate.
- ✓ Support the other WPs providing them with required information about user needs and gaps.

With regard to these objectives and in the setting of the main Project, the Figure 1 illustrated the inter-relationship between WPs. The current deliverable (D 1.2) is a part of WP1 (Fig. 1).



SEACRIFOG Consortium



Fig 1. Simplified overview of the SEACRIFOG project structure including the central aims and the main role of the individual work packages.

1.2 Methodology

To identify essential requirements for EU-Africa cooperation and capacity building (including human capital development) for research on food and nutrition security and greenhouse gas observations under a changing climate three main approaches were used. These approaches have each, various steps to reach the objectives and were compiled together with the aim to formulate appropriate requirements.

The three main approaches of concerned (Fig. 2) are:

- ➢ Literature review,
- Questionnaire design and online surveys,
- Interviews of experts from West African institutions

For the first approach, it has been illustrated by producing a combined mapping and clustering of the most frequently cited publications that appeared in the above mentioned thematic areas of concern for the period 2006-2016 using the Software survey: VOSviewer, a computer program (Eck and Waltman, 2018) as proposed in the project proposal was used. In the case the thematic area does not belong to the Crossref database, simple web search were done till we get the maximum documents which are suitable to our research.

The second approach was based on the questionnaire design and online surveys. The results were presented based on the cluster obtained from each defined sub-theme (Table 1).

When we have finished to gather information collected from the above mentioned two approaches we have decided to fill the gaps by visiting regional institution in West Africa. For this matter a regional trip was done and we were able to have face to face interviews from Consultative Group on International Agricultural Research (CGIARs) and national and regional institutions such as AGHRYMET, ICRISAT; NARS, AfricaRice and universities. This has help to confirm the relevance of what has been obtained from the previous two approaches.

The Figure 2 shows various steps used to obtain the keys findings of our research.





Fig 2. Flowchart showing the methodological approach

Table 1. Key mematic area	Table	1	:	Key	thematic area
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Sub-themes	Number of collected documents from Crossref database if available	Number of clusters	Number of most important selected / searched documents
User needs and knowledge gaps on climate change adaptation strategies	2346	07	39
User needs and knowledge gaps on climate change mitigation strategies	756	08	21
Uncertainties of scientific models on crop yield	-	-	42
Uncertainties in observed precipitation products and weather forecasting models	-	-	12
Climate change and EU-Africa cooperation	-	-	05



2. Results

Inside this WP1 "User needs and knowledge gaps" under the lead of CMCC and under the responsibility of WASCAL, we provide a pioneering approach to underline key information on EU-Africa joint requirements for cooperation and capacity building (including human capital development) for research on food and nutrition security and greenhouse gas observations under a changing climate.

2.1. Requirements for EU-Africa cooperation on climate change

Africa and the EU have interacted in relation to climate policy in several ways. Since the 2011 Durban climate change conference, the EU and Africa have exhibited a rapprochement, perhaps realising that they had more to gain from a joint approach than replicating the antagonistic positions taken in Copenhagen years earlier.

2.1.1 Required common agenda for EU-Africa cooperation to combat Climate Change

The Joint Africa-EU Strategy (JAES), adopted at the 2007 Lisbon Summit, was intended to play a pivotal role in Africa-EU relations. Climate change is a priority area of the Africa-EU relations. According to official documents, a fundamental motive for the JAES on both sides was to establish a more political and strategic partnership than preceding frameworks for Africa-EU relations (AU-EU, 2007). This partnership would be based on common values and interests, pursuing peace, security, human rights, democratic governance, economic and social development, and environmental sustainability on both continents. Initially, the Partnership on Climate Change (PCC), one of the eight thematic partnerships of the JAES, formulated a number of actions to support African negotiators' engagement in the multilateral climate negotiations and implement adaptation and mitigation measures. For the EU, the PCC potentially could build up the web of political and diplomatic relations it had weaved to foster coalitions of the willing in the UNFCCC negotiations and implement the international climate regime. For Africa, this partnership with Europe offered the opportunity to strengthen its role in the negotiations and further develop its continental approach to fighting climate change.

The Partnership on Energy too was intended to contribute to the response to climate change. Overall, this partnership might have improved the communication among African and EU actors and the coherence among some of their joint actions related to climate change compared to a situation without the JAES.



Despite a mixed record, the dialogue framed by the Joint Africa-EU Strategy (JAES) has illustrated how an interregional partnership could contribute to the multilateral climate regime through cooperation at a more practical level (Tondel et al., 2015). Based on their respective and shared experiences, beyond the JAES, Africa and Europe could offer solutions and compromises that break some of the deadlocks in the UN negotiations. This could level the playing field for all actors and promote coherence, effectiveness and equity in global development and climate policies.

2.1.2 Revisiting the rationale of an EU-Africa dialogue on climate change

The main objective of the PCC was to tackle climate change through a continent-to-continent dialogue and cooperation in the context of a multilateral framework. The Africa-EU dialogue could help to elaborate an African climate policy framework providing guidance (governance principles, common priorities, and accountability mechanisms) to African countries for their climate policy processes, supporting local initiatives in the context of the multilateral policy framework, ensuring that climate policies are coherent with policies in other sectors, and strengthening their "readiness" for climate finance instruments such as the GCF and those of European bilateral donors. Such a framework would take into account intra-regional and continental linkages in vulnerabilities and responses to climate change, for example, for the management of trans-boundary forestry and water resources. In addition, in the short term it would be useful to track resources funding capacity building activities for African climate policymaking structures and negotiators.

On the EU side, the EC, EU member states, and various instruments certainly have roles to play in different and complementary ways. For example, EU institutions and member states may have to play complementary roles in supporting the private sector in the development and the transfer of low-carbon technologies. The JAES could facilitate the definition of complementary roles. It could also support a sound dialogue on the coherence of policies in the EU and Africa with climate change adaptation and mitigation objectives (and general development objectives in the context of climate change), especially with regards to the most vulnerable parts of Africa.

2.1.3 Promoting a common notion of equity

According to the Africa-EU ministerial statement on climate change in April 2014, African and European Parties agreed that, given the binding target for the global temperature increase of 2°C, *all Parties* should contribute to mitigating climate change, on the basis of equity. They



also acknowledged that, for developing countries, economic and social development is a priority over mitigation, and that adaptation to climate change and low-carbon economic growth are necessary for sustainable development (European Commission, 2014b).

