What impact of family farms' irrigated development on water resources?

Experimental plan to assess rice-fish farming basins in Guinea

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INTRODUCTION

Hydro-agricultural systems constitute a strong lever for increasing food production in sub-Saharan Africa. Very few studies have been made to try and quantify the impacts of such systems on water resources. However, the IPCC predicts a decline in the level of surface water tables in this region. The aim of this project is to describe and analyze the variations of groundwater (surface water table, perched water table, alluvial water table, etc.) and to establish the relations between water tables and rivers over seasons in order to assess the potential for development, e.g. aquaculture basins (temporary or permanent). The aim is to produce a study system based on a continuous monitoring to improve ponds' design approach. The expected outcomes of this study can be summarized as follows: (i) better understand the hydrogeological functioning of a fish pond and the surrounding lowlands and (ii) deepen knowledge on dynamic processes at water-table interface level. This work will assess the feasibility of a methodology to evaluate the impacts of fish dams on the evolution of water resources in lowlands.

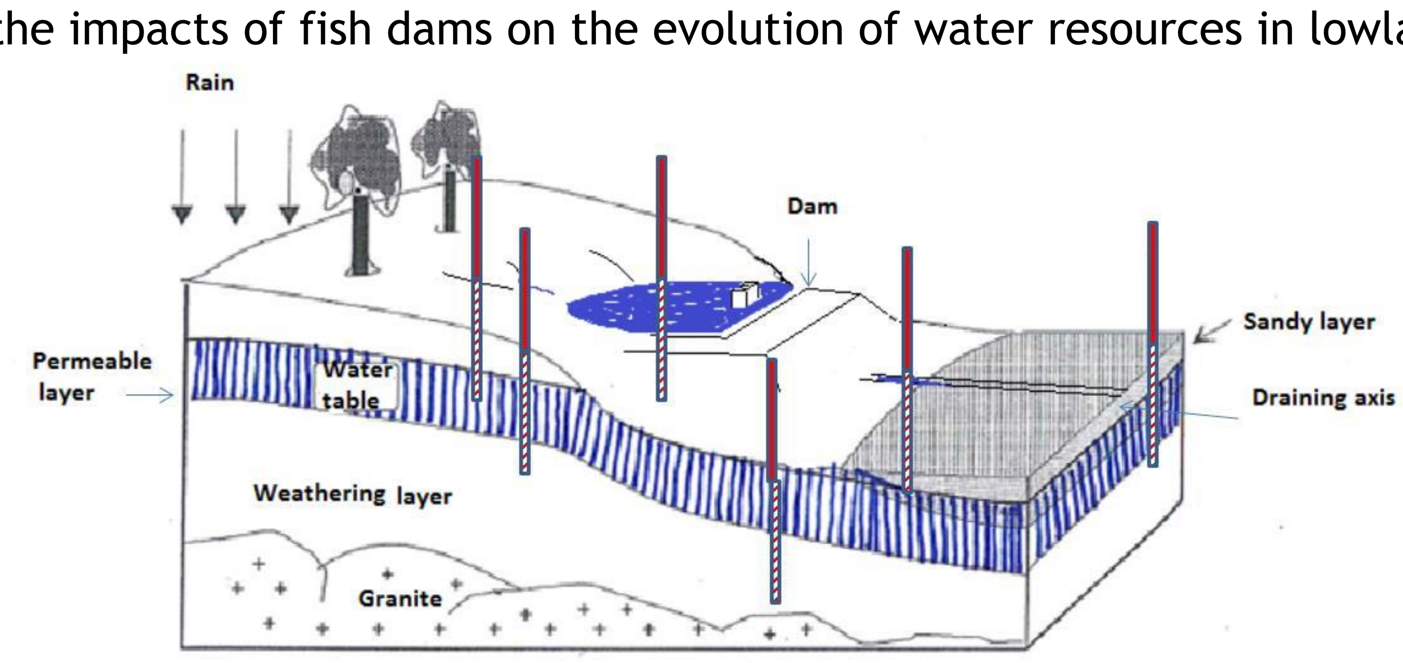

