White Paper

Climate Services for Risk Reduction in Africa (CS4RRA):
from West African Webinars to Multilateral Opportunities

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Executive Summary

The West African countries share a myriad of challenges, including environmental degradation, desertification, enhanced rainfall variability, unprecedented heat waves, floodings and declining agricultural productivity. The accelerated climate change along with other global change stressors like population growth and rapid urbanization contributes to land degradation, chronic poverty, food insecurity, and malnutrition. To address these challenges, the Climate Services for Risk Reduction in Africa (CS4RRA) was initiated by France and Germany through their ministries of higher education and research (MESR and BMBF respectively), with West African regional and national institutions such as ACMAD, AGRHYMET/CILSS, WASCAL, African Centres of Excellence, Universities, National Governmental Services in West Africa with the aim to enhance climate resilience through Knowledge, Innovation, and Capacity Building (KIC). This initiative is built on the achievements of previous EU and AU programmes (H2020, JPI Climate/SINCERE, Copernicus CCS, ERA4CS, Climate-KIC, etc.). Four hybrid webinars (in-person and online), rooted in West African countries, were held to identify gaps and critical issues in climate services for risk reduction in Africa:

- **Webinar #1:** *Improvement of early warning system and adaptation measures for disaster risk reduction*; 28 Sept 2023; Université de Lomé, Togo (around 150 participants: 60 in attendance and between 40 and 80 attended online).
- **Webinar #2:** *Climate and environmental services for excessive water management*; 6 Nov 2023; Université Felix Houphouët Boigny (UFHB), Abidjan, Côte-d'Ivoire (around 250 participants: 150 in attendance and between 80 and 104 attended online).
- **Webinar #3:** *Climate impacts and resilience under present and future scenarios*; 8 Feb. 2024; Université Cheikh Anta Diop, UCAD, Dakar, Senegal (around 250 participants: 170 in attendance and between 80 and 220 attended online).
- **Webinar #4:** *Climate-smart agriculture and sustainable landscapes*; 15 May 2024; Kwame Nkrumah University of Science and Technology, Kumasi, Ghana (around 100 participants: 50 in attendance and between 40 and 60 attended on line).

Between 600 to 750 academic and non-academic stakeholders attended the webinars and highlighted the necessity for comprehensive and collaborative approaches to tackle climate-related challenges in West Africa. Representatives of government and ministries in the different countries hosting the webinars acknowledged the originality of such open webinars and the relevance to organize those forums in Africa prior to any implementation, because they helped to understand local contexts and specific needs of various stakeholders, to build ownership and to gather diverse African and European perspectives crucial for the sustainability of future CS4RRA actions.

To capitalize on such Webinars Forum, CS4RRA will culminate in an international Stocktaking Conference for West Africa, scheduled to take place in Banjul, The Gambia, from 5 - 6 November 2024. Building on conclusions and recommendations from the webinars and aiming to address gaps in knowledge, innovation, and capacity development, this conference will bring

policymakers and representatives of governments, academia, donors, international agencies, and various stakeholders of the climate service value chain together in Africa. The main objective is to agree on the identified necessary research and innovation efforts and to address the corresponding funding gaps. This conference will examine potential areas for multilateral cooperation to support research and innovation on climate services for risk management, resilience, and adaptation in West Africa. The main cross-cutting messages from the webinars to be discussed during the stocktaking conference include:

- There are **data, modelling and forecasting challenges** in Africa, and the **development and integration of advanced technologies**, like artificial intelligence, to improve the accuracy of hazard, impact, and risk forecasts for early warning and climate adaption.
- For **co-developing and co-creating of climate services** through frugal actions crucial research, innovation and capacity development are needed;
- **Citizen science** can play a crucial role in addressing the issue of data availability and quality by actively involving communities in the process of data collection, while also providing valuable socio-economic information that is essential for understanding the broader impacts of climate change.
- **Knowledge exchange and integration with local and indigenous knowledge systems**, including in local languages and citizen perception are very important to successfully develop and implement climate services.
- **Interdisciplinary collaboration** across natural, social, and health sciences are needed to tackle climate challenges comprehensively as well as **long-term partnerships between researchers, policymakers, and practitioners**.
- **Involvement of end-users in the design and implementation of climate services** using a co-development approach, and communication strategies to ensure that climate information is accessible and actionable in local languages.
- There is a need for **robust policy frameworks** that support climate risk reduction and resilience.
- There is a need for actionable steps and **projects aligned with national and regional development plans** to advance weather and climate resilience.
- The importance of building and maintaining **strong partnerships between African and European institutions**.
- **Financial solutions** need to be developed to secure sustainable funding for the climate services ecosystem and the formation of consortia to co-fund and implement joint actions and projects over the long term.

Specifically, this stocktaking conference will prepare the launch of a first multilateral call in 2025 for research, innovation and capacity development projects in West Africa. Funders from JPI-Climate have already confirmed their participation in a joint pilot call to be launched beginning of 2025. The stocktaking conference shall however also be used to expand the circle of funders, especially to include African funders. It will also be an opportunity for the high-level participants from Africa and Europe to discuss next steps, including conditions for a Coordination and Support Action in 2025-26 (potentially funded by the European Commission) to scale-up such co-design strategy to other African regions. It should impulse co-funding actions in 2026-27 and beyond towards a Long-Term European-African Partnership on Climate Risk Reduction and Adaptation (LEAP-CRRA), following the example of LEAP-RE on renewable energies and LEAP-AGRI on food and nutrition security and sustainable agriculture.

