CONCEPT NOTE FOR A REGIONAL PROJECT

PART I: PROJECT/PROGRAMME INFORMATION

Title of Project/Programme:	**Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin**
Countries:	Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo
Thematic Focal Area:	Disaster risk reduction and early warning systems
Type of Implementing Entity:	Multilateral Implementing Entities (MIE)
Implementing Entity:	World Meteorological Organization (WMO)
Executing Entities:	World Meteorological Organization (WMO), Volta Basin Authority (VBA) and Global Water Partnership West Africa (GWP-WAF)
Amount of Financing Requested:	7'920'000 USD (in U.S Dollars Equivalent)

Project Background and Context:

Project Overview

Africa is one of the most vulnerable continents due to its high exposure and low adaptive capacity to water-related disasters in general and climate change impact particularly. Besides measures taken at national level to decrease the negative effect of extreme events, such as floods and drought, it is recognized that additional programs must be implemented at local level in order to build disaster-resilient communities through more integrated climate adaptation measures, policies and practices, including stakeholders' perspectives and a participatory approach.

With a total population over 24 million living on the Volta Basin[1], integrated water resources management (IWRM) and any measures to reduce natural hazards related to extreme events, such as flood and drought, provide high benefits to support socio-economic and environmental development of the six West African riparian countries. The geographic setting of the Volta Basin, covering an area of about 400 000 km^2 and extending from semi-arid to sub-humid areas, is highly vulnerable to meteorological and hydrological events. Over the last 20 years, almost two million people have been affected by floods in the Volta basin. In Burkina Faso alone, close to 20 million people suffered from drought periods since the 1980s.

Key affected stakeholders are mainly people working in the agricultural sector as around 68% of the 24 million people living in the basin are largely dependent on agriculture, which is mainly rain-fed, poorly mechanized and consists of small family farms particularly vulnerable to climate related impacts. Moreover, people affected by poverty tend to move to urban areas and, due to the lack of land-use planning and alternatives, mostly live in areas prone to risks such as valley and mountain slopes, particularly vulnerable to floods and landslides. Besides exposure to riverine floods along

[1] Williams et al, 2016, The Volta River Basin: Water for Food, Economic Growth and Environment and Volta Basin fact Sheet, Flood and Drought Management Tools (FDMT) project (2017-2019)
http://sites3.iwlearn3.webfactional.com/fdmt/en/documents/Information%20sheets/volta-basin-profile/view

the river courses, high intense pluvial events cause localized floods particularly devastating in urban areas, as this has been the case during the June to September 2009 extreme pluvial monsoon over West Africa and event on Ouagadougou with some 120,000 people displaced.

These socio-economic baseline problems in the Volta Basin are exacerbated by a climate that has undergone considerable change in recent decades and is expected to continue changing throughout the 21st century. Through various studies, climate predictions foresee a mean annual reduction of precipitation and an increase of temperature in the Volta Basin. This will modify the current distribution of water resources over the different climatic zones, therefore aggravating an already existing situation of conflict between the competing uses. If drought increase is evident, more severe and frequent pattern of floods are also predicted, due to dry and eroded soil conditions exacerbating the surface runoff during the scarce, nevertheless intense, rainfall events. Overall, dry seasons are expected to be longer and drier, while rainy seasons are going to be shorter but characterized by more intense precipitation events. Combined with the socio-economic context (majority of people depending on rain-fed agricultural production and internal migration towards urban centres, currently not tailored to absorb additional people), this will translate into a hampered food security situation, loss of income and livelihood for farmers and increase of people living in informal settlements located in flood prone areas of urban centres.

Besides the above mentioned socio-economic problems, the West African countries are also suffering from the deterioration of the ecosystem due to increasing pressure on the natural resources and climate variability. In the Volta Basin region, this situation is aggravated by the lack of knowledge and awareness, the need for improved implementation of legislation and policies along with the necessary reinforcement of institutional capacities[2].

With limited adaptation interventions, the regional and national agencies acknowledge that a large proportion of the Volta Basin's population will remain extremely vulnerable to the interacting effects of climate change and ecosystem degradation. There is a need for improving and complementing the adaptation plans, projects and policies on the climate-based threats especially floods and drought events in the Volta Basin region. At the national level, most countries of Volta Basin region have existing climate change adaptation action plans and strategies or are in the process of implementing National Adaptation Plans (NAPs) and National Adaptation Programme of Action (NAPA) enhancing the climate change adaptation efforts of the national agencies and their communities. Furthermore, all countries have listed activities on integrated water resources management, early warning and climate adaptation in their intended nationally determined contributions (INDCs). The main areas for INDCs listed by the six countries are summarized in Table 1 for the topics closely related to the major fields of the Volta programme. The countries are dedicated to find support for achieving the targets.

Table 1: INDC areas of the six countries

Countries / NDC contributions to	Benin	Burkina Faso	Cote d'ivoire	Ghana	Mali	Togo
Vulnerability and Impacts	☒		☒			
Climate change and environment	☒			☒	☒	☒
Agriculture	☒	☒	☒		☒	☒
Water resources	☒	☒		☒		☒
Human awareness and knowledge development	☒					☒
Health	☒	☒	☒			☒
Strengthening early warning system		☒		☒		
Gender				☒		
Coastal zones	☒		☒	☒		☒
Land-Use	☒	☒	☒	☒	☒	

Source: http://www4.unfccc.int/ndcregistry/Pages/All.aspx

[2] GWP and VBA, 2014. Final Report on 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 related ecosystems.

At the transboundary level, the Master Plan for Development and Sustainable Water Management (MPDSWM) is being developed by the Volta Basin authority, the transboundary water management institution of the region, to effectively manage water resources among the Volta Basin countries.

The implementation of regional and national adaptation plans, frameworks and strategies for climate change adaptation and disaster risk reduction is, however, insufficient due to lack of regular monitoring and follow-up activities. With the growing population, improper land-use or land management and climate change variabilities over the years, more and more people are at risks and their resilience capacities have not improved. The government agencies of the Volta Basin countries require support in terms of adaptation projects which will enhance their capabilities and prepare them from the future climate change related impacts therefore contributing to the national implementation of the Sendai Framework (2015-2030).

Transboundary coordination, exchange of knowledge and mutualisation of technical infrastructures are therefore becoming a challenge as growing population and impact of climate change add increasing pressure on natural resources. Already in 2016, assessment of capacity building needs on the six riparian countries and the Volta Basin was performed by national experts in a consultative process with the main relevant stakeholders to form the basis for integrated flood management projects[3]. The main conclusions of these participative consultations highlighted major priorities to build on the current context and to prepare the region to future economic and environmental changes, such as:

- integration of disaster risk reduction in the national management frameworks,
- increase knowledge of communities on risks,
- enhancement of synergy and coordination mechanisms at regional level to foster integrated flood and drought management,
- availability of standardised data and information, especially real-time data,
- early warning systems and strategies to manage disaster risks,
- coordination of information channels and procedures developed for end-to-end early warning systems,
- involvement of communities into flood preparedness and contingency plans.

As a response to this needs assessment, the proposed project aims to implement concrete actions in order to increase the resilience of population and ecosystems and alleviate the impacts of climate change in the Volta Basin. The project will identify and map the floods and drought risks and forecasts future scenarios on the climate, environment, water resources, livelihood etc. The integrated approach for floods and drought events through End-to-End early warning systems will be developed at the national and transboundary level providing support for the decision- makers and people. The project will expand its intervention to improve or update the existing governance policies, guidelines and protocols for the data sharing and water management at the transboundary level increasing their resilience in a coordinated way. Overall improvements of environmental management through education and policy strengthening will increase the resilience of ecological resources and associated livelihoods.

By developing and implementing activities at national and regional level on natural disaster risk reduction, the project will participate to the achievement of the Sustainable Development Goals (SDG) by the six countries. The project will have a direct beneficial impact on SDG 13 (take urgent action to combat climate change and its impact) and more specifically on targets 13.1 (strengthen resilience and adaptive capacity to climate-related hazards and natural disasters), 13.2 (integrate climate change measures into national policies, strategies and planning) and 13.3 (improve

[3] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités. Préparation des projets de gestion intégrée des inondations pour le Bénin, Burkina Faso, Côte d'Ivoire, Ghana, Mali et Togo et le bassin de la Volta en Afrique de l'Ouest. Series of seven reports. Unpublished

education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning). Indirectly, the project will advance the implementation of other SDGs such as SDG 1 (no poverty), SDG 2 (zero hunger), SDG 3 (good health and well-being), SDG 5 (gender equality), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 10 (reduced inequalities), SDG 11 (sustainable cities and communities), SDG 15 (life on land) and SDG 17 (partnerships for the goals).

Background context

Geographical context

The Volta basin is located in West Africa between latitudes 9°N to 15°N and longitudes 6°W to 3°E (Figure 1). It is the 9th greatest fluvial basin in Sub-Saharan Africa and covers an area of around 400,000 km^2.

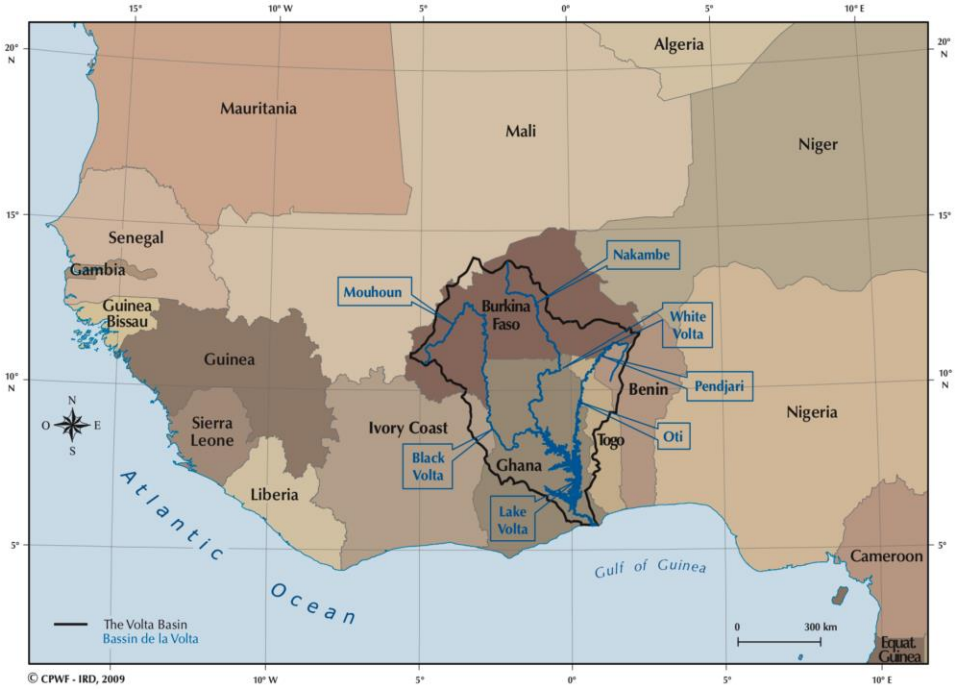


Figure 1: Location of the Volta Basin in West Africa[4]

The basin is shared by six riparian countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Togo and Mali. Table 2 provides basic data for the distribution of the basin over the six countries, and the area of each country that lies within the basin. The Volta basin is made of three major tributaries: The Black Volta River (called Mouhoun in Burkina Faso), the White Volta (called Nakambé in Burkina Faso) and the River Pendjari, which becomes the River Oti in Togo. These rivers meet in Lake Volta and form the River Volta downstream Akosombo dam. The Mouhoun and Oti rivers are respectively part of the borders between Ghana, Burkina Faso and Ivory Coast for the former and between Togo, Benin, Ghana and Burkina Faso for the latter.

[4] Lemoalle J., de Condappa D., 2009. Water atlas of the Volta basin. Colombo, Marseille: CGIAR/CPWF.

Table 2: Area of Volta Basin within respective countries[5]

	Area of basin (km^2)	Percentage of basin in the country	Percentage of the country in the basin
Benin	13 590	3.41	12.1
Burkina Faso	171 105	43.0	62.4
Côte d'Ivoire	9 890	2.48	3.07
Ghana	165 830	41.6	70.1
Mali	12 430	3.12	1.00
Togo	25 545	6.41	45.0
Total	398 390	100	-

Ghana and Burkina Faso cover most (85%) of the basin in terms of surface area.

In Burkina Faso, the Volta Basin covers all or part of most of the regions of the country and is drained by the Mouhoun and Nakanbé rivers.

Within Ghana, the major sub-basins of Volta include the Black Volta basin, White Volta basin, the Oti basin and the Lower Volta basin which includes the Volta Lake. Volta Lake is the largest man-made lake in the world by surface area. It is completely included within Ghana and has a surface area of about 8,500 km^2, an average depth of about 18.8m and a shoreline of about 5,500 km.

Togo contains only a small percentage of the total basin but this area comprises a significant proportion of the entire country, with the basin covering all of two regions, Savanna and Kara, and part of three other regions: Central, Plateaux and West Maritime.

In Benin, the national share of the Volta basin accounts for about 12% of the national territory and extends its influence mainly on the departments of Atacora and Donga, where it occupies 47% of their cumulated territories; respectively 90% and 10% of its area in these departments.

The Ivorian part of the Volta Basin covers the regions of Bounkani and Gontougo. This region is administratively subdivided, respectively, into Bouna and Bondoukou Departments which are in turn subdivided into districts. The Ivorian portion of the Volta Basin covers about 3.5% of the national area and 3% of the basin area.

In Mali, the Volta River basin is represented by the Sourou River sub-basin located in the Mopti Region, a tributary of the Volta River that flows about 80 km in Mali before entering Burkina Faso where it merges with the Mouhoun. The Mouhoun itself is an important permanent tributary of the Volta River, which owes the permanence of its flow to many sources in its upper basin in Burkina Faso. In Mali, it drains an area equivalent to 3% of the total area of the basin.

Socio-economic context

The countries that share the Volta Basin are among the poorest in the world, with underdeveloped economies, and majority of the people living below the poverty line. Table 3 provides the latest Gross Domestic Product figures for the Volta Basin countries, with values ranging from US$ 579 in Togo to US$ 1,526 per capita per annum in Côte d'Ivoire.

[5] UNEP-GEF Volta Project, 2013. Volta Basin Transboundary Diagnostic Analysis.

Table 3: Gross Domestic Product (GDP) for countries in the Volta Basin (2016)

	GDP* (billion US$)	Population (millions)	Population growth (annual %)	GDP per capita (US$)
Benin	8.58	10.87	2.8	789
Burkina Faso	12.12	18.65	2.9	650
Côte d'Ivoire	36.16	23.69	2.5	1526
Ghana	42.69	28.21	2.2	1514
Mali	14.05	17.99	3.0	781
Togo	4.40	7.61	2.5	579

Source: http://databank.worldbank.org/data/home.aspx.

Notes: * Figures are for the countries and not just the basin region.

Benin belongs to the group of least developed countries with a GDP per capita of US$ 789 (current $US) in 2016. In terms of the Human Development Index (HDI), Benin ranks 167 out of 188 in the 2015 UNDP report with an HDI of 0.485 and still is among the 40 poorest countries in the world[6]. The population of the National Portion of the Volta Basin (NPVB) was 750 236 habitants or 7.49 % of the total population of Benin in 2002, a third of them living in urban areas, and 2 third in rural areas[7]. On the NPVB, the main economic activities concern agriculture (rainfed and subsistence type), livestock rearing, fisheries and aquaculture, logging, mining, trade and tourism. The agricultural sector employs about 83% of the population in the whole area. It is the first sector providing resources to households. Of the NPVB, arable land is estimated at 1,400,000 ha and less than 10% is actually harvested[8].

In Côte d'Ivoire, according to the World Bank's latest Living Standards Measurement Study in 2015, the incidence of poverty declined from about 51 percent in 2011 to 46 percent in 2015. Poverty remains a predominantly rural phenomenon, linked to inequalities of access to essential services and gender disparities. 68% of the labour force depends on primary agriculture and 43% is illiterate[9]. The population of the Volta Basin in Côte d'Ivoire is 450,000 inhabitants or 2% of the national population and only 2% of the population of the Volta Basin estimated at about 22 million inhabitants in 2016. Agriculture is the main activity of the NPVB: thanks to its geographical location, straddling two ecological zones (forest to the south and savannah to the north), the climatic diversity allows the cultivation of a wide range of crops, ranging from cash crops (coffee, cocoa) to food and vegetable crops. The area is also suitable for livestock rearing development.

Mali is ranked among the least developed countries with a GDP per capita of US$ 781 in 2016. Human development indicators point to a difficult socio-economic situation. The Malian economy remains highly dependent on the mining sector and on agriculture. In fact, agriculture contributed, on average, to 39% of GDP over the period 2006-2010. The population grows by 3% per year, which does not allow to consider a doubling of the per capita income before thirty-five years. In Mali, the Sourou Basin has a population of 668,000 inhabitants according to the provisional results of the General Census of Population and Housing (RGPH-2009). The population of the basin is mostly young and rural with 330,300 men in 2009 for 335,700 women in 2009, therefore 98 men

[6] http://hdr.undp.org/en/indicators/137506.
[7] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Benin.
[8] UNEP-GEF Volta Project, 2008. Etude sur l'établissement d'un système régional d'échange des données et informations relatives au bassin versant de la Volta au Benin. UNEP/GEF/Volta/NR BENIN.1/2008.
[9] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Côte d'Ivoire.

for every 100 women. The plain of Sourou has undergone major hydro-agricultural development: more than 3,800 ha of land are managed in total water control and operated by more than 3,000 producers. The Sourou Basin has a total economic value estimated at 19.85 billion FCFA (≈35.5 million $US). Among the goods and services identified, land resources are the most important in the area and provide in monetary terms nearly 30% of the resources of the valley. Although fishing is considered a very important activity in the area, its contribution to total economic value is only 10%[10].

In Togo, poverty affects nearly 62% of the population, in rural areas and larger households. According to the 2006 QUIBB survey[11], the incidence of poverty in rural areas is 74.3%, representing 80% of the poor. The economy of Togo is largely dependent on the agricultural sector (including livestock and fisheries), which is the main source of income and employment for 63% of the population, as well as a significant share of merchandise export earnings. The population of the Volta Basin in Togo was estimated at 1.6 million in 2000[12]. In 2010, this population is approximately 2.15 million and is expected to grow to 2.9 in 2020 and 3.9 in 2030. This population increase is a threat for natural resources. The watershed covers about 47% of the national territory. It provides all of the togolese cocoa and coffee production and more than half of the cotton production. The floodplains of the Volta basin offer enormous services for both humans and wildlife: these plains are interesting lowlands for rice growing and also shelter a hydrophilic fauna that attracts a large number of tourists, incurring significant financial inflows for these areas. In the light of this observation, the search for solutions to the various environmental problems will improve the national GDP.

Burkina Faso is a low-income country, with nearly 45% of the population living on less than a dollar a day[13]. According to statistics published in 2009 by the National Institute of Statistics and Demography, the poverty rate in Burkina Faso is estimated at 46%. The report on the Human Development Index (HDI) of the United Nations Development Program (UNDP) for 2015 ranks Burkina Faso 185th out of 188 countries. The population of Burkina Faso, which grows at an average annual rate of 2.9%, is characterized by its youth (more than 60% under 20 years) and its rurality (76%). Burkina Faso economy is highly vulnerable to external shocks due to the predominance of export agriculture (notably cotton) and the importance of external assistance[14]. Since 1995, economic growth - mainly due to the expansion of the primary and tertiary sectors - has been 5.5% per year, but the international context and the adverse climatic conditions have led to a slowdown in activity in 2000. The economy is dominated by the primary sector. Like the national territory, the socio-economic context of the Volta Basin in Burkina Faso remains characterized by the preponderance of the primary sector which is based on agriculture, livestock rearing and forestry. These sectors absorb on average 30 to 35% of public investment programs. 90% of the areas planted for cotton growing is located in the Volta Basin, which contains the two largest cotton basins in the country: the western cotton basin (Mouhoun basin) and the eastern cotton basin (Nakanbé basin). In the Mouhoun basin, cereals and cash crops occupy 67% and 30% of the cultivated area respectively. In terms of industry and mining, the territory of the Volta Basin in Burkina Faso supports most of the country's industrial activity. In the Nakanbé basin, 47 irrigated perimeters are identified but the developed areas are only 2,620 ha, including 1,000 ha for Bagré which is a hydro-agricultural and hydroelectric mixed-use dam. In terms of energy, the Bagré dam with a productivity of 44 GWH per year contributes to about 25% of the national electricity production.

[10] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Mali.
[11] Questionnaire Unifié des Indicateurs de Base du Bien-être.
[12] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Togo.
[13] BAD/OCDE, 2008. Perspectives économiques pour l'Afrique.
[14] MEF, 2012. Schéma National d'Aménagement et de Développement Durable du Territoire.

Ghana is a middle-income West African country which experienced impressive economic growth from 2005 to 2012. This growth has slowed significantly since 2013 in light of macro-economic challenges, such as high budget deficit and inflation, but is still expected to remain positive, due to the country's stable democratic institutions and rich natural resources. Per capita GDP reached US$ 1,514 in 2016, and the Human Development Index improved as access to health care and education increased, making Ghana one of the few 'medium human development' countries in the region. Furthermore, Ghana has met the Millennium Development Goal of halving poverty and hunger before 2015 (MDG1). Nevertheless, over a quarter of the population still remains below the poverty line of US$ 1.25/day, particularly in the Northern regions. Agriculture is a key sector of Ghana's economy, accounting for 23 percent of the national GDP in 2012[15]. Agriculture is even more dominant in the Volta Basin, with more than 50% of employment. Job creation in the basin, as in all parts of the country, has not kept pace with population growth resulting in, among other things, high rates of unemployment, underemployment and poverty. Exports account for a significant share of GDP but are not diversified in terms of products and destinations: gold and cocoa accounted for over 70% of exports in 2009. The Akosombo Dam was constructed to supply electricity from the Volta River for industry and to supply power to the towns and cities of Ghana and neighbouring countries. The Akosombo, Boui and Kpong dams are still Ghana's major source of electricity. Demand for power continues to increase in the country, especially within the urban-industrial sector. The country's continued commitment to hydropower as an engine of growth is demonstrated by the ongoing construction of the Bui Dam in the Bui Gorge (Black Volta). This dam is designed to fill the gap in the supply of electricity and increase Ghana's generating capacity[16].

Environmental and Ecosystem Context

The vulnerability in West African countries is not only increasing because of social changes but also through environmental stresses due to modification of natural hazards, environmental degradation, climate change and losses of natural resources and biodiversity. These stresses have a major impact on the livelihood of the most vulnerable population (security, health condition economic opportunities) as highlighted in Figure 2.

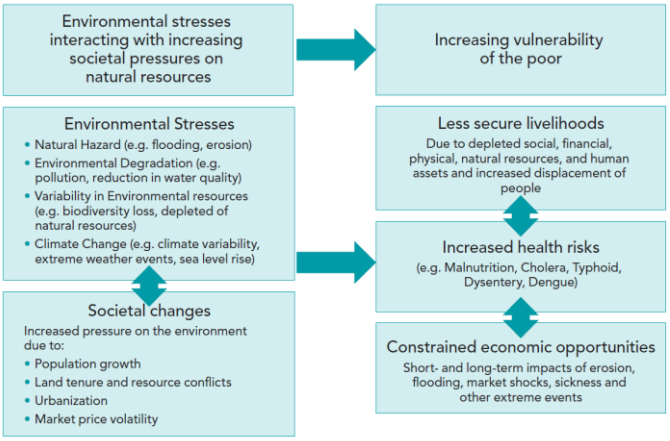


Figure 2: Vulnerability Profile of West Africa[17], [18]

[15] FAO, 2015. Country fact sheet on food and agriculture policy trends, Ghana.
[16] UNEP-GEF Volta Project, 2013. Volta Basin Transboundary Diagnostic Analysis.
[17] Dow, K. 2005:Stockholm Environment Institute https://www.sei-international.org/mediamanager/documents/Publications/Risk-livelihoods/West_Africa_lowres.pdf
[18] WACA Project, 2015: A Partnership for Saving West Africa's Coastal program, World Bank Group http://documents.worldbank.org/curated/en/382201468181130416/pdf/101176-REVISED-PUBLIC-WACA-Brochure-April-2016.pdf

The Volta Basin region host an abundance of natural resources providing vital and diverse ecosystems services both on land and water bodies. The ecosystem resources such as fresh water, lake habitats, protected areas and forest ecosystems play a key role in the economic development and physical resilience to current and future challenges posed by climate, weather and water. The distribution of these ecosystems services varies significantly across the Basin and their direct and in-direct contributions helps in the survival of the living organisms and promote livelihood opportunities for humans. The Basin ecosystems are continuously being threatened by multiple drivers of change mainly due to human activity (use of environmental pollutants and increase of pollution) but also stresses due to climate change variability.

In 2002, the project 'Transboundary Diagnostic Analysis (TDA)' was carried out by the six riparian countries with technical assistance of Global Environment Facility-United Nations Environment Programme[19] to identify the major perceived problems and issues (MPPI) on the environmental aspects of the Volta Basin region. The results of the MPPI were ranked by attributing a score to a list of main issues as shown below on Table 4, to help guide the priorities of future interventions for improving the Volta River Basin ecosystem.

Table 4: Analysis of Land, Water and Environmental issues in the Volta Basin

Problem/Issue	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Mali	Togo	Basin Average	Rank
Land Degradation	8.5	7.5	8.5	8	10	9	8.6	1
Flooding	5.5	6	4.5	5	10	7	6.3	6
Water Scarcity	8.5	9.5	8	7	9	9	8.5	2
Growth of Aquatic Weeds	5.5	6	5	7	7	7	6.3	7
Loss of Biodiversity	7.5	7.5	8	7	9	8	7.8	4
Water Quality Degradation	6	8	7.5	6	9	8	7.4	5
Water-borne Diseases	8	8.5	8	7	9	8	8.1	3
Coastal Erosion	6	-	-	5	-	6	5.7	8

Source: Volta River Basin Preliminary Transboundary Diagnostic Analysis, 2002.

In the second TDA phase in 2012[20], the analysis indicates that the Volta River Basin continues to experience high levels of water quality and flow degradation, coastal erosion, increased sedimentation of rivers, invasive aquatic species, loss of soil and vegetative cover and ecosystem degradation as a result of factors related to climate change, livelihood practices, poor governance and mismanagement of the basin's natural resources. Poor land-use practices are resulting in loss of vegetative and forest cover such as bush-fire to clear land, deforestation, over-cultivation of agriculture land etc. These practices in the upper most of the Volta Basin are contributing to the increased run-off and siltation leading to soil and coastal erosion. Deforestation plaguing areas in the Volta Basin region are resulting in loss of important ecosystems such as wetlands and species such as Ephmeroptera, an important food resource for the fish in the Volta River.

Moreover along the river courses, more than 1180 small reservoirs have been built in the Volta basin. Their water quality has been deteriorating due to harmful water nutrients resulting from land

[19] Volta River Basin Preliminary Transboundary Diagnostic Analysis, 2002
http://www.ais.unwater.org/ais/aiscm/getprojectdoc.php?docid=293
[20] Volta River Basin Institutional Development Project-Concept Stage, Pg-3
http://iwlearn.net/resolveuid/116e4bdf3ac24250be9fb2409a132c02

degradation and through the usage of pesticides and fertilizers for agricultural growth. Rapid urbanization is leading to inappropriate discharges of domestic waste into the streams and rivers, degrading the quality of the water.

Specific considerations to reduce vulnerability include: supporting efforts to maintain soil quality, to enhance productivity and increase capacity to deal with environmental variation; planning for adequate water supply and sanitation to meet both urban and rural populations' needs. These measures will induce benefits in current health and productivity will ensure projected demand is met, and will foster the integration of strategies for climate change mitigation and adaptation into policy and planning[21].

Status of Hydro-Meteorological Observation Network

The hydrological and meteorological networks of the Volta Basin are sparse, as presented in Table 5. Moreover, some stations are not functioning optimally. It is worth noting that 76 %, and 47 % respectively, of the stations operated by the Meteorological Agencies in Burkina Faso and Ghana are located in the Volta basin (Figure 3). Some part of the equipment was bought by national governments whiles others were delivered to countries as supports from various projects. There are still efforts by ongoing projects, such as CREWS, to provide support and install new equipment to strengthen the hydro-meteorological network in the respective countries.

Table 5: Meteorological and hydrological stations of the Volta Basin

Country	N° of synoptic stations	N° of agro-meteorological and climatological stations	N° of rain gauge stations	N° of hydrometric stations	Total
Benin	1	0	8	3	12
Burkina Faso	7	15	102	24	148
Côte d'Ivoire	1	0	4	3	8
Ghana	8	6	40	16	70
Mali	0	0	3	3	6
Togo	1	5	25	11	42

Source: Volta Basin Authority, 2010.

Within the White Volta basin, thanks to the FEWS-Volta project, most of the old stations have been rehabilitated and new ones have been installed including river gauge stations for the Hydrological Service Department (HSD). Currently, 20 river gauge stations have been registered in the NPVB of Ghana but their functioning must be assessed.

All the six countries are aware of the need of funding from governments to support National Meteorological and Hydrological Services in order to improve their network of stations. Of the number of river gauging and meteorological stations in the Volta basin, only a few deliver continuous and reliable data. As a result, the Volta Basin Authority (VBA) through the Volta HYCOS initiative (2005 to 2010, financed by FFEM/ AFD and later 2011 to 2015, financed by AfDB/AWF) selected about sixty (60) hydrometric stations in the countries and installed/upgraded

[21] West Africa vulnerability profile, 2005; Swedish Environment Institute, Sweden https://www.sei-international.org/mediamanager/documents/.../West_Africa_Vuln.pdf

hydrometric stations with new equipment to guarantee the data quality needed for planning water resources. Furthermore, about seventeen (17) synoptic stations, twenty-six (26) agro-climatic stations and several rainfall gauges were selected by VBA for the purpose of data sharing to ensure sustainable planning in the basin.

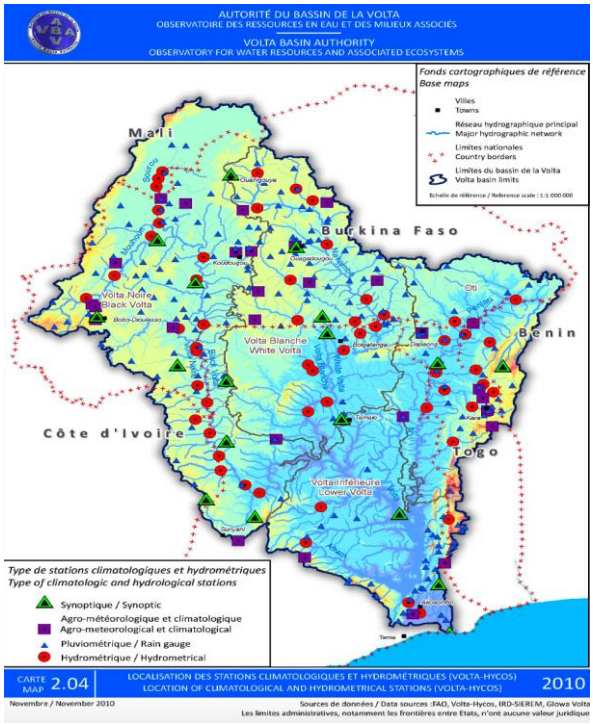


Figure 3: Hydro-stations of the Volta Basin[22]

Status of Flood Forecasting and Early Warning Solutions

Despite the efforts in strengthening the hydrometric network listed above, VBA does not have yet the capacity to provide early warnings to forecast floods. However, efforts are made by the six riparian countries to develop early warnings systems for management and decision making.
Benin is currently implementing an early warning systems (EWS) project that focuses on floods and drought in the entire country. The project aims to strengthen capacity for climatological and hydrological monitoring.

Burkina Faso has initiated several Early Warning Systems for the sectors of water, agriculture and environment. They are related directly or indirectly to flood disasters, such us:

- *The National Information System on water (NIS water)*. NIS water is being implemented by the General Directorate of Water Resources (DGRE) through the Department of Water Studies (DEIE). The NIS water system includes four (4) main components: the definition of information needs, data collection, data storage and processing and the dissemination of the generated information. The NIS water is still under development with most of components not yet operationalized.
- *The forecast system of the General Directorate of meteorology*. The forecast made by meteorological services aims to alert citizens towards preparedness, prevention and management of climate-related natural disasters.

