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**Project : "Integrate flood and drought management and early warning for climate change adaptation in the Volta Basin** **"**

**(Project VFDM)**

**DATA COLLECTION REPORT ON IT AND DATABASES CAPACITIES AND NEEDS OF AGENCIES INVOLVED IN FLOOD AND DROUGHT MANAGEMENT IN GHANA**

**Project** **Partners August 2021**

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# Abbreviations/Acronyms

|  |  |
| --- | --- |
| CERSGIS | Centre for Remote Sensing & Geographic Information Services |
| CIMA | International center for environmental monitoring  |
| CSIR | Council for Scientific and Industrial Research |
| FTP | File Transfer Protocol |
| GMet | Ghana Meteorological Agency |
| GWP-WA | Global Water Partnership – West Africa |
| HSD | Hydrological Services Department |
| IT | Information & Technology |
| IUCN | International Union for Conservation of Nature |
| LAN | Local Area Network |
| NADMO | National Disaster Management Organization |
| NITA | National Information Technology Agency |
| VBA | Volta Basin Authority |
| WMO | World Meteorological Organization |
| WRC | Water Resources Commission |
| WRI | Water Resources Institute |

# Introduction

The World Meteorological Organization (WMO), a specialized agency of the United Nation, the Volta Basin Authority (VBA) and the Global Water Partnership in West Africa (GWP-WA) are implementing the project entitled “Integrating Flood and Drought Management and Early Warning for Climate Change Adaptation in the Volta Basin (VFDM)”. The project activities started in June 2019 are continuing and will be completed at the end of June 2023. The VFDM project is financed by the Adaptation Fund. The implementation of the VFDM project involves the active participation of national agencies (in charge of meteorology, hydrology, water resources management, water security, disaster management and civil protection, etc.) and external technical partners of the WMO, such as CIMA Research Foundation, Italian Civil Protection Agency, UNITAR / UNOSAT, IUCN and CERFE etc.

As part of the activities of the VFDM project, it is planned to assess the current database management systems and IT capacities and needs in the national agencies of the six countries of the Volta Basin and of the Volta Basin Authority. The objectives of the study are: (i) to identify existing data and information on floods and droughts, and how existing open-source data and information can be shared; (ii) identify where new hardware, software, data connection mechanisms, training and other resources are needed. In addition, for each agency there will be an assessment of the structure, capacities and needs of the existing IT network to connect to the national database and to the transboundary VOLTALARM Early Warning System.

The information gathered in this study will also support the VOLTALARM Early Warning System (myDewetra Platform) implementation plan for the Volta Basin region.

Information that is missing or needs to be verified in order to complete the report is highlighted in yellow in the text. Agencies could provide or confirm it before or during the mini-workshop planned for the report finalization and validation.

1. ****Methodology and activities carried out****

## Planning and organizing assessment/consultation meetings

In Ghana, several agencies responsible for Flood and Drought management have been contacted to provide information on their existing capabilities and needs for developing national centralized database as well as IT system and network to access the VOLTALARM EWS. Under the overall coordination of Volta Basin Authority national focal structure (Dr Ben Ampomah, Director, Water Resources), the web-based survey form was shared with the IT/Database focal point of each agency and later the VBA IT expert was able to carry out face-to-face meetings with the focal points of each agency with a dedicated field mission on \_\_\_ May 2021.

## Interviews with IT and Database managers of National Agencies

The IT and Database manager/staff of various agencies provided the requested information through survey as well as during face-to-face meeting. Below is the information on existing IT infrastructure and databases (DB) in each agency.

1. **Ghana Meterological Agency (GMet)**

A reliable internet connection of 10 Mbts is available for downloads and 5 Mbts for uploads and it is used by 150 GMet staff. The internet cost is paid by GMet itself. Some staff use their personal laptop for day-to-day work. The office computers are operating on Windows and Linux system without updated and licensed antivirus.

In comparison to other agencies in Ghana, it has five (05) public IP addresses but only one IP address is available. The computer network is protected by a firewall. The IT unit are managing and maintaining the servers at all time. In case of access or functionality problems, the staff must report them to the IT unit for support and solution.