Indeed, CS4RRA is expected to make a significant contribution to the Climate Change pillar of

AU-EU CCSE Partnership (CCSE Roadmap, 2017), the AU-EU High Level Policy Dialogue on STI, the AU-EU Innovation Agenda (2023), the international partnership of the European Climate Knowledge Initiative Community (Climate-KIC), the Global Framework for Climate Services (GFCS) and the European Joint Programming Initiative on Climate (JPI Climate).

Contents

1. Introduction

West African countries face many shared challenges which require sustainable solutions. Rural, urban, and peri-urban populations are experiencing serious long-term degradation of environmental conditions and natural resources. Extreme climate events such as floods, dry spells, droughts, heat waves, dust, etc., and global shocks make cropping and livestock rising risky enterprises (Diedhiou et al., 2018; Sultan et al., 2019; Awolala et al., 2022) as agricultural and livestock productivity is low, leading to poverty traps and food insecurity (Sanfo and Gérard, 2012; IPCC, 2022). As a result, an increasing number of young men migrate to African cities, often overcrowded and exposed to climate change, or beyond leaving women and children on the farm to face the shocks, further reducing the capacity of farm households to achieve sustainable food production (OECD, 2016; Warner et al., 2012; Sanfo, et al., 2017). Poverty and intra-regional or extra-continental migrations are exacerbated by many factors, including demographic pressures, conflicts, political instability, terrorist attacks, poor road networks, lack of energy and resources, and health conditions both in urban and rural areas. In this context, comprehensive solutions must address these intertwined challenges to create sustainable socio-economic development and green growth (Lamptey et al., 2024) that are resilient to present and future climate changes. Despite progress boosted by GFCS since a decade to develop climate services in Africa, there are remaining challenges to further advance climate service development, provision and use (Hewitt et al., 2020).

Leveraging on previous AU-EU actions on climate services and adaptation to climate change in Africa, and acknowledging the urgent need to coordinate various bilateral and multilateral efforts between EU countries and West African countries for a stronger and sustainable positive impact on populations and economic growth, the French and German Ministries of Higher Education and Research (respectively MESR and BMBF), IRD, WASCAL, and African Centres of Excellence, Climate Chance, KIT, and RCC are implementing the Climate Services for Risk Reduction in Africa (CS4RRA) initiative. Supported by BMBF and MESR, in partnership with JPI Climate and AU-EU CCSE Partnership, the CS4RRA initiative aims to strengthen climate resilience in West Africa and ensure that better climate knowledge and services are available for both disaster risk reduction and adaptation to climate change. CS4RRA aims to encourage co-design of activities between African and European partners on Knowledge of the regional climate system, Innovation of climate services, and Capacity Building for user needs (KIC) by identifying actionable and complementary short/midterms steps to boost KIC via trilateral or multilateral joint calls or actions (South-South or South-North). For this purpose, four hybrid webinars (in-person and online) were held to identify critical issues in climate services for risk reduction in Africa.

CS4RRA will leverage the ongoing efforts of the AU, the EU Mission on Climate Adaptation, and GMES4Africa (Global Monitoring for Environment and Security). The African Union has been actively promoting policies aimed at climate resilience and sustainable development across the continent, particularly through its Agenda 2063 framework. The planed alignment with AU strategies will contribute to tap into a well-established platform that emphasizes integrated climate services and regional cooperation. Moreover, collaborative frameworks fostered by the AU, such as the African Regional Action Plan on Disaster Risk Reduction, will

provide crucial insights and support for the design and implementation of climate services tailored to the specific needs of West African countries.

The EU Mission on Climate Adaptation plays a pivotal role in enhancing adaptive capacities in developing regions, particularly through the sharing of technological innovations and best practices. CS4RRA will build on these efforts by integrating European advancements in climate modeling, climate services development, early warning systems, and risk assessment methodologies. Through partnerships with EU institutions and agencies involved in climate adaptation, CS4RRA will leverage technical expertise and funding opportunities to strengthen its impact. Additionally, CS4RRA will facilitate knowledge exchange programs, fostering a two-way dialogue that enriches both European and West African approaches to climate resilience.

Finally, the GMES4Africa initiative, which focuses on the establishment of earth observation and monitoring systems for environmental and climate services, aligns closely with the objectives of CS4RRA. Using data and analytical tools generated through GMES4Africa will enhance CS4RRA capability to provide accurate and timely weather and climate information, critical for risk reduction. Combining GMES4Africa's satellite-based data with ground observations, local knowledge and practices will contribute to develop a comprehensive understanding of climate risks in West Africa. Ground observation networks across Africa will be needed to validate earth Observation and monitoring systems. This will not only improve the quality and relevance of climate services but also promote regional ownership and capacity building, ensuring that local stakeholders are empowered to utilize the information for effective decision-making and planning.

This white paper intends to sum-up the findings of the webinars and illustrate next steps of the CS4RRA initiative for researchers, decision-makers, and national, regional, and international research funders. In all webinars the importance of climate and environmental services for disaster risk reduction in West Africa has been stressed. By describing the relevance of each topic, providing diagnosis and recommendations the complexity and interlinkages are highlighted. Furthermore, future investments in Knowledge, Innovation, and Capacity Development needed to enable the region to successfully adjust and mitigate to climate change impacts are specified. The paper boosts partnerships and collaboration and influences the national, regional, and international academic and non-academic opinions and policies in investing in climate and environmental services for risk reduction in West Africa and beyond.

