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Tyren John Thompson
Portland State University

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“How Are Oregon’s Rural Indigenous Communities Overcoming Water Access Issues?”

by

Tyren John Thompson

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in
Environmental Science and Management

Thesis Committee:
Melissa Haeffner, Chair
Alida Cantor
Max Nielson-Pincus

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Abstract

This study investigates how water insecurity affects Indigenous communities in Grand Ronde, Warm Springs, and Umatilla, Oregon, through loss of clean drinking water, access to culturally significant foods, and exposure to pollution. Each community offers innovative solutions drawing on their Indigenous knowledge to overcome water supply challenges. Communities with more resources are better equipped to cope with water insecurity and environmental degradation.

Acknowledgments

Portland State University is located in the heart of downtown Portland, Oregon in Multnomah County. We honor the Indigenous people whose traditional and ancestral homelands we stand on, the Multnomah, Kathlamet, Clackamas, Tumwater, Watlala bands of the Chinook, the Tualatin Kalapuya and many other Indigenous nations of the Columbia River. It is important to acknowledge the ancestors of this place and to recognize that we are here because of the sacrifices forced upon them. In remembering these communities, we honor their legacy, their lives, and their descendants.

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1. Introduction

Indigenous communities consider water to be the first food, the food that nourishes all life. Without water, life isn't possible. Access to water is an important cornerstone to modern society, however, access to clean drinking water is not universally enjoyed by all; current estimates point to around 700 million individuals not having basic access to water as of 2023 (UNICEF, 2023). These burdens of water insecurity are not evenly distributed throughout communities either; women, children and marginalized communities often face greater challenges with accessing water, and face worse outcomes due to unequal access to clean water (UNICEF, 2023).

These inequalities are likely to be exacerbated by climate change, which is an environmental injustice (IPCC, 2022). In addition to globally rising temperatures, climate change is altering the temporal and spatial distribution of water (IPCC, 2022). The changes in timing and distribution of water can lead to instances of more severe droughts and flash floods, which means more unstable, unreliable and contaminated water sources for communities globally (IPCC, 2022). Despite the effects of climate change and social inequality being globally distributed, there persists a myth that water insecurity issues are only a concern for the Global South (Meehan et al., 2020). Within the Global North, marginalized communities which include rural Indigenous communities, are more likely to experience water access issues such as a lack of reliable drinking water, than other communities (Meehan et al., 2020; Census, 2020).

Marginalized communities such as Indigenous communities are commonly at the forefront of experiencing the negative effects of climate change, which is another way that these communities experience environmental injustices; despite this, Indigenous communities often see themselves as protectors of the environment (McGregor et al, 2020; IPCC, 2022). In the 2022 Intergovernmental Panel for Climate Change (IPCC) report, the IPCC outlines the risks marginalized communities like Indigenous communities face from unmitigated climate change, and makes suggestions for adaptations to climate change. it is important for Indigenous communities to be able to contribute their place based knowledge and understanding of the environment to adapt to climate change in ways that make sense for their communities and culture (McGregor, 2020)

This research seeks to document some of the Indigenous knowledge surrounding water in the state of Oregon by asking the research question "How are Oregon's rural Indigenous communities overcoming water access issues"? This research also seeks to understand how these local Indigenous tribes understand water culturally and how they overcome water insecurity issues within their communities.

To contribute to a growing body of literature on all matters of water insecurity, this research will focus on the understudied communities of Oregon's rural Indigenous communities. This research will highlight the specific place based Indigenous perspectives and knowledge on these issues, and will examine how three Indigenous communities, the Warm Springs, The Umatilla and Confederated Tribes of the Grand Ronde are overcoming issues such as water scarcity, drought and plumbing poverty. This

research will specifically look at how these communities are overcoming these issues by examining how and where water issues are learned about, and what resources are available to each community for overcoming these challenges.

2. Literature Review

2.1. Social learning about water

To best answer the research question, "How are Oregon's rural Indigenous communities overcoming water access issues?"It is important to analyze how individuals understand water access issues and where they learn about these issues. It is also important to analyze the varying solutions that participants describe for overcoming these water access issues, which includes understanding where participants learned about their solutions. A theory that can be applied to this analysis would be Social Learning Theory by Albert Bundura.

Social learning is a theory for analyzing how individuals subconsciously and consciously learn (Bandura, 1977). In the context of this research and research question, social learning theory is learning by observing other people with the goal of adapting one's behavior in social contexts (Bandura, 1977). Individuals are influenced subconsciously and consciously to adopt behaviors that garner the least amount of criticism in their social environments (Bandura, 1977). According to the theory of social learning, individuals use this technique to adopt the behaviors of another person who has been successful in order to attempt to achieve the same desired outcomes (Bandura, 1977). While social learning can be associated with learning specific content, it actually encompasses a much larger process we subconsciously undergo every day of

our lives (Bandura, 1977); some examples of this include motivation, work ethic, perspectives, and skills (Bandura, 1977).

Understanding the processes of learning within a community is important in this research for a few reasons. The first is to understand the communities specific values and perspectives on water, which is important for understudied communities like Indigenous communities because their values and perspectives are often not included in research studies or policy making decisions (Meehan et al., 2020). Secondly, how and where individuals learn about their adaptations to water access issues is important for policy makers and researchers as behaviors learned through social environments can have a circular impact on those communities, and other communities in similar situations can be influenced to act similarly (Bandura, 1977).

2.2. Capital

To further improve the analysis of how individuals and communities are overcoming water access issues in the state of Oregon, it is important to add the analytical lens of individual and communities resources. Resources such as social, cultural and economic can heavily influence how an individual or community responds to crisis and situations (Bourdieu, 1986). A theory that can be used to analyze community and individual resources is the theory of the Forms of Capital by Pierre Bourdieu.

Forms of Capital is a theory by Pierre Bourdieu that describes three forms of capital, social, cultural and economic, which can all be exchanged for one another through various means (Bourdieu, 1986). The first capital, social capital, is defined as the aggregate of the actual or potential resources which are linked to a durable social network or institutionalized relationships, which can be mutual acquaintances or social recognition (Bourdieu, 1986). Social capital also describes memberships to particular groups, institutional or not, that provide each individual member with access to the collectively owned capital of that group; group membership also gives individuals "credentials", which also entitles them to the credit, in the various senses of the word (Bourdieu, 1986).

Cultural capital can exist in three forms: in the embodied state, i.e., in the form of long-lasting dispositions of the mind and body; in the objectified state, the form of cultural goods (stories, books, dictionaries, instruments, heirlooms, etc.); and in the

institutionalized state, such as educational qualifications, which confer original properties on the cultural capital which it is presumed to guarantee (Bourdieu, 1986).

Economic capital is capital that is immediately and directly convertible into money and may be institutionalized in the form of property rights (Bourdieu, 1986). Economic capital can be characterized as instruments like cash, bonds, real estate and other financial assets which can be converted into other financial assets or other forms of capital, such as cultural or social capital (Bourdieu, 1986).

One way that the forms of capital operate in an individual's lives is through the constraints placed on individual action and choices due to the amount of capital available to them (Bourdieu, 1986). Those restrictions and constraints can be described using the sociological perspective of agent versus structure; in which the agent is thought of as the individual who holds the capacity to act individually, however, they are constrained by the structures of society in their decision-making (Stone, 2015). Structure is the organization of society that is reoccurring, and is upheld by individual actions that are made within the confines of those reoccurring structures of society; in this way, the structure of society is upheld by individual actions, who are constrained by those societal structures (Stone, 2015; Bourdieu, 1986).

People can utilize their capitals to respond, cope and adapt to environmental injustices such as water shut-offs and boil orders. According to the theory of “The forms of Capital”, the more capital a person has available to them, the more equipped they are to reduce harm and pursue benefits (Bourdieu, 1986; Stone, 2015). Measuring individual capitals is common in household vulnerability and resilience studies to

understand how people use their portfolios of capitals in unique ways (Chaudhuri et al., 2002).

2.3. Environmental Injustices and water access

Environmental injustices are not felt equally by all in society; individuals of lower socioeconomic statuses often experience the negative externalities of society at greater rates than those with higher socioeconomic statuses (McGregor et al., 2020; McGregor, 2018; Whyte, 2018; Voyles, 2015; Hoover, 2017). This often leads to the entrenchment of systems that perpetuate harm against lower socioeconomic status individuals because those who determine how the systems run only experience benefits and not the consequences of those systems (Voyles, 2015; Gilio-Whitaker, 2019).

In order to gain a comprehensive understanding of the various factors that contribute to water insecurity, it is essential to add the theory of environmental justice in combination to forms of capital and social learning, to the examination of water access issues in rural Indigenous communities.

Environmental justice contains three pillars: distributive justice, procedural justice, and recognition justice (Menton et al., 2020). Distributive justice focuses on the fair distribution of environmental costs and benefits, the allocation of material goods, such as resources, income, and wealth, or on the distribution of social standing (Menton et al., 2020).

Recognition justice is the recognition of, and respect for, difference (Menton et al., 2020). It has been underlined as a key dimension of justice (Menton et al., 2020). In the case of 'recognition', the conditions for a just society are defined as the recognition of the personal dignity of all individuals (Menton et al., 2020). Recognition refers not only to the individual right to self-recognition, but, most importantly, to the recognition of collective identities and their particular concerns, needs, and livelihoods in relation to nature and the environment (Menton et al., 2020).

Procedural justice addresses the fair and equitable institutional processes of a State (Menton et al., 2020). Procedural justice requires not only an understanding of unjust distribution patterns and the lack of recognition, but, mainly, an understanding of the ways in which the two are tied together in political and social processes (Menton et al., 2020). One of the reasons for the unfair distribution of environmental burdens and benefits is that the decisions that transform the environment are usually made by people who enjoy the benefits rather than the burdens (Menton et al., 2020).

In the context of Oregon's rural Indigenous communities, environmental justice can be used to understand how clean drinking water is still an ongoing concern for marginalized communities like rural Indigenous communities (Census, 2020; Meehan et al., 2020; Mueller & Gasteyer, 2021). These communities continue to struggle to obtain clean drinking water, while other communities have raised questions about the dependability and quality of their drinking water (Desert Research Institute, 2022; Voyles, 2015; Cook, 2020).

In rural communities and agricultural communities in the United States, the future availability of clean drinking water is in doubt due to climate change exacerbating droughts and the over-reliance on dwindling groundwater reserves (Saskova et al., 2018). If clean drinking water is not available, communities may have to rely on alternative sources like bottled water (Mueller & Gasteyer, 2021; Meehan et al., 2020).

However, the utilization of alternative water sources has been found to be a more expensive option for communities compared to public water systems (Meehan et al., 2020). This results in an additional financial burden for these marginalized communities, and is the result of injustices those communities face (Meehan et al., 2020). It has been found that these alternative water sources have been unable to effectively meet the needs of sanitation or irrigation, which require a reliable and consistent flow of water through public water systems (Meehan et al., 2020). The lack of proper sanitation facilities is particularly concerning for minority and marginalized communities, as it perpetuates social inequality due to poor hygiene practices (Meehan et al., 2020). This can lead to stigmatization of individuals without access to showers or baths, which may ultimately result in reduced employment opportunities and increased poverty levels (Meehan et al., 2020).

In addition, there are concerns pertaining to the long-term sustainability of alternative water usage (Meehan et al., 2020). These sources are considerably more expensive than tap water, exacerbating the financial struggles of low-income households, while the packaging, distribution, and selling of bottled water continue to be a source of profit as sales of bottled water have grown every year (Park et al., 2020).

Furthermore, alternative water sources contribute to plastic pollution, which not only impacts other communities but also contributes to climate change (Pierce & Gonzalez, 2017). It has also been observed that individuals who lack reliable access to clean drinking water and purchase alternative water tend to opt for sugary beverages instead, which can lead to long-term health problems and additional burdens for these households experiencing water access issues (Pierce & Gonzalez, 2017).

One of the many injustices that these rural communities face is a lack of investment in their water systems, which in the United States has led to a series of violations of the clean water act - particularly affecting rural, low-income and Indigenous communities (Meehan et al., 2020; Mueller & Gasteyer, 2021). Indigenous communities, in particular, experience plumbing poverty at higher rates than the national average, and this is in part due to a lack of investment in rural communities (Mueller & Gasteyer, 2021; Meehan et al., 2020; Desert Research Institute, 2022; U.S. Census Bureau, 2020). Plumbing poverty is the lack of basic amenities like hot and cold running water, a bathtub or shower, and a sink with a faucet (Desert Research Institute, 2022; U.S. Census Bureau, 2020). At any given time, approximately 1.1 million people, which is 0.4% of the population of the United States, are experiencing plumbing poverty (Census Bureau, 2020). If the quality of the water was considered as well as its safety, more communities would be affected by the issue of poor drinking water (Mueller & Gasteyer, 2021).

Research shows that household water insecurity is a growing issue in the global north, which includes the countries of the United States and Canada. However,

policymakers and advocates have not widely acknowledged these issues (Meehan et al., 2020). Certain communities and backgrounds, such as rural, urban houseless, BIPOC, and women, are disproportionately exposed to the negative effects of disinvestment in water systems, which show as plumbing poverty and violations of the clean water act (Meehan et al., 2020; Mueller & Gasteyer., 2021; Holden et al., 2020; Pierce & Gonzalez., 2017).

In an annual survey of public water users in the United States, the American Water Works Associations found that in 2020, a majority (78%) of people found that their water was excellent (American Water Works Association, 2020). This survey however did find that certain marginalized groups, similar to those highlighted in prior literature as more likely to experience plumbing poverty or experience environmental injustices in regards to water, were less likely to view their water as excellent (American Water Works Association, 2020). Notably absent from this national survey were the perspectives of Indigenous communities on water and their public water quality, despite Indigenous Americans constituting 2.9% of the general population in 2022, they still remain an understudied community (Census 2022; American Water Works Association, 2020).

This study aims to highlight the specific voices of Indigenous communities, and how they view and experience water; Indigenous communities are often overlooked in large national surveys like the American Water Works Associations survey of American water users (American Water Works Association, 2020). A simple survey like the one conducted by the American Water Works Association would not generate enough

responses with the specific experiences needed for this study, thus the need to gain the specific perspectives of these communities (Holden et al., 2021).

In addition to environmental justice perspectives, it is important that Indigenous environmental justice perspectives also be considered when analyzing these Indigenous communities. Indigenous environmental justice is a particular view of environmental justice, and views that humanity alone does not possess all the solutions required to prevent environmental injustices or restore the environment (McGregor et al., 2020; McGregor, 2018; Whyte, 2018; Voyles, 2015; Gilio-Whitaker, 2019). Indigenous environmental justice asserts that in order to create a sustainable future for all, we must consider all of our relationships, including the one with nature, and restore the rights of nature so that it can be apart of the solution to environmental injustice (McGregor et al., 2020; McGregor, 2018; Whyte, 2018). Indigenous people commonly view themselves and the environment as having responsibilities to one another, by restoring the rights of nature and including it in the solution to solving environmental injustice, allows for nature to participate in the solution to environmental injustices (Voyles, 2015; Gilio-Whitaker, 2019).