[22] GWP West Africa, 2016. Regional Needs Assessment Report on Integrated Flood Management – Volta Basin.

- *The Integrated Food Security System (SISA)*. SISA was created by executive order of the Minister of Agriculture. The Directorate General for the Promotion of the Rural Economy (DGPER) is responsible for its implementation and is specialized in the collection, processing and dissemination of information related to early warning for agricultural production and food security.
- *Burkinabe Red Cross Early Warning System* is based on contingency plan activated in the event of disasters including floods.
- *Early Warning System on Climate Information* of National Council for the Environment and Sustainable Development (CONEDD). The system provides climate information at national level to support management of several sectors, such as agriculture, water, health and energy.
- *Strengthening national capacities for EWS Service Delivery in Burkina Faso (CREWS)* will improve the operational capacities in Burkina Faso to produce and deliver hydrometeorological services for flood early warning and risk information for agriculture and food security.

In Ghana, the Flood Early Warning System (FEWS-Volta) has been developed for the White Volta Basin (2011-2012) and for the Oti basin (2016-2018) with the support of the World bank and local ghanaian and togolese (for the Oti basin) governmental institutions. In the same period, the Community Resilience and Early Warning (CREW) project was sponsored by the Norwegian Government and implemented by UNDP through National Disaster Management Organization (NADMO). The project started in 2013 and ended in 2016. It was a follow up of the Africa Adaptation Programme (AAP) in Ghana where flood and drought risk mapping was carried out for 10 pilot districts in the country. Within the pilot districts, hotspots or communities were identified for more in-depth flood and drought risk profiling as well as drawing up of possible mitigation measures. In each of the district, risk, hazard and vulnerability mapping was carried out as well as the setting up of an Early Warning System similar to the FEWS-Volta. In most districts, up to 3 hotspots/communities were mapped. Thanks to both FEWS-Volta project and CREW projects, plans to send weather alerts and flood warnings to end-users at all levels (national, regional, district and communities), using mobile platforms (SMS and voice mails) and web-based application, are far advanced. Some telecommunication companies in Ghana like Vodafone and MTN are supporting some of these initiatives. Mobile Service providers such as Farmerline Limited, ESOKO, Human Network International (HNI) are assisting farmers to get access to weather and hydrological information as well as agronomic and financial counselling.

Côte d'Ivoire, Mali and Togo on the other hand, have not developed any EWS for the part of the countries in the Volta Basin. However, there are early warning systems developed for the Segou area in Mali and Abidjan in Côte d'Ivoire due to the losses suffered by these cities over the years.

Climate change context

Past and present climate change

High confidence for evidence of warming is noted across Africa, consistent with anthropogenic climate change. Over West Africa and the Sahel near surface temperatures have increased over the last 50 years. The number of cold days and cold nights have decreased and the number of warm days and warm nights have increased between 1961 and 2000. Many of these trends are statistically significant at the 90% level, and similar trends are found in extreme temperature indices[23]. All of these trends suggest changes in temperature, rainfall volume and patterns, and

[23] IPCC, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22: Africa.

frequency and intensity of storms. Reductions of rainfall and run-off in the Volta Basin are observed since 1970s[24].

In the period 1960 - 2009, the average annual temperature in Benin increased by 1.3 °C, with a decrease in the number of cold nights and an increase in the number of hot days[25]. Observations also showed a tendency for maximum temperatures to increase, the average of which increased during the period 1971-2000 compared to the period 1940-1970.

According to the second national communication on climate change, the inter-annual variability of rainfall in the Natitingou region in Benin from 1950 to 2010 is negative, especially since the 1970s while that of temperature is increasing. At the seasonal scale, the situation is characterized by anomalies in rainfall with particularly high concentration of rains over a brief period and a sudden interruption of rains in high season[26].

Indeed, during the 1960s, average rainfall across the countries in West African Sahel was around 700mm, but, due to recurrent drought years, average rainfall declined in the 1970s, and particularly in the 1980s, to about 550mm. Average rainfall for the 1982–1985 period was only 381mm[27]. The driest of all years was 1983, with over 90% of the Volta basin in extreme drought conditions.

According to the IPCC report "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)"[28], much more severe and longer droughts occurred across West Africa in the past centuries with widespread ecological, political, and socioeconomic consequences. Furthermore, floods in West Africa are becoming more and more recurrent and damaging and are seen as potential consequences of climate change. In 2007 and 2009 more than 800,000 people were affected in West Africa, but 2010 represents the year when most loss of life was recorded with about 1.9 million people affected[29].

Past and current effects of climate change

In early 1970s, Burkina Faso and other countries in West African Sahel suffered from a series of drought periods, with devastating consequences for the inhabitants of the whole region. The years of recurrent drought, high variability in the monsoon rain and variations in its onset and offset, as well as their intensities greatly affected crop production negatively, inducing structural food shortages and hunger. In Ghana, food production was below normal in 1983. Low water levels in the Akosombo dam in 1998 caused a major energy crisis in Ghana, which may have been caused purely by unreliable and poorly understood rainfall variability, even though many Ghanaians blamed Burkina Faso's water development.

[24] UNEP-GEF Volta Project, 2013. Volta Basin Transboundary Diagnostic Analysis.
[25] PANA-Benin, 2008. Programme d'action national d'adaptation aux changements climatiques du Bénin.
[26] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Benin.
[27] Kasei, R., Diekkrüger, B., Leemhuis, C., 2009. Drought frequency in the Volta Basin of West Africa. Sustain. Sci. 5:89-97
[28] IPCC, 2012. Chapter 3: Changes in Climate Extremes and their Impacts on the Natural Physical Environment.
[29] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités. Préparation des projets de gestion intégrée des inondations pour le Bénin, Burkina Faso, Côte d'Ivoire, Ghana, Mali et Togo et le bassin de la Volta en Afrique de l'Ouest. Series of seven reports.

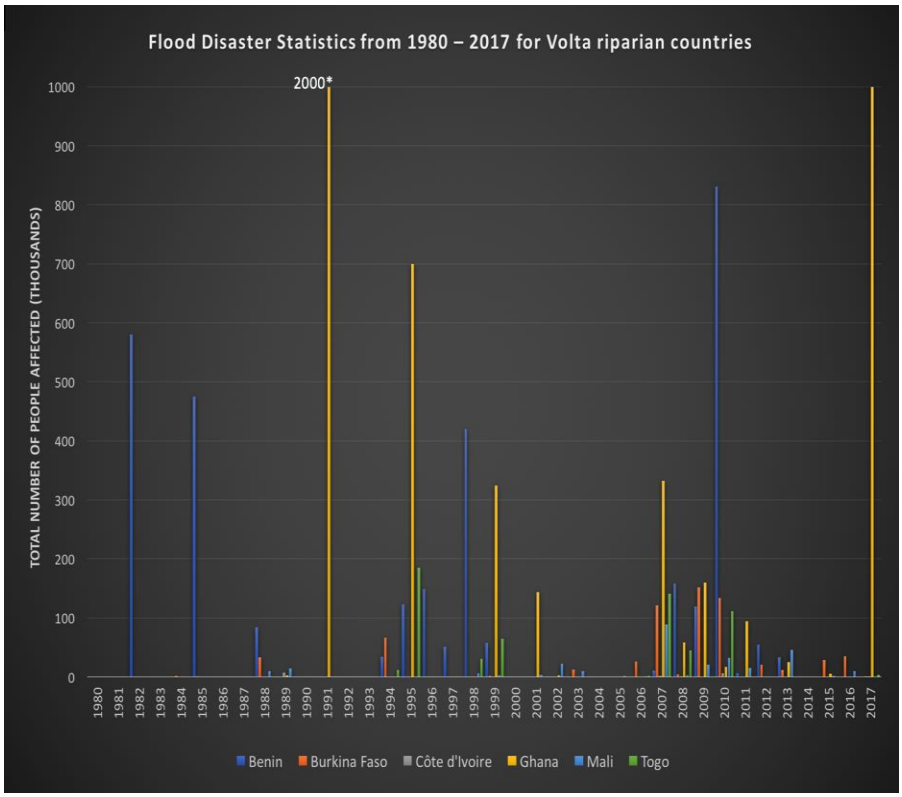
Table 6. Drought Disaster Statistics from 1970 – 2017 for the Volta countries

Year	Country	Total number of people affected
1971	Ghana	12 000
1971	Togo	150 000
1972	Benin	115 000
1977	Burkina Faso	442 000
1980	Burkina Faso	1 250 000
1980	Mali	1 500 000
1983	Benin	2 100 000
1983	Ghana	12 500 000
1988	Burkina Faso	200 000
1988	Benin	270 000
1989	Togo	400 000
1990	Burkina Faso	2 600 000
1991	Mali	302 000
1995	Burkina Faso	75 590
1998	Burkina Faso	20 700
2005	Mali	1 000 000
2006	Mali	25 000
2010	Mali	600 000
2010	Benin	680 000
2011	Mali	3 500 000
2011	Burkina Faso	2 850 000
2014	Burkina Faso	400 0000

Source: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium. Created on: December 07, 2017.

Table 6 shows Drought Disaster Statistics from 1970 to 2017 for the six riparian countries. In 1983, severe droughts affected 2.1 million people in Benin and 12.5 million people in Ghana. According to the information gathered, from 1970 to 2017, more than 33.6 million people were affected in the Volta Basin countries.

Figure 4 gives the Flood Disaster Statistics from 1980 to 2017 for the six Volta riparian countries.



* The value is 2000.

Figure 4. Flood Disaster Statistics from 1980 -2017 for the six Volta riparian countries[30]

Floods have been recorded in various parts of the riparian states of the Volta Basin and their impacts are reflected on three levels as:

- *Social*: loss of human lives and livelihoods, destruction of houses leading to homeless vulnerable people, with possible outbreak of epidemics and trauma by the victims;
- *Economic*: destruction of crops, loss of livestock, reduction of agro-processing activities thereby limiting trade opportunities etc.;
- *Infrastructure*: destruction of runways, bridges, roads, water and sanitation facilities, and other infrastructures, such as schools and health centres.

Benin

Benin is facing more and more recurring floods since the late 1980s. These floods, which are reported each year in the basins of Ouémé, Niger, Pandjari and Mono, affected in 2010 nearly 831,000 victims, 150 000 of them became homeless. According to the Post-Disaster Assessment Report of the 2010 floods in Benin, the economic impacts of the 2010 floods would amount to 127 billion FCFA. As for damage (assets, infrastructures, stocks ...), they are estimated at nearly 78.3 billion FCFA; and the losses (reduced flows, production losses, reduced turnover, costs and expenses incurred as a consequence of the disaster) estimated at nearly 48.8 billion FCFA...".

[30] EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium. Created on: December 07, 2017.

The flood events in the NPVB are recorded almost every year locally at the village, municipal and even intercommunal level. The areas at high risk of flooding represent approximately 32% of the basin area and are located northwest of the sub-basin, particularly on sedimentary formations with a high density of drainage, where agglomerations and crop areas are concentrated, i.e. 33% of the crops cultivated areas. Populations in Atacora-Donga departments' high flood risk zones are potentially vulnerable to flooding due to poverty, food insecurity and lack of access to drinking water, road and sanitation infrastructure.

Togo

Between 1925 and 1992, Togo was affected by 60 urban and rural floods that caused property damage and loss of life[31]. The years 2007, 2008, 2009 and 2010 were particularly marked by floods with disastrous social and economic consequences for the country. During these years nearly 300,000 people were affected by floods. Losses in human lives (68 deaths) have been recorded, as well as the massive destruction of road infrastructure, buildings (homes and workplaces) and fields. These phenomena, previously located mainly south of the Lake Togo basin and part of the Volta Basin (North Oti sub-basin), have become widespread in recent years throughout the country.

The floods within the Togolese part of the watershed are often recurrent. These floods mainly affect the communication routes (tracks, roads, etc.), often isolating some localities throughout the rainiest months, but also areas of food crops cultivation. The stagnation of surface water during these periods of flooding leads to the proliferation of insects, malaria and water-related diseases such as diarrhoea, cholera and guinea worm. The numerous floods induce various negative consequences: land degradation, loss of biodiversity, proliferation of aquatic plants, degradation of water quality, silting up of water courses, the degradation of aquatic ecosystems, erosion and soil depletion.

Côte d'Ivoire

In Côte d'Ivoire, floods events in the last ten years, largely located in the city of Abidjan, have disrupted the living conditions of the resident populations in the flood zones. For example, the most remarkable socio-economic impacts are the loss of 25% of the banana production of one of the major Ivorian companies. Indeed, between 28 and 30 June 2014, Agnéby, the coastal river that borders the plantations of Nieky (west of Abidjan), overflowed its bed and destructed 1,300 hectares of banana plantations. According to the information gathered, from 1996 to 2017, more than 149 people lost their lives following the floods.

On the contrary, the Volta Basin area in Côte d'Ivoire is almost not affected by flooding. A case of urban flooding was reported in the Bondoukou department in Tagadi and Campement, due to extreme rainfall and probably to poor drainage of rainwater.

Mali

The floods in Mali, generally due to the overflow and flooding of rivers and streams, the failure of drainage systems but also the irrational occupation of space by the population, have occurred fifteen times in 30 years, affecting between 1,000 and more than 88,000 people at each event. On August 28, 2013, they caused 56 deaths with a lot of material damage in Bamako. In 2010, they caused 110 deaths; 6,052 homes destroyed; 12,000 hectares of flooded fields and the destruction of roads and bridges in the country.

[31] GWP West Africa, 2016. Evaluation des besoins de renforcement des capacités, Togo.

According to the 2010 UNEP-FEM report "Transboundary Diagnostic Analysis of the Volta Watershed: Mali National Report", the floods have considerable socio-economic impacts in the basin. These impacts are:

- impoverishment of the population through the reduction of production due to the loss of cultivable land in the lowlands;
- loss of medicinal plants due to the disappearance of certain species of plants from the Samori forest;
- increased potential for conflict in the exploitation of the few remaining lowlands for crops and resources;
- increased migration of populations in search of new lands favourable to lowland crops;
- reduced food security.

Burkina Faso

Sahelian country, Burkina Faso offers a context of development very vulnerable to the risks of natural disasters including floods. The country was ranked as the 24th most vulnerable nation by "the Global Leaders for the Tomorrow Environment Task" et al, 2002.

For the period 1980-2017, the floods have made more than 93,000 homeless and caused about 172 deaths. In addition, more women were affected by the disaster than men. The three (3) major floods that the country experienced between 2007 and 2010 affected nearly 400,000 people and caused about 77 deaths. From 31st August to 1st September 2009, torrential rains caused severe flooding in Burkina Faso's capital, Ouagadougou. All five neighborhoods in the district were affected, as well as other nearby regions. The government estimated that approximately 150,000 people were affected by the floods (10% of the capital's population). Significant damage was incurred on infrastructure, agriculture, livestock and housing[32]. These floods cost almost 2% of GDP. They result in both a significant loss of income and fewer investments to improve the livelihoods of the country's population, 78% of them living in the Volta Basin. For the period 2009 to 2015, the year 2010 represents the year that required the most financial resources for assistance to flood victims. According to the Ministry of Economy and Finance, beyond the disaster assistance, the impact felt in 2010, in terms of reconstruction activities as a share of the fiscal weight, accounted for 1.5% of the estimated GDP level after the floods. The budget deficit persisted for the next four years.

In 2016, heavy rainfall, started in June and continued until 23 July, led to widespread flooding across four of the 13 regions in the country. It is estimated that up to 10,260 people have been affected, with 10 injures and 4 deaths also reported[33].

Ghana

In the National Part of Volta basin in Ghana, the worst flood was recorded on 6 September 2009 in the White Volta basin after water level rise as a result of heavy rainfall forcing water from the Bagre dam to be spilled[34]. Prior to this flood event, some flooding had been experienced in the White Volta in September 2007 and 2008[35]. In 2007 event, the three Regions of Northern Ghana (Upper West, Upper East and Northern Regions) were impacted by the floods resulting in over 300,000 people being affected[36].

[32] Global Shelter Cluster, 2011. Review of the IFRC-led Shelter Cluster Burkina Faso September 2009 Floods Response.
[33] International Federation of Red Cross and Red Crescent Societies, 2016. Emergency Plan of Action (EPoA), Burkina Faso: Floods.
[34] Amoah, M., 2011. Nationalism, Globalisation and Africa. Palgrave Macmillan, Macmillan Publishers Limited, England.
[35] GWP and VBA, 2014. Final Report on 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 related ecosystems.
[36] Asumadu-Sarkodie, S., Owusu, P. A., and Rufangura, P., 2015. Impact analysis of flood in Accra, Ghana. Advances in Applied Science Research, 2015, 6(9):53-78.

On September 10, 2010 due to prolonged flooding as a result of the heavy rainfall and the spilling of the Bagre dam, 17 people lost their lives, 3,234 houses from 55 communities collapsed, 23,588 farmers had their farmlands destroyed, 1109 ruminants were carried away, and 25,112 people displaced in the Central Gonja District of the Northern Ghana. In June 2015, although not directly as a result of floods in the Volta basin, more than 100 people lost their lives in Accra after a two-day heavy rainfall over the capital city, coupled with the explosion at a petrol station located at Kwame Nkrumah Circle in Accra.

Future climate change

Temperatures in Africa are projected to rise faster than the global average increase during the 21st century. Under current IPCC future scenarios[37], temperature projections over West Africa for the end of the 21st century from both the CMIP3 GCMs (SRES A2 and A1B scenarios) and CMIP5 GCMs (Representative Concentration Pathways RCP4.5 and RCP8.5) range between 3°C and 6°C above the late 20th century baseline (Figure 5). Regional downscaling produces a similar range of projected change.

As shown in Figure 5, West African precipitation projections show inter-model variation in both the amplitude and direction of change that is partially attributed to the inability of Global Climate Models (GCMs) to resolve convective rainfall. However, Regional Climate Models (RCMs) can alter the sign of rainfall change of the driving GCM. The recent regional model studies suggest that over West Africa both the number of dry and intense rainfall days during the boreal summer are projected to increase indicating that the summer rainfall will be delivered in fewer, but more intense event[38].

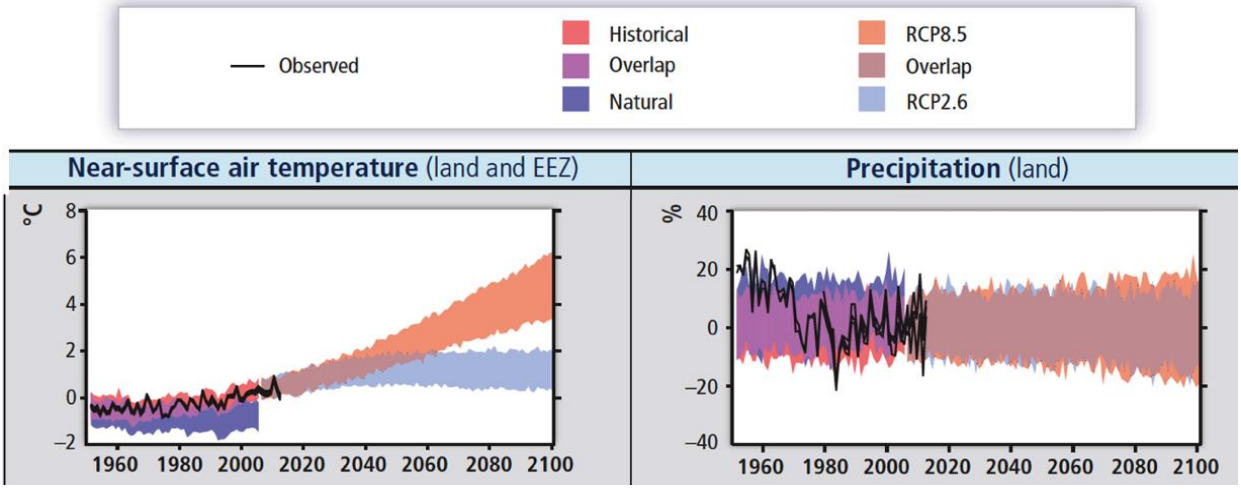


Figure 5: Observed and simulated variations in past and projected future annual average temperature over Economic Community of West African States (ECOWAS)[39]

As shown in Figure 6, the number of extreme rainfall days increases by 10%-30% between April and October, with the largest changes in June (i.e., +0.7 day) and August (+0.45 day), which are statistically significant at the 90% and 80% intervals, respectively.

[37] IPCC, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22: Africa.
[38] Vizy, E.K. and K.H. Cook, 2012. Mid-twenty-first-century changes in extreme events over northern and tropical Africa. Journal of Climate, 25(17), 5748-5767.
[39] IPCC, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22: Africa.

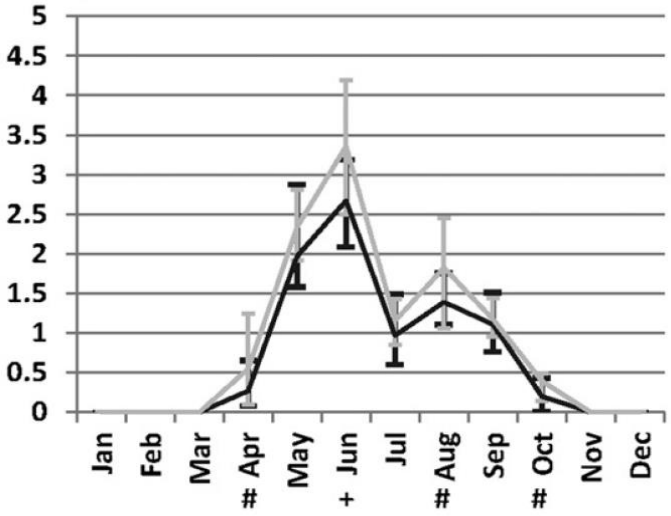


Figure 6: The late twentieth century 1981-2000 (black line) and the mid-twenty-first century 2041-2060 (gray line) ensemble mean average number of extreme heavy rainfall days per month for the West Africa region[40]

Furthermore, an increase in drought intensity and frequency is projected over the Volta River Basin[41]. Figure 7 shows that drought frequency (event per decade) may be increased by a factor of 1.2 (2046-2065) to 1.6 (2081-2100) compared to the present-day episodes in the Basin.

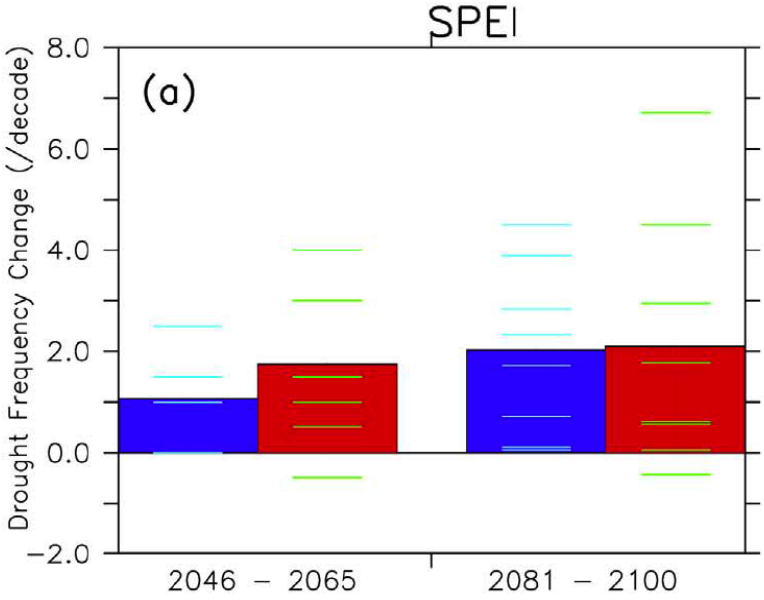


Figure 7: Projected changes in drought frequency per decade for Standardized Precipitation and Evapotranspiration Index (SPEI) over the Volta Basin for RCP4.5 and RCP8.5[35]

[40] Vizy, E.K. and K.H. Cook, 2012. Mid-twenty-first-century changes in extreme events over northern and tropical Africa. Journal of Climate, 25(17), 5748-5767.
[41] Oguntunde, P.G., et al., 2017. Impacts of climate change on hydro-meteorological drought over the Volta Basin, West Africa. Global and Planetary Change 155 (2017) 121-132.

Future effects of climate change

Africa's food production systems are among the world's most vulnerable because of extensive reliance on rainfed crop production, high intra- and inter-seasonal climate variability, recurrent droughts and floods that affect both crops and livestock, and persistent poverty that limits the capacity to adapt[42]. Weather-related crop failures, fishery collapses, and livestock deaths in addition to losses of property are already causing economic losses and undermining food security in West Africa. With the highest rates of population growth, this situation is likely to become more desperate as global warming continues.

Certainly, decreased precipitation and an increase in temperature will pose tremendous challenges to farming and related livelihoods. High temperatures above the ranges tolerated by crops will definitely affect the physiology of plants, including staple crops in the region, with consequences of decreased productivity that will affect food production. This situation could be aggravated by genetic erosion due to the inability of plants to survive harsh conditions. Similarly, animal production, including livestock and fisheries, could be adversely affected[43].

On the other hand, a drastic increase in rainfall in hitherto dry areas could pose serious challenges to adaptation and the conservation of biodiversity, at least in the short run. Increased humidity and flooding could threaten the existence of plants and animals adapted to dry conditions in the Sahel. The mosquitoes and tsetse flies that transmit the pathogens that cause malaria in human beings and sleeping sickness in cattle, respectively, abound in humid conditions. An increase in rainfall in the Sahel could pose a serious threat to the cattle industry, with a need to adjust the prevailing farming system[44].

The climate of the Volta Basin is predominantly semi-arid and sub-humid, hence the potential evaporation in this semi-arid climate exceeds precipitation. Higher temperature will result in an increased evaporation from the crops. It will also dry reservoirs impacting the river basins water balance. Climate change could cause reduction in groundwater recharge between 5 and 22% by the year 2020, and for the year 2050 reduction is projected to be between 30 and 40%. Furthermore, irrigation water demand could be considerably affected by climate change. For the dry interior savannah, increases in irrigation water demand are about 150% to 1200% for 2020 and 2050 respectively[45].

In the case of Ghana, the three main aspects identified during the assessment phase conducted in 2016 with the six countries and that might be impacted are[46]:

- *Water*: Simulations using projected climate change scenarios suggested reduction in river flows of between 15 and 20% and 30 and 40% for the year 2020 and 2050 respectively in all river basins.
- *Agricultural crops*: Potentially high temperatures, along with decreased precipitation, could have serious implications for the yield and production of major food security crops like maize, rice, and groundnuts.
- *Coastal flooding*: With a quarter of the population living below the 30-meter level, an estimated sea level rise of 1 meter by 2100 could inundate 1'120 km^2 of land and put 132'000 people at risk.

[42] IPCC, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22: Africa.
[43] International Food Policy Research Institute, 2013. West African Agriculture and Climate Change.
[44] International Food Policy Research Institute, 2013. West African Agriculture and Climate Change.
[45] Climate Change Adaptation through Integrated Water Resources Management (IWRM) in the three Northern regions of Ghana (DANIDA-WRC).
[46] Institute for Security Studies, 2008. Available at: http://www.iisd.org/pdf/2008/asr_vol17_no3_climate_west_africa.pdf.

During the same assessment phase, the four main consequences of climate change have been stressed out for Burkina Faso:

- *Water*: A projected increase in the frequency of heavy rains and flooding is expected to lead to widespread erosion and siltation along each of Burkina Faso's four basin slopes. When combined with projected decreases in overall rainfall, this will result in reduced run-offs by 2050, ranging from 30% for the Nakanbé basin to 70% for the Mouhoun basin.
- *Agriculture*: Average annual rainfall could drop by 3.4% by 2025 and 7.3% by 2050. For an economy, heavily dependent on rain-fed agriculture, such a drop will have significant impacts for crops and planting cycles across the country. There have already been declines in cotton, maize and yams production in the south as a result of drought.
- *Stockbreeding*: An expected rise in temperature of 1.7°C by the middle of the century will, combine with decreased rainfall, reduce the drinking points open to stock breeders. Floods are expected to supplement these threats by killing livestock.
- *Forestry/fisheries*: Increased erosion and siltation are expected to damage land and water ecosystems, while land clearing is expected to continue apace, due to rainfall pressures.

The future effects of climate change will therefore mainly affect people living in the agricultural sector and in urban areas[47,48,49]:

1) **People working in the agricultural sector** (estimated to 16 million people over the basin such as farmers, pastoralists, fishermen) that accounts for 40% of the basin's economy output. More than two third (around 68%) of the 24 million people living in the basin are largely dependent on agriculture, which is mainly rain-fed, poorly mechanized and consists of small family farms that are particularly vulnerable to climate change impacts, especially risks of drought and floods. This vulnerability is caused by high dependence on rain-fed agriculture but also the low levels of data and information, in addition to the prevalence of poverty and the relatively low capacity of the governments and communities to adapt.

   The projected temperature increase and rainfall decrease will result (and some impacts are already visible) in crop failure and loss of livelihoods for farmers that practice rain-fed and flood recession agriculture (majority of them in the basin).

   In Mali for example, in the Sourou Bassin (national portion of the Volta Basin in Mali), local activities (agriculture, livestock farming and fishing) are completely dependent on the Sourou floods due to the extreme poverty of local communities. However, rainfall have been irregular which directly impact local economic activities. Farmers cannot stock cereals which hinder financial and food security stability. They often choose crop diversification and exodus to cities as adaptation strategies.

   Other major impacts will include higher food prices and inflation in riparian countries, in addition to outbreak of diseases such as malaria, water-borne diseases (e.g. cholera, dysentery, etc.) associated with floods, and respiratory diseases associated with drought.

2) **Poor people living in areas at risk in cities.** Due to the lack of land-use planning and alternatives, people affected by poverty mostly live in areas at risk such as valley floors and slopes, particularly vulnerable to floods and landslides. This population can be estimated to a 10% of the urban population, therefore not far from 1 million people over the basin. As an example, during the September 2009 floods in West Africa, 150,000 people in Ouagadougou (Burkina Faso) were affected by floods, following the heaviest rainfall seen

[47] Volta Basin Authority, 2014. 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.
[48] Available at: http://iwlearn.net/resources/documents/2481.
[49] GWP West Africa, 2016. Country Needs Assessment Report, Ghana.

in the country's capital in 90 years. As floods are predicted to become more severe and frequent with climate change, more people will be at risk in the cities of the Volta basin.

Targeted Project Areas and beneficiaries

In the Volta Basin, extreme weather hazard and climate change affect people on various spatial, temporal and social scale. By alleviating the impact of drought and flood hazard, the project will benefit the overall population of the basin, in particular the Early Warning System will be designed to reach the civil security services and other private and public stakeholders concerned by extreme events, but the general public as well. More specifically, the groups of people who will most directly benefit of the project outputs are related to the types of activity: 1) new tools developed for risk reduction, such as flood and drought risk maps and Early Warning System, and climate change adaptation measures, 2) testing of the EWS on pilot areas, 3) capacity building activities integrated into the three components of the work programme.

Phase 1: In the Volta basin, flood hazard has been mostly reported either as pluvial flood linked to high rainfall precipitation or as riverine flood. The flood risk maps should therefore be developed for the overall surface of the basin to account for possible pluvial floods and more particularly for the floodplains to be prepared for fluvial floods. Drought on the other hand can affect any part of the basin. Through the development of the risk maps and EWS, the programme will therefore provide new information for a large part of the population. The expected beneficiaries of the new tools within the six countries range from:

1. National Meteorological and Hydrological Services (some 500 persons for the six countries), who will be contributing to the development of the tools, providing improved or new services but also gaining in capacities and means of actions;
2. Emergency, Civil protection authorities and Disaster Management Services (estimated from 500 to 1000 persons over the basin), who will be integrating the new risk maps and warnings into their procedures and crisis management;
3. National authorities of the six countries and related departments (estimated to 200 persons) such as Health, Water, Irrigation and Agriculture;
4. Social Institutions such as schools, hospitals, fire stations etc. (estimated to several thousands of people over the basin), who will be able to prepare or improve their emergency plans;
5. Non-governmental organizations (NGO's), International Non-governmental organizations (INGO's) (estimated to several hundreds of persons), who will either directly use the new information to improve their resilience capacity and adaptation or transfer to their partners;
6. Community-based organizations, farmer and fishermen associations, in particular women groups etc. (estimated to some thousands of persons over the basin) who will be using the new tools and methodologies to decrease their vulnerability to extreme events;
7. Managers of industrial sites (estimated to several thousands of people over the basin), who will be able to draw emergency plans and build more resilient infrastructures;
8. Community individuals of urban and rural areas especially youths who are more familiar with Information Technologies (potentially the whole population of the basin, but in a first stage, estimated to only a 1 to 5%, therefore up to 1 million persons) who will upload the applications, get warning messages and possibly contribute to crowdsourcing.