2. Successes of Webinar' Forum in West Africa

The webinars were financed by the Franco-German fund (MESR – BMBF/DLR-PT), in partnership with the European Joint Programming Initiative on Climate (JPI Climate) and the African Union – European Union STI Partnership on Climate Change and Sustainable Energy (CCSE). Implemented by WASCAL & IRD, the objectives of these 4 multilateral hybrid webinars were to:

- address particularly pressing issues in climate services for risk reduction in Africa focusing on Research, Innovation & Capacity Development, on coastal, urban and rural areas;
- identify priorities for joint vision and multilateral actions (South-South & North-South Cooperation);
- feed a Stocktaking Conference at the end of 2024, including short-term actionable steps; and
- contribute to the African Union – European Union Innovation Agenda and CCSE Partnership.

The topics and content of the webinars are the outcome of an intensive consultation process including experts from Africa and Europe, from science and from practice taking into consideration scientific and political discourse. The webinars used a hybrid model with physical participation by West African scientists, researchers, and students, and remotely by partners from Europe and beyond. This approach leveraged the improved practices developed during the Covid crisis. With more than 600 participants, the webinars reflect a sound and representative basis of the current interests of African and European stakeholders beyond researchers, scholars, and from practice, including local, national, and regional policymakers, NGOs, media, and the private sector.

All webinars emphasized the need to encourage interdisciplinary and transdisciplinary research, to create conditions for the co-production of knowledge with all stakeholders taking account of their context and value system, to improve regional cooperation and institutional partnerships, and to train researchers and practitioners in advanced methods including artificial intelligence for analyzing complex systems:

*2.1. **Webinar #1**: Improvement of early warning system and Adaptation measures for disaster risk reduction*

2.1.1. Importance of the issue and highlights

African populations are among the most impacted by climate change because of their limited capacity to adapt to change (Ghio et al., 2023; Boko et al., 2007). This increases the exposure of people to extreme weather events and subsequently, the risks of being impacted by climate change (Ayanlade et al., 2022). Rainfall variability in West Africa is higher compared to other regions. The West African Monsoon, which drives most of the region's rain, is becoming increasingly variable, causing intense periods of both drought and flooding making it

challenging for communities to adapt. Indeed, over the past century, West Africa experienced a 20-30% decrease in annual rainfall in the Sahel from 1970-2000 however, with a little recent recovery (Sanogo et al.,2015). This drop is one of the steepest globally and has not been as severe in other monsoon-dependent regions like Southeast Asia. Droughts are becoming more frequent and severe, especially in the Sahel where projected prolonged dry periods (especially in Western Sahel) are expected to reduce crop yields, diminish water supplies, and increase food insecurity (Diedhiou et al., 2018; Sultan et al, 2019). Moreover, while global flood risks are increasing due to rising sea levels and extreme rainfall, West African cities like Lagos, Dakar, Abidjan and Accra are facing compounding risks (aggravated by poor drainage infrastructure). Africa experiences some of the highest flood mortality rates globally, with 43% of global flood deaths in 2022 occurring in West Africa. Countries like Nigeria, Niger, and Chad were particularly affected by extreme rainfall that led to severe flooding, killing more than 800 people. Recently, extreme rainfall in July 2024 caused significant flooding in Northern Nigeria, particularly affecting states like Kano, Jigawa, Borno and Katsina. Nigeria experienced its worst floods in a decade, with over 600 deaths and 1.3 million displaced (Jonkman et al., 2024 UNDRR, 2022). This is far higher than regions like Europe or North America, where infrastructure and early warning systems mitigate most flood-related fatalities.

Efficient early warning systems can help forecast extreme weather events and anticipate measures to manage climate disasters better and reduce the negative impacts of those events on vulnerable populations. Against this backdrop. Webinar #1 was held at the University of Lomé, Togo, and aimed at improving early warning systems an adaptation measures for disaster risk reduction in West Africa. Webinar #1 raised the urgent need to improve the availability and quality of multidisciplinary data to increase the knowledge of hazards and foster the integration of new technologies, such as artificial intelligence, to improve early warning systems. Around 150 participants attended (60 in-person and between 40 and 80 online). Challenges for better forecasting of hazards at different lead times have been shared from different EU and African experiences and perspectives, and specific issues in the predictability of rainfall and temperature from daily-weekly (weather) to sub-seasonal and seasonal (S2S) timescales have been discussed as well as communication of forecasts and the imperative to migrate from science to policy advice. These discussions enabled an overview of early warning systems challenges in terms of knowledge, innovation and capacity development for disaster risk reduction and adaptation in West Africa to be addressed, highlighting urgent issues that led to a series of recommendations.

2.1.2. Diagnosis

Africa is exposed to extreme climatic risks

- There is an increase in the frequency and intensity of weather and climate extreme events in Africa, with four main risks: drought, floods, storms, heat waves (IPCC, 2022).
- Floods in Nigeria and Niger are 80 times more likely and 20% more intense, according to a recent study by World Weather Attribution (Zachariah et al., 2022).
- According to forecast models, floods will increase by 134% compared to the previous decade (UNEP 2021; WMO 2021; Wang et al., 2023).
- Africa's urban areas are considered high-risk and vulnerable zones (Satterthwaite, D.