A policy dialogue could convene African and European stakeholders in the coming months, bringing together negotiators, policymakers, experts and civil society representatives to share views and jointly elaborate a practical concept of equity in the context of the climate negotiations. It is crucial that the concept of equity considers the multiple elements of the UNFCCC process, including mitigation, finance, adaptation, loss and damage, capacity building, technology, transparency and accountability. In addition, this approach to equity should consider a timetable for countries' commitments (Morgan *et al.*, 2014).

2.1.4 Cooperating for adaptation and mitigation

Globally, GHG emissions abatement commitments for both the pre-2020 and post-2020 periods have to be more ambitious than they currently are to prevent temperatures from rising by more than 2°C. The Africa and EU blocs could join forces to advocate and negotiate for higher mitigation commitments from other Parties. Given the apparent willingness of both sides to formalise a framework for mitigation commitments that goes beyond the developed-versus-developing countries mind set, the Africa-EU dialogue could yield balanced contributions to the debate on differentiation in mitigation commitments in the post-2020 climate regime.

2.1.5 Financing the fight against climate change

Financing low-carbon and climate-resilient development has been a key sticking point of the UNFCCC debates. The EU states that public sector climate finance will continue to play a key role in mobilising resources after 2020, but it also recognises the importance of the private sector (European Commission, 2015b). According to Knaepen, (2014) the private sector may also invest more in mitigation than in adaptation, since the latter does not offer an immediate financial return. Hence, there is a need for finding a burden-sharing mechanism accepted as fair by everyone. The EU and its member states have been criticised for the lack of transparency and accountability of climate finance they provide. A good starting point to overcome transparency issues would be to map and provide an account of what has already been done by developed countries, looking at the impacts of the interventions carried out, and assess needs and remaining gaps.



2.2 EU-Africa joint requirements for capacity building (including human capital development) to combat climate change

2.2. 1 Level of capacity-building activities in the UNFCCC process

The capacity-building in the UNFCCC process encompasses activities at the level of individuals, institutions and systems are well structured in the figure below:



Fig 3. Capacity-building in the UNFCCC process, Adapted from UNFCCC, 2015

2.2.2 Capacity-building Frameworks

In 2001, COP 7 launched two frameworks guiding capacity-building (<u>2/CP.7 and 3/CP.7</u>), one dedicated to developing counties and the other dedicated to countries with economies in transition (EITs). The frameworks aim to enable these countries to implement the provisions of the Convention and effectively participate in the Kyoto Protocol process. In 2005, Parties to the



Kyoto Protocol decided that the two frameworks are also applicable to the implementation of the Protocol.

Although the frameworks are similar in structure and substance, they differ in several details. The following figure provides an overview of common elements and specific provisions.

Common Principles & Approaches

Country-driven, addressing recipient countries' needs, conditions and priorities

Building on existing processes, institutions and endogenous capacities

Implemented in an effective, efficient, integrated and programmatic manner Involves learning-by-doing

Continuous, progressive and iterative process

Provisions for framework for developing countries

Strong focus on institutional capacity-building Special attention to the specific needs of least developed countries and small island developing States

Common Priority Areas

Plans and programmes National communications National GHG inventories Education, training & public awareness Technology Transfer Mitigation Vulnerability and adaptation Kyoto Mechanisms Research and systematic observation

Provisions for framework for EITs

Projections and estimation of GHG emissions Reporting obligations Accounting modalities (under Kyoto Protocol)

Common Implementation

Call on developing countries and EITs to continue to **provide information on their specific needs and priorities**, while promoting cooperation among each other and participation of stakeholders

Include guidance on the support of financial and technical resources to be addressed by the GEF, bilateral and multilateral agencies, and other IGOs

Call on all Parties to **improve coordination and effectiveness** of existing capacity-building activities

Fig 4: Capacity-building framework, Adapted from UNFCCC, 2015



2.2 3 The main important reasons why Capacity Building is critical for implementing the Paris Agreement

In the context of fighting against climate change, here are three reasons why capacity has become such an important foundation of the newly adopted Paris agreement:

Many developing countries still lack the necessary capacity to undertake climate action.

The new paper "*How to Strengthen the Institutional Architecture for Capacity Building to Support the Post-2020 Climate Regime*," points out that despite the wide range of multilateral and bilateral efforts, most developing countries continue to face significant capacity challenges undermining their ability to effectively or fully carry out the climate actions they intend to pursue.

Capacity building efforts need greater coordination, coherence, monitoring, review and reporting.

While capacity building is a crosscutting issue for many countries, no centralized institution or process currently exists to ensure coherence and coordination among the relevant bodies, initiatives, and funding entities working toward this goal.

In addition, no regular monitoring and review process is in place to provide the guidance necessary to shift capacity-building efforts toward sustained and long-term capacity results being built at the institutional and systemic levels.

Accordingly, "How to Strengthen the Institutional Architecture for Capacity Building to Support the Post-2020 Climate Regime" suggests ways to improve institutional architecture by increasing coordination and coherence between the thematic bodies and entities under the UNFCCC while improving monitoring, analysis, and review of capacity-building activities and fostering cooperation at international, national, subnational, and regional levels.

The capacity building improvement on the ground through enhanced national institutional, governance, and administrative systems with sustained resource provisions is critical to success.

The Paris Agreement sets a road map on capacity building.

In order to support the Paris Agreement's implementation, countries agreed during COP21 to enhance capacity building activities together with the associated institutional arrangements by establishing the Paris Committee in Capacity Building (PCCB).

This committee is mandated to oversee a comprehensive work program over the next coming years including:

- ✓ Identify capacity gaps and needs
- ✓ Foster international, regional, national, and subnational cooperation



- Assess how to increase synergies, coordination, collaboration, and coherence among existing bodies and activities within and outside the UNFCCC
- ✓ Promote the development and dissemination of relevant tools and methodologies.
- ✓ Collect best practices and lessons learned, with a goal of enhancing ownership and retention of capacity at national, regional, and subnational levels.

Based on the PCCB program's outcomes and recommendations, countries will choose the initial institutional arrangements for capacity building under the Paris Agreement. In addition, all nations agreed to cooperate to enhance capacity building activities and committed to take measures enhancing climate change education, public awareness, participation, and access to information. Developed countries agreed to enhance support in developing country Parties with less capacity.

