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An overview of emerging issues and potential research priorities. D2.1(Suppl)

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CAAST-Net PLUS

Africa-EU research collaboration on climate change, food security and water linkages

An overview of emerging issues and potential research priorities

caast-net-plus.org

Building Bi-regional Partnerships for Global Challenges

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Introduction

This report summarises key issues and recommendations of a technical workshop on climate change, food security and water resources linkages. The workshop was organized by CAAST-Net Plus and held at the headquarters of the African Union Commission, Addis Ababa, on 25-26 June 2013. Based on presentations by African and European experts, two panel sessions and open discussions by more than 50 participants, a range of issues and ideas for Africa-EU research and innovation emerged. The workshop was one of recent attempts by African and European stakeholders to examine the nexus or relationships between climate change, food security and water. It was organised within the framework of the eighth partnership of the Joint Africa-Europe Strategy (JEG8), on science, information society and space. The overall aim was to discuss the status of, and priorities for, EU-Africa research cooperation on climate change as it stands to affect water resources and the hydrological cycle, and the related issue of food security. The event served the triple purpose of (1) supporting EU external policies, by helping African regions and countries to strengthen and make better use of their STI competences for their socioeconomic development; (2) providing substantive thematic input to the bi-regional policy dialogue platform; and (3) informing CAAST-Net Plus' own future interventions for enhancing the efficacy of bi-regional cooperation, specifically how to promote the uptake or application of research knowledge into both policy and technology development.

This report contains some general observations, recommendations and an indication of common (Africa-Europe) research and innovation issues that CAAST-Net Plus proposes to feed into the AU-EC High Level Policy Dialogue (HLPD) on Science, Technology and Innovation (STI) cooperation.

Background

Climate change is arguably the most significant of a set of interconnected global challenges threatening water resources and food security. The relationship between water resources, food systems and climate change is tightly coupled. Improved food security under climate change and climate variability scenarios requires globally coordinated actions for both technical and policy interventions to achieve greater resilience. The successful implementation of these actions requires a comprehensive scientific knowledge base delivered by extensive global research collaboration, taking into account past and on-going successful STI initiatives.

Africa and Europe have extensive common interests around the impact of climate change on food security and water resources, including the development of effective mitigation and adaptation responses in food production systems. These issues have high priority on the respective regional research agendas and feature prominently in the priorities for bi-regional cooperation elaborated in the Joint Africa-EU Strategy (JAES). Furthermore, there has been an intensive policy dialogue on bi-regional cooperation in these areas over the past few years, both within the context of the JAES as well as part of broader multilateral processes, and there is a growing portfolio of related bi-regional research cooperation, including under the EU's Framework Programme. Nevertheless there is significant scope for enhanced bi-regional research partnerships, which could also, in a more direct manner, serve to inform and strengthen the Africa-EU policy dialogue on food security, water and climate change.

Summary of general workshop observations

- Over the past 15 years there has been an evolution within climate change research and policy debates, away from the narrow focus on the isolated impacts of climate change, towards explicit linkages with tangible issues of food security and water resources. There has also been a growing focus on innovation, applying this concept beyond the private sector.
- The climate change and food-security-water nexus is complex. It requires fundamental research to build a clear understanding of the linkages and adequately inform policies that promote climate change mitigation and adaptation, as well as ensure food and water security in both Africa and Europe.
- There is increasing emphasis on making current research funding mechanisms relevant to innovation, promoting the participation of SMEs as a key source of new ideas. Without the engagement of, and support for, SMEs in Africa, it will be difficult to translate agricultural research and even related climate change research into innovations that have developmental impacts.

