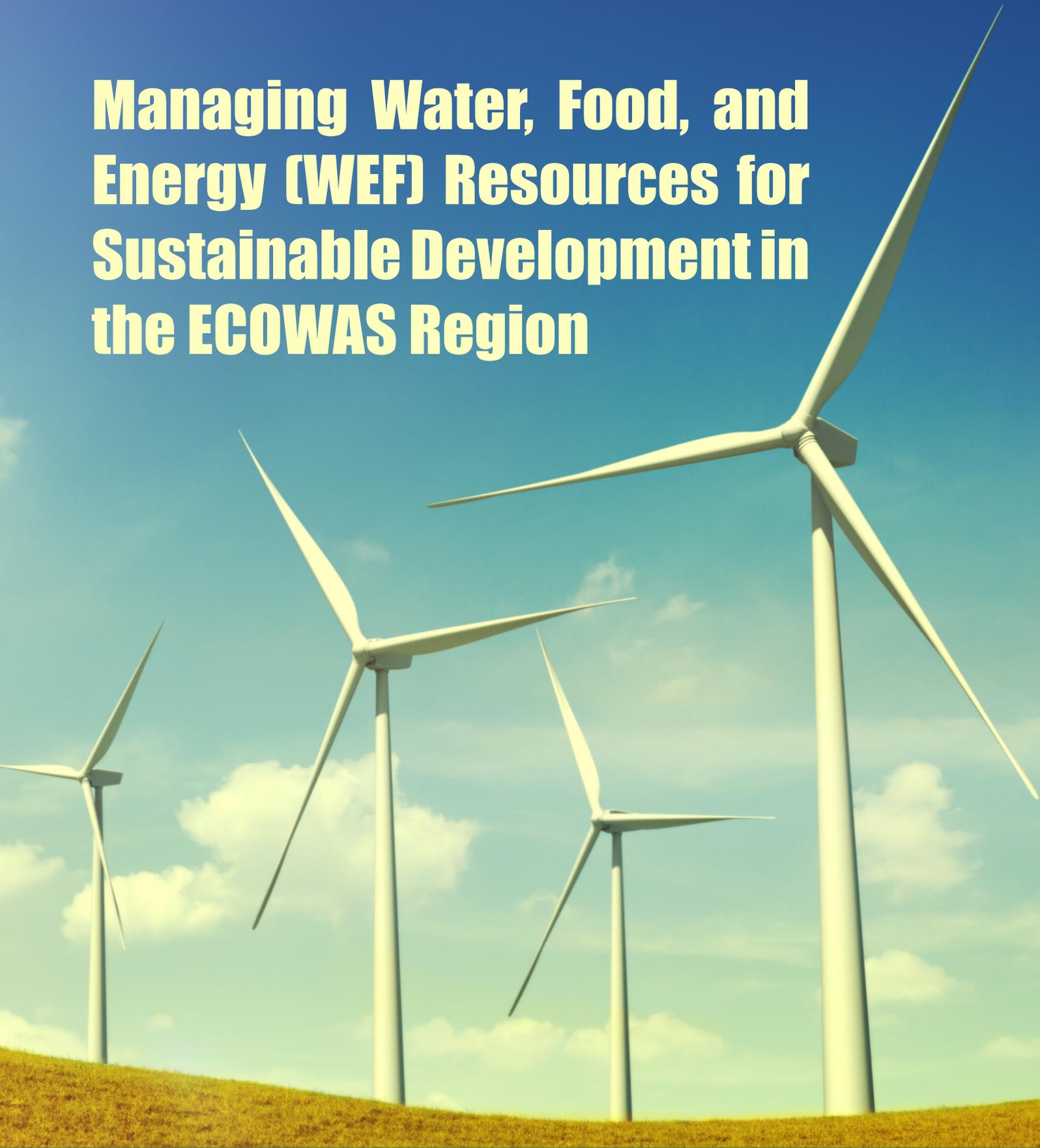


# Managing Water, Food, and Energy (WEF) Resources for Sustainable Development in the ECOWAS Region



Policy brief funded by

Disclaimer: This policy brief was prepared by the ECOWAS Centre for Renewable Energy and Energy Efficiency. Its aim is to highlight the role of Renewable Energy (RE) in addressing nexus challenges in the ECOWAS Region. The findings, interpretations, conclusions, and views expressed in the brief are entirely those of the author(s) and do not necessarily represent the views of ECREEE, its Executive Board or the countries they represent, or affiliated organisations. Comments and enquiries should be addressed to [aadebiyi@ecreee.org](mailto:aadebiyi@ecreee.org) and [apueyo@ecreee.org](mailto:apueyo@ecreee.org).