Phase 2: A series of pilot testing on the dissemination, use and feedback of the flood and drought Early Warning System will be conducted during the monsoon and dry season for selected target areas, which involve representatives of the major groups of beneficiaries. Eight pilot tests areas that could be studied during year 2 and 3 of the programme have been identified on the basis of several criteria (final selection will be performed during the course of the programme):

- agricultural or urban areas on which collaborations are already established with communities and groups of citizen for example in the field of water resources management, land planning, risk reduction, exercises with civil security, any project related to the participation of citizens and communities;
- agricultural or urban areas that have been affected by extreme events (drought or flood);
- areas where Early Warning Systems have been set up (by previous projects) and are being used;
- preferably areas with mobile network coverage or with a good telecommunication system;
- areas where the effect of extreme events is known, or supposed, to be affected by dam operations.

Table 7: Pilot tests location for the flooding and dry season

Location of pilot sites	Estimation of the number of people participating to the pilot testing exercise	Criteria for selection
Ouagadougou, Burkina Faso	50 - 100	Ouagadougou is the capital of Burkina Faso where are concentrated 70% of the industrial activities of the country with a population of 1.5 million inhabitants. In 2020 the capital is expected to reach 3.4 million inhabitants, making it one of the most rapid growing cities in the region. 50% of the population live in poor conditions. Women are particularly exposed, with less access to education, employment and land. The extension of flood prone areas in Ouagadougou is very large due to its flat topography. In 2009, Ouagadougou experienced the worst flooding event in the last 50 years. An estimated 150'000 people were affected. Significant damage was incurred on infrastructure, agriculture, livestock and housing. In flood prone area the people's decisions on urban development seem to be conditioned by poverty and not by their level on risk knowledge.
Bagré dam, Burkina Faso	30 - 50	Bagre Dam is a multipurpose dam on the White Volta located near Bagré Village in Burkina Faso. The dam provides gravity-fed irrigation to some 1'440 hectares of prime agricultural land and 10% of the country's electricity insuring the energy and food security of Burkina Faso. The release or spilling of the dam is controlled and information about the spilling is shared with Ghana and therefore the downstream inhabitants
Centre-Nord Region, Burkina Faso	50 - 100	In early 1970s, Burkina Faso suffered from a series of drought periods, with devastating consequences for the inhabitants of the whole region. In the early 1980s, 14 out of 18 households in the village of Oualaga (Centre-Nord Region) had a food deficit of more than 50%.

Akosombo dam, Ghana	20 - 50	The Akosombo Dam was constructed to supply electricity from the Volta River for industry and to supply power to the towns and cities of Ghana and neighbouring countries. The Akosombo dam is still Ghana's major source of electricity. Demand for power continues to increase in the country, especially within the urban-industrial sector. Low water levels in the Akosombo dam in 1998 caused a major energy crisis in Ghana, which may have been caused purely by weak capacity to forecast extreme weather phenomenon. In 2017, the Akosombo dam contributed to 30% of the energy requirements of the countries. This is also due to low levels of water in the dam.
Upper East Region (UER), Ghana	50 - 100	Upper East Region has the highest proportion of poor people in the country who depend on climate-sensitive livelihoods, especially agriculture. Agriculture engages about 80% of the economically active population. UER borders Burkina Faso and is the first area to flood following the opening of Burkinabe dams which occur almost every year. It has also been shown to be more vulnerable to single hazards and less food secure than other parts of Ghana. In the 2007, all eight districts of the region were hit by floods affecting more than 40'000 people, damaging more than 11'000 homes (most of them were completely destroyed). A UNICEF team estimated that 8'000 to 10'000 people were displaced in six of the region's eight districts. Furthermore, the floods destroyed crops and washed away 12'220 hectares of farmland.
Sourou, Mali	40 - 80	In Mali, the Sourou Basin, classified as RAMSAR site, has a population of 668'000 inhabitants (mostly young and rural). The plain of Sourou has undergone major hydro-agricultural development: more than 3'800 ha of land are managed in total water control and operated by more than 3'000 producers. The Sourou Basin has a total economic value estimated at 19.85 billion FCFA. Among the goods and services identified, land resources are the most important in the area and provide in monetary terms nearly 30% of the resources of the valley. Although fishing is considered a very important activity in the area, its contribution to total economic value is only 10%.
Oti River, Togo	20 - 50	Seven communities of the Oti River Basin in Togo are the poorest in the country with the poverty rate more than 90%. Their livelihoods are derived from subsistence farming, animal husbandry and informal labour, all of which are threatened by the impacts of climate change. Most of the dwellings are informal self-housing units, poorly planned and made of mud walls, wooden doors and windows. Consequently, many buildings collapse from the force of the flood water. Heavy rainfall in September 2007 caused the worst flood that Oti River Basin had ever faced. According to the International Federation of Red Cross and Red Crescent Societies (IFRCRCS), by September 2007, 25 people were killed and 97 people were critically injured. In recent years, the most damaging floods were experienced in 2008, 2010 and 2012.

National Part of Volta Basin (NPVB), Benin	20 - 50	The flood events in NPVB are recorded almost every year locally at the village, municipal and even intercommunal level. The areas at high risk of flooding represent approximately 32% of the basin area and are located northwest of the sub-basin, particularly on sedimentary formations with a high density of drainage, where agglomerations and crop areas are concentrated, i.e. 33% of the crops cultivated areas. Populations in Atacora-Donga departments' high flood risk zones are potentially vulnerable to flooding due to poverty, food insecurity and lack of access to drinking water, road and sanitation infrastructure.

The pilot testing will provide the opportunity to train communities and agencies during virtual flooding or drought situations which will help to assess the effectiveness of the EWS. The results of the exercises will provide lessons learnt and will allow to identify gaps and challenges to improve the system and services. The knowledge gained by the communities and agencies will be helpful to implement similar activities with other stakeholders. The pilot testing communities (100-150 at each site including women and youths) and agencies (10-20 at each site working in disaster management, civil protection, irrigation department, CBO's, NGO's) are expected to disseminate this knowledge and skills in other areas, inside or outside the basin, where floods and drought management are also of growing concerns.

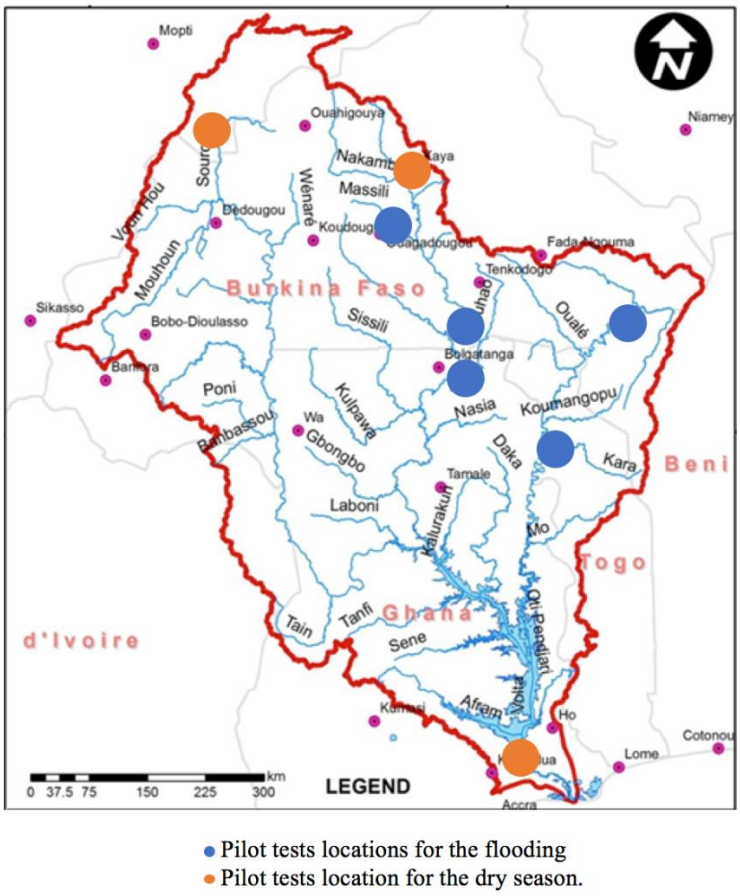


Figure 8: Volta Basin region for which Flood and Drought risk map will be developed

Phase 3: Capacity development activities will be carried out for both agencies at local/national and regional level and communities which are affected by floods and drought events during the different phase of the programme. An estimation of the number of people who will benefit of the capacity development activities is provided in the next Table along with the types of participants (men, women, elderly, youths etc.) from the institutions, agencies, organisations and communities.

Through 3 cycles of sessions, the capacity building activities are planned to reach some 200 representatives in each of the six countries and from the regional agencies. Some of these training sessions will be organized on the same areas and with the people involved in the pilot testing:

- Extreme events, risks maps and climate change adaptations
    - Vulnerability Capacity Exposure and Risk assessment and information on VCER's database;
    - Floods and drought risk maps development at national and transboundary level;
    - Information on future social and environmental risk scenarios and risk management strategies.
- Early Warning System for floods and drought and measures to reduce risk
    - End-to-End Early Warning System;
    - dissemination of early warnings to agencies, communities and citizens;
    - Natural and nature-based solutions for floods considering ecosystem sustainability.
- Governance
    - Mainstreaming Gender in Flood Management;
    - Identification of gaps, and needs for the long-term strategies for floods and drought management and climate change adaptation by local and national stakeholders of six countries;
    - Revision, or development, of plans, policies and guidelines for risk reduction in the view of future climate change by national and regional policy-makers.

The purpose of the training sessions is to raise awareness about the added-value of the tools and methodologies developed during the programme, but also to identify participants who will be able in the future to carry out similar exercises or workshops with other stakeholders. It is also foreseen to plan visits of the pilot sites that could be led by local agencies for non-target communities, where they will interact and learn from each other experiences. Communication using social media, radio, television etc. will be used to inform about the experience of the pilot tests to spread awareness and knowledge over in the region.

Project Objectives:

The main objective of the Flood and Drought Volta programme is to assist the six countries in **the implementation of coordinated and joint measures to improve** their existing management plans at regional, national and local level and to build on the lessons learned from the past and current projects related to **disaster risk reduction and climate adaptation**. The six riparian countries will therefore benefit not only from a **basin-wide transboundary management framework to ensure long-term environmental and economic development, as well as concrete solutions** to alleviate a potential increase of vulnerability and to build an effective network of actors. As droughts and floods are a common feature in the Volta basin region, integrated water resources management, **risk maps and development of early warning systems must be implemented to increase resilience to floods and droughts** and ensure socio-economic sustainable development. Equilibrated management of the water resources will be sought to make better use of the water surplus during floods to be stored in view of drought events. Furthermore, at local scale, agricultural production will be tailored to these challenges with provision of knowledge and early warnings that will enable farmers to adapt their production

methods. To respond to the needs expressed in 2016 by a large number of stakeholders, the programme will include **the selection and implementation of appropriate End-to-End Early Warning Systems for Floods and Drought allowing integration of short-term to seasonal indicators into the long-term management framework**. The system will embed both hazards that will be forecasted using different methodologies (indicators using different criteria to assess risk; hydrological and hydraulic models informing on threshold level; maps showing levels of risk through color-coding). As per the dissemination of warnings, existing systems (e.g. on White Volta and Oti basin) will be implemented within a common platform. The system will be built on the basis of open-source codes and free technologies, future integration of modules covering additional natural and health hazards will be foreseen to allow its upgrading towards a Multi Hazard Early Warning System.

The Volta programme has the ambition to provide the first large scale and transboundary implementation of Integrated Flood and Drought Management strategies by empowering the National Meteorological and Hydrological Services (NMHS) and other competent authorities of the six riparian countries with robust and innovative solutions for disaster risk reduction and climate adaptation, including green solutions and gender sensitive participatory approaches. Existing local and national hydrological modelling systems, decision support and early warning platform will be integrated into the transboundary Early Warning System.

The programme will tackle climate adaptation issues, ensuring transversal solutions from governance to technical and decision making. It will develop the underlying capacity of national and regional institutions to maintain long-term sustainability and to scale up the results. It will support stakeholders at all levels by providing **policy and management guidance and by sharing scientific information, knowledge and best practices for Integrated Disaster Risk Reduction and Climate Adaptation**. One main purpose will be to support the implementation of the Memorandum of Understanding (MoU) between VBA and the six riparian countries to promote data sharing, which is currently not sufficiently structured and demand-driven.

The Volta programme is aligned with the Adaptation Fund objective to ***"reduce vulnerability and increase adaptive capacity of communities to respond to the impacts of climate change at local, national and regional level".*** Implementing climate adaptation strategies and improving the management of water resources is recognised by the six riparian countries as one of the major challenge facing national services and the transboundary Volta Basin Authority. The integrated approach at the scale of hydrological basin ensures that the existing knowledge and resources benefits from a global and unified framework and that further improvements can be more effectively integrated into a common structure. It provides a powerful tool to foster collaboration and exchanges of experiences to national partners, and to the Volta Basin Authority, as any action on the basin at short (due to crisis events) or longer term (due to climate change impact) influences the future socio-economic development of the six countries.

A scheme of the rationale and sequence of the programme phases is presented in Figure 9 to illustrate and summarize how the activities proposed in each of the components contribute to solving the main issues affecting the region.

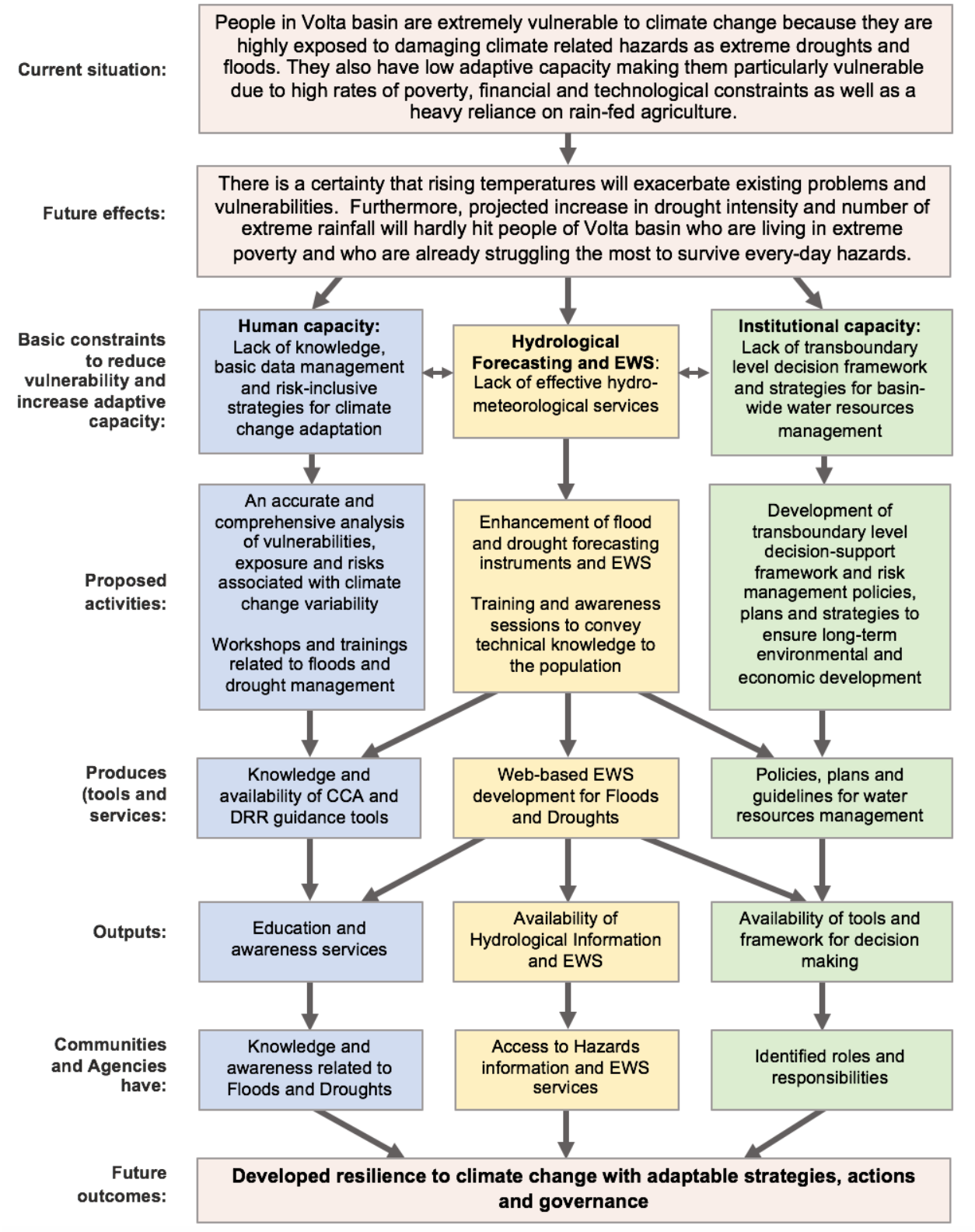


Figure 9: Schematic representation of the Volta programme framework

Project Components and Financing:

Currently, the institutional arrangements for managing the water resources of the transboundary rivers of the Volta basin are lacking or not enforced. This will change with effective synergy and coordination between the Volta Basin Authority and the regional, national and other basin institutions. The separate approach of the respective countries leads to non-integrated management of water resources increasing the risk of water scarcity, land and natural ecosystem degradation.

Over the Volta Basin, flood forecasting and early warning systems have until now been developed only for the White Volta (Ghana) and Oti (Togo and Ghana) sub-basins through the World Bank supported projects. A large part of the whole basin is therefore still needing some type of warning procedure to organize actions between the technical institutions in charge of assessing extreme hazards, the National Meteorological and Hydrological Services (NMHS), the institutions in charge of disaster civil security and the communities and citizens at risk. This means therefore that the technical capacities to develop and run the models must also be developed, on the basis of the Ghana experience. Depending on the responsibilities and capacities of the Meteorological Service/Agency and the Hydrological Service in the six countries, the development and maintenance of the forecasting tools could be assigned at the regional level to the Volta Basin Authority.

Coordination and communication within the agencies and communities on issues of floods and drought must be improved by developing the appropriate information services, radio programmes, websites and mobile platforms. Furthermore, communities should trust and follow the official messages from their national or regional centres. As the most effective way of communication is through mobile platforms, national institutions should explore the use of multiple channels of communication.

Several aspects must be defined and implemented in order to foster appreciable level of participation from communities and citizens into flood, drought and environmental management. Besides Legal Instruments and operational procedures to support integrated water resources management in the Volta Basin, additional non-structural measures, such as development of risk culture, education, capacity building, next to natural and nature-based solutions should be implemented with the involvement of the stakeholders to increase climate resilience of the population.

Project Components	Expected Outcomes	Expected Outputs	Countries	Amount (US$)
Component 1: Develop capacity and established frameworks at the local, national and regional levels to ensure risk informed decision-making	**Outcome 1.1**: Improved knowledge of risks, climate change impacts and risk management capacities through knowledge sharing and participatory mechanisms	**Output 1.1.1**: Inventory of information on vulnerabilities, capacities, exposure and risks (VCERs) for floods and drought in the Volta Basin is conducted	Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo	1'500'000
		Output 1.1.2: Database of VCERs, floods and drought related risk maps are developed		
		Output 1.1.3: Capacity of stakeholders to use Floods and Drought risk maps is enhanced		
		Output 1.1.4: Reports and communication documents on		

		vulnerabilities, capacities, exposure and risks (VCERs) and Floods and Drought risk maps of the Volta Basin are available		
	Outcome 1.2: Bridging the gap in adaptation measures to integrate future scenarios (economic, urban, climate, environment etc.) into current practices and knowledge	**Output 1.2.1**: Scenarios for socio-economic and environment development along with the climate change projections are collected		
		Output 1.2.2: Projected impacts on water resources, urban development and agricultural areas are analysed on the basis of future scenarios		
		Output 1.2.3 Impact on environmental indicators is evaluated for current and future scenarios		
	Outcome 1.3: Risk management strategies in short, medium and long-term to be integrated into development plans (economic, social, environmental aspects)	**Output 1.3.1**: Guidance documents for stakeholders are developed to raise awareness about the future scenarios		
		Output 1.3.2: Capacity of stakeholders to use future scenarios and to develop action plans is enhanced		
Component 2: Develop concrete adaptation and environmentally friendly actions with an integrated approach	**Outcome 2.1**: Improved flood and drought forecasting instruments and Early Warning Systems (EWS) and coordination at the transboundary level to reduce disaster risks in vulnerable communities	**Output 2.1.1**: Needs and existing resources of national and regional agencies staffs for web-based EWS are defined	Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo	4'000'000
		Output 2.1.2: The operational centre for the VoltAlarm Early Warning System is established in synergies with the NMHSs and the Volta Basin Authority		
		Output 2.1.3: The historical and real-time hydrological data from the gauging stations are collected and the procedure to link with the meteorological data is defined		
		Output 2.1.4: Thresholds for Floods and Drought risk levels are selected for the various parts of the Volta Basin and linked with environment thresholds		
		Output 2.1.5: The procedure for producing impact based forecasts for the sub-basins and vulnerable areas on a daily basis is defined		

		Output 2.1.6: The web-based Early Warning dissemination interface for VoltAlarm is designed		
		Output 2.1.7: Knowledge and awareness about VoltAlarm within the user groups are increased		
	Outcome 2.2: Demonstration of the added value of the E2E EWS VoltAlarm through a series of pilot testing during monsoon and dry seasons	**Output 2.2.1**: Pilot testing for a number of areas over the basin during the monsoon and dry seasons is performed		
		Output 2.2.2: Feedback from the series of pilot testing is collected		
	Outcome 2.3: Strengthened awareness of vulnerable people on hydro-meteorological risks, prevention, preparedness, and response strategies through education programs using participative solutions	**Output 2.3.1**: Knowledge and capacity development using the Flood Green Guide (FGG)		
		Output 2.3.2: Capacity development based on the Training Manual for mainstreaming gender in the E2E-EWS-F and flood management		
Component 3: Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels	**Outcome 3.1**: Decision support and policy development for strengthening resilience at the local, national and transboundary levels of the Volta Basin	**Output 3.1.1**: The transboundary governance plans, policies and guidelines about long term flood and drought management are evaluated	Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo	1'000'000
		Output 3.1.2: Awareness of policy-makers from the six countries on the key long-term strategies for floods and drought management and environmental impact is strengthened		
		Output 3.1.3: Experiences of local communities on key long-term strategies for floods and drought management are collected		
	Outcome 3.2: Strengthened capacities of actors and decision makers at national and transboundary level on long term	**Output 3.2.1**: Strengthened implementation of the revised, or new, climate adaptation plans (NAPA, NAP, NDC), policies and guidelines (on data and information exchanges) on issues related to risk reduction		

	risk management policies, plans and strategies	and EWS		
		Output 3.2.2: Improved integration of national policies on long term risk reduction and climate adaptation into the transboundary Strategic Action Programme		
	Outcome 3.3: A collaborative process is developed to ensure those instruments and strategies are accepted by the local organization and communities and adapted to the local context	**Output 3.3.1**: Collaboration with local communities and organizations in defining the procedures and measures to manage risks and to adapt to climate change		
		Output 3.3.2: Collaboration with local communities and organizations in finalizing policies and procedures to manage risks and to adapt to climate change		
Project Execution cost				750'000
Total Project Cost				6'500'000
Project Cycle Management Fee charged by the Implementing Entity				670'000
Amount of Financing Requested				**7'920'000**

Projected Calendar:

Project Duration: 4 years (48 months)

Milestones	Expected Dates
Start of Project/Programme Implementation	January 2019
Mid-term Review (if planned)	January 2021
Project/Programme Closing	January 2023
Terminal Evaluation	January/March 2023

PART II: PROJECT JUSTIFICATION

A. Description of the project components particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

The 3 components of the programme target 3 thematic areas identified by the partner countries in their recent needs assessment: 1) risk informed decision making from local to regional level, 2) development of integrated risk reduction and adaptation measures, 3) policy coordination and community capacity building at transboundary level.

Component 1: Develop capacity and established frameworks at the local, national and regional levels to ensure risk informed decision-making

In the Volta Basin region, integrated management of extreme hazards will help to reduce vulnerabilities and risks of the communities living in different socio-ecological contexts and relying on water resources to support their livelihoods and well-being. With population growth, limited resources, climate threats and the difficulties related to transboundary river basin management, vulnerabilities, exposure and risks related to extreme events of floods and drought have increased over the years.

Activities of the Component 1 are meant to identify and assess the current, and future, vulnerabilities, capacities, exposures and risks (VCERs). Floods and drought risk maps will be developed at local, national and regional level. Climate scenarios will be gathered and disseminated to the stakeholders, together with the risks maps, to study the possible impact of climate change on the current VCERs during capacity building sessions. This will provide opportunities to draw recommendations for integrating climate change adaptation approaches into the current disaster risk strategies.

Outcome 1.1: Improved knowledge of risks, climate change impacts and risk management capacities through knowledge sharing and participatory mechanisms

A warmer climate, with its increased climate variability, will modify the risk of both floods and droughts. Over the last decades, vulnerabilities and exposure to climate variabilities have increased in the Volta basin resulting in additional socio-economic impacts. Assessment of these varying changes will help in planning climate change adaptation solutions.

Output 1.1.1: Inventory of information on vulnerabilities, capacities, exposure and risks (VCERs) for floods and drought in the Volta Basin is conducted

Activities under output 1.1.1

Activity 1.1.1.1 Conduct a desk study (compilation of existing past data (topographic maps, satellite images etc.), studies of extreme events, reports of disasters, etc.) to gather available information on VCERs and identify gaps or additional needs

Activity 1.1.1.2 Develop an action plan to complement gathered information on the VCERs

Activity 1.1.1.3 Organize meetings with the relevant stakeholders working on risk management to select priority areas for community consultations

Activity 1.1.1.4 Conduct pilot field studies (focus group discussion and semi-structured interviews) with communities to identify the multi-dimensional drivers of vulnerability and risk (social, economic, ecological, cultural, political and infrastructural determinants of

vulnerability) in the Volta Basin areas highly exposed to different hydro-meteorological hazards

Activity 1.1.1.5 Draft the field studies reports and the Volta-atlas

Output 1.1.2: Database of VCERs, floods and drought related risk maps are developed

Activities under output 1.1.2

Activity 1.1.2.1 Assess the available IT equipment (computers, servers, databases, etc.) and IT/GIS expertise at the VBA observatory, the NMHSs services and other relevant services (e.g. Geographical Institute, Civil security, etc.). Purchase additional equipment if necessary

Activity 1.1.2.2 Create the Volta Basin information exchange IT network by connecting the VBA observatory and the national services

Activity 1.1.2.3 Develop the database and create the links with the existing databases for the collected information on VCER including the main driving hydro-meteorological parameters for floods and drought events (e.g. precipitation, water levels, temperature, soil moisture, soil type, etc.)

Activity 1.1.2.4 Develop web-based flood and drought risk maps using the VCER database and existing maps developed in Ghana through the past projects funded by the World Bank and the Global Environment Facility (see part G for more information)

Activity 1.1.2.5 Assign roles and responsibilities to the agencies and organisations to regularly complement and improve the database and risk maps

Output 1.1.3: Capacity of stakeholders to use Floods and Drought risk maps is enhanced

Activities under output 1.1.3

Activity 1.1.3.1 Organize training workshop for local professionals (hydrologists, disaster managers, GIS experts etc.) to convey knowledge and improve skills needed for using risk maps

Activity 1.1.3.2 Organize joint workshops for stakeholders to deliver knowledge on VCERs and Floods and Drought risk maps of Volta Basin and to gather feedbacks and suggestions for improvement

Activity 1.1.3.3 Take advantage of community meetings to raise awareness of a larger number of Floods and Drought risk maps' beneficiaries

Output 1.1.4: Reports and communication documents on vulnerabilities, capacities, exposure and risks (VCERs) and Floods and Drought risk maps of the Volta Basin are available

Activities under output 1.1.4

Activity 1.1.4.1 Produce technical report on the added value, success and challenges of VCERs and Floods and Drought risk maps for the stakeholders and Adaptation Fund project technical committee

Activity 1.1.4.2 Develop documentation for raising public awareness (infographics, videos, mobile phone applications, educational tools for children and students, etc.)

Outcome 1.2: Bridging the gap in adaptation measures to integrate future scenarios (economic, urban, climate, environment,etc.) into current practices and knowledge

Historical patterns alone are no longer a good basis for planning and risk reduction measures as climate variability is forcing to modify the past practices. It becomes necessary to confront the current VCERs and risks maps to various scenarios describing the effects of socio-economic development and climate projections in order to foresee possible changes that people would not expect. This will not only help decision-makers to understand the potential impact of Floods and

Drought events on their planning, investment decisions and adaptation measures, but also to envisage with the communities how current practices need to be modified.

This first step will be complemented by a thorough evaluation of the potential direct and indirect impacts of the proposed activities on the environmental function of the humid zones and river courses.
Indirect impacts might be caused by a change in the practices of the communities and farmers when receiving a warning message on flood, drought or even ecosystem stresses, for example:

- In case of flood warning, people living in the flood zone could be migrating to safer places where fight for resources and space could result into an increase of social risk among the population,
- In case of upcoming drought period, the farmers could build small scale water reserves impacting the ecosystem balance.

This approach will be carried out for areas with a large previous knowledge of the ecosystem parameters and the links with the operational hydrology. In the framework of the project, two or three of the pilot sites (the Ramsar site of the Bagré dam is for sure one of them) will be selected to test this methodology. This will involve the enlargement of the partnership to agencies specialized on these topics, such as WWF, IUCN, the RAMSAR convention, etc. The lessons learned will be disseminated over the whole basin and similar approaches could be developed by the partners within national projects.

Output 1.2.1: Scenarios for socio-economic and environment development along with the climate change projections are collected

Activities under output 1.2.1

Activity 1.2.1.1 Gather all available information on climate change scenarios from best scientific studies and global databases for the Volta basin and select the most relevant datasets

Activity 1.2.1.2 Gather the data on input for socio-economic scenarios of the Volta Basin region over the next decades

Activity 1.2.1.3 Organize the data on climate and socio-economic predictions for further integration with VCERs and risk maps developed under outcome 1.1

Output 1.2.2: Projected impacts on water resources, urban development, environment and agricultural areas are analysed on the basis of future scenarios

Activities under output 1.2.2

Activity 1.2.2.1 For areas covered with hydrological and hydraulic models (White Volta, Oti for example) perform a series of runs using the future socio-economic and climate scenarios to determine changes in VCERs and risk maps

Activity 1.2.2.2 For areas not covered with numerical models, carry out a first qualitative assessment of the possible evolution of VCERs and risk maps under future changes

Activity 1.2.2.3 Draft report with the methodologies and tools used for studying the impacts of future scenarios

Output 1.2.3: Impact on environmental indicators is evaluated for current and future scenarios

Activities under output 1.2.3

Activity 1.2.3.1 Define indicators related to environment conditions

Activity 1.2.3.2 Collect and process information for various environmental indicators,

Activity 1.2.3.3 Select thresholds and carry out analysis for current and future climate scenarios

Activity 1.2.3.4 Identify 2 to 3 areas (Ramsar Bagré dam for example) with appropriate dataset on ecosystem services to test the methodology

Activity 1.2.3.5 Draft report with the methodologies and tools used for studying the impacts of environmental flow[50]

Outcome 1.3: Risk management strategies in short, medium and long-term to be integrated into development plans (economic, social, environmental aspects)

It is foreseen that climate change will give rise to major impacts on ecosystems, agriculture and water resources in the Volta basin. Planning for effective risk management strategies will help in reducing disasters in the short to medium-term, while reducing vulnerability and increasing resilience over the longer term.

