



**Volta Basin  
Authority**

# **Assessment of the Current State of Water Management and Climate Change in the Volta Basin as part of the Establishment of an Observatory for Water Resources and Related Ecosystems**





**ASSESSMENT OF THE CURRENT STATE OF WATER  
MANAGEMENT AND CLIMATE CHANGE IN THE VOLTA  
BASIN AS PART OF THE ESTABLISHMENT OF AN  
OBSERVATORY FOR WATER RESOURCES AND RELATED  
ECOSYSTEMS**

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**FINAL REPORT**

May 2014

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## ABBREVIATION AND ACRONYMS

<b>2iE:</b>	Institut International d'ingénierie de l'eau et de l'environnement
<b>AFD:</b>	Agence Française de Développement
<b>AFDB:</b>	African Development Bank
<b>CC:</b>	Climate Change
<b>CGIAR:</b>	Consultative Group on International Agricultural Research
<b>CIDRES:</b>	Centre International de Recherche-Développement sur l'Elevage en zone Subhumide
<b>CIWA:</b>	Cooperation in International Waters in Africa
<b>CPWF:</b>	Challenge Program on Water and Food
<b>CSIR:</b>	Council for Scientific and Industrial Research
<b>ECOWAS:</b>	Economic Community of West African States
<b>EU:</b>	European Union
<b>GEF:</b>	Global Environment Facility
<b>GLOWA:</b>	Globaler Wandel WAsserkreislaufes
<b>GVP:</b>	GLOWA Volta Project
<b>GWP:</b>	Global Water Partnership
<b>HYCOS:</b>	Hydrological Cycle Observation System
<b>IMF:</b>	International Monetary Fund
<b>IPR-IFRA:</b>	Institut Polytechnique Rural de Formation et de Recherché Appliqués
<b>INERA :</b>	Institut de l'Environnement et de Recherches Agricoles -
<b>IUCN:</b>	International Union for Conservation of Nature and Natural Resources
<b>IWMI:</b>	International Water Management Institute
<b>IWRM:</b>	Integrated Water Resources Management
<b>KNUST:</b>	Kwame Nkrumah University of Science and Technology
<b>MAHRH:</b>	Ministre de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques,
<b>MEAHV:</b>	Ministère de l'Eau, de l'Assainissement et de l'hydraulique villageoise
<b>MEE:</b>	Ministre de l'Energie et de l'Eau, Benin : Mali
<b>MEEF:</b>	Ministre de l'Environnement, des Eaux et Forêts
<b>MoU:</b>	Memorandum of Understanding
<b>MW:</b>	Megawatt
<b>MWRWH:</b>	Ministry of Water Resources Works and Resources
<b>NGO:</b>	Non Governmental Organisation
<b>NTFP:</b>	Non-Timber Forest Products
<b>PAGEV:</b>	Projet d'Amélioration de la Gouvernance de l'Eau dans le Bassin de la Volta
<b>SIDA:</b>	Swedish International Development cooperation Agency
<b>TIVO:</b>	Tilapia Volta Project
<b>UEMOA:</b>	Union Economique et Monétaire de l'Afrique de l'Ouest
<b>UN:</b>	United Nations
<b>UNCBD UN:</b>	Convention on Biological Diversity
<b>UNCCD UN:</b>	Convention to Combat Desertification
<b>UNDP:</b>	United Nations Development Program
<b>UNEP:</b>	United Nations Environment Program
<b>UNFCCC:</b>	United Nations Framework Convention on Climate Change
<b>VBA:</b>	Volta Basin Authority
<b>WACDEP:</b>	Water, Climate and Development Programme
<b>WMO:</b>	World Meteorological Organisation
<b>WRCC:</b>	Water Resources Coordination Centre (of ECOWAS)

# EXECUTIVE SUMMARY

## Background

Global Water Partnership (GWP) is implementing the Water, Climate and Development Programme (WACDEP) with the aim of supporting countries and river basin organizations in Africa to integrate water security and climate resilience into their national and transboundary development planning and decision-making processes, and adapt to a new climate regime through increased investments in water security. WACDEP responds to the 2008 commitments expressed by African Heads of State in the Sharm el-Sheikh Declaration on water and sanitation, and the AMCOW's request to GWP in 2009.

The expected medium-term outcomes of WACDEP include the following:

- water security and climate resilience integrated in development planning and decision-making processes;
- capacities of partnerships, institutions and stakeholders to integrate water security and climate resilience in development planning and decision-making processes enhanced;
- “No regrets” investment and financing strategies for water security, climate resilience and development formulated and governments begin to implement them.

As part of WACDEP, GWP is supporting Volta Basin Authority (VBA) to carry out the: “Assessment of the current state of water management and climate change in the Volta basin as part of the establishment of an Observatory for Water Resources and Associated Ecosystems”.

This report presents an overview of past and on-going transboundary programmes and projects that respond to environmental and climate change challenges in the basin since VBA's establishment in 2007.

## Climate Change Impacts

The Volta basin is already vulnerable to floods and droughts that damage property and lives. From a recent climate change modelling study in the basin, climate change impacts are projected to include:

- A median temperature increase of between 1°C and 2.5°C for the long-term;
- Decrease in rainfall by an average of 11% in the 2050s, with consequent reductions in river runoff of between 15-20% by the 2020s and between 30-40% by the 2050s.
- More severe and frequent pattern of drought/flood events.

Flooding events in the basin in recent times (2007 and 2008), have had serious consequences and indicated the need for better flood control infrastructure in the basin. Prolonged extreme dry periods have also triggered energy crises in some basin countries. In addition, increasing temperatures have led to prolonged land degradation, resulting in intensification of desertification which has strong linkages with poverty, migration and food insecurity. As a result of the projected reduction in river flows, on the average only 75% of annual irrigation water demand will be generated by the 2050s. In the same period, there would be enough water for only 50% of current hydropower production from the Volta Lake.

## Policy, Legal and Institutional Responses to Environmental and Climate Impacts

A good number of multi-lateral Conventions, regional and basin-wide Policies and Legislations with accompanying Strategies already exist in the basin to address some of the challenges of environmental degradation and climate change, although there are sometimes weaknesses with implementation. The focus of most the programmes and

strategies is related to achieving human development goals, in particular poverty alleviation and sustainable development. While climate change mitigation and adaptation are not directly captured in the various policies, programmes and projects, their outputs provide very good entry points for addressing challenges of climate change impact; hence promote water security and climate resilience.

All the riparian countries are parties to various multi-lateral environment- and climate-related agreements, such as: UNFCCC, UNCBD, UNCCD and the Ramsar Convention on Wetlands. Given the many inter-linkages between the processes affecting biodiversity, land degradation / desertification and climate change, implementation of the Conventions cannot be meaningfully pursued in isolation from each other. Thus, collaboration both at the basin level and at the level of national implementation presents opportunities for synergic actions that will ensure water security and climate resilience.

Within the Volta basin, in order to institute measures for sustainable transboundary water resources management, the Volta Basin Authority (VBA) was established in 2007 with the signing of the Convention on the Status of the Volta River and Establishment of the Volta Basin Authority. The Convention came into force in August 2009. Towards achieving its mandate and also in order to coordinate the activities of the various on-going projects and programmes in the basin, VBA and its partners have developed a Strategic Plan for the period 2010 to 2014 (VBA, 2010), which aims to facilitate all interested parties to better focus on priorities of the Volta basin while avoiding duplication of efforts.

The five Strategic Objectives of the 5-year Strategic Plan are (Annex 1):

1. Strengthening policies, legislation and institutional framework;
2. Strengthening the knowledge base of the basin;
3. Coordination, planning and management;
4. Communication and capacity building for all stakeholders;

## 5. Effective and sustainable operations.

The key projects executed by VBA that are directly related to climate resilience and water security include the Volta Observatory and HYCOS Project.

To ensure that data and information are readily available for the development and management of the basin, VBA is in the process of establishing an Observatory for Water Resources and Related Ecosystems. As part of the activities, MoUs have been developed between VBA and the Ministries in charge of water in the six Volta basin Member States.

In each country an Addendum to the MoU with the Ministry specifies hydrological data exchange protocols. However, protocols for technical data exchange between the Observatory and other institutions in relation to other themes such as Agricultural Water, Water-related disease and Cartography have not been developed. There is the need to develop these protocols to enhance VBA's monitoring role. The Observatory also needs to strengthen its links with other relevant initiatives such as those of WASCAL and AGRHYMET through MoUs, joint activities and training

The Volta HYCOS Project (now integrated into the VBA Observatory), will give momentum to activities on operational hydrology and integrate them further into socio-economic activities and joint development projects of the basin countries. In a long-term perspective, the HYCOS/Observatory will constitute an important source of reliable data for forecasts of future water resource scenarios including regional climate change impact predictions.

Climate resilience will also be promoted through the contribution of Volta-HYCOS to better design and optimisation of investment projects ('no regrets' investments) in water, such as dams for hydropower, agriculture, water supply, flood control and inland navigation. It is therefore imperative to accelerate the implementation of the Volta HYCOS Project and also ensure the efficiency of the operations and monitoring networks of the riparian countries.

Other completed and ongoing international and local programs and projects that contribute to the climate resilience and water security in the Volta basin include the following:

**The IUCN/PAGEV Project** on Improving Water Governance in the Volta Basin (PAGEV), whose interventions focused on combining the long-term benefits of ecosystem conservation with immediate impacts of meeting the livelihood needs of marginalized communities.

PAGEV contributes to climate resilience of the communities by linking ecosystems/river banks restoration with improved livelihoods assets of communities. The project also promoted multi-level stakeholder participation in shared water resources, which is a key ingredient for climate resilience. The reforestation of degraded watersheds introduced by PAGEV may enhance catchment protection; contribute to reducing greenhouse gas emissions, conservation of water resources, prevention of flooding and preservation of biodiversity. It is proposed that VBA builds on the gains of PAGEV by including ecosystem and related issues in its next Strategic Plan.

**The UNEP-GEF Volta River Project** for Addressing Transboundary Concerns in the Volta River Basin and its Downstream Coastal Area was initiated in 2008 and ended in 2013. The UNEP-GEF Volta Project collaborated with VBA and the riparian countries to review the Trans-boundary Diagnostic Analysis (TDA) of the Volta which was developed earlier in 2001 to 2002. The TDA provides a participatory and science-based assessment of the Volta River Basin, the threats to the basin's resources, and the causes underlying those threats.

Following from the TDA, a Strategic Action Programme (SAP) for the Volta Basin has been developed with active participation of stakeholders from all the six countries of the basin. The SAP implementation plan set out the actions to be taken by each country to ensure sustainable use of resources in the basin in the coming decades. The actions recommended by SAP could be a starting point for

developing the VBA Master Plan for the basin. Many aspects of the SAP are also related to climate resilience and water security. What is required now is funding for these activities to be undertaken. GWP-WA through WACDEP could support the VBA to integrate the SAP into its work plan as part of the implementation of its new Strategic Plan.

**The Challenge Programme on Water and Food (CPWF)**, through its Volta Basin Development Challenge, (VBDC) targeted small-scale farmers in Southern Burkina Faso and Northern Ghana to improve management of rainwater and small reservoirs for multiple uses. The CPWF/VBDC project adopted participatory approaches that allowed farmers and other key stakeholders to contribute to the research. Improving productivity of water contributes to water and food security. Supporting research into soil fertility improvement and development of drought-resistant and early-maturing crop varieties also contributes to climate resilience.

The CPWF/VBDC also contributed to the capacity development of the next generation of young researchers in the Volta basin by training more than 15 graduate students. By contributing to knowledge in the basin, the VBDC has laid a foundation that could also support the development of the VBA Water Charter and Master Plan, while the data generated would also be placed and made available on the VBA Geoportal.

**The GLOWA Volta Project** for Sustainable Water Use under Changing Land Use, Rainfall Reliability and Water Demands in the Volta Basin was implemented by the Center for Development Research (ZEF) and its partners from 2000 to 2010. The project assembled significant information and tools including:

- Volta Basin Water Allocation System that allows incorporating the impact of possible future climate conditions and projected water demand;
- GLOWA Volta Geoportal, which was transferred to the VBA;

- High-resolution Regional Climate Modeling for the Volta Basin;
- Predicting the Onset of the Rainy Season in the Volta Basin.