Summary of researchable issues

In the context of the upcoming Horizon 2020 research funding mechanism and the AU-EU HLPD on Science, Technology and Innovation, the CAAST-Net Plus workshop on climate change identified the following joint horizontal research priorities:

- Systemic or integrated research on the causal relationships of climate change, agriculture and water resources. There is a need to build understanding of the linkages and to generate adequate evidence for policy in both Africa and Europe;
- Africa and Europe have, through the UN system, adopted the 'green economy' concept as presented at the Rio+20 conference. However, there is inadequate country-specific knowledge that could enable countries to clarify and implement the concept of green

economy. African and European research can bring better conceptual clarity and policy recommendations on the green economy discussions;

- There is a need to support the implementation of joint researchable activities that will enable decision-makers to enact key incentives for private sector participation in order to define and drive bottom-up 'green growth', innovating commercial opportunities for higher-value and new agricultural markets;
- Support for scaling-up research (in particular research on complementary knowledge) into, and the dissemination of, indigenous knowledge and technologies on climate resilient crops and agricultural adaptation practices;
- Support for the production and effective communication of disaggregated climate data to help inform national and sub-national planning and infrastructure spending, as well as for local farming;
- Provision of research funding mechanisms that respond to the technical needs of SMEs, i.e. research projects that tackle real-world technical problems faced by entrepreneurs that have limited capacities to invest in R&D.

Priority vertical issues:

- Innovative financial support (for example through equity funds and value chain financing) for rural SMEs that seek to develop products and services that either mitigate or adapt to climate change in the agricultural sector;
- Support the creation and uptake of knowledge on agro-ecology and ecological intensification as a means to increase agricultural yields and to adapt to climate change, moving away from a dependence on non-renewable fertilizers;
- Focussed research into the role and importance of pastoralism in sub-Saharan Africa, specifically the GHG emissions and food security implications of various livestock fodder options and the meat value chain;
- Support for research into the potential of developing low-cost means to utilising ground water resources and small-scale dams, as a means to irrigate, mitigating the risks surrounding rain-fed agriculture;

Annex: summary of key technical issues

Across the world, relative water scarcity is on the increase, and the agricultural sector, by its nature, is most dependent on water. In turn, humans are highly dependent on agriculture for their food supply. Therefore, it is the efficient and effective management of water resources that must help countries in Africa to cope with any scarcities or surfeits of water. **In Africa agriculture is still primarily rain-fed** (in SSA only 4% of the cultivated area is irrigated) and this will become increasingly challenging as climate change is expected to lead to inconsistent annual rainfalls, making droughts more frequent (Mwang'ombe 2013; Uphoff 2012).

With a 2^{o}C temperature increase, climate change is expected to result in a 10–15% **species loss** across Africa and yields from rain-fed agriculture will fall by as much as 20% by 2020 (Jalloh 2013). Grassland productivity in semi-arid and arid regions is likely to register a fall of 40 to 90% and **pests and diseases of many crops**, animals, and humans could change, increasing vulnerability. At the same time, fisheries productivity is likely to be reduced due to climate change-driven habitat displacement towards higher latitudes (Jalloh 2013).

In sub-Saharan Africa, extreme hydrological variability is echoed in its economic performance where there is a **strong correlation between rainfall and overall GDP** (Mwendera 2013). Some 75% of the continent's population are farmers, and the crops they grow provide an important means of livelihood for the most vulnerable smallholder farmers. **Agriculture remains the backbone of the national economies of most sub-Saharan African countries**. In Kenya, for example, agriculture contributes directly 26% of GDP and 60% of export earnings. Through links with other sectors, e.g. manufacturing and services, agriculture indirectly contributes a further 27% to the GDP (Mwang'ombe 2013). Africa has the largest area of available arable land, as much as 60% of the global total, thus the potential is enormous. Yet, at the moment it is a continent facing challenges of malnutrition and hunger. Food insecurity in Africa, as one of the major causes of hunger and malnutrition, continues to deter economic growth and limit progress in reducing poverty. **Sub-Saharan Africa alone has about 20-25% of the total 1.1 billion hungry people in the world today** (Mwang'ombe 2013). Climate change can mean the emergence of totally new diseases/pests – such as Maize Lethal Necrosis (MLN) and an increased risk of aflatoxin production when harvesting gains during wet periods (Mwang'ombe 2013). It should also be pointed out that the contribution of agriculture to climate change is often overlooked; the IPCC estimated that **31% of total emission of GHGs in 2004 came from agriculture and forestry,** hence mitigation efforts must also address the contribution of agriculture to the climate change problem (Mwendera, 2013).

