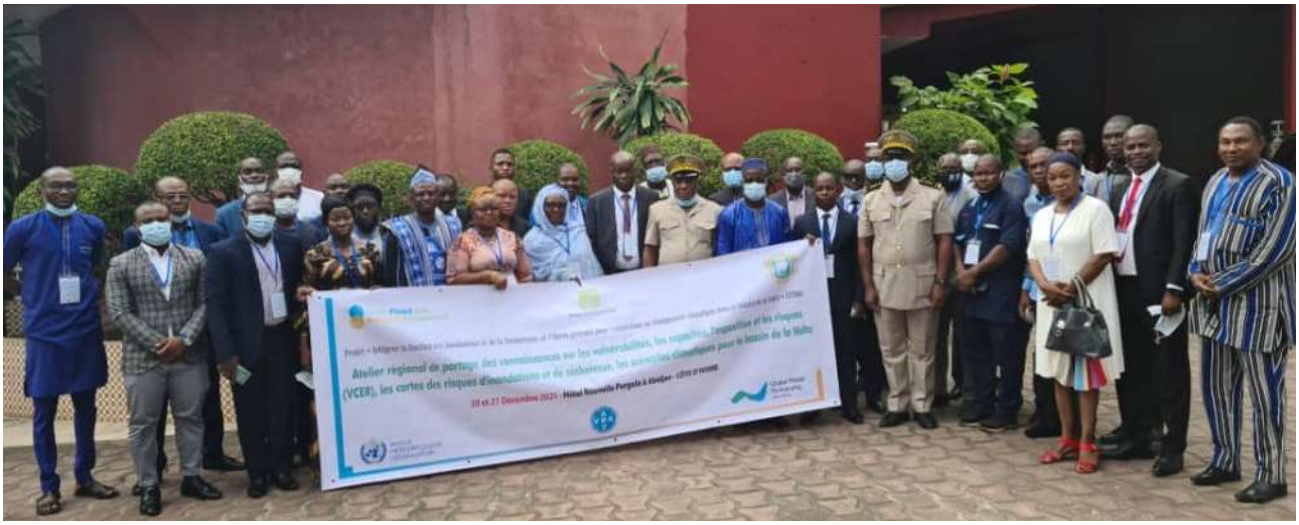
Volta Flood and Drought Management

ADAPTATION FUND

Project: "Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin"

(VFDM Project)

Regional Knowledge Sharing Workshop on Vulnerabilities, Capacities, Exposure and Risks (VCER), Flood and Drought Risk Maps, Climate Scenarios for the Volta Basin



Final report

Implementing Partners

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Volta Flood and Drought Management

Summary

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Acronyms and abbreviations

AAL	Average Annual Loss
CIMA	International Center for Environmental Monitoring
EWS	Early Warning System
NWG	National Working Group
IUCN	International Union for Conservation of Nature
IVM	Institute of Environmental Studies
GWP-WA	Global Water Partnership West Africa
MPL	Maximum Probable Loss
NBS	Nature-Based Solutions
PTAC	Project Technical Advisory Committee
SWIM	Soil and Water Integrated Model
VCER	Vulnerabilities Capacities Exposure and Risks
VBA	Volta Basin Authority
WMO	World Meteorological Organization

1. Introduction

On December 20 and 21, 2021, the regional knowledge-sharing workshop on vulnerabilities, capacities, exposure, and risks (VCER), flood and drought risk maps, climate scenarios for the Volta Basin was held in the conference room of the New Pergola hotel in Abidjan (Cote d'Ivoire). More than 50 participants actively participated in this hybrid workshop and shared their feedback.

The regional workshop was attended by representatives of the national meteorological and hydrological services, civil protection and water resources management agencies of the six member countries of the Volta Basin Authority (see list of participants). The regional workshop follows the process of capacity building, data collection and production of flood and drought hazard maps in the Volta Basin. The regional workshop was organized within the framework of the implementation of the project "Integrating flood and drought management and early warning for climate change adaptation in the Volta Basin" financed by the Adaptation Fund and executed by the consortium composed by the World Meteorological Organization (WMO), the Volta Basin Authority (VBA) and Global Water Partnership West Africa (GWP-WA).

1.1. Background and rationale

As part of the implementation of the VFDM project, the consortium composed of WMO, VBA and GWP-WA and technically supported by experts from the CIMA Research Foundation, carried out the capacity building process, the data collection and the production of flood and drought hazard maps in the Volta Basin using new and existing information available from global datasets (from satellite imagery and sources geospatial data), national and local agencies, as well as other projects in the region. This activity is part of the development of the VOLTALARM early warning system based on the myDewetra platform. The different risk maps and climate scenarios, once finalized, will be visualized through the VOLTALARM system.

