GROUNDWATER RECHARGE MECHANISMS AND WATER MANAGEMENT IN THE COASTAL SEDIMENTARY BASIN OF BENIN

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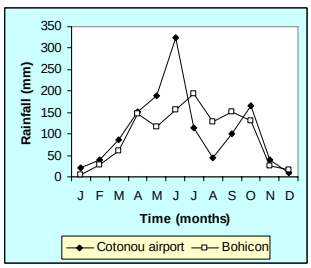
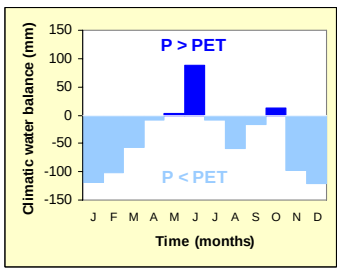
Background / Rationale

The coastal sedimentary basin roughly extends to 10% of the territory of Benin. It is the densely populated area (approximately the 2/3 of the six million inhabitants of Benin) and the most urbanized. It is fortunately dowered with large part (35%) of groundwater resources which constitute the principal source of drinking water supply of the large cities of this basin. In the context of climate change, rapid population growth, increase of water demand, it important to assess climate impact on Groundwater availability.

Objectives / Hypotheses to test

The aim of the study is to analyze groundwater recharge under climate variability conditions or climate change context in the coastal sedimentary basin of Benin.



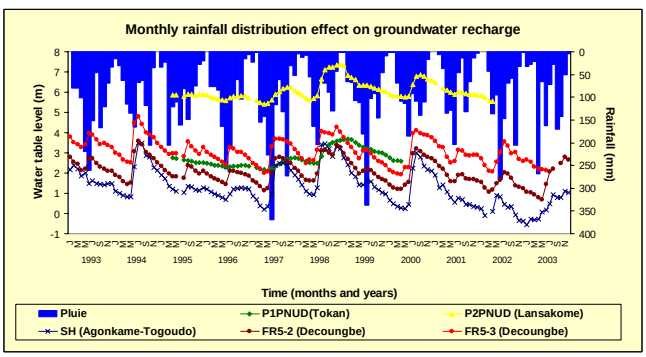


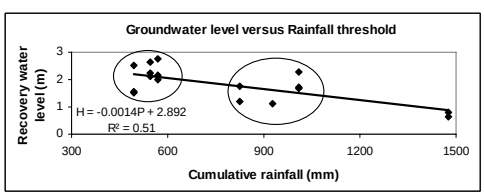
Effective wet months are May, June and October. Cumulative rainwater at June make rise of groundwater levels in the coastal sedimentary basin of Benin.

Results

Groundwater recharge rate is higher in the coastal plain (Quaternary aquifers) and lower in the region of plateaus characterized by deep geological formations.

In the lagoon Djonou basin groundwater recharge average is 125 mm. Taking to account extracted water in the pumping perimeter of Godomey, real annual recharge of groundwater is 405 mm.





Methodology

Data : Rainfall, potential evapotranspiration of the synoptic stations of Cotonou airport and Bohicon, daily groundwater levels of the period 1993-2003, hydrogeological parameters.

➢ Groundwater recharge estimation by the water levels fluctuation method: $R = S_y \cdot \frac{\Delta h}{\Delta t}$

R = recharge; Sy = specific yield of the aquifer; Δh = water table rise and Δt = time period within which the rise occurs.

➢ Recharge estimation by the base flow method in the hydrogeological basin of Djonou:

$$Q = Q_0 e^{-at} \Rightarrow V_{tp} = Q_0 \cdot \frac{t_1}{2.3} \Rightarrow V_t = \frac{V_{tp}}{10^{\left(\frac{t}{t_1}\right)}} \Rightarrow R = V_{tp} - V_t$$

Q = flow at time t, Q_0 = flow at the beginning of the recession, a = constant of recession function of the basin, t = time since the beginning of the recession. Q_0 has logarithmic function with the time. t_1 = time put by base flow to pass from Q_0 to 0.1 Q_0 , a log cycle of Q).

Drillings	Water level	1994	1997	1998	2000	Recharge (mm/year)	Rate (% of Rainfall)
SH Godomey	Δh (m)	2.64	2.30	2.53	2.78	149	?
FR5_2 Dekoungbe	Δh (m)	2.12	1.67	1.53	2.01	122	19
FR5_3 Dekoungbe	Δh (m)	2.24	1.71	1.58	2.16	128	20
P1PNUD Tokan	Δh (m)	-	0.64	1.21	-	53	5
P2PNUD Lansakome	Δh (m)	-	0.82	1.76	1.10	70	7

Discussion

Methods apply to estimate groundwater recharge take account to only climate impact on water level rising. But lateral flows of the northern part of the basin (21%), the lagoon Djonou (0.8%) and the lake Nokoue (11%) also contribute to groundwater recharge in the coastal sedimentary basin of Benin.

According to Boukari et al (2005), saltwater intrusion is in order of 10643 m³/day and affect recharge on the drillings SH.

This situation is related to forcing natural recharge induced by surface water infiltration in response to the over-pumping and declining water table trend from 5 mm/year to 10 mm/year due to climate change (Totin et al, 2006).

Land use change and increasing of impermeable area on the aquifers recharge sites are not included in study parameters. This could impact groundwater recharge estimation.

Conclusions

1. Large recharge of groundwater is observed during a long rainy season where cumulative rainfall caused rise of water table and water storage between April to October.
2. Groundwater recharge mechanisms imply vertical and lateral infiltration. This last caused saltwater intrusion from the lake Nokoue influenced by the sea level rising.
3. The strategies of sustainable groundwater management should be the participatory approach, creation of protected recharge zone and adaptation of water supply to climate variability and change.

Key references:

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