# CONTENTS

INTRODUCTION AND SUMMARY .....	5
ACHIEVING SUSTAINABLE DEVELOPMENT THROUGH A NEXUS APPROACH.....	6
ISSUES CORNER: WEF CHALLENGES IN THE ECOWAS REGION.....	7
INTEGRATED POLICIES IN THE ECOWAS.....	9
OPPORTUNITIES FOR NEXUS IN THE ECOWAS REGION.....	11
CONCLUSION AND POLICY RECOMMENDATIONS .....	12
KNOWLEDGE DEVELOPMENT .....	12
GOVERNANCE AND POLICIES .....	13
NEXUS INVESTING .....	13
INFRASTRUCTURE AND TECHNOLOGY .....	13
CITIZEN PARTICIPATION .....	13
REFERENCES .....	14
ABOUT ECREEE .....	16

## ACRONYMS AND ABBREVIATIONS

ACFTCN	Africa Climate Technology and Finance Centre and Network
AfDB	African Development Bank
DLDD	Desertification, Land Degradation and Drought
ECOWAP	2006 Regional Agricultural Policy for West Africa
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EREP	ECOWAS Renewable Energy Policy
ERERA	ECOWAS Regional Electricity Regulatory Authority
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GWP	Global Water Partnership
IPCC	Intergovernmental Panel on Climate Change
IRWR	Internal Renewable Water Resources
IWRM	Integrated Water Resources Management
LDCs	Least Developed Countries
PV	Photovoltaic
RE	Renewable Energy
SDGs	United Nations Sustainable Development Goals
SDM	System Dynamics Modelling
SRAP-WA	Sub-Regional Action Programme to Combat Desertification in West Africa
UEMOA	West African Economic and Monetary Union
UN	United Nations
WAPP	West African Power Pool
WAWRP	Regional Water Resources Policy
WEF	Water-Energy-Food
WEF	World Economic Forum
WHO	World Health Organisation
WRCC	ECOWAS Water Resources Coordination Centre

## Introduction and Summary

In the Economic Community of West African States (ECOWAS) region, the rate of economic growth<sup>1</sup> is unprecedented—remaining above 5% between 2000 and 2014. As living standards improve, the demand for key resources—water, food, and energy—is also on the rise. Yet, millions of ECOWAS citizens lack access to these vital resources. In 2017, nearly 30% still lacked access to safe drinking water<sup>2</sup>. In the region, the overall access to electricity is approximately 45%, and the statistics on food insecurity reveal that there are 36 million undernourished people (FAO, 2014).

Given the favourable rainfall patterns in the region, there are plenty water resources, sources of energy, and arable land for food production—the combination of which contributes to economic growth. However, these resources are “characterised by trends of degradation and deterioration from natural and human factors” (ECOWAS Environmental Policy, 2008). There is still chronic water deficit<sup>3</sup> and Desertification, Land Degradation, and Drought (DLDD), alongside other environmental externalities persist. Countries in the region are also considered highly vulnerable to climate change and are already experiencing impacts on their agricultural productivity, food, water, and energy security<sup>4</sup>. In addition, 11 countries—out of 15 ECOWAS countries—are classified as least developed countries (LDCs), further constraining their capacity to adapt to climate change.

*To achieve sustainable development and eradicate poverty in the sub-region in the face of a changing climate, managing key resources—water, food, and energy (WEF)—is imperative as the region’s current population of 340 million is expected to reach 500 million by 2030 (ECREEE 2017).*

While the economy continues to grow under a changing climate, demand and supply pressures will inevitably pose risks to the region’s prosperity. The interdependency of these 3 key WEF resources will become more intense as demand increases and supply is affected by climate change and other external factors.