To this end, 61 technicians were mobilized in the six countries of the Volta basin (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo). Between March 2021-October 2021, these technicians followed with interest the online and face-to-face trainings on the preparation of scenario-based exposure and impact maps with the support of the CIMA Research Foundation in collaboration with the Institute of Environmental Studies (IVM) of Vrije University.

In parallel, CIMA and IVM researchers developed flood and drought risk maps and climate scenarios for the Volta Basin region using a probabilistic approach and based on several sets of data, including those from a very detailed hydrological study carried out by the Potsdam Institute for Climate Impact Research (PIK) on the Volta basin and the data collected and produced by the national technicians involved in the trainings. The probabilistic risk assessment considers all possible risk scenarios in a certain geographical area and over a given time horizon. The results provide guidance on possible hazardous events and their impact by considering past events and likely future events in a comprehensive risk assessment exercise.

The objective of the workshop was to present to the national and regional stakeholders of the six target countries, the flood and drought risk maps of the Volta basin, developed by CIMA and IVM researchers with the probabilistic approach, including data collected (at global and national levels) and produced by national technicians for the respective countries and considering current and future climate scenarios.

1.2. Methodological approach and participants

The organization of the regional workshop was facilitated by GWP-WA in collaboration with WMO, VBA and the CIMA Research Foundation.

The methodological approach of the workshop it is based on three main stages: preparation, realization and reporting.

- the preparation stage focused mainly on the development of the concept note and the workshop agenda, the preparation of communications and terms of reference for group works, the targeting and mobilization of participants as well as making logistical arrangements
- the realization stage, alternated the presentation of contents followed by debates as well as group works, whose results were presented in plenary. The workshop was conducted with hybrid modality because the experts from WMO, CIMA and IVM were connected to the workshop's venue through the Zoom platform. Simultaneous interpretation from English to French and vice versa was provided during the two days of the workshop
- the reporting stage, which consisted of synthesizing and analyzing all the productions resulting from the workshop on the one hand, and on the other hand preparing the workshop report.

The workshop was marked by the development of seven (07) sessions, namely:

- Session 1: Introduction to disaster risk assessment, presentation of the VCERs data collected and the training process for technicians
- Session 2: Flood and drought hazard assessment for risk assessment
- Session 3: Introduction to Probabilistic Risk Assessment for Flood and Drought Risk Mapping for the Volta Basin
- Session 4: Impact of floods under the current and future climate, sectoral analysis
- Session 5: Impact of droughts under the current and future climate, sectoral analysis
- Session 6: Proposal of actions for the development of a regional action plan informed by the risk profiles
- Session 7: Overview of VFDM project activities

The workshop had the effective participation of 50 participants from research institutions, national services of meteorology and hydrology, civil protection, water resources management, environment within the Volta Basin.

The moderation and facilitation of the workshop proceedings were provided by Prof Albert GOULA, VBA Focal Point in Côte d'Ivoire and Maxime TEBLEKOU of GWP-WA.

The list of participants is in Appendix 1 of this report.

At the end of the regional workshop, the participants received the digital version of the presentations of each session. This report reflects the proceedings of the regional workshop. It focuses on the following four (4) main points:

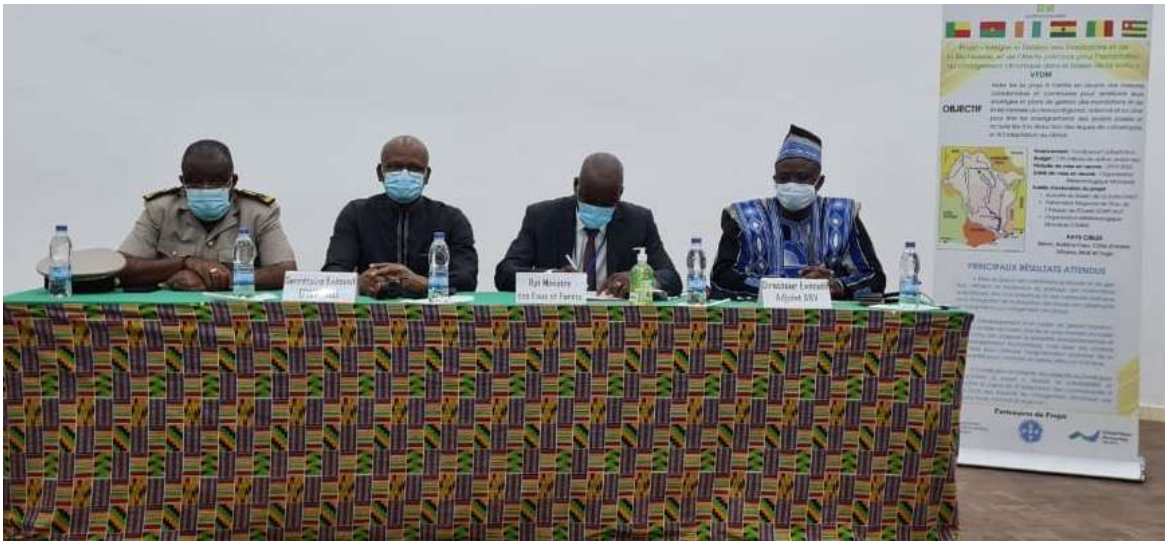
- The opening and start of the regional workshop

- the presentation of each session followed by debates
- the synthesis and closing of the workshop.