2017).

- According to expert forecasts, the Sahelian zone will be at extreme risk in the event of a +3°C rise in temperature (Ayugi et al., 2023).

The monitoring of the regional weather and climate system is poor

- Africa has a limited number of operational surface and upper-air weather stations. Specifically, there are only 37 rain radar stations across the continent, serving a population of 1.2 billion, whereas the United States and the European Union together have 636 weather radar stations for a combined population of 1.1 billion. Additionally, there are currently no operational radar stations in West Africa (WMO, 2021).

- According to the WMO (2021), 60% of Africa's population lacks access to early warning systems to manage extreme weather and the impacts of climate change.

- Human resources in meteorological services are insufficient.

Difficulties to access meteorological and hydrological data in real-time complicates the development of effective warning systems

- The question of data availability and quality arises in Africa.
- Observational data are lacking in West Africa, including climate impacts.
- Existing digital platforms often fail to provide accurate climate services.
- Access to satellite products for field players in the region remains insufficient overall.
- Real-time operational forecasts from sub-seasonal to seasonal forecasting sources (S2S) are generally neither available nor used in most West African Meteorological offices - even though the situation slowly improves.
- Even when human resources are available, they are not always trained in data collection and use.
- Coordination between West African meteorological services and research centers in the field of early warning systems remains inadequate.
- These factors contribute to a lack of understanding of the sources of sub-seasonal to seasonal predictability (S2S) over Africa and their impact on extreme events.

2.1.3. Recommendations

Improve knowledge, forecast and weather data access and use

- Filling the gaps in understanding of sources of sub-seasonal to seasonal predictability (S2S) over Africa and their impact on extreme events.

- Consider the whole “value chain” of early warning systems and perform post-evaluation of climate services and measures in terms of socio-economic value.

- Implement nature-based solutions to provide natural defenses against climate-related hazards such as floods, droughts, and storms and to reduce the risk of disasters.
- Build on citizen science to democratize climate data collection, complement climate models, raise awareness, and inspire local, sustainable solutions to climate challenges.

Innovation for improved and efficient disaster risk reduction strategies

- Ensure that capacity development is an integral part of research initiatives.
- Develop and improve early warning systems that prioritize the needs and vulnerabilities of local communities.
- Develop innovative frugal forecasting strategies or build on AI methods for specific localities and generate impact-based forecasts.
- Build risk assessment and response using open-source data
- Transform data into actionable information for disaster risk reduction.
- Promote use of ensemble forecasts and to act in the event of forecast uncertainty.
- Improve understanding and use of local knowledge in disaster risk reduction strategies.
- Establish innovative mechanisms for disseminating essential information to concerned stakeholders and communities, including in local languages.

Capacity development

- Strengthen the capacities of actors involved in setting up early warning systems.
- Improving preparedness in building capacity related to disaster risk reduction and management, particularly in regions prone to extreme events.
- Strengthen expertise in the operational aspects of early warning systems, enhancing the ability to respond effectively to disasters.

Strengthen political governance linked to disaster risk management

- Empower local governance structures to better integrate disaster risk management into their decision-making processes.
- Integrate disaster risk reduction and climate change adaptation into policy frameworks at regional and national levels.
- Improve communication of forecasts, public awareness and understanding of disaster risk and the effects of climate change.
- Migrate from science to policy advice and build on ongoing local development strategies
- Investigate and implement disaster risk financing and insurance mechanisms to build

resilience.

- Institutionalize climate services through partnerships with regional and national institutions.

*2.2 **Webinar #2:** Climate and environmental services for excessive water management*

2.2.1. Importance of the issue and highlights

According to IPCC AR6 (2021, 2022), precipitation will significantly increase in countries of the Guinea Coast of West Africa and flooding mainly over coastal areas is likely to increase. Indeed, rainfall is expected to increase by 5-10% in the coastal areas and sea-level rise is estimated to increase by 0.5 to 1 meter by 2100 (Horton et al., 2020). This will threaten coastal communities and ecosystems. Coastal ecosystems, such as mangroves and wetlands, are critical for water management but are under threat from urban expansion and climate change. In some areas of West Africa, mangrove cover has decreased by 30% over the past few decades, impacting biodiversity and coastal protection. Despite being a region with abundant rainfall, poor water management and infrastructure have led to water scarcity issues in urban areas. For instance, access to safe drinking water in some parts of the Guinea Coast is below 60%, compared to the global average of 89% (WHO/WSH, 2021). Finally, most of the existing infrastructures and crop varieties are often designed for drier conditions, making them ill-suited for increased rainfall (Zougmoré et al., 2016)

Managing excess water in both rural and urban areas is crucial to mitigate the impact of floods, erosion, and waterlogging in agricultural areas, while also ensuring an optimal and sustainable water supply. Effective water excess management requires a multidisciplinary approach that combines climate science, hydrology, infrastructure planning, and community engagement. Webinar #2 aimed to highlight how climate and environmental services can play a vital role in providing the necessary information and supporting solutions to mitigate the impacts of excess water events and build climate resilience. Around 250 participants (150 in- person and between 80 and 104 online) attended Webinar #2.

