

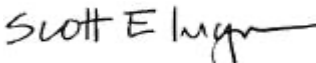
The Romance and Reality of Acequia Farming

An Ethnographic Documentation of a Traditionally Drought Resilient Irrigation
System in San Luis, CO

A SENIOR CAPSTONE PROJECT

Presented to
The Department of Anthropology
The Colorado College

BY
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April, 2024

Approved: 

Date: April 25, 2024

HONORS PLEDGE: On my honor, I have neither given nor received unauthorized aid on this assignment.

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ACKNOWLEDGEMENT

The research presented in this paper was supported by a Jackson Fellowship, provided by the Helen Jackson and William S. Jackson Family Endowment, from The Hulbert Center for Southwest Studies of Colorado College, Colorado Springs, Colorado. I would like to extend gratitude also to the Kathleen A. Jones Memorial fund for supporting my fieldwork and presentation of this research at the Society for Applied Anthropology.

Thank you to the San Luis community for welcoming me into your town and trusting me with stories of your lives, livelihoods, families, and traditions. I hope that this research serves as a gift for everything you did to support me during my time living and working in San Luis. I hope that it does justice to the stories that you have shared with me. I would like to extend a special thanks to Jock Jacober for welcoming me into your beautiful home in San Acacio for the duration of my fieldwork. Thank you, Dr. Becky Brice (USGS) and Dr. Natalie Kehrwald (USGS) for inviting Colorado College to collaborate on such incredible and important projects and your guidance, both pertaining to and unrelated to this report. I looked up to you both as role models of groundbreaking scientists and caring humans. I would like to extend gratitude also to Dr. Scott Ingram for advising me on every single aspect of this project and supporting this ever growing and changing nature.

Thank you to the AN328 Climate and Human Behavior class for helping with the tree coring at the Trinchera Bear Creek site and initial paleoclimate reconstruction. In particular, I would like to acknowledge Jamie Harvie and Evan Arvizu for their continued passion and contributions to this project beyond the course and for joining me in conducting my fieldwork.

Abstract

Acequias are a traditional flood irrigation system prevalent across the Southwestern US that employ physical infrastructure and water management strategies to withstand the persistent aridity and periodic droughts characteristic of the region. Nearly 1000 acequias are still being managed communally in Southern Colorado and New Mexico today. Sustainability-focused academics have studied these systems to understand their implications for maintaining agricultural practices in a more arid future. This study is set in San Luis, CO, where the town's first acequia was dug in 1852 and has remained in continual operation ever since. San Luis acequia community members reported that journalists and academics who write about the San Luis acequias fail to depict how modern pressures have weakened the community's ability to respond to drought using the same strategies historically employed. These outside sources also ignore how the farmers have adapted the system from its traditional form. My results use ethnographic and interview data to supplement these incomplete portrayals of the San Luis acequias. I catalog visions for the future of the system that are diverse and divergent within the community. I capture the daily lives and agricultural practices of the San Luis acequia farmers at the request of community members hoping to portray the system as it currently functions for future generations. This report could serve as a blueprint for others studying traditionally drought resilient communities to inform a more arid future.

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Introduction

The oldest water right in Colorado is held by the San Luis People's Ditch, an acequia in San Luis, CO which has remained in operation since it was dug in 1852 (Colorado Water Conservation Board, 2023) (*figure 1*). Acequias are community-managed irrigation systems built to distribute snowmelt through hand dug channels into the fields of farmers when direct precipitation is insufficient (Arellano, 2014). Acequias were brought to the Southwest US during the Spanish colonial period almost 400 years ago (Lamadrid & Rivera, 2023). Similar forms of irrigation are used in arid landscapes across the world (Lamadrid & Rivera, 2023). *Acequia* is the Spanish word for both the physical infrastructure and the associated social institutions established to manage the water (Lamadrid & Rivera, 2023). Nearly 1000 acequias are still being managed communally in Southern Colorado and New Mexico today, but many are suffering from the threats of modernization as they struggle to maintain their traditional practices in the face of political, economic, social, demographic, environmental, and climatic pressures (Flores, 2020).



Figure 1: A photo of an acequia-irrigated field in San Luis, CO.

Deepening drought and increasing aridity in the Southwestern US has shifted the interest of many Southwestern anthropologists, environmental scientists, and academics to the study of sustainable development and drought resilience. Their work has focused on the ability of these systems to inform water management decisions for communities across the Southwestern US as they plan for a drier future. During my fieldwork in San Luis, CO, acequia farmers often highlighted a disconnect between written work on acequias's enduring drought resilience and the farmers' lived experience. Most acequia literature written by scholars or journalists documents the traditional physical and social infrastructure of the acequias and/or highlights the system's potential to inform future drought resilience outside of the community. These works often fail to mention how modern pressures have weakened the community's ability to respond to drought using the same strategies that they have historically employed or how the farmers adapted the system from its traditional form to respond to those pressures. The literature also does not often include future goals of the community when these goals contradict efforts to sustain the system in its traditional form into the future. This study uses ethnographic and interview data from my time studying the San Luis acequia system to address these inaccurate or incomplete portrayals by outside sources.