2. Getting started with the regional workshop

2.1. Opening ceremony

The opening ceremony of the regional workshop took place under the chairmanship of Prof. Albert Goula, representing the Minister of Water and Forests of Côte d'Ivoire. It was marked by four speeches.



Picture 1: officials at the opening ceremony

The first speech was made by the Deputy Executive Director of the Volta Basin Authority, Mr. Dibi MILLOGO, who welcomed all the participants and thanked them for accepting to honor their presence at the regional workshop despite the heath conditions linked to the Covid 19 pandemic. In his speech, he presented a brief overview of the Volta Basin which, due to its enormous potential, remains the essential source for meeting the development needs of its populations in terms of drinking water supply, hydroelectric production, industrial and mining exploitation, irrigation, fishing, navigation, tourism, etc. Then, he recalled the harmful effects of climate change that the Volta basin has suffered since the 1970s and which are characterized, among other things, by floods and droughts with, each time, significant material and even human damage. In terms of illustration, he cited the floods of 2009, 2016, 2017 and 2020 recorded in the basin with loss of life, loss of crops, destruction of habitats, etc.

The Deputy Executive Director of the VBA did not fail to recall the context of the holding of this regional workshop, which is a continuation of the process of capacity building, data collection and development of risk maps for floods and drought in the Volta Basin. In this context, he expressed his deep gratitude to the technicians and all the partners who took part in this process. Before ending his remarks, he also expressed his deep gratitude to the national authorities of Côte d'Ivoire, to the Executive Secretariat of GWP-WA and to all the structures involved in the organization of this regional workshop. Finally, he

thanked very sincerely all of our Technical and Financial Partners for their multifaceted support to the Volta Basin Authority and more particularly to the Adaptation Fund, which finances the workshop.

Following this speech, the participants followed online the introductory speech of the VFDM Project Officer at WMO, Mr. Ramesh TRIPATHI, who also welcomed all the participants to the workshop. He took the opportunity to recall the context of the workshop and the reasons why they could not make the trip to Abidjan, in particular due to the Covid 19 pandemic. In his intervention, the Project Manager emphasized on the importance of flood and drought risk maps and the conditions under which the work to produce the flood and drought risk maps was carried out. Before ending, he urged the participants to demonstrate their commitment to achieving the expected results of this workshop.

The third opening speech was delivered by Prof. Albert GOULA, representing the Minister of Water and Forests of Côte d'Ivoire. In his speech, he welcomed all the workshop participants who had traveled to Abidjan. Then, he recalled the context of the regional workshop which is part of the implementation of the Project entitled "Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin(VFDM)".This project is funded by the Adaptation Fund and implemented by the consortium comprising VBA, WMO and GWP-WA in the six countries sharing the Volta basin: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo. In his speech, he also stressed that this workshop is being held in a context where the member countries of the VBA like other countries are suffering the effects of climate change, marked by floods and droughts, with enormous damage on people and their property. The project thus aims to develop innovative solutions and approaches in the Volta Basin for disaster risk reduction and adaptation to climate change through participatory approaches.

Before pronouncing the opening of the workshop, the Representative of the Minister thanked all the technical and financial partners who contributed to the holding of the meeting, in particular WMO, VBA, GWP-WA, CIMA Foundation and the Adaptation Fund. By proceeding to the official opening of the workshop, he invited the participants to be assiduous and to engage themselves in fruitful exchanges during the two days of meetings, the results of which will undoubtedly contribute to the improvement of the flood and drought risk maps in the Volta Basin.

Following the speeches, the different participants introduced themselves in turn, to get to know each other better and to know the structures represented.

2.2. Presentation of the concept note and validation of the workshop agenda

The presentation of the concept note and the workshop agenda was made by Mr. Maxime TEBLEKOU of GWP-WA.

The overall objective of the two-day regional workshop is to present the flood and drought risk maps and climate scenarios for the Volta Basin and obtain useful feedback from national and regional stakeholders for their final improvement and their completion. Specifically, these are:

- present the data collected and the methodology used for the probabilistic risk assessment and the development of flood and drought risk maps
- present the scenario-based exposure and impact maps linked to specific scenarios, developed by the national technicians, and the definitive probabilistic risk maps, visualized in the EWS VOLTALARM platform

- bring the participants to provide feedback and suggestions on the risk maps, the impact indicators, the methodological approach for their graphic visualization and the presentation of the results in a document of recommendations and action plan for the prevention of risks for the benefit of communities in the Volta Basin
- present and agree with the participants on the next steps to finalize the risk maps incorporating additional feedback and qualitative inputs as well as for the development of recommendations and an action plan for the prevention of risks and impacts on communities (which will be developed in 2022).