2.2.2. Diagnosis

Knowledge of the risks associated with excess water is limited

There is a link between climate change and the problem of excess water. However, stakeholders' understanding of the risks associated with excess water in Africa is limited by several factors:

- There are very few studies on urban vulnerability or on the close link between climate and sanitation issues in West Africa.
- There is no spatialized rainfall measurement with the installation of meteorological radar in sub-Saharan Africa.
- People are not very aware of the risks associated with water.

Water resource management and planning tools are limited or non-existent

The impact of climate change on the availability of water resources is also visible in the decreasing flow of rivers and floods. In addition, there has been a deterioration in water quality due to human activities and climate change. However, there is a lack of management and planning tools to deal with this problem:

- There are no managed and viable sanitation services (wastewater, solid waste, faecal sludge) due to: poor planning and integration of sanitation (inequality, lack of long-term sanitation services, etc.) in the face of rapid population growth.
- There are several shortcomings, particularly in the forecasting of extreme events and in the consistent implementation of policies to manage excess water.
- There is a lack of urban development plans and early warning systems for the population.

Cross-border cooperation is insufficient

Cooperation between the various West African countries is still underdeveloped for a few reasons:

- Lack of coordination or coherence between research activities and the absence of sharing of research results. This increases the problem of the availability of scientific data.
- Lack of integrated management of regional policies to improve coordination of the various national policies.
- Little use is made of ecosystem functioning or ecosystem services.

2.2.3. Recommendations

Improving capacity development of local authorities, emergency responders and community members of the risks and management of excess water

To improve the understanding of local authorities, emergency responders and community members of the risks and management of excess water, it is necessary to focus research on the urban vulnerability of West African cities of different sizes and to conduct interdisciplinary studies for the urban environment. It is also essential to set up training programmes on the collection, management, analysis and interpretation of climate data to inform urban planning and rainwater management. The following more specific training courses are also to be set up:

- Civil engineering for water storage engineering and all the professions associated with metrology, installation of sensors, monitoring of measurement networks, maintenance, etc.;
- Training in scientific computing (modelling and simulation tools) and in the management of computing centres;
- Training engineers and town planners in the design of infrastructures capable of withstanding the effects of climate change;

- Capacity-building training in access to funding and resources for climate adaptation and rainwater management projects.

Raise awareness and educate the public about the risks associated with excess water

To improve people's knowledge of the risks associated with excess water in Africa, it is necessary to co-construct innovative solutions with communities, such as:

- Community engagement platforms: Using technology for community engagement to raise awareness of stormwater management, encourage sustainable practices and obtain data on the effects of local weather conditions;
- Develop user-friendly mobile applications to provide the public with real-time information in local languages on weather and flooding, enabling residents to take proactive measures;
- Develop programmes to educate and engage communities in sustainable stormwater management and climate adaptation practices;
- Develop and implement with the West African Ministries of Education an environmental education programme aimed at both students and civil society.

Use innovative solutions based on new technologies

To manage excess water, there are innovations in engineering and design to create climate-resilient stormwater infrastructure capable of coping with increased rainfall and flooding. Artificial lakes and dams can be created to collect rainwater and facilitate its reuse. When it comes to monitoring, measuring and collecting data, innovative solutions such as remote sensing and weather radar can be used to facilitate:

- Monitoring weather conditions, changes in land use and the health of green infrastructure to manage run-off water and track groundwater.
- Increasing the density of in-situ observation networks (radiosondes, weather stations, hydrometric stations) in the sub-Saharan African region;
- Developing participatory science to strengthen warning systems, using ICT in local languages;
- The analysis of multi-source data and climate models to better forecast local and regional weather patterns, enabling proactive stormwater management.

Address cross-border water issues through cooperation between all stakeholders

Setting up an effective cross-border cooperation network is essential for developing and implementing shared strategies for managing excess water. This requires:

- Encouraging collaboration between different government agencies, NGOs and international organizations to collectively address climate challenges;

- Strengthening disaster risk assessment and reduction capacities in urban areas, including the creation of evacuation and shelter plans;
- Promoting Integrated Water Resources Management (IWRM) committees into the development of innovative solutions;
- Building the capacity of civil servants to create and implement common policies and climate-resilient regulations for urban development, stormwater management and the living environment.

2.3. Webinar #3: Climate impacts and resilience under present and future scenarios

2.3.1. Importance of the issue and highlights

Building resilience and understanding the impacts of climate in Africa means addressing local challenges while contributing to global efforts to tackle climate change (Conway and Vincent 2021). Investing in climate services to support adaptation and resilience-building measures can protect communities, preserve natural resources, stabilize economies and contribute to a more sustainable future for West Africa and the world (Sanfo et al., 2022). West African countries are particularly vulnerable to the effects of climate change due to their dependence on climate-sensitive sectors such as agriculture, their low adaptive capacity, and their limited infrastructure in both rural and urban areas. This vulnerability threatens their socio-economic development and has global repercussions that require international cooperation and attention (Sorgho et al., 2020). Understanding these climate impacts is essential for developing resilient development strategies and climate services adapted to local realities. This process should consider current and future scenarios of both climate and development trajectories in Africa. Webinar #3 aimed to highlight barriers and enabling conditions for reducing climate change vulnerability and risks, and for designing effective climate services adapted to local contexts for resilient development pathways. Around 250 participants (70 in-person and between 80 and 220 online) attended Webinar #3.

2.3.2. Diagnosis

Existing climate change adaptation and mitigation policies in West Africa are insufficient and limited.