Web-service and support is provided by the National Information Technology Agency (NITA)

One of the servers is running the database and the other one is running the Meteorological models used for forecasting.

A team of four (04) engineers is responsible for managing IT and databases. Database used are CLIDATA format. The type of meteorological data stored in the database are precipitation, temperature, evapotranspiration etc from \_\_\_\_ local observation stations. The GMet database contains the historical data of more than \_\_\_ years.

Data are inputted into the Clidata both manually and also automatically through File Transfer Protocol, (FTP). Database back-up is done monthly and stored in external hard drive.

Some of the clients using the GMet database include Volta River Authority, Ghana Civil Aviation Authority, students, contractors Ghana Airport Company Limited, farmers etc. They pay some fees but for students and researchers the fees required are very low and sometimes they take data for free.

1. **Hydrological Services Department (HSD)**

There are 48 computers (desktops & laptops) available for 56 staffs and running on Windows operating system. The Hydrological Services Department does not have a Local Area network (LAN).Only the "Flood forecasting and EWS" service division has internet access paid for by the Ghanaian state and Internet service and support is provided by the National Information Technology Agency (NITA). Computers are protected by an antivirus with a legitimate license.

Presently, HSD locally stores hydrological data and information such as daily and annual streamflow data, water level data, flood alert levels or have access various Regional and National projects such as Flood Early Warning System on Oti basin and White Volta, CREW project of NADMO etc.

These data are stored in the Hydromet database can exported in text format, csv.

The information is not accessible through the web because there is no web service, and the data is shared locally.

There are no official data sharing and exchange agreements with the National and regional agencies.

Some of the users of HSD data and information are Energy generating companies, water supply agencies, water resources managers. Access to the data is upon request.

Number of IT and Database managers/staff available in HSD?

Are they working 24 hours??

1. **CSIR - Water Research Institute**

It is a research institution which, given its importance and its role in the country, has made it an important agency. It has a computer network of one hundred users with nearly 86 computers. Staff also use their personal laptop.

The internet connection is funded by the government service that is protected by an antivirus with a legitimate license.

Three (03) servers are in operation with an occupancy percentage of 40% managed by the two IT engineers. Are they working 24 hours??

The data store information about variables related to chemical, climatic, biological data etc. They can be exported in csv and texts file formats.

The CSIR database is open source and accessible but does not include documentation, description. It runs on Windows server hosted at the CSIR.

Also back up server??

1. **Water Resources Commission (WRC)**

With sufficient internet connection through Vodafone, it has a local computer network made up of ten desktops and ten laptops all running with Windows, Mac and Linux operating system and it is used by 30 staffs of WRC. All computers are protected by a legal antivirus.

The service uses a single public IP address against 3 IPs that are available.

The server room has a rack cabinet with the possibility of expansion, a cooling system and an inverter.

A Dell branded server (DELL POWER EDGE R730 acquired in 2016) is available with 15% of capacity in use. It is functional and contains data from several real-time water resources observation stations, which will be able to connect with 20 more ?? stations by the year 2022.

The database contains information on water volumes, flows, water quality, reports and other information on customers/users (such as Dam authorities or Water utility companies), who take large withdrawals. Information is stored in .xml format.

Access to this information is controlled by a user account and password and cyberoam firewall is available to manage their network. Internally the information is shared using File Transfer Protocol (FTP). Data and information are shared with other government agencies, partners, researchers and general public based on official sharing data agreements.

The WRC shares information such as water volumes, flows, water quality with other structures at the national level.

There are two dedicated staff which are updating and maintaining the IT and Database system of WRC.

1. **Centre for Remote Sensing & Geographic Information Services (CERSGIS)**

CERSGIS is located within the University of Lagon, Ghana and it uses the university's free internet connection with a speed of 1.5 Mbts and bandwidth of 2 Gigabytes. The internet is used by 23 CERSGIS and it is shared with the University so sometimes the speed is not adequate for using and performing tools and software.