Indigenous perspectives of environmental justice also add the specific and unique histories of Indigenous communities, such as the dimensions of colonialism, to the analysis of environmental injustices, in addition to Indigenous communities perspectives of recognition and justice (McGregor et al., 2020; McGregor, 2018; Whyte, 2018; Voyles, 2015; Gilio-Whitaker, 2019).

This addition of Indigenous perspectives adds to the arguments being made that 'structural' or 'engineered' solutions to addressing environmental problems, such as levies, dams, or fish ladders, only further perpetuates and necessitate those structural or engineered solutions (McGregor, 2018; Whyte, 2018; Voyles, 2015; Gilio-Whitaker, 2019). Indigenous perspectives advocate for solutions that work in harmony with nature, thus allowing communities and nature to co-existing (McGregor, 2018; Whyte, 2018; Voyles, 2015; Gilio-Whitaker, 2019). According to Indigenous perspectives, Western ways of living want to be free from the responsibilities that people owe the environment, which inevitably causes the environment to deteriorate in its ability to give to people (McGregor, 2018; Whyte, 2018; Voyles, 2015; Gilio-Whitaker, 2019; Kimmerer, 2013).

Indigenous perspectives of justice in the water justice literature describe water as a living entity with rights, responsibilities and obligations to ensure the well-being of all life; to recognize this justice, water would need to be given legal rights to protection (Kimmerer, 2013; Quaempts et al., 2018; Gilmore-Whitaker, 2019). Movements to give 'rights for nature' are already underway, in places such as Tamaqua Borough Pennsylvania becoming the first place to enshrine the rights of nature in law in 2006, and Ecuador becoming the first country to give nature rights under its constitution in 2008 (IJC, n.d.; Epstein et al., 2023).

By giving nature, and extension, water, rights and legal status under the law, contradicts a commonly held belief that nature is only a resource, property or something to become commodified (Kimmerer, 2013; Quaempts et al., 2018; IJC, n.d.;

Epstein et al., 2023). Enshrining the rights of nature into law would bring justice to water according to Indigenous environmental justice perspectives (IJC, n.d.; Epstein et al., 2023). Water justice and security are not just about what people can access equitably but justice for water as a living entity with rights and responsibilities of its own (Kimmerer, 2013; Quaempts et al., 2018).

For this research, utilizing environmental justice theories and the specific Indigenous perspectives of justice are important to determine if these communities are experiencing distributive, procedural or recognition injustices. Further analysis of these injustices might also lead to solutions for overcoming these problems if we analyze them through the lens of environmental justice theories.

2.4. Gaps in Literature

Although plumbing poverty is a documented problem, there is a hopeful development in the form of an increasing number of research studies being conducted on the impact of this issue on communities in the Global North (Mueller & Gasteyer, 2021; Meehan et al., 2020; Pollen et al., 2017; Holden et al., 2020). It is important to note that these studies being carried out focus primarily on which communities are being affected and not necessarily on how each community overcomes its water insecurity issues (Mueller & Gasteyer, 2021; Meehan et al., 2020; Pollen et al., 2017; Holden et al., 2020). This differs from this study, which seeks to document how a specific subset of communities affected by plumbing poverty overcome their unique causes of it.

Furthermore, various studies have been carried out on the utilization of alternative water sources and their influence on plastic pollution (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Pierce & Gonzalez, 2017; Teodoro et al., 2022; Geerts et al., 2020; Van et al., 2015; Taylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010). These studies also look at the specific ways micro-plastics and plastic pollution affect the environment and to what extent these issues are (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Pierce & Gonzalez, 2017; Teodoro et al., 2022; Geerts et al., 2020; Van et al., 2015; Taylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010). Additionally, different studies have examined who uses alternative water sources and why they use them, but they have

focused on higher-income urban communities, not the communities most likely to be affected by plumbing poverty (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Pierce & Gonzalez, 2017; Teodoro et al., 2022; Geerts et al., 2020; Van et al., 2015; Taylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010). This is in contrast to this study, which seeks to understand how communities most likely to be affected by plumbing poverty overcome their water insecurity issues.

Nevertheless, it is crucial to acknowledge that a large portion of these studies fail to encompass Indigenous perspectives or experiences with regard to water access issues (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Pierce & Gonzalez, 2017; Teodoro et al., 2022; Geerts et al., 2020; Van et al., 2015; Taylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010).

2.5. Study Site Background and History

Since time immemorial, the Warm Springs, Grand Ronde, and Umatilla tribes have called the Columbia River basin in Oregon their home and have relied on the Columbia River and its tributaries for resources and spiritual significance (Confederated Tribes of Warm Springs, 1855; Quaempts et al., 2018). Prior to colonization, the tribes enjoyed unfettered access to these waters (Confederated Tribes of Warm Springs, 1855; Quaempts et al., 2018). The tribes along the Columbia River have cultivated immense place-based knowledge about the ecosystems that they resided in, knowledge that has been passed down from generation to generation (Confederated Tribes of Warm

Springs, 1855; Quaempts et al., 2018). Tribes along the Columbia River have utilized resources like wapato, Lamprey, and Mussels, among many other abundant foods, to sustain themselves (Confederated Tribes of Warm Springs, 1855; Quaempts et al., 2018). These foods require immense knowledge of cultivation, harvesting, and preparation, but also, in the case of aquatic species, cannot be properly grown in all ecosystems in this region without access to water (Quaempts et al., 2018).

In Oregon, many Indigenous tribes were forcibly relocated from their ancestral and accustomed homelands along the Columbia River (Confederated Tribes of Warm Springs, 1855; Fixico, 2015). The United States government negotiated with these tribes to create reservations and treaties, which proclaimed tribes' right to sovereignty, rights for fishing, hunting, and land within the reservations (Confederated Tribes of Warm Springs, 1855; Fixico, 2015; History of the Confederated Tribes of Grand Ronde, n.d.).

However, through various laws, stipulations, and renegotiations, the amount of land and rights that were entitled to the tribes was reduced (Oregon, 2018; Fixico, 2015). Notably, the Grand Ronde tribe was terminated in 1954 despite objections from the tribe and lost water rights that were attached to the land that the tribe once owned (History of the Confederated Tribes of Grand Ronde, n.d.). With termination also came the loss of land on the Grand Ronde reservation, which disrupted many tribal members' livelihoods (History of the Confederated Tribes of Grand Ronde, n.d.).

These new, shrunken tribal reservations also placed the tribes in areas where they would be surrounded by heavy agriculture (Oregon, 2018; Fixico, 2015). Agriculture

would grow to become a major economic contributor to the state of Oregon, and along with it would the number of agricultural contaminants (Quaempts et al., 2018).

The expansion of industrialized agriculture has brought about many harmful negative effects on ecosystems all around the world, Oregon notwithstanding (Moss, 2008; Throw et al, 2011; Parks, 2022). In Oregon, agriculture pollution, such as nitrogen, phosphate, and pesticide pollution, combined with other forms of environmental injustices against the tribes, like dams along the Columbia and its many tributaries, overconsumption of surface waters, and destruction of native habitats, all of these factors played into a significant decline in the amount of culturally and economically important native foods for the tribes (Moss, 2008; Throw et al, 2011; Parks, 2022; Quaempts et al., 2018; Cureton, 2020; Hrozencik et al, 2021).

A notable victim of this environmental pollution was the decline in salmon, a significant first food for the tribes (Quaempts et al., 2018). In addition to a decline in salmon, a significant first food that plays immense cultural, spiritual, and economic importance to these tribes, was a serious decline in surface water quality (Confederated Tribes of Warm Springs, 1855; Quaempts et al., 2018).

3. Methods

3.1. Site Selection

The target population for this research includes rural, Indigenous communities experiencing or having experienced water access issues. This subset of the population is most likely to face plumbing poverty and issues with accessing clean drinking water, as documented in prior literature (Pierce & Gonzalez, 2017; U.S. Census Bureau, 2020; Meehan et al., 2020; Meuller & Gasteyer, 2021; Fedinick et al., 2017).

To select research sites, the following criteria were used: rural, Indigenous, experiencing or having experienced water access issues, and located in Oregon.

Based on these criteria, several communities were available, including Grand Ronde, Warm Springs, Umatilla, Paiute (located in Burns, Oregon), Fort McDermitt Paiute and Shoshone Tribe (located in Fort McDermitt, Oregon and Nevada), Klamath Tribe (located in Chiloquin, Oregon), Cowcreek band of the Umpqua tribe (located in Roseburn Oregon).

After careful consideration, three communities were selected: Grand Ronde, Umatilla, and Warm Springs based on factors such as documented long-standing water quality problems in Warm Springs and water rights issues in Grand Ronde and Umatilla (Land, 202).

The Confederated Tribes of Grand Ronde has been selected because they are currently experiencing a form of procedural injustice because of their lack of senior

water rights, in addition to the forced consent decree, which has significantly restricted the tribe's right to fish and hunt on its own lands. (Confederated Tribes of Grand Ronde, 2023). This stands in contrast to the Confederated Tribes of Umatilla.

The Confederated Tribes of Umatilla were also selected because of their unique status as having water rights, fishing rights, and not having documented water supply or water quality problems; however, surrounding communities such as Boardman Oregon and the communities that rely on the basalt aquifers that the tribe also utilizes are experiencing water quality problems (United States Bureau of Reclamation, 2020; CTUIR History, n.d.). The combination of these factors would be useful in the analysis of how communities are overcoming water insecurity issues.

Out of the communities surveyed, Warm Springs is notable for its duration of water quality problems and the severity of those problems (Kohn, 2022). Warm Springs, Oregon, has had several boil water advisories, which have started in earnest since at least 2019, the issues of clean water in Warm Springs, Oregon, start long before then (Kohn, 2019). Surrounding agricultural pollution of the surface waters, in combination with the fact that the community water system in Warm Springs gets its water from surface waters, means that the tribe has not had safe or reliable drinking water (Sierra & Samayoa, 2023; Cook, 2020).

Having fallen behind on maintenance and water filtration advancements, the water utility issue in Warm Springs became a prominent issue in 2019 when multiple boil water advisories were issued, followed up by several series of unfortunate events with the public utility leading to an eventual outright outage of drinking water in Warm

Springs (Kohn, 2022). Issues such as main breaks, pump failures, and valve control issues are all attributed to a lack of funding and aging infrastructure (Kohn, 2022). In a culmination of issues, there was a transformer fire at the water treatment plant (Kohn, 2022). This led to a widespread outage throughout the entire community (Kohn, 2022).

Longstanding trends in America of rural disinvestment, combined with decades of underinvestment in water systems nationally, have created the problems seen in Warm Springs (Kohn, 2022; Mueller & Gasteyer, 2021; Arden, 2021). Rural systems like Warm Springs do not generate enough revenue to perform basic system maintenance, and that doesn't cover investment in new pipes, pumps, or water intake systems (Kohn, 2022; Mueller & Gasteyer, 2021; Arden, 2021). This decline in surface water quality has left communities like Warm Springs and Grand Ronde facing water quality problems to varying degrees of severity (Sierra & Samayoa, 2023; Kohn, 2022; Parks, 2022).

3.2. Data Collection

For this study, a purposive sample design was used. This would allow for the intentional selection of participants for their experiences, background, and other characteristics that would be useful for analyzing the research question, "How are Oregon's rural Indigenous communities overcoming water access issues?". This study design was selected because it allows for Indigenous perspectives to be sampled for and

studied, something that wasn't accounted for in the national survey conducted by the American Water Works Association.

Participants in the communities were contacted and recruited to the study via a snowball sampling method, where participants from the study were encouraged to invite others to the study. Initial outreach to participants occurred through flyers which were distributed and through recommendations from community partners.

Participants were interviewed in various locations, chosen at the participant's convenience, including food pantries, workplaces, and community health clinics. The duration of each interview ranged from 15 minutes to over an hour and a half, depending on the participants' responses. The interviews focused on various topics, such as the impact of plumbing poverty on access to water, concerns regarding water quality, climate change, water availability or access, knowledge of the source of their water, worries about the future of their water supply, satisfaction with their water, and past experiences with poor water quality or safety.

The operationalization of theory in this research views water access through the lenses of colonialism, and Indigenous environmental justice, which considers not only the environmental injustices experienced by these communities but the histories and historical context of each community and the views of Indigenous communities.

Adaptions or the ability to address water access issues can be understood when looking at communities' knowledge and capital to address those specific issues. For this, we can use the theories of forms of capital and social learning to understand what

knowledge or resources are being utilized inside communities to overcome water access issues.

During interviews, the different theories were operationalized into questions. Under environmental justice, which for this project distributive, procedural and recognition justice were considered, questions were given to participants to understand better how these particular theories operate in their lives.

For distributive justice, the question asked participants was, “Do you think everyone in your community has fair access to clean water? Why or why not?” This question is crucial because we will examine environmental injustices in rural communities. Examining how people learn about their water quality (through the social learning theory) by having participants explain if they believe that their community has equal (or unequal) access to water, we can reveal if the participant's community is experiencing a distributive justice issue. By also revealing if the participant is in a community experiencing distributive justice issues, this becomes a potential source of learning (Javidi & Pierce, 2018; Delpla et al., 2020; Park et al., 2020; Holden et al., 2020; Bandura, 1973).

Distributive justice had more than one question operationalized; another was, “Do you think your drinking water is affordable to you?”. This would reveal distributive justice or injustices for the participant. Too expensive of water would be a distributive injustice because it would reduce access and increase the burden of water. However, having water that is not expensive would be distributive justice because it means that they have the means to access affordable water. This question must also be analyzed if

this water is clean, affordable dirty water is still a distributive injustice (Javidi & Pierce, 2018; Christopher et al., 2019; Holden et al., 2020).

Procedural justice was operationally defined through the question, “Has there been a time when you were asked for your input, or vote, on any sort of water issue in your community?”. This question is vital because it asks if participants have ever been able to participate in a form of decision making where their opinions and knowledge were taken into consideration.

Under the theory of social learning, an example of a question that was operationally defined using this theory would be, “Can you describe when you learned about the importance of clean water for the environment or health?”. This question asks participants how and where they learn about water and water values. This question is also asking how participants link water to environment and health; by asking participants to describe where, how, and when they learned about the importance of water to health, we are asking them to describe their learning, whom they learned it from, and how they processed that information; it also might reveal their systems of knowledge and ways of knowing the issue of clean water and the context in which they learned this information. This will help analyze data without reproducing an aspect of recognition of injustice (Javidi & Pierce, 2018). Follow-up questions to this question were, “How important is clean water for your health?,” “How do you know that?” “Where did you learn that?” and “How important is clean water for the environment?”. For further reference, the questions asked during the interviews and the number of follow-up questions can be found in the appendix.

3.3. Participant and community engagement

Outreach to participants and the community began once permission was granted from the Warm Springs, Umatilla, and Grand Ronde tribes in their respective communities. Permission was asked to ensure that any further requirements, such as tribal specific institutional research boards (IRB's) or tribal council permission was satisfied prior to engaging with the community and conducting research.

The Grand Ronde community outreach involved calling, leaving messages, and distributing flyers for community partners, such as the Grand Ronde Food Pantry, Chachalu Museum & Cultural Center, and Spirit Mountain Community Fund. Connections were successfully made with the Grand Ronde Food Pantry and Chachalu Museum & Cultural Center, where interviews were conducted with community members. Surveys were also distributed physically to individuals in the Elder Community Center who had difficulties with internet and computer access.