Increasing the coordination and monitoring of existing activities is particularly important to success since the Paris Agreement references strengthening capacity building activities in various articles: e.g. a Capacity Building Initiative for Transparency was established during COP21 while countries called for strengthening capacity to prepare their INDCs and to meet their requirements on adaptation as well as access to finance and technology transfer.

2.2.4 EU-Africa joint requirements for capacity development

Capacity development has become the favoured term used in the programmatic documents of the international development aid agencies (including the European Commission's DG DEVCO), while capacity-building still remains widely used by different stakeholders, including in various EU policy documents. Aside the choice of word itself, what differs is the new approach that the term 'capacity development' attempts to better embed, and which has become generally accepted. Acknowledging the centrality of the concept for development efforts, UNDP states that capacity development is the 'engine of human development' (Zamfir, 2017).

Capacity development is a broad and complex undertaking, implying *change* at multiple levels. The notion of change is central to many documents framing capacity- building/development concepts. It borrows from sociological ideas about the complex ways in which organisations are transformed, the multiplicity of factors affecting change, the fluid and dynamic character of the process and the importance of the affected individuals' and organisations' ownership and leadership.



Despite the variations in the understanding of development capacity, there are common features for all conceptual frameworks.

- ✓ Local ownership of all interventions is considered crucial, and is one of the main elements distinguishing the new approach from traditional views on technical cooperation. Stakeholders in developing countries have to decide on the needs and targets of capacity development; furthermore, they have to design the processes of change and assume leadership for them.
- ✓ The need for partnerships between donors and local stakeholders follows directly from the importance of local ownership.
- ✓ Action is required at multiple levels to achieve sustainable results, because capacity development operates within an understanding of institutions as relying on individuals' skills and motivations, on one hand, and as embedded in a broader social and political context that shapes any transformative process, on the other.
- ✓ The change achieved has to be sustainable over time. According to the UNDP, capacity development starts from 'the principle that people are best empowered to realise their full potential when the means of development are sustainable home- grown, long-term, and generated and managed collectively by those who stand to benefit'.
- Political and governance factors play an important role, given the influence they have on the functioning of institutions and on the possibility for reform.
- ✓ It is important to engage civil society and the private sector in capacity development, both as drivers and as targets of capacity development.

Many policy documents recognise three levels at which capacity development operates: *societal, institutional and individual.* Below is a description of these levels by the UNDP.

The enabling environment is the broad social system within which people and organisations function. It includes all the rules, laws, policies, power relations and social norms that govern civic engagement. It is the enabling environment that sets the overall scope for capacity development.

The organisational level refers to the internal structure, policies and procedures that determine an organisation's effectiveness. It is here that the benefits of the enabling environment are put into action and a collection of individuals come together. The better resourced and aligned these elements are, the greater the potential for growing capacity.



The individual level includes the skills, experience and knowledge that allow each person to perform. Some of these are acquired formally, through education and training, while others come informally, through doing and observing. Access to resources and experiences that can develop individual capacity are largely shaped by the organisational and environmental factors described above, which in turn are influenced by the degree of capacity development in each individual.

The EU's capacity-development effort focuses on the three-tier approach to capacity development, describing capacity as an attribute of people, organisations or groups of organisations. Therefore external partners cannot design and implement it, but only support it. The beneficiaries of capacity development must themselves assess their needs, design the process of change and manage it. EU measures to support capacity-building go beyond development policy, and also include areas that are closely linked to development (Zamfir, 2017).

In the field of climate change, the European Union and Africa have started a strong cooperation¹ which includes also support for capacity development.

Based on the stakeholders experiences and feedbacks in relation to SEACRIFOG activites, what emerges is that particularly in climate change related issues, **capacity development at transboundary and national levels** is urgently needed to enhance local technical, analytical and institutional capacity for climate resilient development. Many obstacles are undermining a proper development and further efforts need to be done in different sectors. Some of the main issues raised up are related to **data management**. Data are needed for land use mapping, particularly missing are detailed mapping concerning land use changes. Information and data are often fragmented, coming from various sources and not easily accessible, and if available, it is common the inaccurate data use for missing experience in data analysis (e.g. if data are used by students the processes of data validation and sensitivity analysis is in some cases omitted, which leads to inaccurate results). Concerning land use and land use change related issues, what is also missing are **ArcGIS capacities, availability of software** (open source often not available). In relation to GHG measurements, the **capacities in GHG observations** and measurements are often lacking as well as the research infrastructure. What could promote

¹ See detail in Annex 1: "Key documents on climate change in Africa-EU relations" (source Tondel et al.2015)

sustainability on the long run would be actions aiming at filling the **gap between educational programs and market demand** of future employers (gap between industrial and governmental demand for skills of the graduates and the actual focus of university programs. Educational programmes at universities often do not respond to the demand of the labour market). Unstable political environment and financial constraints undermine the long term sustainability of targeted programmes and actions. Solutions to some of these problems were proposed by stakeholders and identified with the following actions:

Educational programs

Stakeholders underlined the need for practical "hands-on" experience during the university education (e.g. in form of internship, traineeship programs) that would enrich training of students and support them to provide knowledge and capacities for start of their professional carrier addressing and directing the educational programs on the basis of the labour market demand. The imbalance in training was mentioned in case of Angola and Zambia.

Educational programs on GHG observations are really needed for *ad hoc* training when establishing the network.

Transnational activities

There are already several initiatives but a more effective coordination of activities for example across Southern African Development Community (SADC) countries² should be promoted (e.g. establishing a land use change platform that would provide monitoring and evaluation). Initiatives need to come from the countries but with a transnational prospective. The driving force for the capacity development should preferably come from the countries themselves. It should be rather self-driven process, which would increase the ownership concerning capacity development.

Appropriate use and monitoring of NDCs

Nationally determined contributions that were established by Paris Agreement in order to achieve long-term goals can be used for CC mitigation and capacity development, also in the area of GHG monitoring.

Capacity development across various levels and stakeholders

²The Southern African Development Community (SADC) is a Regional Economic Community comprising 16 Member States; Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. Established in 1992, SADC is committed to Regional Integration and poverty eradication within Southern Africa through economic development and ensuring peace and security. <u>https://www.sadc.int/member-states/</u>



Capacity development needs to be done at different levels – students, researchers, government officials, public society as well as institutional level .Linking research with applications - outcomes not only for use of researchers, but also to be applicable for end-users (e.g. governmental, private sector).