Figure 2: Experimental device

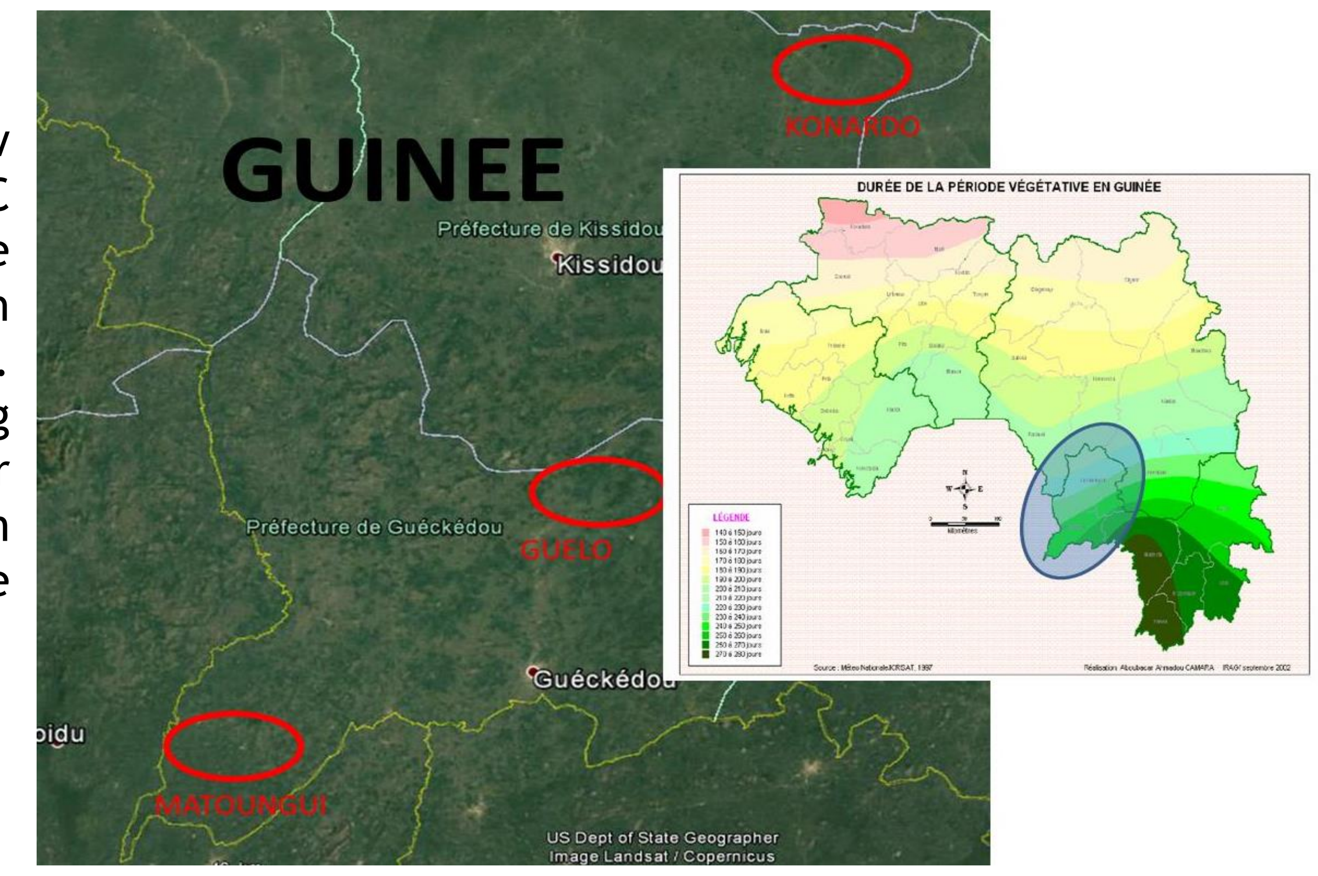

Figure 1: location of the three study areas and map of the length gradient of rainy season in Guinea

CONTEXT AND METHODOLOGY

In the case of this study, an experimental device has been implemented to measure the water table level in fish ponds' catchment basins (Figure 2). The methodological approach to implement this device consisted primarily in prospection and field visit. The choice of sites and points of device implantation was based on (i) geological and soil data collection, (ii) availability and type of water sources, (iii) shape of hillsides, (iv) distance between lowlands and main watercourses, (v) size of fish ponds and their water-retention capacity.

Three villages of the Guinea western Rainy Forest Region have been selected (Konardo, Matoungui and Guélo) following a rainfall gradient representing different climatic behaviours (Figure 1). Three sites have been chosen for each village. This preliminary step allowed the implantation of several experimental stations. 5 to 7 stations are selected per site to illustrate and monitor different hydrogeological situations and / or geological substratum. A rain gauge has been installed in each village. The experiment has been conducted during an entire hydrological cycle (more than one year).