The Water Allocation System helps to project water demand, and therefore enhances water security. Predicting the onset of the rainy season will also help farmers to plan and avoid economic loss, hence increasing climate resilience.

**The West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)** is a large-scale research-focused program designed to help tackle the challenge of climate change in West Africa and thereby enhance the resilience of human and environmental systems to climate change and increased variability. WASCAL continues to work towards deepening understanding of the trends in global climate and land-use changes on water resources in the Volta Basin.

### Conclusions and Recommendations

While the VBA has a strong mandate on paper, the foundations (Water Charter and Master Plan) for identifying roles and responsibilities of riparian countries with regard to water resources development and use is yet to be established. These ongoing and other planned WACDEP initiatives should provide the environment to support actions for formulation of the Water Charter and Master Plan in order to facilitate basin-wide cooperation.

Forecasts of the impacts of climate change on the basin's water resources will also benefit from reliable data adapted to the requirements of various users and beneficiaries as part of the VBA Observatory. It is therefore important to accelerate the implementation of Volta-HYCOS and also ensure the efficiency of the operations and monitoring networks of the riparian countries. WACDEP can support VBA to strengthen

the Observatory and the National Hydrological Services to provide reliable data for hydrological forecasts adapted to the various types of future water resource scenarios including regional climate change impact predictions.

The Observatory, if well resourced will promote sharing of information on all aspects of water security and avoid water conflicts, and reduce vulnerability of communities to drought and flooding. The Observatory also needs to strengthen its links with other relevant initiatives such as those of WASCAL and AGRHYMET through MoUs to remain effective. It is further recommended that a basin-wide climate change adaptation strategy features strongly in the new VBA Strategic Plan.

Regarding the involvement of national and local communities in developing and managing shared water resources, IUCN/PAGEV has established a local transboundary water governance mechanism which can be adapted by VBA as a basin-wide governance structure. PAGEV through development of a Code of Conduct between Burkina Faso and Ghana has provided a basis for development of other bilateral relationships. It is proposed that VBA builds on the gains of PAGEV by including ecosystem and related issues in its next Strategic Plan.

With respect to the activities undertaken through the UNEP-GEF Volta Project, WACDEP should support VBA to implement the Strategic Action Plan as a means of building on the past and on-going experiences and promote water security and climate resilience.

# 1. INTRODUCTION

## 1.1 Background and Context

Global Water Partnership (GWP) is implementing the Water, Climate and Development Programme (WACDEP) with the aim of supporting countries and river basin organizations in Africa to integrate water security and climate resilience in development planning processes, build climate resilience and support countries to adapt to a new climate regime through increased investments in water security (GWP, 2012). The overall objective of WACDEP is to support integration of water security and climate resilience in development planning and decision making processes, through enhanced technical and institutional capacity and predictable financing and investments in water security and climate change adaptation.

The expected outcomes of the programme are:

- i. Water security and climate resilience integrated in development planning and decision-making processes;
- ii. Capacities of partnerships, institutions and stakeholders enhanced to integrate water security and climate resilience in development planning and decision-making processes;
- iii. “No regrets” investment and financing strategies for water security, climate resilience and development formulated and governments begin to implement them. In addition, fundable projects for water security, climate resilience and development defined and shared with development banks.

WACDEP is a pan-African programme being implemented in eight African countries: Ghana, Burkina Faso, Mozambique, Zimbabwe, Burundi, Rwanda and Tunisia; and four river basins: Volta Basin, Lake Chad, Lake Victoria-Kagera, and Limpopo Basin. In West Africa the programme is

implemented in Burkina Faso, Ghana and Volta Basin. WACDEP consists of four Components with eight Work Packages (WP) as follows:

### **Component 1: Investments in regional and national development**

*Work Package 1:* Regional and Transboundary cooperation

*Work Package 2:* National development and Sector Plans

*Work Package 3:* Investments

*Work Package 4:* Project Preparation and Financing

### **Component 2: Innovative Green Solutions**

**Work Package 5:** Demonstration Projects

### **Component 3: Knowledge and capacity development**

*Work Package 6:* Capacity Development

*Work Package 7:* Knowledge and awareness

### **Component 4: Partnership and Sustainability**

*Work Package 8:* Governance and Fundraising

The key output of *Work Package 1* (Regional and Transboundary Cooperation) is investment options and tools for enhancing basin water security and climate resilience are defined and integrated in basin and regional development programmes Under a Memorandum of Understanding signed in April 2013, VBA was invited by GWP to participate in WP 1 (Regional and Transboundary Cooperation) under Component 1.

One of the activities undertaken by VBA under Phase 1 is a study on: “Assessment of the current state of water management and climate change in the Volta basin as part of the establishment of an Observatory for Water Resources and Associated Ecosystems”.

This report describes the potential impacts of climate change on water resources in the Volta Basin, and presents an overview of past and on-going transboundary programmes and projects which address climate change and environmental challenges in the basin since VBA's establishment in 2007. The various interventions are then assessed in the context of water security and climate resilience, which form the basis for recommendations to strengthen the VBA and its Observatory.

## 1.2 Objective of Assignment

The objective of this assignment, as indicated in the Terms of Reference (Annex 1), was to assess the current state of water management and Climate Change in the Volta basin as part of the establishment of an Observatory for Water Resources and Associated Ecosystems. This was in the form of an inventory of relevant activities of VBA and its partners since its establishment in 2007 on the basis of which an analysis/diagnosis was made with respect to the water security and climate resilience.

## 1.3 Methodology and Approach

The study has been based on a review of the literature, on interviews with key persons and on consultations with stakeholders (The list of persons contacted is attached as Annex 2. A number of documents on the activities of VBA and other relevant stakeholders, institutional including frameworks, strategies, policies and reports that have bearing on water security and climate change were also reviewed. The second phase of the review process involved stakeholder inputs to the report, building consensus and validating the report. To achieve this, the Draft Report was sent to National Focal Points of VBA, and other relevant partners for their review and comments. A workshop was organised to validate the report. Based on the outcomes of the consultations the draft report was finalized. (The list of participants at the workshop is presented in Annex 3.

## 1.4 Report Structure

The report is organised in 4 Sections:

This introductory **Section 1** outlines the background and rationale for the study.

**Section 2** provides a summary review of the current state of the basin with respect to transboundary water resources development and management, focusing on the state of water resources (availability and demand), socio-economic development patterns and climate change and its impacts.

**Section 3** begins with a presentation of the activities of VBA and its partners followed by an assessment of these activities in the context of water security and climate resilience.

**Section 4** presents conclusions and recommendations for strengthening VBA's capacity to integrate water security and climate resilience in its development planning and decision-making processes.

## 2. CURRENT STATE OF THE VOLTA BASIN

### 2.1 Basin Characteristics

The Volta Basin in West Africa is enclosed by the latitudes 5°30'N and 14°30'N and longitudes 2°00'E and 5°30'W. Approximately 85% of the nearly 400,000 km<sup>2</sup> catchment area is shared between Burkina Faso (43%) and Ghana (42%). The remainder falls within Benin (3.4%), Côte d'Ivoire (2.5%), Mali (3.1%) and Togo (6%). The main sub-basins are the Black Volta, White Volta, Oti and Lower Volta (Figure 2.1).

The Black Volta, originates as the Mouhoun in Burkina Faso and drains parts of Mali and Côte d'Ivoire; The White Volta, originates as the Nakanbé in Burkina Faso and enters Ghana; The Oti, originates as the Pendjari in Benin, flowing through Togo before entering Ghana; The Lower Volta consists of a number of small rivers, which flow directly into the Volta Lake (created by the dam at Akosombo) and the portion downstream of the Kpong dam to the sea. The Black Volta, White Volta, Oti and rivers in the Lower Volta all flow into Volta Lake. Downstream of the lake, the river empties into the

Atlantic Ocean through a series of interlinked coastal wetlands at Keta and Songor near Ada in Ghana.

Unlike many transboundary basins, the geopolitical configuration of the Volta basin is such that common problems and interests may be limited to two or three countries that share sub-basins. For example, Côte d'Ivoire and Mali in the Black Volta sub-basin share nothing in common with Benin and Togo, which are located at the extreme north-east and share the Oti sub-basin. This complex configuration may influence how future collaborative frameworks will evolve.

More than two-thirds (~68%) of the roughly 24 million people currently living in the basin are mainly dependent on agriculture, which is largely rain-fed, poorly mechanized and dominated by small family farms. Agriculture accounts for around 40% of the basin's economic output. Livestock breeding is also an important economic activity across the basin, and is the second source of income for rural households across the basin after agriculture.

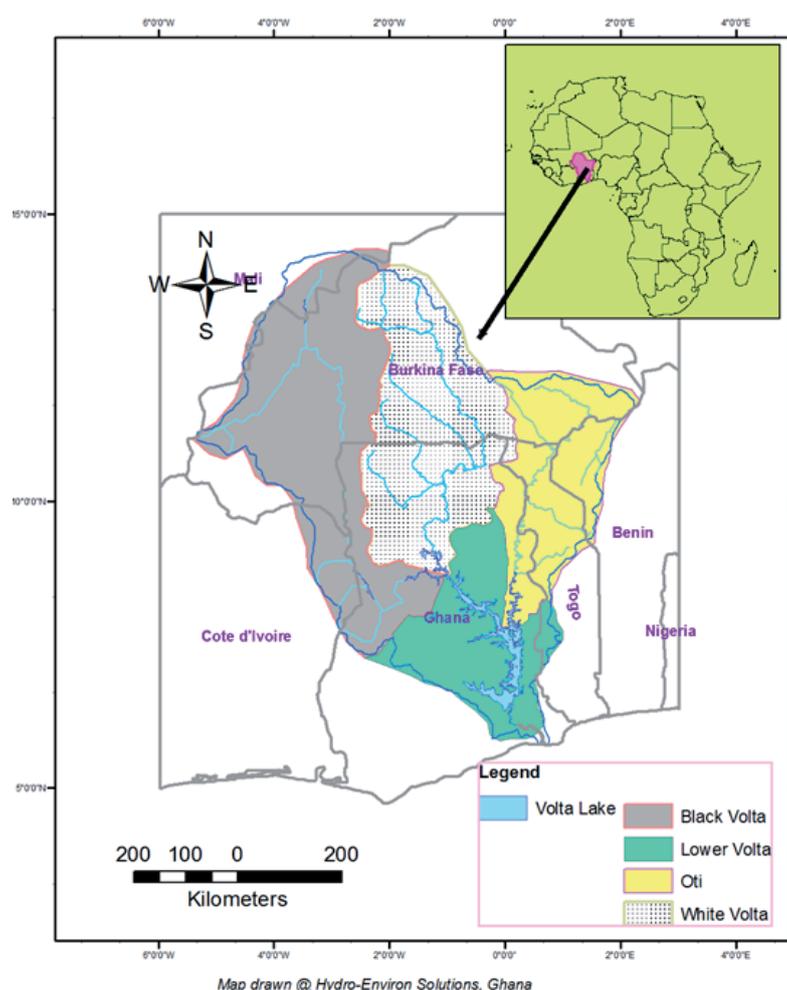


Figure 2.1 : Main Sub-basins of the Volta

Cattle-breeding is typically extensive with trans-human herders and seasonal movements in search of water points. The population of the basin is projected to nearly double in 30 years. If the trend continues, the population will double again before 2050 to about 45 million (UNEP-GEF Volta, 2013). The current growth rate poses a problem of matching the population with the available natural resources, especially those of water, which is a challenge for their sustainable management. This high population growth in the basin will also impact on available infrastructure and facilities and will have social and political implications.

## 2.2. Hydro-meteorological Characteristics

Three types of climatic zones can be identified in the basin (Figure 2.2) as follows: i) the humid zone in southern Ghana with two distinct rainy seasons; ii) the semi-arid in the middle part of Burkina Faso, and iii) the arid zone in the far north of Burkina Faso with one rainfall season that peaks in August.

The Sahelian (Arid) zone located in the far north of the basin receives an annual rainfall of less than 500 mm; the Sudano-Sahelian zone which covers greater part of Burkina Faso receives rainfall between 500 and 900 mm per annum.

The Sudano-Guinea Savannah zone comprises the northern part of Ghana and some parts of Côte d'Ivoire, Benin and Togo and receives rainfall between 900mm and 1100 mm per year and the Transitional to Moist semi-deciduous zone, covering the southern part of the basin, receives rainfall above 1,100 mm.

