**The Intrinsic Vulnerability of Groundwater to Contamination in the Midwest and the Associated Human Health Impacts**

**INTRODUCTION**

Groundwater sources account for 20% of the United States' total water withdrawals. But more importantly, groundwater is a source of drinking water for approximately half the population, and it provides billions of gallons of water per day for agricultural use. While the rate of waterborne disease has decreased significantly due to advances in water management and sanitation, outbreaks continue to occur and the use of contaminated groundwater, often as a result of human activities, is one of the top causes of water-related diseases in the United States. Cryptosporidiosis is one of the leading causes of waterborne illness and outbreaks in the United States, with the Midwest experiencing the highest rates of outbreaks. As the United States continues to rely on groundwater as a viable source for drinking water and agriculture, it is necessary to evaluate the pollution potential of the groundwater, as well as the impact it has on the health of the population.

A common way to evaluate the contamination susceptibility of groundwater is to look through an array of intrinsic vulnerability to contamination. Intrinsic vulnerability, the intrinsic weakness of the hydrogeological system, can be calculated using the DRASIC index, which evaluates seven different variables related to pollution load: Depth to Water Table, Aquifer media, Soil media, Topography, Impact of the vadose zone media, and Hydraulic Conductivity. Aquifer media, Soil media, Topography, Impact of the vadose zone media, and Hydraulic Conductivity. Aquifer media, Soil media, Topography, Impact of the vadose zone media, and Hydraulic Conductivity. The Intrinsic vulnerability of Groundwater to Contamination

**RESULTS & LIMITATIONS**

- In North Dakota, many counties with a low number of groundwater wells are clustered in the same area as counties with a high number of cryptosporidiosis cases.
- In North Dakota, there is a notable number of counties with a high mean DRASIC TV index clustered in the same area as counties with a low number of cryptosporidiosis cases.
- Nearly all the high clustering with low number of counties with a high mean DRASIC TV index occur near the Midwest.
- The majority of counties in North Dakota, South Dakota, and Minnesota do not have significant clustering of any of the three variables.

Given these results, there is evidence of a positive spatial correlation between groundwater contamination susceptibility, the location of groundwater wells, and cryptosporidiosis cases. However, this spatial correlation between the three variables is inconsistent, as there are outliers that demonstrate a negative spatial correlation between parameters of the three variables.

Additionally, there were many limitations while conducting this analysis. The limited availability of data for both the DRASIC model and the water-borne diseases made it difficult to accurately conduct the analysis. Data was not found for the impact of the vadose zone media of the hydraulic conductivity of the aquifer, which is an important variable. Furthermore, the DRASIC variables, soil media and aquifer media data were limited to one county. Also, the cryptosporidiosis cases could not be found on a scale smaller than the county level. Obtaining the data for these variables at the county level is essential for understanding the effectiveness of the actual clustering occurring. Looking at the final DRASIC index, it is clear that there is a notable range of variation of pollution probability within each county, meaning that taking the mean IV index for each variable underestimates the actual groundwater contamination vulnerability.

**CONCLUSIONS**

In North Dakota, South Dakota, and Minnesota, there is a possible correlation between groundwater contamination susceptibility, the location of groundwater wells, and cases of cryptosporidiosis. Areas with significant clustering of these variables, such as the counties surrounding Minneapolis, Minnesota, should be focused on by local authorities to prevent contamination.

Additionally, the resulting DRASIC model of North Dakota, South Dakota, and Minnesota shows that certain areas in the Midwest are extremely vulnerable to groundwater contamination. Moving forward, it is important to do more in-depth analysis of the groundwater contamination susceptibility in the Midwest to get a clear idea of which areas need to be closely monitored for contamination. The DRASIC model is not the catch-all way to evaluate the pollution potential of groundwater, and it is necessary to combine the intrinsic vulnerability of groundwater with other aspects that influence groundwater pollution probability, such as land cover and the location of wastewater plants. With this in mind, this model identified a few good ideas of which areas in the three states need to be monitored for groundwater contamination, seeing as they are the areas most likely to negatively impact the surrounding environment and cause outbreaks of waterborne diseases, such as cryptosporidiosis.

**SOURCES**

- [Net Recharge](#)
- [Aquifer Media](#)
- [Soil Media](#)
- [Topography](#)
- [Impact of Vadose Zone Media](#)
- [Hydraulic Conductivity](#)

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References:


Map projection: NAD 1983_Albers

GISS 02: Advanced G121, Spring 2016

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GISS 02: Advanced G121, Spring 2016