EXECUTIVE SUMMARY

This is the Final Report on the Water Audit study on the part of the Volta basin which is shared by Burkina Faso and Ghana. The two countries share 85% of the 400,000 km^2 area of the basin. The other riparian countries are Benin, Ivory Coast, Mali and Togo.
The audit was sponsored by the IUCN as part of its assistance to the two countries in particular and to the six countries in general to improve governance of the water resources of the basin.
The audit also fits within the context of GLOWA project in the Volta Basin which is focused on land use and climate changes on water resources. It also fits into the Challenge Programme on Water for Food which is aimed at finding ways of producing more food with less water.

OBJECTIVES

The objectives are to:-

- Make available and share scientific knowledge on the status and dynamics of surface and groundwater in the Volta given basin.
- Develop management options for the water resources under various scenarios of water availability and demand.
- Establish a decision support tool for the benefit of the countries.

APPROACH

The audit was carried out by a consulting team made of Burkinabe and Ghanaian experts.

To achieve the above objectives, 19 hydrometric stations were first selected to determine the available water resources in the sub basins namely the Black Volta, White Volta (with its sub-basins the Red, Sissili and Kulpawn) and the Oti. Of the stations, ten (10) are in Burkina Faso and nine (9) in Ghana. Further, six (6) are in the Black Volta, ten (10) in the White Volta and three (3) in the Oti. 63% of the stations had data ranging from 45 to 54 years while the remaining 37% had between 40 to 44 years of data.
The flow stations in Burkina Faso are Samendeni, Borono, Noumbiel and Batie on the Black Volta; Bissiga, Bagre and Bittou on the White Volta; Ziou on the Red Volta and Kompienga on the Oti. The stations in Ghana are Bui, Bamboi on the Black Volta; Nawuni, Pawlugu, Yarugu on the White Volta; Yagaba on the Kulpawn; Nakong on the Sissili and Saboba and Sabari on the Oti. See Map 2.
However, all the stations had varying periods of missing data. The data collected were scrutinized, validated and the missing ones estimated using rainfall-runoff model (Burkina Faso) and linear regression analysis (Ghana). The results of estimating the missing flow data are presented in Tables 2.1.1 to 2.1.10 for Burkina Faso and those for Ghana in Tables 3.1.1 to 3.1.9.

Water Availability Computations

Surface Water Resources

Secondly, water availability estimates at the selected stations covering long-term means, extremes and impact of climate change were computed. The long term means were based on 40-54 years of the flow data up to 2005. The extremes of water availability were defined on the basis of the percentile of flows over the periods of record with the:-

10	percentile	representing	Very Low Flow
25	"	"	Low Flow
75	"	"	High Flow
90	"	"	Very High Flow

The results of the computation of the long-term mean monthly and extreme flows are presented in Tables 2.2.1 to 2.2.10 and charts 2.2.1 to 2.2.10 for Burkina Faso. In the case of Ghana, they are presented in Tables 3.2.1 to 3.2.9 and Charts 3.2.1 to 3.2.9.

The climate change impact on flows arising from increases in greenhouse gases were taken into consideration. The changes in temperature and rainfall were computed using Global Circulation Models. Rainfall/Runoff Models were used to transform, the resulting temperature (evapotranspiration) and rainfall into runoff. The results show that water availability can be expected to decrease by 16% by year 2020 and 37% by year 2050 over flows in the base period 1961–1990.

Groundwater Resources

The current groundwater potential could not be evaluated because the data and information required by the planning model were not available at the time of the audit.

Water Quality

The surface and groundwater quality data and information were found to be in the same situation as described above for groundwater resources.

Water Demand Projections (2005-2030)

As a third step, water demand for various uses (viz domestic and industrial, irrigation and livestock, hydropower and ecosystem needs) based on current population and socio-economic activities and their expected growth rates were projected from 2005 up to the year 2030. The major water demand sites for which the projections were made include Ouagadougou, Bobo-Dioulasso, Kondogou, Ouahigouya, Pouytenga, Bagre in Burkina Faso and Tamale, Damongo, Bolgatanga, Tono, Vea, Bimbila and Wulensi in Ghana. See Map 3.