Nearly 70% of annual rainfall of the basin occurs during the 3 months of July, August and September, with little or no rainfall between November and March over most parts of the basin. The onset of the rainy season is especially unpredictable.

The mean annual temperatures in the basin range

from 27°C in the south to 36°C in the north. In March, the hottest month of the year in the basin, mean daily temperatures in the southern parts may rise from a mean of 24°C to 30°C. There are also vast variations in mean daily humidity, which varies between 6% and 83% depending on the season and the location.

The potential evapo-transpiration ranges from 1176 mm to 2400 mm per annum. There is a large space-time variability of evapo-transpiration in the basin. Values are high during the dry seasons and attenuated during rainy seasons. It is estimated that nearly 80% of the rainfall is lost to evapo-transpiration.

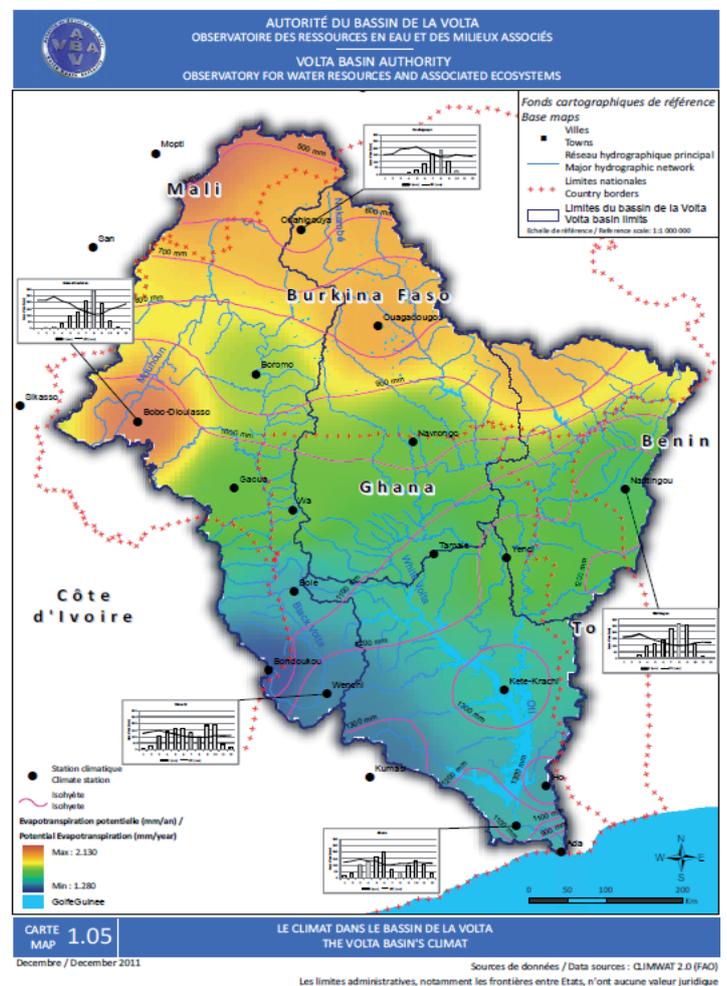


Figure 2.2 : Climatic Zones of the Volta Basin

### 2.3. Water Resources Potential

Surface water in the basin is derived from precipitation, which quickly reaches rivers, streams, reservoirs, dugouts and lakes. The higher latitudes in the basin have less rainfall and thus fewer surface water resources than lower latitudes. Most of the streams at higher latitudes are not perennial, unlike those at more southern latitudes.

Burkina Faso, drained by the Mouhoun and Nakanbé rivers into the Black and White Volta sub-basins respectively, has total potential water resources of 6.07 billion m<sup>3</sup> in the Volta Basin. The Black Volta provides Côte d'Ivoire with 0.79 billion m<sup>3</sup> of surface water. Benin is endowed with 2.01 billion m<sup>3</sup> of water from the Pendjari River. Downstream, Togo receives 4.71 billion m<sup>3</sup> of water from the Oti River.

Ghana receives 15.0 billion m<sup>3</sup> of surface water from upstream countries in addition to 39.4 billion m<sup>3</sup> from within the country, giving a total of 54.9 billion m<sup>3</sup> of water (UNEP-GEF Volta River Project, 2012). With more than 2,000 m<sup>3</sup> of renewable water resources per capita per year, the Volta basin population is considered as slightly above the world standard for physical water stress (World Resources Institute, 2000). At the sub-basin scale, however, most of the northern part of the basin suffers physical water scarcity with less than 1000m<sup>3</sup>/capita/year.

Overall, data on the occurrence of groundwater in the Volta basin is inadequate since there is no systematic monitoring of groundwater. Estimated groundwater recharge for the catchments of the basin in Ghana and Burkina Faso is 12.6 billion m<sup>3</sup> per year, i.e., about 3.7 per cent of rainfall (Lemoalle and de Condappa, 2009). This amount of groundwater comprises about 4 to 10 per cent of the basin's water budget. Further calculation of groundwater production gives a value of 88 million m<sup>3</sup> per year and this corresponds to a figure of less than 1 per cent of average annual groundwater recharge. Since the current usage of groundwater is very small, there is huge potential for exploiting this resource.

### 2.4. Agro-ecological Zones and Functions

The Volta River Basin has globally significant biodiversity and diverse habitats that are threatened by both climatic and anthropogenic factors; perhaps the greatest threat comes from deforestation. The spatial distribution of rainfall has been used to define the agro-ecological zones in the basin. Moving from south towards the north of the basin, various ecosystems are encountered, including the moist semi-deciduous forests, dry deciduous forests and woodlands, savannas and steppes (the latter occurring mainly in Burkina Faso). These contain a vast biological diversity and large numbers and ranges of species – many of which are endemic or threatened, or are otherwise globally important (UNEP-GEF Volta Project, 2011).

The ecosystems make significant contribution to rural income and employment through Non-Timber Forest Products (NTFP) trade. Many plants from the Volta Basin's ecosystems are sources of food and commerce. The plant species (e.g. shea butter, baobab, etc.) are harvested and eaten, fresh or dried, or used in various ways. Many species of terrestrial and aquatic invertebrates and vertebrates are edible and are the main sources of protein. Edible invertebrates encountered in the Volta Basin are mainly molluscs, crustaceans and insects. In Côte d'Ivoire, the market for game fully supplied by wildlife taken from the different ecosystems was valued at about US\$150 million per year in 1996 (UNEP-GEF Volta Project, 2011).

Wood and other biomaterials are the main source of energy in all the countries of the basin. The people derive between 70 to 90% of their energy from wood extracted from the forest. The ecosystems also contain a range of plant species that provide medicinal or pharmaceutical substances (leaves, bark and roots, etc.). The people of the basin are dependent on the plant resources for the treatment of several diseases. Plants are used as construction materials and tools (e.g. mortars, pestles and other utensils). For example, the leaves of coconut (*Cocos nucifera*) and of *Elaeis guineensis*, and *Raphia sudanica* and *Marantochloa leucantha* (Marantaceae)

are used to cover the roofs of huts. Leaves of *Raphia sudanica*, are drawn into strips (commonly called "raffia") and used to weave mats. Mats are also manufactured from the leaves of *Pandanus candelabrum* (Pandanaceae) and *Typha australis* (Typhaceae). Species that provide timber are numerous and are found in almost all ecosystems (rain forests, dry woodlands, savannas and riparian forests). Eco-tourism is also important - birds, reptiles, mammals and landscapes providing tourist attractions.

## 2.5. Infrastructure for Mobilising Water Resources for Development

A number of small, medium and large reservoirs have been constructed primarily for irrigation and hydropower generation. Details of major reservoirs are listed in (Table 2.1).

**Table 2.1 : Major Reservoirs in the Volta Basin**

Sub-basin /Catchment	Name of Dam / Scheme	Location /Country	Storage Capacity (Mm <sup>3</sup> )	Irrigated Area (ha)	Installed Hydropower capacity(MW)
<b>Black Volta Basin</b>					
Nwokuy	Nwokuy Irrigation	Burkina Faso (BF)	-	3,291	-
Dapola	Lerinord	BF	-360	9,646	-
	Dapola Irrigation	BF	-	1,362	-
Noumbiel	Noumbiel Irrigation	BF	-	230	-
Bamboi	Subinja	Ghana (GH)	135	110	=
<b>White Volta Basin</b>					
Wayen	Kanozoe	BF	75	5,319	-
	Loumbila	BF	42	-	=
	Ziga	BF	200	-	-
Yakala	Bagré	BF	1,700	4,695	10
Nagodi	Nangodi Irrigation	BF	-	184	-
Nawuni	Tono	GH	93	2,430	-
	Veá	GH	16	850	-
<b>Oti River Basin</b>					
Kompienga	Kompienga	BF	2,025	-	14
Sabari	Sabari Irrigation	GH	-	1,915	-
<b>Lower Volta Basin</b>					
Prang	Tanoso	GH	125	129	-
Senchi	Amate	GH	120	308	-
Lower Volta	Akosombo	GH	148,000	-	1,020

Sources: McCartney, M. et al. 2012. IWMI Research Report 147

In addition, a number of informal irrigation schemes exist, especially in urban cities, but there is not much information on the extent of their operations. There are nearly 2,000 such small dams and dugouts spread across regions in northern Ghana and southern Burkina Faso with estimated combined storage of approximately 230 Mm<sup>3</sup>. Hydropower potential is underdeveloped and less than 50% of the potential irrigable lands (estimated at 1,487,000 ha) are in production

## 2.6. Climate Change and Water-related Impacts

In West Africa, climate trends since 1960 show an average rate of increase in temperature by 0.21°C per decade, with a

more rapid increase in the northern regions. A decrease of the mean annual rainfall from south to north has also been observed (Onibon et al., 2002).

Specific to the Volta Basin, various projections for temperature under different climate change scenarios show an average increase of between 1.5 to 2.5°C for the long-term future (2050's); with further increases in frequency of floods and droughts. Resulting from the rise in temperature, basin-wide annual potential evapotranspiration will increase by approximately 22%. Rainfall is however erratic and unpredictable, but it is projected to decrease in the basin by an average of 11%. Reductions in river runoff of

approximately 24% by year 2050 and between 45% by 2100 were also projected. Groundwater recharge is also anticipated to decrease (McCartney, M. et al. 2012). As a result of the projected reduction in river flows, on the average only 75% of annual irrigation water demand will be generated by the 2050s. In the same period, there would be enough water for only 50% of current hydropower production from the Volta Lake at Akosombo.

Climate Change impacts on water resources will have cascading effects on human health and many sectors of the economy and society, as various sectors such as agriculture, energy and hydropower, navigation, tourism, as well as the environment directly depend on water. For example, the flooding events in the basin in recent times (2007 and 2008), had serious consequences and sent a strong signal of the need for better flood control infrastructure. Preceding the flood occurrence in September 2007, a prolonged extreme dry period had been realised, which among other things triggered the energy crisis in Ghana due to the diminishing water level in the Volta Lake, with the hydropower generating capacity falling to nearly zero.

The rain-fed agriculture that is largely practiced in the basin is sensitive to fluctuations in climatic conditions. Declining and unreliable rainfall may lead to crop failures in some ecological zones (especially the arid and semi-arid zones of the basin) and cause a reduction in the agricultural sector performance which contributes at least one-third of GDP of

the riparian countries of the basin. This may result in higher food prices, lower domestic revenues and widening of the current account deficit of the riparian countries with increased inflation and increased external debt, hence social and political instability. Also reduction of soil productivity and associated increased food insecurity-particularly in the northern-most parts of the basin will contribute to the abandonment of previously productive lands and increased migration (from north to south and from rural areas to urban centres).

Outbreak of diseases such as malaria, water borne diseases (e.g. cholera, dysentery, etc.) associated with floods, and respiratory diseases associated with drought, are also likely to negatively affect household welfare as well as exert an additional burden on the national economy.

The cross-cutting issues identified in a Transboundary Diagnostic Analysis (TDA) of the basin, including weak institutional capacity, limited skills and equipment for water resources management, limited financial resources, low level of income reflected in per capita income of countries and heavy dependence on rain-fed agriculture, render the riparian countries very vulnerable to climate change.

Examples of impacts of climate change on various sectors and some generic adaptation strategies are summarised in Table 2.2.