My research questions were: *What modern pressures currently threaten the future of the San Luis acequia community? What goals does the San Luis community have for the future of the acequia system?* I argue that the San Luis acequia system is currently facing modern pressures that have weakened the ability of the farmers to respond to drought using the same strategies that they have historically employed. I conclude that aspirations for the future of the acequia system are diverse and contested within the community, but sustainability of the acequia system as it had previously operated was rarely the goal of farmers. The only unanimously articulated goal for the San Luis acequia system was that it be documented for the benefit of future generations. This report addresses this aspiration by capturing the daily lives and agricultural practices of the San Luis acequia farmers for future generations. The intended audience for this study is residents of San Luis, CO. This study also has implications for academics studying traditionally drought resilient systems to inform a more arid future.

I begin this report with a *Literature Review*, an overview of the incomplete and often extractive documentation of acequias in the Southwestern US written by academics not part of an acequia community. In the *Research Design and Methods* section, I explain how I employed a mixed methods approach to ensure that the conclusions I draw about the San Luis acequia community are

comprehensive, well informed and address the goals of the community. In the *Study Site* section, I provide an overview of the social, hydrological and geographic context of the San Luis acequia system. In the *Results* section, I use qualitative thematic analysis to sort the modern pressures experienced by the community into distinct themes. I then use ethnographic and interview data to argue that the goal of San Luis acequia farmers is rarely to sustain the system as it has traditionally functioned. In my Conclusion, I present my research as a possible blueprint for academics studying acequias to integrate the goals of the community into their research.

Literature Review: Studying & Sustaining Acequia Tradition to Inform Future Aridity

Traditional irrigation systems, such as acequias, have attracted the attention of sustainability researchers, scientists, scholars, journalists, students, photographers, artists, writers, tourists, and others looking to understand systems that have withstood aridity historically. Researchers have often studied acequias to understand their implications for maintaining agricultural output in a more arid future. This attention has been focused on “what [acequias] might teach us about sustainable, resilient adaptive strategies” (Rodríguez, 2020). Such research lacks an accurate portrayal of any conflicting sustainability goals between the researchers and communities being studied. To identify this disconnect in the ‘sustainability’ literature about acequias, I consider the question: “*The sustainability of what and for whom?*” (Xu et al., 2022). I respond to these questions by first depicting how academics have presented traditional acequia infrastructure. I then highlight that the primary goal of these depictions is often to inform water management *outside* of the community being studied. Finally, I argue that my research supports a movement within the study of acequias to integrate community goals in the design of the study.

Sustainability of what?

There is a robust body of work documenting the drought resilience of acequia irrigation practices as they have historically functioned (Arellano, 2014; Lamadrid & Rivera, 2023; Rivera, 2005). I draw on this literature to explain how the physical and social infrastructure of traditional acequias were designed to manage irrigation when there is limited water available.

Physical Infrastructure

Originating in the Iberian peninsula and later used in the Southwest by early Spanish settlers, acequias are designed to divert snowmelt from mountains through open ditches into the fields of farmers. Hand dug irrigation ditches funnel water from snowmelt-fed rivers into what is called an acequia madre, the mother ditch (Rivera, 2005). The water is then diverted by individual farmers to flood their fields (Rivera, 2005).

According to Fernald et al. (2010), acequia farmers typically practice flood irrigation because it allows for water to not only be used by crops but also to recharge groundwater, which can be used by downstream farmers. Flood irrigation involves soaking an entire plot of land with water a few times each planting season. The irrigation ditch runs along the top edge of a field and farmers rely on a combination of gravity and technology to pull the water from the ditches into their fields. During a day of irrigating, the farmer uses a tarp or other water stopping mechanism to clog the ditch. Unable to continue running parallel above the field, the water overflows the ditch and floods the plot of land beneath it. After a couple of hours, the irrigator will move the tarp further down in the ditch's flow, flooding the next plot of land.

Social Infrastructure

In response to yearly variability in available water, acequia communities divide water consumption evenly (Fernald et al., 2010). Farmers also work in cooperation to upkeep and manage the system (Fernald et al., 2010). These water management principles improve the ability of acequias to recover from years of water scarcity by diffusing the harm of water deficits and fostering community among the farmers (Fernald et al., 2010).

According to Arellano (2014), water sharing is done according to volume and time. By volume, the water is divided into certain amounts. By time, the water is divided into hours or days. For example, if the upper four irrigators on a ditch get water Monday-Wednesday, the bottom four get water Thursday-Sunday. The next week, they rotate, so that each farmer gets an even amount of irrigation time.

Acequia farmers historically govern water allocation using a few main principles:

- 1) **One-Farmer-One-Vote:** The decision of how much water each farmer can source from the *acequia* each year is voted upon. The acequia system gives each irrigator along the ditch a single vote in how water is allocated, regardless of where they are

along the ditch or how much land they own. In drier years, the farmers would work together to distribute their scarce water resources equitably. This contrasts with the Western Water principle of first-in-time, first-in-right, which allocates water across the Western US based on who is first to use it for “beneficiary use” (Colorado Water Conservation Board, 2023).

- 2) **Asset-In-Place:** The acequia system historically prohibits the transference of water from the watershed in which it is situated (Arellano 2014). This protects the water within acequias from the purchase and permanent transfer of agricultural water rights, widely known as “buy and dry”, that occurs across the Western US.
- 3) **Shared Scarcity:** In years where water is scarce, every farmer gets less water to irrigate their field. The acequia systems treat water as a community resource that irrigators have a shared right to use, manage, and protect (The Acequia Institute, 2012).
- 4) **Communal Labor:** According to Arellano (2014), possibly the most long-standing practice associated with acequia farming is the spring communal ditch cleaning. Every year, the whole community would gather for a day spent clearing the ditch of debris and tending to the system to prepare for the coming planting season. Everyone who could do labor, would.