There are very few examples of successful and proactively planned climate change adaptation in African cities. Planned adaptation initiatives in African cities have mainly been determined at national level. Progress in terms of planned adaptation is slow, particularly in West and Central Africa. The main reasons are as follows:

- A scarcity of adaptation measures aimed at vulnerable populations.
- The virtual non-existence of adaptation policies in more than 80% of Africa's major coastal cities (IPCC, 2022).
- Poor consideration of socio-economic projections in adaptation policies, which are not at all aligned with scenarios and risks.

Climate services are underdeveloped in West African cities

Climate services could play a central role in West Africa, particularly in sectors such as energy or civil security, where there is clear potential. However, they are mainly limited to the acquisition and modelling of environmental data for decision-making in adaptation planning. There are several reasons for this:

- Local information on climate risks and other socio-economic data is often unreliable.
- Where climate data is available, it is not easily accessible or sufficiently used.
- Incomplete knowledge of climate change and its effects at local level.

Climate change is having an increasing impact on socio-agroecosystems, threatening the food security and resilience of communities dependent on agriculture.

Extreme weather events, such as storms, flooding and droughts, are becoming more frequent and threaten the stability of agricultural systems in West Africa. Sahelian agriculture, for example, is experiencing a decline in productivity. According to forecasts, yields of the main crops could fall even further compared with the current situation as a result of higher average temperatures and lower rainfall (e.g. Senegal). Our understanding of this phenomenon is still incomplete due to several obstacles:

- There is a lack of data on the specific effects of extreme weather events on agricultural systems at different spatial and temporal scales, as well as on farmers' adaptation mechanisms.
- There is very little data on the specific impacts of climate change on food production in the arid zones of Africa.

Research projects are limited by difficulties of access to funding.

Although research plays a central role in understanding climate change in West Africa, the sector faces funding difficulties that can vary depending on the subject. For example, climate research funding in Africa focuses on food systems, ecosystems and freshwater, to the exclusion of research on urban areas, which receives very little funding. There is also a mismatch between research funding and development aid funding, which currently operate in parallel despite the need to integrate effective climate resilience into African development trajectories.

2.3.3. Recommendations

Developing participative governance frameworks and integrated local adaptation plans

The development of integrated local adaptation plans and sustainable natural resource management plans are essential for managing climate risks and building resilience to climate change. To this end, governance frameworks involving all stakeholders at all stages of the planning and implementation process are necessary. This includes:

- organizing capacity-building sessions on participatory governance and the integration of adaptation approaches at local level, with an emphasis on developing leadership and facilitation skills.
- Building the capacity of government decision-makers and key stakeholders to integrate Earth observation data and geospatial technologies into decision-making.

Building on existing tools and technologies to improve data collection, develop climate services and increase climate resilience.

Citizen science and social learning platforms increase communities' ability to adapt and their resilience to risks. In addition, the use of innovative technologies such as drones, a new low-maintenance type of rain radars, and satellites can improve the monitoring and modelling of extreme weather events. Several other tools have also been identified as having the potential to improve climate services and climate resilience in West Africa, e.g.:

- the SIMAGRI tool developed by the Institut Sénégalais de Recherches Agricoles, which identifies the best-performing short-cycle variety, as well as the optimum level of fertilisation to increase yield while controlling costs.
- the Machine Learning Algorithm, which can identify the main determinants of poverty from thousands of scenarios.
- the mobile phone applications that can support the collection of climate information.
- The ecoWatt web application, which alerts users to over-consumption to avoid power cuts, could be adapted to the West African context.

Strengthen the capacities of all stakeholders, with an emphasis on the local level

The knowledge of the players involved in drawing up and implementing adaptation plans and measures must be regularly updated in the light of ongoing changes in climatic phenomena. As local players are on the front line, particular attention must be paid to their training, including local languages. Capacity-building workshops on the use of digital tools are needed to enable local players to provide reliable local data. Emphasis should be placed on the agricultural sector through:

- The organization of training workshops on the use of monitoring technologies for local stakeholders and decision-makers, as well as on effective agricultural adaptation practices.
- Capacity development on effective dissemination strategies to enable farmers to adopt the use of organic fertilizers that benefit both food security and the environment.

Funding local research and improving interdisciplinary and multi-level collaboration

It is essential to mobilize financial resources to support local research in West Africa. This requires better coordination of funding sources. Research funding and development aid funding, for example, need to be better coordinated. In addition, areas of collaboration need to be created

to strengthen research. To achieve this, it is necessary to :

- Encourage interdisciplinary and transdisciplinary collaboration in West Africa, which could strengthen the sharing of climate data.
- Create conditions for the co-production of knowledge with all stakeholders, taking account of their context and value system.
- Improve the regional cooperation framework and institutional partnerships.
- Train researchers and practitioners in advanced methods for analysing complex systems, including the use of specialised software and participatory data collection.

