A Manual Pumping Test Method for Characterizing the Productivity of Drilled Wells Equipped with Rope Pumps

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Since the introduction of the rope-pump in Nicaragua in the 1990s, the dependence on wells in rural areas has grown steadily. However, little or no attention is paid to rope-pump well performance after installation. Due to financial restraints, groundwater resource monitoring using conventional testing methods is too costly and out of reach of rural municipalities. Nonetheless, there is widespread agreement that without a way to quantify the changes in well performance over time, prioritizing regulatory actions is impossible. A manual pumping test method is presented, which at a fraction of the cost of a conventional pumping test, measures the specific capacity of rope-pump wells. The method requires only slight modifications to the well and reasonable limitations on well useage prior to testing.

The pumping test was performed a minimum of 33 times in three wells over an eight-month period in a small rural community in Chontales, Nicaragua. Data was used to measure seasonal variations in specific well capacity for three rope-pump wells completed in fractured crystalline basalt. Data collected from the tests were analyzed using four methods (equilibrium approximation, time-drawdown during pumping, time-drawdown during recovery, and time-drawdown during late-time recovery) to determine the best data-analyzing method. One conventional pumping test was performed to aid in evaluating the manual method. The equilibrim approximation can be performed while in the field with only a calculator and is the most technologically appropriate method for analyzing data. Results from this method overestimate specific capacity by 41% when compared to results from the conventional pumping test. The other analyes methods, requiring more sophisticated tools and higher-level interpretation skills, yielded results that agree to within 14% (pumping phase), 31% (recovery phase) and 133% (late-time recovery) of the conventional test productivity value. The wide variability in accuracy results principally from difficulties in achieving equilibrated pumping level and casing storage effects in the pumping/recovery data. Decreases in well productivity resulting from naturally occurring seasonal water-table drops varied from insignificant in two wells to 80% in the third. Despite practical and theoretical limitations on the method, the collected data may be useful for municipal institutions to track changes in well behavior, eventually developing a database for planning future ground water development projects. Furthermore, the data could improve well-users' abilities to self regulate well usage without expensive aquifer characterization. "