General guidance to promote ecosystem services in the Volta Basin

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IUCN (International Union for Conservation of Nature)
Rue Mauverney 28,
1196 Gland,
Switzerland
Tel +41 22 999 0000 / Fax +41 22 999 0002
https://www.iucn.org/
https://www.iucn.org/theme/ecosystem-management/our-work/red-list-ecosystems
https://twitter.com/IUCN

Contents

Acronyms and abbreviations

ACMAD: African Centre of Meteorological Application for Development

AfDB: African Development Bank

AU: African Union

CILSS: the Permanent Interstate Committee for Drought Control in the Sahel

DRR : Disaster Risk Reduction

EbA: Ecosystem-based Adaptation

ECA: Economic Commission for Africa

ECOWAS: Economic Community of West African States

FLR: Forest Landscape Restoration

GGWSSI: Great Green Wall of the Sahara and the Sahel Initiative

GWP: Global Water Partnership West Africa

IUCN: International Union for Conservation of Nature

IWRM: Integrated Water Resources Management

LDN: Land Degradation Neutrality

PAGEV: projet de gouvernance de l'eau dans le bassin de la Volta

NAP: National adaptation plan

NbS: Nature-based solution

NBSAP: National Biodiversity Strategies and Action Plans

NDC: Nationally Determined Contribution

SDG: Sustainable Development Goal

TDA: Transboundary Diagnostic Analysis

VBA: Volta Basin Authority

VFDM: Volta Flood and Drought Management project

WMO: World Meteorological Organization

UNCCD: United Nations Convention to Combat Desertification

UNEP: United Nations Environment Programme

Executive summary

The Volta Basin is endowed with a great diversity of landscapes, including savannahs, forests, mangroves, flood plains, lakes and oceans, thereby favouring richness of flora and fauna. These ecosystems, provide a wide range of ecosystem services and play an important role in securing livelihoods for the populations of the basin, and in the economic development and resilience to current and future threats and hazards. Forest ecosystems protect from erosion, mangroves protect from storms and salt intrusion, and flood plains and wetlands protect from flood peaks that lead to flooding.

The Volta Basin, however, faces a number of environmental stresses due to natural hazards, environmental degradation, climate change and variability, which have impacts on people's livelihoods, biodiversity, ecosystems, and ecosystem services. The main natural hazards that affect the Volta Basin include droughts and floods. These factors increase the vulnerability of ecosystems and people, in particular the most vulnerable groups. Flood and drought events continue to affect economies and millions of people across the basin. Disasters and natural hazards are triggered by environmental degradation. Therefore, to avoid disasters, environmental and ecosystem services considerations, including nature-based solutions (NbS), should be integrated into national policies and plans.

The "Integrating Flood and Drought Management and Early Warning Systems for Climate Change Adaptation in the Volta Basin" project or Volta Flood and Drought Management (VFDM) project, implemented by the World Meteorological Organization (WMO), the Volta Basin Authority (VBA) and the Global Water Partnership (GWP) West Africa in support and collaboration with the National Agencies, seeks to address this challenge.

This report provides an analysis of how we can address disasters and hazards using nature. It promotes the use of NbS to address climate change issues and environmental degradation, and is meant to increase the awareness among policy makers and other key stakeholders about the importance of connecting ecosystem services sustainability to the human and ecosystem well-being of the Volta basin.

The proposed guidance are designed to inform and support government policy and action plan development processes and implementation, through nature-based solutions for its adoption and use in the Volta basin context. Through the analysis of the current ecosystem status in the basin, the current legal and policy frameworks and barriers to address NbS in these frameworks, and the possible NbS to address disaster risk and climate change adaptation, these guidelines identified to recommendations below to better take into account ecosystem services in the management of the Volta basin:

- Establish an operational mechanism for effective coordination of sectoral policies within the Volta basin
- Strengthen regional cooperation to promote NbS for Volta basin management
- Strengthen communication and awareness raising about NbS
- Improve uptake of NbS approach by decision makers and policy formulation to integrate ecosystems risk in early warning systems
- Improve the availability of scientifically robust data
- Formulate and implement Land use and spatial planning (LUSP) participatory policy
- Develop a regional umbrella initiative for NbS in the Volta basin

Introduction

The West African region, including the Volta basin, faces environmental stresses due to natural hazards, environmental degradation, climate change and variability, which have impacts on people's livelihoods, biodiversity, ecosystems, and ecosystem services. The main natural hazards that affect the region include droughts, floods, and erosion. The Sahel is the most affected area of the region, and this is exacerbated by the climate change threat (Boko et al., 2007).

These hazards increase the vulnerability of ecosystems and people including the most vulnerable groups like children, women and the elderly. During 2005-2015, West Africa recorded 17 drought events with almost 32 million affected people. Flood events have been more severe during the same period with a total of 132 events, with more than 14 million people affected, 2,000 dead and almost 400,000 homeless. Economies were also affected as it caused US$ 830 million of economic losses (EM-DAT, 2016).

Disasters and natural hazards are triggered by environmental degradation but this has often been overlooked. As a result, responses to (avoid) disasters do not integrate environmental and ecosystem services considerations, including nature-based solutions (NbS).

In order to reverse the current trends, there is a need for effective responses, including ecosystem-based approaches such as ecosystem-based adaptation (EbA) and Ecosystem-based disaster risk reduction (Eco-DRR) approaches, which are considered NbS. These approaches use the benefits that nature can offer to mitigate the negative impacts of disasters on people and ecosystems. Therefore, ecosystem need to be healthy enough to cope with and resist natural hazards and other environmental stresses.

Such solutions are already implemented in the region, such as mangrove restoration or forest landscape restoration but they do not always make the link with disaster risk management. The "Integrating Flood and Drought Management and Early Warning Systems for Climate Change Adaptation in the Volta Basin" project or Volta Flood and Drought Management (VFDM) project, implemented by the World Meteorological Organization (WMO), the Volta Basin Authority (VBA) and the Global Water Partnership (GWP) West Africa in support and collaboration with the National Agencies, seeks to address this challenge. The VFDM project is a good example on how biodiversity predictions and indicators combined with meteorological data can help countries in elaborating and setting up sustainable management plans for drought and floods. The project will assist the six countries of the Volta Basin in the implementation of coordinated and joint measures to improve their existing natural resources management plans at regional, national and local level and to building on lessons from past and current projects related to disaster risk reduction and climate adaptation. Integrated water resources management, risk maps and development of early warning systems will be implemented to increase resilience to floods and droughts and ensure socioeconomic sustainable development.

In this project IUCN will address the challenge of using nature to address disasters and natural hazards. The project will be the opportunity to assess the ecosystem or environmental services status and impact, promote the use of NbS to address climate change issues and environmental degradation, and increase the awareness among policy makers and other key stakeholders about the importance of connecting ecosystem services sustainability to the human and ecosystem well-being of the Volta basin.

The proposed guidance will inform and support government policy and action plan development processes and implementation, through nature-based solutions for its adoption and use in the Volta Basin context.
Nature-based solutions are cost-effective and long-term no-regret solutions that protect, sustainably manage, and restore natural or modified ecosystems, that also address societal challenges, thereby simultaneously providing human well-being and biodiversity benefits (IUCN, 2016).

The objective of the guidelines is to assist the Volta basin managers, planners, and decision makers to incorporate good practices of integrated Volta basin management in national, regional and transboundary policies and improve policy advice for decision-making. These guidelines should be further presented during events, workshops, awareness campaigns in order to increase awareness on the importance to invest in nature-based solutions to reduce disaster risks and adapt to climate change as well as to mobilize policy and implementation action, and commitments from donors.

Through a literature review of the status of the Volta basin, past and future projects, an analysis and mapping of the current legal and policy frameworks for each country and at the basin level, the guidelines will identify the existing barriers, challenges and opportunities for mainstreaming innovative practices of natural resource management in strategies and programmes.

I. The Volta basin region

1. Resources of the Volta basin: state, threats and challenges, opportunities

1.1. Presentation of the Volta Basin

The Volta basin is located in West Africa between latitudes 5°30’ N to 14°30’ N and longitudes 5°30’W to 2°00’E. It is the ninth greatest fluvial basin in Sub-Saharan Africa and covers an estimated area of 400,000 km^2 (VBA, 2010). The basin is shared by six riparian countries namely: Benin, Burkina Faso, Côte d’Ivoire, Ghana, Togo and Mali (Figure 1).

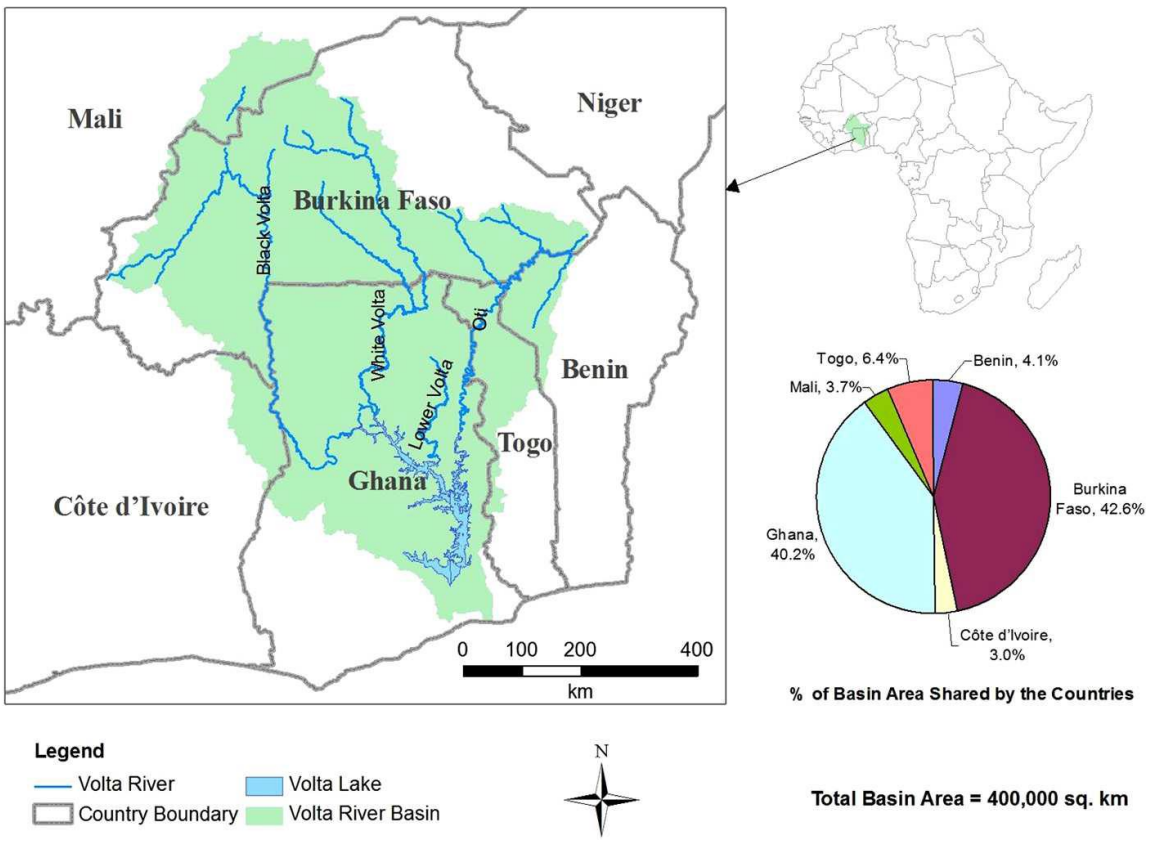

Figure 1: Map of the Volta basin (Julius H. K. et al., 2017)