Each of these aspects govern the contribution of individual farmers to common maintenance and their access to water.

Sustainability for whom?

Sustainability-focused researchers have written extensively about the potential of acequias to inform water management practices in increasingly arid landscapes (Fernald, 2012). The asserted audience for this research is primarily water managers making decisions to address present and future water shortages (Lamadrid and Rivera, 2023). In the Foreword of a collection of acequia essays titled “Acequias of the Southwestern United States: Elements of Resilience in a Coupled Natural and Human System,” Luis Pablo Martínez Sanmartín (2020) writes “Acequias have...passed the test of sustainability. In the face of the challenges posed by hyper-industrialization, globalization, and climate change, acequias encapsulate a wealth of lessons in strategic issues, such as food quality, food security, and water and soils preservation.” In this same collection, Sam Fernald, Carlos G. Ochoa,

and Steve J. Guldan wrote a section titled “*Extracting Clues for Sustainability*”. Both of these depictions further the narrative that acequias possess lessons that can be exploited to inform sustainability efforts outside of the community.

Academics have focused primarily on the sustainability of the acequia system’s drought resilient irrigation practices as they have traditionally functioned and the potential of these irrigation practices to inform water management decisions to plan for a more arid future, but they rarely acknowledge that the system has been adapted by farmers in response to modern pressures. Instead, they inaccurately present the system as one that functions today as it has historically. In the book *Water for the People: The Acequia Heritage of New Mexico in a Global Context*, Lamadrid and Rivera write “operating today as they did in the past, acequias have been able to survive for centuries due to persistent traditional practices that dynamically link the local ecosystem, water, and acequia communities” (Lamadrid and Rivera, 2023, 30). Historically, the research has not included local cooperation or collaboration and therefore has appropriated acequias, extracting the system from the context in which it was created to inform an audience outside of the community being studied (Rodriguez, 2020) .

Towards Community-Informed Acequia Research

According to Rodriguez (2020), current anthropologists studying acequias have recently begun to realize the ethical responsibility researchers have not only to their discipline but also to the communities they study. Today, there is a movement among acequia researchers to integrate both the goals of the acequia community and the scientific/scholarly interests into the design of their studies.

Early and often in my fieldwork, acequia farmers highlighted a disconnect between the literature and newspaper articles on the acequias and the reality of their day to day life. “I always hear ‘we gotta do things the way your granddad did,’ but my grandparents died broke,” said Robert Quintana, who manages the San Francisco ditch, just West of San Luis. The San Luis acequia community has evolved their farming practices in response to modern pressures, but the literature rarely focuses on depicting these pressures, how the system currently functions in response to those pressures, or the goals within the community for the future of the system. I have designed this study to address this literature gap with the intended audience being the residents of San Luis.

Research Design and Methods

This research employs a mixed methods approach to ensure that the conclusions I draw about the San Luis acequia community are comprehensive, well informed and address the goals that the community itself has outlined. In my fieldwork, I use knowledge co-production principles to connect the acequia community with the paleoclimate record of the regions, practice participant observation and conduct “snowball sampling” interviews. I sort and draw conclusions based on my fieldwork using qualitative thematic analysis. In this section, I will describe how I employed each method in my research process.

Paleoclimate Records

This report is a portion of a larger study, which aims to connect the San Luis acequia community with the paleoclimate record of the region, which was generated in a project conducted by the US Geological Survey (USGS) earth systems geographer, Dr. Rebecca Brice. Paleoclimate records use climate proxies (ice cores, tree cores, etc.) to extend the climate history back over thousands and millions of years (USGS, 2022). They have implications for understanding the potential range and effect of future climate and how its changes may affect society, as they provide insight into potential rates and magnitudes of climate variability (*ibid*). Paleoclimate data, when combined with climate modeling, informs understanding of the processes that underlie slow and sudden climate phenomena and indicate how ecosystems have previously responded to a variety of climate and environmental changes (*ibid*). This provides an understanding of the ecosystem’s possible resilience to present climate phenomena (*ibid*). These records are therefore used to project possible future climates and can guide policy makers and community members as they adapt to climate change (*ibid*).

While conducting the USGS project "Historic and prehistoric records of drought and wildfire in the San Luis Valley, Colorado," Dr. Rebecca Brice and colleagues extended the hydroclimate record in the Culebra Creek watershed back to 1613 (Brice, personal communication, 2024). The San Luis acequia system is within the Culebra Creek watershed, where records of past precipitation patterns are very limited prior to 1980 (Brice, personal communication, 2024). Dr. Brice’s newly generated paleoclimate record therefore extends the robust precipitation record back more than 200 years. Extending documentation of drought cycles further into the past allows researchers to place current drought conditions into an even larger context of climate variability. Dr. Brice’s project is

under the larger project "Did we start the fire: Climate, humans and biomass combustion," which is being conducted and managed by Dr. Natalie Kehrwald, a research geologist for the USGS.

Climate research in this region often leaves a large gap between newly generated knowledge and its application for community decision-making that inhibits the community from preparing and finding its own solutions to address climate related threats (Moallemi et al., 2023). In an age when climate change threatens many human-environmental systems, the practice of knowledge co-production incorporates stakeholder communities in the knowledge generation process (Norström et al., 2020). This form of stakeholder engagement has the potential to expand the goal of scientific research to include informing stakeholder decision making (Norström et al., 2020).