*2.4. **Webinar #4**: Climate-smart agriculture and sustainable landscapes*

2.4.1. Importance of the issue and highlights

Africa's Agricultural sector has huge potential, but it is vulnerable and exposed to climate stressors (Durodola, 2019). Extreme climate events such as prolonged droughts, erratic rainfall, floods, storms and heatwaves are harmful to crop yields and livestock. As of 2023, approximately 38 million people in West Africa are classified as severely food insecure, largely due to climate variability and conflict (WFP, 2023). This number reflected a rise from previous years, illustrating the worsening situation. According to UNEP (2021), about 65% of the land in West Africa is degraded due to deforestation, unsustainable agricultural practices, and overgrazing, and significantly impacting agricultural productivity. Agricultural risk management is vital as higher risks often lead to greater rewards in business. Worldwide, sustainable agriculture practices have been adopted at varying rates, with Europe showing higher implementation rates (60-80% of farms using sustainable practices) compared to West Africa, where adoption is significantly lower, estimated at around 25% (OECD, 2022). Climate-smart agriculture and sustainable landscapes offer opportunities amid these challenges. The use of science, technology, and collective action to tackle climate variability and its impact on agriculture and landscapes is relevant (Partey et al., 2018). The Overall objective of Webinar #4 was to thoroughly explore the challenges, solutions, and needs associated with climate-smart agriculture and sustainable land management in West Africa. Webinar #4 helped all stakeholders develop effective strategies to meet the challenges of climate change and land use change in the region. Around 100 participants (50 in-person and between 40 and 60 online) attended Webinar #4.

2.4.1. Diagnosis

According to Ouedraogo (2016), CCAFS (2021), and Agrhymet (2023), technological innovations or economic viability and financing incentives are not significantly deployed in West Africa to enable farmers to access credit and markets. This lack of deployment also hinders improvements in labor productivity and crop yield within the context of climate change. Moreover, the lack of inclusiveness and equity in agricultural activities (including gender-sensitive approaches and social inclusion) weakens the collective ambition to create sustainable land use management solutions (Zulu, 2021; Phili et al, 2022). Given the climatic variability in West Africa, there is a lack of long-term research or experiments that can provide informed insights in the foreseeable future. Indeed,

several interventions in the region currently rely on historical events or studies ad presently, modelling serves as a method to bridge the knowledge and innovation gap by utilizing available data. Finally, the lack of effective policy, legal framework for credit, insurance, climate information services development, mechanization to reduce risks, price regulations and post-harvest losses, and to promote climate smart agricultures interventions.

2.4.3. Recommendations

Development of diverse food systems

The development of diverse food systems requires a full engagement of small and large-scale farmers, researchers, and scientists from diverse social and structural backgrounds, while addressing gender disparities, to enhance adaptive capacities and ensure inclusive development.

Reforming land use policies to raise awareness about agricultural land conservation amid urbanization and providing guidelines to prevent the encroachment of farming lands by expanding residential and industrial areas.

Leveraging public and private partnerships including existing technologies of climate-smart agriculture to enhance food systems.

- Revamping urban agroforestry policies and practices
- Investment in technology, research, and innovation
- improving food value chains to reduce post-harvest losses and increase production efficiency through innovative practices.
- Building and enhancing adaptive capacity

3. Key cross-cutting messages from Webinars Forum in West Africa

CS4RRA webinars highlighted that balanced and collaborative leadership and support between Africa and Europe are crucial for addressing shared challenges and maximizing opportunities for climate resilience and sustainable development. Both continents face common challenges such as climate change, complex compound events, migration, security, and water shortage or excess. Balanced partnerships facilitate the exchange of knowledge, expertise, and best practices. European technological advancements in AI based on data, for example, can complement African innovations and vice versa (in agroecology), leading to more effective solutions that benefit both regions. The main cross-cutting messages from the webinars that will be discussed at the stocktaking conference include:

1. ***Research and innovation priorities:***
    a. Identify critical areas for research and innovation that emerged from the webinars including frugal actions leading to sustainable implementation of climate services.
    b. Discuss specific actionable steps and projects aligned with local, national or regional development plans and priorities that can be pursued to advance weather and climate resilience.
    c. Discuss the limitations, challenges and ways forwards in current weather and

climate models, with the aim to improve early warning and reduce the large uncertainties in climate projections.

d. Emphasize the importance of reliable, high-quality and freely accessible past and present climate data by sustaining and expanding current observational networks.
e. Highlight the need for comprehensive socio-economic data to understand the broader impacts of climate change.
f. Promote citizen science to democratize climate science and enable the collection of localized data that complement broader climate models, raise awareness, and inspire sustainable, community-driven solutions to climate-related challenges.
g. Foster the development and integration of advanced technologies such as artificial intelligence to improve accuracy of hazard, impact and risk forecasts.
h. Display the potential benefits of new technologies such as artificial intelligence, the Internet of Things (IoT), and remote sensing in climate services.
i. Encourage the wider adoption and use of these technologies for better climate risk management, as well as to collect data and evaluation from the user side.

2. ***Capacity development and knowledge transfer:***
    a. Stress the importance of engaging end-users in the design and implementation of climate services (Co-design and Co-development approach) and investigating indigenous and local knowledge systems.
    b. Highlight effective communication strategies to ensure that climate information is accessible and actionable, in local languages. Encourage knowledge transfer and integration with local and indigenous knowledge systems, including in local languages.
    c. Promote the mandatory collaboration across various disciplines, including natural, social and health sciences, to address climate challenges holistically.
    d. Encourage long-term partnerships between researchers, policymakers, and practitioners.
    e. Maintain sustainable research and education hubs, like WASCAL GSP and IRD Joint International Laboratories

3. ***Policy governance and financial constraints:***
    a. Discuss the financial barriers and propose solutions to secure sustainable funding for the climate services ecosystem.
    b. Setup integrated frames to foster involvement of private sector in the funding of climate services and implementation of environmental policies.
    c. Highlight the importance of building and maintaining strong partnerships between African and European institutions to support AU-EU partnership.
    d. Implement holistic approach to link to climate adaptation and mitigation measures.
    e. Address the need for effective policy frameworks that support climate risk reduction and resilience.

f. Encourage the formation of consortia to co-fund and implement joint actions and projects over the long term.

