Available online at www.sciencedirect.com
SCIENCE DIRECT®
C. R. Geoscience 335 (2003) 933–934
COMPTES RENDUS GEOSCIENCE

Perspective

Importance of the maintenance of temporary ponds in arid climates for the recharge of groundwater

Ghislain de Marsily

Laboratoire de géologie appliquée, UMR Sisyphe, université Pierre-et-Marie-Curie, Paris-6, B123, 4, place Jussieu, 75252 Paris cedex 05, France

In a recent article in *Comptes rendus Geoscience*, Martin-Rosales and Leduc [3] report on their observations of the dynamic behaviour of a large temporary pond in Southwest Niger, at Banizoumbou. This is an endorheic area, where runoff accumulates in a series of ponds, occasionally connected by temporary streams, in case of heavy storms; the water then disappears through infiltration and evaporation. Favreau et al. [2] have already described the general hydrological functioning of such systems and found that recharge to the aquifers is presently increasing, as shown by the rising water levels in the aquifers, despite the observed reduction of rainfall in the region over the last 30 years. This phenomenon was reported as early as the mid seventies or early eighties, e.g., by Albergel [1]. This is explained by an increase in runoff due to a more intensive agricultural exploitation of the soil, reducing its natural protection by the endemic vegetation, and leaving it uncovered a longer portion of the time. This increase in runoff also increases erosion and sediment transport. In the same region, Taupin et al. [4] have examined the spatial and temporal variability of the isotopic composition of rainfall and of groundwater, from which they were able to provide estimates of recharge, and to confirm its increase through pond infiltration, over the last decades.

The role of ponds in increasing aquifer recharge has been known for a long time, and it is reported that they were used already in Roman times, e.g., in North Africa. In southern India, for instance, each small stream is most of the time cut by a very ancient small earth dam, called Erys, which fills up during the monsoon, and dries out in the dry season. The water is used for irrigation downstream, but also infiltrates through the bottom of the small reservoir, and recharges the aquifer below, which is exploited by wells. Before the British colonisation, these structures were maintained by the local communities, and the silt that accumulated in the reservoirs was removed and used either for making bricks or as fertilisers in the fields. This maintenance has slowly been abandoned, and the Erys are now almost totally impervious. Because of the present increased use of groundwater for irrigation, the water levels in the aquifers are dropping, and several programmes have been set up by the Government of India to restore the infiltration in the Erys, by removing the silt every year.

The findings by Martin-Rosales and Leduc [3] are interesting because they address the issue of the silting of these ponds. In the case that they have studied, the emptying of the pond by infiltration is initially rapid, for any given year, but diminishes over time, at each new rainfall event, due to the increasing silting of the pond. However, in this arid climate, once the rainy season is over, the ponds become empty and the silt dries and is removed by wind erosion from the outer ring of the pond, but not from its centre, where it is too thick and where the clogging by fine sediments is permanent. Bricks are also made out of these sediments, but only a small fraction of the yearly sediment input is removed this way. The following year, infiltration into this outer ring is possible, and the initial recharge to the aquifer is rapid again, despite the absence of any

E-mail address: gdm@ccr.jussieu.fr (G. de Marsily).

1631-0713/$ – see front matter
doi:10.1016/j.crte.2003.10.001

artificial desilting by man. However, over an observation period of 7 years, the authors found a constant but slow decrease of the recharge rate, most likely due to insufficient natural desilting by the wind.

With the increased demand for groundwater and the likely reduction of rainfall in most semi-arid areas due to the greenhouse effect, it is of utmost importance to manage the hydrological cycle for optimal use of the resources. Increasing the recharge to the aquifers by a better management of the ponds (whether natural or man-made) will have to include the control of erosion (to slow down the accumulation of silt in the ponds) but also artificial silt removal, if the natural process of wind erosion as observed by Martin-Rosales and Leduc [3] is not efficient enough.

References

[1] J. Albergel, Sécheresse, désertification et ressources en eau de surface – Application aux petits bassins versants du Burkina Faso, in: The influence of climate change and climatic variability on the hydrologic regime and water resources, Proc. Vancouver Symposium, IAHS Publ. No. 168, 1987, pp. 355–365.

[2] G. Favreau, C. Leduc, C. Marlin, A. Guéro, Une dépression piézométrique naturelle en hausse au Sahel (Sud-Ouest du Niger), C. R. Geoscience 334 (2002) 43–54.

[3] W. Martin-Rosales, C. Leduc, Dynamiques de vidange d'une mare temporaire au Sahel : exemple de Banizoumbou (Sud-Ouest du Niger), C. R. Geoscience 335 (2003) 461–468.

[4] J.-D. Taupin, G. Gaultier, F. Favreau, C. Leduc, C. Marlin, Variabilité isotopique des précipitations sahéliennes à différentes échelles de temps à Niamey (Niger) entre 1992 et 1999 : implication climatique, C. R. Geoscience 334 (2002) 43–50.