Geostatistical cokriging and multivariate statistical methods to evaluate groundwater salinization in Faisalabad, Pakistan

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A B S T R A C T

In the present study, multivariate techniques and geostatistical cokriging were used to look into the groundwater salinization of district Faisalabad. The groundwater condition of district Faisalabad has become miserable because of the rapid increase in population, industrial wastes, and agrochemical application. As a result, majority of the people do not have access to pure drinking water and, consequently, polluted water is causing many deaths per year. A number of 220 water samples based on instructions of World Health Organization (WHO) were taken from four main sources such as hand pump, injector pump, tube well, and water supply. All samples were tested for 12 water quality parameters and summary statistics were calculated to compare the water quality parameters with WHO permissible limits. Initially, correlation matrix was constructed to evaluate the most significant parameters and later on used principal component analysis (PCA) to select those parameters causing maximum variation. Dendrogram based on cluster analysis conveyed same sort of information as delivered by PCA. First, factor of PCA contributed 41.6% of total variation. Six water quality parameters such as sulfate, calcium, total dissolved solids, sodium, chloride, and magnesium were found to be most alarming because all of these have factor loadings greater than 75%. Cross-variogram based on cokriging showed spatial dependence as well as positive pairwise spatial correlation among all parameters. The prediction maps highlighted the most dangerous and health hazard areas; therefore, may be very helpful for water management agencies to target those high-risk areas. It was found that the area with east latitude 31.0°–31.4° and north longitude 72.8°–73.2° is most alarming zone.

Keywords: Spatial dependence; Health effects; Drinking water; Dendrogram; Cross-variography

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