Knowledge Co-Production

Beyond extending the paleoclimate record of the region, the project has used knowledge co-production principles to understand the data's potential to inform important resource management decision-making by stakeholders in the Culebra Creek watershed (Brice, personal communication, 2024). Knowledge co-production is a user-driven research approach that involves the end users of research in a highly collaborative research process (Moallemi et al., 2023). This is in contrast to the "loading dock method" to community incorporation in research. In the loading-dock method, "You take it out there, and then you leave it on the loading dock and you say, there it is. And then you walk away and go back inside (Cash et al. 2006, 494)".

In the data collection phase, researchers employing knowledge co-production are encouraged to engage directly with the community to establish how their work addresses the community's goals for future resilience efforts (Norström et al., 2020). As an anthropology student, my role in the USGS project was to interview the community to understand how a newly generated tree-ring paleoclimate record could inform future decision making in response to deepening drought and increasing aridity in the Southwestern US. The following report reflects the results of the initial stage of the knowledge co-production process, as informed by the interviews and ethnographic research I conducted in San Luis.

In knowledge co-production, the research subsequently addresses the priorities outlined by the community in a way that is accessible and 'actionable' for informing future decision making (Reed et al., 2022). These outputs could be public outreach material, teaching curricula, or reports tailored to the community (Norström et al., 2020). Dr. Brice, Dr. Kehrwald, Dr. Ingram, Jamie Harvie and I will

work in partnership to conduct this final stage of the knowledge co-production process following the publication of this report.

Ethnographic Research and Interviews

The results of this report are based on ethnographic research I conducted from June-August 2023 in San Luis, CO. During my fieldwork, I practiced participant observations of everyday life in the acequia communities while living along the San Acacio ditch, where I was kindly invited to stay in Jock Jacober's historic adobe home. I supplemented participant observation by conducting semi-structured interviews (n=13) with multi-generational acequia farmers, Costilla County water managers, members of the Sangre de Cristo Acequia Association, and newer community members who have moved to San Luis to practice acequia farming. With a population of only 618, some interviewees represented more than one of these groups. For example, Steven Romaro is a 6th generation acequia farmer as well as a board member of the Sangre de Cristo Acequia Association.

Participant Observation

In this study, I employed the ethnographic method of participant observation as a tool for data collection and community engagement. Participant observation requires that the researcher actively participate in the community they are studying in some way (Badgley, 1994). Historically, anthropologists have employed this method when studying small, isolated groups of people, where “cultural traits were thought to be pure, integrated, and untouched by outside sources” (Badgley, 1994: 95). As the field of anthropology has evolved, however, it has been popularized as a method to study the social life of communities at any scale. Participant observation aims to gather both qualitative and quantitative data through learning about the everyday lives and attitudes of members of the San Luis acequia community (Bernard, 1988). Ideally, this method allows the researcher to understand the underlying cultural patterns well enough to confidently present the results of the study within its cultural context (Bernard, 1988). I engaged in the daily lives of San Luis acequia residents as much as I was invited to through lending a hand with physical labor, participating in community events, like *Fiesta de Santana*, and volunteering at the local market. By doing so, I sought to understand the social order and the cultural norms of the San Luis acequia community.

“Snowball Sampling” Interviews

To supplement my participant observation, I conducted semi-formal interviews. I utilized a method known as “snowball sampling” to identify community members to interview (Kirchherr & Charles, 2018). With snowball sampling, the researcher starts with a small number of initial contacts who fit the research criteria, who are invited to become participants within the research (Kirchherr & Charles, 2018). The agreeable participants are then asked to recommend other contacts, who then in turn recommend other potential participants, and so on (Kirchherr & Charles, 2018). Utilizing this method, I began my research by establishing initial links, primarily water managers and public faces of the community. From there, I built my credibility within the community and began interviewing community members who less commonly interacted with people outside of San Luis. My results, therefore, are informed by members from multiple different positions within the community.

The 13 interviewees are listed below in order of interview date:

EARL VALDEZ: Costilla County Water Manager, Manager of Dos Hermanos Ranch, Identifies as multi-generational acequia farmer. Valdez grew up farming in the San Luis area and irrigating from an acequia. He left San Luis to attend college, then returned to manage Dos Hermanos Ranch.

RONDA LOBATO: Costilla County Water Manager. Lobato lives on a ranch in Chama Canyon, a small canyon above the Town of San Luis and irrigates off of an acequia.

JOCK JACOBBER: President of the Sangre de Cristo Acequia Association. Jacobber is not originally a resident of San Luis, CO, but he used to live on the San Acacio ditch. He grazed 3,000 head of cattle up on the nearby mesa that they would sell to Whole Foods. Jacobber lost his cattle selling business in 2016, when Jeff Bezos bought Whole Foods and he now lives in Taos, NM.

DEVON PEÑA: Farmer on People’s Ditch, Owner of People’s Market. Peña is a professor at University of Washington who is not originally from San Luis, but has published multiple academic articles about the San Luis acequia system (Peña, 1999; Hicks and Peña, 2003).

ANTHONY MONDRAGON: 4th generation acequia farmer. Mondragon has property on San Francisco Creek and San Pedro Creek, but had to move to Colorado Springs 4 years ago to make money pouring concrete. He inherited the ranch from his father in 1994, where he now grows alfalfa and grass mix. He used to sell his crops to reservations down in Taos, but now he doesn't produce enough, so he just sells locally.