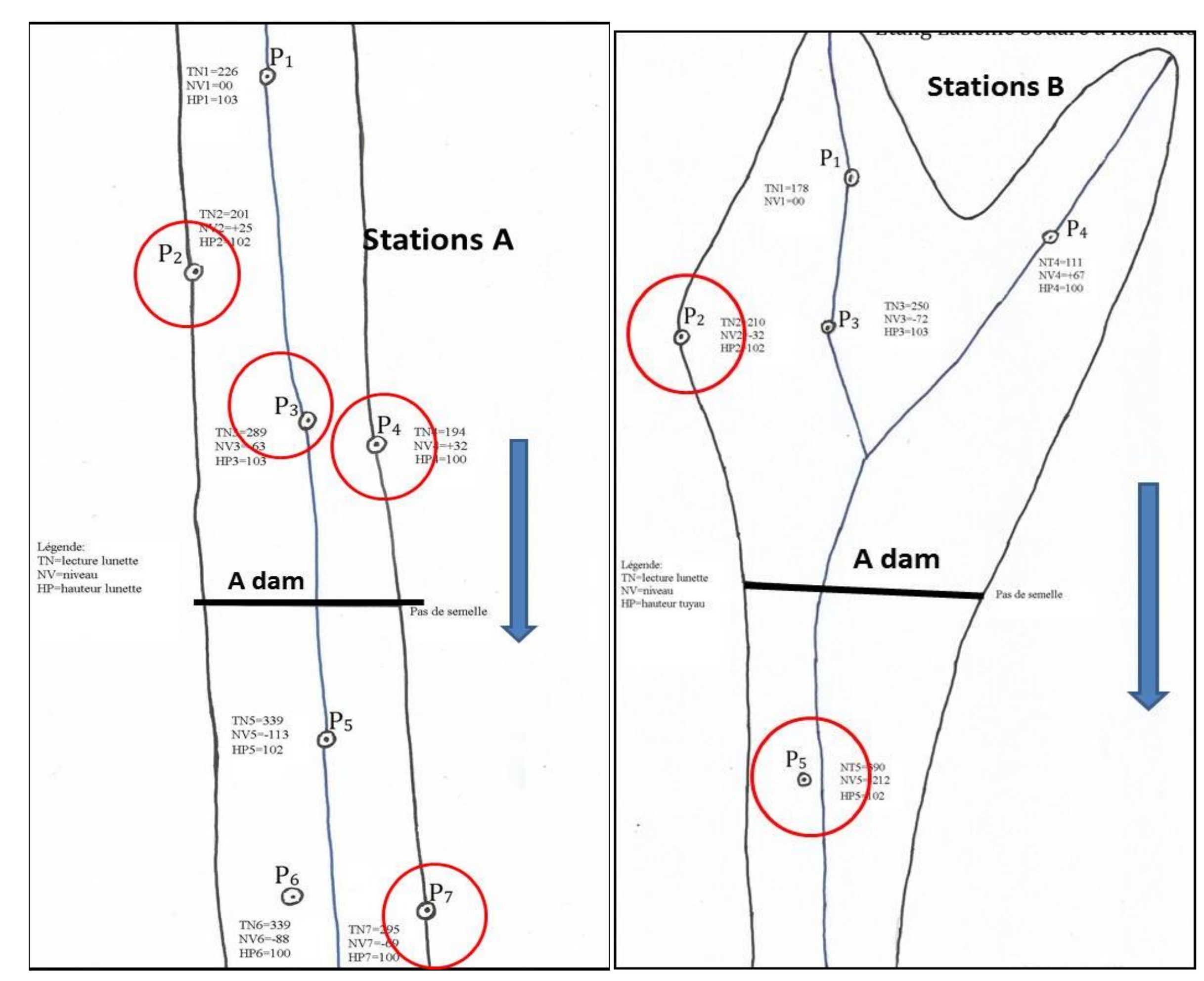

Figure 5: location of the stations on sites A (left) and B (right). Arrows indicate how the water flows and continuous lines indicate low-lands limits and watercourses.