CERSGIS is equipped with eight (08) computers and ten (10) laptops operating with Windows 10 and Mac operating systems. The network infrastructure has five public IP addresses, and the systems are protected by up-to-date Kaspersky antivirus. No intranet or LAN for sharing files or data within the structure. It is mainly shared via Internet (http).

There is no physical server available at the moment, but a cloud server is in place. CERSGIS procured a physical server in 2010 but now it is not usable or obsolete.

OCERSGIS has a Relational Database Management System which contains both spatial and non-spatial data and information. Spatial data is in the form of ESRI Shapefiles, GeoJSON & ESRI Geodatabase with accompanying metadata.

The database contains geospatial data in XML file format managed by three (03) engineers or database managers.

There is weekly backup of the database and quality check is carried out before insertion of data and information into the system.

There are no data sharing agreement in place now with the National or regional entities such as VBA. CERSGIS data and information is accessible to private clients and other organization mostly at a fee.

1. **National Disaster Management Authority (NADMO)**

A single internet provider for more than a hundred users. the computer park includes one hundred computers and more than twenty laptops with fifty printers all protected by a licensed antivirus.

The operating system of the computer park is Windows. It has a file sharing network between collaborators

NADMO has a server room with a rack that can contain 5 peripherals, air-conditioned with an inverter relay.

Two servers are used for collecting the management of hydrological data, flows, satellite data. 65% of spaces are used on servers.

A team of three people are responsible for managing and maintaining the servers.

There are no databases but all information but the institution stores data and information on disaster management in Ghana. This data is stored on disks and also in the cloud.

No dissemination or sharing with similar institutions in the sub-region.

Additional information is available in the Annex 1 which contains the survey responses from different agencies focal points.

## IT Web services and structure security

All agencies in Ghana have access to the internet although this remains weak for the moment and does not cover all offices but nevertheless most agents sometime use their mobile connection to work.

**Table 1: Internet connection capacities**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Agencies** | **internet ADSL (yes/no)** | **speed ADSL** | **Broadband (yes/no)** | **Fiber optic speed** | **other (yes/no)** | **IP addresses** |
| **HSD** | no |  | yes | 5 Mbts |  no |  1 IP |
| **CSIR** | no |  | yes | 5 Mbts | no | 1 IP |
| **WRC** | no |  | no | 10 Mbts | no | 1 IP |
| **CERSGIS** | no |  | yes | 1,5 Mbts | no | 3 IP |
| **GMet** | no | no | no | 10 Mbts | no | 1 IP |
| **NADMO** | no | no | no | - | no | - |

At the Ghana level, we find that all agencies have internet access. This is not the case in most of French-speaking countries of the Volta Basin.

Being close to coast is one of the advantages and also the political will to make Ghana a technology free nation makes them have access to internet and carry out their day-to-day services.

In fact, a great effort remains to be made for the management of web services, which likewise remains an equation to be resolved.

**Table 2: Characteristics and equipment of servers' rooms**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Agencies** | **Server Room (yes/no)** | **Servers** | **UPS (yes/no)** | **UPS adapted to the needs of the room (yes/no)** | **Air conditioning in the room (yes/no)** | **Relay generator set for air conditioning (yes/no)** |
| **HSD** | yes | 1 | yes | no | yes | yes |
| **CSIR** | yes | 3 | yes | no | yes | yes |
| **WRC** | no | 1 | yes | no | no | no |
| **CERSGIS** | yes | Cloud | yes | yes | yes | yes |
| **GMet** | yes | 2 | yes | no | yes | yes |
| **NADMO** | yes | 2 | yes | yes | yes | yes |

Electricity remains the big problem for agencies, but at least all agencies have UPS or inverters to deal with regular blackouts or power cuts.

To be safe from load shedding, most of the agencies has a relay generator.

## Database information

The databases are not accessible online due to the unavailability of open web services. Each agency, according to its data uses a database management system according to its capabilities.