Output 1.3.1: Guidance documents for stakeholders are developed to raise awareness about the future scenarios

Activities under output 1.3.1

Activity 1.3.1.1 Design and develop the guideline presenting the whole process of risk maps development and future impacts on VCERs assessment with examples of implementation on high vulnerable urbans and agricultural areas

Activity 1.3.1.1 Develop supplementary means of communication to reach a wider population (infographics, leaflets for schools, etc.)

Output 1.3.2: Capacity of stakeholders to use future scenarios and to develop action plans is enhanced

Activities under output 1.3.2

Activity 1.3.2.1 Organize trainings and workshops with stakeholders (representatives of communities, local policy-makers and decision makers) to disseminate the information on future climate and risk changes and to obtain additional qualitative input

Activity 1.3.2.2 Design capacity building courses for NMHSs improving their competencies to periodically perform scenarios and assessments

Activity 1.3.2.3 Develop action plan for risk management at medium and long term with the output from workshops and consultations with the stakeholders

Component 2: Develop concrete adaptation and environmentally friendly actions with an integrated approach

Floods and drought have been identified by the six countries as priority areas for transboundary management, together with other factors related to the degradation of ecosystems, such as soil degradation and deforestation[51].The Volta programme will provide the basis for an integrated flood and drought management approach[52] in the region, thanks to the data systems, collaboration

[50] Ecosystem flows is the flow of water in a river or lake that sustains healthy ecosystem and the goods and services that humans derive from them. Effective quantification of these flows include ecologically important range of flow magnitudes (low flows, high flows and peak flows) as well as the timing, duration, frequency and rate of change of these flows conditions. Globally, there flows are most commonly referred to as "environmental flows". https://www.fort.usgs.gov/sites/default/files/products/publications/21745/21745.pdf (page-1)

[51] (2016): Evaluation des besoins de renforcement des capacités. Préparation des projets de gestion intégrée des inondations pour le Bénin, Burkina Faso, Côte d'Ivoire, Ghana, Mali et Togo et le bassin de la Volta en Afrique de l'Ouest. Series of seven reports GWP West Africa. Unpublished

[52] the term "integrated management" refers to the consideration of all aspects of both hazard management from the technical studies, i.e. engineering, hydrometeorological and agronomic solutions, to the socio-economic, environmental and institutional implications that floods and drought entail, as explained in literature produced within the GWP-WMO associated programmes on Flood and Drought Management http://www.floodmanagement.info/publications/concept_paper_e.pdf and http://www.idmp.info/documents/IDMP_Concept_Note.pdf)

frameworks and early warning systems that will be put in place in the basin. The development and implementation of the End-to-End (E2E) Early Warning System for floods and droughts at the scale of the Volta basin is the key output of the programme (outcome 2.1). To improve sharing of information, the system will cover the global chain from vulnerability and risk mapping to forecasting, warning dissemination and decision support. The programme takes into account the results (resources, infrastructures and services) obtained by past and ongoing projects to ensure sharing of knowledge and to avoid overlap of funding. This task is a major challenge as some projects are relatively old and their integration into the new technologies must be assessed. The first development phase will be concentrating on the most vulnerable river courses and on pluvial floods due to high rainfall intensities. Link with flash flood warning could be considered thanks to the future Flash Flood Guidance System (FFGS) under discussion within the CREWS programme. This would allow to benefit from its WMO-USAid successful implementation since 2009 in more than 50 countries using remote sensing, meteorological observation networks and soil moisture data. The E2E EWS will be designed to integrate additional features, thereby possibly including other natural hazards, such as fire and erosion, and also linking with agricultural and health indicators.

The operational use of the new E2E Early Warning platform will be supported by a series of pilot tests (outcome 2.2) in different sub-basins and vulnerable areas, covering different socio-environmental conditions (Figure 8 and Table 7). The implementation of the activities will be done in close collaboration with the stakeholders and end-users. Capacity development activities will be carried out to ensure an adequate uptake of the new products, services or tools developed.

Activities are planned (outcome 2.3) to widen the dissemination of these outputs to a larger circle of institutions and communities, including consultative and participatory meetings with local communities, policy makers, expert groups, advisory committees and other relevant stakeholders (NGOs). Additional solutions are included into this part of the work programme to raise awareness on the benefits of Integrated Flood Management and community participation by making use of recently published guidelines: the Flood Green Guide (FGG) by WWF on natural and nature-based solutions and the WMO-GWP Guide for Mainstreaming gender in early warning systems and integrated flood management (under finalization).

Outcome 2.1: Improved flood and drought forecasting instruments and Early Warning Systems (EWS) and coordination at the transboundary level to reduce disaster risks in vulnerable communities

One of the central output is the development of an End-to-End Early Warning System covering the various areas at risk of floods and drought. The system will allow to produce and disseminate warnings according to pre-defined levels of risks, using colour coding and icons for the different types of hazards, similarly to the warning systems largely installed over a large number of countries and transboundary watersheds (see for example the MeteoAlarm platform that is gathering information from European countries https://www.meteoalarm.eu/). These multi-hazard warning systems provide already information to the end-users on various types of extreme events, from meteorological (wind, temperature, precipitations and heavy rainfall for example) and hydrological (soil moisture, high and low water levels) nature, but also from geological (landslide) or health related (heat wave) origin.

The E2E EWS will make use of available infrastructures and services based on meteorological, hydrological and remote sensing data to generate additional indicators relevant for flood and drought risk management. The web-based interface will provide operational forecasts and indicators for Floods and Drought. It will include short and medium-term predictions of

meteorological parameters (rainfall distribution, intensities, temperatures, etc.) together with forecasts obtained by hydrological rainfall-runoff and/or hydraulic models. It will also include drought indicators which can be used by different sectors (water resources, agricultural etc.) and private companies.

Early Warning Systems deliver successful information when they are suited to the needs of the services in charge of decision making and action in the field. The end-users should therefore contribute to the development of the visualization interfaces and the selection of the decision criteria, as the benefits of Early Warning and risk reduction measures (at short and long term) are greatly increased with stakeholder's preparedness.

A high-level prototype (available in the Annex 2), called VoltAlarm, has been envisaged by WMO and shared with programme partners to illustrate what kind of information could be produced by the NMHSs and disseminated, after registration or with free access on desktops/computers, tablets or mobile phones, either directly or through the VBA observatory to the end-users.

Output 2.1.1 Needs and existing resources of national and regional agencies staffs for web-based EWS are defined

Activities under output 2.1.1

Activity 2.1.1.1 Select the participants (hydrologists, meteorologists, IT and GIS experts, etc.) within the NMHSs and flood or drought related services (Defence, Agriculture, etc.)

Activity 2.1.1.2 Develop the curriculum on the basis of the capacity building documentation developed by GWP and WMO for their programmes on flood and drought management taking into account hydro-meteorological and socio-economic conditions of target areas

Activity 2.1.1.3 Organize the training sessions at the transboundary level (with participants from each riparian country) including theoretical trainings and practical exercises

Output 2.1.2 The operational centre for the VoltAlarm Early Warning System is established in synergies with the NMHSs and the Volta Basin Authority

Activities under output 2.1.2

Activity 2.1.2.1 Define the needs related to facilities (rooms for developers, operational shifts, crisis communication, air conditioning, etc.), equipment (hard and software, including real-time connections), technical capacities, human resources (for daily activities and with additional resources during crisis)

Activity 2.1.2.2 Buy, install and test the equipment needed to create VoltAlarm EWS

Activity 2.1.2.3 Develop capacity of the operational team in charge of VoltAlarm at the national services and at VBA (hydro-meteorological forecasters, IT specialists, communication officers, on-call teams, etc.) in continuous monitoring of the Web-based EWS

Activity 2.1.2.4 Write the operational manual including procedures and responsibilities

Activity 2.1.2.5 Run and maintain the VoltAlarm system

Output 2.1.3 The historical and real-time hydrological data from the gauging stations are collected and the procedure to link with the meteorological data is defined

Activities under output 2.1.3

Activity 2.1.3.1 Make an inventory of the gauging stations with real-time data transfer (or pseudo real-time) in the Volta Basin and prepare descriptive sheets for each station (location, equipment, data series, etc.)

Activity 2.1.3.2 Perform a field/desk study to check the availability and quality of the data and information related to runoff, rainfall and other relevant meteorological and agrometeorological data

Activity 2.1.3.3 Develop the database of hydro-meteorological parameters, or interconnect with existing platforms

Activity 2.1.3.4 Organize training for the NMHSs staff related to data collection, calibration and maintenance of equipment following WMO standards

Output 2.1.4 Thresholds for Floods and Drought risk levels are selected for the various parts of the Volta Basin and linked with environment thresholds

Activities under output 2.1.4

Activity 2.1.4.1 Use topographic data, VCERs database, Floods and Drought risk maps to mark out the boundaries of the basin, sub-basins, highly vulnerable areas

Activity 2.1.4.2 Describe the thresholds for flood events and for drought period based on VCERs and risk maps for various risk levels (level 0: no risk, level 1: very low, level 2 : low, level 3: moderate, level 4: high) through consultations with technical services and local representatives

Activity 2.1.4.3 Define the values of the thresholds for floods and for drought events for each zone or area close to a gauging station, in relationship with past events

Activity 2.1.4.4 Link the environment threshold with the threshold of flood and drought

Output 2.1.5 The procedure for producing impact based forecasts for the sub-basins and vulnerable areas on a daily basis is defined

Activities under output 2.1.5

Activity 2.1.5.1 For the areas with available forecast models in the sub-basins (e.g. White Volta, Oti), create the procedure to use the outputs of the existing models within the network of centers producing VoltAlarm (NMHSs and VBA)

Activity 2.1.5.2 For the areas not covered with hydrological models, develop charts and graphs (with various standard icons and images) to define the flood and drought indicators using hydro-meteorological data from past events

Activity 2.1.5.3 Write the software to collect the meteorological and hydrological forecasts and to calculate the daily warning levels for each of the sub-basin and vulnerable areas

Activity 2.1.5.4 Design and develop the interface to gather all individual warning levels on the main system at the VBA observatory

Output 2.1.6 The web-based Early Warning dissemination interface for VoltAlarm is designed and developed

Activities under output 2.1.6

Activity 2.1.6.1 Organize consultations with the end-users from national and regional agencies and from communities to gather their expectations related to their future use of the prototype proposed on Figure 10 (background maps, zooms, types of graphs, location of evacuation centre, hospital, emergency centre, first-aid, etc.)

Activity 2.1.6.2 Develop and test the web-based dissemination interface

Activity 2.1.6.3 Write the user guide to convey all available knowledge on the interface to the various groups of users (forecasters, IT staff, decision-makers, etc.)

Output 2.1.7 Knowledge and awareness about VoltAlarm are increased within the user groups.

Activities under output 2.1.7

Activity 2.1.7.1 Carry out trainings and capacity development workshops with the NMHS professionals, local/national agencies and users of the web-based EWS

Activity 2.1.7.2 Gather feedbacks, suggestions and scope for improvements from the workshop participants

Activity 2.1.7.3 Organize a workshop to discuss with the trained participants how similar risk maps and early warning systems can be developed for areas outside of the Volta Basin

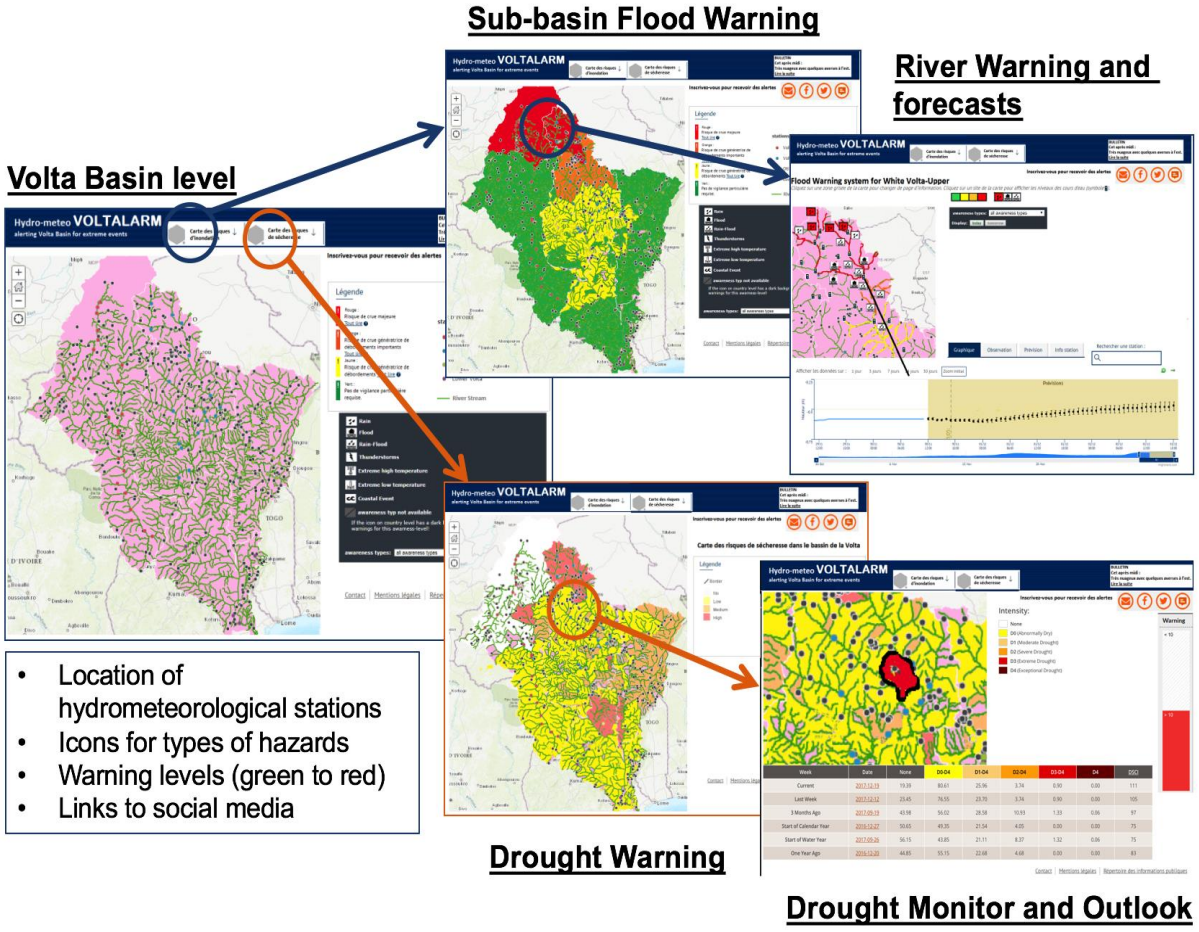


Figure 10: VoltAlarm (prototype of the E2E EWS for Floods and Drought to be developed)

Outcome 2.2: Demonstration of the added value of the E2E EWS VoltAlarm through a series of pilot testing during monsoon and dry seasons

A series of pilot testing will ensure that VoltAlarm is a robust platform, that the warnings messages are delivered on time and understood by the users. These tests in real conditions will also provide the opportunity to clarify the responsibilities, roles and collaborations among actors and stakeholders involved in Floods and Drought management activities. Training and awareness sessions at local level will ensure that warnings are delivered in a suitable way to the population, especially the most vulnerable groups, and that proper actions are undertaken when extreme events are forecasted.

Output 2.2.1 Pilot testing for a number of areas over the basin (Figure 8) during the monsoon and dry seasons are performed

Activities under output 2.2.1

Activity 2.2.1.1 Finalize the selection of the pilot tests areas with the concerned agencies and communities on the basis of the draft list presented in Table 7

Activity 2.2.1.2 Organize meetings on each of the pilot areas to assign the roles and responsibilities of the different groups of stakeholders during the tests and present the coordination and collaboration mechanism enabling first responders to receive and use efficiently the early warning information

Activity 2.2.1.3 Identify the good practices, challenges and limitations of products and services during the Flood and Drought events at each of the pilot testing locations

Activity 2.2.1.4 Raise awareness about the pilot testing using multi-media channels

Activity 2.2.1.5 Develop an action plan to further improve products and services after the pilot testing

Output 2.2.2 Feedback from the series of pilot testing is collected

Activities under output 2.2.2

Activity 2.2.2.1 Organize national consultative workshops (participants from local/national agencies involved in Floods and Drought management) to share the knowledge (new methodologies, concepts and tools for effective forecasting and dissemination of early warnings) from the pilots tests

Activity 2.2.2.2 Collect feedbacks from the workshop participants highlighting their views and perception of developed products and services

Activity 2.2.2.3 Draft the series of reports on the experiences from the pilot testing and provide a summary of recommendations

Activity 2.2.2.4 Develop communication materials to disseminate the results of the pilot testing and describe the added value of VoltAlarm

Outcome 2.3: Strengthened awareness of vulnerable people on hydro-meteorological risks, prevention, preparedness, and response strategies through education programs using participative solutions

Besides the development of new tools to reduce the impact of extreme events, capacity building activities allow to spread knowledge on disaster risk reduction prevention to a larger number of communities and to focus on the most vulnerable groups. To foster enhanced participation of local population, the methodologies from two different guidelines will be implemented: 1) the Flood Green Guide published by WWF in 2017 to help selecting the most appropriate (results and cost efficiency) combination of structural and non–structural methods, including natural and nature-based flood solutions, to maximize the benefits of floods, 2) the Training manual for mainstreaming gender in Integrated Flood Management from WMO. These methodologies highlight special aspects of risk prevention with practical guidance to give attention on urban development, areas of global importance for ecosystems protection and women participation.

Output 2.3.1 Knowledge and capacity development using the Flood Green Guide (FGG)[53]

Activities under output 2.3.1

Activity 2.3.1.1 Organize dedicated short courses (at least one per country) on the FFG approaches and concepts for targeted beneficiaries to disseminate knowledge on natural and nature-based solutions for flood management

Activity 2.3.1.2 Collect feedbacks from the workshop participants on their views and perception of FGG tools

Activity 2.3.1.3 Recommend actions to increase the use of natural and nature-based solutions and environmentally friendly methodologies with the involvement of local population

[53] WWF in partnership with the US Agency for International Development Office of Foreign Disaster Assistance (OFDA), has developed the Flood Green Guide to support communities at a local level in using natural and nature-based methods for flood risk management.

Activity 2.3.1.4 Conduct workshops to provide support for developing bankable project proposals (submission to the internal and external agencies in future) on natural and nature-based solutions for the flood events.

Output 2.3.2 Capacity development based on the Training Manual for mainstreaming gender in the E2E-EWS-F and flood management[54].

Activities under output 2.3.2

Activity 2.3.2.1 Organize and conduct workshops (at least one per country) on the Training Manual for mainstreaming gender in the E2E-EWS-F and flood management with potential participants from NMHSs, local policy-makers, civil authorities, women and community based organizations etc.

Activity 2.3.2.2 Collect feedbacks from the workshop participants on their views and knowledge sharing on mainstreaming gender in E2E-EWS-F and IFM with other stakeholders

Activity 2.3.2.3 Recommend actions that would improve the participation of women into flood management and early warning

Component 3: Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels

Presently, the Volta basin region lacks transboundary level decision framework and strategies to overcome the challenges of the basin-wide water resources management. To increase adaptive capacity and empower people to cope with their changing environment, the development of decision-support framework can help national and local agencies to mutually understand and respond to challenges and opportunities in the Volta Basin.

The programme builds on a number of risk reduction master plans, such as the Volta Basin Strategic Action Programme, development strategies and adaptation measures listed in the Second edition of the Disaster risk management Program published by the Global Facility for Disaster Reduction and Recovery (GFDRR) of the World Bank in 2009. Four of the six Volta Basin countries (Burkina Faso, Ghana, Mali and Togo) are identified as major priorities due to their high vulnerability to natural hazards and low resilience to climate change. Even though considerable funding has already been (or is being) attributed to the six countries, a large coordination effort, joint methodologies and shared tools are still needed to ensure that the results and outputs of the national projects are integrated at transboundary level.

Activities of component 3 explore how coordination efforts will be beneficial to the concerned institutions, such as the integrated programmatic approach proposed for the National Council for Emergency Relief and rehabilitation (CONASUR) and the National Council on Environmental and Sustainable Development (SP/CONEDD) in Burkina Faso. In Ghana, the National Disaster Management Organization (NADMO) will implement new solutions from national to local level through the involvement of the Zonal offices. Joint initiatives will be envisaged with the Economic Community of West African States (ECOWAS), and its Coordination Unit for Water Resources.

Adaptation measures and strategies will be discussed at local level in agreement with local organizations and communities to increase the resilience to floods and drought. The participation and engagement of local stakeholders will facilitate the adoption of the strategies and subsequently result in long-term sustainability.

Outcome 3.1 Decision support and policy development for strengthening resilience at the local, national and transboundary levels of the Volta Basin.

[54] WMO will also test the methodology proposed in the forthcoming training manual for mainstreaming gender in Flood management, and its facilitator guide to support trainers.

Output 3.1.1 The transboundary governance plans, policies and guidelines about long term flood and drought management are evaluated

Activities under output 3.1.1

Activity 3.1.1.1 Conduct a desk study, and hold meetings with partners, to identify the status of climate and future socio-economic changes in the transboundary governance plans, policies and guidelines for flood and drought management

Activity 3.1.1.2 Develop a short report underlining the strengths together with the identified gaps and additional needs related to climate and development impacts

Activity 3.1.2.3 Propose long-term actions for strengthening resilience and capacities at transboundary level to be implemented by VBA and the other regional agencies

Output 3.1.2 Awareness of policy-makers from the six countries on the key long-term strategies for floods and drought management and environment impact is strengthened

Activities under output 3.1.2

Activity 3.1.2.1 Describe the network of the relevant policy-makers responsible for floods and drought management as well as other related fields (health, agriculture etc.)

Activity 3.1.2.2 Organize and conduct national workshops to identify the gaps and needs in policies and plans, and to highlight the key long-term strategies for floods and drought management

Activity 3.1.2.3 Collect feedbacks and recommendation at national level and needs for interconnection with transboundary policies

Activity 3.1.2.4 Present the recommendations to the policy-makers and ministries

Output 3.1.3 Experiences of local communities on key long-term strategies for floods and drought management are collected

Activities under output 3.1.3

Activity 3.1.3.1 Draft a report with experiences at local level

Activity 3.1.3.2 Organize and conduct local workshops to get a wider input of communities

Activity 3.1.3.3 Collect feedbacks and recommendation at local level and provide input on the needs for relationships to national policies

Outcome 3.2 Strengthened capacities of actors and decision makers at national and transboundary level on long term risk management policies, plans and strategies

Output 3.2.1 Strengthened implementation of the revised, or new, climate adaptation plans (NAPA, NAP, NDC), policies and guidelines (on data and information exchanges) on issues related to risk reduction and EWS

Activities under output 3.2.1

Activity 3.2.1.1 Organize and conduct workshops to disseminate the revised, or new, plans, policies and guidelines on climate adaptation measures in the Volta Basin.

Activity 3.2.1.2 Collect feedbacks, suggestions and recommendations from the workshop participants on the links between activities of National Programmes and the Volta basin programme

Activity 3.2.1.3 Identify roles and responsibilities of the individual organizations and define the coordination mechanism to improve the implementation of the climate change adaptation measures

Output 3.2.2 Improved integration of national policies on long term risk reduction and climate adaptation into the transboundary Strategic Action Programme

Activities under output 3.2.2

Activity 3.2.2.1 Launch national consultations in the six countries to gather feedback on the effective coordination between national and transboundary policies in the framework of floods and drought management and climate adaptation

Activity 3.2.2.2 Draft a report with recommendations from the consultations

Activity 3.2.2.3 Organize the dissemination of the report to policy-makers

Outcome 3.3 A collaborative process is developed to ensure those instruments and strategies are accepted by the local organization and communities and adapted to the local context

Output 3.3.1 Collaboration with local communities and organizations in defining the procedures and measures to manage risks and to adapt to climate change

Activities under output 3.3.1

Activity 3.3.1.1 Conduct a desk study and consultation of local stakeholders to gather examples of best practices for flood and drought risk reduction and climate adaptation related measures

Activity 3.3.1.2 Develop capacity building documentation for local communities with the help of the local stakeholders

Activity 3.3.1.3 Draft report on recommendations from local communities

Output 3.3.2 Collaboration with local communities and organizations in finalizing policies and procedures to manage risks and to adapt to climate change

Activities under output 3.3.2

Activity 3.3.2.1 Prepare a framework of actions for community involvement on long term disaster risk reduction with local stakeholders

Activity 3.3.2.2 Conduct community-based workshops with agencies, local communities and organizations to prioritize adaptation measures

Activity 3.3.2.3 Collect feedbacks, suggestions and recommendations

Activity 3.3.2.4 Propose action plans at local and national levels to increase local participation

A schematic representation of the Volta programme components and their outcomes is presented in Figure 11. It illustrates the linkages among the outcomes of components and highlights the activities proposed in each of the components. The continuous project management and coordination, sustainability and dissemination of the project outputs during the programme implementation is also represented.

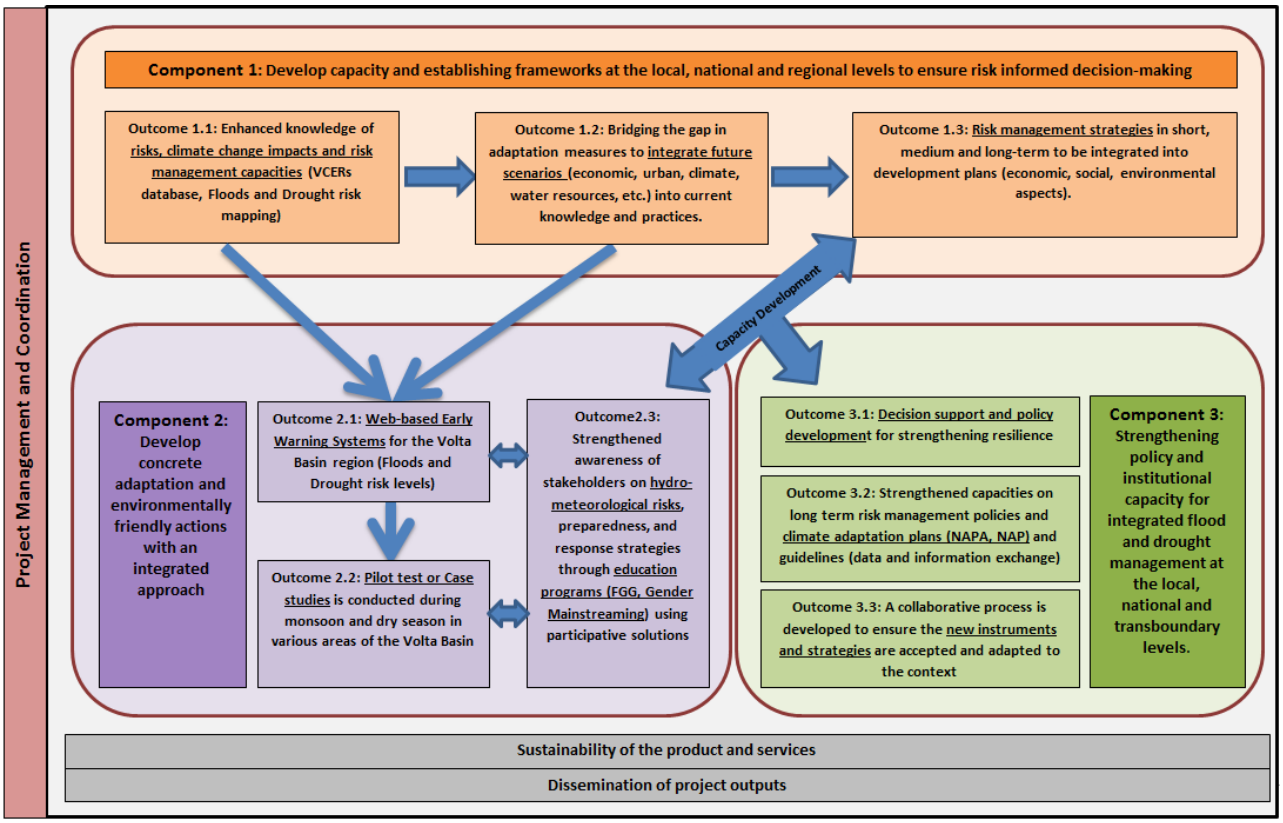


Figure 11: Schematic representation of the Volta programme components and their linkages

B. Describe how the project /programme would promote new and innovative solutions to climate change adaptation, such as new approaches, technologies and mechanisms.

The components of the Volta programme deal with innovative solutions, mechanisms and technologies in the following ways:

Under component 1: Develop capacity and established frameworks at the local, national and regional levels to ensure risk informed decision-making

Component 1 will ensure that the existing vulnerabilities, capacities, exposure and related risks to Floods and Drought events are assessed and mapped so that the risk zones in the Volta Basin are characterized and priorities are attributed to the most vulnerable areas. Moreover, climate change predictions will help the stakeholders at the local/national/transboundary level to identify the future impacts of climate change variabilities and to provide support in risk informed decision-making. These results could be further updated for other types of natural hazards and climate change adaptation initiatives/measures to study the impacts on various sectors of the environment and water resources. The floods and drought risk maps will be open-source and enable the mainstreaming of results into other initiatives focused on Floods and Drought management in the Volta Basin. Coordinating with the VBA at the regional level will help to promote the methodologies of risks assessment and mapping to other countries in West Africa which are also prone to Floods and Drought events.

The preservation of the environmental resources and ecosystem services will be studied by integrating environmental indicators to the more usual human and properties approaches when describing the vulnerability and risks (which are part of component 1 activities). This will be furthermore useful to increase the awareness related to the negative impacts, as well as the benefits, of the environmental resources.

Under component 2: Develop concrete adaptation and environmentally friendly actions with an integrated approach.

An integrated flood and drought early warning system is an immediate need for the Volta Basin where timely and relevant information are lacking for announcing incoming hydro-meteorological hazards. The end-to-end hydrological monitoring, forecasting and disseminating system will be designed based on a web-based open-source, cost-effective and real-time chain of modules that will enable collection and transmission of timely, accurate, and local data to users.

It must be underlined that the methods for producing warnings will differ depending on the characteristics of the hazard (flood or drought), as both hydrological extremes differ in their spatial and temporal distribution: floods are relatively rapid events, caused by intense precipitation, limited in time and affecting localized areas (compared to drought); whereas drought is a more slow induced event, and might have a much distributed impact both in area and time. On the one hand, the data needed to describe both phenomena can be partially shared, such as meteorological, hydrological and agronomical parameters. On the other hand, the methodology to forecast the two phenomena varies considerably and depends on the availability of different types of meteorological forecasts (from nowcasting for short pluvial events to seasonal and sub-seasonal forecasts for drought onset). The hydrological and agronomical forecasts will be produced by a range of methods, from simple graphs using the current levels of indicators (VCER's, upstream-downstream river water levels, rainfall-water level relationships, various drought indicators) to more elaborated modelling (depending on the existing models developed on some of the sub-basins during previous projects. The main point of the approach is to be able to link hydro-meteorological hazards to their consequences on the vulnerable areas from the social and environment point of view. Flood and drought risks maps are therefore a first major input, which still need to be built, and made available to the communities, over the entire watershed.

Information will be transferred to fit local contexts and local languages using multiple technology options including simple message texts on mobile phones, social media, and radio. The goal is to provide localized information to the general public that will be better prepared to the effects of floods and drought. Furthermore, the proposed system will provide possibilities to receive information from the users (crowd sourcing) about their observations during the floods and drought events. The web-based early warning system will be made compatible and scalable to integrate other hazards in future, such as fire, diseases etc.

The integrated web-based Early Warning System (EWS) provides a way to disseminate information to national services, civil security, and to the population which can suffer from these both types of extreme events during the same year. It becomes a support tool to foster collaboration and knowledge sharing between institutions and populations.

Moreover, adaptation strategies could be tested through the early warning system at some of the pilot locations during monsoon and dry period. The experience will be shared with other communities having similar socio-ecological contexts in the Volta Basin. The natural and nature-based solutions for floods and gender mainstreaming in E2E-EWS will help representatives of agencies, organization and communities to develop knowledge and skills enhancing the flood management approach with environmental and social benefits. This approach is rarely included when warning systems are established because the intend is mostly to prevent the loss of lives and properties. In the Volta basin, the interdependency of the human and social impacts with the

environmental resources needs to be linked, therefore increasing the resilience capacity of the environment.