To ensure consistency in the data collected between communities, intentional efforts were made to outreach to participants through community partners in Warm Springs and Umatilla.

In Warm Springs, community outreach involved leaving flyers and talking to participants at the Warm Springs Natural Resource Department, local businesses, the Warm Springs Family Community Center, and members of the Warm Springs Tribal Council.

In Umatilla, community outreach involved leaving flyers at the Umatilla Natural Resource Department, and local businesses. Participants were interviewed at the Umatilla Natural Resource Department.

At the start of every participant interaction, researchers' identities and purpose were described to participants, and they were asked for consent to participate in the research project and interview. Before the start of the interview, participants were informed that they could pause or stop the interview at any time, and they could request that anything be stricken from the record. Participants were informed after the interview that anything they said could be stricken from the record, as a form of member checking (Lincoln & Guba, 2001).

Once interviews were done, and participants were given time to remove things from interviews, they were given the option of receiving a copy of the transcript for review and edits, as an additional form of member checking (Lincoln & Guba, 2001).

3.4. Analysis

To begin the analysis of participants' interview data, the audio files were transcribed into written transcripts using the Microsoft's online transcription tool. These transcripts were checked for accuracy against the audio recording and shared with participants for further verification that ideas, topics, and stories were accurately portrayed (Lincoln & Guba, 2001).

Participants were given a two-week window from the time they were given their transcripts to submit edits, provide feedback, add additional comments, or remove content from their transcripts (Lincoln & Guba, 2001). Only the corrected and reviewed version of the transcript was used in the analysis of participant interviews (Lincoln & Guba, 2001). This type of member check allows participants and the researcher to confirm that the views recorded were accurate and truthful while also allowing the participant to add or subtract anything from the transcript and research (Lincoln & Guba, 2001). This allows for a greater degree of confidence in the validity of the data gathered (Lincoln & Guba, 2001).

After the comment period, each interview transcript was read thoroughly, and a concise summary, a half-page long, was created about the topics discussed. Following that, a list of codes was developed from the summaries of all the transcripts.

The resulting list of 45 codes was divided into seven groups: Culture, Economics, Environment, Environmental Injustice, Learning, Trust, and Water. The five groups identified in the literature review were Economics, Water, Trust, Learning, and Environmental Injustice, which were also identified in the interviews. These five groups were developed deductively, and the remaining two, culture and environment were developed inductively (Timmermans and Tavory, 2012).

Transcripts were coded using the 45 codes and 7 groups using Atlas.Ti, a qualitative software analysis, in order to distill participants' quotes, stories, and experiences into the code groups.

Overall, the analysis of this data followed an abductive approach, which is defined as making probable conclusions based upon observations (usually incomplete) and using known facts or theories to best describe what was found in the observations (Timmermans and Tavory, 2012).

4. Results

4.1. Demographics of the sample

In the communities studied, Warm Springs, Umatilla, and Grand Ronde, participants took a short survey before being interviewed to answer information about their age range, gender identity, and education. The results from this survey are presented here.

4.1.1. Age Range

Of the interviewed participants from Warm Springs, Umatilla and Grand Ronde, the mode age group was the 18-29 age range with four participants responding as being in the 18-29 age range. There were no respondents for the 50-59 age range among those interviewed, and only one participant from the 70-79 age range. These findings are displayed in table format in table 1.

Age Range	Count
18 - 29	4
30 - 39	2
40 - 49	2
50 - 59	0
60 - 69	2
70 - 79	1

Table 1: Participants Age Range

4.1.2. Gender Identity

Of the interviewed participants from Warm Springs, Umatilla and Grand Ronde, more participants identified as female, with seven respondents compared to six respondents identifying as male. There were no respondents who identified as non-binary or other. These findings are displayed in table format in table 2.

Gender Identity	Count
Female	7
Male	6
Other / non-binary	0

Table 2: Participants Gender Identity

4.1.3. Education

Of the interviewed participants from Warm Springs, Umatilla and Grand Ronde, having completed vocational school, some college or having an associate degree was the mode response, with five participants reporting this as their highest level of education. One participant noted that they did not receive a highschool diploma, and two participants noted that they received advance college degrees. These findings are displayed in table format in table 3.

Education	Count
Grades 1-12, no diploma received	1
High school diploma, GED, or alternative credential	1
Vocational school, some college, or associate degree	5
Bachelor's degree	2
Advanced college degree	2

Table 3: Participants Education

4.2. Knowledge about water

The participants in this study had diverse knowledge about water, including spiritual, economic, and legal perspectives. They gained this understanding through personal experience, communal learning, and spiritual teachings.

4.2.1. Spiritual

Throughout the conversation, participants shared their spiritual comprehension of water, an understanding that came from multitudes of perspectives. Some of these perspectives are about viewing water as a medium through which life is sustained. In Grand Ronde, a participant describes, "... But in our beliefs, drinking water is a basis for everything, so it is a basis for our human bodies, for our animals and plants…". In Umatilla, they also describe water in terms of spirituality; one participant quoted as saying, "... in our creation story, water is our first and most important first food. So in our ceremonies, we always start with water. We always end with water because water,

with life, when it comes to the environment, there's nothing in the world that doesn't need water." In Warm Springs, an Elder in the community describes their relationship with water in terms of their spirituality and health, "There's one thing I say about water here, you know the water, we find it very sacred that it provides nourishment for our bodies."

In all three communities, water was described as helpful in conducting culturally important ceremonies, such as utilizing sweathouses, which were described as a form of traditional medicine and therapy. One participant described sweat as a form of prayer, cleansing, and ridding the body of negative emotions or illness. In these situations, the participants described the importance of starting with clean water, as it would be difficult to cleanse the soul and body if the water needed healing. This participant describes their tribe's relationship with water,

> "...We also use it for prayer. So we pray in open waterways to carry forth our beliefs and use it for sweat. So sweat is a fundamental way for us to pray. And so we go into a large river, bring in warm rocks, pour water over it, and then say a prayer, and the smoke takes over us. And when we're done, we cleanse into open running water. So it is important for us to be able to have access to creeks or tributaries with running water that is clean and safe because we believe that's how we purify ourselves and take care of any disease or anything that could be harmful to our bodies…"

For the tribal communities of Grand Ronde, Warm Springs, and Umatilla, conversations about water revealed its importance for healing the body, mother earth, and all the plants and animals. Water in these tribes is considered 'the first food,' meaning it comes before all other culturally essential foods, as it enables life and, thus, creation. One participant went into detail about how water is a foundational piece of their spiritual understanding,

> "It is a part of my religious beliefs, not just because. You know of a belief system. It is the system we live within, the ecosystem we're a part of, and our history and creation story. As a people, we were created, and we were pitiful. We could barely survive; we were figuratively and literally naked in the world and could not care for ourselves. And so the animals and the plants had a council together… and agreed to take care of us and make themselves available to the people so they could survive because we couldn't. We walked the earth and could not take care of ourselves, so the water was their first. So it is technically the very first food for us, and it is there, and it has always been there, but fish spoke up, deer spoke up, roots spoke up, and berries spoke up. And so that's how we set our table. And we honor that whenever we eat in our longhouses and sometimes at home. But we set our table in that way because it is also a recognition of the seasons, but it is also in recognition of the animals that sacrifice themselves for us. And they saw in our future and their future that if

> they took care of us because the Creator so saw so much potential in us, we would be able to return the favor and take care of them."

Water is essential to these communities because it was described as the first food that made itself available to them, and it is the food from which all other food grows, so without it, there wouldn't be anything to eat or grow from. Another participant described their relationship with water differently but in similar terms, relating water's importance not only to culturally essential foods but how those foods tie into identity.

> "...We're salmon people, so our fisheries are vital to us; our roots, berries, deer, elk, and big game populations rely on water. Our treaty rights are based on our first foods; you know, they protect our ability to access our First foods, which are a considerable portion of our ability to continue our culture. And so having that clean water that can support the continuation of our culture is important."

In the communities interviewed, participants described water as necessary for their spiritual understanding, but also identity and sense of self; in these communities, it was common to refer to oneself as 'salmon people,' which refers to the importance of salmon not only for nourishment but also for cultural identity and sense of belonging to a place.

4.2.2. Economics

Water can also be understood in economic terms; these understandings come from understanding water as a limited resource for industry and how water resources are tied to the ability to grow economically. As one member recounts, "A business approached the tribe to try to build a data center; the water is largely recycled, allowing them to use the recycled water on landscaping…There is an issue with water availability - all these economic growth plans require water, and they do not have the water available for things like data centers or golf courses. They want to recycle the water more than once to help build the economy…".

This participant is referring to water as a way for potential economic success for the tribe; without it, businesses that rely on water are not able to set up business in their community, so the tribe and tribal council have to be judicious with which businesses are allowed to be set up, and how efficient they are with their water. Certain businesses require more water than others, such as a golf course, and contribute less to the economy than other businesses do. This thinking was common in Umatilla, where water resources were described as limited, and the tribe and local community approached the 'high end' of their water usage.

It was also common for tribal members to refer to water regarding the economic resources it can bring to communities and how water can be recycled multiple times while acknowledging that there is a limited amount of water resources. Collaboration in terms of resource management, in this case, water management, was understood as

necessary for the economic well-being of the tribe while also maintaining culturally important foods like salmon, as described in this quote discussing drought and water shortages,

> "But nothing will change if we can not find collaborative efforts, whether regenerative agriculture or precision agriculture or means of keeping water in the rivers while also providing potential resources. Maybe we have the Columbia River water exchange where we can pump water in for irrigation. So some challenges like that will happen much more with water scarcity, right?"

Solutions like the one proposed by this participant would be helpful for their tribe by either increasing the availability of water or making better use of the water that already is in use. When talking about the use of groundwater and agriculture in the region, this participant from Warm Springs commented on how corporations do not make decisions with the land or the local people in mind, only profits for the corporation. This was a common topic discussed in all three communities, the attractiveness of modern agriculture and its detriment on the landscape for these communities.

> "Well, corporations make silly decisions sometimes because they're there for profit. They're, you know, they do not care what they do. And as long as it is maintainable and profitable. I think it was a travesty to allow corporations to be considered entities, as people, and have rights because they're not people, and

> they do not care. They do not have it here as people do; they do not need it to survive. Their lives are indefinite; as long as you've got people to populate corporate offices, it lives, continues to live, and doesn't care what it does… As opposed to people, I mean cultures, not only Indigenous cultures. I guess we're all Indigenous at some point, but people who came from the earth and relied on it. To support them and their families and their lifestyles. I think we are more tied to the Earth than we realize."

This participant criticizes how agricultural businesses in their community have negatively impacted the landscape and taken more than they have given back to their communities. Despite the economic importance of agriculture, participants note its extractive nature and detrimental effects on their health and ways of life. Described by participants as a necessity and a detriment, it outlines how these communities understand the trade-offs between economics, water, and the landscape.

4.2.3. Legal

Water can be understood through the Western legal system, where water resources are allocated based on water rights, a "First in time, First in right" system. Even though tribes have been there since time immemorial, not all the tribes have the most senior water rights; these rights can be given to others, such as timber or

agricultural companies. Participants describe frustration with trying to conserve water because it means that the junior water rights holders will eventually end up with it.

Commonly mentioned in Umatilla were conservation efforts to restore salmon runs, as in Umatilla they described themselves as 'salmon people,' they expressed strong desires to restore these runs. However, the current legal, political system stood in the way of that goal: water rights. One participant in Umatilla described how they have been working for a long time with the state of Washington and Oregon to revise the law surrounding water allocations, as the tribe in Umatilla had senior water rights. However, as described by this participant, if they left their water in the stream for salmon, once that water crossed the state boundary, it could be claimed by a junior water rights holder in Washington. This was not the outcome of leaving water in the stream that this community member wanted, so they did not leave water rights to the river. As described earlier by this participant and others within the community, water was directly tied to economics as well as culture and spirituality; by leaving water in the stream for salmon, which was their ultimate goal, they would help restore salmon runs, but also by doing that they would be giving up economic benefits that water can bring. And if that water ultimately does not benefit salmon runs because it is taken back out of the river by a different water rights holder in Washington, then the tribe did not want to give up those water rights.

In Grand Ronde, the situation was slightly different, as the tribe was terminated and lost their water rights, as one participant describes the situation with their water rights,

> “It is frustrating because it is all the tribe's land. But when we were terminated, log timber companies purchased up the land. So timber companies actually have more rights to water than anybody here, even over the farms, which most people aren't aware of because everybody makes the issue about farmers or cattle. But in reality, logging companies have the most power in our area.”

In the Grand Ronde Tribe, located closer to the Pacific Coast than the Warm Springs or the Umatilla, one participant describes how timber rather than agricultural companies become the dominant water rights holders in their community. This participant from Grand Ronde describes how the water rights work within their community and how it’s impacting them,

> “… Water rights are coming to a point where getting water rights is very difficult because you have corporations like the timber community who have access to water rights because they own the most property; they may not need access to the water per se, but selling those water rights are very lucrative—so having the land ownership that access allows you to sell those water rights at a very high premium. And there are only so many water rights to be had. But we're finding that because water ebbs and flows, so as it goes up and down, there's more or less water to sell so that they can oversell water rights. Those that are higher upstream will have access to it first, prohibiting those lower in the lower area to

> not have access or very limited access. So we're finding that now people are buying land with water rights attached to it so that they can resell the water rights to the highest bidder. But it is not even about the land itself; it is just finding those who have those rights and can access them, so unfortunately for our area, we're just trying to buy it…So then, hopefully, we can have some water rights."

This quote from a Grand Ronde community member outlines how water can be bundled with land and legal entitlements, something that was taken away from their tribe during the termination era. Participants' quotes illustrate water's existence and control via legal systems.

4.3. Barriers to water access

Almost every individual interviewed experienced some form of barrier to water access, either in the past or present. Their experiences are characterized by individual or structural barriers to accessing water, whether infrastructure or economic, and pollution.

4.3.1. - Individual barriers

Participants described how they or their community face struggles with accessing water because of plumbing poverty, poverty, houselessness, or boil water notices. One participant noted that while water is commonly available in their community, access issues hold back those community members from accessing water; those access issues are homelessness and a lack of services for those individuals.

One participant in Grand Ronde noted that during the COVID-19 pandemic, families experiencing houselessness lost most of their water access when schools and businesses closed and had to turn to outside help to meet their water needs. This community member describes how they assisted families who were experiencing houselessness,

> "... But even on a day-to-day basis, what we're finding, and because of COVID, is that many of our families do not have access to healthy drinking water, and it is at an expense that many families have to choose between food or water. Which is a silly thing to choose between. One water is so readily available; it is just access to it that is difficult …"

While in this situation, water has been described as readily available; it may not be readily accessible for various people in Grand Ronde, which is still a barrier to water access for some individuals. Different participants in Grand Ronde also described having to trade off between purchasing water for drinking and having money available for food or using money that could have otherwise been available to purchase water. In Warm Springs, the drinking water issue was described differently than it was in Grand Ronde, as this participant from Warm Springs describes,

> "We've been having some water challenges here in Warm Springs with the piped water. You know they've had water boil notices off and on. For some time, water wasn't available. You know... It wasn't pressurized because they had breaks in the system. So to have some reliable water sources, I've been drinking bottled water."