Science-policy interface

Science and policy need a communication interface to make available and usable research results with end-users, such as private and governmental stakeholders to support decision-making based on research outcomes.

Science-policy-end users interface

Improving the use of climate science data for agricultural planning can reduce the uncertainties generated by climate change, improve early warning systems for drought, flood, pest and disease incidence and thus increase the capacity of farmers and agricultural planners to allocate resources effectively and reduce risks There is the need for more "translators" of climate information, who can bridge the gap between science and field application, assisting communities and planners to understand the implications of results for their immediate planning decisions. Enhancing communication between producers and users of climate science is also clearly a requirement.

2.3 EU-Africa joint requirements for research, food security and greenhouses gas observations

2.3.1 Comparative analysis of literature review and experts viewpoints in adaptation strategies to climate change

The table 2 provides the key information for EU-Africa requirements for cooperation, capacity building and research in Africa. The gathered information based on literature review, online surveys and expert judgement as requirements for cooperation and capacity building in the field of adaptation strategies to climate change are as follow:

:



N°	Essential requirements	Comments / Observations from experts	Level of agreeme nt (1 -3) of experts
R1	According to (Flannigan et al. 2006, Lamarque et al. 2011, Hoegh-Guldberg 2011, Adimo et al. 2012, Ford and King 2015) for the East African region, there is a need for prioritizing adaptation and mitigation efforts at local level.	This point of view is approved by 80% of our respondents. Evidence is really proved by stakeholders. This is true for all African countries.	3
R2	Projections of fire activity for this century can be used to explore options for mitigation and adaptation (Flannigan et al. 2006, Jacob et al. 2014, Bindi and Olesen 2011, Brown 2005, Mirza 2011, Refsgaard et al. 2013).	Most of respondents think that there is any fire simulation model for Africa. An example of integrated fire research framework developed by (Lavorel et al. 2007) is a good way to follow.	2
R3	Euro-Cordex model is a new high resolution climate change projection models which support adaptations at the regional level in Europe (Jacob et al. 2014, Bindi and Olesen 2011, Brown 2005, Mirza 2011, Refsgaard et al. 2013).	About 50% of experts think that the way of using CORDEX-Africa to support adaptation for improving food security in Africa is needed.	2
R4	According to Bindi and Olesen (2011), the most appropriated adaptation strategies to climate change for the European regions are changes in crop species, cultivar, sowing date, fertilization, irrigation, drainage, land allocation and farming system. This is also suitable for Africa.	Sowing data, irrigation and farming systems are most appropriate for Africa. This has been approved by stakeholders.	3
R5	A novel framework that conceptualizes adaptations to climate change as actions (Eisenack and Stecker 2012) is needed. According to the author, the important role of uncertainty and time in adaptation suggest promising lines of research that give more explicit consideration to how stimuli and means unfold in time, along with the perceptions and beliefs of actors.	Evidence has been approved by stakeholders for the African context. Local knowledge can also be taken into the consideration for this purpose.	3

Table 2. Summary of the key findings with regards to requirements in the field of adaptation strategies to climate change

R6	 In its study on "Conceptual elements of climate change vulnerability assessments (VA): a review" Bruno Soares et al. (2012) underlined remaining challenges such as: The need to better understand how human and environmental systems are coupled and the ways in which they interact (Birkmann, J. and Wisner 2006), The need to further explore the relationships and links between the key components of vulnerability (Benett et al., 2016), The need to continue developing new ways of integrating Uncertainty in VA (Kuntz-Duriseti 2008) and policy-making. The vulnerability index assessment in developing countries such as African countries is a big challenge because of non-availability of relevant data (Rygel et al., 2005, Cooper and Wheeler 2017)." There is an urgent need to focus on this issue. 	In fact, assuming that vulnerability is ahead of adaptation, there is a need for the models on the couple human-environmental systems which will help to improve adaptation. Expertise in the development of such models is very scarce in Africa argued most of interviewed experts.	3
R7	According to Sissoko et al. (2011), in terms of development, priority needs to be given to adaptation and implementation of comprehensive programs on water management and irrigation, desertification control, development of alternative sources of energy and the promotion of sustainable agricultural practices by farmers.	Evidence has been approved by respondents during field surveys.	3
R8	According to Oberlack (2017) more coherence and integration of adaptation research are needed if we are to foster learning about the role of institutions in adaptation situations in a cumulative fashion.	We hope there is a need for institutional mapping regarding climate change issues in Africa.	2
R9	According to Measham et al. (2011) climate adaptation was widely accepted as an important issue for planning conducted by local governments.	Benin case study revealed this evidence. Local governments face the challenge of introducing climate change mitigation strategies into the planning actions.	3
R10	According to Connolly-Boutin and Smit (2016), the predominant approach to analyzing climate change and food security in sub- Saharan Africa has been to model the effects of future climate change scenarios on food production.	70 % of our respondents confirmed this as an important requirement for EU-Africa cooperation.	3

There is a need to go beyond the individual level, and to plan and	
provide support for appropriate technologies and strategies and in	
addition considerable efforts should be made to increase the initial	l
likelihood of adoption (Manandhar et al. 2011, Tambo and Abdoulaye	
2012).	1
	l .

Sources: Literature review, online surveys and WASCAL field data, November 2018 **R1:** Requirement 1

Level of agreement: 1= Low agreement, 2= Moderate agreement, 3 = high agreement





Fig 5: Keys EU-Africa requirements for cooperation and capacity building – Adaptation strategies to climate change

The most supporting actions from Europe to Africa in adaptations strategies to climate change were focus at the regional and national level. According to Adimo et al., (2011; Measham et al., 2011) there is a need for prioritizing adaptation and mitigation efforts at the local level. Infact, local government have the lack of knowledge with regards to the introduction of adaptations strategies to climate change into various decision making documents or planning. In addition thee is a need to strengthen the capacity of the local government officers who were most concerned by the implementation of various projects in the field. In this context human development or the capacity building is crucial to target development at the local and household level.