**Table 2.2 : Impacts of Climate Change and Some Generic Adaptation Strategies**

Weather Pattern	Impacts on sectors			Adaptation strategies
	Water resources	Agriculture	Others (Energy, water supply, etc)	
<b>Temperature rise</b>	<ul style="list-style-type: none"> <li>- Increased river and lake temperatures;</li> <li>- Increase in evaporation;</li> <li>- Increased algae growth reducing dissolved oxygen levels in the water body which may lead to eutrophication and loss of fish.</li> </ul>	<ul style="list-style-type: none"> <li>• Changes in suitability of crops at different agro-ecological zones;</li> <li>• Possible impact on aquaculture;</li> <li>• Less water available for agriculture, more irrigation needed;</li> <li>• Changes in growing season.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Degradation of freshwater quality;</li> <li>▪ Increased bacteria;</li> <li>▪ Changes in vector-borne diseases</li> </ul>	<ul style="list-style-type: none"> <li>★ Research in /application of land cover and land-use;</li> <li>★ Assessment of temperature changes and impact on rivers, lake and ecosystems.</li> </ul>
<b>Increased variability in rainfall patterns</b>	<ul style="list-style-type: none"> <li>- Erratic river flow patterns.</li> </ul>	<ul style="list-style-type: none"> <li>• Major impact on non-irrigated crops (rainfed farming).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduced hydro power production</li> <li>▪ Reduced river transport.</li> </ul>	<ul style="list-style-type: none"> <li>★ Soil and water conservation;</li> <li>★ Water harvesting, irrigation,</li> <li>★ Improved agriculture technologies;</li> <li>★ Improved seed varieties,</li> <li>★ Developing models to predict on-set of rainy season.</li> </ul>
<b>Increased likelihood of water shortages/drought</b>	<ul style="list-style-type: none"> <li>- Reduced dry season flows;</li> <li>- Drying up of some minor tributaries.</li> </ul>	<ul style="list-style-type: none"> <li>• Major impact on rainfed cropping.</li> <li>• Some impact on irrigated cropping</li> <li>• Land degradation</li> <li>• Lower yields/crop damage and failure</li> <li>• Increased livestock deaths</li> <li>• Increased risk of wildfire.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduction in water availability for hydropower, irrigation, and water schemes.</li> <li>▪ Loss of some perennial sources of potable water</li> <li>▪ More widespread water stress.</li> </ul>	<ul style="list-style-type: none"> <li>★ Soil and water conservation;</li> <li>★ Water harvesting, irrigation,</li> <li>★ Improved agriculture technologies, and new seed varieties.</li> <li>★ Move from annual to perennial crops including agro-forestry;</li> <li>★ Improve irrigation and water supply efficiencies.</li> <li>★ Establishing Early Warning Systems.</li> </ul>
<b>Increase in extreme rainfall intensity</b>	Flooding	<ul style="list-style-type: none"> <li>• Flooding of farmlands</li> <li>• Damage to crops</li> </ul>	<ul style="list-style-type: none"> <li>▪ Overtopping of dams &amp; inundation of downstream communities</li> <li>▪ Destruction of water supply infrastructure and roads</li> </ul>	<ul style="list-style-type: none"> <li>★ Soil and water conservation;</li> <li>★ Insurance;</li> <li>★ Establishing Early Warning Systems</li> </ul>

Source: Adapté de Orbicon, PEM Consult. 2009. Draft Climate Screening Report – ASPSP II, WSSPS II – Bangladesh

## 2.7 Policy, Legal and Institutional Frameworks

### 2.7.1 Global Context

The six riparian states of the Volta Basin are parties to various international environment- and climate-related agreements, including: the United Nations Framework Convention on Climate Change (UNFCCC), UN Convention on Biological Diversity (UNCBD), UN Convention to Combat Desertification (UNCCD),-and Ramsar Convention on Wetlands. All the three Rio Conventions, namely UNFCCC, UNCBD and the UNCCD are influenced by climate variables and water resources.

Assessment of the capacity needs revealed the following common and cross-cutting issues, which offer themselves for complementary and synergic actions. These are:

- i. The three Conventions stipulate that there should be inter-agency coordination, supported by science through public dissemination of information;
- ii. Implementation of the activities under the Conventions should be subjected to Environmental Impact Assessment (EIA) and must build capacity for effective implementation through training and awareness creation;
- iii. The 3 Conventions have common obligations with respect to land use, utilisation of forest products and sustainable soil management for agriculture and forestry;
- iv. The Conventions deal with demographic characteristics, such as population density, poverty and encroachment of settlements, which can result in natural resources degradation, and emission of greenhouse gases (GHG);
- v. The implementation of the Conventions require the participation of stakeholders such as governmental agencies and organisations, local authorities, the private sector, the academic and scientific community, NGOs and civil society and the media.

Establishing a framework for monitoring the progress made

by the riparian countries on international conventions as part of the VBA Observatory will contribute to enhancement of VBA's coordination role with respect to water management and climate change.

### 2.7.2 Regional/West Africa Context

#### ECOWAS

All the six riparian countries of the Volta Basin are members of the Economic Community of West Africa States (ECOWAS), a regional body constituted by 15 West African States. The mission of ECOWAS is to promote economic integration in "all fields of economic activity, particularly industry, transport, telecommunications, energy, agriculture, natural resources, commerce, monetary and financial questions, and social and cultural matters". Three major documents adopted by ECOWAS are particularly pertinent: - **the West Africa Water Policy (2007)**, **the West Africa IWRM Action Plan** and **the ECOWAS Environment Policy (2008)**. ECOWAS has also developed a **regional Agricultural Policy (ECOWAP) for West Africa (2005)**, and it has prepared regional plans to address desertification and climate change (ECOWAS, 2006). These provide guidance and a framework for necessary regional cooperation.

Specific to water, the Assembly of Heads of State and Government of ECOWAS in December 2001 established the Permanent Framework for Coordination and Monitoring of water resources in West Africa (PFCM). The PFCM executive body, the Water Resources Coordination Centre was established in Ouagadougou in 2004 as the water department of ECOWAS. The Water Resources Coordination Unit (WRCU) now called Water Resources Coordination Centre (WRCC), has developed a regional framework and a range of tools to enable countries and basin organisations to make quicker and more concerted progress towards concrete actions to implement IWRM. The main tools for integration in respect of IWRM include:

- Creating a regional policy framework for the water sector (West Africa Water Policy);

- Managing and sharing information; and
- Facilitating dialogue on large infrastructure projects in the water sector in the ECOWAS sub-region.

ECOWAS, through WRCC, serves as an institutional entry point for the many water initiatives and programs financed by development partners. WRCC is thus closely associated with the work of the European Water Initiative (EUWI), the European Water Facility (EUWF), GWP, the World Bank, and other bilateral partners.

Specific to climate change, the countries in West Africa are promoting climate change adaptation (CCA) needs and priorities through a variety of intergovernmental and national policy initiatives. An example is the Regional Plan of Action for Reducing Vulnerability in the Face of Climate Change in West Africa, launched in March 2010 by the member states of ECOWAS. Through regional cooperation, the plan seeks to develop the mechanisms, stakeholders and capacity needed to support adaptation by communities and governments.

These policies and strategic plans provide guidance and a framework for necessary regional cooperation. ECOWAS can also provide or mobilize technical and financial support. It could also facilitate activities in ensuring water security and climate resilience as the participating countries share priority adaptation needs and transboundary natural resources.

### **Global Water Partnership -West Africa**

The Global Water Partnership (GWP) is an international network created to foster an integrated approach to water resources management (IWRM). Its vision is for a water secure world. The GWP operates through a worldwide network of partners, including the West Africa Water Partnership (GWP-West Africa). GWP-West Africa has since its establishment in March 2002, been able to establish 12 Country Water Partnerships (CWPs) in West Africa. It has

also supported a number of countries including Benin, Cape Verde, Mali and Senegal, to prepare their respective National IWRM Plans.

The strategic plan of GWP-West Africa for 2009-2013 has the following objectives;

- . Supporting countries to implement a better management of water resources for water security
- ii. Promote water resource management to better address adaptation to climate change and other challenges
- iii. Make GWP a broker of knowledge on the management of water resources through a global communication platform, and;
- iv. Strengthening the GWP-West Africa network.

As part of the strategies to achieve its objectives, GWP-West Africa is working together with WRCC of ECOWAS to promote IWRM in the sub-region and help countries and stakeholders to operationalise IWRM principles. GWP-West Africa has through its 12 Country Water Partnerships created multi-stakeholder and cross-sectoral neutral platforms for dialogue, thus supporting national water policy development in West Africa. It is also contributing to the implementation of the recently adopted West Africa Water Policy.

Currently, GWP-West Africa is coordinating the implementation of WACDEP in West Africa towards helping countries to develop resilience to climate change.

### **2.7.3 Volta Basin Context**

VBA Convention and Statutes: The mandate of the VBA according to Article 6 of its Convention is to:

- i. Promote permanent consultation tools among the parties for the development of the basin;
- ii. Promote the implementation of IWRM and the equitable distribution of the benefits resulting from

their various utilization;

- iii. Authorize the development of infrastructure and projects planned by the stakeholders and which could have substantial impact on the water resources of the basin;
- iv. Develop joint projects and works;
- v. Contribute to poverty alleviation and the sustainable development of the Parties in the Volta basin, for better socioeconomic integration in the sub-region.

The mandate is made operational by its Statutes, Article 2 of which defines the specific objectives of VBA. The pillars of IWRM are implemented with respect to the:

- i. Establishment of the necessary governance for dialogue;
- ii. Sharing of information;
- iii. Management of the resource through knowledge building, data compilation, and improvement in expertise; and
- iv. Understanding and development of the basin

through provision of the necessary infrastructure for sustainable development.

The VBA has three interconnected functions that collectively will enable the Authority perform its responsibilities. These are: i) Promotion of Stakeholder Responsive Development; (ii) Water Authorisations and Conflict Prevention; and (iii) Knowledge and Information Services.

A platform for effective information exchange is provided with the establishment of the Observatory.

While the VBA has a strong mandate on paper, the legal foundation (the Water Charter) for identifying roles and responsibilities of riparian countries with regard to water resources development and use is yet to be established. These ongoing and other planned WACDEP initiatives should provide the environment conducive to supporting actions for formulation of the Charter and facilitate basin-wide cooperation.

## 3. DESCRIPTION AND ANALYSIS OF ACTIVITIES RELATED TO THE MANDATE OF VBA

Within the Volta basin, several completed and ongoing international and local programs and projects continue to contribute to the development and management of its water resources. The activities of all these projects and programs have common strands such as sharing information, promotion of stakeholders' participation and transfer of results to the basin organization and decision makers. However, virtually all country-based projects in the Volta basin have no links with the VBA. There is therefore the need for VBA to pursue a process for improving project coordination and integration by identifying modalities to establish a permanent coordination system between VBA and all potential partners.

This section outlines discrete transboundary water management and climate change programs and projects since VBA's establishment in 2007. In particular, it does not capture the broad array of actions at the community and country levels.

### 3.1. Activities Undertaken under VBA Strategic Plan

The five-year strategic plan (2010 – 2014) serves as a guideline for operationalising VBA in its early years of establishment at the organizational, technical, political and financial levels. The key objectives of the plan are as follows:

1. Strengthening policies, legislation and institutional framework;
2. Strengthening the knowledge base of the basin;
3. Coordination, planning and management;
4. Communication and capacity building for all stakeholders;
5. Effective and sustainable operations.

Some progress has been made in implementing the Plan.

Key outcomes include: i) facilitating the ratification of the VBA Convention by the remaining riparian states ii) establishment of statutory organs of VBA already identified (e.g. Summit of Heads of State, Council of Ministers, Committee of Experts and Forum of Parties) and iii) identification and collaboration with various stakeholders and partners. The implementation of the plan is however yet to make any significant impact basin-wide because the tools and mechanisms required for harmonization of policies and improved coordination and management such as Water Charter, Communication Plan and Master Plan are yet to be developed.

This is due, among others, to inadequate financial resources and the fact that VBA is a young organization, which is yet to establish the full complement of staff.

