Examining the Effects of Fracking on Groundwater: A Comprehensive Data Analysis of the United States Fracking Well Data Nationwide

William Lin, Belmont High School, Belmont, MA
Faculty Advisor: Magaly Koch, Boston University

Abstract:

Ever since fracking technology, drilling downward and then horizontally, has been developed to extract oil and gas from underground bedrock, the number of fracking wells has been drilled at an accelerating speed, and the amount of underground water consumed has also increased enormously. The goal of this paper is to address this alarming environmental and climate threat from the proliferation of fracking wells, accompanied by a surge in groundwater consumption, through analyzing the up-to-date registry data available as of October 2023 from FracFocus.org on the fracking wells nationwide. The paper starts with a literature review to study the existing research findings on fracking water consumption issues. Next, it provides a comprehensive data analysis of the water consumption by fracking wells at both national and state levels. It also explores the relationships between the water consumption with various other factors such as the vertical depth of the wells, the chemical ingredients of the fracking fluid, and the purposes of the additives, and aims to provide insights from the correlation and causality analyses that may offer potential strategies to reduce groundwater consumption in the fracking industry. In addition, the paper employs machine learning techniques such as the Random Forest model to explore using predictive models to identify wells that have a high likelihood of causing a water contamination issue so that proactive controls can be developed to reduce the occurrence of water quality issues.

The research identified that the significant use of large quantities of water for hydraulic fracturing in some areas may severely impact drinking water availability and even cause drought near fracking wells. Machine learning techniques identified positive correlations between the vertical depth of the well and the base water volume consumed, as well as with ingredients such as acid, alcohol, ethoxylated, silica, petroleum, and crystalline. Conversely, negative correlations are found between base water consumption and factors such as percent high additive, sodium, salt, quartz, glycol, and methanol. While hydraulic fracturing (fracking) has brought substantial economic benefits to the United States, it has concurrently posed significant environmental and climate threats, primarily from excessive and surging water consumption and water contamination due to the chemical ingredients used in fracking fluids.