The main outputs and outcomes expected from the workshop are:

- participants will have knowledge of the methodological approach used to develop flood and drought risk maps (including scenario-based exposure and impact maps, developed by national technicians) with current and future climate scenarios for the Volta Basin
- participants provide comments and suggestions on risk maps and climate scenarios for their finalization and graphic visualization
- participants provide suggestions on the approach to integrate the risk maps into the recommendations and action plan document
- the technical report of the workshop is elaborated and shared with the participants for finalization.

2.3. Establishment of the presidium

A presidium was proposed by the organizers, validated, and accepted by all the participants. The presidium is composed as follows:

- Presidency: Prof. Albert GOULA from Ivory Coast
- Vice-presidency: Mr. CHEDE Félicien from Benin and Mr. ISSAOU Latifou from Togo
- Secretariat: Ms. Fatimata SAWADOGO from Burkina Faso; Mr. Eric ASUMAN from Ghana; and Mr. Ibrahim SIDIBE from Mali.

3. Progress of the regional workshop

3.1. Session 1: Introduction to disaster risk assessment, VCER data collection and the training process for technicians

This session was marked by three communications. The first communication was developed by Mr. Marco Massabo of the CIMA Research Foundation and focused on the introduction to the assessment of flood and drought disaster risks.

Overall, we retain from this presentation that disaster risk management is based on understanding disaster risk in all its dimensions (characteristics of hazard, exposure, and vulnerability). Several guidelines exist for disaster risk assessment (ISO standards, European Union guidelines, United Nations recommendations, and Joint Research Center recommendations, etc.).

Disaster risk assessment is defined as a qualitative or quantitative approach to determining the nature and extent of disaster risk by analyzing the hazard and assessing the existing conditions of exposure and vulnerability, which could harm people, goods, services, livelihoods, and environment on which they depend.

The risk assessment methods consist of:

- historical analysis
- scenario analysis (quantitative and qualitative): it gives the geographical distribution of the severity of the loss due to the occurrence of a specific event characterized by a return period
- the probabilistic analysis which defines the probability of having a certain level of loss in a defined period. Risk is the result of multiplying the probability of occurrence of an event by the impact of this event. It also gives the loss return period. It is recommended for planning purposes. The probabilistic assessment considers a wide range of possible events (from which it is possible to estimate an annual average loss value). It is more informative but very complex.

The last two approaches are those that will be developed during this workshop.

Following the presentation, the discussions focused on:

- the possibility of including hydraulic facilities (dams) and surface conditions in the risk assessment for the preparation of maps
- the minimum resolution to be able to to validate a risk map
- the solutions proposed or the responses provided by the VFDM project to the impacts of climate change
- the application of the probabilistic assessment method in the context of our countries marked by a lack of data
- the possibility of including empirical and baseline data in probabilistic assessment
- data availability issues and the fact that high magnitude hazards have a return period of 100 years
- the possibility of taking into account socio-economic and environmental impacts as well as loss of human life in the probabilistic assessment methodology
- the possibility of considering factors such as the opening of dams and torrential rainfall causing flooding in the probabilistic assessment methodology.

The CIMA Foundation's experts have tried to provide answers to all these concerns. Indeed, for the first concern, the hydraulic facilities as well as the surface conditions are considered in the risk assessment for the development of vulnerability maps. In the case of the Volta basin, topographic, geomorphological, demographic, land use and urbanization data are considered in the probabilistic assessment.

Data collection is very difficult, but arrangements have been made to collect data in the various countries which have been supplemented by existing general data at the global level. Synergies have been developed with other projects that have provided the project with available data or data developed at their level. Historical data is very important and very necessary in the probabilistic evaluation.

About the question related to the importance of risk maps, it was underlined that this is the first level of knowledge of risks. Once the risk is known, adaptation strategies must be developed to strengthen the resilience of populations.

The second presentation of Session 1 focused on Vulnerability, Capacity, Exposure and Risk (VCER) data and data collection. It was moderated by Mrs. Anna Mapelli, from the CIMA Research Foundation. In her presentation, she returned to the different components of risk, namely hazard, exposure, vulnerability and capacity. Data collection consisted of first establishing a detailed list of the desired information in different formats. The data was collected from the national institutes of statistics, geography, Ministries or local administrations and other Agencies of the countries concerned by the project. Data to be collected referred to administrative boundaries, built-up areas, population statistics, agricultural production, infrastructures (educational and health), etc. The data was obtained thanks to the contribution of the technicians mobilized for the training on risk mapping. However, the diversity of format and the multitude of data did not facilitate their processing. In addition, some data are still not available.