Traditional ways of life, for example **pastoralism which is recognized as an adaptive strategy** to climatic variability and a practical and cost-effective land use option, are also being threatened. The African Union 2010 policy framework for pastoralism in Africa, notes with growing concern the increasing impact of drought on pastoralists and suggests that "policy should promote research and understanding among stakeholders on the role of pastoral rangelands in carbon sequestration and the possibilities for carbon trading" (AU 2010, p.21). The research and extension strategy prioritizes "the quantitative assessment and monitoring of rangeland resources with analysis of the factors causing rangeland degradation and reduced access to rangelands for pastoralists" (AU 2010, p.32). The AU policy document also acknowledges the need for fully institutionalizing **livelihoods-based drought cycle management** as part of a risk-based disaster management strategy and early response rather than depending on crises and delivery of food aid (AU 2010, p.30).

Existing scientific knowledge indicates that global warming will result in **a general acceleration of the global hydrologic cycle**, meaning that surface water will evaporate more readily, and the moisture-holding capacity of the atmosphere will increase, leading to an overall increase in atmospheric water vapour. In turn, this is likely to trigger both **extremely heavy precipitation events and longer, hotter dry spells.** There is also a fairly high level of agreement across climate models on gross regional patterns of precipitation change. The evidence points to increased precipitation in far northern and southern latitudes, drier conditions in many subtropical locations, and wetter again in some areas along the equator – but the quantitative estimates of these changes are highly uncertain, and in the mid-latitudes, even the direction of change in average annual precipitation cannot be reliably predicted. However, we do know that warmer air temperatures themselves will have significant impacts on evaporative losses from soil and surface water bodies; plant-water use; and the ambient temperatures of streams and lakes. Warmer water temperatures, in turn, will tend to degrade water quality by reducing dissolved oxygen content and thus waste assimilation capacity, while promoting algal growth. We also know that sea level rise is inevitable, and will cause saline intrusion into coastal aquifers as well as eventual inundation of some coastal areas (Miller 2011).

The above-summarised issues have strong direct and indirect impacts on water availability and agricultural productivity, which, in turn, influences food security. Addressing these issues in African, Caribbean and Pacific countries, a recent ACP-EU report (Uphoff 2012) identified **the need for greater scientific understanding of various plant-soil-water-nutrient-soil biota interactions, crop models within various micro-climates**, and of the use and refinement of biologically-based revisions of 'modern agriculture' in order to integrate and build on traditional practices and involve farming communities. **Early warning systems** and integrated management information systems also remain a priority to support policy and decision-making. Developing and making available **crop varieties**

with a wide range of adaptation to moisture and temperature could ensure the preservation of a valuable gene pool in a changing climate situation (Jalloh 2013).

However, there is currently much uncertainty in the climate change projections in Africa; predicting how these uncertain changes will affect agricultural and food systems remains difficult. Most of the vulnerability and sensitivity mapping studies have been at regional scales, masking enormous variation at the local level. Thus the principal research challenge is how to achieve a **downscaling of vulnerability assessment and mapping exercises** (Mwendera 2013). By extension, research should focus on the process by which knowledge informs actions given that agriculture is intensely local, and requires that information be relevant and useful at that level (Mwendera 2013). Here, research should also fill the gap in **reliable climate information that will guide farmers' management of scarce resources**, as well as improved modelling that could guide farmers' decision-making and inform policy formulation (Jalloh 2013).

While most African countries have accepted the principle of integrated land and water management, major challenges remain and the water-land dynamic does not cover all the key variables that influence the availability of water for agricultural production. Indeed, current thinking on water resource management endorses a move away from the standard, hard-focus view of water as an object to be managed on its own terms, towards a consideration of how water resources influence, and are influenced by land management and ecosystem sustainability (Uphoff 2012). The challenge becomes all the more intractable in the light of climate change. The key conclusion of the ACP-EU Think Tank on Science and Technology for Agricultural and Rural Development identified **water governance** – which embraces the perspectives of landscapes, watersheds and catchments – as the way forward. Specifically, when dealing with the requirements for greater efficiency and productivity of water use in agricultural systems, there is need for a softer focus, with less clear-cut boundaries and with a broader conception of both water and agriculture, moving beyond conventional thinking about the integrated management of water. As such, it is argued that water for agriculture needs to be governed, not just managed, and this needs to be assessed and utilized in broader contexts in order to assure future agricultural production to achieve 'green' economic growth in a changing climate.

