



Background

At the end of the Cold War, there was a drive for natural resource exploration – specifically uranium. This exploration was heavily felt amongst the Navajo people. Although all 500+ uranium mines have been shut down for several decades, the Navajo People are still experiencing the negative impacts of uranium mining. These impacts include countless contaminated water sources, the majority of which (75%) contain detectable concentrations of uranium at least 12.5% above the maximum contaminant level (MCL). (Hoover et al. 2017)



Figure 1. Navajo miners in early 1950s operating a mucking machine.



Figure 2. Amount of Abandoned uranium mines located in each mining district on Navajo reservation. Report to Congressional Requesters.

Spiritual Connection

Due to limited rain water and desert conditions, the Navajo people rely heavily on groundwater. Limited water availability deprives crops of nutrients needed for successful production. **Naadą́q' (corn)** is one of the few crops that has thrived under these conditions.

Naadą́q' is used as a source of nourishment and is central to all ceremonial practices. It can be dried and stored for later use, allowing it to be eaten year-round. It can also be ground into powder form and mixed with water to produce traditional foods. Unmodified, it is used as a ceremonial offering to the Spirit World.



Figure 3. Dried women gathering sacred corn pollen. Harrison Begay - Adobe Gallery.

This research project examines how Naadą́q' can be used to remediate contaminated soils on the Navajo reservation.

Research Question

How can the relationship between the Navajo People and **naadą́q'** be used to address the impacts of uranium contamination on the Navajo Reservation?

Analysis



Figure 3a. Abandoned uranium Mine in Cameron District. Gabriel Suardit. On-Peison Land.



Figure 3b. Little Colorado River, West of Cameron mine. EPA 2017 November.

Uranium from abandoned mines leeches into nearby soils and waterways. The Little Colorado River, at just 0.5 miles away, is at risk of contamination. Once contaminated, the uranium continues downstream leaching into agricultural lands used especially for maize (corn) (figures 3a–3c).

Soil surrounding Cameron, Arizona is a combination of textures from coarse to fine, with slow to medium infiltration rates (figures 4a–4b). Although the rates are moderate, leaching influences the contamination radius. In medium to high infiltration rates, corn can accumulate an average of 70 mg Ukg⁻¹ in their roots based on 100 mg Ukg⁻¹ in the soil. The accumulation in roots is significantly higher compared to tissue above ground. The shoots can accumulate an average of 6.09 mg Ukg⁻¹ and 4.83 mg Ukg⁻¹ out of 100 mg Ukg⁻¹. Concentration of uranium in roots of maize in pseudogley (medium to high rates) is higher than cementum (very slow to slow rates). (see figure 5)

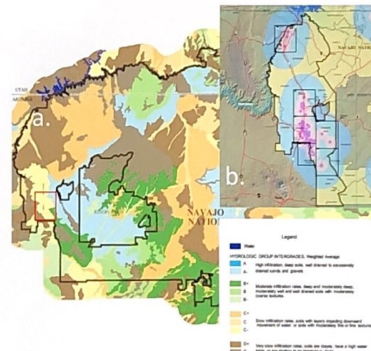


Figure 4a. Soil infiltration rates amongst the Navajo reservation. Navajo Nation AUM Screening Assessment Report and Atlas with Geospatial Data. Figure 4b. Location of abandoned uranium mines in Cameron District. Navajo Nation AUM Screening Assessment Report and Atlas With Geospatial Data.

Figure 3c. Uptake of uranium through fibrous roots of maize. Dave Carlson

Remediations

Various studies have investigated the remediation of:

- Micro-organism remediation: microbial flora feed on contaminants
 - **In situ**
 - Remediation occurs at site of contamination
 - Minimal disturbance to natural plants and wildlife
 - Preferred: contamination low and widespread
 - **Ex situ**
 - Soil removed and remediated in optimized conditions
 - Preferred: contamination medium to high and local
- Phytoremediation
 - Using a plants ability to uptake contaminants (uranium) from the soil
 - Corn successfully uptakes contaminants and can be used to decontaminate soils and waterways

Series	Element	Root %	Shoot %	Root %	Shoot %
1	U	6.12	45.81	6.98	46.91
2	U	1.8	6.29	4.92	6.95
3	U	20.04 mg Ukg ⁻¹	12.22	2.87	11.83
4	U	10.02 mg Ukg ⁻¹	22.01	1.5	17.68
5	U	1.02 mg Ukg ⁻¹	22.98	6.28	61.88
6	U	6.12	45.81	6.99	46.91
7	U	100.00 mg Ukg ⁻¹	6.26	100.00	3.29
8	U	2.00 mg Ukg ⁻¹	389.8	15.43	388.54
9	U	100.00 mg Ukg ⁻¹	13.58	100.00	10.00
10	U	1000.00 mg Ukg ⁻¹	1164.8	1000.00	100.00



Figure 6. Close up of microorganism remediation. Muckdirt. The Use of Microbes for Soil Remediation.

Conclusions

Abandoned Uranium mines have contaminated water, soil, and crops used to sustain the Navajo people. People residing within a 10 km radius have the highest risk of experiencing the impacts caused by contaminated resources.

The unique relationship between the Navajo people and corn can be used to reclaim contaminated lands caused by decades of uranium exploration on tribal lands.

Since uranium is spread throughout Navajo lands (roughly 27,000 acres) phytoremediation can be used as a cost-effective strategy that causes minimal damage to indigenous wildlife and plants.

As any remediation, phytoremediation using corn does have its drawbacks including the slow process of decontaminating the soil, disposal of contaminated crops, and convincing the Navajo people to stop using crops they planted since each planting cycle is needed.

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