The water demand projections are presented in Tables 4.1.1B, 4.1.3A and 4.1.3B for Burkina Faso, and in Table 4.2.1 for Ghana.

The projection did not include hydropower impact at Bagre in Burkina Faso, nor irrigation water demand at Vea, Tono and Botanga in Ghana for lack of adequate and timely data.

Evaluation of Water Availability to meet Demand up to 2030

As the final step in the audit process a number of models were considered for use as a Decision Support System. In view of its cheaper cost and data requirements, the Water and Environmental Planning (WEAP) model developed by the Stockholm Environmental Institute (SEI) was selected.

The results of the water availability and water demand computations together with other data were fed into the WEAP model to customize it. It was then used to run the various scenarios namely: Mean, Very Dry, Dry, Wet, Very Wet years and under the impact of Climate Change, to find out the outcomes.

RESULTS OF THE EVALUATION

The results of the model run for all the scenarios mentioned above are presented in Table 5.7. For this Executive Summary, only the results for the significant or critical scenarios are presented.

The significant water availability situations relate to the Mean, Very Dry Year and Climate Change flows. For these, the preliminary results show that if demand is allowed to grow and "nothing is done" about the present resource capacity or infrastructure described as the Current Account Year (which for this study was chosen as year 2005), the ability to meet demand under the above water availability scenarios will be as follows:-

Water availability based on long-term mean flows

i) *In the case of domestic and industrial water supply*

There will be sufficient water to meet demand up to year 2030 in all the towns and cities in Ghana and Burkina Faso except Ouagadougou; Ouagadougou will experience water shortages in the dry months, starting from the year 2013. In 2015, 88% of Ouagadougou's demand will be met, while only 78% of the demand in 2030 will be met.

ii) *In the case of irrigation there will be shortfalls at:-*

- The Bagre scheme beginning 2013. In year 2015, only 45% of the water demand will be met. In year 2030, the available water will meet only 42% of the demand.
- The Lac Bam scheme. The demands that can be met will only be 23% in year 2010 to 2030. This is because the maximum area that can be brought under cultivation will be attained in 2010.

Water Availability in a Very Dry Year

i) *Domestic and industrial water demand*

- Demand can be met in all the towns and cities except the dry months in Ouagadougou, Tamale and Damongo.
- In Ouagadougou, 86% of the water demand can be met in 2015, and 69% in 2030.
- In Tamale, 99% of the water demand can be met in 2015 and 91% in 2030.
- In Damongo, 98% of the water demand in 2030 will be met.

ii) *In the case of irrigation water demand*

- Only 15% can be met between 2015 and 2030 at the Bagre irrigation scheme.
- Only 13.5% can be met at Lac Bam irrigation scheme between 2015 and 2030.

Water Availability with climate change impact

i) Domestic water supply

- There will be pronounced shortages in the dry season months in Ouagadougou, Tamale & Damongo while other sites will have their demand met in full.
- In Ouagadougou shortages will start from 2009 and by 2015, 88% of demand will be met reducing to 69% in 2030.
- In Tamale the shortages will be experienced in the months of January, February and March. Demand shortages will be significant from 2030 when 93% of the demand will be met.

ii) Irrigation water supply

- For the Bagre scheme 30% of the demand will be met in 2015, reducing to 15% in 2030.
- For the Lac Bam scheme, only 18% of the demand can be met over the period 2015 to 2030.