These adaptation strategies will ensure the transfer of best practices, skills and lessons learned from the pilot-sites trained beneficiaries to the non-targets actors and communities. Subsequently, the knowledge upscaling and replication of methodologies beyond the pilot sites will be encouraged, which will strengthen the adaptive capacity and resilience of other communities prone to climate-based extreme events. It will also empower individuals to participate in the decision making processes at local/national/regional level.

Under component 3: Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels.

The upstream and downstream countries of Volta Basin must coordinate their responses in managing water resources (excess water during monsoon and transfer of water during dry season). Component 3 includes knowledge exchange, inter-country dialogue and cooperation which will strengthen the development of policy, plans and guidelines for managing shared water resources and climate extreme events. For decades, VBA has been working on protocols on data sharing and coordinated strategies at the transboundary level. The Volta programme will facilitate engagement between VBA and the riparian countries in understanding the present challenges and develop strategies and action plans to build robust cooperation on transboundary resource management. The other initiatives under this component will be to:

- Establish mechanisms for information exchange and networking (including exchange visits of officials to other countries to share ideas, knowledge, practices and lesson learned) ;
- Developing open source databases with tools, polices and guidelines;
- Framework and expertise for carrying out regular monitoring and evaluation after the project period ensuring long-term sustainability.

Strengthening of stakeholder knowledge through capacity building

Additionally, the capacity building activities at the national and local level will be key in achieving the long-term support: to ensure a better adoption of the innovative solutions proposed in the project. The wide range of training curriculum will involve local and national counterparts and communities to develop knowledge and skills in end-to-end early warning systems for flood management, integrated drought management, hydrological status and outlooks, community based flood and drought management, mainstreaming gender, roving seminars for farmers on agro-meteorology, etc. These trainings will be delivered based on materials already tested and made available by WMO in the framework of specific activities such as the Flood Forecasting Initiative, or the Integrated Drought Management Programme (IDMP). These training could also be embedded in wider WMO initiatives (e.g. corresponding to the work plan of the WMO Commission for Hydrology), and therefore provide an in-kind commitment from WMO in the development of training materials and the logistical organization of the training workshops.

Countries would benefit from this training and at the same time contributing in-kind by having their NMHSs staff attending the workshops, or assisting on the local logistical arrangements for holding the workshops. These trainings will strengthen NMHS capacities in generating and delivering climate information and prediction products for climate services by developing skills required to access forecasts and reforecast data from Global Producing Centres for Long-Range Forecasts (GPCLRF). GPCLRF is an integral part of the WMO Global Data-Processing and Forecasting System (GDPFS) underpinning the generation of climate information products by the NMHSs. The GPCLRFs follow a strict designation process according to which the Centres adhere to well-defined standards to ensure consistency and usability of output. These standards include a fixed

forecast production cycle, a standard set of forecast products and the WMO defined verification standards. Currently there are 13 WMO designated GPCLRFs.

Figure 12. WMO Global Producing Centres for Long-Range Forecasts

Considering that climate forecasts produced by the Global Producing Centres (see Figure 12) often do not have sufficient resolution for application in national scale climate services and differ in format, uniformity and forecast visualization techniques, the trainings will also focus on WMO Regional Climate Centres (RCCs) and two Lead Centres: the Lead Centre for Long-Range Forecast Multi-Model Ensemble prediction (LC-LRFMME) and the Lead Centre for Standard Verification System for Long Range Forecasts (LC- SVSLRF).

RCCs have been established to deliver regionally focused high resolution data and products including long-range forecasts that support regional and national climate activities and climate services. Regional Climate Centres are operated as Centres of Excellence that strengthen capacity of WMO Members in a given region to deliver the best climate services to national users.

Long-Range Forecast Multi-Model Ensemble is jointly managed by the Korean Meteorological Agency and NOAA's National Centre for Environmental Prediction in the USA. Its functions include: collection of long-range forecast data from all GPCs each month; maintaining a central portal from which forecast users can access the GPC output in standard digital and graphical formats; developing and providing multi-model forecast products with improved skill and promoting research into techniques for combining predictions from different models.

LC-SVSLRF is jointly managed by the Australian Bureau of Meteorology and the Meteorological Service of Canada. The key role of the LC-SVSLRF is to collate and display GPC hind-cast verification diagnostics in standard formats that allow easy comparison between models. The Lead Centre provides access to: verification datasets; verifying software; documentation of the system; broad technical support; and, access to the final verification data as well as graphing and display of results.

To enhance the predictions of droughts and floods' consequences (crop damage, water shortages, epidemic outbreaks, food insecurity, etc.), the trainings will promote NOAA's Climate Prediction Center which updates regional hazards outlooks for food security for many regions of the world every week. The outlooks are prepared in partnership with government agencies including United States Agency for International Development (USAID), United States Geological Survey (USGS), United States Department of Agriculture (USDA), National Aeronautics and Space Administration (NASA), and the private sector, and draw from expertise in a variety of fields, including meteorology, hydrology, agriculture, remote sensing, environmental and social science. The hazard outlooks feature both long-term (past conditions throughout the season) monitoring of the climate system and outlooks into the near future about one week to a season. The objective is to provide targeted forecasts for areas that are vulnerable to floods or drought that might result in adverse impact on crops or pastures.

The procedures outlined are analogous to impact-based climate forecasting systems for other socio-economic sectors, provided that NMHSs and stakeholders from these sectors are both involved in the preparation of the forecasts either together or at different stages of the forecasts. The WMO Climate Services Toolkit (CST) could serve as an excellent resource for providing NMHSs and RCCs with much of the climate monitoring, forecasting, and climate data management tools that are required to manage data and create graphics for the preparation of impact-based forecasts.

The trainings will be coordinated with the Regional Climate Outlook Forum For Sudano-Sahelian Africa (PRESASS), coordinated by the African Centre of Meteorological Application for Development (ACMAD) in Niamey (Niger) and which covers all Volta Basin riparian countries. PRESASS provides consensus-based, user-relevant climate outlook products by adapting the large and regional scale forecasts to the national context.

The PRESASS implementation process includes:

- A pre-COF training workshop on seasonal climate prediction to strengthen the technical capacity of national and regional climate experts;
- Meeting to present and interpret available real-time climate monitoring and assessment, seasonal prediction products from WMO global data and monitoring centres, GPC-LRFs and RCCs as well as the country-level forecasts, assess the skills of forecasting systems, and develop the consensus seasonal climate outlook statement for the region;
- Together with the user representatives, the forum participants discuss the potential applications of RCOF products for decision making in the agriculture, disaster, water and health sectors;
- Special outreach session involving media experts to develop effective communication to stakeholders;
- Verification of past outlooks by NMHSS and ACMAD/RCC, assessment of the use of climate information through surveys, meetings, regional food security and DRR forums, group discussions, dialogue days, exhibitions and side events;
- Share recent studies and findings on regional climate variability, predictability and climate change and discuss their integration in forecasts operations;
- Updates of the consensus product.

Sessions for hydrologists and agrometeorologists are organized in parallel generating discharge outlooks and agrometeorological advices presented at the forum plenary. ACMAD/RCC prepare and publish for the disaster management sector a brief for policy and decision making including a synthesized climate outlook, related expected hazards and potential impacts as well as measures for contingency plan updates and implementation.

The RCOF outlook is communicated to participants at meetings of the West African regional Committee on disaster management and the national flood management committee in Niger in collaboration with the National Meteorological Service.

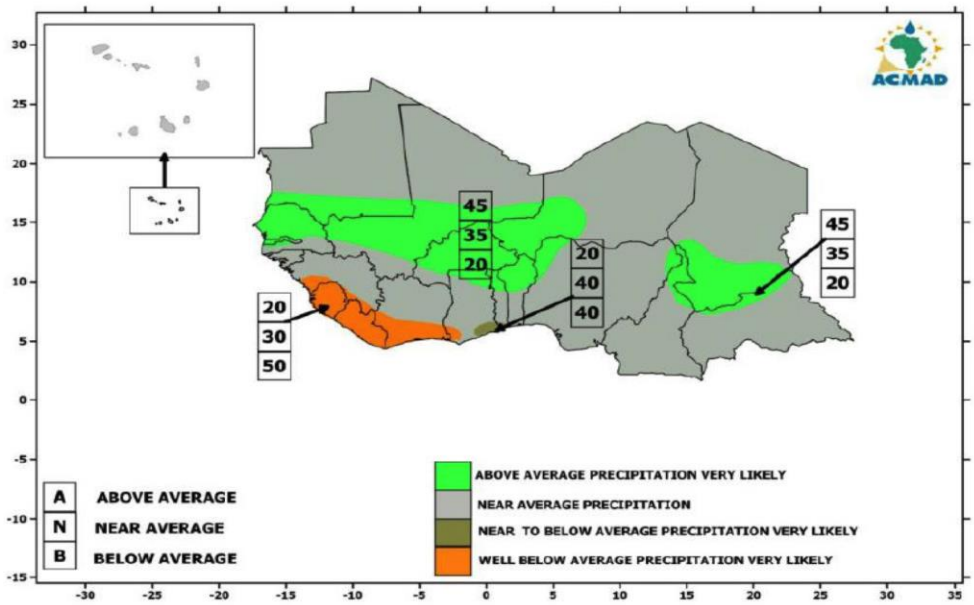


Figure 13. Seasonal Precipitation forecasts issued on May 19, 2017 and valid for July-September 2017 over West Africa, Chad and Cameroon.

Often RCOFs are followed by National Climate Outlook Forums (NCOF) to develop detailed nationally-scale climate outlooks and risk information (see example on Figure 13), including advisories for communication to decision-makers and the public. Based on the needs of specific sectors, Climate Services User Forums (CSUF), such as CSUF Water, Health, Agriculture for South Asia, and specialized, sector-oriented outlook forums, such as the Malaria Outlook Forums in Africa, are being held in conjunction with Regional Climate Outlook Forums.

During the proposed programme's implementation period, an innovative monitoring programme (including a Monitoring & Evaluation plan) will be established under component 1, 2 and 3. This monitoring and evaluation (M&E) programme with local/national/transboundary agencies will collect information on the effectiveness of project implementation cost and monitor the results of the climate change adaptation interventions across various socio-economic contexts. This M&E methodologies and resources could be easily used after the project completion and further integrated into the other on-going and future adaptation projects at the local/national and regional level.

C. Describe how the project / programme provide economic, social and environmental benefits, with particular reference to the most vulnerable communities, and vulnerable groups within communities, including gender considerations. Describe how the project / programme will avoid or mitigate negative impacts, in compliance with the Environmental and Social Policy of the Adaptation Fund.

In line with the Environment and Social Policy of the Adaptation Fund and its principles, the ecosystem approach is fundamental in the concepts of Integrated Flood, and Drought,

Management supported by WMO and GWP and it will be one of the major aspects considered when developing medium and long-term adaptation measures. This will be achieved by taking into account the existing guidance material developed by the Associated Programme on Flood Management (APFM) with its partners based on the IFM concept (e.g. IFM Tool Series and WWF Flood Green Guide). Awareness on prevention, preparedness and response (component 2.3) will mostly involve national agencies, Civil Protection, NGOs, to develop education programs using participative solutions.

National policies, regulatory instruments, coordination institutions for risk reduction and climate change impacts are already in place at the level of each individual country but an integrated approach at the scale of the watershed will allow to evaluate the impact of individual measures on the whole water cycle and on the related agricultural development (component 1).

The six countries of the Volta basin count a large number of stakeholders and institutions that will contribute to the development of technologies and trainings proposed in the Programme. Risk mapping, risk prevention measures and nature-based solutions, Early Warning System designed to integrate further natural and agricultural hazards, enhanced community (particularly vulnerable groups such as women) preparedness to risk and climate change impact will provide economic, environmental and social benefits.

Economic benefits	Social benefits	Environmental benefits
• Water and water-related hazards have a significant effect on economic growth (Sadoff et al., 2015)[55]. Economic benefits in the short-term will be achieved through disaster risk reduction measures of the project activities, by reducing damage to agricultural land with flood water, restoration of wetlands and other infrastructures through the implementation of Flood and Drought management and Early Warning Systems. The technical knowledge of local communities and agencies will help in planning for climate resilient adaptation interventions, potentially delivering significant environmental benefits as well as cost savings. Exchange of knowledge at a regional scale will promote the adoption of climate-resilient livelihoods.	• More than 10000 people especially farmers in the project locations will be benefiting from the Early Warning System for Floods and Drought, supporting agricultural production and water security. • Urban population (estimated to be around thousands) will also benefit of the EWS to gain knowledge on natural hazards and be better prepared and more reactive when events will be forecasted • Participation of NGOs, community based organizations (CBOs) including women's and indigenous groups will be promoted in the awareness activities and decision making processes related to climate change adaptation and disaster risk reduction. • More gender sensitive approach in the capacity	• Historical data on weather and other relevant environmental variables will be useful to develop the future scenarios with index time series and determine values at risk (such as crop yield, water resources, aquatic habitats, wetlands and farming land). • The proposed early warning system will be able to deliver information regarding the water scarcity or abundance, water quality of the major reservoirs, etc. to the communities and agencies of the Volta Basin. • The project will contribute in lowering the excess demand for natural resources through fair and equitable sharing of water resources, especially at transboundary level • Increased protection against land degradation and desertification will be achieved through the actionable plans and policies at local and

[55] Sadoff C.W. et al. (2015), Securing Water, Sustaining Growth, report of the GWP/OECD Task Force on water security and sustainable growth.

• Livelihoods of vulnerable groups especially farmers will be enhanced and the viability of the ecosystems (they depend highly on natural resources) will be strengthened and maintained. This will possibly help to reduce the number of people migrating to urban areas/cities for livelihoods and subsistence. • To increase water security, the countries' efforts will be focused on building flood and drought risk maps for different climate scenarios and adaptation guidance for local governments. The latter will help agencies in revising laws and regulations such as sustainable water abstraction thresholds, building codes and land-use planning. They will also be adjusting economic instruments such water-related environmental taxes, and flood and drought insurance schemes. • Representatives of rural communities will be trained and better organized to use flood plain for income-generating activities. They will also provide valuable human resources for future livelihood based on climate change adaptation activities beyond the lifespan of the programme • Effectively and efficient management of water resources in the Volta Basin will ensure energy and water security, which may alleviate the reduction of water for daily-usage and energy supply disruptions.	development activities such as attention to the vulnerable groups, involvement of women, elderly and youths etc. will promote social integration in the communities and diversify livelihood on the basis of disaster risk reduction activities. • Local stakeholders will be involved in the monitoring of the project activities, so as to develop medium- and long-term sustainability. • The involvement of communities, Community Based Organizations (CBO), NGOs and local policy-makers in the capacity development activities will help in developing sustainable climate adaptation strategies and early warning systems.	national level. • A better understanding of the interaction between climate, environment and human factors which impact the sustainable use of natural resources • Availability of information on water ways and channels helping agencies and communities to improve the sustainability of the natural resources through reduced soil erosion and siltation.

The final Environment and Social Risk Management plan (ESRMP) aligning with the Adaptation Fund ESP will be developed and presented in the programme proposal. The Social and Environment risk management plan will be improved in consultation with stakeholders, analysing the potential impact to the population and environment and appropriate measures to mitigate the side effects of the programme activities, if any. A grievance mechanism will be provided in the ESRMP to account for any social and environmental effects during the project implementation. If found any issues or complaints of the communities can be directly reported to the implementing and funding agency.

D. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

Until now, little focus has been put on determining the cost-effectiveness of climate change adaptation interventions across the Volta Basin as a whole. As a result, there is limited baseline information that can be used for comparative analyses of adaptation approaches which are sustainable and replicable across the entire Volta Basin.

In the Volta programme, new solutions will be implemented to improve risk reduction and climate change adaptation. Special attention will be given to promote Community of Users, guidance material, decision-support tools, online training, social networks and crowdsourcing. All these solutions will be tailored according to the local needs and capacities, to account for social and cultural issues. The End-to-End Early Warning Systems will be tested with additional climate projections to study the impact of future scenarios on spatial and urban planning and their consequences on the socio-economic development.

The basin scale approach is a suitable way to identify and implement cost-effective measures. By involving the six-countries, previous knowledge and funding, as well as current projects, can be considered to ensure minimum overlap and transfer of methodologies from one area to the other. The development and maintenance of the End-to-End Early Warning System and all related functionalities can be mutualized and shared depending on the individual needs and uses. The developed methodologies can be tested at larger scale within the basin, or easily adapted to similar types of environments, therefore creating a community of users jointly considering climate change perspectives will also foster the integration of risk and climate approaches.

The proposed programme is directly related to the climate change adaptation and disaster risk reduction initiatives, utmost required for the Volta Basin countries; the solutions are participatory, cross-border, innovative and provide positive cost-benefit ratio.

Objective	**Component Cost (US$)**	**Number of Beneficiaries** (approximately from the six countries of Volta Basin)	**Proposed Benefits**	**Alternatives to proposed approach and cost**
Develop capacity and established frameworks at the local, national and regional levels to ensure risk informed decision-making	1 500 000	10, 000	By improved knowledge on two extreme hazards, vulnerability and climate-related risk, more efficient planning and investment decisions will be taken at all levels, on the basis of soft structural measures, to reduce human,	Instead of adequate vulnerabilities, capacities, exposure and risks studies, adoption of structural flood reduction measures, such as the construction of dams or reservoirs to reduce the flow and overflow of river courses are alternative measures.

			environmental, material and livestock losses from sudden or slow onset of Floods and Drought.	Additionally, the time for dam construction will be highly depending on the political and economic condition of the countries. Environmental consequences of the structural measures will need to be assessed.
Develop concrete adaptation and environmentally friendly actions with an integrated approach	4 000 000	20,000	The End-to-End Early Warning System will be developed with compatible technologies and provide similar types of messages for both Floods and Drought. The beneficiaries will gain knowledge and tools to increase preparedness for extreme events. Additionally, the capacity development activities for the natural and nature-based solutions to Floods and mainstreaming gender in E2E-EWS-F and Flood Management will enable actual beneficiaries to improve their self- response whilst strengthening the sustainability of impacts.	Early warning systems are developed independently for both Floods and Drought and not coordinated at the basin scale. This approach will require more investment cost and time as it will need additional infrastructures and resources to manage the system. Furthermore, uncoordinated efforts will decrease the benefits of the investments. The decision procedures that will be designed for each separate projects will create difficulties when a joint system will be planned.
Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels	1 000 000	1000 directly (several millions indirectly)	The policies on disaster risk reduction and environmental issues will be improved at local and national level. By concentrating additional efforts on two major natural hazards at transboundary level, the regional policies will be reinforced and more effective water management agreements will be implemented.	The alternatives to the riparian countries is to strengthen their own governance system to manage Floods and Drought events without taking additional roles and responsibilities at the transboundary level (compared to the current status of agreements signed with VBA).

E. Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

The proposed Volta programme aims at reinforcing the role of VBA and national agencies, especially NMHSs and focal point of GWP and VBA, in flood and drought management. GWP and

WMO are working since many years with key partners[56] on that issue, taking into account national and regional strategies and plans. The Head of the six Meteorological Services, acting as WMO Permanent Representatives and their Hydrological Advisors, form a network of focal points with the Ministries ensuring that the activities of the Volta programme will follow national strategies and action plans.

Transboundary /regional level

Consistency with climate change adaptation and sustainable development strategies of the Volta Basin Authority

Improving climate change adaptation and developing floods and drought early warning systems are part of the regional and national sustainable strategies supported by the riparian countries. The project aligns with the strategies and plans to develop transboundary water management framework for the Volta Basin. The Volta Basin Authority (VBA) has the mandate to harmonize national policies addressing the management of the water resources of the whole basin, indeed uncoordinated policies threaten the sustainability of the natural resources, as well as the socio-economic development of the six countries. Additionally, VBA is developing the governance framework for data sharing and information exchange related to water resources management between the countries.

The Master Plan for Development and Sustainable Water Management (MPDSWM) developed by the Volta Basin Authority with support of GWP-West Africa is a detailed IWRM-based Development Plan that will provide an integrated basin perspective to the basin's development and management[57]. It will include the water development and management priorities selected by all basin stakeholders and ensure coherence in decision-making by incorporating the different national programmes and sectoral development plans.

The principles for MPDSM development are:

- Define the scope of opportunities for water resources development (irrigation, water supply, flood and drought management), their associated risks and the actions needed to optimize opportunities and minimize risks
- Define other water-related opportunities, environment and ecosystems, watershed management
- Provide a coordinated, participatory and transparent process that promotes sustainable development.

Some additional issues that are taken into consideration as part of the basin planning processes align with the objectives of the proposed Volta programme:

- Establishing monitoring systems that will have the capability for early detection of water level changes;
- Promoting the development and improvement of models (climate and hydrological aspects) and scenarios for the basin;
- Investigating the effects of climate change on various sectors in the Volta basin and evaluating indirect increases in impacts on water resources;
- Conducting a climate vulnerability assessment of basin ecosystems;

[56] A large group of experts institutions and agencies, called Support Base Partners (SBP), are contributing to the activities of joint GWP and WMO programmes on the Flood (30 SBPs) and on Drought (10 SBPs)

[57] Outlines and Principles for Outlines and Principles for Sustainable Development Sustainable Development of the Volta Basin http://www.gwp.org/globalassets/global/gwp-waf_files/wacdep/brochure_outlines_principles_wacdep_abv_en.pdf

- Encouraging the riparian states to promote and apply methodologies and standards for climate-proofing infrastructure projects and integrating climate considerations into EIA and SEA procedures;
- Providing a platform for sharing of research information on climate change in the basin;
- Integrating all knowledge, results and lessons learnt related to climate change threats in the VBA Observatory.
- Promote high-level exchanges, dialogue and cooperation to enhance trust and understanding within the national agencies with a view to improve water resources management at the transboundary level.

At transboundary level, VBA faces many development challenges to meet the increasing needs of climate change adaptation and poverty alleviation. The Volta programme will provide additional capacity development and technical support to develop and implement the MPDSM at the transboundary level.

Country Level

Burkina Faso

An inclusive and participatory process, adopted on 20 July 2016, the National Economic and Social Development Plan (PNDES) is implemented during the 2016-2020 period. The PNDES takes into account the lessons learnt from the assessment of the implementation of Burkina Faso's past socio-economic development strategies, and notably of the strategy for accelerated growth and sustainable development (SCADD). It is underpinned by a new dynamics of strong, sustainable and inclusive economic growth through the structural transformation of the economy. The plan seeks to "Build, along with the people, a country of democracy, economic and social progress, freedom and justice". The Volta programme will also follow other plans and strategies, such as:

- Projet de Plan d'Action pour la Gestion Intégrée des Ressources en Eau du Burkina Faso 2016-2030, 2014;
- Programme d'Action National d'Adaptation à la Variabilité et aux Changements Climatiques, 2007;
- Cadre Stratégique de Lutte contre la Pauvreté, 2004.

Poverty–Environment Initiative (PEI)

Poor people depend on the environment for their livelihoods and well-being. Improved management of the environment and natural resources contributes directly to poverty reduction, more sustainable livelihoods and pro-poor growth. To fight poverty, promote security and preserve the ecosystems that poor people rely on for their livelihoods, pro-poor economic growth and environmental sustainability must be placed at the heart of our economic policies, planning systems and institutions. To tackle this challenge, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UN Environment) joined hands and launched the Poverty-Environment Initiative. The Poverty-Environment Initiative is a global UN programme that helps countries to integrate poverty-environment linkages into national and sub-national development planning, from policymaking to budgeting, implementation and monitoring.

With both financial and technical support, UNDP and UN Environment assist government decision-makers and a wide range of other stakeholders to manage the environment in a way that improves livelihoods and leads to sustainable growth. The Initiative works with key government partners to raise awareness, influence policy making and strengthen the mainstreaming of poverty-environment into budget processes, sector programmes and sub-national planning. The overall

aim is to bring about lasting institutional change and to catalyse key actors to increase investment in pro-poor environmental and natural resource management.

Burkina Faso National Climate Change Adaptation Plan (NAP)[58] and Burkina Faso National Adaptation Programme of Action (NAPA)

National adaptation programmes of action (NAPAs) provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change; those for which further delay would increase vulnerability and/or costs at a later stage. Burkina Faso has identified major threats and priorities for Burkina Faso.
Climate Related Hazards:

- Strong decrease in water availability
- A drastic decrease and a deterioration of pastures
- Decrease of the biomass potential

Moreover, in coherence with the action 4 “Strenghtening the capacities of water agencies and other stakeholders” of the Projet de Plan d’Action pour la Gestion Intégrée des Ressources en Eau du Burkina Faso 2016-2030, the programme will strengthen policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels (component 3). Similarly, in light of Action 5 that supports a “National information system on water”, components 1.1. and 2.1 aim to develop a data collection and forecasting system (hydrological, meteorological and climatological) for the countries and the whole region. To achieve this goal, the programme will, among other activities, improve the existing data collection tools in each country, strengthening the human and technical capacities of the relevant agencies.

Benin

The Poverty-Environment Initiative (PEI) of the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UN Environment) helps the national government of Benin to identify opportunities and priorities for adopting integrated approaches to include pro-poor climate change adaptation and environment management into national policy, plan and budgets. The Volta programme will contribute to this goal by providing capacity development support to identify the priority areas and existing resources for adopting climate change adaptation and disaster risk reduction approaches. The other programme activities will help to:

1) Achieve the goal of the Intended Nationally Determined Contributions (INDC) in the Volta Basin regions of the Benin by integrating Climate Change issues in development plans, training of rural development actors, communities and local authorities on climate issues and the promotion of local knowledge for Floods and Drought management.
2) Mitigating the effects of climate change on agricultural production through Flood and Drought Warning system and concept of Integrated Flood and Drought management as specified in the various strategies of the National Agricultural Investment Program of Benin (NAIP 2010-2015) and Growth and Poverty Reduction Strategy (2011-2015)
3) The project activities such as capacity development of key stakeholders (environmental NGO’s) to adopt Natural and Nature-based solutions for Floods will help in implementation of the National Environmental Management Program (NEMP 2) of Benin.

[58] Burkina Faso National Climate Change Adaptation Plan (NAP)
http://www4.unfccc.int/nap/Documents/Parties/PNA_Version_version%20finale[Transmission].pdf

Ghana

National Environmental policies of Ghana

Several policies, bye-laws and regulations forbid the use of floodplains for infrastructure projects such as buildings, farming, mining etc.. The Environmental Assessment Regulation, LI 1652 of 1999 and the Strategic Environmental Assessment (SEA), drafted by the Metropolitan Municipal District Assemblies from the National Environmental Policy (NEP 1991), must protect the environment against such developments however they are not always fully enforced.

The EPA Act of 1994 (ACT 490) requires the preparation of an Environmental Impact Assessment for any activity with potentially negative impact on the environment. Based on the results of the assessment, the Environmental Protection Agency may issue an environmental permit for the developer. Environmental Protection Inspectors are supposed to be visiting floodplains often to control if they have been used for any development threatening the environment; they can impose to demolish or to stop them.

Ghana has adopted the Strategic Environmental Assessment (SEA) as a tool for mainstreaming environmental and climate change issues in all developmental projects or programmes including the Ghana Poverty Reduction Strategy (GPRS), the Ghana Shared Growth and Development Agenda (GSGDA) and thereby the District Medium Term Development Plans of the MMDAs in accordance with the National Development Planning commissions (NDPC) guidelines. The main aim of the SEA is to enhance the integration of national policies and development needs at the grass-roots starting from the District Assemblies which is the lowest level of governance for a more coordinated and improved decision making process in Ghana. It is mandatory or a requirement to all institutions to screen development projects, plans, programmes and policies using the SEA, to predict the impact of their policies, plans and programmes on the environment. SEA is used at the planning stage while Environmental Impact Assessment (EIA) is used at the design and implementation stage for most of the Basin Flood Management processes.

Issues on floods and drought are handled under the National Climate Change Policy (NCCP) drafted by the Ministry of Environment, Science, Technology and Innovation (MESTI) and approved in 2013 by the Cabinet of Ghana. The Volta programme will contribute to the implementation of the NCCP by focusing on 4 of its 7 pillars, namely: Governance and coordination, Capacity building, knowledge management and International cooperation by developing knowledge and coordinating efforts on climate change events. The National Climate Change Adaptation Strategy (NCCAS) specifically looks at

i. Ensuring a consistent, comprehensive and a targeted approach for increasing the resilience and decreasing the vulnerability of the population;
ii. Deepening the awareness and sensitization of the general population and policy makers in particular on their critical roles in enhancing national adaptation efforts;
iii. Strategically positioning the country to attract funding to meet its national adaptation needs;
iv. Strengthening international recognition to facilitate action; and
v. Facilitating the mainstreaming of climate change and disaster risk reduction into national development.

The national policies in Ghana are well advanced. However, guidelines to promote cross-border cooperation on extreme natural hazards, and particularly flood prevention, such as proposed in the Volta programme, need to be improved with joint implementation of transboundary activities to enhance the cooperation.

Togo

The Volta programme will contribute to the:

1) capacity development of local and national stakeholders to achieve the promotion of joint management of natural resources and the national policy on action for the environment of Togo.
2) priority measures identified in its Plan d'Action National d'Adaptation aux Changements Climatiques (NAPA) and Strategy for Accelerated Growth and Employment Promotion (SCAPE) 2013-2017, and contributes to the achievement of key objectives of the new program for sustainable development, following the MDGs.
3) National Strategy for Disaster Risk Reduction in Togo (December 2009) through the development of integrated flood and drought management resulting in enhanced preparedness for the climate change events.

Mali

The Volta programme will fully reflects the priority measures identified by the Mali government in its NAPA and improve the work carried out for the Hyogo Framework for Action for 2013-2015 and the national strategies for disaster risk reduction which contributes to the development and success of the country achieving the key objectives for sustainable development, following the Millennium Development Goals (MDGs).

Mali's National Adaptation Programme of Action (NAPA) 2007 is aimed at addressing the need to develop a realistically achievable country-driven program of action for adaptation to climate change in key vulnerable sectors, such as agriculture, water resources, and coastal zone. The Volta programme will improve the potential adaptation measures for water resources management through the development and implementation of flood and drought monitoring and early warning systems. The low adaptive capacity of Mali to respond to climate change impacts will be improved with better management of water resources, subsequently lifting their socio-economic conditions.

This project will be consistent with other strategies of Mali which are:

1) The Strategic Framework for Growth and Poverty Reduction (SFGPR, 2012-2017)
2) National Environmental Protection strategy to develop and support the implementation of participatory natural resource management programs which will reduce the effects of degradation, desertification and/or drought;
3) The national strategy for disaster risk reduction through prevention and management of disaster risks.
4) National Policy on Climate Change of Mali (NPCC) which has following objectives:
    - Strengthen the adaptability and resilience of ecological systems, economic systems and social systems to the effects of climate change through the integration of adaptation measures in priority to the most vulnerable sectors;
    - Build capacity for prevention and risk management and natural disasters;
    - Contribute to the global effort to stabilize greenhouse gas emissions in the atmosphere, particularly by promoting clean and sustainable projects;
    - Promote national research and technology transfer for climate change; and
    - Strengthening national capacities on climate change.
5) National, Regional and Local Plans Related to Disaster Risk Reduction and Preparedness by developing strategies for the integration of the Reducing Disaster Risk (RDR) in adaptation strategies to climate change.

Cote d'Ivoire

Cote d'Ivoire adopted a sustainable development strategy whose main components are defined in parallel to its national plan to combat degradation of environment and poverty. Also, Cote d'Ivoire

is advancing in the process to adapt National Adaptation Plan (NAP) identifying the key actions and financial needs to mainstream climate change adaptation (CCA). This project addresses livelihood (agriculture) and environment as a vulnerable sector to climate change and variability and will align with the implementation of national policies and programme focusing on disaster reduction and risk management, capacity building, training and institutional strengthening, data and information needs, public awareness, community participation and access to information, transboundary governance and international cooperation.

Additionally, the project will support Cote d'Ivoire National Strategy for Disaster Risk Reduction (DRR) by reducing the vulnerabilities and increasing the resilience to the extreme events such as floods and drought. There is a lack of capacity to undertake adaptive measures to address environmental problems and socio-economic costs of climate change and the project will develop the knowledge, skills and resources of the stakeholders.