Table 1: Distribution of the Volta basin in the riparian countries

Country	Area of Basin (km2)	% of country area in basin	% of basin population
Burkina Faso	171,105	62.4	47.6
Ghana	165,830	70.1	35.5
Togo	25,545	45	8.55
Benin	13,590	12.1	2.56
Mali	12,430	1	3.35
Cote d'ivoire	9,890	3.1	2.13
Total	398,390		

(Mul et al. 2015)

The Volta River Basin has four major sub basins, namely (Doktorgrades et al, 2009; Mul et al. 2015):

- The Black Volta (approx 142,056 km^2), originates as the Mouhoun in Burkina Faso and drains western Burkina Faso, northwest Ghana and small parts of Côte d'Ivoire and Mali.
- The White Volta (approx 106,742 km^2), including its major tributary, the Red Volta originates as the Nakanbe in Burkina Faso and drains northern and central Burkina Faso and Ghana.
- The Oti River (approx 72,778 km^2), originates as the Pendjari in Benin and flows through Togo.
- The Lower Volta (71,608 km^2), downstream of Akosombo Dam.

The Black Volta, the White Volta, and the Oti River flow into Lake Volta. Downstream of the lake, the Volta River empties into the Gulf of Guinea in the Atlantic Ocean through the Volta Estuary about 100 km from Accra, Ghana (UNEP, 2013).

Ghana and Burkina Faso cover most of the surface area of the basin (85%). 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. Togo contains only a small percentage (approx. 6%) 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 Central, Plateaux and West Maritime regions. In Benin, the national share of the Volta basin accounts for about 12% of the national territory. 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 covers a large portion of Mopti region and a small part of Sahel region (UNEP, 2013).

1.2. Socio economic context

The countries of the Volta Basin are among the poorest in the world, with a majority of the people living below the poverty line. The 2019 Gross Domestic Product (GDP) for the Volta Basin countries range from US$ 675.5 in Togo to US$ 2,286.2 per capita in Côte d'Ivoire. Approximately 23 million people live in the Volta Basin, more than 70% of which reside in rural areas and depend on the basin's natural resources for their livelihood (GEF/UNEP/DHI/IWA, 2017).

The characteristics of the demography of the Volta Basin has implications in terms of the integrity of the natural resources of the basin (PNUE, 2013):

- Rapid population growth suggests that there will be increasing pressure on natural resources of the Volta Basin as a result of human activities.
- The largely rural nature of the population implies a higher direct dependence on the natural resources base. Between 64% and 88% of the population of the Volta Basin is rural and depends directly on natural resources.
- People continue to move to urban areas as they look for jobs. Population growth in urban areas will be even greater than in rural areas, which will lead to increased demand for natural resources, including water.

In terms of the Human Development Index (HDI), table 2 below shows the latest world ranking. Mali has the lowest ranking among the countries of the Volta basin (184 out of 189 in the 2019 UNDP Human development report), and with an HDI of 0.427. Ghana has the highest ranking with (142 out of 189) with an HDI of 0.596.

Table 2: GDP per capita, population, and HDI in the countries of the Volta basin

Country	GDP per capita	HDI (value)
Benin	1,219.4	0.520
Burkina Faso	774.8	0.434
Cote d'Ivoire	2,286.2	0.516
Ghana	2,202.1	0.596
Mali	890.7	0.427
Togo	675.5	0.513

Source:https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=ZG accessed on 13 September 2020, and http://www.hdr.undp.org/ accessed on 13 September 2020

The **main economic activities** within the Volta Basin are agriculture, livestock rearing, fisheries and aquaculture, logging, mining, trade and tourism. The agricultural sector employs about 83% of the population of the basin. Arable land of the basin is estimated at 1,400,000 ha (Giesen et al., 2010). The diversity of climate and ecological zones allows the cultivation of a wide range of crops, ranging

from cash crops (coffee, cocoa, cotton) to food and vegetable crops. The farming system is a combination of crop rotation and mixed cropping, but there are also monocropping systems. Parkland agroforestry systems maintain economically valuable and multipurpose trees such as shea (*Vitellaria paradoxa*), African locust bean (*Parkia biglobosa*) and Kapok (*Ceiba pentandra*) on farmlands (Mul et al. 2015).

The Volta basin area is also an area of livestock production; this occurs mainly in the northern parts of the basin (Burkina Faso and Northern Ghana) because of the prevalence of tsetse flies and trypanosomiasis throughout the tropical southern part of the basin. In the northern part, livestock production is an important source of rural livelihood. Livestock is also an important source of income for farmers. The predominant livestock comprise cattle, sheep, goats, pigs, fowls and guinea fowls (Mul et al. 2015).

Transhumance is widespread in the Volta basin. In the sub-catchment of the Black Volta Basin in Ghana, for instance, transhumance has increased because of ecosystem degradation (specifically water resources and vegetation), resulting from dam construction and other water and land management structures. Competition for the resources available creates social tension that sometimes leads to conflicts among transhumants and between transhumants and nomads (UNEP-GEF Volta Project, 2010).

In the Black Volta basin, women tend to be disadvantaged in terms of access to fertile land for farming. This is because of cultural considerations: the traditional roles of men as heads of the family give them the advantage of access to these productive lands. In the Black Volta in Ghana, access to land for farming is authorized by these family heads of the Tindanis/Tindanba groups who manage the land. What mostly happens is that men choose to take the arable lands for farming. As a result women do not have any other choice but to take the lands with low soil fertility. (UNEP-GEF Volta Project, 2010). In addition, one of the main transboundary issue reported in the basin also relate to gender based violence.
There is an urgent need for gender equity and equality in economic activities to reduce poverty among women.

The IUCN/GWP Volta water governance project (PAGEV) implemented from 2004 to 2011 in 2 phases, facilitated public participation and dialogue between the government and civil society to lay the foundation for equitable and sustainable transboundary integrated water resources management. The project acknowledged the benefit of the participation of community groups across boundaries in planning and implementing water resource management. (IUCN, 2012).
This is an opportunity to also address gender mainstreaming, which should lead to increase the participation of marginalised groups, women and youth in IWRM.

1.3. Physical and environmental features and opportunities of the Volta basin

Geology and soils

The geology of the main Volta is dominated by the Voltaian system. Other geological formations include: the Buem formation, Togo series, Dahomeyan formation, and Tertiary-to-Recent formations. The Voltaian system consists of Precambrian to Paleozoic sandstones, shales and conglomerates. The Buem series lie between the Togo series in the east and the Voltaian system in the west. The Buem series comprise calcareous, argillaceous, sandy and ferruginous shales, sandstones, arkose, greywacke and agglomerates, tuffs, and jaspers. The Togo series lie toward the eastern and southern parts of the main Volta and consist of alternating arenaceous and argillaceous sediment. The Dahomeyan system occurs at the southern part of the main Volta Basin and consists of mainly metamorphic rocks, including hornblende and biotite, gneisses, migmatites, granulites, and schist. The different soils groups that are found in the basin are: Savannah Ochrosols, Groundwater Laterites (GWL), Savannah

Ochrosol – GWL Intergrades, Savannah lithosols, Savannahs Gleisoils, Savannahs Gleisoils Alluviosols Intergrades (Barry et al, 2005).

Climate

The climate of the Volta basin region is controlled by two air masses: the North-East Trade Winds and the Southwest Trade Winds. The Northeast Trade winds, or the harmattan, blowing from the interior of the continent, are dry and dusty. The South-West Trade winds, or the monsoons blow from the seas and are moist. The inter-phase of these two air masses is called the Intertropical Convergence Zone (ITCZ), rainfall from March to October in the Volta Basin region.