The nexus also has severe implications for the agricultural sector, which is both water- and energy-intensive. As the main driver of economic growth for most countries in the region, besides Nigeria, agriculture is the largest single consumer of water, and also competes directly with the energy sector for water and land. Agriculture is often the sole source of household income for millions of people in rural areas; 60% of the population depend on agriculture for their livelihood. It also accounts for 35% of the region’s GDP and 16.3% of exports (ECOWAS, 2016). Unarguably, understanding and managing the interplay of these resources will ensure a vibrant agricultural sector by enhancing productivity through improved

<sup>1</sup> Real growth of the ECOWAS region was consistently above 5% from the beginning of 2000 until 2014, mainly driven by the dynamism of the Nigerian economy, which is by far West Africa’s economic powerhouse (making up nearly 70% of the region’s GDP).

<sup>2</sup> According to World Health Organisation (WHO), access to safe drinking water is estimated by the percentage of the population using improved drinking water sources.

<sup>3</sup> West Africa has significant water resources, but suffers from chronic deficits, because of uneven distribution of rainfall and flows in time and space, insufficient knowledge about water resources, low allocation of potential resources, and poor resource management. West Africa Water Resources Policy, 2008.

<sup>4</sup> ECOWAS Annual Report: ECOWAS adaptation to climate security and development challenges. December 2013.

crop yields, employment, food security, and rural development.

This policy brief is aimed at policymakers and other stakeholders dealing with the broader issues of the Water-Energy-Food (WEF) nexus in the West African region. This brief in no way provides a thorough assessment of nexus challenges in the region; however, it seeks to turn policymakers' attention to the importance of an integrated or nexus approach to harnessing the region's natural resources in order to achieve the community's 'Vision 2020'<sup>5</sup>

The brief also highlights key findings and recommendations from a research conducted and published in April 2018 by the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) in collaboration with the Solar Institute of the University of Madrid, Spain. The research, which looked into the technical and economic feasibility of large power photovoltaic (PV) Irrigation systems in the ECOWAS region, was GEF funded by the Africa Climate Technology and Finance Centre and Network (ACFTCN) project implemented by the African Development Bank (AfDB).

### Achieving Sustainable Development Through A Nexus Approach

There is no universally recognised definition of the 'Nexus Approach' for natural resources management. However, in this paper, a nexus approach, will be regarded as paying equal attention to the interdependencies between the water, energy, and food sub-systems during their

supply, processing, distribution, and use stages.

The interconnectedness of the aforementioned resources is exemplified by the use of water in the production processes of both food and energy (such as in the case of hydro-power plants, biofuels, or for cooling in fossil fuel-based power stations). Crops and agro processing waste can be used to generate energy through biofuels, while energy is used for water pumping, irrigation, distribution, waste water treatment, and desalination. Energy is also a key input at different stages of the food production process, including land preparation, irrigation, transport, cooling, food processing, and cooking.

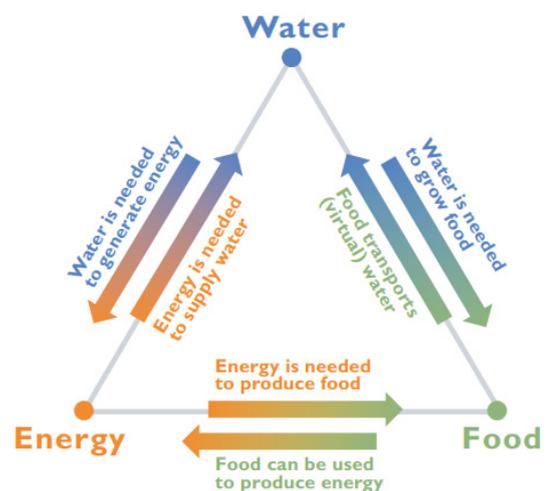


Figure 1: Simple WEF Nexus framework showing water, energy and food connections. Source: OFID, 2017

<sup>5</sup> Community refers to the ECOWAS region.

It can be argued that uncoordinated actions in one sector can bring about risks and uncertainties in the other(s), especially because there can be competition in the use of these resources. For example, when food crops are used for energy feedstocks, it contributes to supply and price competitions.

Integration of management and governance across the WEF sub-systems is thus crucial to reducing trade-offs and maximising synergies between them. One of the most prominent mechanisms to support nexus approaches is the use of comprehensive resource planning at regional and national levels. At the global level, the nexus approach is considered a crucial policy and planning tool to achieve the United Nations Sustainable Development Goals (SDGs) by 2030 and the Paris Agreement, which aims to address climate change. All 3 sub-systems are atop the sustainable development global agendas. Water and food security are considered global issues that need to be tackled urgently by the United Nations (UN), with the World Economic Forum (WEF) listing water crisis as one of the top 5 societal risks in 2018.