The climate change and variability have impacted the sowing date in many regions of Africa and mainly the Sudan and Sahel zones of Africa. For this purpose there is a need for cooperation between African and European scientists for research development for updating of the sowing date in these regions of Africa. This cooperation must involve the technology transfer process and the way to strengthen capacity of technical officers of various institutions in Africa for the acquisition and the maintenance of these technologies related to rainfall stations.

In terms of development, according to Sissoko et al., (2011), priority needs to be given to adaptation and implementation of comprehensive programs on water management and irrigation, desertification control, development of alternative sources of energy and the promotion of sustainable agricultural practices by farmers.

Infact, the actions against climate change effects for the improvement of livelihood of household need to be targeted through these above mentioned conditions.

2.3.2 Comparative analysis of literature review and experts viewpoints in mitigation strategies to climate change

Even if mitigation is not a priority for Africa, It is urgent to underline some few key requirements (Fig. 9) for EU-Africa for cooperation and capacity building. These requirements can be involved or coupled together with adaptation initiatives when defining the ways for cooperation between Europe and Africa in a multi stakeholder's panel's engagement for research and capacity building.



Table 3. Summary of the key findings with regards to r needs and knowledge gaps per cluster in the field of mitigation strategies toclimate change

N°	Essential requirements	Observations /	Level of agreement (1
		Comment	-3) of experts
R1	For now, emphasis should more usefully remain firmly on reducing fossil-fuel	Evidence can be	3
	emission through improving energy efficiency, reducing unnecessary energy usage	approved by	
	and generating energy by alternative means such as wind, solar, hydro, or from	stakeholders	
	biofuels (Kirschbaum, Miko 2006, Huesemann, Michael 2006).		
	What is missing in particular is studies that try to quantify the energy and		
	emission reductions resulting from technology transfer (Peterson 2008a, b).		
	According to Ravindranath, (2007), there is need for research and field		
	demonstration of synergy between mitigation and adaptation, so that the cost of		
	addressing climate change impacts can be reduced and co-benefits increased.		
R2	According to Plummer et al. (2006), there is a need for the integration of	Evidence can be	3
	observations (Earth observation and in situ), models (diagnostic and predictive),	approved by	
	process and manipulative experiments and case studies to close the gaps in	stakeholders	
	knowledge related to the spatial and temporal patterns of carbon stocks and fluxes,		
	particularly over land.		
R3	According to Lehmann et al. (2006a and b) strategies such as producing bio-char,	Evidence can be	2
	while producing energy from renewable fuels may offer a potential way forward. In	approved by	
	one word, there is a need to replace slash-and-burn to slash-and-char.	stakeholders to prove if	
		this option must be taken	
		ahead mitigation	
		strategies in Africa	
	A key issue for bio-energy is that its use should be modernized to fit into a	Evidence can be	2
	sustainable development path (Faaij 2006b).	approved by	
		stakeholders to prove if	
		this option must be taken	
		anead mitigation	
		strategies in Africa	

R4	Areas of concern in new energy vehicles include inferior technologies, immature	This sector of climate	1
	products, and the lack of monitoring and evaluation (Gong et al. 2013, Zhou et al.	change mitigation, for	
	2014).	our point of view should	
		not be a priority for	
		Africa.	
R5	There is currently great interest in microalgae as sources of renewable energy and		3
	Biofuels (Borowitzka et al., 2013; Chanakya et al., 2012; DuPont, 2012; Fon Sing		
	et al., 2013 ; Frank et al., 2013, Singh and Ahluwalia 2013)		
	A new appraisal must be focused on CO ₂ mitigation and renewable oil from		
	photosynthetic microbes (Huntley et al. 2007).		
R6	Management strategies are needed to mitigate the impacts of climate change on sea		1
	turtle's terrestrial reproductive phase (Fuentes et al. 2012, Jourdan and Fuentes		
	2013).		





Fig 6. Keys EU-Africa requirements for cooperation and capacity building – Mitigation strategies to climate change

2.3.3 EU-Africa joint requirements for filling the gaps of uncertainty in crop yield model *Analysis-based literature review*

According to Refsgaard et al. (2013) from the management point of view, uncertainty is, quite simply, the lack of exact knowledge, regardless of what is the cause of this deficiency. In addition, it has been asserted that crop model uncertainty limits assessments of future food production (Challinor et al. 2014b).

1. It is important that a uniform file format is defined for storage and distribution of weather data, so that they can easily be exchanged among agro-meteorologists, crop modelers and others working in climate and weather aspects across the globe. A strong cooperation between South and Northern scientists must conduct to a platform on which data format protocol will be designed.



 Easy access to weather data, preferably through the internet and the World Wide Web, will be critical for the application of crop models for yield forecasting and tactical decision making.

Expert's viewpoints

According to the expert's viewpoints the requirements for cooperation between Africa and Europe is to fill the gaps due to underlined data needs mentioned above. In addition to this, uncertainty can be reduced by using local agronomy data through a global platform. This must follow the data sharing protocol rule. Another approach to reducing uncertainties in crop yield predictions is ensemble modelling i.e. to use several models to give you a range of yields instead of a single value from a single model. In another way there is a need for a strong cooperation between modelers to set out the strength and weakness of most frequent used models by users and to find the way to build this ensemble models.

Coverage area of models and data needs for Africa

For this study we were able to get responses from 25 experts from various international organizations. The coverage areas of various models used were presented in the figure below.



Fig 7. Coverage area of various implemented crop yield models

About 67 % of experts used the models applicable at the global level whereas 33 % were used at the country level.

In addition, under the climate change conditions, according to the respondents care should be taken to the following for the strong cooperation between Africa and European Union.





Fig 8. Expert's viewpoints for the requirements to fill the gaps in crops yield models

2.3.4 EU-Africa joint requirements for observed precipitation products and weather forecasting

Available observed precipitation products over Africa are limited and station density is too low for comprehensive monitoring of extreme events. Therefore, care should be taken in order to take advantage of the improvements and developments in observational datasets for Africa. To build these chains, the EU-Africa research institutions should work closely together in order to increase the density of the network, adapt the stations to the newest technology (Photo 1) and ensure a reliable transfer of observations on the global or regional telecommunication system. Increasing the availability of gauge data can be done through participation of local meteorological and hydrological services in regular validation exercises which can improve our



understanding, applicability and visibility of satellite derived rainfall estimates. The creation of new datasets, in particular from the local stations, ensuring consistency across time and space and among variables, as well as the best use of information will be benefit. Finally, a systematic initiative should be taken in order to improve the quality, value, and training in use of NWP products for local meteorological agencies in Africa will be significant for better data collection and communication by the local meteorological agencies.