Four types of climatic zones can be identified in the Volta basin region (Mul et al, 2015):

- The Guinean Zone extending from approximately 8° N to 11° N
- The Sudan Zone located below 11° 30' N parallel
- The Sudano-Sahelian zone located between the 11° 30' N and 14 °N parallels
- The Sahelian Zone located above the 14° N parallel

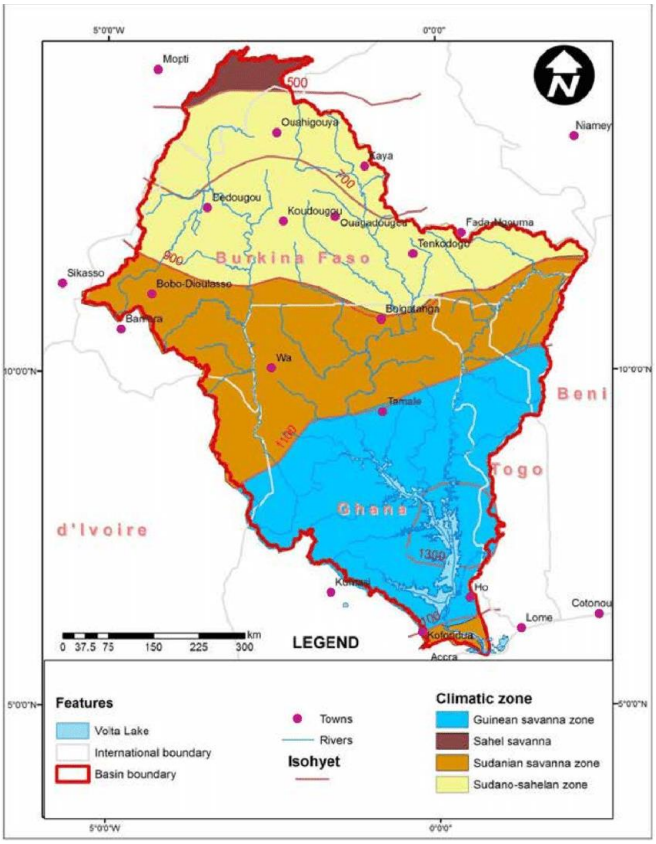

Figure 3: climatic zones in the Volta basin (Mul et al, 2015)

- **average annual rainfall** is highly variable in time and space. The Sahelian zone (northern part of the basin) receives an annual rainfall of less than 500 mm; the Sudano-Sahelian zone covers the greater part of Burkina Faso), receives rainfall of between 500 and 900 mm per annum. The Sudanian zone (northern part of Ghana and some parts of Côte d'Ivoire, Benin and Togo) receives between 900 and 1,100 mm of rain per year. The Guinean zone (southern part of Ghana) receives rainfall in excess of 1,100 mm per year. Approximately 70% of annual rainfall in the basin occurs during July, August and September (UNEP-GEF VOLTA PROJECT, 2013).
- **mean annual temperature** ranges from 27°C in the south to 36°C in the north. Extreme temperatures have been observed: in the northern part of Burkina Faso a minimum value of 5°C was recorded in Markoye in 1975 and a maximum value of 47.5°C in Dori in 2016 (ANAM, 2016).

- **potential evapotranspiration** ranges from 1,176 to 2,400 mm per annum. Evapotranspiration rates are variable in time and space. Approximately 80% of rainfall is lost to evapotranspiration during the rainy season. Real evapotranspiration in most parts of the basin depends on soil condition and is between 10 mm per day in the rainy season and 2 mm per day in the dry season.
- **evaporation** is relatively high, especially in the Sahelian zone, and at the same time progressively increases from south to north. The average annual evaporation rate varies between 1,400 mm in Benin and 3,015 mm in Mali.
- **humidity** is high during the rainy season and low during dry periods. In Burkina Faso, for example, the average annual minimum and maximum values are, respectively, 10% and 90%. Humidity also varies with latitude: in Ghana, it varies from less than 30% in the north to 80% along the coast.
- **winds** speeds are, in general, low and vary between 0.5 m per second at night and 2.0 m per second during the day. Weaker line squalls with heavy rains and strong winds of short duration occur occasionally. Between December and February, fresh dry north-easterly Harmattan winds occur when the ITCZ deviates from its southerly position (UNEP-GEF VOLTA PROJECT, 2013).
- The assessment of **potential changes in temperature and rainfall** across West Africa from scientists suggests a general warming trend. This is in agreement with global climate models, which that a projected increase in temperature is very likely to occur. There is also an increase in variability from scientific regional climate results, which could result in a greater frequency of extreme climatic events (heavy rains, heatwave, etc). The projections of rainfall patterns are highly variable, and contain little to no consensus on either the direction or magnitude of potential changes in rainfall (IUCN, 2017).

Ecosystems, ecosystem services and biodiversity of the Volta basin region

Ecosystem services are "the benefits people obtain from ecosystems''. There are four main categories of services: provisioning services such as food, water, fibre, wood; regulating services such as climate regulation, regulation of floods and drought, disease control, water purification; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious benefits (MEA, 2005).

The West Africa region, which includes the Volta Basin region, is endowed with a great diversity of landscapes, including savannahs, forests, mangroves, flood plains, deserts, lakes and oceans. These ecosystems, provide a wide range of ecosystem services and play an important role in securing livelihoods for the populations of the basin, and in the economic development and resilience to current and future threats and hazards. Forest ecosystems for instance protect from erosion, and mangroves protect from storms, and salt intrusion.

The high diversity of ecosystems in West Africa - comprising the Volta basin region – explains the exceptional richness in fauna and flora. The ecosystem of Upper Guinea is an area with high biodiversity values and high endemism. Four countries of the Volta basin (Côte d'Ivoire, Ghana, Togo and Benin) are in the priority zone for the conservation of biodiversity at the international level ("hotspots") due to the level of significance of its specific richness, the high rate of endemic species and due to threats to its biological diversity (Conservation International, 2011). In the Togolese part of the basin alone, 708 bird species have been recorded (Projet PNUE-FEM-Volta, 2014). The Sourou transboundary floodplain between Mali and Burkina Faso, and the inland delta of the Niger River Ramsar sites constitute remarkable ecological features of these countries (IUCN/PACO (2016). The Volta Basin contains dryland areas. Dryland areas are characterized by scarcity of water; as a result they can experience drought events. However they contain unique habitats, unique ecological communities with high level of biodiversity, including endemic species that have adapted to the variability of rainfall, and to water scarcity. Drylands have also adapted to fire and depend on fire to maintain specific ecological communities. Approximately one-third of the biodiversity hotspots of the world are in the drylands. Drylands, like other ecosystem, provide a wide range of ecosystem services,

such as water and food provision, climate regulation, biodiversity conservation, livestock production (Mortimore et al, 2009; Davies, 2017).

The Volta Basin contains a number of protected areas, which attract tourists. Because the Volta basin in an important area for water birds (migratory and non migratory birds), bird-watching is an important touristic activity, both for water birds (in particular in Mali and Burkina Faso) and for parrots in forest reserves. Large and small mammals can also be viewed in these protected areas, as well as reptiles that also attract tourists. Fishing activity is (sports-fishing) occurs in freshwater ecosystems of the basin (Mul et al. 2015).

Mangroves are coastal forests particularly found in tropical and subtropical regions, and they are frequently inundated with salt water. Mangroves are very productive ecosystems: African mangroves are home to very diverse fauna, such as molluscs, and crustaceans. They are important areas for the production of oysters. Mangroves constitute nurseries for many fish species; many commercially caught fish have spent part of their lives in mangroves. Mangroves protect against storms and sea level rise; therefore they play an important role in climate change adaptation, and the protection of communities from the impacts of climate change (IUCN, 2017).

Water resources

The very rich and diverse freshwater ecosystems of the Volta Basin provide various ecosystem services, such as food and water, fuel and construction materials, regulation of flows, provision of habitats for animals, including migratory birds, and other water-based animals such as crocodiles and hippos, and plant and tree species. These ecosystem services contribute to local livelihoods and play an important role in the promotion of economic development and poverty reduction in the basin. Farming, livestock-rearing and fishing are commonly found in these ecosystems.

There are several types of wetlands across the Volta Basin, including:

- Lakes and wetlands formed in natural local depressions that contain water throughout the year such as the Lac de Dem in Burkina Faso, the natural wetland of *La Valley de Sourou* in Mali and Burkina Faso and *La Mare aux Hippopotames* along the floodplains of the Black Volta in Burkina Faso;
- Seasonally flooded valley bottoms, and reservoirs formed by the construction of dams such as Bagre Dam, and Lac de Bam and Kompienga Dam sites in Burkina Faso
- The Volta Estuary also has key wetland systems in the form of coastal lagoons.

National parks and other important areas with significant water bodies include *Zone Humide de la Rivière Pendjari* in Benin; Parc National de la Kéran; and Bassin Versant Oti-Mandouri in Togo. In the Volta Estuary in Ghana, the Songor Lagoon and the Anlo-Keta Lagoon Complex are Ramsar sites. In addition there are smaller wetlands and lakes that are important for local communities: along the main streams of the Black and White Volta and Oti rivers, seasonally flooded floodplains provide replenishment of groundwater and deposits of fertile soils. In Ghana, these systems are increasingly being used for rice production (Mul et al. 2015).

Rainfed agriculture is the principal livelihood activities and development for most of the people living in the basin and it generates about 40% of the basin's economic output (GEF/UNEP/DHI/IWA. 2017). Therefore the population of the basin is highly vulnerable to the spatial and temporal variability of rainfall and climate change. The basin is exposed to a growing scarcity of water resources due to the effects of deforestation, land degradation, high population growth rate and climate change. As a result water supplies reduce and cannot meet the water demands of the growing population[1].

[1] https://www.gwp.org/en/WACDEP/IMPLEMENTATION/Where/Volta/

2. Threats and challenges of environmental resources in the Volta Basin

A full Transboundary Diagnostic Analysis (TDA), conducted in 2012 and that built on a preliminary study provides a participatory and science-based assessment, threats, and underlying causes of threats in the Volta Basin.
According to the results of the full TDA the Volta River Basin continues to experience high levels of degradation of water quality, coastal erosion, increased sedimentation of rivers, invasive aquatic species, loss of soil and vegetation cover and ecosystem degradation. This is due to unsustainable practices, and exacerbated by climate change, poor governance of the basin's natural resources. The analysis identified three clusters of transboundary problems and two priority cross-cutting concerns (Mul et al. 2015):

- transboundary problems include: changes in water quantity and seasonal flows; degradation of ecosystems; and water quality concerns.
- priority cross-cutting concerns include Governance and Climate Change.

2.1. Hazards and risks

Human activity that cause environmental stresses and increase the occurrence of natural hazards threatens the ecosystems of the Volta basin. As a result environmental degradation and the loss of natural resources and biodiversity occurs with impacts on the integrity of the resources and on the livelihoods of the most vulnerable population of the basin.
The main hazards in the Volta region are floods and drought. The Sahel is more vulnerable to these hazards because of climate conditions (Van Giesen et al, 2010). The Volta River Basin is characterized by high seasonal rainfall variability, with a distinct dry season. During the wet season, large areas are flooded. Natural floods are linked to high rainfall intensities, exceeding 100 mm in 5 days. In more recent years, floods have also been attributed to the operation and management of dams. These include operations of the Bagré dam in Burkina Faso causing flooding in downstream Ghana and Togo, respectively (Mul et al. 2015).

Drought is also frequent in West Africa, and the frequency of high temperatures may increase the frequency of droughts. However ecosystem and land degradation can be considered as another important factor causing drought, in addition to climate conditions. Land degradation is the result of unsustainable management practices by humans. These include: deforestation, and over-exploitation of land uses, which leads to soil erosion and negatively affects water resources. The degradation of soil affects land productivity and its ability to store water.

