

Characterization of shallow unconsolidated aquifers in West Africa using different hydrogeological data sources as a contribution to the promotion of manual drilling and low cost techniques for groundwater exploration

Fabio Fussi (1), Letizia Fumagalli (1), Tullia Bonomi (1), Cheikh H. Kane (2), Francesco Fava (1), Biagio Di Mauro (1), Barry Hamidou (3), Magatte Niang (4), Souleye Wade (4), and Roberto Colombo (1)

(1) University of Milano Bicocca, Department of Environmental and Earth Science, Milano, Italy (fabio.fussi@usa.net), (2) University of Thies, Senegal, (3) SNAPE (Service National de Point d'Eau), Guinea, (4) Université Cheik Anta Diop Dakar, Senegal

Manual drilling refers to several drilling methods that rely on human energy to construct a borehole and complete a water supply (Danert, 2015). It can be an effective strategy to increase access to groundwater in low income countries, but manual drilling can be applied only where shallow geological layers are relatively soft and water table is not too deep. It is important therefore to identify those zones where shallow hydrogeological conditions are suitable, investigating the characteristics of shallow porous aquifers.

Existing hydrogeological studies are generally focused in the characterization of deep fractures aquifers, more productive and able to ensure water supply for large settlements. Information concerning shallow porous aquifers are limited.

This research has been carried out in two different study areas in West Africa (North-Western Senegal and Eastern Guinea). Aim of the research is the characterization of shallow aquifer using different methods and the identification of hydrogeological condition suitable for manual drilling implementation.

Three different methods to estimate geometry and hydraulic properties of shallow unconsolidated aquifers have been used:

The first method is based on the analysis of stratigraphic data obtained from borehole logs of the national water point database in both countries. The following steps have been implemented on the original information using the software TANGAFRIC, specifically designed for this study: a) identification of most frequent terms used for hydrogeological description in Senegal and Guinea database; b) definition of standard categories and manual codification of data; c) automatic extraction of average distribution of textural classes at different depth intervals in the unconsolidated aquifer; d) estimation of hydraulic parameters using conversion tables between texture and hydraulic conductivity available in the literature.

The second method is based on the interpretation of pump and recovery test in large diameter wells. K values obtained from these tests provide direct information on hydraulic parameters of shallow porous aquifers (while pump tests data obtained from deep mechanized boreholes, exploiting fractured aquifers, cannot be considered representative for the target shallow aquifer of manual drilling).

The third method is based on the interpretation of stratigraphic logs and simplified pump test from manual drilled wells carried out since 2012 in Guinea. In this country a standard and systematic procedure to collect hydrogeological data from these wells (therefore indicating properties of shallow aquifer) has been put in place in 2011; it is considered one of the best example worldwide about technical data collection and systematization from manual drilling activities, but its development has been stopped because of the outbreak of Ebola in this country.

The integration of these 3 methods allow to estimate geometry and hydraulic behavior of shallow unconsolidated aquifer, identifying those areas where manual drilling is feasible and estimating potential yield that can be extracted.

In the mean time this research provides relevant indications concerning the use of data obtained from low cost open hand dug or manually drilled wells (rarely used in hydrogeological research) for groundwater explo-

ration of shallow aquifers.