Adopting the nexus approach in the ECOWAS region could provide benefits such as aligning environmental and economic goals, enhancing regional integration, promoting efficiency of resources, and accelerating access for the poorest.

Yet, there are barriers to harnessing these benefits, including the absence of tools and consistent policies that consider dependencies between the three resources and the lack of coordination amongst the stakeholders. There are also knowledge gaps, ranging from data on available resources, to impacts of over utilisation of the

resources. In addition, WEF infrastructure in the region faces degradation and decay.

### Issues Corner: WEF Challenges In The ECOWAS Region

In the area of water resources, the ECOWAS region has an abundance of both fresh and underground water. Internal Renewable Water Resources<sup>6</sup> (IRWR) of the entire region constitute 27% of Africa's IRWR, and is only second to Central Africa, which holds 45% of the continent's IRWR. According to the Global Water Partnership (GWP), the ratio of renewable water resources withdrawn for use in the region is 75% for agriculture, 17% for domestic consumption, and 7% for industry. Water also serves as a medium of transportation across the region, and provides hydro-electric power for many countries.

Both fresh and underground water are seriously threatened by wastage, poor management, and pollution. The West Africa Water Resources Policy (WAWRP) 2008 notes that, even with significant water resources in the region, countries continue to face shortages. In addition, countries are highly interdependent when it comes to water resources. Except for Cape Verde, each ECOWAS country shares at least one watercourse with another Member State, which causes tensions between neighbouring countries, competition, communal and political concerns, and poor inter-state coordination—all of which are beyond the scope of this policy brief.

<sup>6</sup> Internal Renewable Water Resources (IRWR) is that part of the water resources (surface water and groundwater) generated from endogenous precipitation. (FAO)

*Water is central to the WEF nexus, thus, if policies directed at improving food and energy security do not take into consideration the current water challenges in the region, the problems could escalate with significant impacts. Environmental and economic goals, enhancing regional integration, promoting efficiency of resources, and accelerating access for the poorest.*

Land resources in the region are significant. Together, countries in the region boast a land area of 5.1 million square kilometres; however, land resources face threats from DLDD (SRAP-WA, 2013)<sup>7</sup>. Mining, over-cultivation, climate change, changes in natural features to accommodate for urban population growth, and migration are key contributors to DLDD. The most obvious effect of land degradation is food insecurity due to loss of arable land for agriculture.

Food security is threatened by more than land degradation. Post-harvest contamination and losses are prevalent in the region. There is a tendency by policy makers to undermine the important role of energy in preservation of agricultural goods. Access to modern, affordable and reliable energy can help combat the phenomenon of perishing foods and the attendant loss of productivity, thus sustaining food products for both domestic food security and exports.

Energy resources are also substantial. Though unevenly distributed, the region has considerable deposits of both conventional and renewable energy resources. Conventional resources (oil, gas, and coal) exist in specific countries, while renewable energy resources (hydro, solar, biomass, and wind) are well distributed among all the countries. Currently, the renewable energy potential in the region is underutilised. This is clearly illustrated by the fact that, of the estimated 25,000 MW of overall hydroelectric potential (small, medium, and large scale) located in the fifteen (15) ECOWAS countries, only around 16% has been exploited.

The region has low level of access to electricity and a high dependence on biomass, which provides for 80% of the domestic energy needs of the population (ECOWAS Renewable Energy Policy [EREP] 2013). Also, about 60% of the community's electricity generation capacity is based on climate change inducing fossil fuels. Poor infrastructure is a constraint to growth in the sector, with installed electricity generation capacity pegged at 21 GW, only half of which is operational yet inadequate to meet rising demand. Overall, energy consumption per capita is low, due to lack of access and low productive uses.

In addition to the different sectoral challenges, there are competing interests between the three (3) WEF resources, thus, decisions regarding resource use and/or development may favour one sector over the other, depending on governance priorities. For instance, the development of many large hydropower plants in the region has contributed to various environmental perturbations in the form of changes to the natural flow of rivers, resulting in loss of livelihoods in fishing com-

<sup>7</sup> Sub-Regional Action Programme to Combat Desertification in West Africa.

munities. The development of the Akosombo Dam in Ghana in 1963, for example, was mainly to enhance and accelerate economic growth, but it caused an “alteration to the ecological and biophysical processes in the river basin such as: slowing of the flow of the river, both upstream and downstream, and flooding of cultivated fields, upstream<sup>8</sup>”.

