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Tangafric: a software for the estimation of textural and hydraulic properties in shallow aquifers from well logs in Senegal and Guinea

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Background
In order to increase access to drinking water in Africa there is more and more interest in the promotion of manual drilling techniques, without need of expensive drilling equipment, but they can be applied only in those areas with suitable hydrogeological conditions: thick layers of unconsolidated sediments and shallow groundwater level. Mapping of suitable zones for manual drilling at national level in Africa is a crucial activity and local institutions and UNICEF are implementing specific programs for its promotion, but the limitation in available data concerning shallow hydrogeological aquifers are limited.

The research has been developed in the project "Use of remote sensing and terrain modeling to identify suitable zones for manual drilling in Africa and support low cost water supply", within the scientific cooperation between the University of Milano-Bicocca, Universite' Cheick Anta Diop (Dakar Senegal) , SNAPE - Service Nationale de Points d'Eau (Conakry Guinea), UNICEF Senegal and UNICEF Guinea. The project is funded by NERC (National Environmental Research Council, UK).

Objective of the research:
The presented work is only the starting point of the project aiming to elaborate an automatic procedures to manage and improve the existing database of borehole logs in Senegal and Guinea for the interpretation of shallow hydrogeological conditions and identification of suitable zones for manual drilling, in two pilot areas: Louga (Northwestern Senegal) and Faranah/Kankan (Eastern Guinea). Within the objective of the project is also considered the integration of Remote Sensing to support hydrogeological interpretation, especially where borehole logs are not present.

Methodology
Focus is to create a hydrogeological database, TANGAFRIC, to organize, codify and elaborate hydrogeological data. The metodology derives from the software TANGRAM (www.tangram.samit.unimib.it) produced by the University of Milano Bicocca, with innovative aspect of stratigraphic data codification, quantification and processing, connected to a hydraulic conductivity value associated to each primary lithology.

Results
Starting from the database of borehole logs available at national level in Senegal and Guinea (about 1400 borehole logs in Senegal and 800 in Guinea, with 20000 definitions), their structure and information have been compared and a new common database has been set up; it has a consistent structure with the structure of existing national database and data can be easily imported and exported.
From this joint, the new software TANGAFRIC has been created with different purposes:
-to organize in the same way wells data, since the two countries have different administrative divisions (ID code, name of village, district, regions, coordinates);
-to add new wells data, not existing in the previous databases;
-to codify the stratigraphic layer of each well logs with a 5-digit alphanumeric codes, using a list of categories describing texture, status and color or each layers, identified from the most recurrent lithological classes and attributes;
-to attribute a specific value of hydraulic conductivity to each texture, from well data, field pumping test, bibliographic review.

TANGAFRIC includes one module for data input and a second module to process the data, and extract specific parameters concerning mean texture, hydraulic conductivity and transmissivity in selected depth ranges. This is made possible by attributing a weight to the digits of the code for textures. The program calculates the percentage of the chosen lithology, as related to each individual layer, and also a weighted average of hydraulic conductivity.

It has been possible to produce maps showing the distribution of main texture classes, thickness of saturated unconsolidated sediments and expected transmissivity. Furthermore, these parameters have been used to estimate the suitability for manual drilling under the hydrogeological coniditions described in each borehole logs.