2.4 EU-Africa joint requirements for greenhouse gas observations under a changing climate.

The newest technologies mainly automatic station which are capable to collect in addition to weather variables some key greenhouses gas can be implemented in Africa. These variables such as CO_2 , NO_2 , SO_2 , CH_4 are the main GHGs that needs to be know with the low level of uncertainty in Africa. In addition CO was identified to be added to these automatic stations as a non-greenhouse gas to be collected.

Infact, CO molecule containing just two atoms of different elements, such as carbon monoxide (CO) do absorb infrared radiation, but is short-lived in the atmosphere owing to its reactivity and solubility. Therefore it do not contributes significantly to the greenhouse effect and often is omitted when discussing greenhouse gases.

In addition to the required technologies transfer, training of new generation of experts needs to be performed since national education programs were not designed to this matter.



1	Temperature	°C
2	Humidity	RH%
3	Global solar radiation	W/m ²
4	Wind direction	GN
5	Wind speed	m/s
6	Precipitation	mm
7	Global solar radiation	W/m ²
8	Sunshine duration	Hours
9	Pressure	hPa
10	CO ₂	ppm
11	СО	Ppm
12	NO ₂	Ppb
13	SO ₂	Ppb
14	CH4	Ppm
15	Evapotranspiration *	mm
	1 2 3 4 5 6 7 8 9 9 10 11 12 13 14 15	1 Temperature 2 Humidity 3 Global solar radiation 4 Wind direction 5 Wind speed 6 Precipitation 7 Global solar radiation 8 Sunshine duration 9 Pressure 10 CO2 11 CO 12 NO2 13 SO2 14 CH4 15 Evapotranspiration *

Photo 1. Automatic station for weather and greenhouses gas variables collection³

3. Difficulties

The WASCAL team of SEACRIFOG project met few difficulties when producing this deliverable D1.2. These difficulties are:

 \checkmark The very scares publications which dealt with uncertainties in crops yield models.

Infact, about 40 papers were downloaded from the international journal in the field of agriculture, climate change, food security and crop yield. Only very few of them dealt with sources of uncertainty in crop yield models. This situation has delay our analysis.

- ✓ The delay feed-back of identified respondents (experts). The feed/back of experts regarding online questionnaire was not at the rate we expected.
- ✓ The designed questionnaire for crop yield models was submitted to the identified expert who published in the field of crop yield models. Unfortunately, after two months we only received the feed-back of one of them. We were oblige to send a reminder before we get the response of four of them. Due to the deadline of the deliverable we were oblige to process the obtained responses from them.
- \checkmark The VOSviewer is not applicable to all thematic areas due to the gaps in Crossref database.

³ At the left automatic station and the right the table showing weather and greenhouses gas variables



Despites all these difficulties our regional trip has help to fill the gaps of missing collected information from online surveys.

CONCLUSION

This report on EU-Africa joint requirements for cooperation and capacity building (including human capital development) for research on food and nutrition security and greenhouse gas observations under a changing climate formulate appropriate requirements. In regards to this, we emphasized the requirements for cooperation and capacity building, for food and nutrition security, for research and greenhouses gas observations between Europe and Africa for the profit of RI development in the future.

Finally, for a real development of African countries under a climate change conditions, care should be taken to these underlined requirements or priorities when developing projects proposal in the future.



References

- Adimo, Aggrey Ochieng, John Bosco Njoroge, Leaven Claessens, and Leonard S. Wamocho. 2012. 'Land Use and Climate Change Adaptation Strategies in Kenya'. *Mitigation and Adaptation Strategies for Global Change* 17(2):153–71.
- AU-EU (African Union-European Union). 2007. The Africa-EU Strategic Partnership: A Joint Africa-EU Strategy. http://www.africa-

eupartnership.org/sites/default/files/documents/eas2007_joint_strategy_en.pdf Bennett, Nathan James, Jessica Blythe, Stephen Tyler, and Natalie C. Ban. 2016.

'Communities and Change in the Anthropocene: Understanding Social-Ecological Vulnerability and Planning Adaptations to Multiple Interacting Exposures'. *Regional Environmental Change* 16(4):907–26.

Bierbaum, Rosina et al. 2013. 'A Comprehensive Review of Climate Adaptation in the United States: More than before, but Less than Needed'. *Mitigation and Adaptation Strategies for Global Change* 18(3):361–406.

Bindi, Marco and Jørgen E. Olesen. 2011. 'The Responses of Agriculture in Europe to Climate Change'. *Regional Environmental Change* 11(SUPPL. 1):151–58.

Borowitzka, Michael Armin and Navid Reza Moheimani. 2013. 'Sustainable Biofuels from Algae'. *Mitigation and Adaptation Strategies for Global Change* 18(1):13–25.

- Brown, H. Carolyn Peach. 2005. 'Institutional Adaptive Capacity and Climate Change'.
- Bruno Soares, Marta, Alexandre S. Gagnon, and Ruth M. Doherty. 2012. Conceptual Elements of Climate Change Vulnerability Assessments: A Review. Vol. 4.

Challinor, A. J. et al. 2014b. 'A Meta-Analysis of Crop Yield under Climate Change and Adaptation'. *Nature Climate Change* 4:287.

Chanakya, H. N. and Durga Madhab Mahapatra. 2012. 'Algal Biofuel Production and Mitigation Potential in India'.

Connolly-Boutin, Liette and Barry Smit. 2016. 'Climate Change, Food Security, and Livelihoods in Sub-Saharan Africa'. *Regional Environmental Change* 16(2):385–99.

Cooper, Sarah Jane and Tim Wheeler. 2017. 'Rural Household Vulnerability to Climate Risk in Uganda'. *Regional Environmental Change* 17(3):649–63.

Dupont, Andre. 2012. 'Best Practices for the Sustainable Production of Algae-Based Biofuel in China'.

Eck, Nees Jan Van and Ludo Waltman. 2018. 'VOSviewer Manual'. (April 2018).

Eisenack, Klaus and Rebecca Stecker. 2012. 'A Framework for Analyzing Climate Change Adaptations as Actions'. *Mitigation and Adaptation Strategies for Global Change* 17(3):243–60.

