# Groundwater potential assessment in Kompienga dam basin using multiple methods

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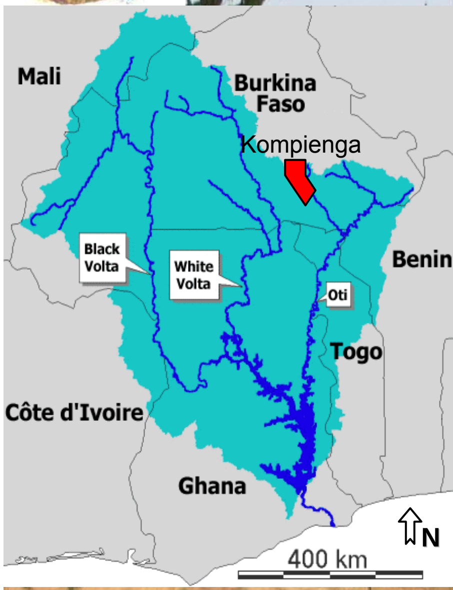


Map 1. The study site location on the Volta river basin in Burkina Faso (modified from GLOWA Volta project)

## INTRODUCTION

Groundwater has become a key water resource for population worldwide and especially in the sahelian country of Burkina Faso where rainfall is erratic. Therefore decision makers are putting more emphasis on the sustainable management of groundwater in terms of quantity and quality. To assess the potential of the groundwater system in the Kompienga basin, the chloride mass balance method and the water table fluctuations method were used.

## SITE PRESENTATION

The study site is located in the Kompienga watershed of 5911 km² hosting an important national hydropower dam of 2.05 billions m³ of water. Rainfall at the site has a monomodal pattern of 5 months of rainy season. The geological formations are mainly crystalline rocks basement consisting of granites and amphibolites covered by relatively thick regolith of lateritic, sandy clay loam, sandy loam, clay and silty soils.

## MATERIALS AND METHODS

To assess the groundwater potential within the study basin, rainfall, groundwater levels and chloride concentrations were measured. The chloride mass balance method used data derived from laboratory analysis of water samples monthly collected from raingauges and boreholes through four sites across the dam basin. The recharge was also estimated using daily water levels fluctuations data collected with piezometers at the four sites.

## RESULTS & DISCUSSIONS

| Methods | R (mm) | Percent of rainfall | Formulas |
|---|---|---|---|
| Chloride mass balance | 22.2 | 3 | $R = P.\frac{Cl_p}{Cl_{gw}}$ |
| Water levels fluctuation | 31.4 | 4 | $R = S_y.\Delta h/\Delta t$ |

R, annual groundwater recharge in mm;
P, average annual precipitation on the basin in mm;
$Cl_P$, chloride concentration in rainfall in mg/l;
$Cl_{gw}$, chloride concentration in groundwater in mg/l;
$\Delta h$, rise in the water table in mm;
$\Delta t$, time period within which water table rise is observed;
$S_y$, specific yield of the aquifer

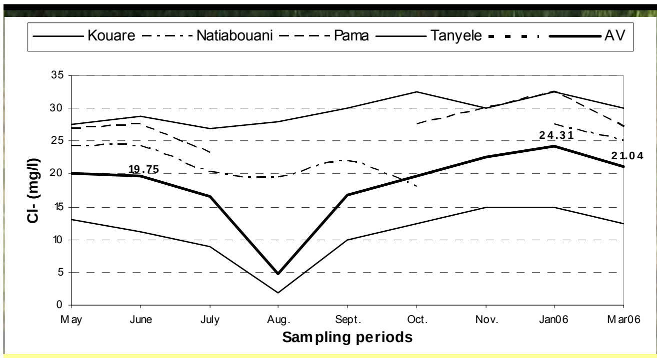


Fig.1. Monthly chloride concentration (mg/l) in groundwater samples from boreholes during 2005 rainy season

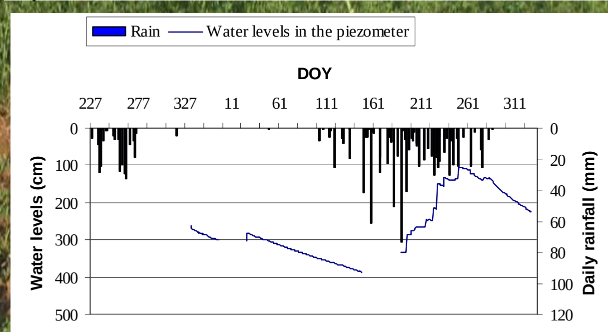


Fig.2. Water levels fluctuations in a piezometer of one of the monitored sites on the Kompienga basin and daily rainfall depths from julian day 227 in 2004 till day 328 in 2005.

Groundwater recharge in 2005 for the Kompienga basin indicated an annual range between 22 mm and 32 mm. The water table fluctuation method depicted a higher value certainly due to incertainties in the specific yield determination from the standard values specified in Healy and Cook (2002) based on the site's soils texture. However, the estimations give a range of recharge in accordance with previous evaluations within the site area of crystalline basement aquifers consisted of fractured porosity.

The recharge flow processes prevealing on the site have been revealed by the monitoring water levels in the piezometers and the variation of the chloride concentration in the groundwater (figures 1 and 2). The time lag of three months observed between the first rainfalls and the first rise of the water table on figure 2 indicates a diffuse flow process for the basin groundwater recharge through progressive evolution of the wetting front filling the soil moisture to its field capacity for percolation to the deep water table. This recharge process is accompanied and often preceeded by preferential flow process (figure 1) mainly occuring in crystalline basement aquifers through fractures and cracks like the study site.

## CONCLUSION

The 2 methods have provided evidence of recharge in the Kompienga basin ranging from 3 to 4% of the annual rainfall. The recharge process is revealed to be through preferential and diffuse flow.

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