This participant's description of water access issues in Warm Springs was described by others in the community, who also noted that they had been receiving boil

orders and that they felt uncomfortable drinking the water within Warm Springs due to the color, smell, or taste of the water, or over fear of the amount of chemicals found in the water.

4.3.2. Structural barriers

Participants also talked about structural barriers that exist throughout space and time, such as a recent community development project threatening their water supply in the future, a historical lack of funding to develop water systems, or an agricultural company overdrawing aquifers causing wells to go dry.

These participants from Warm Springs talk about how little funding there is for the water system in their community and communities like theirs around the country. Participants identified a lack of funding and an urban-rural priority divide as a primary cause of funding going towards cities, as this participant from Warm Springs describes,

> "Well, there's supposed to be federal funding for this stuff yearly through the Bureau of Indian Affairs and Indian Health Service. There's a lot of demand for that kind of stuff, and the money isn't there to address all of the issues because, you know, Warm Springs is just one of many reservations with these kinds of problems. You know the Navajos haven't had good water for forever? You know, many reservations are like that, and they learn how to suffer and get along, and

> they're not paid attention to, and, unfortunately, we have to compete with the cities with a tax base and the county space in the states. They can address their issues through public funding. But there's not much attention being paid to people who are living on reservations or in rural communities where there isn't the kind of funding available."

This participant from Warm Springs also mentions how there has been a longstanding recognition issue and that tribes are ignored due to the lack of recognition surrounding the severe nature of plumbing poverty in their communities. Another participant from Warm Springs also identified the same problem as above, with the feeling that bigger cities receive more attention and funding from the state of Oregon or the federal government than the community of Warm Springs does,

> "When there are big decisions and everything like that, they're just based on big cities and their problems and things like that, but you know, small communities have our own different problems."

This community member is describing how their community is being overlooked, similar to how the prior community member described recognition of the plumbing poverty problem as a severe issue for tribal nations around the country. Another community member in Warm Springs identified a different problem within their community, which was another community development project being developed along the river, which

would ultimately draw more water from the already overdrawn Deschutes River, and described how they could use more water differently than they can in Warm Springs,

> "There's been this development inland called Thornburg that has been taking about 15 years to get through the planning process… But they're still having to deal with concerns about, you know, the use of water; you're going to have a couple of golf courses there, and you know, it is nice for tourism, but it doesn't take into account the people who live here. And you know, can not get away."

This Warm Springs community member describes how a new development can have water for golf courses, but their community still has problems accessing drinking water. These last few quotes illustrate an issue with recognizing the water access problems in their community and how this turns into a lack of priority in funding and legislation for their communities.

In a different community, one community member from Umatilla talked at length about helping a community member who had a deep well run dry due to an upstream irrigator drawing too much water; after digging the well deeper, they could get water again. Before the tribe took over surrounding agricultural land, irrigators were overdrawing groundwater, negatively impacting tribal residents' well water. Another community member from Umatilla also mentioned that wells were going dry within the community, and its impact on community members,

> “Also, you know some of the wells out here on the reservation, because too many wells were put in at the same time, they're being overused. So people are struggling. They're having to redrill wells or go deeper with their wells…”

In Umatilla, multiple participants described the use of well water as a primary source of water for their families and communities and how those wells have gone dry due to agricultural overconsumption of groundwater. Participants also stated that they have helped others get wells dug deeper so they can have access to water again. According to the participants, irrigators were responsible for the overdrawing of groundwater. However, community members were responsible for footing the bill for digging deeper wells, not the irrigators.

4.3.3. Pollution

Nearly every participant had stories and experiences with pollution, and the impacts it has had on their and their family's health, the safety of cultural foods from the environment, and their community's water supply. Participants also discussed their fear of contamination of the environment and how it has negatively affected them and their communities. Participants in all communities talked about the effects of pollution on fish, as described by this participant from Warm Springs who talks about pollution and its effect on fish in their community,

> "Well, for one thing, it is probably poisoning our fish, which is one of our primary traditional foods, our eels. We eat eels, and I know sometimes you can taste it inside the eels or the salmon that's coming up. You seem not to have as many fish as we used to a long time ago, and I can not say it is from that [pollution], but I think it is a contributor."

This community member from Warm Springs described how they can taste the pollution, and they speculate that the pollution might have something to do with declining fish and eel populations. In Warm Springs, pollution concerns also centered around nuclear waste, being downstream from the Hanford nuclear site. Similarly, a different participant from Grand Ronde discusses pollution in salmon,

> “I think they're going to tell us, oh, your salmon are too dangerous to eat because they're filled with toxins from runoffs or something… Even on the Columbia River, I know there was that one fear when Hanford was up, where we had glowing fish, and it was filled with the nuclear runoff from the Hanford Project, and those kinds of things. And I'm glad that it shut down, but that still doesn't mean the bottom of the rivers are clean.”

This participant from Grand Ronde describes fears surrounding the health of salmon due to the legacy contamination from the Hanford Nuclear site. Legacy pollution was a common fear in all three communities. In Grand Ronde, participants talked extensively about the amount of pollution in their community due to agriculture, past and present, and how it has caused the loss of life for family members, illness, pests, and illegal dumping. One participant from Grand Ronde describes how mint, a common agricultural product in their community, contributes to pollution,

> “...We have one of the largest mint contracts, like double, mint, gum, and mint, as it uses a lot of water. It also includes increased pests. So this is a whole other issue brought about by the stagnant water that mint creates and then the spraying they do to keep the pests down. So now we're adding additional chemicals to get rid of something that we never would have had to if we hadn't had this agriculture business going on there.”

This participant from Grand Ronde discusses how industrialized agriculture, in this situation, mint farms, creates new problems for the area, namely in the form of pests that must be controlled with pesticides. Similarly, another participant from Warm Springs also noted that the agricultural industry in the region was polluting the river waters, where they get their drinking water, with fertilizers and other chemicals from agricultural production. They noted that the surrounding communities where the farmers live get their water from aquifers which are not polluted with those agricultural runoff products, while the tribe's water comes from the river that the farmers are polluting. This participant from Warm Springs describes that situation with this quote,

> "Well, they take the water from the river. So they have to filter out the fertilizer and all that stuff and I do not like it. I do not think it is as pure as they get in Madras. You know in Madras they have the… Albel Springs and that's really pure water that comes from aquifers. So it is not polluted, so they have it great. You know they do not have to worry about drinking their fertilizer. So they're not really too concerned about it, but, you know, we take our water from the river so you're in a little bit of a different situation than they are in Madras."

A different participant from Warm Springs notes how in their lifetime, they have seen a visible decline in the health of the river, going from clear and full of fish to murky and devoid of fish. This Elder from the Warm Springs tribe describes how in their lifetime, they have seen a change in the state of the water,

> "…in its natural state you could see everything clear to the bottom of the water. And nowadays, sometimes you cannot even see the rocks at the bottom anymore, but we used to be able to drink out of our local creeks, and they say we can not do that anymore because of different things. And we said, you know, so I remember when, so I tried to think of what it was like then. And the ability to see clear waters, to actually see inside of the water to see the fish. You'd see the ground, the bottom fish. You could see them. That's how clear the water was."

In a different quote from a participant in Grand Ronde, they note how water pollution makes the harvesting of culturally significant foods and materials potentially unhealthy since those things potentially have large amounts of pollution in them now,

> "…I thought it was so simple to say clean water for everybody. It seems so simple. But it is not because there are so many health issues created by different things. Even finding out about the tire tread and its impact on our creeks and tributaries on our fish, the other small life, and plant life like cattail. Cattail is one of the things that we're trying to get access to, including wapato, but wapatos we use for food, for medicine, and also for weeding, so it can come into our lives In many different ways… it grows in these little roadsides and the creeks and stuff. Our families used to go and gather those and use those, and now we're

> learning there are so many more things to be concerned about than we ever knew possible, like, how, how would we know this if we weren't being informed?..."

A different quote from Grand Ronde recounts how the effects of the Hanford nuclear site have potentially caused a cancer cluster within their immediate community and how it has caused not only a loss of life but a loss of culture and knowledge,

> "...We grew up downwind from Hanford and have cancer clusters in our community. And we are learning more about the impact that Hanford is having both on our water, the air, and on our food and our plant life. And my husband, who was also raised in that area, has had seven great aunts who all died from cancer. That's one entire generation of sisters who were lost to breast cancer. We are to make connections and assume it is due to Hartford because of that large cluster. As for the number of families we've had who grew up in the agricultural industry. The pesticides they came into contact with without safety on any know-how or thoughts around safety for themselves."

In these participant quotes, fears and concerns about pollution's effect on the environment were dominant themes between communities. Participants described pollution as coming from the agricultural, timber, or dairy industry, as well as nuclear

waste from the Hanford nuclear site making its way into the fish and sediments of the Columbia River.

These participants also linked environmental pollution to instances of illness; in doing so, they raised concerns about how the environment impacts their and their community's health. The participants also noted that some surrounding communities have better water and do not experience the same pollution as their communities.

4.4. Adaptations to individual water access problems

As previously mentioned in Chapter 4, individuals were surveyed about their access to water and their strategies for overcoming barriers if they were present. These strategies are categorized as water filters and water bottles, environmental water, and community-provided water.

4.4.1. Water filters, water bottles

Some community members who were experiencing water access issues noted that they had been using bottled water and water filters as a way of having a reliable and safe supply of drinking water. These participants also noted that the reason that they were using these alternative water sources despite them being more expensive than tap water was because of concerns about the safety of the water that came out of their tap. This participant from Grand Ronde describes how they manage the cost of their drinking water against food,

> "Oh, yeah, I have food stamps at the moment so it is not that bad. And honestly, I probably wouldn't spend like, any of the money I work for on it…. I usually get the Winco brand, like the store brand, like the cheap ones. In big packs for forty

of them, it is 12 to 15 bucks, so it is not too terrible. Not too bad. But you know, still, that's like $10 to $15 that you're not getting in food”

This participant from Grand Ronde is describing how water is available but not accessible and how other community members have to decide between food and water, the participant from Grand Ronde describing how they use the money they would have used for food on water illustrates that point. Another participant from Warm Springs also describes how using alternative water sources can be expensive for them,

“...I mean, the filters aren't cheap, you know? They're like 30 bucks apiece. And they last a couple of months. And you know it'd be more convenient, naturally, to just be able to use tap water, but I start distrusting, you know, the water, and you do not want to, you know, become sick by it...”

The quotes from these participants demonstrate how water bottles and water filters are used by community members experiencing clean water access issues, but also how utilizing these alternative water sources is expensive. These participants noted that they worry about their health as a primary reason for drinking bottled water despite the inconvenience of needing to fill up water filters or purchase water bottles.

4.4.2. Environmental water

Another way that participants acquired their drinking water when they were experiencing water access issues was through sources in the environment, such as streams or springs. Similar to how participants utilized water bottles or water filters to overcome short-term water access issues, environmental water was used to fill in gaps in water access not already covered by water bottles or water filters. These environmental sources were described by participants as being knowledge passed around within the community, as demonstrated by this quote from a participant from Warm Springs,

> "... it has been there for quite some time. You know there are a couple of natural springs here on the reservation. And you know, there's quite a few, and it is just basically, I mean, going out and knowing that it is there."

This participant from Warm Springs describes how their knowledge of the springs and places to get water within their community helps them go out and get water from the environment. Multiple different participants brought up the use of streams and springs as a source of water when they were asked about how they get their drinking water; these participants also noted that they utilize water bottles, water filters, and other sources as well when they felt that the safety of their drinking water was questionable.

Another community Elder from Warm Springs, describes going out to the natural springs described above,

"… I'll go a little like about 15 miles out to our natural springs and fill up our water bottles…. it is tastier …"

And another participant describes how they get water for drinking in Warm Springs, "...we get it from the stream. And we just boil it." These participants from Warm Springs noted that they are getting water from springs and streams around their community and that these source locations are also known to the immediate community. Participants did note that using environmental water was in addition to using alternative water sources like water bottles and water filters.

4.4.3. Community-provided water

Another way that participants in this study received water was through community-provided sources. These community-provided sources were detailed by participants as community-organized donations of water bottles, a weekly distribution of water that came through a specialized system in Warm Springs, or other systems that tribes organized to get clean drinking water to those in need. One community member from Grand Ronde describes how they are getting water subsidized through their tribe,

> "... I live in the tribal housing, so we do not have to pay for water in the low-income units. But when I was living in a normal unit out here [Grand Ronde], we did. And I think my maximum water bill was like $86 for a family for a month…. I've had to make a deal with the water company out here before because I couldn't pay for a couple of months. I was unemployed..."

For this participant in Grand Ronde, they were able to get their water subsidized through the tribe, which allowed them to have reliable access to water. This participant noted that they had in the past fallen behind on water bills when they were not receiving help. Similar to how participants described using alternative water sources, the financial costs of water can be an access issue. However, in Warm Springs, the system of community-provided water differs, as there are different systems for getting water to those in need. Participants described a system of water distribution that occurs weekly; this water comes from a system that generates water from the air and turns it into potable drinking water for the community. This participant from Warm Springs describe how this system works for them,

> "They have this water system that they've been supplying water [with]. They take [water] from the air and put it in containers that the tribal members can access for clean water."

This participant from Warm Springs is describing that they are able to get drinking water on a regular basis from this system; however, they have to travel to get to this water. Like in Grand Ronde, this water is provided for free for tribal members. Another participant from Warm Springs describes the water resources that they know about within the community,

> "I know they get a lot of water donations down here in Warm Springs in terms of bottled water and stuff that the public has access to."

These quotes from community members in Warm Springs and Grand Ronde describe how the communities are organizing to provide water for those in need, either through water distribution or through subsidizing water. Many participants interviewed in these communities noted that they regularly take advantage of these resources.

4.5. Ways of addressing structural water access problems

When individual participants were asked about water availability in their community, they discussed various water-related projects, programs, and community-level initiatives aimed at overcoming barriers the community faces. These community initiatives include water recycling, individual and collective water conservation, community education on water issues, environmental restoration, economic adaptation away from water-intensive industries, and community organizations to provide water to those in need.

4.5.1. - Water recycling

One of the many ways that participants described community-wide initiatives to address water availability issues for their community was through recycling water that has been used already. In Grand Ronde, a participant describes a potential system that they would like to see for providing food for the community while also recycling water,

> “But we want to improve everyone's access to healthy and safe water in building our community garden. We wanted to create a small orchard that wouldn't need much water. Maybe in the beginning, but towards the end, we figured the rain and stuff would help care for that, so we wouldn't need water as much for the orchard. We were told that we couldn't do that. We couldn't create a

> community; we couldn't expand our garden or build an orchard for our community… They didn't feel they were capable of keeping up with that type of use. But for me, if somebody were to do this in their own yard, I feel like more water would be used and wasted versus having one spot where we could set up timers, and there we could have more of a watch on big water usage itself. But then we're also trying to work with the casino as a major creator of gray water and trying to research with Oregon State University over the use of gray water that we could use for farming or an orchard. So if we had a drip water system that could feed the orchard, the casino said we could have all the gray water we wanted. So there's access to water, but not always the water that you need or in a way that you can use it. The potential is very great. So right now, that water is just going out onto hay fields for feed, but what's the potential for human food? And how do we get there, and how do we find a partner that wants to do that work with us?"