Ms. Anna Mapelli continued with the third presentation on the capacity building process for technicians from national services on the analysis and mapping of flood and drought risks in the Volta Basin. The main elements covered during the training sessions organized for the benefit of technicians include:

- scenario-based risk analysis
- description of the drawing up of hazard maps for specific scenario
- exposure analysis
- vulnerability analysis and impact assessment.

This training enabled the development of basin-scale exposure and impact maps for specific flood scenarios, based on return periods of 25 and 1000 years. Following this presentation, discussions focused on:

- The fact that drought was not taken into account in the presentation
- the role of remote sensing in the process
- the possibility of considering hydro-agricultural infrastructures and grazing land in data collection and risk mapping
- the possibility of making forecasts at the local level using the software used
- the future possibilities reserved for the technicians who contributed to the development of the maps.

To all these concerns, the team of consultants from the CIMA Foundation and the project partners have provided some answers. Indeed, we retain that the methodology used for the case of drought will be treated in the next sessions. Satellite image data was used to supplement data provided by countries. The project has contributed to building the capacities of national actors in order to equip them to take ownership of the approaches developed.

3.2. Session 2: Flood and drought hazard assessment for risk assessment

The second session of the workshop was animated through four presentations.

The first presentation focused on hydrological modeling at the basis of flood hazard analysis, presented by Mr. Stefan LIERSCH from the Potsdam Research Institute for Climate Impact Research (PIK). The hydrological model used is SWIM (Soil and Water Integrated Model) developed by PIK. It simulates natural processes (recharge, vegetation) and water resource management options. Assessments have been made under different scenarios: the first considers the increase in future water needs; the second considers possible evolution of climatic parameters such as rainfall, evaporation, etc. The probable climate impacts considered are:

- Excess of precipitation and increased temperatures
- increase in rainfall intensity
- increase in the number of rainy days
- the water level will be significantly impacted.

Following the presentation, the participants wanted to know more about the model presented. Indeed, the participants wanted to know if, about the diversity of uses, the model integrates an optimal use of water management throughout the year. Others would like to know the accuracy of the model, the difference between the SWIM, SWAT and WEAP model, and then whether the model can be applied to all multi-purpose dams. Among the answers to these concerns, it was noted that it took 2-3 years of intense work to develop the SWIM model. Using the software requires time and experts to learn how to use it. The software does integrate data on climate change.

The second communication was related to the hydraulic analysis and flood mapping based on the results of hydrological modeling and necessary for the assessment of the flood hazard for the probabilistic assessment. The purpose of this presentation is to characterize the extreme statistics of flow discharge during the historical and future period (1979-2100). Concretely, for each sub-basin of the river network, an adjustment of the probability distribution functions was carried out on the annual time series of the maxima to evaluate the values of the quantiles over return periods of 5, 10, 25, 50, 100, 200, 500 and 1000 years. Nine (09) probability distributions were used. The best fitting distribution is selected for each section and the flow quantiles have been calculated for each sub-basin of the whole river network as input data for flood hazard mapping with the geomorphological model REFLEX, developed by the CIMA Foundation. The geomorphological approach can provide high resolution results over large areas, allowing the mapping of the flood hazard over the entire hydrographic network, passing from flow discharge to floods. The purpose of this exercise is to:

- map the flood hazard in the Volta Basin with uniform accuracy
- help stakeholders identify river network‘s sections that merit further local analysis
- provide robust results for ungauged areas, using available information
- generate a base map to assess the impact of future changes in the climate regime.

The limitations of these methods include (i) flash floods and urban run-off floods which cannot be represented ; (ii) taking into account only the main river network given the extension of the area analyzed.

Following this communication, the participants followed the presentation concerning the drought risk assessment. Indeed, if we look at the countries of the Volta basin, we realize that several countries have been hit by drought with consequences for the populations. The risk of drought integrates, in addition to vulnerability, exposure and hazard, several aspects such as lack of water. Drought is a relative phenomenon. It is very arbitrary to choose when a dry situation becomes a drought. There are many types of droughts: meteorological drought, hydrological drought, soil moisture drought, etc. The current characterization method employed is based on standardized indices for the assessment of drought conditions.

Within the framework of the VFDM project, several domains were considered for the assessment of exposure to drought risk. These are: population and livestock density, agricultural production, environment. In addition, the method considers that vulnerability to drought is a broad concept that can affect the economic, social and institutional dimensions of the member States.

The discussions that followed the communication focused on (i) the indices that were calculated or used as well as the consideration of agricultural drought indices in the analysis of vulnerability linked to drought; (ii) the use of WMO-recommended indices in the analysis; (iii) the accuracy of the results which show the assessment for the African continent while we are interested in the Volta basin; (iv) determination of thresholds in the area of drought; etc.