Flooding has caused significant damage to infrastructure (bridges, access roads, buildings and dams), affected people, their livelihoods, and destroyed ecosystems and ecosystem services. The destruction of farms in some parts of the basin forced people to displace; floods events have also caused loss of lives.
The worst floods were recorded on 6 September 2009 in the White Volta basin after a rise in water level as a result of heavy rainfall forcing water from the Bagre dam to be spilled. 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, 25,112 people displaced in the Central Gonja District of the Northern Ghana. Because of this event, the Government of Ghana secured US$500 million loan to build the Pwalugu dam in the White Volta Basin to attenuate the peak flows resulting from the spillage of water from the Bagre dam. These events also lead to the development of the Flood Early Warning System (FEWS-Volta) by the Water Resources Commission of Ghana in 2012 for the White Volta Basin, later extended to the Oti Sub-basin (VBA-WMO-GWP, 2016).

During 2005–2015, West Africa counted 17 drought events, which affected 32 million people. Between 1900 and 2015, a total of 170,012 people were killed as a result of drought (UICN, 2017).

Good practices of sustainable land management, including integrated water resources management in the basin and restoration of degraded areas, can reduce the frequency of drought events, and the vulnerability of ecosystems and people that depend on them for their livelihoods. This need a better understanding of ecosystem degradation as a trigger to hazards and disasters in order to facilitate integration of ecosystem restoration actions into drought management strategies and plans.

2.2. Water quality

Water quality degradation is mainly attributed to the presence of phosphates and nitrates from agriculture due to poor farming practices. Water quality degradation is more prevalent in the north of the basin because of the effects of dilution in the south due to the ever-increasing water supply from upstream downwards. These chemicals are transferred downstream into other countries without any restriction. Discharge from untreated sewage is discharged into the waters. This pollution has socio-economic impacts such as scarcity of potable drinking water, scarcity of nonpolluted water for agriculture and animal husbandry, water-borne diseases and the associated effects on human and animal health, and decrease of fisheries, and loss of biodiversity.

In addition to poor farming practices, water quality degradation in the basin also results from unsustainable land use, intensive grazing activities of cattle and sheep, and bushfires. Rapid urbanization is leading to inappropriate discharges of domestic waste into the streams and rivers, degrading the quality of the waste. Poor awareness and education about public health, population pressure, urbanization and poverty also contribute to causes of water quality degradation.
The growing population increases the competition over water uses, which can generates changes in discharge and stress on water resources; but this is also impacted by climate variability, hydrological changes and hydropower dams constructed on several river courses of the Volta Basin. (UNEP, 2013).

Artisanal mining activities pose an additional risk to water quality. These activities are increasing in the northern part of the basin. In Ghana, unsustainable gold mining methods pose a serious threat to land degradation and river pollution (by mercury) in the affected areas (UNEP-GEF Volta Project, 2010 ; Projet PNUE-FEM Volta, 2010).

Land and ecosystem degradation
Bushfire to clear land, deforestation, over-exploitation of agriculture are poor land-use practices and lead to the reduction of vegetation cover. These practices contribute to the increased run-off and siltation leading to soil and coastal erosion in the uppermost reaches of the Volta Basin. Because of deforestation a loss of important ecosystems such as wetlands is observed. Over grazing also contributes to land degradation.

The strategic plan of the Volta Basin has defined 4 major ecosystem degradation in the Volta basin Projet PNUE-FEM-Volta, 2014:

- Coastal erosion, caused by changes in the river flows, increased storm intensities and sea-level rise. Unsustainable practices like sand winning are also an important factor of coastal erosion. Togo and Ghana are the most affected;
- Invasive aquatic species: these species are a threat to ecosystem functioning and to biodiversity. alien invasive species can affect water flows by increasing transpiration and evaporation losses. The most important invasive species that proliferate in the Volta basin include: the water lettuce *(Pistia stratiotes),* the giant salvinia (*Salvinia molesta*) and the water hyacinth (*Eichhornia*

crassipes). Aquatic alien species have social consequences as it causes the decline of marketable fish.
- Loss of soil and vegetation cover: due to poor management practices. It is exacerbated by changes in climatic conditions
- Increased sedimentation of river courses, which affects ecosystem productivity: this due to farming along river banks and on steep slopes, burning of farmland, excessive sand and gravel winning, mining on river banks and beds, harvesting of fuelwood and more systematic deforestation

Besides, land and ecosystem degradation causes drought (see section above). Loss of soil cover for instance affects and disrupt hydrological cycles due to the reduction of the soil's capacity to infiltrate and retain water. This leads to increases in run-off, soil become drier. Poorer or degraded soils lead to drought events. This can be observed mostly in the Northern part of the Volta basin (Sahel region) where the climate conditions combined with anthropogenic pressures have increased the frequency and severity of drought.

The Volta Basin region will experience changes in water needs because of the growing population; this as well as climate change are additional threats that will lead to loss of the biodiversity of the diverse ecosystems of the basin including savannahs, grasslands, forest, wetlands, mangroves, ponds, lakes and lagoons. This situation is exacerbated by the increased prevalence of floods and water shortages during the dry season, lack of knowledge and awareness, policies and legislation enforcement, and poor technical capacities of the relevant institutions.

Climate change

The climate of the Volta Basin is predominately semi-arid and sub-humid. The potential evapo-transpiration therefore exceeds precipitation. Climate predictions in the basin suggest an increase in water availability (Jin et al. (2018); predictions also suggest higher temperatures with increased evapo-transpiration, which will have negative impacts on water availability for energy production and agriculture that will become unreliable. High variability of rainfall patterns and distribution is the main factor causing fluctuations in food production in the Volta Basin especially the northern parts. Rainfed agriculture is the most important economic activity within the Volta Basin. A number of other sectors can be impacted by climate change and these include coastal zone resources, human health, industry, forestry, fisheries and wildlife.

Climate change will not only affect rainfall, evapo-transpiration and river flows directly, but also lead to an increase of water demand for irrigation. Throughout the Volta Basin this will lead to an expansion of irrigated agriculture[2].

Detailed climate models for the basin show that there seems to be a forward shift of the onset of the rainy season. At the same time, the end of the rainy season, as well as the total rainfall, are relatively stable. This implies that rain is more concentrated in time. Because the river flow in the Volta is sensitive to the exact distribution of rainfall over the year, more run-off over shorter times can be expected (Giesen et al 2010).

Human pressure as well as climate change are threatening ecosystem viability and sustainability. Ecosystems and ecosystem services are crucial for the preservation of the livelihoods of the population living in the Volta Basin region, as well as in addressing hazards and reducing impacts on people and infrastructure to disasters, and in increasing their resilience. Well and sustainably managed

[2] https://www.gwp.org/en/WACDEP/IMPLEMENTATION/Where/Volta/)

ecosystems resources of the Volta Basin, integrating ecosystems management in strategies and plans that address climate change and variability affecting the Volta Region will help reverse the current trends. As stated above, ecosystems, if managed in a sustainable way, can play an important role in both the adaptation and mitigation of climate change.

Strategies to address climate change need to include adaptation and mitigation options. Ecosystems can play an important role in adaptation and mitigation: by protecting wetlands and flood plains, we reduce the occurrence of flood events; by sustainably managing dryland areas, we create an environment that becomes resilient to drought.

Early warning systems are important tools to address and monitor the potential climate change impacts. These systems could be even more efficient if they consider the benefit of considering ecosystems and ecosystem services in their design and implementation. Early warning systems should connect the wellbeing of people with the wellbeing of the environment, ecosystems and the ecosystem services.

2. The Volta Basin Authority

The Volta Basin Authority (VBA) was established in 2006 in order to set up measures for sustainable transboundary water resources management.

The Volta Basin Authority mandate is to:

- Promote permanent consultation tools among the parties for the development of the basin;
- Promote the implementation of integrated water resources management and the equitable distribution of the benefits resulting from their various utilization;
- Authorize the development of infrastructure and projects planned by the stakeholders and which could have substantial impact on the water resources of the basin;
- Develop joint projects and works;
- Contribute to poverty alleviation and the sustainable development of the Parties in the Volta basin, for better socioeconomic integration in the sub-region.

The VBA is composed of six divisions including the Department of Planning and Integrated Water Resources Management (IWRM), which is composed of the Coordination Unit for Basin Stakeholders and National Focal Points among others, and the Volta Basin Observatory. (VBA, 2010)

The vision of the VBA is: ''*A basin shared by willing and cooperating partners managing the water resources rationally and sustainably for their comprehensive socio-economic development.*''
The mission of the VBA is to ''*Promote permanent consultation and sustainable development of the water and related resources of the Volta basin for equitable distribution of benefits towards poverty alleviation and better socio-economic integration*. ''

The different decision-making and consultative organs and the Executive Directorate of the VBA are responsible for the implementation of the above mission. The successful implementation of this mission depends on effective facilitation and coordination between the consultative organs and the Executive directorate.

The long-term objective of the 2014 Strategic Plan of the VBA is to ''enhance the ability of the countries to plan and manage the Volta Basin and its aquatic resources and ecosystems within their territories on a sustainable basis''. This will be done through institutional capacities strengthening of the Volta Basin countries, building knowledge and monitoring of environmental and water resources, and protection and restoration action of natural resources of the basin (Projet PNUE-FEM-Volta, 2014).

As part of this long term objective, a Water Charter for the Volta Basin was developed to define the principles, rules, procedures and modalities of an equitable, concerted and sustainable use of natural resources of the Volta Basin, that is aligned with the VBA mandate.

II. Current environmental policy framework in the Volta basin and how they relate to the challenges of the Volta basin

We acknowledge the importance of coordinated policies, strategies and plans to address the challenges of the Volta basin mentioned above related to climate, environmental degradation and biodiversity loss, water quality degradation and the occurrence of natural hazards such as floods and droughts. This section will present the different policies in the different sectors that can influence the management of the Volta basin.