It is important to note that resources in the region are looked at collectively, despite the region being made up of 15 different socio-cultural states with different geo-climatic conditions and varying resource endowments. This is chiefly as a result of the progress achieved under the ECOWAS regional integration framework, which emphasises the notion of shared natural resources and the need for rational management for the sustainable development of the region.

*This has been clearly articulated in the ECOWAS Vision 2020, as “ECOWAS of People” not of states. Nevertheless, nexus impacts are often-times immediate, location specific, and affect the poorest of the poor.*

Climate change is bringing additional stress to all three WEF sectors. The Intergovernmental Panel on Climate Change (IPCC) 2013 report notes that in West Africa, climate change will affect the evolution and structure of natural resources. For in-

stance, prolonged droughts and heavy floods will affect agricultural productivity in the region. On the other hand, the global priority of combating climate change is creating new incentives to promote renewable energy, and this can create both synergies and competition with food and water systems.

### Integrated Policies In The ECOWAS

Nexus governance<sup>9</sup> involving regional, national, as well as local governments and policies across sectors is one of the prerequisites to the successful implementation of a nexus approach. Together, they are responsible for developing coherent policies, setting regulatory frameworks, removing barriers, providing funding, and facilitating coordination among sectors and different levels of government. Nexus governance in the ECOWAS region, however, faces many challenges due to the large number of stakeholders and their conflicting interests. These challenges include lack of inter-sectoral co-operation between the different governmental ministries in most of the countries where there are individual government parastatals for energy, water and agriculture. Lack of institutional frameworks, poor capacity, and insufficient data limit or make integrated assessments seem complex, thus hindering nexus decision making.

Still, there are reasons to be optimistic. A review of national and regional policies related to water, energy, and food security in the ECOWAS<sup>10</sup> noted that there are signs of progress at the regional

<sup>8</sup> Remediation of the Environmental Impacts of the Akosombo and Kpong Dams in Ghana.

<sup>9</sup> Nexus governance refers to governments and policy decision makers.

<sup>10</sup> Prof. Subhes Bhattacharyya et.al. A bottom-up approach to the nexus of energy, food and water security in the Economic Community of West African States (ECOWAS) region. Nexus Network Thinkpiece Series September 2015).

level in terms of developing an integrated agenda for key resources, mainly for water. The importance of water for socio-economic development and the links to other key sectors is evident in the adoption of a regional plan for integrated management of water resources as an essential component of the regional water resources policy.

The regional water resources policy, also known as the West African Water Resources Policy (WAWRP), notes that water resources management is complex because of different needs and uses of water and the presence of various stakeholders. A permanent water resources management framework was set up to promote integrated water resources management practices, coordinate, and monitor regional actions to achieve integrated management of water resources in the region. In addition, a dedicated entity was established in 2004 to ensure regional coordination of water resource related policies and activities. The ECOWAS Water Resources Coordination Centre (WRCC) is based in Burkina Faso and is responsible for implementing the water resources policy for West Africa.

The 2006 Regional Agricultural Policy for West Africa (ECOWAP) is another attempt to integrate policies for key resources. ECOWAP considers a nexus paramount to implementation. Its objectives are: ensuring food security for people in the region, reducing food dependence and vulnerability, and achieving food sovereignty. The rationale is that pooling regional resources can create economies of scale and increase regional productivity. To achieve this, there is a strong focus on management of water and other natural resources.

Energy is also an integral part of the ECOWAS regional integration framework. Article 28 of the initial ECOWAS treaty of 1975 focuses on energy, seeking development of energy resources of the

region, harmonisation of energy policies, and collective solutions for the energy challenges of member countries. With a view to increasing access to modern energy services for its citizens, ECOWAS is actively engaged in promoting cross-border infrastructure projects for electricity and gas supply, as well as harnessing renewable energy and energy efficiency potentials.