3.3. Practical demonstration of the VOLTALARM regional EWS platform

Following the interest shown by the participants during the day, an extra-program communication focused on the presentation of the VOLTALARM platform. It was made by Mrs. Anna MAPELLI. In her communication, she made a brief presentation of the platform. It should be noted that it is already available to national and regional institutions with temporary access credentials because it is not yet fully operational, and experts are still working to make it more efficient with the integration of new available products at regional or local level. However, the existing version has global data, freely available, for hydrometeorological monitoring and forecasting.

She also presented different static map layers regarding baseline information, hazard, exposure and risk coming from previous projects, global and regional datasets, and other activities already completed by the VFDM project. The results of the different drought and flood exposure and impact assessment scenarios can also be visualized or extracted from this platform.

The first day of work ended with this communication.

3.4. Session3: Introduction to Probabilistic Assessment for Flood and Drought Risk Mapping for the Volta Basin

The third session was moderated by Ms. Anna Mapelli and focuses on the introduction to probabilistic risk assessment for flood and drought risk mapping for the Volta Basin. From the communication, it appears that the probabilistic assessment makes it possible to consider a wide range of events, calculating and associating to each event the probability of occurrence and the associated impact. The events emerge from several simulations (generated with the application of the statistical approach of the Montecarlo method). The objective of a probabilistic risk assessment is to calculate, from the full range of events, highly informative risk metrics: the Average Annual Loss (AAL) and the Maximum Probable Loss (MPL).

The AAL is the expected loss per year, calculated as an average over several years; the MPL represents the loss that can be expected in correspondence of a certain likelihood (expressed as the probability of exceeding or its reciprocal, the return period).

With the aim of enabling participants to familiarize and better understand these two-risk metrics, following this communication, participants practiced in groups by country how to calculate the annual average of losses, how to determine the most frequent, the frequent and less frequent damage value from a time series of loss data provided as an example. Each country had a timeseries of loss values, apparently different one from each other. Still, each series was only a different chronological distribution of the same loss values sample. Therefore, the participants achieved the same results in terms of AAL and MPL.

Following this exercise and the summary made by Ms. Anna MAPELLI of the CIMA Foundation, the discussions between the participants and the experts focused on: (i) the accuracy or degree of reliability of this methodology; (ii) additional work to finalize the risk maps and disseminate the results; (iii) training of technicians on the algorithms used for impact assessment; (iv) the existence of other factors that can characterize drought and how to arrive at an optimal and judicious choice; (v) use of maize crop data as drought factor knowing that there are several factors that affect maize crop yield; (vi) the use of the 100 year return period, which is very long, and the possibility of also considering return periods of 2 to 3 years. In particular, the IVM expert specified that the maize crop was selected for this study on the basis of the availability of data at international and national level, as well as for the high sensitivity of the crop to drought.

3.5. Session 4: Impacts of floods in current and projected climate scenarios, sectoral analysis

The results of the probabilistic flood risk assessment in the Volta Basin were presented by Mrs. Anna Mapelli from the CIMA Foundation. From the communication, it appears that the conceptual framework for assessing the impacts related to flood risks is derived from historical, demographic, hydrological, climatic and other data introduced into the assessment model. Mathematical modeling made it possible to simulate a wide number of possible events.

The work undertaken has made it possible to assess, in current and projected climate conditions, the affected population as well as the average annual losses linked to buildings, housing, industry and the basic social sectors consisting of health and education. The results can be disaggregated by country and by region, being available at the scale of the whole Volta Basin, entire national portions and regions of each national portion.

In general, the values obtained become important when the scale considered becomes larger and larger. The advantages linked to this methodology are, among others, (i) the fact that it can be carried out by also including national data; and (ii) the fact that it includes the physical vulnerability of certain elements.

Following this communication, the participants took the time to see and analyze the maps provided and compare the information, especially in terms of average annual loss, at different geographical scales.

Table 1: Annual losses for the basin and the case of Burkina Faso

Sectors	Units	Annual losses by geographic scale			
		Volta Basin		Burkina (admin 0)	
		Current	Projected	Current	Projected
People affected	People	27 000	42 400	5 000-10 000	15 000-22 000
Buildings	Million$	14	26	05-10	15-23
Lodging	Million$			05-11	10-16
Service	Million$	8	13	0-1	0-1
Industry	Million$	2	4	0-1	0-1

3.6. Session 5: Impact of droughts in current and projected climate scenarios, sectoral analysis

The results of the probabilistic drought risk assessment in the Volta Basin were presented by Ms. Marthe WENS from the Institute for Environmental Studies (IVM) of the Vrije University of Amsterdam. She pointed out that drought is a relative phenomenon, and it is very arbitrary to choose when a dry situation becomes a drought. This is due to the slow onset and blurred boundaries of dryness. It is further complicated by the fact that there are many types of drought hazard: meteorological drought, hydrological drought, drought related to soil moisture, etc. The current method of analyzing the hazard of drought, using standardized indices, makes it possible to express the rarity of a situation, for all types of droughts.