1. Climate change related policies

At the regional level: There is no specific policy on climate change, but climate change-related action plans and programmes were developed at the West Africa or Africa level:

- the Economic Community of West African States (ECOWAS), the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), the Economic Commission for Africa (ECA) and the African Centre of Meteorological Application for Development (ACMAD) developed a subregional action programme to reduce West Africa and Chad's vulnerability to climate change; the objective to develop and build resilience and adaptation capacities to manage climate change and extreme climatic events.
- the African Development Bank (AfDB) second climate change action plan (CCAP2) 2016-2020 seeks to achieve a '*low – carbon and climate-resilient'* development in Africa, and has four pillars: Mitigation, Adaptation, Climate Finance and a Cross Cutting pillar that addresses technology transfer, capacity development, and institutional reforms. Adaptation pillar focuses, among others, on special initiatives that support adaptation and climate-resilience. Mitigation pillar supports climate smart agriculture and reducing emissions from deforestation and forest degradation, and green infrastructure.

At the national level: National Adaptation Programmes of Action (NAPAs) identify priority activities that respond to the urgent and immediate needs to adapt to climate change. All countries have submitted their NAPA except Cote d'Ivoire and Ghana. However Ghana has established a national climate change adaptation framework aimed at strengthening national resilience to disasters, and proactive and effective risk reduction measures. As part of this process Ghana launched in 2012 its national climate change adaptation strategy (NCCAS), in which the country identified temperature increase, rainfall variability and decrease, sea level rise, extreme weather events and climate related-disasters as key elements of vulnerability.
National adaptation plans (NAPs) established under the Cancun Adaptation Framework are developed by countries to identify adaptation needs and develop and implement strategies and programmes to address the needs. Burkina Faso and Togo finalised their NAP in 2015, and 2018 respectively.
The Nationally Determined Contribution (NDCs) is a communication through which countries communicate their post-2020 climate actions, requested by the Paris Agreement. All countries developed their first NDC except Cote d'Ivoire.

2. Biodiversity related policies

National Biodiversity Strategies and Action Plans (NBSAPs) are the principal instruments for implementing the Convention on Biological Diversity at the national level. The Convention requires countries to prepare a national biodiversity strategy and to ensure that this strategy is mainstreamed into the planning process of all sectors whose activities may have an impact on biodiversity. Countries of the Volta basin, in their NBSAPs, make the link between biodiversity and disasters/climate change:

- Benin: Strategic objective 9 of the plan is about reducing to the minimum human pressures on vulnerable coastal and marine ecosystems affected by climate change or ocean acidification.
- Burkina Faso: in its article 7, promotes better management and protection of wetlands against siltation, pollution and invasive species, through the elaboration and implementation of operational programmes to combat these hazards and programmes to restore and protect sites and manage river basins.
- Ghana highlights nine targets for biodiversity conservation and mainstreaming, including: integrated control of Invasive alien species on important water bodies (e.g. Volta); and appropriate technologies for agro-biodiversity conservation for climate change adaptation and mitigation identified and adopted.
- Mali: objective 14 addresses ecosystem resilience through climate change adaptation measures and actions to combat desertification. Activities include the restoration of degraded areas and vulnerability assessments.
- Togo: objective 7 addresses wildfires by implementing efficient measures.

Concrete results are yet to be seen on the ground on how the targets have been achieved and how they have impacted the state of the Volta basin.

3. Integrated water resources management policies

Each country of the basin has a water management framework in general under the Ministry of Water to address integrated water resources management. The countries of the basin have also developed national programs for integrated water resources management. However, these programs do not establish a direct link between water resources and ecosystem protection. For example, Burkina Faso's program is developed for the period 2016-2030, and aims at sustainably contributing to the freshwater needs of users and aquatic ecosystems. The actions proposed in this plan, however, do not suggest sustainable management of ecosystems to improve water resources.
In Ghana, another major body is the Water Resources Commission, which has the mandate to regulate and manage the utilization of water resources and coordinate relevant water-related government policies. It is the Water Resources Commission that represents Ghana on transboundary-related issues with their counterparts in the riparian countries of the Volta basin (Mul et al. 2015).

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

At the regional level, the Water Resources Policy for West Africa and its Regional Action Plan are implemented by the ECOWAS Water Resources Coordination Centre. The Water Resources Coordination Centre monitors and supervises ECOWAS activities in the field of water management through the implementation of this policy. The objective of the Water Resources Coordination Centre is to ensure the promotion of integrated water resources management practices, coordination and monitoring of actions in the region.

4. Disaster risk management related policies

At the national level

Cote d'Ivoire has developed a National Action Plan to strengthen the capacities to reduce disaster risk (2016-2020); the plan seeks to reduce human, livelihoods, infrastructure, economic, cultural and environmental losses and risks associated with disasters. Priorities of the plan include, among others, strengthening capacities on understanding disaster risk; investing in economic, social, cultural and environmental resilience, to name a few. Mali has a National Strategy for Disaster Risk Management. Togo has a National Civil Protection Policy since 2017 that takes into account disaster risk management and a Disaster Risk Reduction Strategy with a programmatic framework of actions (2009-2013, 2013-2017, 2021-2025 under development). Burkina Faso has a National Action Plan for Capacity Building for Risk Reduction and Emergency Preparedness (Plan CADRI). Benin has a national policy for integrated disaster prevention and management, and a national drought plan 2019-2024, which aims to develop actions to address drought management. However, this plan does not propose solutions that use the potential of ecosystems to combat drought.

National Platforms for Disaster Risk Reduction (DRR) exist in all six countries of the Volta Basin. These platforms are national coordinating multi-sectoral and inter-disciplinary mechanisms for advocacy, coordination, analysis and advice on disaster risk reduction. They should play an important role in the coordination and collaboration of all sectors involved in nature-based approaches to integrated water resources management in the Volta region.

At the regional and subregional levels

The African Union (AU) established an Africa Regional Strategy for Disaster Risk Reduction, which aims to contribute to achieve sustainable development and poverty reduction by facilitating the integration of disaster risk reduction into development. A Programme of Action (2006–2015) to implement the strategy aims to reduce social, economic and environmental impacts of disasters on people and economies. The AU also established a disaster risk reduction programme and set up and operationalised the Africa Working Group on DRR with a view to providing coordination and technical support to Regional Economic Communities, Member States, and other stakeholders for the implementation of the Program of Action (African Union, 2004). However the strategy does not have any objectives that relate to the link between disasters and integrated water resources management or ecosystem management.

The Great Green Wall of the Sahara and the Sahel Initiative (GGWSSI) was launched in 2007 by the AU to tackle the issue of land degradation and desertification, improve food security, and help communities adapt to climate change. Countries of the GGW are currently implementing several interventions that contribute to achieve this aim, including climate change adaptation and mitigation actions based on ecosystem approaches, e.g. protection of dryland ecosystem to combat drought in Burkina Faso. Two countries of the Volta basin (Mali and Burkina Faso) are among the current focal countries for the initiative.

A regional policy on preventing disaster risk was adopted by the Heads of State of ECOWAS in 2007, as well as an Action plan (2010–2015) to facilitate the implementation process for mainstreaming DRR into sustainable development planning and activities in West Africa. One of the strategies to support integration of disaster risk reduction into adaptation to climate change, in particular is the management of drought and the fight against desertification. ECOWAS further developed the Action Plan (2015-2030) to align with the Sendai Framework and the new ECOWAS Regional flood strategy, which makes provision for linking flood management to IWRM at local administrative levels.

The policies/frameworks above do not specifically suggest a clear relationship between ecosystems functions and services and land health. This is because of insufficient knowledge and a lack of

integrated policies. Integrating ecosystems into management plans to address climate adaptation in The Volta Basin gives this opportunity to address multiple benefits, including biodiversity conservation, climate regulation, and disasters, etc, through the sustainable management of different land uses in a landscape. Integrating ecosystems and ecosystem services in the above policies will facilitate the development and implementation of mechanisms to coordinate policies that address floods and droughts in the Volta Basin.

In addition to the lack of integration of policies and insufficient knowledge on linkages between ecosystems functions and DRR, the problem is partly attributed to the policy approach to the management of water, land, DRR and ecosystem in the ECOWAS countries. Currently, the approach to disaster risk management is mainly based on administrative boundaries and has little or no linkages to the management of land, water and ecosystem.

5. Links with regional/international commitments

Regional and national policies for integrated water resources management to reduce the risk of disasters relate to some global commitments that countries of the Volta basin have signed and ratified.

The **Sendai Framework for Disaster Risk Reduction** 2015-2030 was adopted. It outlines seven global targets and four priorities for action. Among priorities for action, the framework will: i. improve understanding disaster risks, linking hazards with ecosystem degradation; ii. strengthen disaster risk governance to manage disaster risk, emphasizing the need for transboundary cooperation for the implementation of ecosystem-based approaches to build resilience and reduce disaster risk; iii. invest in DRR resilience including the resilience of the environment. As such, the framework recognizes that environmental degradation is a trigger to disaster, and commits to invest in protecting the environment to build disaster resilience, and can relate to any plan or strategy that address hazards in the Volta Basin countries.

There are several references to ecosystem-based approaches for adaptation, e.g. in decisions X/33, XII/20 and XIII/4, XI/15, XI/19, XI/21 of the CBD CoP. The **post-2020 global biodiversity framework** under elaboration builds on the Strategic Plan for Biodiversity 2011-2020, and sets objectives for biodiversity conservation and maintenance of ecosystems services by 2050. Actions to reduce the threats to biodiversity and its benefits will contribute to build healthy ecosystems and protect species, hence increase their resilience and help them contribute to manage disaster risks. The framework will foster synergies and coordination with relevant global, regional, and national processes, and will contribute to the SDGs.

Several goals of the **Sustainable Development Goals** (SDGs) are directly related to ecosystem based approaches to climate change and disasters that we want to promote in the Volta Basin such as: SDG 13 (climate action); SDGs 15 on Life on land, SDG 1 (end poverty), SDG 2 (end hunger), SDG 3 (human well-being), 6 (access to water and sanitation).

The United Nations Convention to Combat Desertification (UNCCD) addresses the issues of land degradation, desertification and drought. The **UNCCD 2018–2030 Strategic Framework** will contribute to:

- achieve the objectives of the Convention and the 2030 Agenda for Sustainable Development, including the SDG 15 and target 15.3 on LDN[3] and other interrelated SDGs

[3] Land Degradation Neutrality (LDN) is defined as: *A state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems*

- improve the living conditions of affected populations; and
- enhance ecosystems services.