Several regional energy decisions have been made over the years, including the development of the ECOWAS Energy Policy and Protocol; the development of the ECOWAS/UEMOA Regional White Paper on Access to Energy Services for Populations in Rural and Peri-urban Areas (The ECOWAS White Paper); the establishment of the West African Power Pool (WAPP), the West African Gas Pipeline Project, and the ECOWAS Regional Electricity Regulatory Authority (ERERA); and, last but not least, the establishment of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE). As a result, regional energy integration can be said to be as advanced as regional integration for water resources.

*ECREEE has been instrumental to the development and adoption of the two landmark regional clean energy policies (the ECOWAS Renewable Energy Policy and the ECOWAS Energy Efficiency Policy).*

ECREEE sees the nexus approach as an important tool to advance its mandate and contribute to the sustainable development of the region in terms of highlighting the potential role of renewable energy in transforming the agricultural sector of

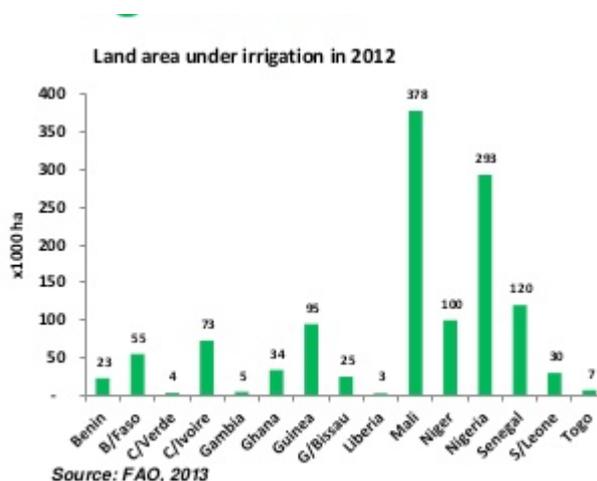
the region.

At the national level, all the regional policies and frameworks are typically translated into national actions. For example, ECOWAS countries have been guided to develop national agricultural investment plans based on the regional agricultural policy. National renewable energy plans and action plans have also been developed to implement regional clean energy policies. Micro-level policies or initiatives are described as bottom-up initiatives that are already in practice and yielding results. Their impacts are quite immediate and visible. In the ECOWAS region, there are many examples of micro-level initiatives to enhance WEF security. These initiatives, which are being promoted mainly by Non-Governmental Organisations (NGOs), development agencies, and the private sector, are particularly effective for addressing nexus challenges for the bottom of the billion.

### Opportunities for NEXUS In The ECOWAS Region

Within the ECOWAS region, the nexus approach has far-reaching implications for agriculture, which is the largest single consumer of water and which competes directly with the energy sector for water and land. The agricultural sector in ECOWAS is both water and energy constrained and is impacted by increasing demand for food in the region. Most farms are small holdings and are decentralised, with only 12% of suitable land irrigated. Lack of access to reliable electricity constrains irrigation, and the efficiency of exist-

ing systems remains poor and underdeveloped.



Current methods to provide water for farming activities are either burden intensive, with women typically carrying most of the burden, or rely on unsustainable and expensive fossil fuel-based technologies. Unreliable power access also limits the development of “cold chains”, thereby increasing food waste. All these constraints hinder the region’s goal to have “a modern and sustainable agriculture based on effective and efficient family farms and the promotion of agricultural enterprises through the involvement of the private sector”<sup>11</sup>.

For the reasons above, the agricultural sector would benefit immensely from an integrated approach. It is in this context that Renewable Energy is strategically placed to help the region achieve sustainable development by providing reliable, mature, economical, and clean energy for productive agricultural purposes. Renewable energy-based irrigation and optimisation of water resources management could be one of the pillars of the region’s transition towards low car-

<sup>11</sup> Regional Agricultural Policy for West Africa (ECOWAP) pg. 9 [https://www.diplomatie.gouv.fr/IMG/pdf/01\\_ANG-ComCEDEAO.pdf](https://www.diplomatie.gouv.fr/IMG/pdf/01_ANG-ComCEDEAO.pdf)

bon growth.

A recent research into the economic assessment of large power photovoltaic (PV) irrigation systems in the ECOWAS region<sup>12</sup> showed that large power photovoltaic<sup>13</sup> irrigation systems in the range of 380 kWp are technically and economically viable and can be more cost-effective than grid-powered and diesel-powered irrigation systems, mainly in large farm settings. Also, Large PV irrigation systems that pump and store water in storage tanks are the best options, after low-pressure sprinklers, in terms of costs savings in some ECOWAS countries. In addition, PV irrigation systems have a short payback period (an average of 6 years). Considering its long operational life of up to 25 years, this reduces investment risks considerably.