Details of other activities undertaken towards the achievement of the strategic objectives of the VBA Strategic Plan are:

#### 3.1.1. VBA Observatory for Water Resources and Related Ecosystems

To ensure that data and information are readily available for the development and management of the basin, VBA is in the process of establishing a monitoring and observation system (the Observatory) for water resources and related ecosystems. The VBA Observatory aims at strengthening the knowledge base of the Volta Basin for a better management of water and other natural resources; creating and improving the tools and collection networks for processing, conserving and disseminating data and information.

The Observatory project is made up of the following three components:

- i. Establishment of baseline environmental conditions of the Volta basin (i.e. characterization of water uses, evaluation of associated water demands, availability of the water resources, issues and challenges on water management and impacting related ecosystems);
- ii. Establishment of communication, information and decision-support tools;
- iii. Involvement of relevant stakeholders in water resources management and environmental monitoring.

A number of landmark consultative workshops have been organised to identify key stakeholders and their roles in contributing to the establishment of the Observatory for Water Resources and Associated Ecosystems. These include;

- i. The Regional Forum on Cartography in the Volta Basin which was held in Ouagadougou in March 2010;
- ii. The Regional Workshop on Agricultural Water held in May 2010 at Accra;
- iii. Consultative Workshop on Utilization and Administration of VBA/GLOWA Geoportal in June 2010, with GLOWA Volta;
- iv. Project Training sessions on Volta Basin Information Sharing Tools, 22-26 February 2010; 01-05 March 2010; 26-30 September 2011, with UNEP GEF Volta Basin Project;
- v. IUCN PAGEV/VBA 2nd Regional Forum on Sustainable Groundwater Resources Management in the Volta Basin, Ouagadougou, Burkina Faso, 8-9 August 2010;
- vi. IUCN PAGEV/VBA 3rd Regional Forum on Sustainable Groundwater Resources Management in the Volta Basin, Cotonou, Benin, 23-24 August 2011;
- vii. Observatory for Water Resources and Associated Ecosystems Regional Forum on Water-related Diseases, Benin 25-26 August 2011.

The workshops deliberated on partnerships and coordination processes between the producers of data and the VBA, within their respective mandates in order to, among others, make the VBA benefit from national acquisitions in terms of data management relative to the use of agricultural water, groundwater, water-related diseases and cartographic maps (acquisition and data processing).

The need for a more accurate assessment of the groundwater potential was recommended highly. In addition to the consultations, an inventory of the hydro-meteorological situation in the Volta basin was carried out by a consultant and the report validated in December 2010.

The study for the establishment of baseline environmental and socio-economic conditions in the basin was also undertaken by a consultant and completed in 2011. A metadata base on the Hydrometeorological Networks and an Atlas of Thematic Maps on the Volta basin have also been developed.

The process of formally involving Civil Society Organizations (CSOs) in VBA activities was initiated as part of Component 3 of the Observatory project. A study on identification of stakeholders in the basin was completed in 2012. Subsequently, the first workshop between VBA and selected CSOs was organised in December 2012. A draft MoU was adopted by the workshop and a data base on the CSOs identified during the study is being developed to be put on line for information, easy access and update.

MoUs have also been developed between VBA and the Ministries in charge of water in the six Volta basin Member States. In each country an Addendum to the MoU with the Ministry specifies hydrological data exchange protocols. However, protocols for technical data exchange between the Observatory and other institutions in relation to other themes such as agricultural water, water-related disease and cartography have not been developed. There is the need to

develop these protocols to enhance VBA's monitoring role. In addition, CSOs and local community groups may be consulted by the National Focal Points on issues related to biological diversity, desertification and adaptation to climate change.

The Observatory, if well resourced will promote sharing of information on all aspects of water security and avoid water conflicts, and reduce vulnerability of communities to drought and flooding. Forecasts of the impacts of climate change and variations on the basin's water resources will benefit from reliable data adapted to the requirements of various users and beneficiaries as part of the Observatory.

The platform for information sharing will enable the riparian countries deepen their understanding of climate change effects, improve their models, and better assess the vulnerabilities connected to climate change. Therefore, the Observatory needs to strengthen its links with other relevant initiatives such as those of WASCAL and AGRHYMET through MoUs to remain effective.

### 3.1.2 Volta-HYCOS Project

The Volta-HYCOS Project is part of the World Hydrological Cycle Observing System (WHYCOS) coordinated by the World Meteorological Organisation (WMO) with the objective to provide free exchange of hydrological data, information, and knowledge across national boundaries.

It is a basin-wide hydrological monitoring system, which started in 2006 with financial support from the French Development Agency (AFD) and was initially managed by WMO in cooperation with International Institute for Water Engineering and Environment (2iE) of Burkina Faso. The French Institute of Research for Development (IRD) was a technical and financial partner of the project. At the beginning of the project, there was no river basin authority. With the establishment of the VBA, the administration of the Volta-HYCOS was transferred to the Authority at the end of June

2009. Subsequently, the Africa Water Facility supported VBA with a grant to strengthen the Volta-HYCOS Project and build the capacity of VBA to handle other projects.

VBA, through the Volta-HYCOS Project is supporting National Hydrological Services (NHS) of Member States to improve on their monitoring networks and data generation capacities. This will help in generating reliable data under varying climatic conditions. The main components of the Volta HYCOS are:

- Supporting the operations of NHSs;
- Strengthening of the Project Regional Centre (PRC) and Development of Hydrological Information System for the Volta Basin;
- Training on various aspects of data collection and analysis; and
- VBA Capacity Building and Integration of the Volta-HYCOS into strategies of VBA

The Volta-HYCOS project (now integrated into the VBA Observatory), will give momentum to activities on operational hydrology and integrate them further into socio-economic activities and joint development projects of the basin countries. Climate resilience will be promoted through the contribution of Volta-HYCOS to better design and optimisation of investment projects in water infrastructure (such as dams for hydropower, agriculture, and water supply), flood control (including early flood warning) and inland navigation. In a long-term perspective, the VBA Observatory/HYCOS will constitute an important source of reliable data for hydrological forecasts adapted to the various types of future water resource scenarios including regional climate change impact predictions.

Information and knowledge generated as a result of Volta-HYCOS will support the riparian countries in developing policies and strategies for climate variability and change adaptation, including early warning systems. Providing relevant, reliable and timely hydrological information products also enhances decisions on water allocation and contributes to water security. The project has however been affected by procedural delays.

The current level of information on national hydro-meteorological networks and also on water quality at the VBA is inadequate. It is therefore imperative to accelerate the implementation of the project and also ensure the efficiency of the operations and monitoring networks of the riparian countries. Stream flow and ground water quality monitoring should form an important part of water resource monitoring.

### **3.1.3 Tilapia Volta Project (TIVO)**

The Tilapia Volta Project is a pioneering effort to produce and supply good quality tilapia seed to fish farmers. The project which is based on a priority programme 'Better seed for African fish farmers' is an example of an initiative to establish a sub regional programme for improving fish strains for aquaculture and protecting native gene pools.

FAO is assisting West African countries with key elements for development of aquaculture as part of its food security strategy in the sub-region. Within this framework, the FAO Regional Office for Africa signed a Letter of Agreement (LoA) with VBA in 2011 for the provision of services to undertake a Risk Analysis relating to imported strains of Tilapia into West Africa, and the validation of study data appropriate to undertaking such analysis. The LoA was aimed at strengthening the region's capacity to ensure sustainable access to one of the inputs – quality fish seed – that are essential for economically viable fish farms.

The aim of this set of activities is to provide the countries of the Volta Basin with recommendations for the future use of genetically improved strains of tilapia, taking into consideration the possible impacts on the existing fish populations, the benefits of using such strains and their possible impact in the alleviation of poverty in the participating countries. Partners involved in the activities included CIRDES of Burkina Faso; CSIR-WRI of Ghana and Wageningen University of The Netherlands.

TIVO will be an important source of data on aquatic

ecosystems for the Volta Observatory. It will also contribute to improving food security and resource use, hence to climate resilience. The project, which ended in December 2013, needs additional funding to continue with a wider sub-regional approach.

### **3.1.4 EU Capacity Building Project**

The EU co-funded project on "Strengthening VBA capacity to implement the priority actions of the 2010 – 2014 Strategic Plan" aims at supporting VBA to consolidate and improve the efficiency of the established permanent organs of VBA (i.e. Committee of Experts, Forum of Parties and Executive Directorate). The first meeting of the VBA Forum of Parties was held in Ouagadougou in January 2012. The project also helped in organising the 6th meeting of the VBA Experts Committee in May 2012 during which the Experts' Committee finalized the Guidelines for the Terms of Reference for the VBA Master Plan. Other partners involved in the project are INBO, AFD, OIEau and the French Water Agencies – Seine-Normandie and Adour Garonne. Development of specific guidelines for action that will ensure effective implementation of VBA mandates are being supported. These include the VBA Water Charter and Master Plan for the sustainable development of the basin.

### **3.1.5 TIGER Net Project**

This project is a major component of the TIGER initiative launched in 2002 by the European Space Agency (ESA). The main goal of the TIGER NET project is to support capacity building of African water authorities in water resources monitoring. The project seeks to develop and demonstrate a user-driven Water Observation Information System (WOIS) based on satellite earth observation technology and serving a range of information products for Integrated Water Resource Management (IWRM) in Africa.

The project was launched during the 6th World Water Forum in Marseille in March 2012. Since then, the user requirements

and technical specifications for the WIOS have been developed and successfully consolidated by the selected pilot basins (the users) and the consultants involved. The initial installation of the software and initial training on its use in VBA was undertaken in May 2013. The WIOS is an obvious contribution to climate resilience and water security.

## **3.2 Transboundary Projects and Programmes implemented by Partners of VBA**

### **3.2.1 PAGEV**

The International Union for the Conservation of Nature (IUCN) implemented the Volta Water Governance Project - PAGEV (*Project for improving Water Governance in the Volta Basin*), from 2004 to 2012. PAGEV aimed at establishing a framework for dialogue, building trust and cooperation towards sustainable management of shared water and other natural resources of the Volta River Basin. PAGEV focused on combining the long-term benefits of ecosystem conservation with immediate impacts of meeting the livelihood needs of marginalized communities.

The project focused on three key thematic areas, namely:

- Compilation of knowledge and information to support planning and decision making;
- Intervention in community based IWRM actions to promote local participation in transboundary water management;
- Improvement in institutional and legislative instruments to promote transboundary cooperation.

Some key outputs recorded by the project include the following:

- ◆ Completion of a water audit of the basin to provide reliable data and information for planning and hydrological forecasts adapted to the various types of future water resource scenarios including regional climate change impact predictions; The information generated from the water audit

is available on the VBA Geoportal..

- ◆ Establishment of river bank protection committees in communities on both sides of the Ghana-Burkina Faso border. These committees undertook re-vegetation of degraded river banks to reduce soil erosion and protect water quality. Fruit trees and fuel-wood trees were also cultivated to combine environmental management and provision of livelihood options.

- ◆ Establishment of a set of multi-stakeholder forums for water resources management. The forums were designed to operate at local, national and transboundary levels, and also to “mix” the different levels, with the aim of increasing involvement by local communities in transboundary water management.

- ◆ Supporting communities to dig wells and rehabilitate an irrigation dam in Ghana. These initiatives supported water security and created benefits (i.e. dry season vegetable farming, rice cultivation, water supply) for the communities and at the same time built awareness and capacity in sustainable water management and conservation of natural resources

- ◆ Formulation of a Code of Conduct on the shared management of the Volta River system between Burkina Faso and Ghana. The process involved stakeholder consultation, national workshops and joint validation workshops.

- ◆ After supporting the formulation of a roadmap for the creation of the VBA, IUCN through PAGEV collaborated with VBA to establish other multi-stakeholder forums for water resources management. Notable among which are:

- ◆ The Forum for Sustainable Groundwater Resources Management in the Volta Basin initiated in 2009;

- ◆ Training of water experts of riparian countries in the use of the decision support model - Water Evaluation and Planning System (WEAP), that was developed through a collaborative arrangement between PAGEV and IRD;

- ◆ Joint water quality monitoring campaigns by scientists from Burkina Faso and Ghana;

IUCN/PAGEV also established a local transboundary water

governance mechanism in the White Volta sub-basin and proposed a framework that can be adapted by VBA as a basin-wide governance structure (Annex 4). Furthermore international co-operation on river basin management was institutionalised through development of a Code of Conduct between Burkina Faso and Ghana.