Drought vulnerability analysis is based on the fact that many factors influence vulnerability, and it is very difficult to combine them. While for floods, we can make a curve of vulnerability by type of building, this is not useful for droughts. Furthermore, the link between drought severity and drought damage (this is what is normally visualized in the vulnerability curves) is difficult to establish, because it also depends on the timing and duration of the drought, and the type of drought. This is further complicated by the fact that there are many indirect damages and secondary impacts of droughts.

So, to overcome the problem of finding a drought risk threshold and also the challenge of quantifying drought vulnerability, an artificial intelligence algorithm was used. By feeding this algorithm with data from several standardized drought indices and historical drought impact data, the algorithm is able to learn under which hydrometeorological conditions a drought impact can be expected. Thus, the probabilistic analysis of drought risk, has focused on the combination of the probabilities of different types of drought events and their adverse consequences for the environment and society. The results produced relate to the average annual loss and the probable maximum loss of maize yield, as well as an estimate of the population and livestock potentially exposed. The results can be disaggregated by country and by region, being available at the scale of the whole Volta Basin, entire national portions and regions of each national portion.

An important result, which emerges from the analysis for the projected climatic conditions, is that the average annual yield loss for the maize crop will increase and become more significant upstream in the basin according to the results obtained.

3.7. Session 6: proposal of actions for the development of a regional action plan informed by the risk profiles

This session was moderated by Anna Mapelli from the CIMA Foundation. Participants were requested to make proposals and recommendations for the improvement of the risk maps for floods and drought in the Volta basin. Thus, it was recommended to:

- finalize the maps by highlighting the borders of the countries
- highlight in the maps, the hydrographic network of the Volta basin
- train technicians on the disaggregation of maps at the provincial, municipal, and sub-basin levels
- indicate indices related to the characterization of floods and droughts
- provide the countries with the finalized maps produced
- sensitize basin communities on flood and drought risk maps
- periodically update risk maps for flood and drought in the Volta Basin.

3.8. Session 7: Overview of VFDM project activities

The update on the implementation of the VFDM project was presented by Mr. Ramesh TRIPATHI from WMO. In his communication, he recalled the components and the expected results of the project for each of the components.

The VFDM project is justified by the extreme vulnerability of the populations of the Volta basin to climatic hazards, in particular floods and droughts, but also their low capacity to adapt which makes them more vulnerable due to the high rate of poverty, financial and technological constraints as well as heavy reliance on rain-fed agriculture.

Considering this situation, the project aims to develop capacities for coordinated management of national and regional institutions and communities, in terms of integrated management of both floods and droughts. It also aims to help the six countries of the Volta Basin to implement coordinated and common measures to improve their existing management plans at regional, national, and local levels and to learn from past and current projects related to the disaster risk reduction and climate change adaptation.

The project has three components:

- **component 1: Risk prevention** whose main results are the development of Risk Maps, the definition of Climate Scenarios, the evaluation of ecosystem services, the definition of long-term risk management strategies in the Volta Basin
- **component 2: Concrete adaptation measures and stakeholders' engagement** whose main expected results are the establishment of a basin-wide early warning system, the identification of pilot sites to test concrete adaptation measures, the promotion of nature-based solutions, and gender mainstreaming in flood risk management

- **component 3: Improving Governance** whose expected essential products are the strengthening of resilience, the strengthening of the capacities of political decision-makers and the development of local collaborations.

The implementation of the project is ensured by the WMO, GWP-WA, VBA consortium in collaboration with the NMHSs of the basin countries and other external partners such as the CIMA Research Foundation, the CERFE/Knowledge & Innovation Research Center, the IUCN, etc.

As of December 31, 2021, the following activities have been carried out:

For component 1 related to risk prevention:

- needs and capacity assessment for the establishment of EWS for floods and drought in the Volta Basin. The reports are available and published on the project site
- community-level vulnerability mapping carried out in 60 pilot sites in the Volta Basin. The report is available and one vulnerable site per country has been identified for community flood and drought management initiatives
- capacity building of 61 technicians for the development of flood and drought risk maps in the Volta Basin
- development of risk maps and climate scenarios still in progress
- assessment of environmental and ecosystem services related to the prediction and management of floods and droughts. A regional workshop was organized for the presentation of the results of the studies followed by the organization of two national training workshops on NBS
- evaluation of IT capacities and establishment of a centralized database at the level of national structures.

For component 2 related to concrete adaptation measures and stakeholders' engagement:

- implementation (in progress) of the EWS for floods and drought at the scale of the Volta basin accessible on the website: https://volta.myDewetra.world
- capacity building of actors in the Volta Basin on gender mainstreaming in flood risk management
- development and implementation (on going) of community-based flood and drought management initiatives in six (6) pilot sites
- capacity building of forecasters (Meteorology, Hydrology, Civil Protection) on the use of the VOLTALARM platform (in progress)
- capacity building of national and regional agencies on E2E-EWS-FF and GIT.