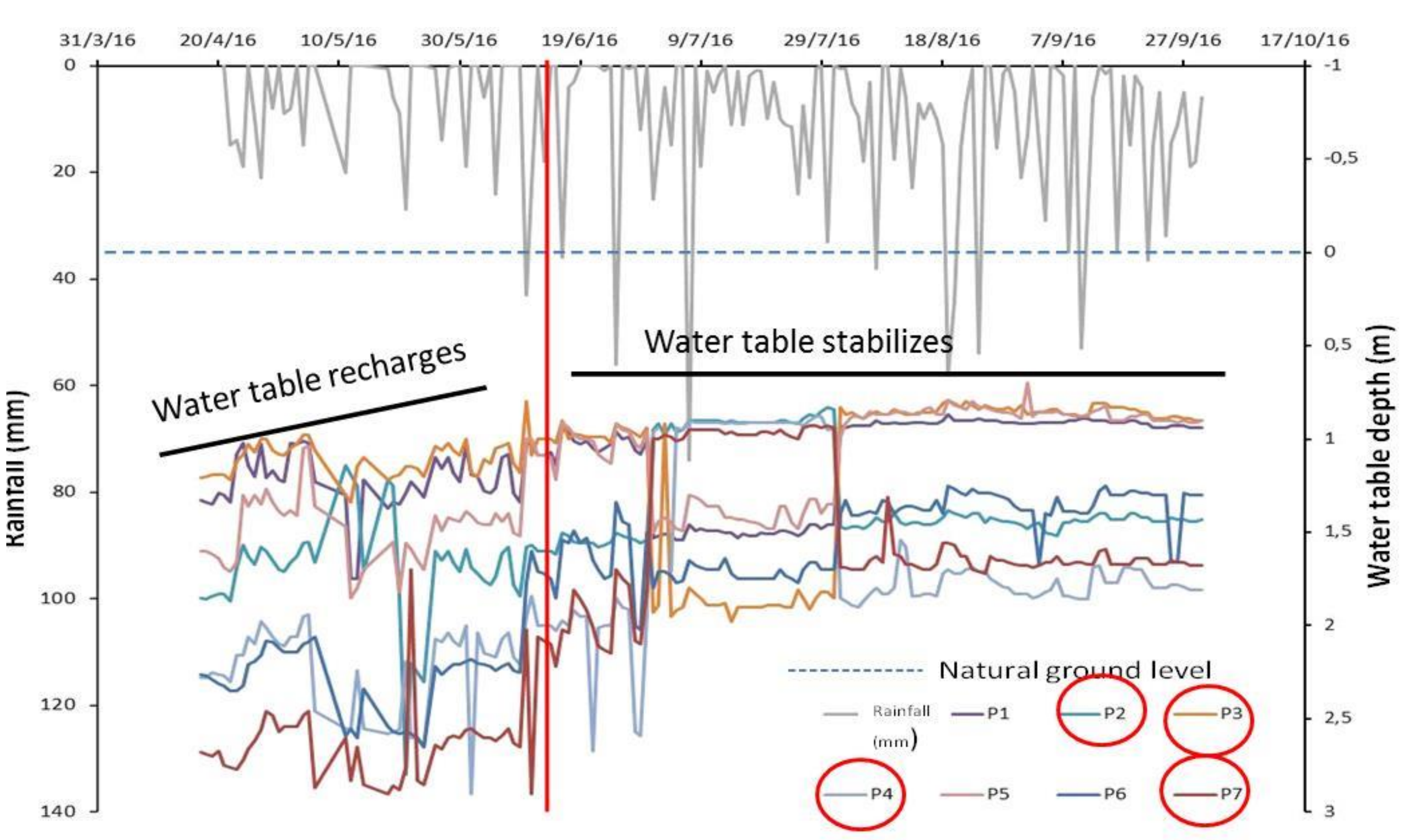

Figure 3: variation of piezometric level in Guélo Village (stations A)