**Table 3: Databases available in the agencies**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Agencies** | **Database (yes/no)** | **Relational Database Management System (yes/no)** | **Data Format** | **Database type (eg: Oracle, MySQL, MSSQL)** | **Data stored in the structure or accessible by customer (suddenly stored within a supplier)?** |
| **HSD** | yes | no | Clidata | yes | stored in the structure |
| **CSIR** | yes | no | CSV | no | stored in the structure |
| **WRC** | yes | yes | XML | no | stored in the structure |
| **CERSGIS** | no | yes | XML | no | Cloud |
| **GMet** | yes | yes | Clidata | no | Cloud |
| **NADMO** | no | no | all | no | Cloud |

## Analysis and Findings

Considering information provided through online survey and results of the visits in each agency, we present here a resuming diagram to show the proposal for a centralized national databases management system. The central element is the WMO MCH centralized database and the agency potentially more able to host it according to its current capacities (infrastructure, human resources). All different possible existing DB and agencies providing these data, could be connected to centralized DB, based on interinstitutional data sharing agreements.

## Diagram N°1 : Proposal for a centralized national database management system

**Agencies with**

**Climatological Data**

**GMeT, HSD**

**Agencies with Meteorological Data**

 **GMet**

**Names of agencies with**

**Hydrological Data**

 **Ghana HSD**



**WMO MCH centralized DB to establish**

**GMet**

**New Hydro-Meteo models or direct connection to the Mydewetra platform for Hydro-Met EWS**

**VOLT**

**ALARM**

**EWS**

**Completed and on-going Projects**

**Oti Basin and White Volta FEWS**

**CREW**

**FANFAR**

**Agencies with Civil protection (social and**

**Structural) data**

**NADMO, CERSGIS, Statistics dept**

**Agencies with environmental and ecosystems data**

**Source: WMO**

Information related to access to data and interinstitutional sharing data agreements is presented in the following table in order to better understand how to manage the interconnection of all the DB to the centralized one.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Agency** | **Free access to data? (yes/no)** | **Any data sharing agreement?** | **If yes, list of agencies involved** | **Comments or other relevant information** |
| **HSD** |  |  |  |  |
| **CSIR** |  |  |  |  |
| **WRC** |  |  |  |  |
| **CERSGIS** |  |  |  |  |
| **GMet** |  |  |  |  |
| **NADMO** |  |  |  |  |

At the national level, we see several agencies with a good capacity for the management of a national database given the availability of resources (staff, equipments and infrastructures) at their level.

## Diagram N°2: IT architecture proposal and access system to VOLTALARM EWS

Considering information provided through online survey and results of the visits in each agency, we present here a resuming diagram to show the availability of conditions to get access to VOLTALARM system for each agency.

**Ghana HSD**

**Staffs**

**Internet**

**Computer**

**Legend**

**GMet**

**Staffs**

**Internet**

**Computer**

Not available

Available





**WRC**

**Staffs**

**Internet**

**Computer**





**CERSGIS**

**Staffs**

**Internet**

**Computer**





**NADMO**

 **Staffs**

**Internet**

**Computer**

**WRI**

**Staffs**

**Internet**

**Computer**

**Source: WMO**

Either way, it should be noted that it is important to make the capacity indentation according to the needs of each structure.

## Proposals and suggestions for the National database set-up and access to the VoltAlarm EWS

Ghana is making a difference in this area. All structures collect data at all levels. This shows that the work is already being done in this country which collects a large part of the Volta's water resources. which is quite normal because Ghana is experiencing flooding.

The answers to the questions are not exhaustive, which does not give us a compilation with better results. All in all, it will be important to seek the collaboration of all stakeholders.

Thus, the central database can be installed in the midst of these structures that we deemed technically suitable to ensure their management and maintenance: GMet, WRC, CERSGIS

# Conclusion

For the agencies, there is a need for capacity building because there is an increasingly shortage of personnel with IT and DB skills and knowledge. The Agencies are trying to do what it can be possible through government support but there are needs in terms of IT equipment's, services and capacity development of staff.

Infrastructures are not keeping up with the development of technology and information management is becoming more and more important given the volume of data and need to develop products and tools for saving lives and economic activities.