F. Describe how the project / programme meets relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, etc., and complies with the Environmental and Social Policy of the Adaptation Fund.

The Volta programme will be aligned with the requirements of the March 2016 Revision of the Environmental and Social Policy (ESP) of the Adaptation Fund (see Part II: L). The Adaptation Fund-accredited Implementing Agency, WMO, together with the VBA, GWP-WAF and relevant national partners, will ensure that the programme follows procedures outlined in the ESP. This includes the requirement that activities funded by the Adaptation Fund reflect local circumstances and needs and draw upon national actors and capabilities.

In addition, the programme activities will be validated by national partners, including inter alia the Permanent Representatives of the National Meteorological and Hydrometeorological Services:

- Ministère des Travaux Publics et des Transports (MTPT) (Benin);
- Ministère des Transports (Cote d'Ivoire);
- Ministry of Communication (Ghana);
- Ministère des Travaux Publics, des Transports de l'urbanisme et de l'habitat (Togo);
- Ministère de l'Equipment, des Transports et du Désenclavement (Mali);
- Ministère des Infrastructures, du Désenclavement et des Transports (Burkina Faso).

The national partners will be consulted during the development of the full proposal to ensure that all activities comply with relevant national standards, as well as the environmental and other statutory laws and regulations of the six riparian countries. If required, Environmental Impact Assessments of the on-the ground activities will be undertaken.

Other national laws on environmental and social assessment in each of the countries will be followed during the programme design and implementation to ensure compliance and to complement with the ESP of Adaptation Fund. The following list of laws and regulations cover most of the fields that are included into the Volta programme: environment protection and impact assessment, sustainable development, water resources management, risk and crisis management, public participation, labour, regional and local responsibilities.

Benin[59]:

- ✓ Law No. 98-030 of 12 February 1999: Framework Law on the Environment in Benin;
- ✓ Law No. 2010-44 of 21 October 2010: water management in the Republic of Benin;
- ✓ Law No 87-016 Act of 21 September 1987: Water Legislation in Benin;
- ✓ Decree No. 2001-190 of 19 June 2001: organization of the Public Hearing process in Benin;

Burkina Faso:

- ✓ Law N° 005/97 / ADP of 30 January 1997: Environment Legislation in Burkina Faso;
- ✓ Law No. 14/96/ADP of 23 May 1996: Agrarian and Land Reform and Decree No. 97-054/PRES/PM/MEF of 6 February 1997;
- ✓ Decree No. 2001-342 / PRES / PM / MEE1 of 17 July 2001: scope and content of the Environmental Impact Assessment (EIA) and the Environmental Impact Notice (NIE) procedures;
- ✓ Law No. 008-2014 / AN: Orientation on Sustainable Development in Burkina Faso;
- ✓ Law No. 002-2001 / AN of 8 February 2001: Orientation law on water management;
- ✓ Law No. 012-2014/ 2014: Orientation for the prevention and risk, crisis, humanitarian and disaster management providing the composition of the platform at the national level with defined roles

Cote d'Ivoire[60]:

- ✓ Law No O96-766 of 3 October 1996: Environment Legislation (to set up the rules and procedures regarding the impact of development activities on the environment) of Côte d'Ivoire
- ✓ Law No. 98-755 of December 12, 1998: Water Legislation

Ghana:

- ✓ The Environmental Assessment Regulations 1999, L.I. 1652 and its Amendment Regulations, 2002;
- ✓ The Water Resources Commission Act 1996, Act 522;
- ✓ The Local Government Act 1993, Act 462;
- ✓ The Lands Commission (LC) was established by Article 258 of the 1992 Constitution and the Lands Commission Act, 2008 (Act 767)
- ✓ Town and Country Planning Ordinance (Cap. 84) No. 13 of 1945;
- ✓ The New Labour Act 2003, Act 651;
- ✓ The State Lands Act 1962, Act 125;
- ✓ The Lands (Statutory Wayleaves) Act, 1963;
- ✓ The Rivers Act, 1903.

Mali:

- ✓ Act No. 02-006/AN-RM of 31/01/2006 relative to the water legislation. The water legislation stipulates in its article 2 the rules of use, conservation, protection and management of water resources.
- ✓ The law N ° 08-033/AN-RM of 11 August 2008: classified installations for the protection of the environment;

[59] Legal documents extracted from Concept note submitted to Adaptation Fund https://www.adaptation-fund.org/wp-content/uploads/2016/08/PCN_FA_BOAD_ARAA_CLEAN-REVIEW-AOUT-2016.pdf for Benin, Burkina Faso, Ghana and Togo

[60] http://www.environnement.gouv.ci/

- ✓ Decree No. 06-258/P-RM of 22 June 2009: conditions for the implementation of the audit of the environment;
- ✓ The provisions of the legislation on environmental and social impact studies are based on the following principles:
  - The environmental assessment is an integral part of Programs and Projects and the results of the impact study are presented for approval by the administration;
  - The proponent is responsible for the completion of the study, of the constitution of the EIA documentation and provides costs;
  - The proponent also ensures the realization of measures of correction, reduction and/or compensation of the negative impacts of the Project, as well as the internal monitoring according to the required standards

Togo:

- ✓ Law N° 2008-005 30 May 2008: framework law on the environment;
- ✓ Decree No. 2006-058/PR of 05 July 2006 : list of jobs and activities subject to environmental impact assessment (EIA) and the main rules for this assessment;
- ✓ Order No. 18/MERF of 09 October 2006: terms and procedures of information and participation of the public in the EIA process;
- ✓ Order No. 013/MERF of 1 September 2006: regulation of the procedure, methodology and content of the environmental impact studies;
- ✓ Law N° 2007-011 of 13 March 2007: decentralization and local liberties.

G. Describe if there is duplication of project / programme with other funding sources, if any.

In the region, funding for environmental, disaster risk reduction and climate change projects has been, and still is, provided by UNDP, World Bank and other Development Banks, GEF, FAO, WWF, national development agencies (AFD, DANIDA), the European Commission, the Consultative Group on International Agricultural Research (CGIAR), the International Water Management Institute (IWMI), the Red Cross.

Several programmes and projects have already been screened for duplication and synergies: the currently endorsed concept note of the ADAPT-WAP project submitted by the Sahara and Sahel Observatory to the Adaptation Fund, CREWS-Burkina Faso, the Implementation Project of the Volta River basin Strategic Action Programme, the Flood and Drought Management Tools project (FDMT) in Ghana, the Oti River flood hazard assessment, the Climate and Development Programme (WACDEP), the WACA project on coastal floods, the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), Community Resilience Through Early Warning (CREW), the White Volta Warning and Flood Forecasting System, the Volta-HYCOS Project, the PAGEV 1 and 2 Projects for improving Water Governance in the Volta River Basin the GLOWA Volta Project. A summary of the main findings of this first survey based on existing reports, publication, and meetings with participants is presented in the following Table:

Projects	Objective	Possible Synergies
Integration Of Climate Change Adaptation And Mitigation Measures In The Concerted Management Of The WAP Transboundary Complex: Adapt-	The Adapt WAP project of the Sahara and Sahel Observatory (OSS) project is planning to establish a multi-risk early warning system (MREWS) over an area on the North-Eastern part of the Volta basin in Benin, Burkina Faso and Niger. The system aims at improving resilience of agricultural	Both projects will be able to learn from each other experiences and challenges, especially as OSS will be invited to participate to the advisory committee of the Volta programme. A part of the results and methodologies of Adapt-WAP will be complementary to the Volta programme as both projects aim at improving early warning: the type of information provided by the OSS multi-risk

WAP Project (in preparation) https://www.adaptation-fund.org/wp-content/uploads/2017/04/ADAPT-WAP-CN-OSS-AF-April2017.pdf	communities and vulnerable ecosystems.	early warning system (MREWS) could be integrated into VoltAlarm and therefore extended to the scale of the whole Volta basin. The methodology for crop warnings proposed in Adapt WAP could be linked to VoltAlarm similarly to an experiment on one of the pilot sites. Adaptation solutions of Adapt WAP to improve the resilience of ecosystems and livelihoods could be integrated while developing Components 2 and 3, and some of them could be further transferred in the different regions of the basin. Additionally, OSS could take an active role into the dissemination of information with a wide range of stakeholders, including decision-makers of Flood and Drought Management.
Strengthening national capacities for EWS Service Delivery in Burkina Faso (CREWS – Burkina Faso) (2017-2019) http://www.crews-initiative.org/en/projects/burkina-faso-strengthening-national-capacities-early-warning-system-service-delivery	CREWS project will improve the operational capacities in Burkina Faso to produce and deliver hydrometeorological services for flood early warning and risk information for agriculture and food security. Capacity development of the National Meteorological Service is part of CREWS, together with strengthening its cooperation with sectoral ministries and other stakeholders.	The Volta programme will fully benefit of the efforts of CREWS Burkina Faso in strengthening the hydrometeorological observation network in Burkina Faso and in developing monitoring and forecasting capacities. The coordination and transfer of knowledge will be facilitated as both projects are under the responsibility of WMO and follow each other in time. The institutional strengthening during CREWS will be useful in developing capacities for floods forecasting and early warning systems and the trained experts could be used to disseminate knowledge and skills to the stakeholders of other countries in the Volta Basin. Moreover, the Monitoring and Evaluation tool of CREWS will be used to follow the development of the products and services delivered through the Volta programme. In the future, other national components of CREWS in Mali and West Africa could provide support for developing a Flash Flood Guidance Systems (FFGS), a platform supported by USAID and WMO, which could further be linked to VoltAlarm.
The Implementation Project of the Volta River Basin Strategic Action Programme (2015-2019) http://documents.worldbank.org/curated/en/443971468171858975/pdf/PAD1287-PAD-P149969-GEF-R2015-0009-1-IDA-	The SAP implementation project objectives are to strengthen capacities of the VBA for transboundary water resources management and to implement priority actions of the Strategic Action Programme (SAP) resulting in direct environmental and livelihood benefits. The project components include the development of an agreement on	The coordination between both projects/programmes will be facilitated through the involvement of VBA as executing entity in the Volta programme. The Water Charter will clarify the contribution of the riparian countries with regards to transboundary water resources use, hydro-meteorological data and information sharing polices and plans and participation in decision making. The Volta programme will implement and continue the activities of the

R2015-0101-1-Box391422B-OUO-9.pdf	the roles and responsibilities of the countries, called Water Charter, and activities of facilitate dialogue and communication,	Communication Strategy and Plan.
Flood and Drought Management Tools (FDMT) Project (2014-2018) http://www.flooddroughtmonitor.com and http://fdmt.iwlearn.org/	Funded by GEF through the United Nations Environment Programme (UNEP), the FDM project aims at developing methodologies and tools to produce information on risks and support decision-making for integrated water resources management. The Volta Basin is one of its three pilot basins.	The tools, methodologies and information supporting the FDMT website will be integrated into the design of the VoltAlarm platform. Linkage between the FDMT and the VCERs databases will be evaluated. The selection of indicators for drought onset will also be coordinated between both FDMT and the Volta programme.
The Oti River flood hazard assessment in Ghana and Togo (2016-2017) http://www.worldbank.org/en/news/feature/2016/08/08/expanding-flood-resilience-in-the-volta-basin-with-expertise-and-support-from-japan	Supported by the World Bank and GFDRR and Japan, the project aims at increasing flood preparedness by setting up a Flood Early Warning system, developing flood hazard and risk maps, capacity development of local experts, and basic input into Emergency Preparedness Plans.	The Volta programme will build on the experience gained while developing the hydrological and 1D/2D hydraulic models (digital terrain model, gauging sections and rating curves, real time data transmission etc.), the databases, the dissemination interface of the Flood Early Warning System (FEWS), and the capacity building activities. The assessment of the success criteria of the Oti project will be used, together with the expertise of WB, to define where similar flood risks maps, flood forecasting and early warning system could be developed for other sub-basins.
Water, Climate and Development Programme (WACDEP) in the Volta Basin (2011-2017) http://www.gwp.org/en/WACDEP/ABOUT/Outcomes	The goal of WACDEP is to promote water as a key part of sustainable national and regional development and contribute to climate change adaptation for economic growth and human security. Since 2016, GWP and WMO supported the initiative of the six riparian countries to assess their needs for integrated flood management and further build their capacities for developing bankable project proposal	Disaster risk reduction strategies, risk culture, availability of data and early warning systems have been identifies as major areas of concern. The fields of governance, organisation of actions between technical services and decision making institutions, as well as engagement of local partners must especially be developed. The Volta programme is designed to fulfil these needs with the engagement of partners at transboundary, national and local level, while adding the dimension of the impact of climate change.
The West Africa Coastal Areas Management Program (WACA) (2015-on-going) http://www.worldbank.org/en/programs/west-africa-coastal-areas-management-program	Funded by the World Bank, the West Africa Coastal Areas Management Program (WACA) provides convening platform that helps countries access expertise and finance to sustainably manage growing coastal erosion and flooding problems. Countries already participating in the program include Benin, Côte d'Ivoire, Ghana, and Togo.	The Volta programme will collaborate with WACA to gain technical expertise in identify the needs and proposing adequate early warning solutions for coastal floods to be possibly included in the future into the VoltAlarm system.
The West African Science Service Centre on Climate Change and Adapted	WASCAL is a research-focused program designed to help tackle the challenge of climate change in West Africa and thereby enhance	Link with the WASCAL Centre will be initiated to benefit of its infrastructures, databases and research capacities and experience in the field of vulnerability, capacities, exposure

Land Use (WASCAL) (on-going) http://www.wascal.org/	the resilience of human and environmental systems to climate change and increased variability.	and risks related to Floods and Drought Events, as well as trends in global climate and land-use changes on water resources in the Volta basin.
Community Resilience Through Early Warning (CREW) in Ghana (2014-2016) http://www.gh.undp.org/content/ghana/en/home/operations/projects/environment_and_energy/crew.html	CREW developed drought and flood hazard, vulnerability and risk maps at national level and for 10 pilot areas throughout Ghana. National maps were developed with open source data sets for the current situation and future scenario in 2050. District maps were developed with a digital terrain model. A drought and flood early warnings system was developed in the 10 pilot areas. Training and communication at national and community level were organized to raise capacity of stakeholders on the maps and EWS.	The Volta programme will benefit of the CREW methodologies, tools and database structure while developing the risk maps, the early warning system VoltAlarm, and the capacity building activities. Most of the results obtained during CREW should be integrated into the VCERs assessment for Ghana. The national masterplan for EWS implementation of CREW will also be useful to enlarge the methodology over the whole basin. The flood and drought EWS developed for the 10 pilot sites will be a source of knowledge, or even a transfer of methodologies, when developing VoltAlarm. The experience gained during the pilot testing will also be used when making the final selection the Volta programme pilot sites in Ghana. Indeed, the trained groups of people of CREW could help to disseminate the knowledge and tools to other stakeholders of pilot testing areas.
The White Volta Warning and Flood Forecasting System (2012-2016) http://www.worldbank.org/en/news/feature/2014/10/01/drmhubtokyo-country-program-ghana-strengthening-flood-management-in-volta-basin	The World Bank with resources from the Global Facility for Disaster Reduction and Recovery (GFDRR) financed the development of a flood forecasting system on more than 800km of the White Volta River from the border with Burkina Faso to Lake Volta. This forecasting system is operational since 2012.	Component 2 of the Volta programme will build on the existing flood forecasting capacities and integrate the output of the early warning system on the White Volta into the global VoltAlarm system. The White Volta programme provides experiences on the challenges, and lesson learnt during the implementation phase of a forecasting system and address also the issues of the sustainability of the flood forecasting and early warning system.
The Volta-HYCOS Project (part of the larger World Hydrological Cycle Observing System) (2006-2015) http://www.whycos.org/whycos/projects/under-implementation/volta-hycos	Volta HYCOS has been funded by the Fonds Français pour l'Environnement Mondial (FFEM) and the AFD between 2006 and 2009 and then by the African Water Facility (AWF) of the African Development Bank (AfDB) from 2011 to 2015. The project provided reliable water resources information through the improvement of hydrological data collection infrastructure and data management in the Volta basin member countries. The exchange of information on water resources facilitated national and regional development.	Through the coordination within WMO of the expert teams on hydrology and hydrometry, the Volta programme will benefit of the existing HYCOS services and further improve the hydrological observations networks and the data collection procedures for flood and drought forecasting and early warning systems. The link with the WHYCOS system will ensure that the results of the Volta programme will be embedded into global platforms and will be made available at larger scale.
PAGEV 1 and 2	Both PAGEV projects improved	The Volta programme will benefit of the

Project for improving Water Governance in the Volta River Basin (2004-2011) https://www.iucn.org/sites/dev/files/import/downloads/pagev_annual_report_05_fr.pdf and http://cmsdata.iucn.org/downloads/pagev_ii.pdf	water management practices and water governance in the region of Burkina Faso and Ghana. PAGEV 1 initiated policy dialogues by the establishment of multi-stakeholder platforms at community and national level to support ecosystem restoration. PAGEV 2 concentrated on the compilation of knowledge for decision support, capacity building on IWRM and improvement of the governance framework of the basin.	PAGEV experience gained on participatory governance for the joint management of water resources. The transfer of knowledge will be facilitated through the participation of the VBA in the Volta programme, which has been involved in PAGEV in particular through the Volta Observatory. The network of national agencies, decentralized institutions and civil society organizations involved into PAGEV will be a valuable resource when selecting partners and pilot sites for the Volta programme
The GLOWA Volta Project funded by the Centre for Development Research (ZEF) (2000-2009) https://www.zef.de/projects/project-details.html?project=53&contact=1423&cHash=aa9e032807820a6d8d6db3c50a4dcdca	GLOWA promoted sustainable water use under changing land use, rainfall variability and water demands in the Volta Basin. Information and tools concerned: • Water Allocation System that allows incorporating the impact of possible future climate conditions and projected water demand of the Volta Basin countries • GLOWA Volta Geoportal, transferred to VBA • High-resolution Regional Climate Modelling • Predicting the Onset of the Rainy Season	Even though GLOWA is now about 10 years old, the Volta programme will look for synergies with the experiences and services developed through the GLOWA project, such as the GLOWA Volta Geoportal which has been transferred to VBA, and the climate modelling which allowed to forecasts and deliver information about the incoming rainfall to farmers in the region to plan and avoid economic loss due to floods and drought. The communities trained during GLOWA could be efficient partners for the pilot testing of the Volta programme

H. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

Components 1, 2 and 3 include dedicated outputs related to the documentation and dissemination of knowledge generated through the proposed activities. The dissemination of knowledge and good practices will enhance the learning achievements and could further facilitate the replication of success stories by government agencies and communities facing similar issues in other regions or globally. Different ways are planned to ensure proper coordination and to widen the dissemination of the programme outputs to a larger circle of institutions and communities in the six riparian countries of the Volta Basin.

1) **Knowledge Management and Experience sharing**
   - ✓ Development of e-learning module(s) for capacity building of key stakeholders. Online learning and training will be an option for those (e.g. representatives, local agencies, etc.) who cannot attend events, conferences and workshops. The modules will be accessible to the programme stakeholders and to a certain extent to the general public and local organizations.
   - ✓ As solutions should be co-designed, co-developed and co-implemented in a trans-disciplinary, multi-stakeholder and participatory context, a “Living lab” could be also created in the frame of the proposed Volta programme. In this “Living lab”, citizens, organizations, policy-makers and other stakeholders will be involved in a multidisciplinary approach where each participant could contribute with his knowledge and experience about the Floods and Drought Management and/or EWS. Discussions

and exercises in groups, round tables and/or presentations could be implemented to stimulate discussions, as well as to develop and test innovative solutions in real world conditions.

- ✓ The programme also envisage to create a Community of Users (CoU) to coordinate a collaborative effort between civil society, community groups, private companies, research institutions, international organizations, and public sector to exchange knowledge, share expertise and discuss about best practices.
- ✓ The contribution to the Community of Practice on Flood Management and End-to-End Early Warning Systems which is being created in the framework of the activities of the WMO Commission for Hydrology.

2) **Outreach to the wider public**

- ✓ Facebook, LinkedIn and Twitter will serve as a wider dissemination strategy to update information, specially targeting the young generation.
- ✓ Mass media channel such as radio services will also be one effective information dissemination strategies as it is widely used in the Volta countries.
- ✓ Leaflets and panels (in the buildings of the partners and on the pilot sites) highlighting the lessons learned and success stories will be shared with stakeholders and in social media for the general public, emphasizing the importance of the programme activities and achievements.
- ✓ Other dissemination tools such as videos, comic books and infographics will be used to reach a wider non-specialized public, using a non-technical language and, if necessary, local language of the member countries. The comic books and case studies could be turned into videos with a storyboard avoiding scientific terms. With the contribution of WWF, the content of the Flood Green Guide could be divided by themes or chapters to develop a series of 2-5 minutes' video that could be part of training materials.
- ✓ The APFM Support-Base Partner UNESCO-IHE will be contacted to develop IFM decision-support games such as SimBasin, highlighting the importance of Nature Base Solutions to improve flood mitigation strategies.

3) **Technical reports/documents and dissemination of the programme results:**

- ✓ The programme activity reports (both in English and French, and when needed in local language) will be disseminated via a web portal, briefs to stakeholders, press releases, national and climate change and disaster risk reduction forums, scientific publications and development of awareness raising tools (digital storytelling, video, success stories etc.)

4) **Post-programme completion assessment**

- ✓ A post-programme assessment activity will be conducted with the government representatives and focal point of communities to determine the lessons learned, impacts and sustainability. The assessment report will be prepared and shared with relevant organisations for any follow-up activities.

5) **Crisis communication**

- ✓ Presently, communications between agencies occur always through phone calls, emails and short messaging service. Automatic systems are not in place to monitor the activities of all others and trigger an emergency alert. The development of a communication procedure between the partners and the decision-makers will be one of the solutions provided on the VoltAlarm platform
- ✓ The use of social media such as Whatsapp, Facebook and Twitter for communication between the institutions will also be given some attention[61].

[61] Need assessment report of the Ghana, 2016 (unpublished)

6) **Organisation and participation to conferences and other events**
   - ✓ Workshop involving partners, key stakeholders, end-users, beneficiaries and international partners will be organized about once a year to present the progress of the programme and to ensure a larger communication outside of the basin, the exchange of information, collection of feedback and coordination of activities.
   - ✓ The participation to conferences, meetings, workshops and trainings of the programme partners will provide the opportunity to discuss information and findings about Integrated Floods and Drought Management-EWS approach and tailored materials for the different stakeholders in the Volta basin.

7) **Dissemination of results through external institutions**
   - ✓ Development and humanitarian agencies, NGOs and other actors in charge of the implementation of programmes could use the flood and drought management products and develop actions in their field of competence (e.g. identification of community-based flood management solutions for populations living in small catchments of the basin).
   - ✓ Similarly, researchers and other public institutions could work on the base of the actions developed under the Volta Programme, to further engage in the development of adaptation measures (e.g. assessing climate change impacts and solutions in specific locations).
   - ✓ Through collaboration with the national institutions responsible for technological transfer, private companies working on innovative solutions will be contacted to develop national projects that integrate our identified solutions and disseminate them within their areas of work/sectors.

8) **Integration of best practices into the WMO, GWP and VBA communication and guidance materials**
   - ✓ The success stories and progress of the Volta programme will be published using the communication media of the implementing and executing entities
   - ✓ New guidance material in the line of the APFM Tools series http://www.floodmanagement.info/tools/ could be drafted to promote the results of the Volta programme, as well as the case studies on the basis of the pilot testing.

I. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations, in compliance with the Environmental and Social Policy of the Adaptation Fund.

The potential stakeholders and partners of the programme were identified and consulted not only during the development of the pre-concept and concept note but since several years through the GWP and WMO projects and activities in the region.

Already in 2013, the Country Water Partnerships (CWP) of Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali and Togo contacted the GWP-WMO Associated Programme on Flood Management (APFM) to assess their needs for capacity building on the IFM concept and for support in preparing projects on flood management. A first consultation was organized:

- ✓ at institutional level, it included city mayors, representative of associations of municipalities, stakeholders from the Meteorological Services, the General Directorate for Water Resources, from the Civil Protection Services and focal points for flood management and early warning systems[62],

[62] As stated in the Annexes of the country Needs Assessment reports (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali, Togo), 2016, Unpublished GWP report

- ✓ at community level, NGOs, universities and representatives of flood-prone communities (women, elderly, youths) have been directly consulted by the international consultants of the countries to gather the required information on flood management
- ✓ Additionally, stakeholders (local policy makers, development and humanitarian agencies, private companies etc.) from the past and on-going projects were regularly involved in consultative missions to assess the shortcomings, sharing of the resources, understand the short-term and long-term impacts.

Through various studies and discussions, needs assessment reports were drafted by the national consultants in 2016 for each riparian country highlighting major issues and priorities of actions for flood management.

Other key stakeholders were consulted in the framework of the GWP-WMO current activities in the Volta basin, such as the GWP Water, Climate and Development Programme (WACDEP), the African Network of Basin Organizations (ANBO). Later, the submitted draft need assessment reports of the six countries were reviewed by APFM. All this information was used to design the Volta programme "Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin".

Both Executing Entities of the programme, GWP-West Africa and VBA, have been a critical facilitator during the consultation process functioning in close partnership with the Ministry of Environment, Ministry of Development, and Ministry of Water resources management working together in many development projects in the six countries.

Before summer 2017, GWP-West Africa and VBA were consulted during the development of the pre-concept note for the Adaptation Fund and finally the draft pre-concept was shared with the WMO Permanent Representatives of the six countries who contacted the Designated Authorities for their feedback and approval.

In the fall of 2017, APFM conducted a joint workshop in partnership with GWP-West Africa and VBA in Burkina Faso during November 20th-24th 2017 involving representatives and other stakeholders of the Volta Basin. The purposes of the consultation workshop were to:

- ✓ Introduce the programme concept;
- ✓ Receive preliminary comments and suggestions;
- ✓ Collect information regarding Volta basin background, climate change variabilities, flood and drought events, environment, social and gender policies and other observations by the local stakeholders;
- ✓ Consult on the proposed activities to be carried out in the framework of the project and pilot site selection for the testing or demonstration of adaptation interventions;
- ✓ Exchange on the long-term sustainability of the programme activities;
- ✓ Consult on the multi-level engagement, roles and responsibilities of potential national, sub-national and local partners working in climate, water, ecosystem and development sector.
- ✓ Introduce the role of women and youths in the programme activities and benefits thereafter;
- ✓ Foster synergies and add-ons to other similar projects (completed or ongoing)
- ✓ Discuss the need for knowledge, skills and tools sharing through multi-media communication aimed at the other beneficiaries and actors outside the programme locations;

Some 40 experts of the six countries were invited to the November 2017 consultation workshop, jointly organized by GWP/WAF, VBA and WMO, including representatives of:

- Ministries in charge of Water, Environment and Sustainable Development in the six countries (MCVDD/Benin; MINEF, MINSEDD, ME-ONEP/Cote d'Ivoire; WRC/Ghana; MEADD, MEE/Mali; MERF, MAEH/Togo)
- Meteorological services (ANAM/Burkina Faso, SODEXAM/Cote d'Ivoire, METEO Mali)
- Ministry in charge of civil protection (CONASUR/Burkina Faso),
- Regional authority (ALG/Burkina Faso)
- Country Water Partnerships (Benin, Burkina Faso, Cote d'Ivoire, Ghana
- Transboundary basins commissions/organizations,
    - the Water Resources Coordination Centre/ Economic Community of West African States (ECOWAS),
    - the West African Economic and Monetary Union (UEMOA)
    - l'Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS)
- International Union for Conservation of Nature (IUCN)

to gain an overall understanding of the context and integrate each of the vulnerable sectors into the decision-making (see complete list of participants in Annex 1)

The major outcomes of the workshop are: i) the representative of the participating countries expressed strong interest and consensus for the Volta programme, as it will not only benefit the local communities and beneficiaries, the property and livelihoods to be safeguarded from the extreme weather events, but also institutional and agencies which value the consistency of the programme with local and national development priorities; ii) information available at VBA (Volta Basin maps, shape files, programme reports etc.), suggestions and comments were received and have been incorporated into this concept note; iii) the countries will provide support and participation to the adaptation measures and capacity development activities; iv) the countries expressed interest in continuing the activities after the programme period, taking ownership for sustainability and v) the countries agreed to work in coordination and collaboration with different actors and stakeholders at national and transboundary level.

The countries representatives agreed to provide later the lists of pilot sites where the programme activities could be demonstrated and other informations as and when required. The inputs of the stakeholders were integrated in the various components and activities to be implemented under the proposed programme.

Lately, technical meeting were organised with the teams of on-going programmes to discuss the transfer of knowledge from these projects to the Volta programme:

- HKV consultants, Netherlands[63] were consulted to exchange about their experience of working in Ghana with local communities and the Ghana National Disaster Management Agency (NADMO) on the project "Community Resilience Through Early Warning (CREW)" between 2014-2016. The consultation provided information on the activities, pilot test sites, challenges, etc. of the CREW project. HKV consultants are interested to provide additional information and technical support during the next phase of the programme development, APFM is planning to develop in the next stage:
    - ✓ An advisory committee which will be set up with representatives of the major on-going and planned projects to share exchange of experience and methodologies, and to define coordination activities.
    - ✓ An expert group will be created to discuss technical issues and provide advice to the executing entities.
- Similarly, the International Water Association was also consulted about their experience from the Flood and Drought Management Tool (FDMT) project in the Volta Basin. The

[63] https://www.hkv.nl/en/

discussion helped in understanding the FDMT project activities, available tools for the flood and drought management. Moreover, the Volta programme was presented during the recently concluded training workshop on "Flood and drought tools for basin planning" held at the WMO secretariat on 14th December 2017. The participants from various international organizations such as IWA, United Nations Economic Commission for Europe (UNECE), DHI and some 15 transboundary basins authorities over the world provided constructive comments and suggestions to the FDMT tool which could be integrated into the Volta programme activities.

A new series of consultations is foreseen during the final proposal preparation phase to verify and validate the roles and responsibilities of the implementing entities, and to agree about the budget distribution and the work schedule within the project partners. An additional major activity to be conducted during the same period is related to the assessment of the potential social and environmental impacts of the proposed programme activities aligning with the Environment, Social and Gender policies of the Adaptation Fund. The consultation will allow to reach the general population and communities by conducting semi-structured interviews, focus-group discussions or workshops during field visits, focusing on the minority groups, women, marginalized and vulnerable groups and indigenous people (selection of members will be through age, gender, social position and other aspects) prone to extreme hydrometeorological events and to the effect of climate change. The consultation process will provide information on acceptance of programme activities by the communities and on their willingness to take roles and responsibilities in the Environment and Social Risk Management Plan (ESRMP). Special attention will be given to generate consensus from every stakeholders to allow active participation of women and other vulnerable groups in all proposed activities ensuring successful implementation and sustainability of the programme.

The consultation will also provide the opportunity to get feed-back about the high-fidelity prototype of VoltAlarm early warning system envisaged by WMO and national partners (attached in Annex 2). The proposed functionalities (language, type of information, forms of warning etc.) and benefits of the VoltAlarm service will be discussed with the participants so that their views, suggestions will be acknowledged and incorporated in the final design and development of the web-based early warning system. Additionally, the consulted members can suggest further requirements or functionalities in the VoltAlarm to provide better sourcing, access and delivery of the early warning information to every section of the communities (potentially have a last-mile connectivity) prone to floods and drought.

J. Provide justification for funding requested, focusing on the full cost of adaptation reasoning.

Climate changes have been severely affecting the Volta Basin countries with regular and large-scale floods and drought events especially impacting agriculture and ecosystems. The government of the six riparian countries are developing and implementing various strategies and action plans to be better prepared to these extreme events, with technical and financial support from partners and agencies.