DELMER VALPEDO: *6th generation acequia farmer raised on Culebra Creek, Sangre de Cristo Acequia Association board member.*

JULIAN TAYLOR: *Mayordomo of San Francisco Creek ditches.* Taylor has been subsistence farming his whole life on land his dad and grandfather farmed.

STEVEN ROMERO: *Mayordomo of People's Ditch, multi-generational acequia farmer.* Romero left San Luis to attend college, but returned to continue farming after college.

ROBERT QUINTANA: *Mayordomo of San Francisco, Frisco Sanchez, School teacher in San Luis.*

HUBERTO MAESTAS: *Sculptor in San Luis, son of multi-generation acequia farmer.*

AMAYAS MAESTAS: *Grandson of Huberto, farmer.* Maestas was born and raised in Alamosa, CO. He is attending an agricultural college in Vermont, but plans to return to San Luis to start a farm.

ANONYMOUS INTERVIEWEE: *Grew up on Montez Ditch, now lives on Cerro Ditch.* Further information is redacted to maintain anonymity.

ANONYMOUS INTERVIEWEE: *Acequia farmer on Cerro Ditch, identifies as multi-generational acequia farmer.* Further information is redacted to maintain anonymity.

Although common themes emerged during my research in San Luis, each individual I spent time with informed these themes with their individual lived experience, which varied depending upon socioeconomic status, familial legacy, land ownership, geography of owned land, and other identities. I include quotes and vignettes throughout my *Results* section to highlight the voices of the community and emphasize that all of my documentation was sourced from individual testimony and experience. Any quotes and citations of community members I include in the paper, therefore, do not necessarily speak for the community as a whole, but instead captures the perspective of the member quoted.

I received Institutional Review Board (IRB) approval for this project. My research proposal was accepted with a modification: I could receive verbal permission in place of written permission to include results of the interviews.

Qualitative Thematic Analysis

I used qualitative thematic analysis to organize the results of my research. My data analysis is sorted into seven modern pressures to the acequia system that were recurrent themes in my interviews

and supported by ethnographic data. I identified those themes as I interpreted the procured data in the months following my fieldwork. After the sorting of data into seven modern pressures, I supplement the explanation of these pressures with vignettes that exemplify the larger themes that emerged from my fieldwork.

Researcher's Reflection: Insider/Outsider Perspective

I don't remember the 2002 drought that changed the lives of so many residents of the Southwestern US. It didn't change my life. Granted, I was only two years old, and didn't live in the Southwest, but while I was oblivious to the 2002 drought in San Luis, its impact remains vivid through the stories told by parents, grandparents, and local communities for whom the effects of that drought were monumental.

In 2002, my parents flew to Santa Fe, New Mexico, with baby Cecilia in arms, from the East Coast to attend the Hot Air Balloon festival (*figure 2*), also ignorant of the drastic environmental event unfolding around them this climate indifference illustrates the levels of protection my family and I had from the 2002 drought: I was disconnected from the production of my food, the source of my water. I was protected from annual variation in climate that led to annual variation in food and water systems. There was an entire infrastructure between the climate and me, keeping me ignorant because I had the socio-economic status to afford ignorance about where my food and water were sourced and the urban upbringing to take unknowing comfort in it.



Figure 2: Cecilia, author, at the Santa Fe hot air balloon festival (2002).

I was raised by a journalist and an anthropologist on Capitol Hill in Washington, DC, so complete blindness to injustice was impossible. I would jog past the Supreme Court in the morning and pause to watch grievors scattering ashes of their loved ones on the marble steps. I never knew exactly what injustice killed this time, but I knew that the Supreme Court was being blamed for the death.

Still, I could easily protest climate change at an arm's length from its impact. I would march from my front yard to the Washington Monument holding a sign with a Lorax quote inscribed. When the protest ended and the expo marker message on my poster was smudging in the June DC humidity, I would toss the poster into a nearby trash can, walk home slowly with an overpriced ice cream, and return to my AC-cooled rowhouse.

For me, my parents, my grandparents, even my aunt in Santa Fe, 2002 was just another year rolling past. My status as a complete outsider meant that curiosity, not necessity, drove me to the study of the San Luis acequia system. A month into my fieldwork, I both was told and observed that the detailed accounts that I was being told of this traditional agricultural system *within* the context of

modern systems were not recorded in the literature of acequias that I had read previously. They were absent in online databases and did not lie within the shelves of Colorado College's library. My field notebooks were teeming with academically undocumented stories.

Now aware of the complex and unwritten (in an academic setting) stories I was being told, the notebooks in my pockets seemed heavier and were filled much faster---my interview notes were bookmarked with pages of self reflection and panic. How could I write a report that would do justice to the lives of the people who had trusted me with their anxieties and histories? I felt like I needed 1,000 lifetimes to translate this one summer studying a community that holds less than 1,000 lives. This story had become so close.

"A little while back, you would have already been beat up coming into here, just because you are cute and have a nice smile. I kind of miss those days," Robert Quintana had told me jokingly in an interview while we leaned together against his tractor one balmy August afternoon. It was a joke, but the sentiment rang true: With the influx of tourists upsetting many San Luis residents, even my sense of welcome there was a byproduct of unwelcome change

My title as conservationist put me in complex relations with the community. I was an environmental studies and anthropology major from Washington, DC drawn here by now clouded dreams of conserving a system foreign to me. Even my title as conservationist put me in complex relations with the community.