This last objective is directly relevant to the challenges faced by the countries of the Volta basin, especially those located in vulnerable regions such as the Sahel, and is aligned with the LDN objective to maintain or improve the sustainable delivery of ecosystem services. Sustainable land management that uses and improves the condition of ecosystem services will help address Volta basin management. To date 127 countries including the 6 countries of the Volta Basin have set their LDN targets by 2030. Some countries have started to translate these targets into action through Transformative Projects and Programmes (TPP) to scale up restoration actions that will transform and strengthen society, the economies, and the environment. The Volta basin countries have defined several specific voluntary targets whose implementation is directly linked to the VFDM project, and the management of the Volta basin's natural resources. Among these target are: improve land productivity (all countries), recover bare land (Cote d'Ivoire, Burkina), increase the soil organic carbon and other carbon stocks (Cote d'Ivoire, Burkina, Ghana), restore and preserve of wetlands (Mali, Benin).

The **Paris Agreement** aims to strengthen the global response to the threat of climate change by keeping a global temperature rise below 2°C and even further to 1.5°C. The Agreement will strengthen national adaptation and mitigation efforts and recognises the importance to protect ecosystems and biodiversity to reach targets regarding mitigation and adaptation. The Agreement calls for an integration of adaptation into relevant environmental policies and actions, and for building the resilience of ecosystems through sustainable management of natural resources. The Parties will address climate change, under the Agreement, through the nationally determined contributions (NDCs).

The Ramsar Convention recognises that degradation of wetlands reduces resilience against water-related hazards such as floods, droughts and storm surges, with impacts on society, economies, people and ecosystems. The Convention encourages Parties to recognize and integrate wetlands as a cost-effective ecosystem approach to address DRR, as wetlands can mitigate hazards and increase the resilience of local communities of the river basins or coastal zones. The Convention also calls for an effective collaboration between the development, humanitarian and environmental sectors to design and implement wetland-related solutions to increase resilience to disasters. Benin and Mali have included specific targets on wetlands protection and restoration in their LDN commitments.

III. Ecosystem services and nature-based solutions to address challenges of the Volta Basin region

1. Nature-based Solutions: context and definition

The Nature-based Solutions (NbS) concept is based on IUCN's work in the past decades on Forest Landscape Restoration (FLR), Ecosystem-based Adaptation (EbA), Ecosystem-based disaster risk reduction (eco DRR), and Sustainable Land Management (SLM). IUCN strives to promote NbS and increase knowledge and understanding of the concept among key stakeholders. Because there are different interpretations of the concept, IUCN has developed a global standard for NbS to clarify and define the concept, which is about using conservation actions to meet people's needs, but not only biodiversity and ecosystems needs. The global standard was launched in July 2020.

IUCN adopted a definition of NbS in 2016 as: ***"actions to protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges (e.g. climate change, food and water security or natural disasters) effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".***

Figure 5 represents how the different ecosystem based approaches can address multiple societal challenges.

Figure 5: Nature-based Solutions (IUCN, 2020)

The societal challenges that NbS can address include (IUCN, 2020):

- Climate change mitigation and adaptation: healthy and well managed ecosystems (forests, mangroves, oceans, soils) can effectively store and sequester carbon, thus reduce the emission of greenhouse gases, and can effectively reduce the impacts of hazards such as erosion, floods, storms, drought.
- Disaster risk reduction: directly linked to the above, NbS reduce the prevalence of hazards and reduce the risk of disasters with the associated impacts on people and ecosystems.
- Food security: well managed ecosystems provide food and can meet the daily supply of proteins and other essential nutrients. Sustainable agriculture contributes to the conservation sector by maintaining healthy and productive soils that are the foundation for provisional, regulating and cultural ecosystem services
- Water security: Integrated water resources management coupled with ecosystem-based approaches will enhance water availability, water supply, water quality for the benefit and security of the populations.
- Socio economic development: NbS creates benefits for people. Healthy ecosystems provide the opportunity to develop sustainable value chains (e.g. non timber forest products or livestock production) that will increase the income of rural communities. NbS are also an opportunity to engage with humanitarian or sustainable and green jobs related institutions.
- Human health and wellbeing relate to the provision from nature of clean air, clean water, cultural and aesthetical services, medicinal plants, etc
- Environmental degradation and biodiversity loss: NbS directly addresses biodiversity loss by protecting and restoring the integrity of ecosystems.

Nature is therefore used as a response, which leverages multiple benefits, since a single intervention helps meet the above mentioned societal challenges; this is also an opportunity to create synergies between the different sectors on water, agriculture, conservation of nature/environment. NbS is also

directly connected to many of the SDGs. This approach should be promoted and adopted by the Volta basin countries at the local, national, regional and transboundary levels.
Protection, restoration and sustainable use are the responses to the seven societal challenges, which is the basis of the global standard for NbS that will help stakeholders develop and implement long term solutions.

The aim of the global standard is to (IUCN, 2020):

- Have a common language and framework to bring together partners and mainstream NbS. The standard will ensure the quality and credibility of NbS, secure effectiveness to provide benefits to both human well-being and biodiversity.
- Increase demand for NbS thus bringing about positive sustainable change
- Embed a framework for maximum impact for positive gains towards biodiversity-human wellbeing
- Manage risks of further unsustainable use of natural resources
- Manage risks of further inequity in the world

Figure 6: summary of the standard and the 8 criteria (IUCN, 2020)

The standard is composed of 8 criteria and 28 associated indicators, as indicated in Figure 6.
The standard is also a self-assessment tool. Guidelines have been developed to instruct users how to: use the concepts in the standard to design new NbS; Upscale pilots by identifying gaps and; Verify past projects and future proposals. The output will be in the form of a percentage match, with a traffic light system and circumflex chart to identify areas for further work. Even if a solution is rated 35%, the importance is to identify what needs to be done to improve the percentage or reach 100%.

2. Nature-based solutions as a support for IWRM of the Volta Basin

From the description above, water as well as land resources play an important role in securing the livelihoods of the population of the Volta Basin by providing key ecosystem services. Water is a vital resource for human beings, and supports agriculture, livestock production, biodiversity, industrial sector development and the environment. Water scarcity has increased over the last years mainly because of population growth and increase in demand for water for domestic uses, but also other uses to support the above-mentioned sectors. Because of this competition over water resources from different sectors, and also given that climate change and variability affects the availability of water

resources, there is a need for integrated management of water resources in a way that it can respond to the needs of all sectors. This requires addressing the issues related to climate change, including adaptation and mitigation, and natural hazards such as floods and droughts that are triggered by environmental degradation.

Integrated Water Resources Management (IWRM) promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment[4].

IWRM therefore helps protect the environment, secure people's livelihoods and improve human wellbeing, and promote economic development and growth. IWRM considers water resources as an integral component of the ecosystem, and a social and economic good. Today, water policy and management reflects this relationship with nature, as well as with the different sectors involved (urban development, water, agriculture, environment and nature conservation): if water from municipal and industrial waste is contaminated it will pollute rivers and degrade ecosystems and the ecosystem services that they contain; if water has to be left in a river to protect fisheries and ecosystems, less can be diverted to grow crops. IWRM has shifted to take into account these considerations. Solutions based on ecosystems and ecosystem services management to address the threats and challenges of the Volta Basin can be considered as they will at the same time protect ecosystems, increase their resilience, and provide multiple benefits to the population, as well as foster and enhance coordinated policies.

IWRM provides the opportunity to address the issue of natural resources management in the different sectors involved and coordinate the actions across sectors that will lead to natural resources management and restoration. IWRM-related institutions at the national level can lead and facilitate this process with the other sectors. In addition, national IWRM policies should be strengthened to integrate ecosystem and ecosystem services in their planning and management. The VBA can play a leadership role as the IWRM strategies and plans endorse the use of NbS in the Volta Basin.

2.1. Nature-based solutions for disaster risk reduction

As indicated in the previous sections of this document, the Volta Basin region has experienced several episodes of drought and floods, which are the main hazards encountered across the basin. The countries of the Volta Basin are vulnerable to drought and floods because of human pressures that weaken the protection role of the basin's ecosystems, and because of climatic conditions. These events have caused damages to people, infrastructures and the environment.

Ecosystem-based disaster risk reduction (eco-DRR) is the "Sustainable management, conservation and restoration of ecosystems to provide services that reduce disaster risk by mitigating hazards and by increasing livelihood resilience." (PEDRR, 2013). Eco-DRR is a nature-based solution because it is an ecosystem approach that addresses societal challenges. Eco DRR is NbS for disaster risk reduction.
There is increasing recognition that ecosystems can play an important role in disaster risk reduction if they are healthy.

Wetlands and floodplains play an important role in controlling floods. Floodplain vegetation provides a protective barrier against flooding. Through their water retention capacity, they reduce the intensity and slow the speed of flooding. Then they release the floodwater gradually, thus regulating the water flow and guaranteeing a constant supply in water. Floodplains also reduce droughts, especially in

[4] https://www.gwp.org/en/GWP-CEE/about/why/what-is-iwrm/

drylands, by recharging the groundwater. Then, during severe droughts, the water in the soil can reduce the impact of drought.

Dryland areas have unique features, habitats, ecological communities with a high level of biodiversity, that have adapted to the variability of rainfall, and to water scarcity. These features require adapted strategies for conservation and sustainable management. Drylands provide a wide range of ecosystem services, including water and food provision, climate regulation, and biodiversity conservation. Unsustainable management of these areas threaten ecosystem services, and increase risks. Adaptation in drylands also includes adaptation to fire. Drylands areas include plant species that can resist fire and are adapted to fire. The sustainable management of the vegetation in drylands improves drought resilience. The reforestation of degraded forest or woodland ecosystems with specific species that have particular abilities such as drought- tolerant species addresses drought in these regions. (UICN, 2017)

Mangroves are coastal wetlands, productive ecosystems, and home to fisheries resources such as oysters, and crustaceans, and they provide nurseries for many fish species. Mangroves protect from winds, sandstorms, storm surges and reduce coastal flooding. Mangroves and other coastal vegetation stabilise shorelines, thus reducing the impacts of storms. Mangroves therefore maintain the biodiversity of coastal areas, support the livelihood of coastal communities, and reduce coastal flooding, and the related impact on ecosystem and people. Restoring mangroves contributes to the restoration of fish and other species' habitat, the support of livelihoods and at the same time the protection of coastlines.