The system outlined by this community member from Grand Ronde touches upon two issues within their community: broader food insecurity that they describe due to poverty and using water more than once to water an orchard. While this system hasn't been implemented at the time of writing this paper, it offers insight into how community members are aware of the benefits of recycling water and how much water is being wasted. Similarly, participants in Umatilla also described the desire to recycle water for other projects and were aware of the economic benefits it could bring their

community. Participants from Umatilla also described how recycling water could allow them to move away from water-intensive industries, which would be good for the environment.

4.5.2. Water conservation

Another way that communities addressed broader water supply constraints was through water conservation. In Umatilla, where water use is described as near the 'high end' of what's available, participants describe wanting to remind people to conserve water and reduce their current consumption through behavioral changes, which, unlike water recycling, would not require new infrastructure. This participant from Umatilla outlines that vision in the quote,

> "Well, we're currently operating towards the high end of our use. So you know that that certainly could change, but in the end, the question becomes pretty soon for us is, you know, do we dig deeper [wells] or do we access different aquifers? You know, we got some aquifers that are pretty old and we just completed a well six to provide more water for some of the infrastructure and housing needs that we have and things like that. But at some point we need to make sure that… we're making old infrastructure better and that's probably one of the concepts that gets sometimes forgotten, I guess is how to conserve water as well… How simple things from shower heads to how you run the water. It

certainly has a big impact that we do not realize sometimes. And in our own little bubble, it becomes easy to forget that at the very same time there are hundreds, if not thousands, if not millions of people using water at the same time."

As described by this participant, water conservation is an integral part of the community's strategy to help reduce the amount of water needed per person and help reduce the demands on aging infrastructure. Water conservation was a common theme in Umatilla and Grand Ronde, and trying to find ways to reduce consumption of water so that more water can be left in the stream for salmon, something the communities hold essential, but also so that more water can be available for use in other ways.

4.5.3. Education and outreach

Commonly mentioned by participants, alongside conservation and recycling of water, was education about water issues. The topic of education surrounding water issues was brought up frequently in all three communities. In Grand Ronde, a participant noted that they had people close to them who started water and environmental pollution activism because of illness that spread within their community due to environmental and legacy contaminants,

"So in the late 1980s, we had a family who started testing this water because many of our families started becoming sick, and cancer started popping up. And

> so she [family] is still active today. She's been pushing for dairy farms to be moved out of our area, where there are more residencies versus agricultural land… She started coming to the school to talk to the parents during parent nights and trying to talk people into testing their well water. That's when we found out we had to be individually responsible for testing it."

This participant from Grand Ronde describes how environmental pollution started causing illness within their community and how someone they knew started activism surrounding the issue of water quality testing. This participant learned about their responsibility to test their water through this activist, something they were not made aware of before. In Warm Springs, a similar activism approach was noted, as one participant noted that they were part of a regional development board to advocate for their water issues at the regional level; they describe how rural communities such as Warm Springs are overlooked if no one advocates for them,

> "In many cases, it just doesn't rise to their level of attention. And then it is a very expensive sort of thing, going to bat. I used to be on the development board. They stopped funding those boards about 15 years ago, I guess. But you know, they used to have people that would be connected to the USDA and be able to bring attention to those problems in rural communities, and [they] stop funding those things, and the voice is no longer there to advocate for rural needs…"

This participant from Warm Springs is describing how the communities ability to advocate for itself has changed over their lifetime; now, the community doesn't have the same amount of access to bring attention to their specific issues as they used to in the past. This participant notes that this has led to a shortage of funding in their community. A different participant in Grand Ronde describes a different problem; the water quality reports that they receive are sometimes incorrect or simply hard to read,

> "And then, even if we're being informed [of water issues], what does that really mean? Many of our families do not understand those water reports where I grew up. The water reports are provided, but we're finding out that some of us are receiving water reports that do not even affect us. So like, if you lived in the white swan area, the water report you're receiving is for white swan town proper. But if you are using a well or in the county that doesn't access that water, then those water reports do not mean [anything], which means your water is not being tested, and that [report] doesn't really affect you. So if it is telling you your water is healthy and that's all you read, do you really understand the boundaries of that report falls into and then what they're actually testing for? They may be testing for just basics, so there might be things that are not being caught."

This participant from Grand Ronde is describing an issue they have noted in their community, which is misleading information about their water quality. This participant

describes how these reports can contain a lot of information that is not adequately described and sometimes can be misinterpreted by those receiving the report. This community member is describing an issue in their community that they see as needing someone to educate others on, which is how to read these potentially misleading reports being circulated in the community.

In all of the quotes by participants, education was an underlying theme that surrounded discussions about water, either needing to educate others or describing a need to educate others in the community.

4.5.4. Environmental restoration

One method of addressing water-related problems within the communities is by restoring the environment. In all three communities, participants described environmental restoration efforts such as restoring habitat for important first foods, improving water quality, or restoring the environment for future generations. This participant from Grand Ronde describes environmental restoration that is occurring within their community,

> "...Around Willamette Falls has been a large one [project] lately for us about cleaning up of the blue Heron site after the paper mill products closed and knowing the different chemicals that were in there and trying to restore that as a

> fishing and lamprey based food base for us, and then the other issues we've been working is the Portland Super Funds. So we have tribal properties there where we've been trying to access wapato, which is of course a water based plant that can be used for clean up."

This community member from Grand Ronde succinctly describes how restoring the environment will improve the habitat for first foods, address legacy contamination, and utilize Indigenous knowledge surrounding environmental restoration. Another community member from Umatilla describes how they view environmental restoration as a necessity to pay respect for the foods that they harvest from the environment,

> "And so that's why it is such a responsibility that we get put in… us as Indian people to do that very thing is provide, fish and hunt and gather and do all those things. But pay our respects by being there for those foods because they in turn take care of you. You're taking care of the water. You're taking care of the land. You're taking care of the air, and you're taking care of those future generations."

These quotes from participants in Grand Ronde and Umatilla illustrate how environmental restoration is being utilized within the community to restore habitat for first foods and improve water quality. According to the participants, environmental restoration would address many community-wide issues at once.

5. Discussion

From this study, participants noted a variety of factors impacting their community's access to water, such as pollution, unreliable supply, or affordability. The cause of these participants described a variety of solutions to overcome these water access issues, which can be categorized as short-term or long-term solutions. Figure 1 visually displays the findings from this research and how they are organized.

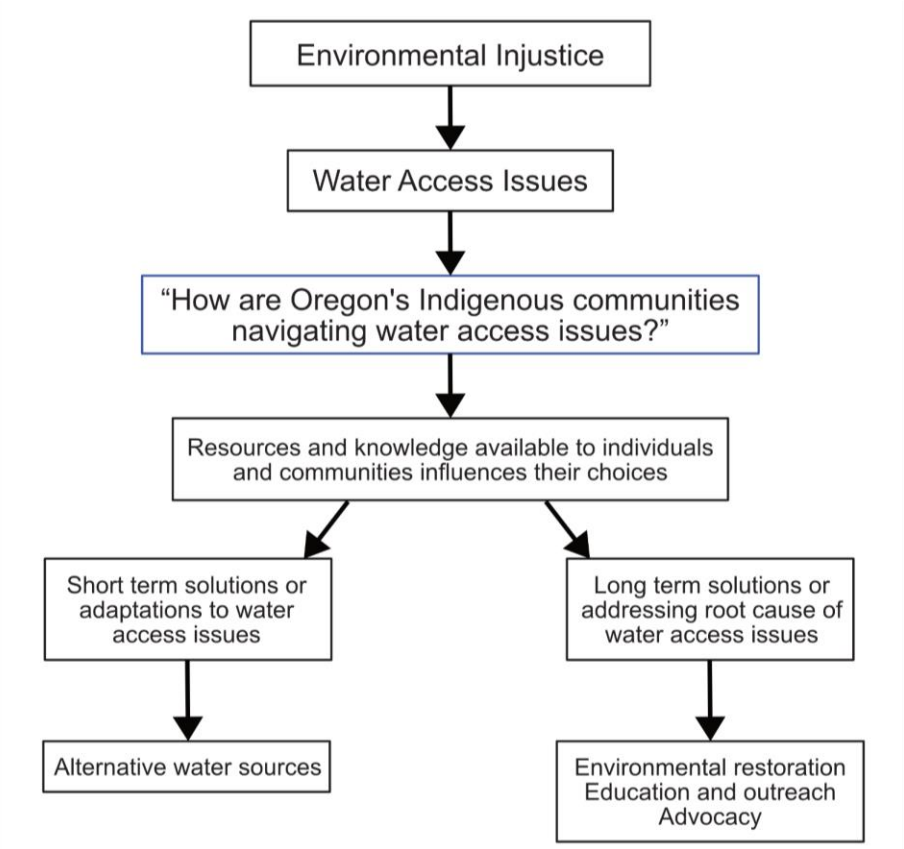

Figure 1: Environmental injustice leads to water access issues.

Water access issues lead to the research question, "How are Oregon's Indigenous Communities navigating water access issues?". Resources and knowledge available to individuals and communities influence the answer to the research question. This leads to two generalized outcomes; the first outcome is short-term solutions or adaptations to water access issues. Short-term solutions include the use of alternative water sources. The second outcome is long-term solutions or addressing the root causes of water access issues. Long-term solutions include environmental restoration, education, outreach, or advocacy.

5.1. Linking environmental injustices to water access issues

Participants from Grand Ronde, Umatilla, and Warm Springs have identified agricultural activity as one of the primary causes of water quality problems in their communities. In Warm Springs, Oregon, the community has been having ongoing issues with water quality and water supply, as the Deschutes River, where the town of Warm Springs gets its water, is heavily polluted by agricultural waste and is overdrawn by the surrounding farming communities (Newman & McGroarty, 2019; Roberta, 2007; Berg, 2022). Overdrawing water from rivers and groundwater is one indirect way that agriculture contributes to pollution; while pulling water out of streams does not cause the types of pollution as putting pollutants into the water, the water that is left behind often stagnates and gets hot, which is a significant threat to salmon and other aquatic

life (Berg, 2022; Sasakova et al., 2018; Moss, 2008; Lee & Reiman, 2011). One participant from Warm Springs describes the situation they are experiencing,

> "Well, they take the water from the river. So they have to filter out the fertilizer and all that stuff, and I do not like it. I do not think it is as pure as they get in Madras. There in Madras, they have the Albel Springs, and that's really pure water that comes from aquifers. So it is not polluted, so they have it great. You know they do not have to worry about drinking their fertilizer. So they're not really too concerned about it, but, you know, we take our water from the river…"

Agriculture has created difficulty to solve drinking water quality problems, and in combination, communities like Warm Springs are vulnerable to rural disinvestment, creating disproportionality higher rates of clean water act violations than urban communities (Kristi et al., 2017; Holden et al., 2020; Moss, 2008; Whyte, 2018; Sasokova et al., 2018). Small rural water systems, like those found in Warm Springs, accounted for nearly 70% of all violations in 2015 despite serving a proportionally smaller set of population (Kristi et al., 2017; Holden et al., 2020). This participant from Warm Springs describes their water system,

> "Well, we've been having some water challenges here in Warm Springs with the piped water. You know they've had water boil notices off and on. For some time,

> water wasn't available. You know... It wasn't pressurized because they had breaks in the system."

The combination of these factors described by participants from Warm Springs amounts to distributive injustices. The community is experiencing an unfair share of pollution from agriculture and receiving fewer funds than urban counterparts for their water distribution system (Pullen et al., 2017; Holden et al., 2020). This has resulted in water quality violations as described by participants and even has resulted in complete loss of access to running water.

Similarly, the community of Grand Ronde has been adversely affected by the impact of agriculture. This participant from Grand Ronde recounts their experiences with the agricultural waste that has been negatively affecting their water,

> "...So I've driven behind a truck that had left the valve open, and cow feces and urine are just pouring out onto the road. And so I'm driving behind it, going, what is this stuff? Why is this brown sludge all over the road? And so then when we call and complain, they are like, 'Oh yeah, we'll send somebody out there,'; and it can happen on a weekly basis. So this is how they're getting rid of it [agricultural waste] without putting it into the creeks because they were getting in trouble for that. So now they're just pouring it onto the roadway. So then, when the rain hits it, It'll just put it there eventually anyway,"

These incidents are environmental injustices, in particular, distributive injustice (Whyte, 2018; Voyles, 2015; McGregor et al., 2020). In this recounting described by the participant, dairy farmers have been given fines and been told not to dump cattle waste into streams and local waterways; this is an agricultural waste that directly contributes to the eutrophication of waterways and also exposes people or animals that drink out of those waters to seriously harmful pathogens such as E. coli, salmonella, and Listeria (Moss, 2008; Sasakova et al., 2018).

Agricultural waste being dumped into Indigenous communities also reflects how wastelanding affects Grand Ronde and Warm Springs (Voyles, 2015); to the farmers, these communities are acceptable places to dispose of waste. In similar patterns, Voyles describes how the Diné people of the four corners region of the United States were victims of uranium mining and tailings dumping, leaving legacy pollution which affects them till this day, and in Warren County, a majority Black and heavily impoverished county, being selected to receive a PCB dump for illegally dumped PCB chemicals in North Carolina (Voyles, 2015; Bullard & Wright, 2008).

To gain a deeper understanding of the injustices faced by the Umatilla community, it's necessary to analyze the Western water rights and how they impact this group in comparison to the communities of Grand Ronde and Warm Springs. It is important to acknowledge that agriculture has varying effects on different communities, and the systems set up to structurally benefit farms have far-reaching impacts.

Western water rights follow the prior appropriation doctrine of “first in time, first in right,”; which means that the first individuals to start using water that follows a

principle of “beneficial” use have senior water rights, while junior water right holders, those who came to the area later or who were granted water rights after others, have little to no say in how much water is available to them (Newman & McGroarty, 2019; Desert Research Institute, 2022; Mueller & Gasteyer, 2021).

The current system of water rights in Oregon and the Western United States is a form of procedural injustice, as the system of water rights in the Western part of the United States is a “first in time, first in right” system, tribes such as Grand Ronde do not have senior water rights, despite them being first in time, and tribes like Umatilla can not exercise those rights in ways that they wish, such as leaving water in streams to support culturally significant first foods like salmon (Meehan et al., 2020; Quaempts et al., 2018).

In addition to experiencing procedural injustice from the current legal system that structurally benefits large agricultural farms, the Western United States has also been experiencing a prolonged drought since the early 2000s, which would not have been possible without the effects of climate change (Zeighami et al., 2023). Drought has impacted California and Eastern Oregon the most (Zeighami et al., 2023), with large amounts of agriculture in these areas being supported by groundwater now (Patel & Tierney, 2022). Groundwater withdrawals can only last for so long before there is insufficient water to grow crops in these regions (Patel & Tierney, 2022).

As groundwater is drawn down, there is less water in the ground for everyone else, and the water table drops, necessitating deeper wells to be dug to continue accessing the water (Patel & Tierney, 2022). Wells are costly, which means that only the

wealthy, or those who make immense economic sacrifices, can afford to dig deeper wells, effectively excluding lower socioeconomic status communities and individuals from having access to water (Herald, 2021). This lack of access contributes to plumbing poverty in low socioeconomic status communities, especially rural communities without access to city water (Herald, 2021; Meuller & Gasteyer, 2021).