These messages will help ensure that the stocktaking conference builds on the insights gained during the webinars, fostering a coordinated and impactful approach to climate risk reduction and resilience in West Africa.

4. The stocktaking conference: Multilateral opportunities and potential instruments

The webinars highlighted the commitment of regional and international stakeholders to improving climate resilience and disaster risk reduction in West Africa. By emphasizing environmental monitoring, geophysical and socio-economic data availability and quality, leveraging new technologies, building local capacities, and promoting interdisciplinary collaboration, the initiative has set a solid foundation for meaningful progress. The international stocktaking conference in Banjul will be a pivotal moment to consolidate insights, forge new partnerships, and define actionable steps for future R&I. It will also serve as a platform to bridge funding gaps and streamline efforts towards a long-term African-European partnership on climate risk reduction, resilience and adaptation. Joint long-term research initiatives promoted through this collaboration will advance sustainable development goals (SDGs), ensuring economic growth, social inclusion, and environmental protection.

This stocktaking conference has two main objectives: i) review the webinars' outcomes comprehensively and ii) identify priorities to forge a joint roadmap towards a long-term partnership on R&I between Africa and Europe for climate risk reduction, resilience, and adaptation. Outcome of the Stocktaking conference will scale up to a 2025 joint call for proposals to address the critical issues identified during the webinars. The significance of hosting an inclusive international stocktaking conference in West Africa is to consolidate insights gathered from webinars and foster collaboration among research funders, practitioners, and stakeholders. The conference will equally help attract key institutions and countries beyond the initial CS4RRA circle in the aim to address the significant gap in funding relevant research and innovation activities to be undertaken for sustainable development of the region.

Beyond such a conference and a first call focused on West Africa, it is envisaged to build a consortium in 2025 to scale-up such co-design process to other African regions that could latter impulse co-funding actions towards a Long-Term European-African Partnership on Climate Risk Reduction and Adaptation. In particular, partners from JPI Climate, EC Projects (Horizon 2020 and Horizon Europe), AU-EU CCSE Partnership, and beyond, interested either in co-design and co-funding one or more joint calls are explicitly invited and encouraged to consider the report on the webinars (see https://cs4rra.wascal.org/), and to actively collaborate in the preparation of the stocktaking conference with a view on developing and publishing a 1st joint call in 2025 and/or subsequently setting up a consortium to co-design and co-develop a coordination and support action in 2025-26 with potential support from EU-COM and implement a co-funding action together in 2026-2027 and beyond.

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Glossary

ACE: African Centres of Excellence
ACMAD: African Centre of Meteorological Applications for Development,
AGRHYMET: Regional Centre on science and technology applied to agriculture, hydrology, rural development, and natural resource management (Centre of CILSS).
AI: Artificial Intelligence
AR6: Sixth Assessment Report
AU: African Union
BMBF: German ministry of higher education and research
CCSE partnership: AU-EU partnership on Climate Change and Sustainable Energy
CILSS: Permanent Interstate Committee for Drought Control in the Sahel
CIS: Climate Information Service
Climate-KIC: EIT Knowledge and Innovation Communities on Climate (https://www.climate-kic.org)
Copernicus CCS: Copernicus Climate Change Service
CS4RRA: Climate Services for Risk Reduction in West Africa
CSA: Climate Smart Agriculture
DRR: Disaster Risk Reduction
ER4CS: ERA-NET Consortium "European Research Area for Climate Services" (https://jpi-climate.eu/programme/era4cs)
EU: European Union
GFCS: the Global Framework for Climate Services, (https://wmo.int/site/global-framework-climate-services-gfcs)
H2020: Horizon 2020
IoT: Internet of Things
IPCC: Intergovernmental Panel on Climate Change
IRD : Institut de Recherche pour le Développement
IWRM: Integrating Integrated Water Resources Management
JPI Climate: European Joint Programming Initiative on Climate (https://jpi-climate.eu)
KIC: Knowledge, Innovation, and Capacity Building.
KIT: Karlsruhe Institute of Technology
KNUST: Kwame Nkrumah University of Science and Technology (Kumasi, Ghana)
MESR: France ministry of higher education and research
NGO: Non-Governmental Organisations
UFHB: University Felix Houphouët Boigny (Abidjan, Côte d'Ivoire)
UCAD: Université Cheikh Anta Diop (Dakar, Senegal)
UL: University of Lomé (Lomé, Togo)
OECD: Organisation for Economic Cooperation and Development
RCCC: Red Cross Red Crescent Climate Centre
S2S forecast: Subseasonal to seasonal forecast
SDG: Sustainable Development Goals
SINCERE: Coordination and Support Action "Strengthening INternational Cooperation on climatE change Research" (https://jpi-climate.eu/programme/sincere)
STI Dialogue : AU-EU dialogue on Science, Technology and Innovation
WASCAL: West African Science Service Centre on Climate Change and Adapted Land Use
WMO: World Meteorological Organization