Over time, though, the residents had softened to my presence. Once I was identified as merely a short brunette who asked a lot of questions, the initial skepticism of my presence in the town dissipated. I was no longer perceived as a threat, I was told. I was just a new addition to the cast of characters that wandered the main street.

Study Site: The San Luis Acequia System

The Present in a Historic Town

It takes 45 seconds to drive straight through San Luis, Colorado. Maybe it will take a minute if you slow down to read the giant white letters on the mesa above: *Oldest Town In Colorado*.

Maybe it will take you 6 minutes if you stop for a coffee at the new San Luis Coffee House, 16 minutes if you stop at the Visitors Center and ask for directions. Betty (*figure 3*), who works selling souvenirs and pastries, loves to pair driving directions with a story, a book recommendation, and a subtle joke. But many people drive through in 45 seconds. They pass the church in the center of

town. They turn left on a county road, and point their headlights towards Culebra Peak, aiming to climb to its summit, or South towards Taos, NM to catch a powder day. They don't even stop at the far end of town, where Culebra Creek flows right underneath Main Street (*figure 4*). Ask around about the creek and you will get stories of history, resilience, culture, and change. At least I did. Ask further, and you will find that this history, and associated culture, are threatened by the lengthening drought, increased aridity, and other modern pressures.



Figure 3: Betty at the door to the San Luis Visitors Center.

“I’m Teddy, by the way. Since you’ll be around for a bit, any chance you know how to play softball? Our team is looking for a shortstop.”

He had grown up and gone to school in North Carolina to study film. When he was stationed for a year in Alamosa through Americorps, he moved West. Two years later, he now works as the assistant to the Town Manager of San Luis, CO.

He was chatty and seemingly eager to talk with someone his age. Betty, who had been hanging the flowers, came in and joined in on the banter. Soon, the three of us were laughing at stories of people I had never met but would come to know well. This town is full of characters, so if it was stories and opinions I was looking for, this town was overflowing with them, they assured me, but only if people trusted me enough to talk.

I was walking out the door with a list of contacts to call and a new found confidence that I would be able to meet my interview quotas when Teddy called after me.

“Cecilia!!”

“Ya?”

“You know what my favorite part of my job is?”

“Umm...filling the softball team roster?”

“Good guess but no. Every night, I get to go up there,” he gestured to a white church on a bluff looming above the town, “Stations of the Cross, it’s called, and lock up the church. Every morning I wake up and unlock it. I watch every sunrise and sunset up there. If you ever want to see it, just come by around sunset. I’ll be here.”

I took him up on the offer in one of the coming days. We began climbing the half mile up to the church. I had met a handful of the “characters” that he had pointed me towards as contacts in the acequia community over the past couple of days. I was eager to add my anecdotes of the town to his own.

Our banter quieted, though, as the sun lowered over the Culebra Range. We were high enough now to see for miles in each direction. North: the land between here and Blanca Peak was segregated into yellowed circles, looking like the arid midwest. West: the golden of the San Luis Hills rolled off towards the San Juan Mountains. South: Rows of dark green crop fields were punctuated by the occasional farmer, on tractor or knees working right until darkness (*figure 5*). East: small canyons etched into the edge of Culebra Peak, still snow blanketed (*figure 6*). The canyons then widened and flattened beneath us into the Town of San Luis. I could track the water as it followed the path of least

resistance from Culebra Peak's snow field to the west of us into the earth beneath the fields to the South.



Figure 5: View to the South from Station of the Cross.



Figure 6: View to the East of San Luis from Station of the Cross.

Removing myself from the street level, for the first time, I could see how the town was embedded in the larger landscape. The sunset weaved golden patches into the green fields, framed against the snow peaks of the Culebra Range. From above, I saw San Luis as part of a larger, thriving ecosystem. Part natural and part manmade, it was clear from this vantage point how the acequia farmers cleverly used gravity to funnel snowmelt into their fields. Surrounded by central pivots and constant dust storms, it looked like the farmers had fostered an oasis of sorts, strikingly green against the rest of the high-elevation desert valley.

The Arid Future of Colorado

Colorado is experiencing long-term warming and drying, known also as aridity, which has centered the conversation on sustainable development and drought resilience when planning for the state's future (Colorado Water Conservation Board, 2023). Drought resilience includes building infrastructure and creating strategies that reduce the impacts of drought shocks and ongoing climate

stresses on communities, economies, and ecosystems, and allow them to rebound more quickly when acute drought occurs. Droughts can be widespread and have state-level impacts, but they can also be felt disproportionately in a single region. Agricultural sustainability means securing profitable farm income, promoting environmental stewardship, enhancing the quality of life for farm families and communities, and increasing the production of food in response to population growth.

According to the Colorado Water Conservation Board (2023), future models of the Southwestern US predict longer and more intense droughts and extreme aridity. Combined with a projected potential irrigated acreage losses of 400,000 to 500,000 acres in Colorado and a growing population, finding ways to irrigate with less water and maintain agricultural output is critical.

The San Luis Valley: An Arid Agricultural Center

San Luis, CO is located in the San Luis Valley, a high-elevation desert in Southern Colorado with an average elevation of approximately 7,500 feet and average annual precipitation of less than 8 inches (Colorado Water Conservation Board, 2023) (*figure 7*). Despite the low precipitation rate, agriculture is the basis of the San Luis Valley's economy with the vast majority of water for irrigation coming from snowmelt runoff from the surrounding mountains and summer storms (Emery, 1971) (*figure 8*).