In Umatilla, community members recount the need to dig deeper wells because of groundwater overconsumption. The agricultural industry, which has been overdrawing groundwater, causes community members to need to dig deeper wells, a form of distributive injustice. In combination with this distributive injustice, the community of Umatilla also experiences procedural injustices because the structural system of Western water rights limits how the tribe can use their water to support their own first foods policy (Quaempts et al., 2018).

5.1.1. Short term solutions or adaptations to water access issues

Comparatively, there is less written about how individuals and communities are overcoming unreliable water access issues compared to who is experiencing those issues (Holden et al., 2020; Meehan et al., 2020; Mueller & Gasteyer, 2021; Pullen et al., 2017; Pierce & Gonzalez, 2017). Participants from Warm Springs and Umatilla have described at length the adverse outcomes of legacy pollution and unreliable access to tap water in their communities.

Within the communities of Warm Springs, Grand Ronde, and Umatilla, participants described troubles accessing clean drinking water, with water having a 'metallic, ground [like] taste to it' that 'turns everything brown' in Grand Ronde. In Umatilla, multiple community members describe needing to dig deeper wells because theirs keep going dry due to overconsumption of water by nearby farmers. And in Warm Springs, agriculture has been identified as being a contributor to drinking water pollution, namely through fertilizer, pesticides, animal waste by-products, and overconsumption of groundwater (Sasokova et al., 2018).

In Warm Springs, community members described their water as bad, and 'unhealthy,'; they expressed concern about the safety of the water for community members, as one Elder of Warm Springs described it,

> "...I worry about my children, my great-grandchildren and all my family about their health if they continue to use the water, but for the most part, I encourage them to use bottled water."

This was a finding that was also found in the paper by Pierce and Gonzalez, individuals who believe that their tap water is unhealthy often would resort to using alternative water sources (Pierce & Gonzalez, 2017). Another paper noted that individuals who thought their tap water was unsafe would resort to bottled or alternative water sources, which they believed to be safer and better regulated than tap water (Park et al., 2020).

Water is often assumed to be safe and trustworthy in countries such as the United States, however there is evidence that counters that myth (Meehan et al., 2020). As found within this research, participants had strong feelings of mistrust about the status of their tap water and how they resorted to drinking bottled water, which was a similar finding in many of the papers where they describe participants using bottled water due to a mistrust of the tap (Holden et al., 2020; Pierce & Gonzalez, 2017; Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Teodoro et al., 2022; Geerts et al., 2020; Viscusi et al., 2015; Saylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010).

Utilizing plastic bottles and other forms of alternative water sources such as environmental water can be considered short term solutions for addressing water access issues. The utilization of alternative water sources does not address or fix the root cause of water access issues, of which agriculture may be considered the biggest

driver of water pollution. Instead, plastic pollution has been identified in multiple studies as a growing problem worldwide, as single-use water bottles continue to grow in popularity every year (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Pierce & Gonzalez, 2017; Viscusi et al., 2015; Saylor et al., 2011; Triplett et al., 2019).

These studies have found that the people who use plastic water bottles the least are wealthy, white, and upper-class people, and the people who use plastic water bottles the most are lower-class, minorities, and women (Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Viscusi et al., 2015; Triplett et al., 2019). In addition, the burden of plastic waste often falls on those who do not create it, a further problem of distribution injustice for those communities (Cousins et al., 2022).

The other alternative water source that community members in Warm Springs utilized besides bottled water was water sourced from the environment. In Warm Springs, community members describe getting water from the environment, through springs and highland creeks, where the water they describe as being 'clearer' or 'having better taste' than the water that comes out of the tap. Participants described upstream waters as being safer than downstream waters because there were less inputs in those highland sources; this is a form of Indigenous traditional ecological knowledge, but also a practice that many communities practice in order to control their water supply, such as Portland, Oregon with the Bull Run Watershed (Oswald, n.d.).

Using environmental water over tap water might also be due to limitations in resources that individuals have in the communities of Warm Springs, poverty has been identified as being correlated to plumbing poverty, and alternative water sources are

typically significantly more expensive than tap-water alone (Meehan et al., 2020; Mueller & Gasteyer, 2021; Holden et al., 2020; Javidi & Pierce, 2018; Teodoro et al., 2022).

In Warm Springs, community members describe places that are held as community knowledge, and kept within the community, as places where they can get clean drinking water; as one participant describes it, “That's like one of the purest water here. it is more pure than just tap water or anything else.” Another participant describes how this information is shared within the community,

> “it is just gets passed down from generation to generation like, you know, this is a water source and it is a clean water source. And you know, you come here and get as much water as you can, but yeah, I mean some people know about it and you know some people over the years kind of lose touch about it.”

As a form of cultural capital and social learning, in this example a knowledge of the land and how to use it, can be considered a form of capital that can be drawn upon by those communities in order to solve a problem, such as a lack of access to clean water, and community members learn about knowledge by experiential learning (Bourdieu, 1973; Bandura, 1977).

In the communities interviewed, there were many long term plans to address environmental pollution and equally as many ideas on how to restore the landscape, but individuals faced a more pressing and immediate problem of dealing with the lack of

running water (Quaempts et al., 2018; Kohn, 2022). As one participant from Warm Springs describes how they get their water, mirroring a majority of participants experiences in this study,

> "it is usually from the bottle… or I'll get it here in Warm Springs at the natural springs. The spring water that comes out [of the ground]. So that's another place [to get water] and there's this place down here, just right down the road where they hand out gallons of water, bottled water. So I get those as well…"

Participants in all communities described not having water that they felt comfortable drinking, and most resorted to drinking out of bottled water for either part of all of their drinking water needs. Individuals in these communities have incomes that fall below the US average income (U.S. Census Bureau, 2020), and this places additional burdens on households who often can not afford it the most (Javidi & Pierce, 2018). This is a form of distributive injustice, as these communities disproportionately are affected negatively by factors outside of their control like pollution or climate change, and do not always have the means to overcome these issues. As described in prior literature and through the US Census, rural Indigenous communities are more likely to face plumbing poverty, where they can not access regular piped water through a faucet (U.S. Census Bureau, 2020; Meehan et al., 2020; Mueller & Gasteyer, 2021). Although, and suggested in other papers, if we were to include drinking water safety in this definition, we might find that

a broader subset of America faces issues with plumbing poverty (Mueller & Gasteyer, 2021).

Described in literature surrounding water bottle usage, researchers noted that BIPOC, Women and low income individuals were more likely to be purchasing bottled water, and to use bottled water as a replacement for water from the tap (American Water Works Association, 2020; Meehan et al., 2020; Mueller & Gasteyer, 2021; Holden et al., 2020; Pierce & Gonzalez, 2017; Javidi & Pierce, 2018; Christopher et al., 2019; Park et al., 2020; Teodoro et al., 2022; Geerts et al., 2020; Viscusi et al., 2015; Saylor et al., 2011; Triplett et al., 2019; Delpla et al., 2020; McSpirit & Reid, 2010). The populations identified in these studies reflect in part the community identified as using water bottles in this study, which is Indigenous communities, rural residents and those who are experiencing poverty. In addition, the American Water Works Association (2020) survey of America noted that while a vast majority of Americans have positive thoughts about their tap water, BIPOC, women and low income households were more likely to report negative perceptions of their tap water, a finding also found within this study (American Water Works Association, 2020).

Individuals in this study described having conflicting feelings about the use of single use plastic, especially for something like water, as described by this participant from Umatilla,

> "Its about finding that balance of not only space but time, you know, right now we need this but, do the future generations need it as well, right? And if they do

not, and if it is actually a negative and a hindrance upon them, then we really need to rethink about what we're doing in a crisis situation… It bothers me, but I get why people need water… But there has to be a better way and I know that there are better ways to be able to do that.… you think about each one of those water bottles and you know where they come from and all of the shipping and packaging and manpower and energy that went into that one little tiny bottle, you know, versus finding a local source that could do a lot of the same things… These crisis situations are always [something] that you have to deal with as it comes, but I just hope as we move forward that we rethink crisis situations. We rethink them because they're going to influence our everyday… Sometimes crisis just means an excuse sometimes, you know it is like 'I have the greatest excuse right now to use this,' You know this simple solution or waste this money or drill this hole or take out this hillside. it is like we always use those as an excuse, and sometimes we make things worse for the future."

In these situations, as described above as crisis situations by this participant, do not solve the structural issues with water access that is affecting these communities, in keeping with this participant's views, makes things worse for the future by creating additional problems in the form of single use plastic waste.

The situation cited by the participant from Umatilla also outlines an agent versus structural debate in sociology; in this case, the participant wants to move away from single-use plastics, as do the other participants from Warm Springs and Grand Ronde.

However, they continue to use single-use plastics because they find themselves in situations where they do not have any other choices (Stone, 2015). The participant from Umatilla describes an alternative scenario that better aligns with their worldview; in this scenario, there would be no single-use plastics, and the solutions to their drinking water problems would not cause future generations environmental problems, stopping the cycle of water insecurity and single-use water bottle usage. However, as an individual agent with little control over the larger structure of society, this scenario would require long-term changes geared toward changing the structure of society to prevent water insecurity initially (Stone, 2015).

Single water bottle usage has often been described as a choice of convenience for consumers by some researchers, those findings are based upon the assumption that everyone has equal access to clean running water (Javidi & Pierce, 2018; Park et al., 2020; Pierce & Gonzalez, 2017; Viscusi et al., 2015; Saylor et al., 2011). A paper called "Exposing the Myths of Household Water Insecurity in the Global North" describes how this myth was created, and the belief of equal access to clean drinking water is assumed in wealthy developed countries such as America (Meehan et al., 2020). This quote by a community member of Warm Springs describes their fears about what could happen to the river that supplies them with their drinking water,

> "... it is getting, I think, super bad. I'd like to compare it to the muddy waters of the Mississippi and how brown that is… I'm afraid we're going and we're moving towards that."

The Mississippi River is considered one of America's most polluted rivers, and in certain sections of the river, it is known colloquially as Cancer Alley due to a high amount of petrochemical facilities in that region (Baurick et al., 2019). The people who live along the Mississippi River experience environmental injustices because they experience rates of cancer from pollution at higher rates than the national average (Baurick et al., 2019). Another participant is quoted when asked what would happen if they find it inconvenient to have to resort to bottled water for drinking,

> "Yeah, I feel it was pretty inconvenient for me and I would like to be able to just go fill up a pot in my [house] out of my tap or or fill my water bottle or whatever out of my tap, but it is inconvenient because if I do not have the my bottled water then I have to go get it somewhere, and so it is quite, it is kind of inconvenient… I feel unsafe If I have to drink tap water, and I will boil it if I have to."

And this participant from Warm Springs also describes why they are using bottled water,

> "... So overall, because of my age and my health, I decided bottled water would be the best way to go. Basically because I do not know what's in it. What they call clean water. I do not know what's in it, what they're making it clean with because I know our water as it is today comes out of the Deschutes. And hard

telling what's within that. So I choose to just drink bottled water. Yeah, I do that with my cooking also, so I just use a lot of bottled water."

Participants in this study did not enjoy drinking bottled water, as described by this participant, they found it 'inconvenient', but also expensive, polluting, and not aligned with their values about future generations. Participants in all communities who drank bottled water noted that they did not have regular access to clean drinking water, and there is distrust because of their drinking water due to a history of drinking water safety violations, in the form of boil orders, but also due to environmental degradation within the communities they are located. A lack of safe drinking water is a distributive injustice for these community members, as they are experiencing the negative externalities of agriculture and legacy pollution not experienced by nearby communities.

In the community of Umatilla, the community faces different challenges than the community of Warm Springs. Participants in Umatilla described wells running dry, and how their tribal communities were able to help them dig deeper wells. This would be a form of economic capital as well, as the community was assisting individuals monetarily with well digging, but also a form of social capital as those tribal members were able to utilize their relationships to the tribe and community to get assistance with their wells (Bourdieu, 1986). Overconsumption of ground water to substitute for a lack of surface water has a recognized negative externality, and that is neighboring wells can be caught in a cone of depression, and the result of that is those wells going dry (Sasakova et al., 2018;Moss, 2008). Water rights currently allow for agricultural users of ground water

wells in Oregon to regularly use larger volumes of water than water for public consumption (Oregon Water Resources Department, 2018). There also is little to no recourse for individuals whose well has gone dry due to overconsumption of groundwater from an agricultural farm nearby in the state of Oregon (Oregon Water Resources Department, 2018). This lack of enforcement would be an example of a structural issue found within the communities interviewed, and for some of the participants interviewed, was identified as a barrier to accessing clean drinking water.

As community members have described, the use of environmental water or alternative water sources in groundwater depletion would address a short-term need for drinking water. However, it doesn't address those identified structural problems that initially caused community members to lose access to drinking water.

5.1.2. Long term solutions or addressing root causes of water access issues

By utilizing connections through boards, meetings, and various other activities, the Umatilla tribe is trying to change the situation of water rights for their tribe so that they can restore salmon runs for their people (Quaempts et al., 2018). In a sociological sense, this would address structural problems that have caused the Umatilla tribe, and to a broader degree, all Indigenous tribes, issues with water access and tribal sovereignty (Stones, 2015; Whyte, 2018; McGregor, 2018). Structural problems in this particular sense are the system of Western water rights, and addressing them would solve one of many root problems that Indigenous tribes across the country face with rights to water access (Stones, 2015; Ferrell et al., 2021).

Within all three communities, participants expressed strong desires to restore the environment to a state where they can continue their cultural practices and eliminate the pollution that harms the ecosystem; the confederated tribes of Umatilla have even released papers that outline their intent to restore the environment to begin harvesting culturally important foods (Quaempts et al., 2018). A participant from Grand Ronde described the restoration process at one site,

> "...Around Willamette Falls has been a large one [project] lately for us about cleaning up of the blue Heron site after the paper mill products closed and knowing the different chemicals that were in there and trying to restore that as a fishing and lamprey based food base for us, and then the other issues we've

been working is the Portland Super Funds. So we have tribal properties where we've been trying to access wapato, a water-based plant that can be used for clean up."

Environmental restoration would accomplish multiple goals for Indigenous communities; it would allow for the harvesting of first foods for tribes so that they can have safe access to cultural foods, which would also allow for the passing down of cultural knowledge about food and all the cultural knowledge surrounding it (Quaempts et al., 2018; Hoover, 2017). Secondly, it would help prevent or reduce environmental pollution in those sites, improving water safety and quality at the source (Quaempts et al., 2018).

Environmental restoration would be an exercise of cultural and economic capital on the part of the tribes, as acquiring properties would require capital investment by the tribe, and cultural capital would be used to restore the landscape using Indigenous traditional ecological knowledge (Bourdieu, 1986; Quaempts et al., 2018). Restoration of the environment would also be an exercise in reducing one structural issue tribes face: an overabundance of polluted lands (Ferrell et al., 2021). Environmental restoration, however, would not address a different structural problem, which is the production of these polluted lands, described as wastelanding (Voyles, 2015). Addressing the structural problem of producing polluted lands would entail changing the structures of society that produce those polluted lands (McGregor et al., 2020; Whyte, 2018; Stone, 2015).