The Adaptation Fund will support the Volta programme to expand on, and complement existing projects, in accordance with the development priorities of the countries in the urban and rural areas. The yearly flood and drought events have reduced community capabilities and their investments in socio-economic growth, such as houses, assets, livestock, food security etc. The proposed programme will provide benefits to both communities and agencies and opportunities to work in a coordinated and collaborated way achieving long-term adaptation measures for Flood and Drought management. The need for concrete adaptation measures to extreme events is an important requirement for the six riparian according to the initial consultation by WMO and GWP

with the stakeholders of the Volta Basin. The Volta programme includes the following components for developing adaptation measures and capacities:

Component 1: Develop capacity and establish frameworks at the local, national and regional levels to ensure risk informed decision-making
Baseline situation (without any support from the Adaptation Fund)

In general, 80 percent of the land and natural resources in the Volta Basin region are prone to Floods and Drought events. The hydrological and meteorological characteristics of the Volta Basin and the projected climate change impacts on socio-economic vulnerabilities have not been adequately addressed and incorporated into development planning and other land use practices over the years. The government agencies of the countries also lack adequate information about the increasing risks related to extreme events, resulting in improper planning and decision-making for flood and drought management. Therefore, private and community infrastructures and natural resources are continuously exposed to climate variability, resulting in damage and degradation of adaptive capacities.

Impact due to the proposed programme (with the support of Adaptation Fund)
The Volta programme plans detailed assessments of vulnerabilities, capacities and exposure to Floods and Drought events in the Volta Basin countries and the development of the related risk maps. Moreover, the programme will help in the development of risk management framework and capacities of the stakeholders (especially policy-makers, disaster managers etc.) to take risk informed decision-making for Floods and Drought events. In addition, the programme will bridge the gap in adaptation measures to integrate future scenarios (economic, urban, climate, environment, etc.) into current knowledge (risks mapping, hydrometeorological features) and practices to improve the future planning and design of concrete adaptation measures or interventions. For this purpose, synergies will be created between country level projects or programmes on climate change adaptation to develop integrated Flood and Drought management strategies and approaches at regional level.

Component 2: Develop concrete adaptation and environmentally friendly actions with an integrated approach

Baseline situation (without any support from the Adaptation Fund)
Presently there is no systematic measurement practices appropriate for Floods and Drought forecasting over a large part in the Volta Basin (at the exception of the White Volta and Oti basin). The available instruments such as radars, sensors and gauges provide information but there is no timely availability of Flood and Drought forecasting and warning information to the communities prone to these hazards. The existing Flood and Drought preparedness and response measures are ineffective, due to the lack of technical capabilities of various national agencies working on Floods and Drought management. Without AF support, the situation will not change, or even deteriorate, and the population in the six Volta Basin riparian countries will continue to remain highly exposed to extreme weather, water and climate events and face consequent damages. Additionally, local actors and flood prone communities lack knowledge and tools for mainstreaming Gender and developing natural and nature-based solutions for flood management, however they have useful traditional solutions and adhoc experiences which need to be captured and improved in new Flood and Drought management strategies.

Impact due to the proposed programme (with the support of Adaptation Fund)
The Volta programme will support the development and implementation of VoltAlarm, an End-to-End Early Warning System for both Floods and Drought resulting in tailored hydrometeorological information services for the agencies, communities and the general public. The AF support will be used to strengthen data collection, transfer and management from the existing instruments on the

Volta Basin and from external sources (NWP, global platforms, satellite data etc.): this is a mandatory step towards a robust and appropriate network for forecasting and early warning information. The GIS-based early warning information system will be developed for the beneficiaries at all level made of simple colour coded graphs and risks zoning, as proposed in the VoltAlarm prototype. The EWS will improve the stakeholder's capacities to take decisions and prepare for reducing impacts and if required, implement alternative practices. These systems will be more efficient with improved coordination between the hydrometeorological services, the other concerned departments at local and national levels and the communities prone to floods and drought. The capacity development activities, such as gender mainstreaming for End-to-End Early Warning Systems for Floods and Integrated Flood and Drought Management through natural and nature-based solutions will help in developing pro-active approaches to account for climate change variability.

Component 3: Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels

Baseline situation (without any support from the Adaptation Fund)
Although the Volta Basin countries have recognized the need to adapt to climate change variability, the existing governance structure at the transboundary and national levels does not provide coordination and collaboration in water and natural resources management. The policies, guidelines or plans for collecting and sharing data and information related to hydrometeorological conditions are not yet enforced to improve preparedness to extreme events. The shortage of policies, plans and strategies at local, national and transboundary level for the management of short- to medium-term disaster risks exposes the Volta Basin population to non-sustainable socio-economic conditions.

Impact due to the proposed programme (with the support of Adaptation Fund)
The AF support will allow to develop an enabling environment between local, national and international actors and stakeholders. Systematic coordination between six riparian countries will facilitate the achievement of the common objective to develop concrete risk reduction and climate adaptation measures. Additionally, the programme will develop capacities of beneficiaries to review or develop new policy frameworks to integrate climate risks to land, water, environment, livelihood with development plans and practices at local, national and transboundary level on the Volta Basin.

K. Describe how the sustainability of the project/programme outcomes has been taken into account when designing the project / programme.

Programme sustainability will be achieved through close collaboration and capacity building of stakeholders at all levels i.e. local, national and transboundary ensuring their long term commitments for climate change adaptation activities and services. The participatory consultative process during the programme preparation phase ensured that the stakeholders' needs are properly addressed. Individuals of communities (adults, elderly, women and youths) will be involved in identifying their expectations and contributions to implement effective Floods and Drought management in the Volta basin. The wide curriculum of trainings covering aspects ranging from hazard and risk mapping, water balance, hydrological outlooks, community based flood management, roving seminars for farmers on agro-meteorology, integrated drought management to End-to-End Early Warning Systems for flood management etc. will provide technical support and new decision-support tools for the operational centres. The joint activities of the partner organisations, such as requirements specifications, installation of equipment in the NMHSs and provision of new information to the public, field work in the pilot testing locations will also foster

exchanges, create groups of users and form trainers, who will take up project ownership in the future and prolong the programme efforts.

For the outcomes of component 1: Long term sustainability will be developed by facilitating participatory stakeholder engagement and knowledge exchange between local communities and government agencies. By showing if, how and when, the risks for Floods and Drought events will change over short and longer periods in the Volta basin, the stakeholders will become aware of the value of the vulnerability, capacity, exposure and risks assessment activities, the related alteration of the risks factors for Floods and Drought and their impact on their daily life. Hence, the periodical assessment of the VCERs will need to be developed by the national agencies to update the associated Flood and Drought risk maps of their communities in order to be prepared for climate related extreme events. Local communities will, therefore, be incentivized to continue implementing and maintaining the various outputs under component 1 upon which their lives and livelihoods depend. This will encourage programme sustainability at both the community and government/agencies levels.

For the outcomes of component 2: Long term maintenance of the tools and methodologies for the activities under component 2 will be sought through commitment of the countries to provide sufficient resources for the sustainability of the new system. WMO will build on lasting collaborations with the Volta basin countries, as the pilot project AOC-HYCOS and the subsequent Volta-HYCOS programme were endorsed 15 years ago by the six countries. The Flood forecasting and Early Warning Systems (EWS) for Floods and Drought, as envisaged in the VoltAlarm prototype, will be developed and used by the actors of national agencies, especially the representatives of NMHSs, VBA, the Country Water Partnerships and national disaster management authorities. The long term share of duties and responsibilities for the Flood forecasting and EWS will be taken up by VBA and the NMHSs, with support at governmental level in the Ministries. Additional institutions involvement will be discussed during the capacity development activities of component 2.1.

Regarding component 2.2, the involvement of vulnerable groups, will be assisted with the coordination of WMO and GWP-WAF on issues related to gender mainstreaming and natural and nature-based solutions for Floods. In the future, APFM will provide technical assistance to the countries agencies to develop bankable project proposals to get funding for local projects and in particular for the implementation of the natural and nature-based solutions for Floods. Moreover, other funding sources, such as the National Environment and Climate Fund of Benin (FNEC) could finance national projects for the additional themes identified during or after the completion of the proposed Volta programme in order to gain long term sustainability of the programme outputs. A large dissemination of the programme results will be ensured by the involvement of a large network of partners (NMHSs and related agencies, country partners of GWP-WAF, VBA partners).

For the outcomes of component 3: The involvement of VBA and OSS is extremely valuable to ensure the temporal dimension of component 3, and specifically the sustainability and long-term effects of data sharing policies, sustainable development plans and practices and code of conducts at the local, national and transboundary scales. VBA will extend its operational role and maintain the programme results on the longer term, therefore contributing to the implementation of the Volta basin Strategic Action Programme (SAP). Major institutions in charge of coordination and civil defence activities from national to local level will be integrated while detailing, and later implementing, the programme components: such as for example NADMO and the Water Resource Commission in Ghana, the General Directorate of Water Resources (DGRE), the Permanent Secretariat of the Action Plan for Integrated Water Resources Management (SP-PAGIRE), CONASUR and CONEDD in Burkina Faso, and the similar institutions in the four other countries of the basin. They all will integrate some of the innovation and methodologies of the Volta programme into their procedures after contributing to the training and operational activities.

The methodologies adopted and trained resources (both agencies and communities) programme are expected to be a support for other actors and stakeholders in developing floods and drought risks maps, climate change scenarios and GIS-based early warning system of their respective countries (regions outside of the Volta Basin). Furthermore, through the collaborative process with external entities, including among others OSS, other Basin Authorities, economic commissions, international organizations etc. the Volta programme results, experiences and success stories will be further disseminated into the whole West African region, as illustrated in Figure 14.

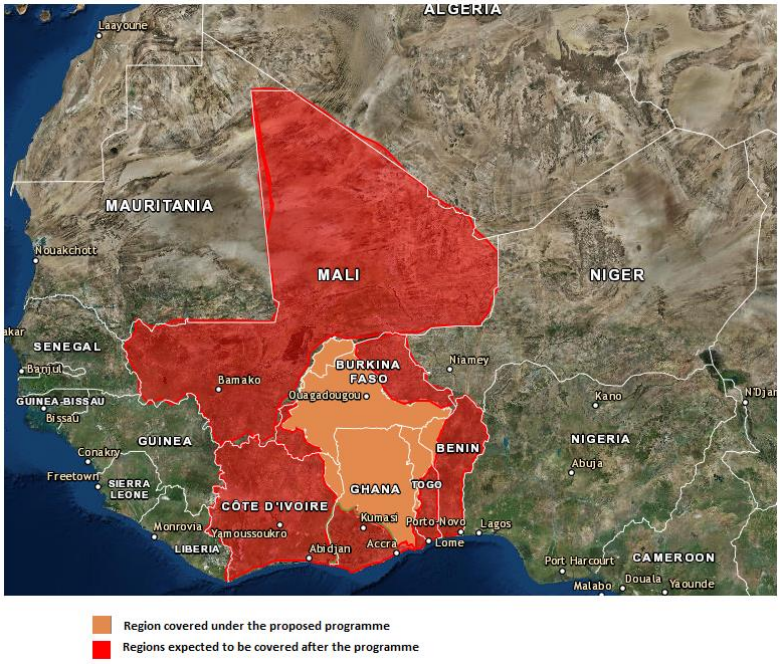


Figure 14: Areas of transfer of knowledge to provide long-term sustainability

Funding organisations will be invited to follow the programme success stories, as an example, the National Environment and Climate Fund of Benin (FNEC), as financing instrument of national environment and climate projects, FNEC will be able to contribute to the identification and implementation of community centred climate change adaptation and green infrastructures solutions on the Benin territory. FNEC could provide assistance in the strengthening of regional and national institutions during the continuous monitoring and reporting of the programme activities. FNEC will be able to contribute to the governance structure of the programme, either directly by participating to the advisory basin committee, or by proposing experts from the thematic groups. In the future, FNEC could also finance national projects for the additional themes identified during or after the completion of the proposed Volta programme in order to gain long term sustainability of the programme outputs.

L. Provide an overview of the environmental and social impacts and risks identified as being relevant to the project / programme.

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law	The programme will ensure that the existing national and transboundary laws, policies and guidelines of Volta Basin will be followed during the implementation of adaptation measures or in capacity development activities. If required international laws on data sharing protocol among different countries will be consulted. During the design of the programme specially component 3.1: both regional and national stakeholders will be consulted to update data sharing protocol/laws between the six countries.	
Access and Equity	The programme will provide impartial and equitable access to programme benefits. The programme design is developed to allow representative of vulnerable groups in every capacity development trainings/workshops. The selected participants are expected to disseminate the training knowledge to other members of communities or organisations so that everyone will have fair and equitable access to all programme benefits. The selection of beneficiaries will also be made in consultation with local practices, traditions and access to social facilities.	However, the programme has capacity development activities to which only few members of the communities will be able to participate.
Marginalized and Vulnerable Groups	The programme will contribute to the reduction of existing inequalities for EWS for floods and drought, particularly those affecting marginalized or vulnerable groups dependent on agriculture or living in urban areas. The EWS system for floods and drought will be available through technological sources. The members of communities and local agencies will be provided with adequate knowledge and explanations about the systems to use it for their own benefits.	There is a risk that vulnerable and marginalized groups will have insufficient knowledge and access to technological devices such as mobile phones or lack of good cellular connectivity specially required for component 2.1 of the proposed activities. To avoid the exclusion of marginalized and vulnerable communities, traditional practices will be implemented to reach these groups especially women, girls, elderly, physically challenged individuals.
Human Rights	The proposed activities are or will not be against any of the established international human rights. Moreover, the proposed programme will promote the basic human rights of access to water, food and information.	

	The programme will provide opportunity for every individual to give their views, perceptions and needs in developing better climate change adaptation measures.	
Gender Equity and Women's Empowerment	The proposed programme will improve the gender equity and women empowerment through the WMO developed tool: Training Manual for mainstreaming gender in End to End Early Warning system for Floods and integrated Flood Management through a participatory design approach. This will help in increasing the participation of women, girls and other vulnerable groups in Flood and Drought management activities as well as decision making processes.	The proposed programme is targeting region where men occupy the majority of the leadership positions. Women participation to disaster preparedness and decision making is often limited due to cultural and social norms. There is therefore a risk that women will not benefit equitably from the proposed adaptation measures and capacity-development interventions.
Core Labour Rights	The programme will be implemented and managed in compliance with the countries designated labour laws. No individual will be hired without pay and the payment will be according to the countries labour legislation/laws. Children's labour will be forbidden and it will not be accepted from other programme partner agencies. Local communities will be involved in the adaptation measures but will not be exposed to any risk of accidents. Core labour rights will be respected and considered in programme design and implementation.	
Indigenous Peoples	The indigenous population in the region will be consulted and involved during the design and implementation of the programme activities. The traditional knowledge of indigenous people on Flood and Drought will be useful when preparing the risk maps, the early warnings and information dissemination.	There is a risk that the traditional use of water resources, irrigation system and land use pattern will be challenged. Therefore, a detailed analysis will be carried out by local and national agencies to understand the use of natural resources especially regarding to water and land use.
Involuntary Resettlement	There are no activities proposed in the programme which will create direct involuntary resettlement of communities.	*This will be further evaluated during the Environmental and social assessment*
Protection of Natural Habitats	There is no potential direct risks to the protection of ecosystems and its natural habitats and biological diversity through the programme activities. Natural and nature-based solutions will be promoted using the Flood Green Guide by WWF, but they will not be implemented in the course of the Volta programme as they would need detailed ecological assessment.	*This will be further evaluated during the Environmental and social assessment*
Conservation of	There will be no direct risks associated	*This will be further evaluated during the*

Biological Diversity	with the conservation of biological diversity	*Environmental and social assessment*
Climate Change	The programme does not only increase the flood and drought adaptation capacity and resilience of the local population but also contributes to develop better governance structure, policies and plan at both national and regional level for climate change adaptation.	
Pollution Prevention and Resource Efficiency	The programme activities are not expected to result in water, air and soil pollution.	
Public Health	The programme activities should not have negative effect on public health. On the contrary, it will contribute to prevent the population from natural disasters, to improve income for getting access to health facilities, etc.	*This will be further evaluated during the Environmental and social assessment*
Physical and Cultural Heritage	The programme should not have any activity related to affecting physical and cultural heritages. The significance of the programme is to develop better management of water resources and have traditional and cultural integration among the individuals.	*This will be further evaluated during the Environmental and social assessment*
Lands and Soil Conservation	The programme will promote the conservation of soil and land resources, especially through the selection of natural and nature-based solution with environmental-friendly solutions.	*This will be further evaluated during the Environmental and social assessment*

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation.

WMO, as Implementing and Executing Entity, will be involved at several levels into the programme activities and supervision, allowing to benefit from international as well local presence:

- ➢ The WMO Field Office for North, Central and West Africa, will coordinate with national authorities, especially their National Meteorological and Hydrometeorological Services (NMHSs).
- ➢ The Technical Support Unit (TSU) of the Associated Programme on Flood Management (APFM) and the Integrated Drought Management Programme (IDMP), both hosted in the Climate and Water Department of WMO, will ensure as Executing Entity close contact with both regional Executing Entities (VBA and GWP-WAF).
- ➢ Other WMO teams in the Climate and Water Department, especially the Global Framework for Climate Services (GFCS), Climate Prediction and Adaptation Branch, Flash Flood Guidance System, HydroHub project, will contribute to the activities and extend the reach of the programme

The Volta basin programme will benefit of the knowledge base and network of some 50 Support-Base Partners (institutions involved into Environmental issues, Disaster Risk Reduction, capacity building, community aspects and research, NGOs, National Services) of the two WMO and GWP associated programmes targeting Integrated Flood Management (APFM since 2001) and Integrated Drought Management (IDMP since 2013). Next to their possible contributions to the Advisory committee, they will be contacted to participate to the requirements specifications, or possibly to the development of some part of the activities depending on their field of competences.

At the regional transboundary level, two Executing Entities, to the side of WMO, will fulfil the coordination and relationships with the institutions and stakeholders on the basin:

- The Volta Basin Authority (VBA) will be the focal point for data sharing and dissemination through its Observatory, and for transboundary coordination and links with the national structures
- The Global Water Partnership West Africa (GWP-WAF) will foster the integration of communities and local stakeholders, while connecting with national policy makers.

VBA will take over a part of the tools developed during the Volta programme and maintain the service, ensuring the long-term sustainability of the tools, procedures and methodologies of the programme. VBA has still not achieved that level of maturity to act as reference for issues related to data sharing in the region, and its involvement in the programme will contribute to increase its credibility vis-à-vis to NMHSs and strengthening its transboundary facilitation role. At the same time, the involvement of VBA will also allow to identify synergies with other major development partners such as the African Development Bank, and possible gaps not covered by national investments at each country level.

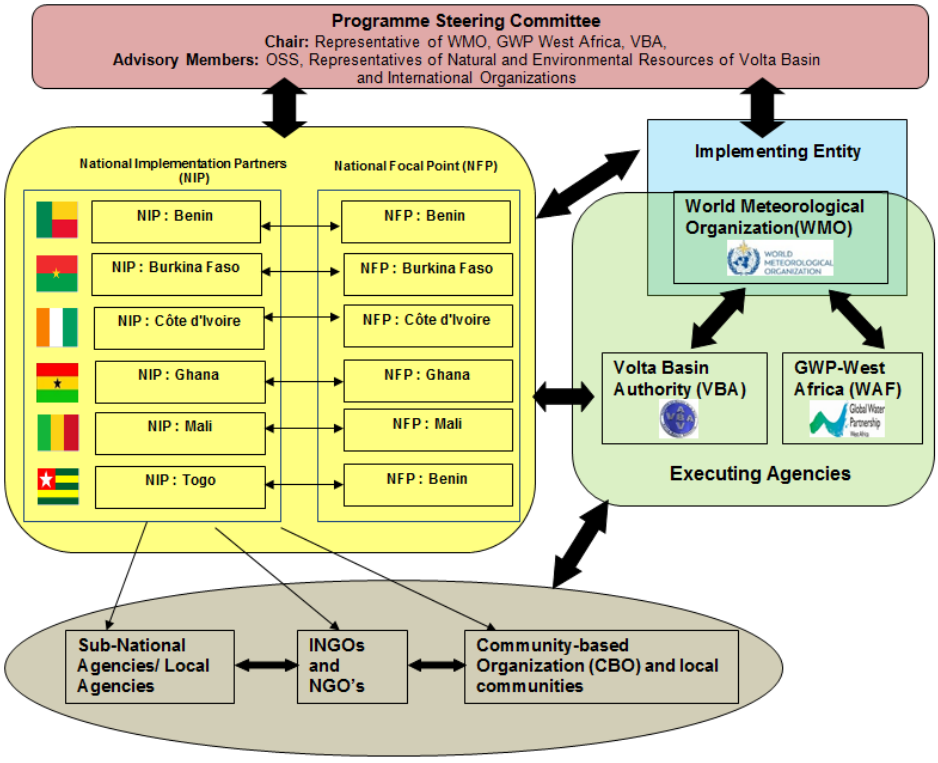
Since 2009, VBA is developing the VBA Observatory, with the goal of providing an operational tool, with communication and information capacities. The VBA observatory must help facilitating effective decision-making (management of water and environment & governance) between the six riparian countries. Furthermore, through regularly collection of data from gauging stations and data and information with its members, the VBA observatory will also support countries into applying the transboundary data sharing protocol. The proposed Volta basin programme is an opportunity for the VBA Observatory to strengthen its role into data and information sharing of national and

regional databases on hydrology, and also to provide assistance in analysing how this information could be useful for delivering impact-based forecasts of Floods and Drought.

Through its capillary network in the region among water practitioners, GWP West Africa will ensure strong diversification of partnership in the beneficiary countries and will facilitate the organization of locally-based activities. Its inclusion among the executing entities will ensure a geographically spread distribution of activities related to the programme. The network of GWP country partners (in the order of several dozen related to the programme activities) will disseminate and mainstream the programme results at local level.

At national level, WMO can count on the support of the Permanent Representatives and their Hydrological Advisers of the NMHSs, forming a network of technical assistance to disseminate the programme results towards the related Ministries in charge of Water Resources, Hydraulics, Environment and Civil Defence, and international level within the 191 WMO member countries and territories. The NMHSs are also envisaged as focal points for the technical activities to take an active role in the programme implementation.

Strong relationships will be established with the Sahara and Sahel Observatory (OSS) promoting management of transboundary water resources and the implementation of Multilateral Environmental and Gender Equity Agreements, notably those addressing desertification, biodiversity and climate change. OSS has been, and is being, implementing several projects in the region of West Africa. Exchanges of information will be organized between the OSS projects and the Volta programme to help identifying common synergies and further developing and sharing resources useful for structural or non-structural measures on climate change adaptation. OSS representatives will participate into expert groups and advisory programme committee. A scheme of the management structure of the Volta programme is illustrated in Figure 15.



NFP for technical activities – NMHSs

Figure 15: Organisational management structure

B. Describe the measures for financial and project / programme risk management.

Financial and programme risks measures will be assessed as an on-going process throughout the design and implementation of the programme. The potential risks identified are:

Type of risk and how it affects the programme	**Risk impact on the programme goal** (low, medium, high)	**Probability of occurrence** (low, medium, high)	**Mitigation measure(s)**
Acceptance of the programme Even though detailed needs assessments have been conducted since 2013, the support of the stakeholders can differ in the six countries. This results in differential levels of acceptance and slow down of the inception phase of the programme.	Medium	Medium	- During the preparation phase of the programme, all relevant stakeholders (government, agencies, departments and communities) will be/are clearly identified, so that they fully share the vision and goal of the programme and are aware of their contribution to the programme, hence fostering ownership over the process. - MoU will be signed with the participating stakeholders. - Roles and responsibilities of the implementing agencies and executing agencies will be defined in the initial stages of the programme so that all the activities are completed in a coordinated way.
Physical risks Administrative barriers hinder sharing of social and topographic data. This result in difficulties to implement components 1 and 3.	Medium	Low	The executing and implementing entities will ensure from the National Focal Points and National Implementation Committee that the required data and information are shared. Furthermore, VBA is mandated for regional exchange of information and can request the enforcement of the agreements.
Technical/quality risks Component 2 of the programme is too technical and not adapted to specific area or countries. This results in low commitment and interest from stakeholders	Medium	Low	The programme activities will be first reviewed by experts of WMO, GWP-WAF and VBA, eventually with the support of NFP and NIC, local decision-makers and participants from community to understand the expectations and suggestions from the participants. The feedbacks and suggestions from the participants will be integrated.
Restructuring of government officials Restructuring in the government work structure may cause possible shifts of responsible persons at local and national levels to a different location. This can result in delays and loss of	Low	Medium	Alternative persons from the departments will be involved in most of the activities so that implementation of programme activities will not be hampered at any time.

support.			
Financial/resources risks Inadequacy of the financial management system: procurement system, financial availability, monitoring, reporting and auditing system, etc. Availability of programme resources This will result in slowing down the programme activities	Low	Low	During implementation, programme and financial monitoring/reviews will be conducted to ensure efficient management of programme resources.
Human resources/capacity risks Lack of skills or human resources availability Adequacy between existing and required experience and skills This results in slowing down the programme activities	Medium	Low	- The programme benefits from the deployment of professionals/staffs by the implementing and executing agencies (WMO/GWP WAF/VBA) who are selected by a panel of experts. Their ToRs are developed based on the programme needs and in collaboration with the hosting institutions. - National support is obtained at the level of the governmental agencies to ensure sufficient human resources
Documentation/Reporting risks Lack of available tools and templates for developing reports and progress report Delays of reporting by the partners This results in delays in the reporting process and financial access to funding	Low	Medium	Appropriate tools/templates and reporting structures and procedures will be put in place by WMO to ensure proper documentation and reporting so that donor agencies and steering committee receive timely reports.
Political risks Interference from the local/national political parties This will result in delaying the programme activities	Low	Low	The programme will adhere to the goals, laws, and policies of the respective programme countries. Whenever and wherever required, permission of national consensus of the countries will be shown.
Gender neutral approach Techniques and technology developed are not accepted by all groups of the communities. This decreases the gender equality compliances	Low	Medium	The programme includes gender sensitive approach in all activities. Wherever required non-technological or traditional methods will be adopted to reach and get participation from every group of the communities.

C. Describe the measures for environmental and social risk management, in line with the Environmental and Social Policy of the Adaptation Fund.

The environmental and social risks which will result from the Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) studies (in line with the Environmental and Social Policy of the Adaptation Fund) will be conducted before the formulation of the final programme document (full proposal). The programme proposal will also include the environmental and social risk management plan which will be utilised during the programme implementation phase.

D. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.

Monitoring and Evaluation (M&E) measure the overall progress and impact of the programme activities through Key Performance Indicators (KPI). They will be monitored regularly to identify the achievements or insufficiencies, therefore supporting the development of additional strategies to achieve the targets. M&E tool will be made available for programme activities, as well as programme management.

Monitoring and evaluation arrangements for the programme activities
A monitoring and evaluation system will be developed to support the programme management and decision-makers team in designing, implementing and adjusting the program activities. The overall (short, medium and long term) impact of the planned activities will also be assessed using the resources, methodologies or tools etc. The M&E arrangements will be structured and organized at various level of programme institutional set-up such as:

- **Local level:** for the local executing partners and other stakeholders
- **National level:** for the technical departments of the Volta Basin Countries.
- **Regional level:** for the regional technical support or consultation that will be regularly carrying out the monitoring and mid-term and terminal evaluations.

Monitoring and evaluation arrangement for Programme Management
The Programme Management Unit (PMU) will be made available with monitoring and evaluation tools of programme activities and resources. The PMU under the implementing agencies will ensure that the executing agencies have adequate resources and capacity to measure and monitor results at the local, national and transboundary level. The quarterly monitoring and annual evaluation reports of the executing agencies along with the financial statements and resource management will be submitted to the implementing agencies and further to the Adaptation Fund Secretariat for the review.

Monitoring and Evaluation reports:

Quarterly report	Monitoring will be carried out after each quarter and reports will be prepared with key results achieved, issues encountered or potential problems and proposed solutions.
Annual Report	Annual report will be prepared to monitor the progress in the time period of twelve months. This will be useful to monitor progress made in different activities. The annual report will be presented by the programme leader to the programme steering committee to assess the overall progress and provide their suggestions or feedbacks.
Mid-term Assessment Report	The programme will conduct the mid-term review after two years of kick-off to get the feedback of external experts.
Final Evaluation or Programme Termination Report	Two months prior to the completion of the programme, an independent evaluation will be conducted to check the overall impact of the programme. The final evaluation report will be developed and presented to the Adaptation Fund secretariat, programme steering committee and other stakeholders.

The M&E activities with their budget are shown in the table below:

Monitoring & Evaluation Activity List	Accountable Parties (short name)	Timeline																Budget (USD$)
		2019				2020				2021				2022				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Design, development and review of the Monitoring and Evaluation tools	The accountable parties will be defined after the next consultation phase	■																The estimated budget will be made available in the final proposal
Monitoring the programme activities and outputs (quarterly)		■		■		■		■		■		■		■		■		
Improvement or additional changes in the Monitoring tool			■															
Monitoring the activities and reporting the programme outputs (every six months)			■		■		■				■		■		■			
Mid-term Evaluation of the programme activities and assessing the progress									■									
Improvement or additional changes in the Evaluation tool										■								
Final evaluation and reporting (before the completion of programme)																	■	
Final Programme Audit																	■	
Total Cost for M&E																		

Additionally, M&E tools for both programme activities and programme management following the Adaptation Fund (AF) standards will be developed and available in the final programme proposal submitted to the AF Secretariat.

E. Include a results framework for the project proposal, including milestones, targets and indicators.

The results framework of the project defines the key performance indicators (KPI) and means of verification for every component and its activities. The KPI will be used during the monitoring and evaluation to assess the progress and divulge any scope for improvements.

The detailed programme result framework will be developed in the final proposal.

Table: Project Result Framework

Objectives	Components related activities	Overall Baseline situation	Key performance Indicator	Target to be achieved	Methods of Verification
The Volta programme will strengthen community resilience through integrated approach for flood and drought management and support to decision-making. It will also improve livelihood and minimize loss of lives through the establishment of an end-to-end early warning system as well as capacity development on climate change adaptation measures The programme will further develop synergies	**Component 1:** Assessment of the VCERs, development of the floods and drought risk maps (pluvial and fluvial) and integration of climate scenarios into the action plans. **Component 2:** Support to develop early warning systems for floods, drought, and fires etc. Capacity development for strengthening knowledge and awareness related to climate change adaptation measures (Flood Green Guide and gender mainstreaming). **Component 3:** Revision of the transboundary	Number of floods and drought disasters without adequate and integrated management Increasing growth of populations losing interest in agriculture based economic activities Lack of investment for concrete measures developing resilience to climate change Insufficient understanding of VCERs, shortage of hydro-meteo infrastructures and resources Lack of participation of Volta Basin countries at the national and transboundary level for flood and	• Degree of improvement in populations' resilience to floods and drought events • Quantitative details for the reduced number of the deaths and damage to assets and environment •Local /national agencies and communities are trained on climate change adaptation measures for floods and drought and mainstreaming of gender • Percentage of households with improved livelihoods or	• Development of the risks map and end-to-end web-based early warning systems for floods and drought events. • 70% of floods and drought events are foreseen and adequate preparedness measures are taken by the beneficiaries • Climate scenarios are mainstreamed into national plans and decision-making tools. • More than 1000 individuals from communities, agencies and organizations are trained through various workshops and are expected to disseminate knowledge and tools to other stakeholders. • National and transboundary agencies are trained and water and natural resources policies and guidelines are developed	• Web-based monitoring system for floods and drought • Monitoring and evaluation reports • Field visits reports • Success stories from the pilot testing • Workshops and trainings participation lists, • Multi-media channel • Community of Users • Amendment to plans, policies and guidelines documents.

between the beneficiary countries by supporting the transboundary governance helping in participatory management of water and natural resources while contributing to climate change adaptation strategies.	governance plans, policies and guidelines and their links with the national climate adaptation agreements.	drought management Unavailability of IT equipment's, trained resources for data and information management and sharing.	economic benefits •Policies and guidelines at national and transboundary level for flood and drought management are better integrated and action plans are developed.		

F. Demonstrate how the project / programme aligns with the Results Framework of the Adaptation Fund

The Volta programme will be in coordination with the Strategic Results Framework of AF and this part will be developed in the full proposal document.

Project Objective(s)[64]	**Project Objective Indicator(s)**	**Fund Outcome**	**Fund Outcome Indicator**	**Grant Amount (USD)**
Project Outcome(s)	**Project Outcome Indicator(s)**	**Fund Output**	**Fund Output Indicator**	**Grant Amount (USD)**

G. Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.

The total budget of the Volta programme is estimated to USD 7.92 million to support implementation over the six riparian countries. Funding for project management is evaluated to USD 750,000. Additional funding of USD 670,000 is included to cover the expenses of the Implementing entity.