Green Economic Growth can be defined as a strategy to stimulate economic growth in rural and urban areas, ensuring poverty eradication and quality of life for all without overexploitation of natural resources: soil, water, biodiversity, energy and cultural capital (Froebrich 2013). This concept, which requires national or local-level policy definition, complements the principles of **ecological-intensification** which aims to insure high levels of yields while reducing environmental impacts and the dependence to non-renewable resources, based on a more intensive used of ecological processes (Chotte 2013). Moving from sustainable development towards a green growth strategy requires a shift towards activities and strategies, which stimulate economic recovery. Working together governments, businesses, research institutions, NGOs will enable the transition to a Green Economy. Eventually, green innovations lead to growth (Froebrich 2013).

The concept of water governance is related to that of **climate-smart agriculture**, which is influencing current thinking on rural sustainability in developing countries. Climate-smart agriculture, i.e. the use of low-cost farming techniques and soft technologies adapted to climate change, is based on the use of local investments, harnessing mainly local-level financing. However, in order to raise local financial capital, it is first necessary to stimulate sustainable rural economic growth. Some Africa-EU research collaborations have already focused on the climate-smart agriculture aspects of 'green growth', however more work should be done on the **science-business-policy interface** in Africa, to get entrepreneurs involved as key stakeholders in the process of defining, planning and implementing relevant projects, programmes and policies (Stepman 2013).

Regarding the critical issue of financing for bi-regional cooperation to address climate change, food and security issues in Africa, Stepman (2013) first sets out the **shortcomings in the policies of donors**. Namely, the absence of well-elaborated national policies, over-compensated by an excess of donor initiatives; the unrealistic time frame of donor-initiated development goals; the frequent 'adjustments' according to the donors' own priorities; that the methods and procedures are subject to fashions and that donors and their aid administrators have short memories, repeating the same mistakes. On the side of the aid recipients, Stepman (2013) points out that there are generally **too many disorganized, uncoordinated and technically weak actors at all levels**, resulting in a multitude of fragmented, competing, contradicting, parallel activities which have often interfered with the development of national institutional capacities by enticing the best people to come and work for them. There is also a weak enabling environment for private investments and for farmers to re-invest in their farms.

Stepman (2013) identified the following **constraints to private sector/SME participation**: that most businesses focus on managing their operations. They are not necessarily focused on how to improve their competitiveness through innovation; many businesses have limited ability to develop good proposals; developing concept notes and grant proposals and assembling the required documentation entails transaction costs time and resources. The private agri-sector may also find it very difficult (or be reluctant) to provide time and cash to match the grant, and limited experience and mistrust make the private sector reluctant to engage with NGOs or government-driven research activities and thereby prevent actors outside the private sector from entering into collaborative arrangements.

However, there are emerging funding mechanisms that aim to overcome these constraints. For example, SME equity funds, value chain based research funding and the use of national research calls. The Delegation of the European Union to Uganda will (in 2013) launch an **SME Development Fund (Equity Fund)** over 2-3 months and be open to all sectors of agribusiness, including livestock. The selection will be made on the basis of socio-economic-environmental criteria and financial return criteria, and the EU/Uganda aims at targeting at least 25-30 companies with the first closing of the fund. In an effort to develop **value chain financing**[1] some countries have put in place structures for platforms to encourage the operational use of research results by producers. For example, in the Ivory Coast 18 value chains work with the Fond Interprofessionnelle de la Recherche et du Conseil Agricole (FIRCA) and 13 to 14 are collecting fees. The value chain actors identify the projects which FIRCA finances in the field of applied research, agricultural advice, technical training and the reinforcement of capacities. Examples include hevea, palm oil, coffee, cacao, pigs, poultry and citrus fruit. **National research calls** can also function as an effective means to manage funding. In Burkina Faso, the Ministry of Research Science and Innovation created in January 2011 the National Fund for Research and Innovation for Development (FONRID). This fund is focused on research that meets national priorities; improving the quality of scientific research; the promotion of invention and innovation; diversification of the scientific, technical and financial partnership. In this area, and in others related to climate adaptation for food and water security, there is a strong need to **capitalize on indigenous knowledge** across the region to provide adequate information on relevant entry points for research and development (Jalloh 2013).