Within these communities, addressing structural issues like water rights and allocations has been difficult, as described by this community member,

> "It gets really hard because water in the West has always been contentious and water supplies have been over-allocated for decades, and I think moving forward, some of those are going to have to be rectified, which are really hard, right because we rely on them [water rights]. We also rely on agriculture. We'd like to say that we'd like to be able to pick one or the other, but we can not, and so it is going to be a challenge in collaboration more than anything because, moving forward, the answers are going to have to be formed in collaboration."

Working against tribes' interest in protecting the environment are people who benefit from this current system and do not want to see it changed, as described by tribal members. Negotiating with individuals and systems who do not want to change the status quo but whose actions threaten tribal culture and livelihood is a form of recognition injustice (McGregor et al., 2020). All communities interviewed described various forms of recognition injustice.

The Umatilla tribe also utilizes social capital differently. As a tribe, they are working with policymakers regarding the allocation of water rights and resources to benefit in-stream flow, something a community member described as "frustrating" because if they left water in the stream, then junior water right holders downstream in Washington would be able to utilize that water, meaning there is no way that the tribe

can influence how much water is left for fish, a significant first food. The state of Oregon also allows for junior water right holders to pull water out of a stream during a drought, even if senior water right holders like the Umatilla tribe leave water in stream specifically for fish, because the state of Oregon prioritizes 'beneficial human and livestock water consumption' (Oregon Water Resources Department, 2018). The structural system of water rights in the state of Oregon favors Western views of water as a utility to be used, which is different from the views held by tribal communities like the Warm Spring, Umatilla, and Grand Ronde (Gregor & Whitaker, 2020; McGregor, 2018; Whyte, 2018; Kimmerer, 2013).

5.2. Linking environmental injustices to disruptions of Indigenous communities

Another finding that emerged from the discussions with participants was that environmental degradation, pollution, and loss of land are leading to a disruption of social learning in the communities. It was found that environmental pollution reduces the amount of culturally important foods and materials available to these communities but also raises concerns about the health and safety of those culturally important foods and materials. Both factors can lead to reduced opportunities for learning and experience in culture, which can disrupt social learning. Figure 2 shows this finding visually.

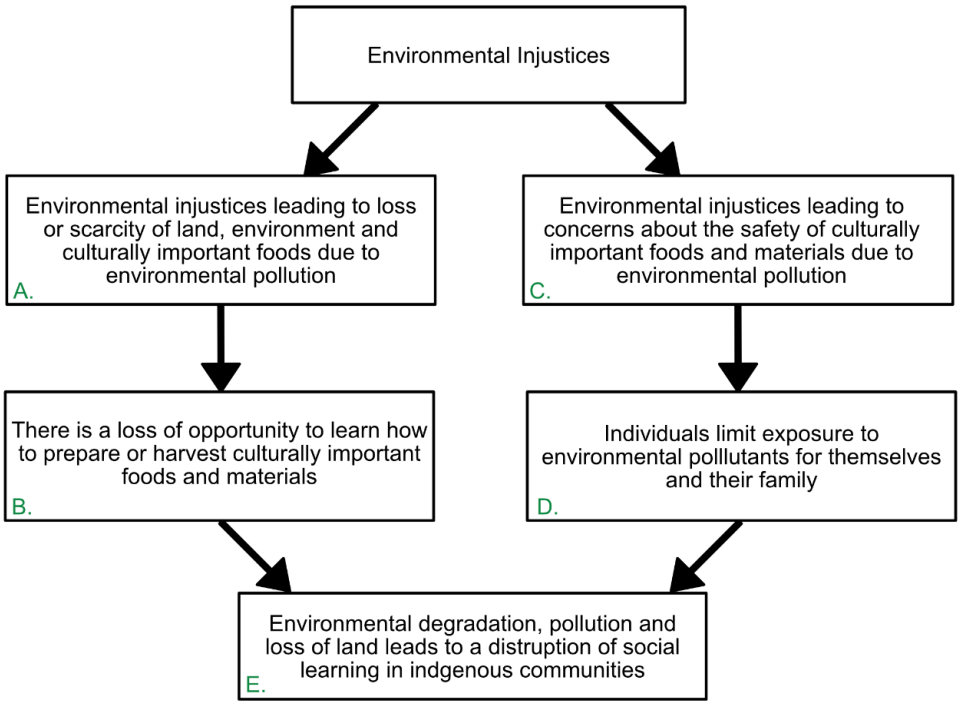

Figure 2: Environmental injustices can lead to disruption of social learning within Indigenous communities.

Environmental injustices can lead to scarcity of land, environmentally and culturally important foods due to environmental pollution. This can result in a loss of opportunity to learn how to prepare or harvest culturally important foods and materials, which can disrupt social learning. Environmental injustices can also lead to environmental pollution of culturally important foods and materials. This can result in individuals and families limiting their exposure to environmental pollutants for their health and safety, disrupting social learning in Indigenous communities.

5.2.1. Environmental injustices leading to a loss of land, environmental and culturally important first foods.

Since the industrialization of agriculture, streams and rivers in agricultural communities have suffered from immense pollution (Ferrell et al., 2021; Throw et al., 2011; Moss, 2008; Sasakova et al., 2018; Baurick et al., 2019; Newman & McGroarty, 2019). This pollution comes from fertilizers, pesticides, and sediment runoff from plowing fields, which participants of every age group described as occurring in all three communities. Like in many other rural communities, the rivers and streams surrounding farms in Warm Springs, Grand Ronde, and Umatilla have been negatively impacted by the agriculture in their surrounding communities, which participants in all three communities have described (Newman & McGroarty, 2019; Baurick et al., 2019; Throw et al., 2011).

Environmental pollution from agriculture is a form of distributive injustice; the tribal communities themselves are not receiving the economic benefits of farming; however, they are receiving the externalities of farming, namely pollution, which has many detrimental knock-on effects (Newman & McGroarty, 2019; Quaempts et al., 2018; Roberta, 2007; Menton et al., 2020). An Elder from Warm Springs describes the negative effects of pollution,

> "Well, for one thing, it is probably poisoning our fish, which is one of our primary traditional foods, our eels. We eat eels, and I know sometimes you can taste it

inside of the eels or the salmon that's coming up. You seem not to have as many fish as we used to a long time ago."

As described by the Elder from Warm Springs, environmental pollution is potentially leading to the poisoning of fish and eels, which are primary foods for the tribe. In addition, the Elder recounts not seeing as many fish as before, which is also verified by studies showing declining salmon runs in the Pacific Northwest (Crozier et al., 2021). The connection between environmental degradation, loss of first foods, and opportunities for younger generations to participate in social learning is shown visually in Figure 2, and denoted by the symbol A and B.

This relationship is important because salmon runs are expected to decline even further in the near future despite significant efforts to restore habitat (Crozier et al., 2021). This is another way that tribes are experiencing environmental injustices; salmon remain culturally significant and important for many tribes, they also have treaty rights guaranteeing tribes the rights to fish for salmon; however, salmon runs continue to decline due to inaction on climate change and physical infrastructure that impedes their ability to travel up or downstream (Crozier et al., 2021).

Pollution from industrial farming has many environmental effects (Quaempts et al., 2018; Roberta, 2007). Sedimentation can cause rocky stream habitats to be buried in sediment, which reduces spawning habitat for salmon and other aquatic organisms that rely on a clear rocky bottom for their habitat (Throw et al., 2011; Moss, 2008; Berg,

2022; Sasakova et al., 2018; Quaempts et al., 2018). The runoff from fertilizers, namely nitrogen, and phosphorus, are directly linked to algae blooms, which can cause anoxic conditions within streams, smothering plant life and creating harmful levels of nutrient accumulation within these aquatic ecosystems (Sasakova et al., 2018; Quaempts et al., 2018). Another form of pollution that is less direct is when agricultural farms draw water from the river ecosystem, leaving the streams with less water and with reduced flow (Quaempts et al., 2018; Moss, 2008; Throw et al., 2011). This causes temperatures to rise, which, combined with other forms of pollution, can drastically reduce fish counts in these streams (Throw et al., 2011). An Elder from Warm Springs who has lived within the community describes how the environment has changed in their living memory, including the depletion of a salmon known as the Dolly Varden,

> "…Some like the Dolly Varden; we used to catch those mostly for fun, but some people used to eat them, but they're no longer here."

For tribal communities, whose sense of identity is tied to place, the destruction of these habitats impacts more than the environment; it also has detrimental effects on the tribal communities themselves (McGregor, 2018; Kimmerer, 2016; Roberta, 2007). In many tribal communities, first foods, traditional food that a tribe has relied upon since time immemorial, are essential for the identity and cultural heritage of those tribes, as it is in many other cultures, food plays a vital role in the maintenance of cultural identity (Quaempts et al., 2018). The continuation of culture and traditions, in the case of

Indigenous tribes, relies a lot on the practice of eating and preparing culturally important foods; through the theory of social learning, a lot of culture is passed down through the growing, harvesting, preparing and eating of culturally important foods, without that occurring (Quaempts et al., 2018; Kimmerer, 2016; Bandura, 1973). An Elder from Warm Springs describes how a reduction in first foods leads to a loss of culture,

> "I feel like that's a loss in our spirituality, the context of our traditional and sacred foods, because that is one of our primary sacred foods is the salmon, and how we treat it, how we wear it. You know, and how we celebrate it when it first comes up the river and gives thanks for it, we have a feast that celebrates the coming back of the salmon. And maybe we won't have a feast down the road if the salmon is not healthy enough to eat. And that's taking away our lifeways, our culture, and how we've lived for time immemorial. Eating salmon is one of our first foods. So if that goes away, what is to say what would be next?"

As described by the Elder from Warm Springs, the loss of culturally important foods like salmon would lead to a loss of spirituality and culture because of how significant first foods like salmon are to their tribe's sense of identity. A loss of salmon also would mean that younger generations would not be able to participate in any of those culturally significant activities that have occurred since time immemorial. According to social

learning and capital theories, this could impede the younger generation's cultural education as they are deprived of hands-on learning experiences and the opportunity to acquire knowledge by observing and learning from others (Bandura, 1977; Bourdieu, 1986).

5.2.2. Environmental injustices leading to concerns about the safety of culturally important foods and materials

As outlined in Figure 2, symbols A and B, environmental injustices may lead to a disruption of passing down of cultural knowledge because of the reduction of culturally significant foods in the environment. Figure 2, symbols C and D outlines the other pathway that may lead to a disruption of passing down cultural knowledge, which is through concerns about the health and safety of foods or materials gathered through the environment.

The passing down of cultural knowledge has been described as disrupted by participants within the communities interviewed. Several factors were identified by participants which may have contributed to a disrupted passing along of culture knowledge, among the biggest concerns was health, safety and environmental degradation. One participant described how in their community, which was downwind and downstream of the Hanford nuclear plant, is experiencing cancer cluster

> "...We grew up downwind from Hanford and we have cancer clusters in our community… And my husband, who was also raised in that area, has had 7 great aunts who all died from cancer. That's one entire generation of sisters who were lost to breast cancer."

In the book Wastelanding, by Traci Voyles, she talks about the Diné people in the United States, and how their land was deemed less valuable, and thus a suitable place for uranium mining (Voyles, 2015). In this book, the author describes the legacy of wastelanding and its impact on the Diné people, among them cancer clusters and longstanding health issues within the communities who worked for the mines, which were mostly comprised of Indigenous and native people; they continue to face the environmental repercussions of those choices made by the US government decades after those choices forced upon the Diné people were made (Voyles, 2015).

Against the backdrop of the Hanford site and its ongoing contamination, agriculture and colonization has contributed to a different type of pollution (Ferrell et al., 2021; Sasakova et al., 2018; Moss, 2008; Hoover, 2017). An unsafe environment for these communities poses many threats, both to safety and the future of their culture. When community members worry about the safety of their environment they are less likely to want to interact with it, as described by this community member,

> " It seems so simple. But it is really not because there's so many health issues that are created by different things. Even finding out like the tire tread and the impact it has on our creeks and tributaries and our fish, and then the other small life and then plant life like wapato. Cattail is one of the things that we're trying to get access to including wapato, but, we use cattails for food, for medicine and also for weeding so it can come into our lives In many different ways… it grows in these little roadsides and the creeks, our families used to go and gather those

and use those. Now we're learning there's so many more things to be concerned about than we ever knew possible."

Given that in these communities have paid for pollution with their health as described earlier by many participants, and one who recounted a cancer cluster within their community, older community members expressed hesitancy to continue harvesting natural resources like wapato, salmon, among other materials, either out of fear of pollution or because the pollution has caused those resources to disappear from the landscape.

In the theories of social learning, experiential learning is an important part of passing down culture, without the ability for these communities to safely pass down that knowledge, it may be hindering the transfer of cultural knowledge from older generations to younger generations (Bandura, 1973; Bourdieu, 1986).

These quotes from participants in Grand Ronde and Warm Springs mention how the environment that they grew up in is no longer the same environment today due to pollution. This quote is from a participant in Grand Ronde who has children themselves, and is describing how they are curtailing their own children's experience with the environment that they grew up in,

"...And I'll be honest, when we were growing up as kids, we thought that was like our little swimming creek, so we would swim in it. Now we have to tell the kids 'please stay away'."

Another quote from a participant in Warm Springs describes how the environment has changed for them and their children,

> "...The Hanford uranium mine did some damage to a lot of salmon and they're depleted those runs to where they're not existent right now. So, yeah, that Hanford project, it is still to this day open. it is still an open pit… Yeah, I mean that's doing some damage to the river…"

This participant is expressing concern about legacy contaminants in the Columbia River from the Hanford nuclear site. This participant has children of their own, and is concerned that the salmon that they are still left in the river are unhealthy and potentially contaminated from the uranium mines, something they described as not wanting to expose their children too. Another quote from Warm Springs illustrates how a participant is seeing the decline in the environment,

> "...And so they're getting smaller… They're getting, like, a 40-pound salmon is a big salmon nowadays when it was like the, you know, 30s and 40s, that was a small fish. I mean, it is still pretty good-sized salmon, but you know, 40 pounds, I guess you could call that like a medium-sized fish, but nowadays it is a large fish."

This participant, who is a young parent, is describing how the average size of the salmon has declined in their lifetime, what was once a small or medium sized fish is now considered a large fish. The combination of these experiences highlight how environmental degradation has influenced the views of the environment, and how these participants are not able to fully enjoy the environment as they once did. This has resulted in participants from Warm Springs and Grand Ronde understanding the environment in terms of environmental pollution.

5.2.3. Environmental degradation, pollution and loss of lands leads to disruption of social learning in Indigenous communities

As discussed in the prior two chapters, 5.2.2. and 5.2.1., environmental injustices have led to a countable decline in significantly important first foods and environmental pollution, which in turn have restricted access to the environment in ways that can hinder the accumulation of cultural knowledge through social learning (Bandura, 1973; Bourdieu, 1986). In Figure 2, symbol E, it is shown visually how these disruptions to the environment can lead to similar outcomes, which is a loss of opportunities for younger generations to gain experiential knowledge about culture and the environment in ways that older generations have.