European Commission, 2014b. *EU-Africa Ministerial Statement on Climate Change*. Brussels, 2 April 2014. http://europa.eu/rapid/press-release_STATEMENT-14-97_en.htm.

European Commission. 2015b. Energy Union Package. The Paris Protocol – A Blueprint for Tackling Global Climate Change beyond 2020. (COM(2015) 81 final). Brussels, 25 February 5015

Faaij, Andre. 2006b. Modern Biomass Conversion Technologies. Vol. 11.

Flannigan, M. D., B. D. Amiro, K. A. Logan, B. J. Stocks, and B. M. Wotton. 2006. 'Forest Fires and Climate Change in the 21ST Century'. *Mitigation and Adaptation Strategies* for Global Change 11(4):847–59.

Fon Sing, Sophie, Andreas Isdepsky, Michael A. Borowitzka, and Navid Reza Moheimani. 2013. 'Production of Biofuels from Microalgae'. *Mitigation and Adaptation Strategies for Global Change* 18(1):47–72.

Ford, James D. and Diana King. 2015. 'A Framework for Examining Adaptation Readiness'.



Mitigation and Adaptation Strategies for Global Change 20(4):505–26.

- Frank, Edward D., Amgad Elgowainy, and Jeongwoo Han. 2013. 'Life Cycle Comparison of Hydrothermal Liquefaction and Lipid Extraction Pathways to Renewable Diesel from Algae'. 137–58.
- Fuentes, M. M. P. B., M. R. Fish, and J. A. Maynard. 2012. 'Management Strategies to Mitigate the Impacts of Climate Change on Sea Turtle 's Terrestrial Reproductive Phase'. 51–63.
- Gong, Huiming, Michael Q. Wang, and Hewu Wang. 2013. 'New Energy Vehicles in China: Policies, Demonstration, and Progress'. *Mitigation and Adaptation Strategies for Global Change* 18(2):207–28.
- Hoegh-Guldberg, Ove. 2011. 'Coral Reef Ecosystems and Anthropogenic Climate Change'. *Regional Environmental Change* 11(SUPPL. 1):215–27.
- Huesemann, Michael H. 2006. Can Advances in Science and Technology Prevent Global Warming? A Critical Review of Limitations and Challenges. Vol. 11.
- Huntley, Mark E. and Donald G. Redalje. 2007. *CO2mitigation and Renewable Oil from Photosynthetic Microbes: A New Appraisal*. Vol. 12.
- Jacob, Daniela et al. 2014. 'EURO-CORDEX: New High-Resolution Climate Change Projections for European Impact Research'. *Regional Environmental Change* 14(2):563– 78.
- Jourdan, J. and M. M. P. B. Fuentes. 2013. 'Effectiveness of Strategies at Reducing Sand Temperature to Mitigate Potential Impacts from Changes in Environmental Temperature on Sea Turtle Reproductive Output'.
- Kirschbaum, Miko U. F. 2006. 'Temporary Carbon Sequestration Cannot Prevent Climate Change'. *Mitigation and Adaptation Strategies for Global Change* 11(5–6):1151–64.
- Knaepen, H. 2014. *The catalytic role of the EU on private sector investment: The Case of climate financing*.GREAT Insights, Volume 3, Issue 3. March 2014.
- Kuntz-Duriseti, Stephen H. Schneider and Kristin. 2008. 'Uncertainty and Climate Change Policy'. *Economic Analysis & Policy* 38(2):203–10.
- Lamarque, Pénélope et al. 2011. 'Stakeholder Perceptions of Grassland Ecosystem Services in Relation to Knowledge on Soil Fertility and Biodiversity'. *Regional Environmental Change* 11(4):791–804.
- Lavorel, Sandra, Mike D. Flannigan, Eric F. Lambin, and Mary C. Scholes. 2007. 'Vulnerability of Land Systems to Fire: Interactions among Humans, Climate, the Atmosphere, and Ecosystems'. *Mitigation and Adaptation Strategies for Global Change* 12(1):33–53.
- Lehmann, Johannes, John Gaunt, and Marco Rondon. 2006a. 'Bio-Char Sequestration in Terrestrial Ecosystems - A Review'. *Mitigation and Adaptation Strategies for Global Change* 11(2):403–27.
- Lehmann, Johannes, John Gaunt, and Marco Rondon. 2006b. 'Bio-char sequestration in terrestrial ecosystems A review'. (x):403–27.
- Manandhar, Sujata, Dietrich Schmidt Vogt, Sylvain R. Perret, and Futaba Kazama. 2011. 'Adapting Cropping Systems to Climate Change in Nepal: A Cross-Regional Study of Farmers' Perception and Practices'. *Regional Environmental Change* 11(2):335–48.
- Measham, Thomas G. et al. 2011. 'Adapting to Climate Change through Local Municipal Planning: Barriers and Challenges'. *Mitigation and Adaptation Strategies for Global Change* 16(8):889–909.
- Mirza, M. Monirul Qader. 2011. 'Climate Change, Flooding in South Asia and Implications'. *Regional Environmental Change* 11(SUPPL. 1):95–107.
- Morgan, J., Y. Dagnet and D. Tirpak. 2014. Elements and Ideas for the 2015 Agreement.



(Working Paper). World Resources Institute: ACT 2015.