Figure 7: A map of the San Luis Valley with San Luis, CO highlighted in red.

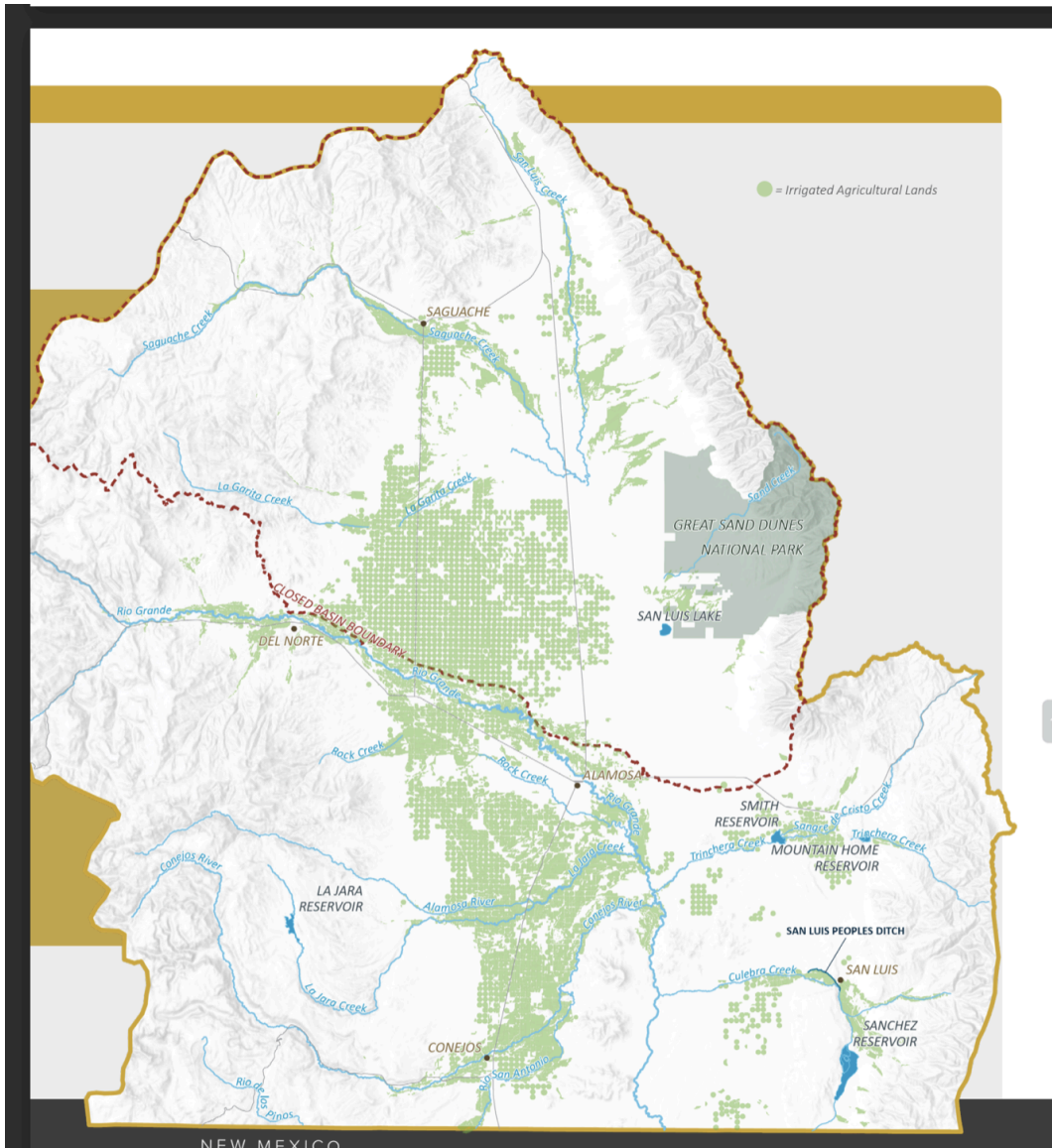


Figure 8: A map of the Rio Grande River Basin, the watershed that encompasses the San Luis Valley, with the irrigated land highlighted in green. The San Luis People’s Ditch is labeled in the bottom right corner of the map (Colorado Water Conservation Board, 2023).

Acequias are not the predominant irrigation strategy within the valley. Agricultural developments in the last century have popularized central pivot irrigation, which pulls from groundwater, aquifers, and streams to water crops (Emery, 2010). The aquifers and streams, though, do not often hold enough water to support irrigated agriculture, recreation, municipal and industrial uses and these shortages are exacerbated by the fact that the San Luis Valley functions as an agricultural mecca for the rest of Colorado (Colorado Water Conservation Board, 2023; Emery,

2010). Much of the crops that grow in the San Luis Valley are transported over to the Rocky Mountains to feed front range municipalities (Colorado Water Conservation Board, 2023).