The VBA is currently implementing the “Observatory for Water Resources and Related Ecosystems” and the Volta-HYCOS Project. It is also partnering IUCN to ensure that the PAGEV outputs contribute to improve the quality and diversity of information required for the Observatory. The PAGEV interventions also promoted multi-level stakeholder participation, which is a key ingredient for climate resilience, as community members become well informed and are part of the design of poverty reduction strategies and also bring traditional knowledge to bear in the design of Early Warning Mechanisms. Linking ecosystems (river banks) restoration with improved livelihoods assets of communities contributed to climate resilience of the communities and may also result in slowing deforestation and forest degradation (loss of carbon density). Reforestation of degraded watersheds will enhance catchments protection in a number of communities in Burkina Faso and Ghana, and may significantly contribute to reducing greenhouse gas (GHG) emissions, conserve water resources and prevent flooding, control erosion, reduce river siltation, and investments in dams, and at the same time preserve biodiversity. It is proposed that VBA builds on the gains of PAGEV by putting more emphasis on ecosystem and related issues in its next Strategic Plan.

### 3.2.2 UNEP-GEF-Volta Project

The UNEP-GEF Volta River Project on “Addressing Transboundary Concerns in the Volta River Basin and its Downstream Coastal Area” was a regional initiative designed to facilitate the integrated management, sustainable development and protection of natural resources of the Volta River Basin within the six riparian countries. The project was initiated in 2008 and ended in 2013.

In line with international best practices to address environmental and social concerns in the basin, the UNEP-GEF Volta Project collaborated with VBA and the riparian countries to review the Trans-boundary Diagnostic Analysis (TDA) of the Volta which was developed earlier from 2001 to 2002. The TDA provides a participatory and science-based assessment of the Volta River Basin, the threats to the basin’s resources, and the causes underlying those threats (UNEP/GEF Volta Project TDA, 2012). The TDA also provides a mechanism for improved and collaborative decision-making at the regional level. The updated Volta Basin TDA identified six priority transboundary issues and problems, which have been grouped into three distinguishable clusters as follows:

1. Changes in water quantity and seasonality of flows;
2. Degradation Ecosystems, which in turn has been divided into four impact areas:
  - i. Loss of soil and vegetative cover,
  - ii. Increased sedimentation of river courses,
  - iii. Coastal erosion downstream of the Volta river basin, and
  - iv. Invasive aquatic species
3. Water quality deterioration (from agricultural, industrial and domestic/municipal effluents);

The TDA also identified and assessed cross-cutting concerns, notably those related to governance and climate change. Following from the TDA, a Strategic Action Programme (SAP) for the Volta Basin was developed with active participation of stakeholders from all the six countries of the basin. The long-term objective of the SAP is to enhance the ability of the riparian countries to plan and manage the Volta Basin and its aquatic resources and ecosystems on a sustainable basis.

The SAP has set priorities for actions, responsibilities and targets and will be mostly implemented through a series of national SAP implementation plans. These plans set out the actions to be taken by each country to ensure sustainable use of resources in the basin in the coming decades.

At the basin level, the SAP actions include a mix of structural and non-structural, regulatory and economic instruments and measures to address the priority problems identified in the TDA including climate risks. The actions will promote - water conservation, ecosystem conservation through reforestation

and land use management, and regulate the exploitation and use of ground and surface water. Awareness creation and information sharing activities will also contribute to strengthening climate resilience. The short- to medium-term SAP actions are summarised in Table 3.1.

**Table 3.1 : SAP Actions for the Volta Basin**

	<b>Component A: Ensuring consistent water availability</b>
A1	Promote techniques of adaptation to climate variability and climate change through the integration of climate change into national policy and sectoral documents and the education and training of stakeholders
A2	Update and strengthen the hydrological, hydrogeological and water-quality monitoring networks in the national parts of the Volta Basin
A3	Set up an early warning system for droughts, floods and inundations in the Volta Basin
A4	Conduct research on climate change impacts on the natural resources of the Volta Basin
	<b>Component B: Conserving and restoring ecosystem functions</b>
B1	Promote sustainable development and management of ecosystems in the Volta Estuary
B2	Implement a regional programme to combat invasive aquatic plants in the water bodies of the Volta Basin
B3	Protect the wetlands of the Volta Basin
B4	Make an inventory of, and develop a monitoring plans for biodiversity in the Volta Basin
	<b>Component C: Ensuring high water quality</b>
C1	Promote productive re-use of treated wastewater in urban centers
C3	Reinforce the capacities of national water-quality laboratories
	<b>Component D: Strengthening governance and improving the quality of information on water resources</b>
D1	Prepare the Water Charter for the Volta Basin
D2	Prepare the Master Plan for the Volta Basin
D3	Support and reinforce sustainable regional cooperation for management of transboundary use of water resources
D4	Improve and harmonize regulations and safety standards on hydro-infrastructures in the Volta Basin
D5	Support the Volta Basin countries to implement the institutional aspects of their IWRM plans
D6	Reinforce public awareness and knowledge on laws related to water and environment in the basin
D7	Support the operationalization of the Observatory of the VBA
D8	Conduct a socio-economic study in the Volta Basin on the relationships between water uses and the environment

The recommendations made at the end of the SAP processes could be a starting point for developing the VBA Master Plan for the basin. Many aspects of the SAP are related to climate resilience and water security. What is required now is funding for these activities to be undertaken. GWP-WA through WACDEP could support the VBA to integrate the SAP into its work plan as part of the implementation of its new Strategic Plan, which is based on the VBA's Convention.

### **3.2.3 Challenge Program on Water and Food (CPWF)**

The Challenge Programme for Water and Food (CPWF) is a research-based initiative of the Consultative Group on International Agricultural Research (CGIAR) that seeks to increase water productivity for agriculture in order to improve livelihoods and leave more water for other users and the environment.

Phase 1 of CPWF, which started in 2003, was implemented in nine benchmark river basins including the Volta and addressed different aspects of water productivity at different scales.

During Phase 1, CPWF found common grounds with PAGEV for the development of a decision support system (DSS) using the Water Evaluation and Planning (WEAP) model of the Stockholm Environment Institute (SEI), US-Center. The CPWF-PAGEV collaboration culminated in the development of a common WEAP for the Volta basin.

Phase II of the CPWF (2010-2013) was identified as a Volta Basin Development Challenge (VBDC) and targeted small-scale farmers in Southern Burkina Faso and Northern Ghana to improve management of rainwater and small reservoirs for multiple uses. It focused on five thematic areas;

- i) Targeting and scaling out –(TAGMI Tool),
- ii) Integrated management of rainwater for crop-livestock agro-ecosystems,
- iii) Integrated management of small reservoirs for multiple uses,

- iv) Sub-basin management and governance of rainwater and small reservoirs, and
- v) Coordination and learning for adaptive management and change.

The VBDC program combined institutional, socio-economic and technical innovations to maximize water for food (including crop, livestock and fisheries) and ecosystem services. It also integrated different disciplines, involved several organizations (local, national and international) and operated at different scales of intervention (farm household, community, watershed, and basin) to contribute to a wide range of expected outcomes.

Benefits of CPWF-VBDC include capacity building and institutional strengthening as well as improved institutional linkages in data exchange and information management.

The CPWF/VBDC project adopted participatory approaches that allowed farmers and other key stakeholders to contribute to the research. In improving productivity of water per drop - smallholder farmers are able to intensify their production, use less water to grow more crops, and rear more livestock, thus contributing to both water and food security. The VBDC contributed further to the capacity development of the next generation of young researchers in the Volta Basin.

The programme trained more than 15 graduate students. By contributing to knowledge in the basin, the VBDC has laid a foundation that could also support the development of the VBA Water Charter and Master Plan, while the data generated would also be placed and made available on the VBA Geoportal. Supporting research into soil fertility improvement and development of drought-resistant and early-maturing crop varieties contributes to climate resilience.

### **3.2.4 GLOWA Volta Project**

The GLOWA Volta Project for Sustainable Water Use under Changing Land Use, Rainfall Reliability and Water Demands

in the Volta Basin was implemented by the Center for Development Research (ZEF) and its partners from 2000 to 2010, with financial support from the German Federal Ministry of Education and Research (BMBF). It had the central objective of analysis of the physical and socio-economic determinants of the hydrological cycle in the Volta Basin in the face of global change. Over the 10-year period, the project trained more than 400 experts and assembled significant information and tools including:

- Volta Basin Water Allocation System that allows incorporating the impact of possible future climate conditions and projected water demand;
- GLOWA Volta Geoportal, which was transferred to the VBA;
- High-resolution Regional Climate Modeling for the Volta Basin;
- Predicting the Onset of the Rainy Season in the Volta Basin.

The Water Allocation System helps to project water demand, hence enhance water security. Predicting the onset of the rainy season will help farmers to plan and avoid economic loss, hence increasing climate resilience.

### **3.2.5 WASCAL Project**

The West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) is a large-scale research-focused program designed to help tackle the challenge of climate change in West Africa and thereby enhance the resilience of human and environmental systems to climate change and increased variability. It does so by strengthening the research infrastructure and capacity in West Africa related to climate change and by pooling the expertise of ten West African countries and Germany. With financial support from the German Federal Ministry of Education and Research, WASCAL seeks to establish together with the West African partner countries, a Centre of Excellence on climate change and adapted land use in West Africa.

WASCAL is currently supporting generation of knowledge and developing the analytical capability in the sub-region to solve current and future water and land management problems caused by changing climate and weather conditions. This is being achieved through training of graduate students, collaborative research and establishment of a Competence Centre. The WASCAL Graduate Studies Program supports and facilitates academic education amongst West African universities in association with German counterpart institutions. The activities focus on the training of Doctoral and Master's students. The training of students is being carried out in collaboration with African Universities including; Kwame Nkrumah University of Science and Technology (KNUST), Kumasi-Ghana, Federal University Technology, Akure-Nigeria, Institut Polytechnique Rural de Formation et de Recherche Appliquee (IPR-IFRA) de Katibougou-Mali, and Université Felix Houphouet Boigny-Côte d'Ivoire.

The capacity building programmes of the Universities and research institutions will develop the analytical capability of graduate students in the basin on climate change issues which among others, will enable the Volta Basin riparian countries to participate and contribute constructively to the ongoing international negotiations on climate change. Table 3.2 presents a summary of the extent to which a particular policy, programme or project is capable of addressing water security and climate change.

**Table 3.2 : Contributions of Programmes / Projects to Water Security and Climate Resilience**

Project/Plan/Study	Contribution to Water Security and Climate Resilience	Recommended Follow up Actions
<b>VBA Observatory</b>	Strengthening water resources knowledge is a catalyst for promoting sustainable economic growth, hence climate resilience and water security;	It is imperative to accelerate the complete establishment of the Observatory and also ensure efficiency of the operations and monitoring networks of the riparian countries A more accurate assessment of the groundwater potential is needed There is need for more effective linkages with other interventions like WASCAL and AGRHYMET. Protocols (MoUs) for technical data exchange with other institutions in relation to agricultural water, water-related disease and cartography need to be developed to enhance VBA's monitoring role.
<b>Volta-HYCOS Project</b>	Providing relevant, reliable and timely hydrological information and products enhances decisions for water allocation, hence water security Facilitating the development of Early Warning System;	Stream flow and ground water quality monitoring should form an important part of water resource monitoring; The current level of information on national hydro-meteorological networks available at the VBA needs improvement; It is therefore imperative to accelerate the implementation of the project and also ensure the efficiency of the operations and monitoring networks of the riparian countries Availability of water quality data and information needs to be improved
<b>UNEP-GEF Volta Basin Project</b>	Transboundary Diagnostic Analysis and development of a Strategic Action Plan for the Volta basin.	The SAP actions provide the framework conducive for achieving the expectations of WACDEP. VBA should therefore be supported to implement the SAP actions as a means of promoting water security and climate resilience
<b>Challenge Program for Water and Food (CPWF)</b>	Support to small-scale farmers in Burkina Faso and Ghana helped to improve management of rainwater and small reservoirs for multiple uses for water security. Improvement in exchange of information and knowledge between different stakeholders; Improved knowledge on soil fertility, and development of drought-resistant and early-maturing crop varieties;	VBA should pursue the multi-level engagement and negotiation methodologies developed by CPWF. Continuous interest and involvement, from the centralized services (SP/PAGIRE and DGRE, and WRC) is needed to sustain momentum.
<b>GLOWA-Volta program (Global Change in Hydrological Cycle)</b>	Water Allocation System allows for incorporating the impact of possible future climate conditions and projected water demand that enhance water security; Predicting the Onset of the Rainy Season in the Volta Basin would help farmers to plan and avoid economic loss.	Improve data collection through Volta-HYCOS to validate Climate Models
<b>IUCN/PAGEV Project</b>	Reforestation of river banks helped to reduce river channel siltation; Rehabilitation of dams ensured water availability during dry seasons; Multi-level stakeholder participation is a key ingredient for climate resilience; Providing alternative livelihood support to women;	VBA should be supported to upscale the PAGEV actions to cover the other riparian states as a means of building on the past and on-going experiences and promote water security and climate resilience

## 4. CONCLUSIONS AND RECOMMENDATIONS

Transboundary cooperation is still at its formative stage in the Volta basin, as VBA was only established in 2007. Most of the staff requirement has not been met, as the riparian countries (especially the most downstream State) show little commitment to financially support VBA. So far, the development of transboundary structures has been driven by donors, who have been involved in financing the establishment of the VBA, financing participatory processes, and financing concrete research projects in the basin.