Conserving and sustainably managing **forests** to reduce greenhouse gas emissions and increase carbon sequestration is also An efficient way to reduce the risks of soil erosion or landslides by stabilising slopes.

The Volta Basin contains diverse ecosystems that have the potential to be part of a **basin strategy for disaster risk management**. There is an opportunity to preserve this natural capital for the benefits of ecosystems of the whole basin and of people depending on these ecosystems for their livelihoods. NbS for DRR in the Volta Basin will provide a long-term solution to the environmental threats and challenges, but also to societal challenges.

The population of the basin will continue to grow as well as the demand for resources, including water and land. Competition over the uses of natural resources will increase, which will lead to ecosystem degradation. The degradation of ecosystems exacerbates the vulnerabilities of people and the impacts of disasters on populations. Implementing NbS to address DRR across the basin will help reduce the impacts of disasters, increase the resilience of the population to these impacts or other climate-related events. Thus, ecosystems of the Volta Basin will remain healthy and be able to continue to support livelihoods and provide ecosystem services such as food, clean water, climate regulation, hence enhance resilience.

2.2. Nature-based solutions for climate change adaptation

High variability of rainfall patterns and distribution are observed in the Volta Basin, which causes fluctuations in food production, and affect energy production. According to climate predictions in the Volta basin higher temperatures with increased evapo-transpiration is expected in the future. Rainfed agriculture is the most important economic activity within the Volta Basin. The expected changes will require local farmers to put in place adaptation strategies to the shortened and intensified rainy season; or this could lead to an increase in water demand for irrigation and expansion of irrigated agriculture. Irrigated agriculture, if not well implemented and monitored, can lead to additional

pressure on natural resources. Long-term effect of climate variability can exacerbate events such as floods and drought.

Ecosystem-based adaptation (EbA) is an approach that farmers that have become vulnerable due to climate conditions can adopt. EbA is the use of biodiversity and ecosystem services to help people adapt to climate change. It aims at maintaining and increasing resilience and reducing the vulnerability of ecosystems and people to the negative impacts of climate change. EbA is NbS for climate change adaptation. One of the main goals of EbA measures is to target negative impacts from climate change. Like Eco DRR and other ecosystem-based approaches, EbA is often referred to as low-regrets or no-regrets options as they can generate benefits despite climate change threats (IUCN, 2020). For example, mangroves restoration, by improving habitat for fish, also support livelihoods and contribute to carbon storage. Climate is regulated and the prevalence of climate-related events is reduced.

Like Eco DRR, and given the diversity of ecosystems present in the Volta Basin, EbA provides an opportunity to address climate change using NbS. Wetlands and flood plains are important ecosystems that have the potential for irrigation and the potential to provide the water requirements for the whole basin to function efficiently, and therefore also address droughts, and the needs of the populations of the basin. In addition the vegetation of floodplains is a protective barriers from floods. However, due to the reduction of soil and vegetation cover, and other threats that affect water quality and soil primary production role, this potential can be compromised. The protection and restoration of these ecosystems therefore become a key element to take into consideration in the climate change adaptation strategies and plans to manage and develop the Volta Basin region, and build the resilience of the populations of the Volta Basin.

The Great Green Wall Initiative for the Sahara and the Sahel is a good example of a flagship initiative that has the opportunity to implement EbA measures that will address climate change in the Northern part of the Volta Basin. The initiative is about scaling sustainable land management practices through and an integrated landscape approach and creating a mosaic of different resilient land uses. The initiative seeks to contribute to climate change mitigation and adaptation, food security and sustainable livelihoods. Examples of EbA measures towards the achievement of the GGW include, for instance: the sustainable management of livestock and grazing areas to improve soil quality and water availability, regenerate vegetation; the development of climate-resilient/climate-smart agriculture to reduce impacts of floods, droughts and saline intrusion into groundwater and farmlands; wetland protection and rehabilitation. All measures are meant to improve food and income security for the local communities.

2.3. Some experiences of NbS in the Volta Basin and beyond

Several NbS approaches have been implemented in the countries of the Volta basin. Some examples below:

The Ecosystems Protecting Infrastructure and Communities (EPIC) project, implemented from 2011 to 2016 in six countries, including Burkina Faso and Senegal for the West Africa region, has improved ecosystem management for disaster risk reduction. The project has worked with local communities to respond to climate change impacts and restore arable lands that have been degraded by droughts, salinization, floods and soil erosion. The project has also built community resilience. In Burkina Faso and in Senegal, assisted natural regeneration and reforestation was carried out to increase tree cover and improve soil quality (Monty et al 2017).

The Integrated disaster and land management project, implemented community-based activities in watersheds and flood-prone areas to strengthen resilience to flooding and soil erosion. Activities like

consolidation of the banks (Maritime Region) and stabilisation of Bombouaka reservoir through de-silting and reforestation of the surrounding area (Savanna Region), enabled communities to better manage disaster risk and land degradation. Tree plantation helped reduce soil erosion, and at the same time protected and restored the whole landscape and watershed management system (World Bank, 2017).

The project "Adapting natural resource-based livelihoods to climate-induced risks in the landscapes of the Boucle du Mouhoun forest corridor and the wetlands of the Mare d'Oursi basin in Burkina Faso" (EBA-GEF), implemented since 2015, aims to reduce the vulnerability of local communities to additional risks posed by climate change, and strengthen their resilience by focusing on natural resource management in the Boucle du Mouhoun forest corridor and the Mare d'Oursi basin wetlands. Thus, through assisted natural regeneration and reforestation, 4079.4 ha of land have been rehabilitated. Social benefits include improved living conditions for the most vulnerable people and support to several communities to take into account climate change adaptation and the environment in development planning[5].

The promotion of the conservation and sustainable use of open forests in the lower Ouémé River Valley in Central Benin, helped reduce the effects of floods in downstream areas. This action also improved the capacities in land management and disaster risk reduction. The project recognised the importance of, among others, mapping and early warning systems to improve the capacity to respond to disasters, and the promotion of local forest management based on forests to ensure sustainable management; however the project did not call for integrating ecosystem services in the design of early warning systems (IUCN/PACO, 2016).

In Ghana, mangroves as a barrier for protection against flood is used by the communities in the Volta delta. However, this has not prevented the harvesting of mangroves along the lagoons. It is only the Volta Delta communities that have an old culture of mangrove cultivation and rotation cycle of 8 to 15 years and then coppiced for fuelwood; largely for smoking fish and domestic use. Recently, The Development Institute with support from IUCN-France has introduced the Community Resource Management Areas (CREMA) mechanism in five of the communities close to the east bank of the Volta estuary. The CREMA mechanism seeks to delineate mangrove areas for protection as core zones and other areas for sustainable use and introduction of pen culture for sustainable incomes to reduce dependence on mangroves as livelihoods (pers. comm.).

Protected areas are one of the important tools to conserve biodiversity (a means of conservation). Many protected areas have been established around the world and have proven to be effective in protecting species and the integrity of the ecosystem function and services. Beyond the Volta basin, the Delta du Saloum national park in Senegal is a biosphere reserve, a world heritage site and a Ramsar site. The reserve is managed to strengthen resilience to climate change: communities are involved in restoration activities of the degraded lands of the reserve in order to increase their resilience. Restoration will also improve the capacity of the protected area to protect the ecosystem and communities from floods and coastal erosion, and to provide other ecosystem services necessary to secure communities' livelihoods (IUCN/PACO, 2016).

Likewise, outside African borders, the sub-basin of the Sumpul River, shared by Honduras and El Salvador in South America is degraded due to deforestation and contamination of soil and water. Furthermore there are conflicts between border neighbours over the use of water from the Sumpul River. The main climatic threats in the sub basin include: strong variations in rainfall patterns, extreme temperature fluctuations and strong winds; landslides, floods and recurrent droughts also occur.

[5] https://www.bf.undp.org/content/burkina_faso/fr/home/presscenter/articles/2020/eba_fem.html

These all lead to damages in infrastructure, food production and local livelihoods and increase the vulnerability and migration of people. Gaps in local management of water resources and in knowledge about ecosystem-based adaptation to address integrated water management have led to poor management practices. In order to address the issues of water scarcity and extreme weather events in the sub-basin EbA measures were implemented in the sub-basin, with a focus on water and soil ecosystem services, on productive diversification and on mitigating the impacts of climate change on crops and community assets. In collaboration with communities and land users, fruit and timber trees were introduced into agroforestry systems bordering 7 water sources, and the promotion of organic agriculture allowed families to diversify their income and reduce the vulnerability of their crops, protect infrastructure and housing, which are affected by strong winds. In addition, soil and water conservation practices (e.g. hillside irrigation ditches, non-burning and crop residue incorporation), helped reduce soil erosion caused by extreme rainfall, and improved soil moisture and fertility, and water infiltration and capture in the area. This EbA built resilience in agro-ecosystems and increased the availability of water for households (more than 400 families in the sub-basin).[6]

3. Ecosystem risk assessment

Risk and vulnerability assessments are undertaken to identify the main climate change and disaster risks and impacts on the socio-ecological system of interest. It helps identify ecosystems that are particularly vulnerable to the negative impacts of climate change, and then the appropriate adaptation and disaster risk reduction interventions based on the risk, which gives the opportunity to implement NbS according to the sections above. Risk assessment (using the IUCN Red List of Ecosystems (RLE) for example, therefore further help inform:

- Natural resource and disaster risk management strategies and national adaptation plans (NAPs),
- The development of governance systems that improve ecosystem management, livelihood security and other social outcomes
- Landscape planning.

The Volta basin countries would benefit from assessing the state of their ecosystems, using a scientifically robust and globally recognised tool such as the RLE. It will help countries prioritize their conservation actions based on scientific evidence, and further mainstream the most appropriate measures, strategies and plans in their national policies.

As part of the VDFM project, a feasibility study for ecosystem risk assessment was conducted for the Volta Basin countries. The feasibility study helps identify whether all the necessary data to conduct the risk assessment is available.