CONCLUSIONS

From the study it is concluded that:-

i) The PAGEV project has resulted in a Decision Support System for assessing the feasibility of meeting water demand up to year 2030 for various needs at different locations or settlements within the Volta basin shared by Burkina Faso and Ghana. The Decision Support System is based on the WEAP Model. As presently constructed or customized, it can be used by the countries as a tool to provide preliminary information for policy making, negotiations, planning and development.

ii) The audit has enabled the gaps in the flow data at the selected stations to be filled. The SMAP Rainfall/Runoff Model was used in Burkina Faso while in Ghana, Linear Regression Analysis of hydrological and meteorological parameters were used. The results of the different methods were accepted for use in the assessment of water availability because a random check of results obtained by estimating the flows at Pwalugu with the SMAP Model showed good agreement with the results obtained by the Regression method.

iii) Long-term flow statistics have been computed for the stations for various water availability scenarios (viz means, extremes and climate change).

iv) The water availability/water demand (domestic, industrial, irrigation, environment) balance model constructed covers the period 2005 to 2030. The model has been run on the "Do Nothing" scenario and the preliminary results show that for:-

a. Domestic and industrial water demand;
    - Present supply will be inadequate to meet the demands in Ouagadougou, Tamale and Damongo from 2015 up to 2030;
    - The demand in Tamale will not be met in the dry season even for now. On an annual basis, the demand can be met except under climate change impact.

b. Irrigation
    - The demand cannot be met by the supply from the Bagre and Lac Bam dams from 2008.

v) The gaps in the stream flow data show that not enough resources are being made available to the relevant services in the two countries to provide regular and accurate data on a long-term basis.

vi) Water quality (surface and groundwater) monitoring is not being given the attention it deserves.

RECOMMENDATIONS

On the basis of the findings and conclusions, it is recommended that:-

i) The databases in the two countries be harmonized. Burkina Faso is better organized with spatial presentation of data within basin and administrative frameworks. The use of GIS data bases and GIS ArcView are well developed. Ghana on the other hand organizes its data in an administrative framework.

ii) Since the gaps in the river flow data were filled by different methods, the two countries investigate and adopt a method agreeable to them. This should take into account similar work being done under the GLOWA Volta and the Challenge Programme on Water for Food.

iii) Stream flow monitoring should be continued on a regular and long-term basis at all the 19 selected stations. Stream flow and ground water quality monitoring should form part of the water resource monitoring. This work should be harmonized with the Volta – HYCOS project.

iv) The Groundwater Assessment Project in Ghana should be completed to provide data on the groundwater characteristics at sub-basin and if possible at demand site levels. Similar assessment should be carried out in Burkina Faso using the data from the 38 monitoring stations of DGIRH. The information should be used to run the model for an evaluation of the groundwater potential to meet demand.

v) Since present and future water demand projections in the two countries are based on different standards (e.g. per capita water use per day), it will be important to adopt one standard wherever feasible.

vi) The model be refined by disaggregating the demands for irrigation and livestock to their proper locations in the sub-basins so as to avoid skewing the results.

vii) As the data on hydropower was incomplete, and was not incorporated in the model run, the data about the flow and reservoir characteristics should be completed and used to re-run the model to assess the impact of various flow sequences.

viii) Based on the results of the “Do Nothing Scenario”, negotiations be entered into by the riparian countries to address the water shortages expected in Ouagadougou and Tamale under the mean and climate change low conditions from 2013 to 2030. This will contribute to meeting the National and Millennium Development Goals for water supply and sanitation.
Similarly, negotiations to increase water supply for irrigation after the domestic demands have been met should start concurrently.

ix) Since a number of structural and non-structural options are available for achieving the above, the feasible ones should be evaluated and their impacts assessed for equity and sustainability. These include:-
   a) Increasing storage at the intake of the Tamale water supply;
   b) Creating a new surface storage for the Bagre Irrigation project or do away with the plan to bring additional land under irrigation or mobilize groundwater to supplement the surface supply.
   c) Using non-structural means such as Water Demand Management and Regulatory Measures.

x) A training seminar should be organized for the staff of the relevant institutions in Burkina Faso and Ghana on the use of the WEAP model and how it has been customized for use as a Decision Support System by the two countries. The institutions should be assisted to acquire the model.

xi) It is suggested that the new Volta Basin Authority (VBA) leads the way in implementing the above recommendations.