Nevertheless, caution is important when improving access to energy for agriculture. Some studies show that, in some cases, improved access to energy intensifies irrigation, leading to over-exploitation of water resources. This reinforces the urgency and importance of a nexus approach when improving energy supply for the agriculture sector.

## Conclusion and Policy Recommendations

West African countries are faced with ever-increasing demands for food, water and energy, a challenge compounded by climate change. The

region is confronted with significant challenges in the way it manages and utilises water, energy, and food. Isolated management of these resources creates barriers to harnessing the benefits of the nexus approach. These benefits include enhancing water, energy, and food security by increasing efficiency, reducing trade-offs, building synergies, and improving governance across the sectors.

While the individual analyses of energy, water, and food systems are undertaken routinely for planning purposes, there is a lack of integrated assessments in the region. Consequently, decisions about the use of WEF resources are made in separate and disconnected institutions.

This policy brief notes that significant progress is being made at the regional level to integrate and harmonise sectoral policies for water, energy, and food, to achieve sustainable development. Among these, integrated management of water is the most advanced as most ECOWAS countries are implementing an Integrated Water Resources Management (IWRM) programme. To avoid “silos mentality”, further attention is needed for the other two pillars of the nexus. To overcome the barriers to harnessing the benefits of nexus and improve quality of life and welfare of the population in the ECOWAS region, the following key actions are recommended:

### 1. Knowledge Development

Measures should be taken to develop greater

<sup>12</sup> This research was developed under framework collaboration between the ECREEE and the Universidad Politécnica De Madrid (UPM) to evaluate the economic feasibility of substituting diesel-powered and grid-powered systems with photovoltaic technologies, considering the solar resource potential in the region. The research was published in April 2018 and was funded by the Africa Climate Technology Center ACTC of the African Development Bank (AfDB).

<sup>13</sup> Large power photovoltaic (PV) irrigation systems in the research is described in the range of 100 to 380 kWp and above.

understanding of the WEF nexus at the local, national, and regional levels—there is need for knowledge development that quantifies the inter-linkages between water, energy, and food. Harmonised modelling tools and data collection efforts that support integrated decision-making should be developed and applied in the region. Several such modelling approaches exist to quantify and qualify the impacts of the nexus. For example, System Dynamics Modelling (SDM) allows for comprehensive analysis of multi-sectoral levels at the micro and macro levels by considering causal feedback loops among the sub-systems. Each of them is appropriate for different circumstances according to policy aims, scale, and data availability. Integrated modelling frameworks at the regional level can support decision-making; policy assessments; policy harmonisation and integration; impact evaluations for new infrastructure or technologies; and scenario development.

## 2. Governance and Policies

Improve nexus governance in the region by adopting integrated policies and planning practices for stakeholders to share knowledge and resources, co-operate and coordinate efficiently. A coordination desk within the Ministry of each resource could facilitate this co-operation and increase policy coherence. Besides this, integrated resources planning at regional and national levels should be financed and implemented.

## 3. Nexus Investing

Nexus-friendly investments should be promoted through collaboration between the public sector, business and finance sectors, and civil society. This should include proactive and in-

novative financing to achieve water, energy and food security. Development banks in the region should focus on synergistic investments that meet the needs of the region's poor. Some examples of such investments are solar irrigation, solar cool rooms for food storage, and power generation with bio-waste. An enabling environment for these synergistic investments should be created.

## 4. Infrastructure/Technology

In the face of aging infrastructures, planning for future infrastructural systems needs to take into consideration interdependencies between WEF and the role of external pressures such as climate change. An integrated assessment of technological options should support the choice of new infrastructure. In this respect, renewable energy technologies should be promoted as a “natural fit” to improve agricultural productivity and to minimise food's environmental footprint.

## 5. Citizen Participation

Finally, policy makers should ensure greater participation of citizens in WEF decision-making, to achieve water, energy, and food security. Citizens are at the heart of the nexus challenge. Their participation in the decision-making of water, energy, and food development is important because they possess the indigenous knowledge that allows for bottom-up approaches to solve nexus challenges. This will also combat the power dynamics that benefit some social groups over others when accessing resources.