The study analysed the distribution of ecosystems, threats to ecosystems, and disaster risk management processes. General recommendations from the study include the need 1) to strengthen national data collection and monitoring systems as well as capacities in ecosystem data/environmental assessment; and 2) to increase awareness of the role of ecosystems data in improving the functioning and delivery of early warning systems.
The study recognised that opportunities to conduct ecosystem risk assessment in the Volta basin exists, provided the two aspects of the recommendations above are addressed. Opportunities relate to, among others: i. the interest and willingness of partners to mainstream environment into disaster risk management; ii. The availability of data sets; ii. Pre-existing networks to help with data compilation and analysis; iv. Partners are aware that ecosystem risk assessment will help address IWRM through NbS and enhance the coordination of sectoral policies.

[6] https://panorama.solutions/en/building-block/community-implementation-adaptation-measures-forests-and-agroforestry-systems. Accessed on 23 February 2021

Once the risk assessment has been finalised, the nature-based solution is selected, and tested via the Standard.

4. Opportunities and barriers for mainstreaming nature-based solutions in early warning systems for climate change adaptation

NbS is an option that should be considered for the management of the Volta Basin to protect ecosystems on the one hand, and generate multiple benefits for basin populations. Opportunities exist given that the basic policies and framework are in place, however the effective implementation of this approach may face many barriers that will have to be overcome.

The main **barriers** to the integration of NbS in early warning system or policies at the regional or national level include the lack of knowledge and understanding about the concept and the lack of a mechanisms that coordinates the different relevant sectoral policies.

In order to mainstream NbS in early warning systems it is important to understand the links between the health of nature and the risk of disasters caused by climate change and climate variability. Extreme events caused by climate change affects the distribution, availability and performance of ecosystem services. **Information and knowledge** can help understand the impacts of droughts on ecosystem services. In fact many countries are implementing nature-based solutions approaches such as eco DRR without referring to it as such. Indeed the actions implemented respond to the objectives and ambitions of NbS (for instance by addressing societal challenges such as food security or floods) but the actions do not necessarily make this link, and only focus on the conservation of biodiversity or ecosystems objective.

Stakeholders, including decision makers, need to better understand this link, as well as the NbS concept to be able to better communicate it, hence increase awareness and information about these concepts and therefore promote the development of the relevant projects and programmes, and foster countries' commitments to NbS.

Effective and operational mechanisms to **integrate and coordinate sectoral policies**, strategies and programmes and promote a collaboration between the different sectors to address common challenges are another barrier as effective collaboration and coordination is still lacking. This is a prerequisite that would help and facilitate the institutionalization of NbS in policies. However, If NbS is adopted this can be the glue that will connect and make all sectors work together. It has the potential to enhance the definition of joint interventions towards reducing damages from disasters, increasing the resilience of populations and ecosystems, and provision of many other benefits. For example ecosystem managers will identify the risk associated to a specific ecosystem, and disaster risk managers develop their plan accordingly ; that way disaster managers also reduce the costs associated to emergency responses since they will have put in place adaptation strategies based on ecosystem management before the disaster occurs.

Linked to both barriers above is the lack of appropriate **technical capacities**. Because the management of basin does not work across sectors, or do not always recognise the importance to do so, integrated water management structures do not have the staff with the skills required to adequately address ecosystems and ecosystem services in the management of the Volta basin. Ideally these structures should include environment/natural resources management experts with an emphasis on nature-based solutions, climate change expert, disaster risk management experts, and socio economic development experts to make the link with the multiple benefits that NbS can provide.

Mainstreaming nature-based solutions in the management of the Volta basin, including in the design of early warning systems, offers a number of **opportunities** for a sound management of the basin and to ''build back better''.

The **coordination of sectoral policies** mentioned above is a barrier but also an opportunity as NbS will address multiple societal challenges, which will encourage all sectors to work together to assess the status of the basin resources, identify the threats and challenges, and jointly propose the strategies and programmes that will address the identified problems and reduce the threats. Section 5 of the present document recalls the link of integrated water resources management policies with the relevant international instruments and commitments. Concerning LDN for example, using a **landscape approach** to manage the Volta basin will help countries consider and effectively endorse the broader thinking about LDN (and NbS) and the many benefits that they can get from managing the different land uses, including agricultural lands, protected areas, pastoral lands; and then countries should recognize this when they develop policies and investment plans. That is a way to connect the different sectors involved (water, agriculture, environment, health).

Strengthening of policies. Likewise, policies and instruments exist at the national level and at the level of the basin. In general, these policies are defined to address policies in silos. If countries recognize that natural hazards and disasters are triggered by environmental degradation, climate change policies and disaster risk management policies are the policies that could be strengthened by integrating ecosystem and ecosystem services aspects.

Mapping and early warning systems are important and powerful monitoring tools to help address climate change and climate variability effects in an area that is strongly influenced by its climate. Mapping, coupled with ecosystem risk assessment, identifies risks to some hazards such as drought and will inform on the vegetation types including species that are resistant to fires; fires, even if human-induced, are exacerbated by the climate conditions (winds, temperature), and the prolonged periods of drought. Early warning systems come to inform if a fire will potentially occur in a specific area according to the species present. It helps increase the resilience of local communities to natural hazards. Early warning systems do not currently integrate biodiversity and ecosystems, and this is one of the gaps that the VFDM project is now trying to address; mainstreaming NbS in the management of the Volta basin is an opportunity to improve disaster risk management and response.

Since the resources of the basin are shared between 6 riparian countries, there is an opportunity to **enhance regional and transboundary cooperation,** when managing the Volta basin using NbS, and encourage the development of Volta basin management plans that take into account ecosystem sustainability.

IV. General recommendations for future policies and action plans

The recommendations below can be supported by the VBA by strengthening the current strategic programme.

Establish an operational mechanism for effective coordination of sectoral policies within the Volta basin

Given the various societal challenges that NbS can address, it is important that the different sectoral policies work together and coordinate their actions. The Volta basin Authority should establish an operational mechanism that will include all relevant experts, with the specific mandate to: build and consolidate collaboration among the different sectors; organise information, awareness raising and capacity building sessions among the different sectors about NbS for climate change adaptation and

disaster risk reduction; share the priority issues of the Volta basin with the VBA, and identify possible options to respond to the challenge.
This mechanism will also provide inputs into the improvement of the formulation of policies.
This could be done through the VBA to strengthen its institutional framework. The Volta Basin Observatory should be strengthened to catalyse the coordination of polices.

Strengthen regional cooperation to promote NbS for Volta basin management
As mentioned above, regional cooperation could be strengthened through the management of the Volta Basin using NbS. It may require harmonizing policies, legislations and institutions in charge of the water basin management in the riparian countries.
Strengthening human and institutional capacities through targeted capacity building training workshops on NbS, exchange of experts, strengthening of education programmes to include NbS for integrated water resources management at the country and basin level, will also help strengthen regional cooperation. In terms of institutional capacities, the mandate of water resources management institutions at the national and regional level should be extended to include specific provisions related to the integration of NbS, and the related capacities should be developed. This will improve the development of regional strategies and plans.

Developing and submitting joint projects to the relevant donors will strengthen the collaboration around NbS for integrated water resources management and for addressing disaster risks.

Strengthen communication and awareness raising about NbS
Nature-based solutions needs to be more communicated especially in relation to reducing the risk of disasters in the Volta region. Experiences on best practices and success stories from around the world that used NbS to address climate change adaptation should be disseminated across the countries of the basin and beyond. Policy briefs, factsheets, newsletters, and other communication material should be periodically developed to highlight these relationships and shared through the diverse channels including website, social media but also meetings at the national and local levels to make sure that it reaches all stakeholders.

Improve uptake of NbS approach by decision makers and policy formulation to integrate ecosystems risk in early warning systems
The Volta Flood and drought management project will be a first step towards guiding national and regional institutions of the Volta basin in developing policies that take into account ecosystems and ecosystem services in the management of the Volta basin. This requires endorsement by public authorities, facilitated by the VBA, hence the demonstration that such an approach will effectively improve the status of the resources of the basin and also generate the benefits of applying NbS.

Improve the availability of scientifically robust data
Develop the tools to collect and analyse reliable data that highlight the link between ecosystem, ecosystems services and integrated water resources management. This is an important step in understanding and analysing these relationships in the Volta basin. In the Volta basin project, data are being gathered to inform the design of the early warning systems for climate change adaptation. The tool includes environment data. Additional data collection tool for the work on ecosystem risk assessment feasibility was developed to better take into account ecosystems services, and integration in the early warning system. In general the data collection tools and protocols need to be developed in such a way as to integrate these links, and making sure that they can be adapted to the local context and involve and take local community needs into account.

Strengthen Land use and spatial planning (LUSP) policy and implementation

Land use and spatial planning is a catalyst for NbS uptake by countries and communities in the Volta Basin. However, the Volta Basin countries are not up to date in this planning framework. One of the basic requirements for the successful implementation of the NbS within countries and the basin-wide are tools and capacity development for participatory LUSP policy formulation and implementation. The LUSP policy would proactively designate areas for specific use, thus enhancing the implementation of NbS at all levels in the Volta Basin.

Develop a regional umbrella initiative for NbS in the Volta basin

The initiative would be developed under the VBA, and would have the objective to support national projects in the riparian countries address the integrated water resources management using NbS. The initiative will generate success stories and best practices on NbS for disaster risk reduction, will be responsible for a regional knowledge exchange hub across the Volta basin countries, and will facilitate countries commitments into applying NbS in basin management related projects and programmes.

Conclusion

The climate of the Volta region is unpredictable and unreliable to maintain the ecosystems of the Volta basin and their ecosystem services in a healthy condition to cope with hazards such as floods and drought. Rainfed agriculture in the Volta basin is dependent on climate condition and it is already affected by the irregularity of rainfall, which has effects on livelihoods, food security and poverty. The growing population is another threat because it will increase the demand for natural resources including water, and this will exacerbate the degradation of resources, hence the call to be proactive.

Nature-base solutions can address ecosystem management and at the same time meet people's needs such as food and water security, health, socio-economic development, etc. By applying NbS through protection, restoration or sustainable management and use of nature, all these societal challenges can be met.

The present guidelines suggest that knowledge and understanding of the relationship between ecosystem services and climate change adaptation and disaster risk reduction should be improved, and NbS integrated in the management of the Volta basin. There are several ways to do so: improve communication and awareness raising about the NbS concept; collect and analyse data in order to provide a basis for developing policies, strategies and plans that integrate sustainable development issues and ecosystems and their services. The development or improvement of these policies should be made in collaboration with all sectors involved and in close cooperation with the riparian countries. This will enhance the uptake and implementation of the new policies and plans.

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