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APPLICATION OF FACTOR ANALYSIS IN GROUNDWATER CLASSIFICATION IN NEETIYAGAMA, ANURADHAPURA

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Groundwater is generally free from pathogens but contains chemical pollutants—high salinity and fluoride in groundwater result from geogenic factors. Therefore, groundwater classification is highly desired. Piper trilinear diagrams based on major ions in water are conventionally used to elucidate different water types. The major limitations of this method are: a) classification is made using major ionic species, b) only fourteen water types can be identified, and c) chemical species cannot be accounted for the classification. This study aimed to develop an improved geochemical classification method to address these limitations. We developed a classification based on multivariate statistics that can include water quality parameters without imposing an upper limit. R-mode factor analysis has proven highly effective in studies of groundwater quality. The technique can identify the hidden factors behind observed variables. We collected thirty-six groundwater samples from Neetiyagama village (X-181018, Y-347127 Anuradhapura) in the dry season to determine major and minor constituents in water by ICP-OES, IC and multi-parametric analyzer. Groundwater types were classified using Piper diagrams, and factor analysis was performed for only major ions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^{-}, Cl^{-}, SO_4^{2-}) by R studio 3.4.3. The correlations among the major ions were analysed using Bartlett's test of sphericity and identified the significant correlations. The four-factor model was suggested based on the Parallel Analysis. After rotating the factors, the final factor model with respective ion concentrations was selected and mapped. Factor 1: Ca^{2+}, Mg^{2+}, HCO_3^{-}, Cl^{-}, Factor 2: Na^{+}, Factor 3: K^{+}, and Factor 4: Ca^{2+} and SO_4^{2-}. Piper diagram classification also showed that four water types are predominant in this area (NDC -HCO_3 – 50%, Ca-HCO_3 – 44%, Mg- HCO_3 – 3%, Na+K- HCO_3 – 3%). Both classifications prove that Ca^{2+}, Mg^{2+}, Na^{+}, K^{+} are the major ions controlled by the water chemistry in this area and are mainly influenced by basement geological conditions.

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Keywords: Factor analysis, Groundwater, Multivariate classification, Piper trilinear diagrams