## REFERENCES

Bhattacharyya, S., Bugatti, N. and Bauer, H. (2015). *A Bottom-up Approach to the Nexus of Energy, Food and Water Security in the Economic Community of West African States (ECOWAS) Region*. Nexus Network Think-piece Series, September 2015.

ECOWAS 2016 ANNUAL REPORT. *ECOWAS Common External Tariff (Cet): Achievements, Challenges and Prospects*. [\[link\]](#)

World Economic Forum. *The Global Risks Report 2018*. [\[link\]](#)

African Development Bank Group. *West Africa Economic Outlook, 2018: Macroeconomic Developments and Poverty, Inequality and Employment, Labor Markets*. [\[link\]](#)

International Union for Conservation of Nature. *West African Environmental Policy*. [\[link\]](#)

Global Water Partnership, West Africa. (2003). *Brief Assessment of Country Progress in the Development of "IWRM and Water Efficiency Plans" in West Africa*. [\[link\]](#)

DAI. (2013). *West Africa Environmental Threats and Opportunities Assessment*. USAID. [\[link\]](#)

Loma-Ossorio, E., Lahoz, C., & Portillo, L. F. (2014). *Assessment on the Right to Food in the ECOWAS region*. Food and Agriculture Organisation of the United Nations. [\[link\]](#)

Siala, F., Al-Soof, M., & Mazraati, M. (2017). *The Energy–Water–Food Nexus: Managing Key Resources for Sustainable Development*. The OPEC Fund for International Development (OFID). [\[link\]](#)

ECOWAS, UEMOA, UNCCD, & CILSS. (September 2013). *Sub-Regional Action Programme to Combat Desertification in West Africa*. [\[link\]](#)

Dalberg, & Open Society Initiative for West Africa. *Review of ECOWAS Policies in the Agricultural and Indus-*

*trial Sectors.* [\[link\]](#)

*Nearly 30% of the West Africans Lack Access to an Improved Water Source* | West Africa Gateway | Portail de l'Afrique de l'Ouest. [\[link\]](#)

*Definition of Indicators.* [\[link\]](#)

Bashir, D. (2009, January 19). *Perspectives for IWRM Reforms in West Africa* [Power point slides]. [\[link\]](#)

Policy brief, International Water Resources Association (IWRA) September 2016. *Multi-stakeholder Dialogue: Water-Energy-Food (WEF) Nexus and Implementing the SDGs.*

Fobil, J. N., & Attuquayefio, D. (2008). *Remediation of the Environmental Impacts of the Akosombo and Kpong Dams in Ghana.* Horizon International Solutions. [\[link\]](#)

Zhang, C., Chen, X., & Li, Y. (2018). Water-Energy-Food Nexus: Concepts, Questions and Methodologies. *Journal of Cleaner Production*, 195, 625-639. [\[link\]](#)

Bazilian, et al. (2011). Considering the Energy, Water and Food Nexus: Towards an Integrated Modelling Approach. *Energy Policy*, 39(12), 7896-7906. [\[link\]](#)

ECOWAS, UEMOA, & CILSS. *West Africa Water Resources Policy (WAWRP).* [\[link\]](#)

FAO. *Concepts and Definitions.* [\[link\]](#)

West Africa Water Resources Policy, 2008. [\[link\]](#)

Regional Agricultural Policy for West Africa: ECOWAP. [\[link\]](#)

## ABOUT ECREEE

The ECOWAS Centre for Renewable Energy and Energy Efficiency (ECEEE) is a specialised ECOWAS agency with a public mandate to promote renewable energy and energy efficiency markets in the West African region. It was established in 2010 in Cabo Verde with support of the ECOWAS Commission, UNIDO, and the Austrian and Spanish Governments. The regional centre of excellence works in fifteen West African countries, including the two small island developing states, Cape Verde and Guinea Bissau. ECREEE aims to contribute to the sustainable economic, social and environmental development of West Africa by improving access to modern, reliable and affordable energy services. ECREEE also contributes to the achievement of the targets of the ECOWAS Renewable Energy and Energy Efficiency Policy. The centre addresses the various existing market barriers for renewable energy and energy efficiency technologies and services and implements activities in the areas of policy development, capacity development, knowledge management, awareness raising and business and investment promotion.



