

Statement of Purpose

Rahul Garg

Growing up in a semi-arid town of Rajasthan, India, scarcity of clean drinking water was part and parcel of my daily life. In summers, I would often notice a salt-like white layer deposit on our desert cooler, and we had to replace it every year because of its severe rusting. I also watched my mother using Alum (Fitkari in Hindi) to purify our drinking water which I later learned was a sound method for fluoride removal. Observations such as these fueled my curiosity about the subsurface processes and inspired me to pursue a career that let me explore the evolution of rocks and the accumulation of fluids beneath the ground.

The undergraduate and graduate studies in Geology at the two most prestigious institutes in India provided me with a solid educational foundation to build upon and trained me in many quantitative and qualitative tools required for an aspiring hydrogeologist. The lab classes and the extensive fieldwork effectively added to my arsenal of analytical tools. Among all branches of geology, I am inclined towards hydrogeology because of its vast interconnectivity with societal and environmental problems. The groundwater classes by Dr Abhijit Mukherjee and geochemistry classes by Dr Ravikant Vadlamani were truly enlightening for me as the hydrological system analysis and the nuanced way of using stable isotopes in environmental modeling respectively taught me a new way of investigation. The knowledge acquired put tested in the prestigious Graduate Aptitude Test for Engineering(GATE) Geology examination, where I achieved All India Rank 08 among 5000 graduate students.

In the past few years, I have worked on several projects including my master's thesis under the supervision of Dr Abhijit Mukherjee on Multi-criteria decision analysis of potential groundwater zones using geospatial technologies for which I extensively worked on Remote Sensing and GIS tools. The findings uncovered the immense role of lineaments on groundwater availability in the region. Part of this work is published in the AGU Fall 21 meeting. Besides, I familiarized myself with visualizing terrestrial water storage anomalies using satellite gravimetry and surface hydrological modeling. The satisfaction I felt in overcoming the challenges of the project is unmatched and this has motivated me to pursue graduate studies.

Currently, I am working on a groundwater salinity problem in the semi-arid region of Mewat, Haryana. I started with major cation and anions analysis of groundwater samples then plotted several hydrochemical plots (Gibbs, Piper, correlation matrix, bivariate plots), used PHREEQC to calculate saturation indices of equilibrating phases, and established the relation between origin and geochemical evolution of salinity with regional geology. I have written up a manuscript on our findings in this research and submitted it to the Urban Climate journal for peer review in January 2022. Moreover, I am experimenting with the Aquifer Storage and Recovery (ASR) method to remediate aquifer salinization. I have also written a book chapter on this which is under cycles of revision.

I wish to pursue my doctoral studies in hydrogeology, precisely, I want to address the global and regional scale problem of water scarcity, quality, and associated hazards; and how evolving global phenomena like climate, geology, and population exacerbate the disparate hydrological budget and groundwater quality in varying spatio-temporal scales. My educational background and spectrum of experience in groundwater research enabled me to adopt an interdisciplinary approach combining analytical chemistry, groundwater modeling, geospatial tools, and data science to effectively tackle a research problem. I have closely worked with Dr Abhijit Mukherjee during my masters thesis and is also my mentor after graduation. His work in Arsenic geochemistry and alleviating the water problem in the Bengal basin greatly shaped my professional aspiration and outlook towards research and the water crisis in India. My interaction with Dr David Polya was really insightful, I understood the grievance threat of emerging contaminants and how developing countries like India are more vulnerable. His work on groundwater geochemistry worldwide is breathtaking. I am confident that my desire to study hydrogeology would be best sufficed under the tutelage of Dr Abhijit Mukherjee and Dr David Polya.

The unique structure of the Indian Institute of Technology, Kharagpur - University of Manchester Joint PhD program will allow me to address some fundamental questions in hydrogeology. The joint supervision from both universities will provide me with the opportunity to explore wide research topics, adopt an interdisciplinary approach, and work with like-minded people whose interests resonate with mine. The graduate program will be a stride forward in my future goal to become a researcher and professor in the field of hydrogeology. After my PhD, I would like to undertake post-doctoral studies to gain the expertise to lead an independent research group before applying as an assistant professor in a university.