Within these communities, the younger participants mentioned water in utilitarianism terms, as described in the following quotes when asked about the importance of clean water, and what clean water means to them,

> "And here like a lot of people say 'purified water,' and then they're like your 'water bottles aren't actually pure, like, you know, the plastic ones. Oh, it has, like this chloride or whatever. And it is this way it is chloride and stuff.'"

This is a quote from a young person in Warm Springs, who is describing what clean water means to them. Another quote from a different young person in Warm Springs describes what clean water means to them,

> “I can’t really say it's like it's just kind of like, I've just always assumed. Not necessarily learned or read about. I just always assumed water was a given commodity that we all can consume…”

Compared to how an Elder in the community described water, the importance of clean water, and what clean water means to them.

> “... There's one thing that I say about the water here. You know the water, we find it very sacred with that [it] provides nourishment for our bodies. And then it also, you know, is a source to conduct certain ceremonies and we need water, clean water to do that.”

An Elder in the same community described at length the importance of clean water, but also what regrets that they have with not being able to share that knowledge with younger generations,

> “What I get afraid of is that people of my age who know the importance of water and understand that religious and our spiritual context of our waters; is something that our younger generation seem to lack and so they just think waters just for swimming, playing and having fun with, whatever, but not to really understand that water is the giver of life.”

When looking broadly between the communities, the younger participants interviewed did not describe water in similar terms as older generations, and older generations of the community also described hesitancy and significant concerns about safety with the environment. Crucially, younger generations also described concerns about the safety of their water, land, and foods, especially in light of the events of Hanford or agricultural pollution. Experiences of environmental injustice are shared equally between generations and communities, similar to environmental injustices such as loss of water rights, timber, agriculture, nuclear waste, and plumbing poverty.

Within these communities, a key transfer of knowledge and culture might not be occurring because of an inability to access and utilize the environment in ways older generations have since time immemorial (Bandura, 1973; Bourdieu, 1986). This disruption of the passage of knowledge may occur through the loss of environment and contamination of what is left of the environment still available to the tribes. A lack of ability to pass down cultural knowledge, described in the theory of forms of capital as cultural capital, through physical restraints placed upon the tribe due to the legacy pollutants left over from industrial agriculture or the Hanford nuclear site, has left older generations the inability to pass down knowledge through experiential learning, as described in social learning (Bandura, 1973; Bourdieu, 1986). Instead, a new type of knowledge and cultural understanding might be occurring: the transfer of knowledge about pollution, restoration, and concerns about the environment's future (Bandura, 1973; Bourdieu, 1986).

Older generations described sites where the collection of cultural foods and materials might occur but also described the genuine concern about the legacy of pollution those sites have, such as the Portland Superfund site or property acquired from private landowners, where they might not want to consume or use those materials in the recreation of cultural goods like baskets or hairbrushes. Older generations also describe environmental restoration as a path forward for their culture, allowing them to resume cultural activities and use first foods or expand their capacity to use first foods (Quaempts et al., 2018).

Several Indigenous environmental movements are based upon Indigenous communities' knowledge and leadership; those movements have gained international recognition surrounding the importance of biodiversity, health, water, and preserving the environment for future generations (Nakamura, 2021; Alfonseca, 2022; Falquez & Verde, 2022).

In the context of these communities, environmental pollution has led to severe and ongoing water issues, which has led to a loss of culturally important plants, animals, and places. Without these crucial cultural resources, observational learning might not occur, which is how cultural knowledge is transferred from generation to generation (Bandura, 1973; Bourdieu, 1986). This can translate into being unable to perform activities necessary to culture, such as fishing, harvesting or preparing foods, making traditional goods, or passing along associated knowledge, a form of cultural capital under Bourdieu's forms of capital (Bourdieu, 1986). In more than one instance, participants in this study linked poor water quality in their communities to a decline in

fish populations, concern about severe pollution within those fish, and concern about the health of their community if they ate those fish.

In the theories of cultural capital, the transfer of cultural capital occurs early and continuously between families and communities, and is important to understand how to not only know how to use certain cultural objects, in this example a basket or weirs, but how to create them, and when to use them (Bourdieu, 1986). Without the passing of this cultural knowledge, important contexts of a culture go missing, even if the knowledge of how to build baskets and weirs continues (Bourdieu, 1986).

This can be understood in the context of this research as understanding Indigenous traditional ecological knowledge and cultural practices tied heavily to place and are the accumulations of generations of knowledge (Kimmerer, 2016; McGregor, 2018; Whyte, 2018; Bourdieu, 1986). Participants in this study understood how water is impacted by pollution and misuse, but only older generations understood water in terms of spirituality, culture, first foods, and practices.

5.3. Further research and limitations

Although the study design and execution were carefully considered, the findings are limited to the studied communities and cannot be directly applied to others. In this study, three primary limitations were identified.

The study interviewed only 11 participants and targeted a specific community to avoid the need for a large sample size. This was in contrast to the much larger 2020

American Water Works Association, which lacked Indigenous perspectives (American Water Works Association).

When using purposivel sampling, it is important to acknowledge unknown representativeness (Etikan et al., 2015). This method alone may not produce a representative sample, especially when researching underrepresented populations like rural Indigenous communities (Etikan et al., 2015). Participants recruit individuals within their social networks, excluding those who do not belong (Etikan et al., 2015). The purposivesampling method may also yield biased results, as like-minded individuals are often recommended to participate, potentially skewing the study outcomes (Etikan et al., 2015).

This research was also made more difficult because of the researcher's urban location, and the research communities' rurality and distance. The communities researched also did not share the same educational background as the researchers, which may have resulted in a bias in the selection of community partners contacted.

In conducting this research, additional questions arise, which further studies in the same communities, particularly Indigenous and rural communities, can answer. This study raises questions about the environmental impacts on first foods and how Indigenous communities are navigating tribal food sovereignty. Additionally, this research questions tribal involvement in land practices and how integrating Indigenous traditional environmental knowledge can improve tribal food sovereignty. Further research could bring important insights into the connections between environmental health and cultural practices in Indigenous communities.

5.4. Positionality statement

As the primary researcher on this research project, I share identities with the communities I interviewed, but, I also differ in certain aspects of my lived experiences. As a registered member of an Indian tribe in the state of Washington, I shared this identity with my participants and community members, this informed my analysis and understanding of participants' lived experiences and struggles. For some of the participants I talked to, my experience of attending a four-year university and receiving a degree was shared, while other participants did not share this experience with me.

My experience of living in an urban center while conducting this research was not a shared experience my participants had, although this was an identified difference between myself and the community participants I interviewed prior to starting the research. I also shared gender identities with some of my participants, but again, not all of the participants interviewed had that same identity. This was expected prior to beginning research.

Finally, my identity as a student was shared with some of my participants, however, a majority of the participants I held interviews with were much wiser and had much more wisdom to share than I did. With time I will eventually share this identity with the participants I interviewed.

6. Conclusion

6.1. Overview

In conclusion, the three Indigenous communities interviewed all had some variation of a water access issue, in Grand Ronde, it is a loss of water rights; in Warm Springs, it is a lack of clean drinking water; and in Umatilla, it is a loss of water in streams and groundwater to agriculture. All three communities responded to these challenges differently, utilizing different forms of capital and resources to overcome these structural challenges in the short and long term by addressing the systemic issues causing their problems.

What also emerged as a finding was that environmental degradation has reduced cultural foods, affecting the harvesting and preparation practices for some of the tribes. Participants described this as a barrier to practicing and passing down cultural knowledge. These findings are also found in other tribes across the United States. They reinforce the need to protect the environment so Indigenous communities can practice their culture and traditions without fear of legacy contaminants from industrial or agricultural industries.

Despite these two findings, the Indigenous communities studied were empowered to respond to these environmental injustices with their knowledge of the environment and desire to restore cultural lands for future generations.

This study has also raised new questions about the linkage between environmental degradation, the obstacles it places on culture in Indigenous communities, and how that might be overcome by Indigenous communities moving forward. These questions emerged as a topic of concern for participants when discussing the importance of clean water.

Since the beginning of the research project, the Warm Springs community has received federal funding to restore parts of their water system (Land, 2022; Fedinick et al., 2017). This funding is necessary and will have positive impacts on the community for years to come (Land, 2022). However, it does not address the structural problems identified in this research that caused the water system failures in the first place, namely disinvestment in rural water systems, which is still an ongoing issue in America (Fedinick et al., 2017). This one time round of funding for tribal water systems will not reverse a decades-long trend of disinvestment (Fedinick et al., 2017).

This research discovered that communities in Warm Springs, Oregon are using environmental water to supplement a lack of clean and safe drinking water, and are determined to provide their own safe drinking water through community-led distribution systems. The Warm Springs, Grand Ronde, and Umatilla Indigenous communities are also willing and determined to address long-standing structural issues in accessing clean drinking water.

6.2. Recommendations

As outlined in this research, Indigenous communities face numerous challenges with water access and are active in addressing these issues. However, barriers remain to allow Indigenous communities the same opportunities for practicing their culture and traditions as other communities. Access to water and control over that water plays a vital role in the ability of Indigenous nations to grow, harvest and maintain their culturally essential foods, which play directly into their culture, as they do with other cultures (Bandura, 1973; Bourdieu, 1986; Quaempts et al., 2018).

Despite constituting approximately 2% of the United States population, Indigenous and Native Americans were not included in the American Water Works Association (U.S. Census Bureau, 2020; American Water Works Association, 2020). Their perspectives, unique histories, and experiences were not documented in this survey, despite the fact that Indigenous communities are more likely to be experiencing plumbing poverty compared to any other racial group in the United States (U.S. Census Bureau, 2020).

One suggestion for better representing Indigenous communities and other marginalized communities is to identify key communities, in this case, Indigenous people, since there is a documented history of plumbing poverty and other related water issues in Indigenous communities for further examination. Survey practitioners could intentionally over-sample communities such as Indigenous communities to ensure

enough respondents since, in large surveys, those communities have a high chance of being overlooked or not generating enough data for analysis (Etikan et al., 2015).

By sampling marginalized communities intentionally, a large national survey such as the American Water Works Association survey can have a more extensive, more richly detailed set of statistics about every community in America, which includes Indigenous communities and other marginalized communities (Etikans et al., 2015). Examining the national state of infrastructure, especially for something as critical as water, should be a goal of survey practitioners to ensure that the data is accurate and reflects every community.

To best reach marginalized communities, it is suggested that purposive sampling methods of marginalized or small communities be used because those communities can often be overlooked by broad, general surveys (Etikans et al., 2015). The intentional sampling of these communities can introduce limitations to the study, i.e., that the intentionally sampled communities are not representative of the broader population; instead, these limitations are what makes social research relevant and necessary for policy work as it samples the communities who are the most affected by these issues (Etikans et al., 2015; Timmermans & Tavory, 2012).

Sampling marginalized communities can be aided by reaching out to key community stakeholders within those communities, this can facilitate connecting with and sampling a marginalized community in a way that best reflects their needs and ability to contribute to surveys. Finding a community stakeholder can be made easier by understanding the needs within those communities, such as a particular service

frequently used by community members or places of gathering (Guba & Lincon, 2001). Identifying those places can assist in finding a community partner or stakeholder who can be helpful in making connections between the community and researchers.

Sources

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Appendix A: Consent Form

Consent to Participate in Research (No Signature)

Project Title: Oregon Water Stories, Q-methodology

Researcher: Melissa Haeffner, Environmental Science and Management

Portland State University

Researcher Contact: melh32@pdx.edu, 503-725-2497

You are being asked to take part in a research study. The box below shows the main facts you need to know about this research for you to think about when making a decision about if you want to join in. Carefully look over the information in this form and ask questions about anything you do not understand before you make your decision.

Key Information for You to Consider
● **Voluntary Consent**. You are being asked to volunteer for a research study. It is up to you whether you choose to involve yourself or not. There is no penalty if you choose not to join in or decide to stop. ● **Purpose**. The reasons for doing this research are to understand Oregonian's primary water concerns throughout the state. ● **Duration.** It is expected that your part will last 20-40 minutes. ● **Procedures and Activities.** You will be asked to complete a short survey and, if receiving your gift card through email, you will be asked to provide your email for the gift card. Then you will be asked to view a 6-minute video explaining how to do the sorting task. You will be asked to sort 24 statements relating to water priorities in the state of Oregon. After sorting the statements, you will be asked to write your thoughts about the statements in a survey format. ● **Risks.** Some of the possible risks or discomforts of taking part in this study include taking time from your day. ● **Benefits**. No direct benefit aside from compensation, but the researchers hope to learn more about Oregonians' water priorities. ● **Options.** Participation is voluntary and the only alternative is to not participate.

What happens to the information collected?
Information collected from you for this research will be used to learn about Oregonians' water priorities. Aggregated results might be shared with state agencies who work on water-related concerns.

How will I and my information be protected?
We will take measures to protect your privacy including not recording your name or address. Despite taking steps to protect your privacy, we can never fully guarantee that your privacy will be protected. To protect all of your personal information, we will keep your responses in password protected files. Despite these precautions, we can never fully guarantee that all your study information will not be revealed.

What if I want to stop being in this research?
You do not have to take part in this study, but if you do, you may stop at any time. You have the right to choose not to join in any study activity or completely stop your participation at any point without penalty or loss of benefits you would otherwise get. Your decision whether or not to take part in research will not affect your relationship with the researchers or Portland State University.

Will it cost me money to take part in this research?
There is no cost to taking part in this research, beyond your time.

Will I be paid for taking part in this research?
Participants will receive a $50 gift card.

Who can answer my questions about this research?
If you have questions or concerns, contact the research team at:

Melissa Haeffner
503-725-2497
Melh32@pdx.edu

Who can I speak to about my rights as a research participant?
The Portland State University Institutional Review Board ("IRB") is overseeing this research. The IRB is a group of people who review research studies to make sure the rights and welfare of the people who take part in research are protected. The Office of Research Integrity is the office at Portland State University that supports the IRB. If you have questions about your rights, or wish to speak with someone other than the research team, you may contact:

Office of Research Integrity
PO Box 751
Portland, OR 97207-0751
Phone: (503) 725-5484
Toll Free: 1 (877) 480-4400
Email: hsrrc@pdx.edu

Consent Statement

I have had the chance to read and think about the information in this form. I have asked any questions I have, and I can make a decision about my participation. I understand that I can ask additional questions anytime while I take part in the research.

☐ I agree to take part in this study

☐ I do not agree to take part in this study

Appendix B: Recruitment poster

Appendix C: Interview Questions

Questions for interview

1. How do you usually drink water - from the tap, bottled water, or something else?
2. How would you describe your tap-water quality?
3. Have you or your family ever gotten your water quality tested?
4. Do you think that everyone in your community has fair access to clean water?
5. Can you describe when you learned about the importance of clean water for the environment or health?
6. To you, what makes water clean and safe to drink?
7. If you had a problem with your water, do you think it would be addressed?
8. If you had a concern about your tap-water supply, who would you talk to to fix this issue?
9. Do you trust your government, community, or local media to inform you of an issue in your community?
10. Has there been a time when you were asked for your input, or vote, on any sort of water issue in your community?
11. Have you heard anything on the news about water quality problems?
12. Is there anything else you want to say about drinking water that we didn't cover?