For future activities, it is planned:

- the supply and the installation of the Centralized National Database from January 2022
- the maintenance of the cloud system VOLTALARM through the integration for visualization of the risk maps, climate scenarios and other necessary information to users and by providing training during the regional workshop to national stakeholders on the use of VOLTALARM (until 2023)

- the development of VOLTALARM manual including data consultation procedures
- the continuation of the 4 national training workshops on nature-based solutions (NBS) and the development of the concept note of bankable projects
- development of a guidance document including recommendations and key messages for an action plan (for medium to long term risk management) to present to national and regional stakeholders and use to publicize the risk maps in current and projected climate scenarios
- capacity building of national structures with online training on drought management and also on the EWS for floods and droughts including the decision support system and response to alerts
- review of regional and national strategies, plans and guidelines on climate change adaptation and disaster risk reduction
- the mid-term evaluation of the project
- Project Technical Advisory Committee (PTAC) Meeting.

Following this presentation, Mr. NIAMPA Boukari of the VBA presented the situation on the establishment of the national working group. It should be noted that the implementation of project activities will be carried out with the support of the States through national working groups (NWG). To this date only, Burkina Faso, Cote d'Ivoire and Mali have not yet named the members of their NWGs.

This presentation raised some concerns about the functioning of the working group. Thus, it was proposed to discuss a mechanism to find resources to make the working group work, through the workshops organized within the framework of the project.

4. Closing ceremony of the workshop

The closing ceremony of the workshop was chaired by the Representative of the Focal Point of the VBA, Prof. Albert GOULA, with the presence of the Deputy Executive Director of the VBA and the Executive Secretary of GWP-WA. Ramesh TRIPATHI from WMO and Marco MASSABO from the CIMA Foundation took part in the closing ceremony virtually.

Overall, they all expressed their deep appreciation to the participants for their diligence and active participation in the work of the workshop. Their gratitude also goes to the national authorities of Côte d'Ivoire. They also expressed they're thanks to the technical and financial partners of the VFDM project, in this case the Adaptation Fund and to all those who, directly or indirectly, have worked to achieve the objectives targeted by the workshop.

5. APPENDICES

Annex 1: Agenda of the regional workshop

Day 1		
Time (GMT)	**Description**	**Responsible**
8:30 a.m. - 9:00 a.m.	Welcoming of participants / logistical details	VFDM-Team
9:00 a.m. - 9:30 a.m.	Opening session	Minister, VBA, WMO, CIMA
9:30 a.m. - 10:30 a.m.	**Introductory session** • Presentation of participants • Concept note and presentation of workshop content • Establishment of the presidium	VFDM-Team
10:30 a.m. - 11:00 a.m.	**Family photo and coffee break**	
11 a.m. - 1 p.m.	**Session 1: Introduction to disaster risk assessment, presentation of the VCERs data collected and the training process for technicians**	CIMA trainers + VFDM team
1:00 p.m. - 2:00 p.m.	**Lunch**	
2:00 p.m. - 3:30 p.m.	**Session 2: Flood and drought hazard assessment for risk assessment**	CIMA trainers + VFDM team
3:30 p.m. – 5:00 p.m.	**Session 3: Introduction to Probabilistic Assessment for Flood and Drought Risk Mapping for the Volta Basin**	CIMA trainers + VFDM team
Day 2		
Time (GMT)	**The description**	**Responsible**
8:30 a.m. - 9:00 a.m.	Welcome of participants and quick recap	CIMA + VFDM team
9:00 p.m. - 10:30 p.m.	**Session 4 Impact of floods under current and future climate, sectoral analysis**	CIMA trainers + VFDM team
10:30 a.m. - 11:00 a.m.	**Coffee break**	
11:00 p.m. - 12:30 p.m.	**Session 5: Impact of droughts under the current and future climate, sector analysis**	VU/CIMA trainers + VFDM team
12:30 p.m. - 1:30 p.m.	**Lunch**	
1:30 p.m. – 3:00 p.m.	**Session 6: Proposal of actions for the development of a regional action plan informed by the risk profiles**	CIMA trainers + VFDM team
3:00 p.m. – 4:30 p.m.	**Session 7: Overview of VFDM project activities**	VFDM team
4:30 p.m. – 5:00 p.m.	Synthesis and closing of the workshop	Presidency and authority of the host country

Annex 2: List of participants

Atelier Régional de partage des connaissances sur les vulnérabilités, les capacités, l'exploitation et les risques (VCER), les cartes des risques d'innondations et de sécheresse, les scénarios climatiques pour le Bassin de la Volta en Côte d'Ivoire.

Date : 20/12/2021

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