While the VBA has a strong mandate on paper, the foundations for identifying roles and responsibilities of riparian countries with regard to water resources development and use are yet to be established. The implementation of the VBA Strategic Plan (2001 – 2014) is yet to make any significant impact basin-wide because the tools and mechanisms required for harmonization of policies and improved coordination and management (such as Water Charter, Communication Plan and Master Plan) are yet to be developed. This is due, among others, to inadequate financial resources and the fact that VBA is a young organization, which is yet to complete its establishment.

The ongoing and other planned WACDEP initiatives should therefore provide the enabling environment to initiate actions for formulation of the Water Charter and the Master Plan to facilitate basin-wide cooperation. Regarding the involvement of national and local communities in developing and managing shared water resources, IUCN/PAGEV has established a local transboundary water governance mechanism which can be adapted by VBA as a basin-wide governance structure (Annex 4). PAGEV through development of a Code of Conduct between Burkina Faso and Ghana provided a basis for development of other bilateral relationships.

Currently, VBA has no basin-wide climate change adaptation strategy. Most climate change adaptation projects in the basin are internationally funded and based at country levels. Fortunately, all the six basin countries are signatories to the three Rio Conventions (UNFCCC, UNCBD and the UNCCD) and are implementing actions to meet their respective obligations under the Conventions.

The Conventions individually and collectively, act as catalysts for action on adaptation at all levels (e.g. combating desertification and preventing biodiversity loss promote climate resilience). Facilitating knowledge-sharing and learning, strengthening technical and institutional capacities, and facilitating access to financial and technological support as part of the Conventions will present opportunities for VBA to enhance its coordination role with respect to climate change and sustainable development.

For example, VBA could as part of the Observatory, build on the established reporting framework by the riparian countries with Conventions as a means to enhance its coordination role. It is also recommended that a basin-wide climate change adaptation strategy features strongly in the new VBA Strategic Plan.

The implementation of national climate change and IWRM projects often involves a number of national and local Civil Society Organisations (CSOs), including NGOs. The CSOs/NGOs can therefore play valuable roles in the management of water resources of the Volta Basin. As part of the VBA strategies, actions for a better involvement of civil society groups have been initiated by creating platforms (including signing of MOUs) for better engagement of CSOs.

Improved linkages to local and national government structures, community plans and resources could be forged by establishing a joint reporting framework between the CSOs/NGOs and the Observatory. VBA could also gain from GWP-West Africa and IUCN-PACO's experiences with working with CSOs in West Africa.;

Strategies for climate resilience cut across sectors and national boundaries, and can take many forms, including:

- i. Improving information and knowledge management; (VBA Observatory);
- ii. Conducting research on changing climate issues (IWMI, WASCAL, CPWF);
- iii. Transforming the policy environment (Preparation of VBA Charter and Master Plan);
- iv. Mainstreaming climate change in National Development Plans of riparian countries (VBA Observatory);
- v. Implementing measures to ensure water security through water and ecosystems protection and conservation;
- vi. Improving access to public and private finance.

The on-going and planned interventions in the Volta basin contribute one way or the other, to the achievement of the six climate resilience targets listed above. Specifically, the SAP actions (Table 3.1), which include a mix of structural and non-structural, regulatory and economic instruments, provide the framework conducive for achieving the above targets, as well as the underpinning expectations of WACDEP. Fortunately, the SAP actions were formulated through a basin-wide consultation processes and has the potential to promote transboundary cooperation.

Therefore, VBA should be supported to implement the SAP actions as a means of building on the past and on-going experiences and promote water security and climate resilience.

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### WATER, CLIMATE AND DEVELOPMENT PROGRAMME (WACDEP) TERMS OF REFERENCE FOR

#### Assessment of the Current State of Water Management and Climate Change in the Volta Basin as part of the Establishment of an Observatory for Water Resources and Related Ecosystems

##### 1. Background

The Volta is a transboundary river, which is shared by six countries in West Africa - Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali and Togo - that are dependent on its natural resources for their development. In order to institute measures for sustainable transboundary water resources management of the basin, the Volta Basin Authority (VBA) was established in 2007 with the signing of the Convention on the Status of the Volta River and Establishment of the Volta Basin Authority. The Convention came into force in August 2009.

Article 6 of the VBA Convention mandates the Authority to:

- i. Promote permanent consultation tools among the parties for the development of the basin;
- ii. Promote the implementation of integrated water resources management and the equitable distribution of the benefits resulting from their various utilizations;
- iii. Authorize the development of infrastructure and projects, which could have substantial impact on the water resources of the basin;
- iv. Develop joint projects and works;
- v. Contribute to poverty alleviation, the sustainable

development of the Parties in the Volta basin, and for better socioeconomic integration in the sub-region.

The jurisdictional coverage of the Authority in the performance of its functions, as stated in Article 7, includes the Volta River, its tributaries and sub-tributaries, the reservoirs and lakes, groundwater and wetlands as well as the aquatic and land ecosystems linked to the basin, the estuary of the river including the zone of coastal and oceanic influence.

Before the establishment of the VBA, several institutions had, in reaction to the increasing pressure on the water resources of the basin, initiated various projects and programmes to provide information and develop solutions for sustainable management of the water and other natural resources of the Volta basin. These include:

- UNEP/GEF Project on Addressing Transboundary Concerns in the Volta Basin and its Downstream Coastal Area;
- IUCN Project for Improving Water Governance in the Volta Basin;
- Volta HCYOS Project
- Challenge Program for Water and Food;
- GLOWA Volta Project.

## 2. VBA Strategic Plan

Towards achieving its mandate and also in order to coordinate the activities of the various on-going projects and programmes in the basin, VBA and its partners have developed a Strategic Plan for the period 2010 to 2014 (VBA, 2010), which aims to facilitate all interested parties to better focus on priorities of the Volta basin while avoiding duplication of efforts. The five Strategic Objectives of the 5-year Strategic Plan are (Annex 1):

1. Strengthening policies, legislation and institutional framework;
2. Strengthening the knowledge base of the basin;
3. Coordination, planning and management;
4. Communication and capacity building for all stakeholders;
5. Effective and sustainable operations.

As part of Strategic Objective 2 of the Strategic Plan on 'Strengthening the knowledge base of the basin', VBA is in the process of establishing an Observatory for Water Resources and Related Ecosystems with support of Fonds Francais pour l'Environnement Mondial, SIDA/IUCN and the Member States. The Observatory will be a reference base on the water resources and related ecosystems that can be continuously updated. It will also enhance future development of simulation models, decision support and other analytical tools, while improving the coordination role of VBA. The general objective is to contribute towards satisfying the water requirements of the Volta basin on a sustainable basis while ensuring restoration and protection of the environment.

The establishment of the Observatory is under the following three components:

- i. Establishment of baseline environmental conditions (characterization of water uses, evaluation of associated water demands, availability of the water resources, issues and challenges on water management and impacting related ecosystems);
- ii. Establishment of a communication, information

and decision-support tool;

- iii. Involvement of relevant stakeholders in the water resources management and environmental monitoring.

VBA is also implementing the Volta HYCOS Project, which is a basin-wide hydrological monitoring system coordinated by the World Meteorological Organisation. This project, which is being executed with support from the African Water Facility, is an integral part of the Observatory for Water Resources and Related Ecosystems.

Strategic Objective 3 of the Strategic Plan also envisages the development of a Master Plan for Development and Sustainable Management of Water Resources. Using the Master Plan, the riparian countries will identify and plan projects and investments to be jointly implemented for optimum benefits, including improved adaptation and increased resilience to on-going impacts of climate change and variability.

## 3. Climate Change in the Volta Basin

West Africa is among one of the most vulnerable regions to climate change because some of its physical and socio-economic characteristics predispose it in such a way as to be disproportionately affected (Niasse et al, 2001). Such characteristics include the highly visible contrast between wetlands and arid zones and continuing poverty. Within the Volta basin, several studies have predicted negative impacts including increasing temperatures, reduced rainfall and decreased availability of water resources, water quality deterioration and spread of some water-related diseases (Biney, 2012). With water resources already stressed by non-climatic factors such as rapid population growth and development, pollution and deforestation, the impacts of climate change will further aggravate the situation.

In reaction to the above, West African countries have recognized the need to strengthen their efforts to adapt to the changes resulting from climate change as well as other

global changes. Attempts are also being made to mitigate the emission of greenhouse gases such as through reduction in deforestation. There is also the recognition that climate change presents various opportunities that can accelerate national and regional development (UNECA et al., 2010). These require mainstreaming the issue of climate change into national development activities to elevate it from an environmental challenge into a development challenge. Among others, solutions to such challenges would rely on strengthening the scientific and technological capacities of sub-regional and regional institutions and also supporting the countries to increase their capacity to cope with the impacts of climate change.

#### 4. The Water, Climate and Development Programme

The Water, Climate and Development Programme (WACDEP) was initiated by the Global Water Partnership (GWP) to meet the demand of the African Ministers' Council on Water (AMCOW) for the implementation of the Declaration of the Summit of Heads of States in 2008. According to its Terms of Reference, WACDEP is a 5-year programme, from May 2011 to April 2016, which aims to integrate water security and climate resilience in the development planning processes, build climate resilience and support countries to adapt to a new climate regime through increased investments in water security. By building climate resilience, the initiative will contribute to peace building and conflict prevention, support pan-African integration and help safeguard investments in economic development, poverty reduction and the Millennium Development Goals. On a pilot basis, WACDEP will be implemented in eight countries: Ghana, Burkina Faso, Mozambique, Zimbabwe, Burundi, Rwanda and Tunisia; and four river basins: Volta Basin, Lake Chad, Lake Victoria-Kagera, and Limpopo Basin.

The overall objective of the WACDEP is to support integration of water security and climate resilience in development planning and decision-making processes, through enhanced technical and institutional capacity and predictable financing

and investments in water security and climate change adaptation. The expected outcomes of the programme are:

- Water security and climate resilience integrated in development planning and decision-making processes
- Capacities of partnerships, institutions and stakeholders enhanced to integrate water security and climate resilience in development planning and decision-making processes
- "No regrets" investment and financing strategies for water security, climate resilience and development formulated and governments begin to implement them. In addition, fundable projects for water security, climate resilience and development defined and shared with development banks

WACDEP consists of 4 components with 8 Work Packages. Component, 1 on Investments in Regional and National Development, has the following 4 Work Packages:

- Work Package 1: Regional and Transboundary Cooperation
- Work Package 2: National Development and Sector Plans
- Work Package 3: Investments
- Work Package 4: Project Preparation and Financing

Under a Memorandum of Understanding signed in April 2013, VBA has been invited by GWP to participate in Work Package 1, Regional and Transboundary Cooperation, under Component 1.

The objective of Work Package 1 is to support AMCOW, African Union and Regional Economic Communities (RECs) and River Basin Organisations (RBOs) to advance regional cooperation in climate change adaptation in transboundary waters and shared aquifers for regional and economic development. The key output is investment options and tools for enhancing basin water security and climate resilience are

defined and integrated in basin and regional development programmes.

