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Integration of Remote Sensing and other public GIS data source to identify suitable zones for groundwater exploitation by manual drilling

Fabio Fussi (1), Francesco Fava (1), Biagio Di Mauro (1), Tullia Bonomi (1), Letizia Fumagalli (1), Margherita DI Leo (2), Cheik Hamidou Kane (3), Gayane Faye (4), Magatte Niang (4), Souleye Wade (4), Barry Hamidou (5), and Roberto Colombo (1)

(1) University of Milano Bicocca, Remote Sensing of Environmental Dynamics Laboratory, Department of Environmental and Earth Science, Milano, Italy (fabio.fussi@usa.net), (2) European Commission, Joint Research Centre, Italy, (3) University of Thies, Senegal, (4) University Cheik Anta Diop – Dakar, Senegal, (5) SNAPE (Service National de Points d'Eau) - Conakry, Guinee

In several countries of the world the situation of water supply is still critical, far from the international target defined by United Nations for 2015 (Millenium Development Goals) and producing a huge impact on health and living condition of the population.
Manual drilling (it means techniques to drill boreholes for water using human or animal power) is well known and practiced for centuries in many countries. In recent years, it has been considered a potential strategy to increase water access in poor countries and has raised the attention of national governments and international organizations.

Manual drilling is applicable only where hydrogeological context is suitable, according to the following conditions: thick layers of unconsolidated sediments and shallow water table. Mapping of zones with suitable hydrogeological context has been carried out in several countries in Africa, but the results have evident limitations; previous methods are based on existing direct data and qualitative experience, leading to unreliable interpretation when direct data are limited.

This research aims to develop a methodology to estimate shallow hydrogeological features and asses the distribution of suitable zones for manual drilling through the integration of indirect information obtained from remote sensing and other existing source of data.

The research is carried out in two different study areas, in Senegal and Guinea (Western Africa), with semi-arid climate, moderate vegetation cover, unconsolidated sandy and clay deposits overlaying sedimentary and igneous rocks

A set of variables have been obtained through processing of three categories of data, listed below:
- geology, geomorphology, soil and land cover, obtained from existing thematic maps;
- vegetation phenology, apparent thermal inertia, and soil moisture, obtained from analysis of multitemporal optical (MOD13Q1), thermal (MOD11A1), and radar (ASAR) remotely sensed data:
-morphometric parameters, obtained from public digital elevation models available (ASTER GDEM and SRTM).

These variables have been combined using multivariate statistical methods (e.g. regression and classification trees) in order to study their relationship with hydrogeological parameters of shallow layers (namely thickness of porous aquifer, hydraulic conductivity and depth of water table) and estimate the suitability for manual drilling. Direct hydrogeological data in selected points obtained from semiautomatic analysis of stratigraphic borehole logs have been used in the definition and validation of the model.
The results obtained demonstrate the potential of the proposed methodological approach to improve the estimation of manual drilling suitability using public data, widely available worldwide. Therefore, it has considerable potential to be replicated in other countries with limited costs.
Furthermore, the maps of suitable zones for manual drilling produced in this research can help the promotion of this technique in Senegal and Guinea by different national and international organizations involved in water supply programs.

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