Chapter 4
Fluoride Contaminated Groundwater

ABSTRACT

In this chapter, the authors explore Fluoride (F) in groundwater as a major issue of water pollution. Geo-statistical analysis of groundwater quality in Newai Tehsil (India) has been done in order to identify the possible spatial distribution of water quality parameters and to assess the spatial dependence of water properties with the help of principal component analysis (PCA) structure. Two types of maps (spatial map and principal component map) of groundwater quality have been developed. A field experiment was conducted to investigate the effect of different Fluoride (F) concentration combined with Pseudomonas fluorescens (P.F) on Prosopis juliflora plant. The field design was used as completely randomized block design with three replicates. The study revealed that parameters were found to be positively and highly correlated with principal component. Low and high values (with their acceptable limit) have also been displayed over each spatial map. Plants treated with P. fluorescens showed the highest F uptake in root, shoot, and leaves tissues were 33.14, 19.41, and 15.15 mg kg^{-1} after 120 days, respectively. Both total bioaccumulation factor (BF) and translocation factor (TF) were obtained above one (i.e., 1.06 and 1.04). This confirmed the high accumulation and translocation of F in plant tissues. The F uptake efficiency of plant was enhanced to 67.7%, and plant biomass was increased to 57.03%. The present study will be beneficial for researchers working towards further improvement of F phytoremediation technology.

DOI: 10.4018/978-1-5225-9016-3.ch004

INTRODUCTION

Fluoride (F) contamination is a worldwide problem and severely affected by high F concentration, including India (Singh et al., 2018). About 260 million people worldwide are affected by F contamination (Amini et al., 2008; Banerjee, 2015; Kumari and Khan, 2017; Chaudhary et al., 2019). In India, Rajasthan state is the most severely affected from high F contamination in water and soil (Hussain et al., 2010; Saini et al., 2013). Dental and skeletal fluorosis is the most common effects of F contaminated water on human health and still there is no cure reported for it. F contamination also affect fetus, cerebral function, reduced intelligence in children and damages neurotransmitters (Xiang et al., 2003). The permissible limit for F in drinking water is specified by the World Health Organization as 1.5 mg L^{-1} (WHO, 2008). Fluoride is present in groundwater basically in the form of fluorite-CaF_2, cryolite-Na_3AlF_6 and fluor-apatite-$Ca_5(PO_4)_3F$, (Rao, 2009; Raj and Shaji, 2017). The fluorite and fluorapatite (FAP) are generally formed which is considered as groundwater fluoride contamination (Reddy et al., 2010). The calcite precipitation can be an enhanced dissolution of fluorite and fluorapatite (FAP) by the following reaction $CaCO_3 + 2F^- + H^+ = CaF_2 + HCO^-_3$. Fluoride has low mobility in soils and does not accumulate in upper soil horizons, but in slightly acidic soils, it is more soluble and shows greater leaching (Nowak, 2002; Amini et al., 2008). The large amount of F tend to accumulate in soil, which has an unfavorable impact on agricultural production (Chaudhary and Khan, 2016; Thapa et al., 2017).

Fluoride in groundwater is a serious problem (Crevecoeur et al., 2011). Groundwater is the most valuable fresh water used for drinking purposes in different areas. Irrigation is one primordial sector in India where one third of land surface falls under arid and semi-arid climate and rainfall is seasonal and erratic. Semi-arid climate prevailing in Tonk district necessitates the characterization of groundwater quality for optimizing its use in irrigation as well as in domestic consumption. The majority of underground water contains high concentration of salts and their continuous use adversely affects soil, animal and plant health, thereby crop production (Shahid et al., 2008). Geo-informatics technologies help in achieving goals viz. mapping of groundwater contamination and its availability and encompassing the modern tools of remote sensing (RS), Geographic information system (GIS), and Global positioning system (GPS) (Marwah, 2003; Magesh et al., 2012). In India, GIS has been introduced in various fields like optimizing land use plans, characterization

Ecosystem Services-Climate-Health Associations: Water-Climate-Leishmaniasis Nexus in an Endemic Focus of Zoonotic Cutaneous Leishmaniasis

Ahmed Karmaoui, Siham Zerouali, Ashfaq Ahmad Shah, Mohammed Yacoubi-Khebizaand Fadoua El Qorchi (2019). *Climate Change and Its Impact on Ecosystem Services and Biodiversity in Arid and Semi-Arid Zones (pp. 280-290).*
www.irma-international.org/chapter/ecosystem-services-climate-health-associations/223767