H. Include a disbursement schedule with time-bound milestones.

The disbursement schedule for the each outputs of the components proposed in the Volta programme will be developed and presented in the final programme proposal.

[64] The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology but the overall principle should still apply

Component/ Output/ Activities	Description	Timeline (▌= milestones)																Time of Budget disbursement	Budget (USD$) Disbursed
		2019				2020				2021				2022					
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4		
Component 1	Develop capacity and established frameworks at the local, national and regional levels to ensure risk informed decision-making																	The estimated time of budget disbursement will be made available in the final proposal	The estimated budget to be disbursed will be made available in the final proposal
Outcome 1.1	Improved knowledge of risks, climate change impacts and risk management capacities through knowledge sharing and participatory mechanisms																		
Output 1.1.1	Inventory of information on vulnerabilities, capacities, exposure and risks (VCERs) for floods and drought in the Volta Basin is conducted																		
Output 1.1.2	Database of VCERs, floods and drought related risk maps are developed																		
Output 1.1.3	Capacity of stakeholders to use Floods and Drought risk maps is enhanced																		
Output 1.1.4	Reports and communication documents on vulnerabilities, capacities, exposure and risks (VCERs) and Floods and Drought risk maps of the Volta Basin are available							▌											
Outcome 1.2	Bridging the gap in adaptation measures to integrate future scenarios (economic, urban, climate, etc.) into current practices and knowledge																		
Output 1.2.1	Scenarios for socio-economic development and climate change projections are collected																		
Output 1.2.2	Projected impacts on water resources, urban development and agricultural areas are analysed on the basis of future scenarios							▌											
Outcome 1.3	Risk management strategies in short, medium and long-term to be integrated into development plans (economic, social, environmental aspects)																		
Output 1.3.1	Guidance documents for stakeholders are developed to raise awareness about the future scenarios							▌											
Output 1.3.2	Capacity of stakeholders to use future scenarios and to develop action plans is enhanced																		

Component 2	Develop concrete adaptation and environmentally friendly actions with an integrated approach																		
Outcome 2.1	Improved flood and drought forecasting instruments and Early Warning Systems (EWS) and coordination at the transboundary level to reduce disaster risks in vulnerable communities																		
Output 2.1.1	Needs and existing resources of national and regional agencies staffs for web-based EWS are defined																		
Output 2.1.2	The operational centre for the VoltAlarm Early Warning System is established in synergies with the NMHSs and the Volta Basin Authority																		
Output 2.1.3	The historical and real-time hydrological data from the gauging stations are collected and the procedure to link with the meteorological data is defined																		
Output 2.1.4	Thresholds for Floods and Drought risk levels are selected for the various parts of the Volta Basin																		
Output 2.1.5	The procedure for producing impact based forecasts for the sub-basins and vulnerable areas on a daily basis is defined																		
Output 2.1.6	The web-based Early Warning dissemination interface for VoltAlarm is designed																		
Output 2.1.7	Knowledge and awareness about VoltAlarm within the user groups are increased																		
Outcome 2.2	Demonstration of the added value of the E2E EWS VoltAlarm through a series of pilot testing during monsoon and dry seasons																		
Output 2.2.1	Pilot testing for a number of areas over the basin during the monsoon and dry seasons is performed																		
Output 2.2.2	Feedback from the series of pilot testing is collected																		
Outcome 2.3	Strengthened awareness of vulnerable people on hydro-meteorological risks, prevention, preparedness, and response strategies through education programs using participative solutions																		
Output 2.3.1	Knowledge and capacity development using the Flood Green Guide (FGG)																		
Output 2.3.2	Capacity development based on the Training Manual for mainstreaming gender in the E2E-EWS-F and flood management																		

Component 3	Strengthening policy and institutional capacity for integrated flood and drought management at the local, national and transboundary levels																		
Outcome 3.1	Decision support and policy development for strengthening resilience at the local, national and transboundary levels of the Volta Basin																		
Output 3.1.1	The transboundary governance plans, policies and guidelines about long term flood and drought management are evaluated																		
Output 3.1.2	Strengthened awareness of policy-makers from the six countries on the key long-term strategies for floods and drought management																		
Output 3.1.3	Experiences of local communities on key long-term strategies for floods and drought management are collected																		
Outcome 3.2	Strengthened capacities of actors and decision makers at national and transboundary level on long term risk management policies, plans and strategies																		
Output 3.2.1	Strengthened implementation of the revised, or new, climate adaptation plans (NAPA, NAP, NDC), policies and guidelines (on data and information exchanges) on issues related to risk reduction and EWS																		
Output 3.2.2	Improved integration of national policies on long term risk reduction and climate adaptation into the transboundary Strategic Action Programme																		
Outcome 3.3	A collaborative process is developed to ensure those instruments and strategies are accepted by the local organization and communities and adapted to the local context																		
Output 3.3.1	Collaboration with local communities and organizations in defining the procedures and measures to manage risks and to adapt to climate change																		
Output 3.3.2	Collaboration with local communities and organizations in finalizing policies and procedures to manage risks and to adapt to climate change																		

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. **Record of endorsement on behalf of the government**[65] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

République du **Bénin** - Mr Euloge LIMA, Directeur de la Gestion des Risques et de l'Adaptation aux Changements Climatiques, Ministère du Cadre de Vie et du Développement Durable	Date: 12 January 2018
Burkina Faso – Mr Ambroise KAFANDO, Director General of Cooperation, Ministry of Economy, Finance and Development	Date: 12 January 2018
République de **Côte d'Ivoire** – Mr Jean Douglas ANAMAN, Head of Adaptation Unit at National Climate Change Programme, Ministry of Urban Sanitation, Environment and Sustainable Development	Date: 11 January 2018
Ghana – Mr Fredua AGYEMAN – Director for Environment, Ministry of Environment, Science, Technology & Innovation	Date: 12 January 2018
République du **Mali** – Dr SEYDOU KEITA, Technical Advisor, Ministère de l'Assainissement , de l'Environnement et du Développement Durable	Date: 12 January 2018
République du **Togo** – Mr Thiyu Kohoga ESSOBIYOU, Director of Environment, Ministry of Environment and Forest Resources	Date: 12 January 2018

[65] 6. Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

B. Implementing Entity certification

Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address

<table>
<tr><td colspan="2">I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.</td></tr>
<tr><td colspan="2">Mary Power, Director, Development and Regional Activities Department, WMO

Signature.....
Implementing Entity Coordinator</td></tr>
<tr><td>Date: 12/01/2018</td><td>Tel. and Email: +41 22 730 8003
MPower@wmo.int</td></tr>
<tr><td colspan="2">Project Contact Person: Jean-Paul Gaudechoux and Giacomo Teruggi</td></tr>
<tr><td colspan="2">Tel. And Email: +41 79 514 4261; +41 22 730 8354
jpgaudechoux@wmo.int; gteruggi@wmo.int</td></tr>
</table>

Annex

Annex 1: List of participants who attended the consultation workshop in Ouagadougou, Burkina Faso during 21-25th November 2017

Global Water Partnership West Africa

ATELIER REGIONAL DE FORMATION SUR LA GESTION INTEGREE DES INONDATIONS (GIC), SUR LA PREPARATION ET LE FINANCEMENT DES PROJETS SUR LA GIC DANS LE BASSIN DE LA VOLTA

Lieu : Salle de réunion de l'ABV

N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature		
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N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature 22/11/2017	Signature 23/11/2017	Signature 24/11/2017
9	TRAORE	Gaoussou	touramakaan@yahoo.fr	Chef Bureau	Mali-Météo	[signature]	[signature]	[signature]
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13	AMPOMAH	Benjamin	byampomah@yaho.com	Exe. Sec.	WRC, Ghana	[signature]	[signature]	[signature]
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N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature 22/11/2017	Signature 23/11/2017	Signature 24/11/2017
19	BANDE EP TONDE	Adama F. S. Audrey	soniaaudreytonde@gmail.com	Assistante juridique DP/GIRE	ABV	[signature]	[signature]	[signature]
20	ASSAO Abdoulkarim	Abdoulkarim	aassao@uemoa.int	Chargé des Ressources en Eau	Commission de l'UEMOA	[signature]	[signature]	[signature]
21	SALOU SOUMANA	Abdourahmane	+226 72 93 45 08 asalou@liptakogourma.org	Chef de service Infrastructures et Communications	ALG	[signature]		
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25	SROHOUROU	Bernard	srohorous@yahoo[illegible]	Chef Départ. Suivi Développement Environnement	SODEXAM DMN	[signature]	[signature]	[signature]
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28	SANOUSSI	Razaki	sanoussi.raz@gmail.com	DP-GIRE	ABV	[signature]	[signature]	[signature]

N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature		
						22/11/2017	23/11/2017	24/11/2017
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30	Nacoulma	Julien		Chauffeur	GWP-HC			
31	Nacoulma	Julien		Chauffeur	GWP-AO			
32	TAMAKLOE	Gloria	sahnokpokpo@gmail.com	hôtesse				
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34	GASCON	Tania	tgascon@wmo.int	project officer	WMO			
35	Wittwer	Caroline	cwittwer@hotmail.fr	project officer	WMO-CLW			
36	FOFANA	Rafaatou	fofrafaat08@gmail.com	Hydrologue	ABV			
37	Daouamba	Frédéric A	frederic.daouamba@iucn.org	Chargé du programme en Suivi-Eval	IUCN-PACO			
38	JIOFACK FEUZE	Rollis Ernest	rollisjiofack@yahoo.fr	Etudiant Master Stagiaire	OMM			

N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature		
						22/11/2017	23/11/2017	24/11/2017
39	MILLOGO	Dibi	fredmill@yahoo.fr 00226 78834155	DEA	ABV			
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41	Kane	Michael	michaelk@pegasys.co.za	Consultant	Pegasys			
42	TUMBULTO	Jacob	jwtumbulto@gmail.com	D/Observatoire	ABV			
43	CHABI-GONNI GP. VODOUNHESSI	B. G. Felicité	felicite.vodounhessi@gwp.org	chargée de Projet	GWP/AO			
44	BIDIMBOU	Sadjinamaou	agitine04@gmail.com	Chargée du Protocole et des Relations Publiques	ABV			
45	Dibloni	Y. Faiti	dybloti@outlook.fr	Hotesse	—			
46	DESSOUASSI	Y. Robert		Secrétaire Exécutif	ABV			
47	DAN	Mogbante			GWPAO			
48	HOUANYE	Armand		SE				

N°	Noms / Surname	Prénoms / Name	Emails / Téléphone / Phone	Fonction / Function	Structure	Signature		
						22/11/2017	23/11/2017	24/11/2017
49	YARO	Aguiratou	aguiratou.yaro@gwpao.org	RAF	GWP/AO			
50	OUEDRAOGO SOME	K.N. Reine Esther	gwp.westafrica@gwpao.org	AA	GWP/AO			
51	COULIBALY	Sidi	sidi.coulibaly@gwp.org	RCGC	GWP/AO			
52	BAZIE	Josiane	Dome.josiane@yahoo.fr	AFA	GWP/AO			
53								
54								
55								
56								
57								
58								

Annex 2: High level prototype screen-prints of the envisaged interface 'VoltAlarm' (Flood and Drought Informations with EWS)

Hydro-meteo VOLTALARM

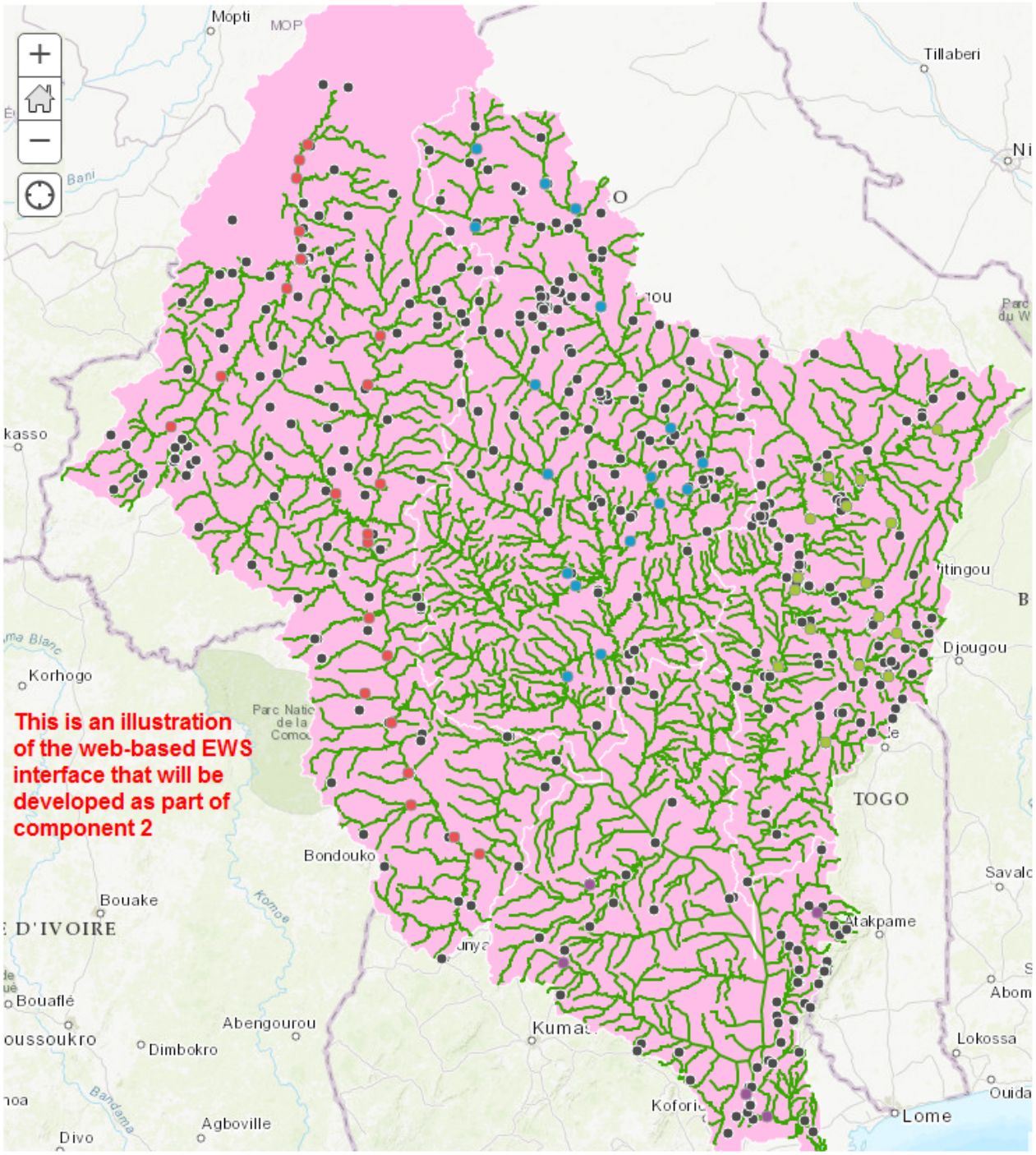
alerting Volta Basin for extreme events

Carte des risques d'inondation ↓

Carte des risques de sécheresse ↓

BULLETIN
Cet après midi :
Très nuageux avec quelques averses à l'est.
Lire la suite

Inscrivez-vous pour recevoir des alertes



Légende

! Rouge :
Risque de crue majeure
Tout lire

! Orange :
Risque de crue génératrice de débordements importants
Tout lire

! Jaune :
Risque de crue génératrice de débordements Tout lire

! Vert :
Pas de vigilance particulière requise.

stations_hydrometriques_volta_hycos

- Volta Noire
- Volta Blanc
- Oti
- Lower Volta

River Stream

- **Rain**
- **Flood**
- **Rain-Flood**
- **Thunderstorms**
- **Extreme high temperature**
- **Extreme low temperature**
- **Coastal Event**
- **awareness typ not available**

If the icon on country level has a dark background: The country doesn't issue warnings for this awarness-level!

awareness types: all awareness types ▾ **Awareness Level »**

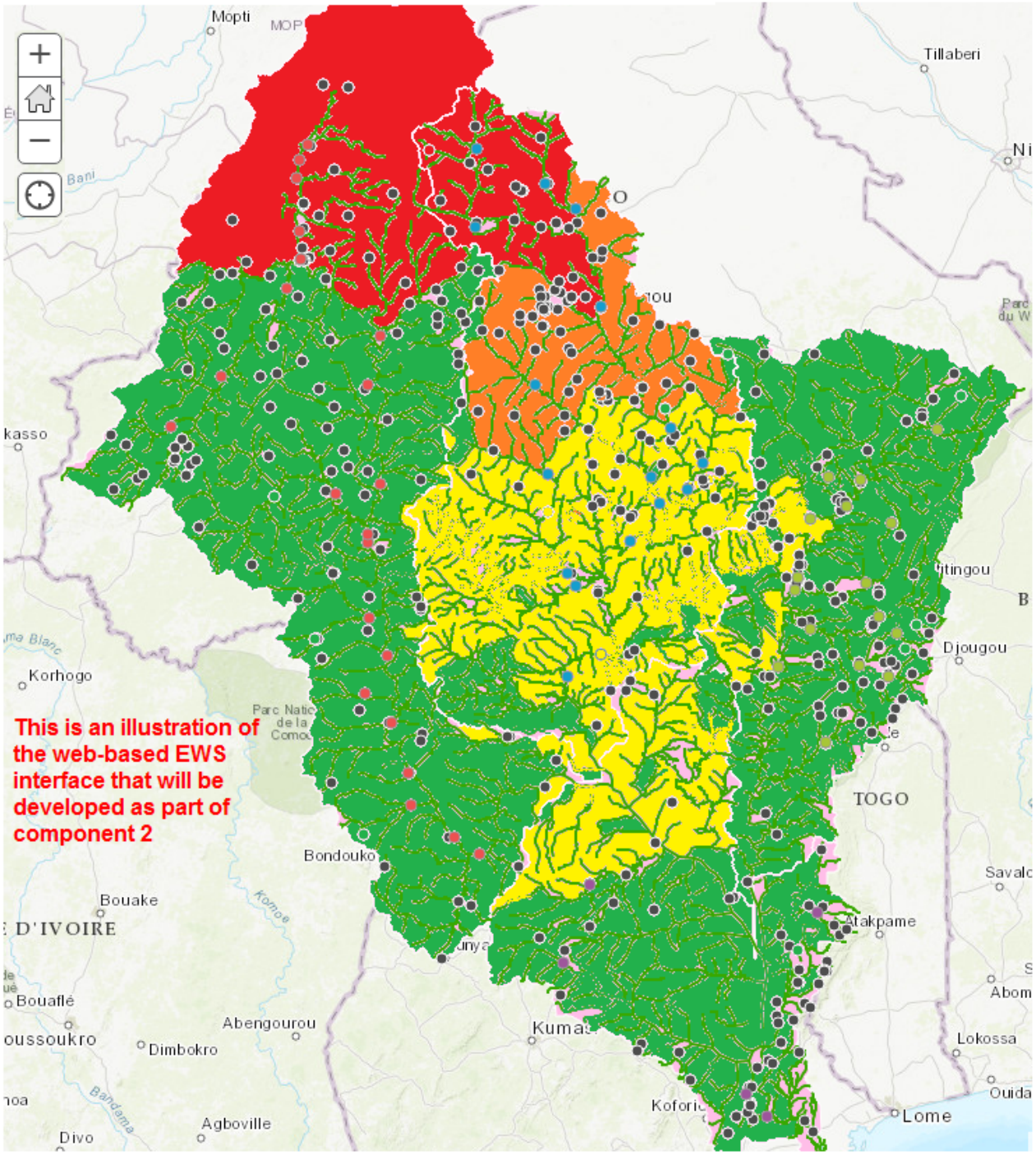
Hydro-meteo VOLTALARM

alerting Volta Basin for extreme events

Carte des risques d'inondation ↓

Carte des risques de sécheresse ↓

BULLETIN
Cet après midi :
Très nuageux avec quelques averses à l'est.
Lire la suite



Inscrivez-vous pour recevoir des alertes

Légende

- Rouge : Risque de crue majeure — Tout lire
- Orange : Risque de crue génératrice de débordements importants — Tout lire
- Jaune : Risque de crue génératrice de débordements — Tout lire
- Vert : Pas de vigilance particulière requise.

stations_hydrometriques_volta_hycos

- Volta Noire
- Volta Blanc
- Oti
- Lower Volta

River Stream

- **Rain**
- **Flood**
- **Rain-Flood**
- **Thunderstorms**
- **Extreme high temperature**
- **Extreme low temperature**
- **Coastal Event**
- **awareness typ not available**

If the icon on country level has a dark background: The country doesn't issue warnings for this awarness-level!

awareness types: all awareness types ▾ **Awareness Level »**

Hydro-meteo **VOLTALARM**

alerting Volta Basin for extreme events

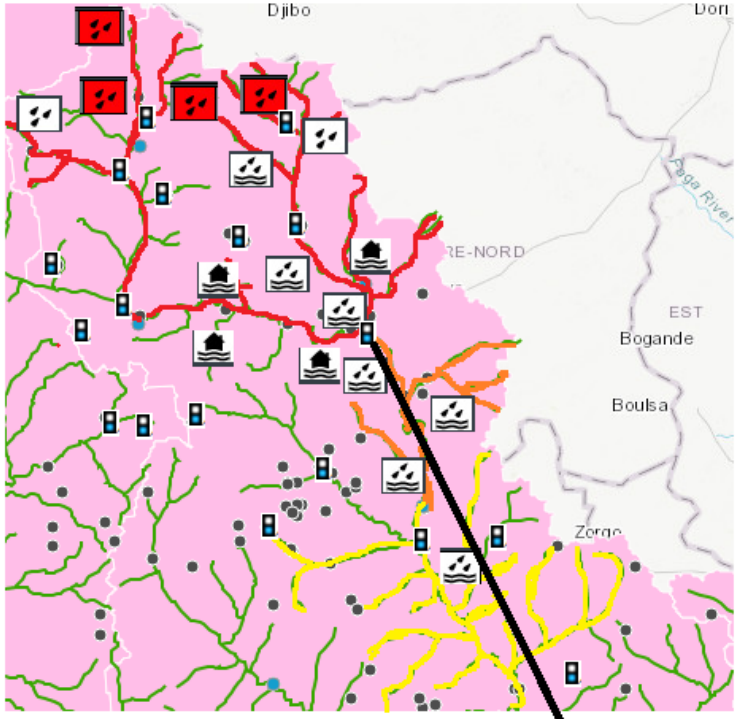
Carte des risques d'inondation ↓ | Carte des risques de sécheresse ↓

BULLETIN
Cet après midi :
Très nuageux avec quelques averses à l'est.
Lire la suite

Inscrivez-vous pour recevoir des alertes

Flood Warning system for White Volta-Upper

Cliquez sur une zone grisée de la carte pour changer de page d'information. Cliquez sur un site de la carte pour afficher les niveaux des cours d'eau (symbole).



awareness types: all awareness types

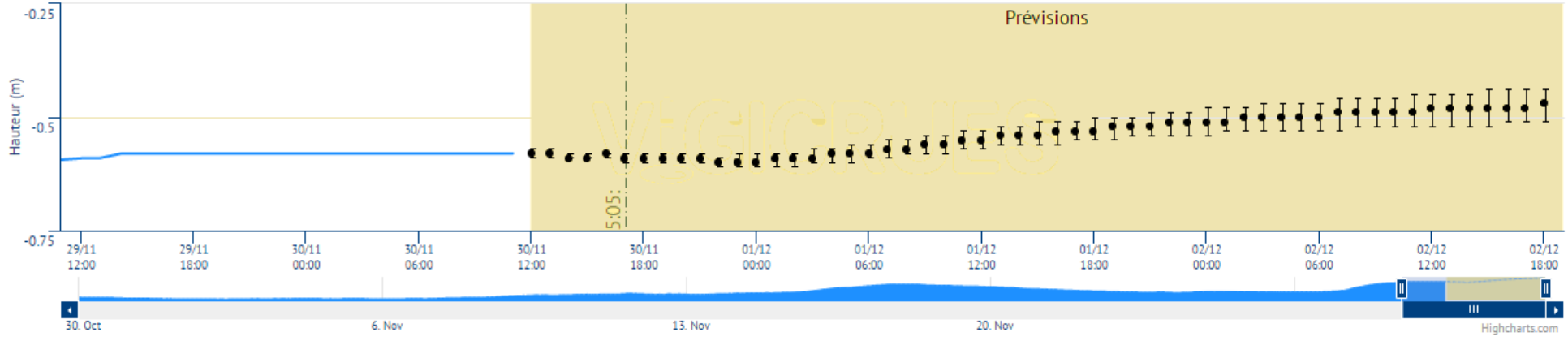
Display: today | tomorrow

This is an illustration of the web-based EWS interface that will be developed as part of component 2

Graphique | Observation | Prévision | Info station

Rechercher une station :

Afficher les données sur : 1 jour 3 jours 7 jours 14 jours 30 jours Zoom initial



Hydro-meteo VOLTALARM

alerting Volta Basin for extreme events

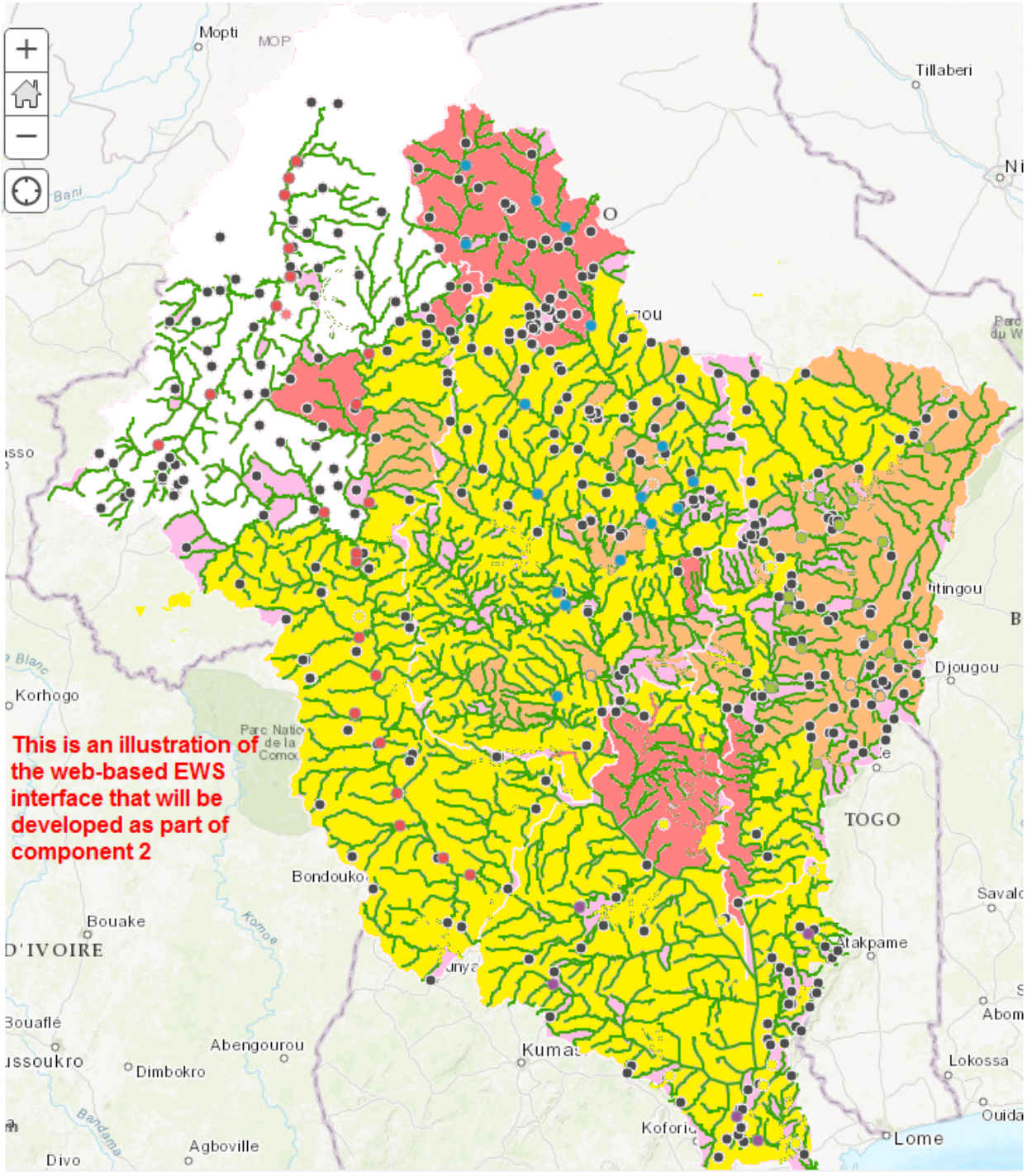
Carte des risques d'inondation ↓

Carte des risques de sécheresse ↓

BULLETIN
Cet après midi :
Très nuageux avec quelques averses à l'est.
Lire la suite

Inscrivez-vous pour recevoir des alertes

Carte des risques de sécheresse dans le bassin de la Volta



Légende

- Border
- No
- Low
- Medium
- High

stations_hydrometriques_volta_hycos

- Volta Noire
- Volta Blanc
- Oti
- Lower Volta

River Stream

Hydro-meteo VOLTALARM

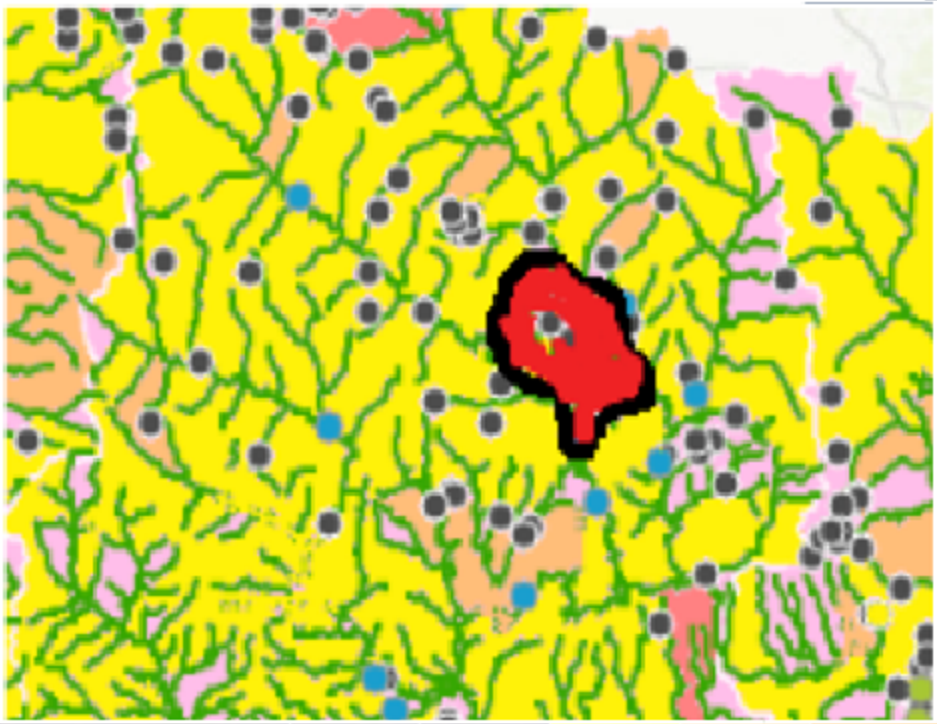
alerting Volta Basin for extreme events

Carte des risques d'inondation ↓

Carte des risques de sécheresse ↓

BULLETIN
Cet après midi :
Très nuageux avec quelques averses à l'est.
Lire la suite

Inscrivez-vous pour recevoir des alertes



Intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)

This is an illustration of the web-based EWS interface that will be developed as part of component 2

Warning

< 10

> 10

Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
Current	2017-12-19	19.39	80.61	25.96	3.74	0.90	0.00	111
Last Week	2017-12-12	23.45	76.55	23.70	3.74	0.90	0.00	105
3 Months Ago	2017-09-19	43.98	56.02	28.58	10.93	1.33	0.06	97
Start of Calendar Year	2016-12-27	50.65	49.35	21.54	4.05	0.00	0.00	75
Start of Water Year	2017-09-26	56.15	43.85	21.11	8.37	1.32	0.06	75
One Year Ago	2016-12-20	44.85	55.15	22.68	4.68	0.00	0.00	83