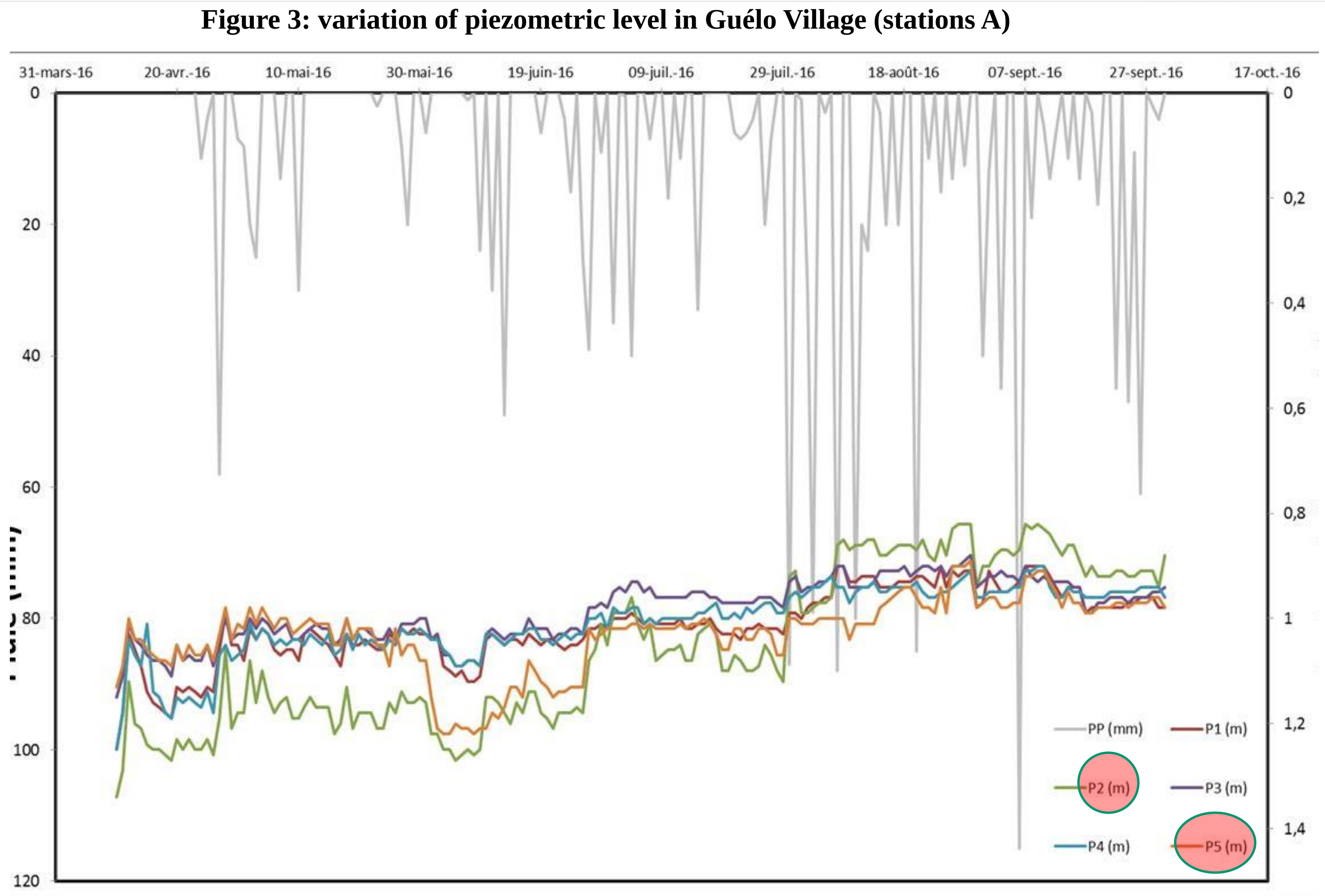

Figure 4: variation of piezometric level in Konardo Village (stations B)

RESULTS

Here, two examples of a six months survey around the beginning of the rainy season have been selected (Figure 3 and 4). The reconstruction of the water table rise when rainy season starts shows that there are two main phases: (i) first, the water table recharges at the beginning of rainy season (April to July); (ii) then the water table stabilizes, from July to the end of August. In a second moove, after the first rise at the beginning of rainy season, a group of piezometers (P2, P3, P4, P7 for station A – Figure 3 and Figure 5- and P2 P5 for station B - Figure 4 and Figure 5 -) are declining from end of July and water flows directly from the aquifer surface zone to the drainage axis of the basin contrary to the other piezometers. For P5 station B, the rise in August is likely the consequence of a flooded lowland. Excess water could increase drainage, which limits water storage capacity of these dams except if this has occurred because of rice planting requirements.

This highlights a paradoxical situation where water recharge can be more important downstream hill than in the pond or upstream hill. This depression in the water table reflects an unexpected functioning of the water table at fish basins level. Two main factors involved in conception phase seem to be in opposition: (i) maintain water reserves on one hand and (ii) make basins drainable on the other.

CONCLUSION

The particular fish ponds monitoring example presented here provided information on the quantification of water resources temporally exchanged between aquifers and rivers. The results obtained in the three selected villages appear necessary to better understand the management's hydrogeological functioning and the dynamic processes at the groundwater-river interface.

The overall results of this study enable to understand the impact of water resource on fish-rice farming development during the year and pave the way for new types of design.

SPECIAL THANKS

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