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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 |
| EPA | Environment Protection Agency |
| 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 |
| CSIR-WRI | CSIR-Water Research 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 (Mr Ben Ampomah, Executive Secretary, Water Resources Commission), 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 MB/s is available for downloads and 5 MB/s 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 eight (08) public IP addresses but only three (3) IP address are 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 21 synoptics and 21 automatic weather stations, 34 agro-stations and 27 climatological stations at various locations. The GMet database contains the historical data of more than 60 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 3 external hard drives.

Some of the clients using the GMet database include Volta River Authority, Ghana Civil Aviation Authority, students, Kwame Nkrumah University of Science and Technology, University of Ghana, Ghana Airport Company Limited, NADMO, WRC, HSD, Ghana Air Force, road and building contractors, fishermen and 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 have a Local Area network (LAN). There is internet facility in the Department and it 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 and can exported in text format, and csv.

But it is not accessible through the web, and the data is shared locally.

There are no official data sharing and exchange agreements with the National and regional agencies. However, data is shared on project basis.

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.

There is one database manager available with HSD and no IT expert is presently available for support.

The HSD is presently not operational for 24\*7.

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 desktop computers. Staff also use their personal laptops.

There are two fibre internet connections to the institute, and it is paid for by government. The system 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 managers. IT managers work for 8 hours.

The database stores information related to chemical, climatic, biological, streamflow, groundwater data etc. They can be exported in csv and text file formats.

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

There is no backup server available in CSIR-WRI.

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

It has sufficient internet connection through Vodafone. There are 25 desktops and 30 laptops all running on Windows, Mac and Linux operating system. All computers are protected by a legal antivirus.

The internet service uses 7 public IP address available.

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

A Dell branded server (DELL POWER EDGE R730 acquired in 2016) is available with 15% of capacity in use. It is functional and contains both real-time and historic data.

The database contains information on water volumes, flows, water level, water quality, hydrological, meteorological, social, demographic, reports and other information on raw water users, who take large water withdrawals. Information is stored in .xls format.

Access to this information is controlled by a user account and password. The cyberoam firewall is available to manage the 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, groundwater level, water quality with stakeholders. However, some fees are paid for commercial data request.

There are two dedicated staff who update and maintain the IT and Database system of WRC.

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

CERSGIS is located within the University of Ghana, Legon and it uses the university's internet connection. The internet is used by 23 staff members of CERSGIS. The speed is sometimes not adequate for data processing and analysis.

CERSGIS is equipped with eight (08) computers and fifteen (15) laptops operating on Windows and Mac operating systems. The systems are protected by up-to-date Kaspersky antivirus. There is a LAN for sharing files or data within the institution.

There is a physical server available at the moment, and a cloud server is in place.

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

The database contains geospatial data in shapefile and geodatabase format managed by three (03) system administrators.

The data is quality checked before entry into the database. The database is backed up weekly.

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 institution has one hundred computers and more than twenty laptops with fifty printers all protected by a licensed antivirus.

The operating system is Windows. It has a file sharing network between collaborators

NADMO has a server room with a rack that can contain up to 5 servers with 2 in use. The server room is equipped with air-conditions and an inverter relay.

The two servers are used for collecting and the management of hydrological data, flows, satellite data. 65% of space is used on servers.

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

There are no databases for storing data. However all information received from various institutions are stored on various computers, drives and 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. However, some institutions have internet challenges such as low bandwidth, connection interruption.

**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 | no | yes | 5 MB/s | no | 1 IP |
| **CSIR-WRI** | no | no | yes | 10 MB/s | no | 1 IP |
| **WRC** | no | no | no | 10 MB/s | no | 7 IP |
| **CERSGIS** | no | no | yes | 1.2 MB/s | no | none |
| **GMet** | no | no | no | 10 MB/s | yes | 8 IP |
| **NADMO** | no | no | no | 20 MB/s | no | 2 IP |

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 issue 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** | no | 1 | no | no | yes | no |
| **CSIR-WRI** | no | 3 | Yes | no | yes | yes |
| **WRC** | no | 1 | yes | no | yes | yes |
| **CERSGIS** | yes | 4 | yes | yes | no | yes |
| **GMet** | yes | 6 | yes | yes | 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 | CSV, Clidata | Oracle | stored in the structure |
| **CSIR-WRI** | Yes | no | CSV, xls | PostGre | stored in the structure |
| **WRC** | Yes | yes | Xls, csv | **MySQL** | stored in the structure |
| **CERSGIS** | No | yes | Geodatabase | PostGre | Cloud |
| **GMet** | Yes | yes | csv, xls | Oracle | Stored in the structure |
| **NADMO** | No | no | all |  | 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, GARIB, PREE**

**Agencies with Civil protection (social and**

**Structural) data**

**NADMO, CERSGIS, Statistics dept**

**Agencies with environmental and ecosystems data**

**EPA, Forestry Commission, Fisheries Commission, Centre of African Wetland**

**,**

**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** | No | Yes | CSIR-WRI, WRC, GMet, VRA, NADMO | Project specific data is shared |
| **CSIR-WRI** | No | No | - | Project specific data is shared |
| **WRC** | No | Yes | CSIR-WRI, WRC, GMet, HSD, NADMO |  |
| **CERSGIS** | No | No | No | Project specific data is shared |
| **GMet** | No | Yes | Civil Aviation, VRA, NADMO, WRC, Ghana Air Force, Universities etc | Project specific data is shared |
| **NADMO** | YES | Yes | UN Charter for Space and Major Disasters, UNDRR, Global Flood Awareness Systems (GloFAS), Copernicus Emergency Mapping Services, European Operational Satellite Agency for Monitoring weather, Climate and the Environment from space (EUMETSAT), etc | NADMO relies on several agencies for data (HSD, GMet, etc)  Project specific data is shared |

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, equipment 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 build capacity according to the needs of each institution.

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

Ghana is making a difference in this area. All institutions 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 proposed institutions that we deemed technically suitable to ensure their management and maintenance: GMet, WRC, and CERSGIS. Upon further discussion and consultation among stakeholders, GMet was selected as the hosting institution for the Centralized database.

# 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.