

Assessment of Heavy Metals Contamination Levels in Groundwater: A Case Study of the Bafia Agricultural Area, Centre Region Cameroon

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Abstract : Groundwater is the major water resource in the whole of Bafia used for drinking, domestic, poultry and agricultural purposes, and being an area of intense agriculture, there is a great necessity to do a quality assessment. Bafia is one of the main food suppliers in the Centre region of Cameroon, and so to meet their demands, the farmers make use of fertilizers and other agrochemicals to increase their yield. Less than 20% of the population in Bafia has access to piped-borne water due to the national shortage, according to the authors best knowledge very limited studies have been carried out in the area to increase awareness of the groundwater resources. The aim of this study was to assess heavy metal contamination levels in ground and surface waters and to evaluate the effects of agricultural inputs on water quality in the Bafia area. 57 water samples (including 31 wells, 20 boreholes, 4 rivers and 2 springs) were analyzed for their physicochemical parameters, while collected samples were filtered, acidified with HNO₃ and analyzed by ICP-MS for their heavy metal content (Fe, Ti, Sr, Al, Mn). Results showed that most of the water samples are acidic to slightly neutral and moderately mineralized. Ti concentration was significantly high in the area (mean value 130µg/L), suggesting another Ti source besides the natural input from Titanium oxides. The high amounts of Mn and Al in some cases also pointed to additional input, probably from fertilizers that are used in the farmlands. Most of the water samples were found to be significantly contaminated with heavy metals exceeding the WHO allowable limits (Ti-94.7%, Al-19.3%, Mn-14%, Fe-5.2% and Sr-3.5% above limits), especially around farmlands and topographic low areas. The heavy metal concentration was evaluated using the heavy metal pollution index (HPI), heavy metal evaluation index (HEI) and degree of contamination (Cd), while the Ficklin diagram was used for the water based on changes in metal content and pH. The high mean values of HPI and Cd (741 and 5, respectively), which exceeded the critical limit, indicate that the water samples are highly contaminated, with intense pollution from Ti, Al and Mn. Based on the HPI and Cd, 93% and 35% of the samples, respectively, are unacceptable for drinking purposes. The lowest HPI value point also had the lowest EC (50 µS/cm), indicating lower mineralization and less anthropogenic influence. According to the Ficklin diagram, 89% of the samples fell within the near-neutral low-metal domain, while 9% fell in the near-neutral extreme-metal domain. Two significant factors were extracted from the PCA, explaining 70.6% of the total variance. The first factor revealed intense anthropogenic activity (especially from fertilizers), while the second factor revealed water-rock interactions. Agricultural activities thus have an impact on the heavy metal content of groundwater in the area; hence, much attention should be given to the affected areas in order to protect human health/life and thus sustainably manage this precious resource.

Keywords : Bafia, contamination, degree of contamination, groundwater, heavy metal pollution index

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