The Work Package activities will be implemented in the following 4 phases:

#### **Phase 1: Understanding the Problem**

- Basin-wide Assessment and Adaptation Responses: Build on past and on-going basin climate impacts and risks assessment studies to enhance understanding of current and future constraints to basin water security and development;
- Hydro-climatic Information: Analysis of hydro-climatic information from regional climate service centres to ensure climate information is made available for water security interventions;

#### **Phase 2: Identifying and Appraising Adaptation and Investment Options**

- Basin Investment Decision Making: Support RBOs and RECs to elaborate investment options and tools for enhancing Basin Water Security and Climate Resilience defined.;

Phase 3: Delivering Solutions

- Integration of Investments: Support RBOs and RECs to incorporate basin and regional water security and climate resilience investments into regional, basin and national development programmes;

Phase 4: Monitoring and Moving Forward

- Regional Partnerships for Water Security and Climate Resilience: Promote collaboration and partnerships among key regional for implementation; an effective monitoring system for the implementation; and the application of tools for water security and climate resilient investments in transboundary waters and shared aquifers.

In 2013, the following 2 activities are to be undertaken by VBA:

- i. Phase 1: Assessment of the current state of water management and climate change in the Volta basin as part of the establishment of an Observatory for Water Resources and Associated Ecosystems;
- ii. Phases 2 and 3: Support for the elaboration of the VBA Master Plan: Outlines and Principles for Sustainable Development of the Basin.

#### **5. Objective of Assignment**

The objective of this assignment is to assess the current state of water management and climate change in the Volta basin as part of the establishment of an Observatory for Water Resources and Associated Ecosystems.

#### **6. Scope of Work**

The scope of work will be in the form of an inventory of relevant activities of VBA (and its partners) since its establishment in 2007 on the basis of which an analysis/diagnosis will be made with respect to the vision of the WACDEP Project. This vision is linked to the issue of water security, which covers various sectors including energy, food and ecosystems.

The inventory will focus on the VBA Observatory as well as on other activities of the VBA Strategic Plan and relevant projects with other partners. The consultant will therefore be required to:

- i. Review reports of studies and activities to ascertain their relevance to the objectives of the WACDEP Project as stated above and detailed in the Terms of Reference of the project.

These will include but not be limited to the following:

- VBA Observatory for Water Resources and Related Ecosystems;
- GLOWA Volta Project and VBA Geoportal;
- Volta HYCOS Project;
- TIGER Net;
- WASCAL;

- IUCN Project on Improving Water Governance in the Volta Basin;
- EU Capacity Building Project for the implementation of priority actions of the 2010 – 2014 Strategic Plan;
- Challenge Program for Water and Food;
- UNEP GEF Volta Basin Project;
- TILAPIA Volta Project;
- Dialogue on Large Infrastructure;
- ii. Hold consultations with staff of Executive Directorate and relevant technical partners as well as other stakeholders;
- iii. Make an assessment of the relevance of the above VBA activities with respect to the vision, aims and objectives of the WACDEP Project;
- iv. Make recommendations to strengthen VBA's capacity to integrate water security and climate resilience in its development planning and decision-making processes through but not limited to the following:
  - Improving linkages with national and local players to ensure that adaptation efforts take regional issues into consideration;
  - Improving the use and uptake of climate information produced by Regional Climate Centres into Basin investment decision making processes;
  - Enhancing the knowledge base on climate impacts and vulnerabilities and defining basin water security and climate resilience investments;
- vii. Present the report at a workshop for input from VBA, GWP and other partners;
- viii. Incorporate comments and inputs from the workshop and prepare final documents for approval by GWP.

## 7. Expected Outputs of the Consultant

The expected outputs shall comprise the following:

- i. An Inception Report detailing activities and timelines of the assignment;
- ii. Draft Reports, in English and French, based on the requirements of the Scope of Work and other relevant issues to be submitted not later than four (4) weeks after the signing of the agreement for the assignment;
- iii. Revised Draft Reports in English and French to be submitted, not later than one (1) week, after taking into account comments from the VBA and GWP.
- iv. Final Reports in English and French to be submitted, not later than two (2) week, after taking into account inputs received from workshop.

## 8. Experience and Knowledge Requirements

The consultant for this assignment shall be an individual or a firm, which should propose an individual with the following key qualifications and expertise:

- i. Post-graduate qualification in Environmental or Water Resources Management and at least 10 years of relevant work experience;
- ii. Additional qualification in Climate Change Analysis or related areas will be an advantage;

Other key requirements include:

- iii. Familiarity with and working experience in the riparian countries of the Volta basin and the West-African sub-region in general;
- iv. Good understanding of developments in international transboundary water resources management;
- v. Excellent knowledge of either French or English and ability to work in the other.

## 9. Mode of Application

Interested consultants should submit the following

documents, in English or French, to the VBA not later than 04 October 2013:

i. Technical Proposal that should include:

- A Work Plan for carrying out the assignment within the allocated timeframe;
  - The Consultant's interpretation of the Scope of Work;
  - Any other comments that may improve the final outcome of the assignment;
- ii. Financial Proposal detailing the budget for the assignment in F CFA.
- iii. Curriculum Vitae of the individual responsible for the assignment.

Applications should be forwarded to one of the following addresses:

- i. By email to :secretariat.abv@abv-volta.org and secretariat.abv@gmail.com;
- ii. By post: 10 BP 13621 Ouagadougou 10, Burkina Faso
- iii. By direct deposition at the Executive Directorate of the VBA at Ouaga 2000, Ouagadougou, Burkina Faso; Tel. + 226 50376067

For more information, you may consult the VBA website: [www.abv-volta.org](http://www.abv-volta.org)

## 10. Negotiations Meeting

The selected consultant will meet with staff of the Executive Directorate of VBA to discuss and finalize the activities and timeframe for the assignment. The meeting will be concluded with the signing of the Contract.

## 11. References

- Biney, C., 2012. Connectivities and linkages within the Volta basin. In: River Basins and Change, 152-167, Bogardi, J. J., Leentvaar, J and Nachtnebel, H-P, eds. 206 p.
- Niasse, M., Afouda, A. and Amani, A. (Eds.) 2001. Reducing West Africa's Vulnerability to Climate Impacts on Water Resources, Wetlands and Desertification. Elements for a Regional Strategy for Preparedness and Adaptation. IUCN Report, 88p.
- UNECA, AUC and AfDB., 2010. Science, Technology, Innovation and Capacity Building for Addressing Climate Change. 7th African Development Forum, Addis Ababa. Issue Paper No. 10, 6p.
- VBA, 2010., Strategic Plan, 2010-2014.

## 12. Available Documents from VBA

- VBA Strategic Plan, 2010-2014;
- VBA Convention and Statutes;
- Progress and Annual Reports of the VBA;
- Reports on Technical Activities, e.g., VBA Observatory, Volta HYCOS Project;

## ANNEX 2 : SUMMARY OF SPECIFIC OBJECTIVES, EXPECTED OUTCOMES AND PROGRAMME (2010-2014)

Expected Outcomes	Activities
<b>1.0 Strengthening of Policies, Legislation and Institutional Framework</b>	
1.1 Policies for good water governance guide VBA	1.1.1 Ownership and internalization of water resources policies in West Africa and the Volta Basin States
	1.1.2 Assist member States as necessary to introduce IWRM into national legislations and harmonization of approaches where necessary.
1.2 Legislation for water governance in the Volta basin established	1.2.1 Draft a Water Charter for the Volta basin
1.3 All VBA organs are operationalized	1.3.1 Establish and organize regular meetings of the statutory VBA organs (e.g., Council of Ministers, Forum of Parties...)
<b>Strengthen the Knowledge Base of the Volta basin</b>	
2.1 The state of water and environmental resources is known	2.1.1 Conduct inventory of water resources and their uses
	2.1.2 Conduct studies on the environmental status including land use, biodiversity, climate change and socio-economic aspects
2.2 Data management and sharing mechanisms are in place	2.2.1 Support national institutions to strengthen or create qualitative and quantitative monitoring networks
	2.2.2 Support national institutions to strengthen monitoring and evaluation of the quality and quantity of water resources
	2.2.3 Finalize establishment of the VBA Observatory
<b>Coordination, Planning and Management</b>	
3.1 Sustainable management and regulation of water resources	direct sustainable water resources management initiatives in the
3.2 Knowledge and coordination of projects	3.2.1 Formulate a process for the identification, monitoring and dialogue in respect of projects
3.3 A Plan for environmental management and planning launched	3.3.1 Draft a sustainable Master Plan
<b>Communication and Capacity Building for All stakeholders</b>	
4.1 Through communication and dissemination of information, ensure common understanding of the basin	4.1.1 Develop and implement a communication plan that takes into account both technical information and general awareness raising
4.2 Capacity for all stakeholders to share and collaborate in t IWRM	4.2.1 Develop and implement plan for stakeholder participation and capacity building
	4.2.2 Identify and establish partnerships and networks with stakeholder groups in the basin
<b>Effective and Sustainable Operations of the VBA</b>	
5.1 Ensure implementation of the Strategic Plan	5.1.1 Monitoring and evaluation framework drafted and activities carried out regularly including mid-term and 2013 revision.
	5.1.2 Direct the implementation of the plan
5.2 Financial resources and partnerships mobilized	5.2.1 Engage and extend the Consultative Group network of technical and financial partners
	5.2.2 VBA plays its role in the network of basin organizations
	5.2.3 Consolidate the internal funds of the VBA
5.3 Human and material resources and administrative procedures developed	5.3.2 Procedures for internal regulations established and implemented
	5.3.3 Qualified personnel recruited according to needs and trained
	5.3.4 Training in basin management for VBA and partners

### ANNEX 3 : LIST OF INSTITUTIONS/PERSONS CONTACTED

	<b>Institution</b>	<b>Name</b>	<b>Position</b>
1)	Volta Basin Authority (VBA)	Dr. Charles Biney	Executive Director
2)	VBA Observatory	Dr. Jacob Tumbolto	Director
3)	CPWF, Ouagadougou Office	Mr. Mamadou Savadogo	Researcher
4)	GWP-West Africa	Prof. Abel Afouda	Chairman
5)	GWP-West Africa	Mr. Dam Mogbante	Executive Secretary
6)	GWP-West Africa	Mr. Tim Toure	WACDEP Regional Project Manager
7)	West Africa Science Service Centre on Climate and Adapted Land Use (WASCAL)	Dr. Boubacar Barry	WASCAL Coordinator in Burkina Faso
8)	ECOWAS/CCRE (Ouagadougou)	Ms. Anna Tengnas	ASDI Technical Assistant
9)	IWMI West Africa Office, Accra	Dr. Olufunke Cofie	Snr. Researcher and Head of Office
10)	Water Resources Commission, Ghana	Mr. Ben Ampomah	Executive Secretary

## ANNEX 4 : LIST OF PARTICIPANTS

ID	Country/ Institution	Name	Position	e-mail
1)	Benin	Dr. Elegbede Manou Bernardin	Direction Générale de l'Eau – Point Focal ABV	<a href="mailto:elegbedebern@yahoo.fr">elegbedebern@yahoo.fr</a>
2)	Burkina Faso	Mahamadi PORGO	Directeur Générale des Bassin Hydrographique	<a href="mailto:mahamadiporgo@yahoo.fr">mahamadiporgo@yahoo.fr</a>
3)	Côte d'Ivoire	KOUAKOU Bouho Jérôme	Sous-directeur de l'évaluation des ressources en eau, Ministère des eau et Forets	<a href="mailto:kbjero@yahoo.fr">kbjero@yahoo.fr</a>
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9)	GWP/AO	Dr. Karidia SANON	GWP/WA, Gender Focal Point	<a href="mailto:karidia.sanon@yahoo.fr">karidia.sanon@yahoo.fr</a>
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11)	GWP/WA	Oduro DONKOR	Country Water Partnership of Ghana.	<a href="mailto:odurodonkor@gmail.com">odurodonkor@gmail.com</a> ; <a href="mailto:gwpghana@yahoo.com">gwpghana@yahoo.com</a>
12)	GWP/AO	Dam MOGBANTE	Secrétaire Exécutif	<a href="mailto:dammogbante@gmail.com">dammogbante@gmail.com</a>
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22)	ABV	Mme Sonia TONDE/BANDE		
23)	ABV	Ayayi AJAVON	Translation ABV	<a href="mailto:lanbiscut@yahoo.co.uk">lanbiscut@yahoo.co.uk</a>

**ANNEX 5 : GOVERNANCE FRAMEWORK PROPOSED UNDER PAGEV**