Albergel (2013) argues that large scale dams can play a positive role in achieving water governance. There are 53 large dams in Africa (defined as containing over 1 billion m^3) with a total capacity of 798 km^3. However, there is an uneven geographical distribution of dams and that many have a low storage capacity in relation to the surrounding populations and the geographical areas. Furthermore, most dams in Africa underperform in achieving their intended benefits and services. Albergel (2013) argues that a **dams can provide electricity for urban centres and reduce floods for the downstream ecosystems** and users if they are well designed and that the management of dams is based on

[1] Value chain finance, or supply chain finance, "allows a supplier to sell its invoices to a bank at a discount as soon as they are approved by the buyer. That allows the buyer to pay later and the supplier to secure its money earlier. Instead of relying on the creditworthiness of the supplier, the bank deals with the buyer – usually a less risky prospect. Supply chain finance is seen by many supply chain experts and managers as the great hope for easing problems with suppliers. Although it actually refers to several different solutions, at its most basic it allows both the buying company and the supplier to improve their working capital – a crucial attribute given the recent financial crisis" (Financial Times, http://lexicon.ft.com/Term?term=supply-chain-finance)

scientific knowledge of the natural hydrology and ecosystems; releases of water are well timed and where there is an inclusive, transparent, management process.

Smaller reservoirs are also a technology that should be promoted in Africa to help achieve effective water governance, as they have multiple purposes including the use of flood-flow harvesting; water mobilization for local development; erosion control and infrastructure protection, and a generally smaller environmental impact than larger dams. Water harvesting also offers a way to increase water availability for crops and is a proven technology to increase food security in drought areas, as well as controlling erosion and recharging groundwater, basic irrigation and the storage of drinking water.

Support for, and the subsequent performance of **Science, Technology and Innovation in Africa** is relatively poor. Low investments (<1% GDP) have exacerbated underperforming universities. For innovation and technology development, low levels of production, processing and marketing systems have led to little value creation, partly reflecting weak innovation policy frameworks (incl. IPR systems). Similarly, institutional mechanisms for intra- and inter-regional STI cooperation are weak (Francis 2013). There is the need for an interactive process, adding value to knowledge for socio-economic gain, where the inputs are knowledge, science, technology, resources, capital and the outputs are new/improved products, services, markets, jobs, income, wellbeing, etc. Here, the key elements are the processes of learning and developing linkages, which points to the need to study innovation systems, i.e. networks of actors who demand, create, diffuse and use knowledge within an institutional and economic framework.

Regarding the need to support S&T policy dialogue, Francis (2013) points to **the politicization of science and well as the 'scienticization' of policy** where there is a need to consider engaged vs. the ‘neutral’ scientists when developing evidence-based policy making. The demand for certainty from policy-makers vs. the inherent uncertainty of science is a constant challenge, exacerbated when taking into account the different motivations and time scales of the policymaking and scientific communities where there is often a need to reconcile specialized expertise vs. the democratization of knowledge. Francis (2013) argues that STI policy dialogues can be enhanced by a greater understanding and appreciation of the policy priorities and well as targeting ST&I information to the needs of specific policy actors in the processes of agenda setting, implementation and evaluation. There is also a need to engage intermediaries and knowledge brokers, foster interactions and deliberations and provide policy options and improve the public understanding of STI. Froebrich (2013) points to the need for research in helping to understand how to set up an effective science-policy interface (SPI) and policy design process, including how to define actors’ roles.

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