- Oberlack, Christoph. 2017. 'Diagnosing Institutional Barriers and Opportunities for Adaptation to Climate Change'. *Mitigation and Adaptation Strategies for Global Change* 22(5):805–38.
- Peterson, Sonja. 2008a. 'Greenhouse Gas Mitigation in Developing Countries through Technology Transfer ?: A Survey of Empirical Evidence'. 283–305.
- Peterson, Sonja. 2008b. 'Greenhouse Gas Mitigation in Developing Countries through Technology Transfer?: A Survey of Empirical Evidence'. *Mitigation and Adaptation Strategies for Global Change* 13(3):283–305.
- Plummer, Stephen, Olivier Arino, Muriel Simon, and Will Steffen. 2006. 'Establishing a Earth Observation Product Service for the Terrestrial Carbon Community: The Globcarbon Initiative'. *Mitigation and Adaptation Strategies for Global Change* 11(1):97–111.
- Ravindranath, N. H. 2007. 'Mitigation and Adaptation Synergy in Forest Sector'. *Mitigation and Adaptation Strategies for Global Change* 12(5):843–53.
- Refsgaard, J. C. et al. 2013. 'The Role of Uncertainty in Climate Change Adaptation Strategies-A Danish Water Management Example'. *Mitigation and Adaptation Strategies for Global Change* 18(3):337–59.
- Rygel, Lisa, David O'Sullivan, and Brent Yarnal. 2006. 'A Method for Constructing a Social Vulnerability Index: An Application to Hurricane Storm Surges in a Developed Country'. *Mitigation and Adaptation Strategies for Global Change* 11(3):741–64.
- Singh, Uday Bhan and A. S. Ahluwalia. 2013. 'Microalgae: A Promising Tool for Carbon Sequestration'. *Mitigation and Adaptation Strategies for Global Change* 18(1):73–95.
- Sissoko, Keffing, Herman van Keulen, Jan Verhagen, Vera Tekken, and Antonella Battaglini. 2011. 'Agriculture, Livelihoods and Climate Change in the West African Sahel'. *Regional Environmental Change* 11(SUPPL. 1):119–25.
- Tambo, Justice Akpene and Tahirou Abdoulaye. 2012. 'Climate Change and Agricultural Technology Adoption: The Case of Drought Tolerant Maize in Rural Nigeria'. *Mitigation and Adaptation Strategies for Global Change* 17(3):277–92.
- Tondel F., Knaepen H. and van Wyk L-A., 2015. Africa and Europe combatting climate change: Towards a common agenda in 2015. *Maastricht: European Centre for Development Policy Management (ECDPM)*.
- UNFCCC, 2015. Building capacity in the UNFCCC process visited on january 2019 at https://unfccc.int/topics/capacity-building/the-bigpicture/capacity-in-the-unfccc-process
- Zamfir I. 2017. Understanding capacity-building/ capacity development A core concept of development policy. EPRS | European Parliamentary Research Service <u>http://www.europarl.europa.eu/RegData/etudes/BRIE/2017/599411/EPRS_BRI(2017)599411_EN.pdf</u>
- Zhou, Yan, Michael Wang, Han Hao, and Larry Johnson. 2014. 'Plug-in Electric Vehicle Market Penetration and Incentives : A Global Review'.



Annex 1: Key documents on climate change in Africa-EU relations

- 1. 2000, Cotonou Agreement between the African, Caribbean and Pacific (ACP) countries and the European Community: Article 32 concerns "Environment and Natural Resources" and states that ACP-EU cooperation will take into account 'the vulnerability of small island ACP countries, especially to the threat posed by climate change'(Official Journal of the European Communities, 2000).
- 2. 2005, EC Strategy for Africa: qualified climate change as a critical issue to address through its relations with African institutions and its support to Pan-African integration. This Strategy preluded the elaboration of a thematic partnership on climate change in the JAES (European Commission, 2005).
- **3. 2006**, **Joint ACP-EU Declaration on Climate Change and Development**: this declaration emphasised the need to enhance dialogue in preparation of multilateral negotiations, including a commitment to consult regularly in the context of the UNFCCC meetings, and to enhance dialogue on mainstreaming climate change in development and poverty reduction strategies (ACP-EC, 2006).
- **4. 2007**, **Joint Africa-EU Strategy**: the first joint Africa-EU strategy that clearly stated that '*Africa and the EU have a clear common interest to address [...] climate change*'. Partnership 6 on Climate Change (PCC) of the Strategy emphasised that addressing climate challenges is the basis for economic growth, job creation, social stability, adaptation and mitigation. It also stated that Africa and the EU should cooperate in global climate fora. Its main focus was climate adaptation and desertification (AU-EU, 2007).
- **5. 2008**, **Joint EU-Africa Declaration on Climate Change**: this document was prepared ahead of the UNFCCC Conference (COP14) in Poznan in 2008. It includes references to principles of "equity" and "sustainable development". It also called for African governments and the EU to commit to fight climate change, based on the CBDR-principle (JAES, 2008). More specifically, it emphasised adaptation needs, opportunities for Africa to access market mechanisms, including REDD+, and related capacity building and climate finance requirements, in particular the need to improve the effectiveness of climate finance mechanisms, notably the AF and the (GEF (JAES, 2008).
- 6. 2008, First Joint Africa-EU Action Plan (2008-2010): this plan identified two priority actions of the PCC. The first priority refers to the creation of a common agenda on climate change. The second priority was to address land degradation and desertification (JAES, 2007).
- **7. 2009**, **Joint ACP-EU Declaration on Climate Change and Development**: this updated declaration (first one in 2006) put forward the need to promote sustainable land management and biodiversity conservation in the international climate change regime.
- 8. 2009, Joint Roadmap for the Climate Change Partnership: this document clarified the strategies for the implementation of the climate change declaration and action plan (2008-2010). It pointed out key components of the action plan, notably developing the capacities of African countries and regions in fighting climate change and it proposed specific activities to achieve the goals, mainly for capacity building. It also identified stakeholders and technical and financial means.



- **9. 2010**, **Joint Africa-EU Strategy, Action Plan 2011-2013**: the PCCE drew attention to the importance of "Green Economy", mitigation activities, funding for adaptation in Africa as well as fast start finance. Since this action plan, P6 has covered climate change and biodiversity issues (JAES, 2010).
- 10. 2014, EU-Africa Ministerial Statement on Climate Change: this is the outcome document of a climate seminar, hosted by DG CLIMA's Commissioner, the President of AMCEN and the AU Commissioner for Rural Economy and Agriculture (See Section 1), in the margin of the EU-Africa Summit (April 2014). It draws attention on the EU's and Africa's determination to adopt a legally binding UNFCCC agreement in 2015 and the urgent need to fund Africa's adaptation gap (European Commission, 2014b).
- **11. 2014**, **EU-Africa Declaration**: in this document "climate change" is recognised as a threat to peace and security and it is stated that *'the EU will continue to support African countries in the preparation of national and regional climate-resilient and low-emission development strategies [...]' (General Secretariat of the Council, 2014a).*
- 12. 2014, EU-Africa Roadmap (2014-2017): "climate change" falls under one of the five Priority Areas ("Global and Emerging Issues"), in contrast with the previous action plan (2011-2013) where one Partnership was entirely dedicated to "climate change" (General Secretariat of the Council, 2014b)