In this report, I refer to all of the acequias within the Culebra Creek watershed and as the ‘San Luis Acequia System’ (*figure 9*). Historically, the Culebra Creek watershed has resisted the agricultural industrialization that has developed across the rest of San Luis Valley because of the prevalence of acequias (Peña, personal communication, 2023). The watershed is 360 sq mi in area and includes the People’s Ditch, San Acacio Ditch, San Pedro Ditch, San Francisco Ditch, Cerro Ditch, Vallejos Ditch and other smaller ditches. Culebra Creek is located on the Southern edge of the San Luis Valley, within the larger Rio Grande River Basin in Colorado (*ibid*). Most of the water that falls within the creek’s watershed and the crops grown there are shared among the local farmers (*ibid*). Today, however, the San Luis acequia system is facing the same pressures of modernization that plague the rest of the valley and all of the Southwestern US.

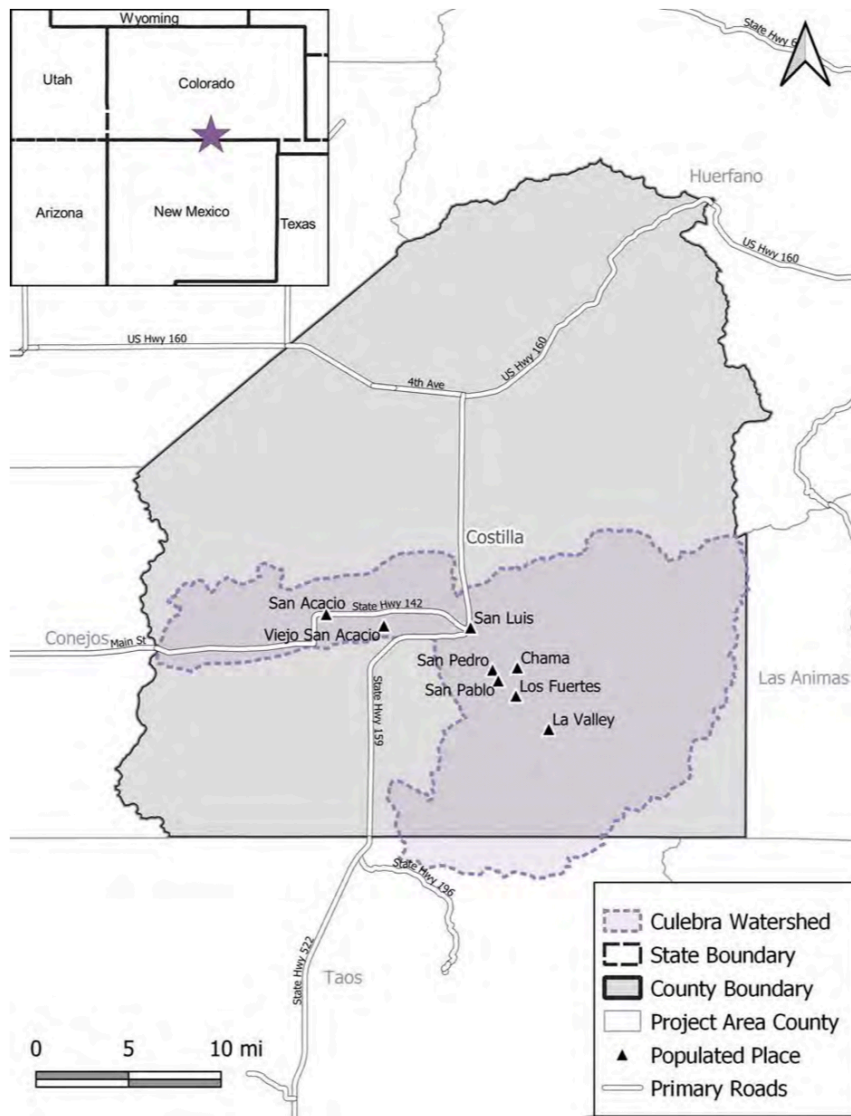


Figure 1-3 Upper Culebra Watershed Assessment Location Map.

Figure 9: Culebra Creek watershed map with smaller tributaries included (Tailwater Limited, 2023).

Results

In my results, I document how the acequia community in San Luis currently experiences and addresses drought while facing pressures of modernization. I argue that modern pressures have weakened the ability of the San Luis acequia community to respond to drought with the same strategies that they have historically employed. I sort the pressures using qualitative thematic analysis.

I then present the visions for the future of the system as diverse and contested within the community. Sustaining the acequia system as it had previously operated was rarely stated as the goal of farmers. The single unifying sentiment of everyone I spoke to was that the system should not be romanticized as one forever resilient to drought, but instead documented in its present complexity so the experiences of the San Luis acequia farmers can be captured for future generations.

Modern Pressures On the San Luis Acequia Community

In this section, I use qualitative thematic analysis to respond to the research question: *What modern pressures does the San Luis acequia community currently face?* I argue that the community can no longer respond to drought presently using the same strategies that they have employed prior to deepening drought and widespread industrialization in the valley. I sort the current pressures experienced by San Luis acequia farmers into 7 types: environmental, infrastructural, economic, legal, cultural, institutional, and out-migration (*table 1*). Although isolated for the sake of clarity, these pressures work in tandem. For example, economic pressure and infrastructural pressures both contributed to the depth to which the San Luis acequia system suffered from the 2002 drought. I provide examples, often in the form of vignettes, of experiences and adaptations in response to each pressure.

| Types of Pressures | Examples | Responses |
|--------------------|--|--|
| Environmental | Decreased precipitation/snowmelt, extreme year-to-year precipitation changes | New infrastructure to avoid water evaporation, Surface water storage |
| Economic | Buying/selling water, growing cash crops (ex. hay/alfalfa), Higher cost of equipment | Easements, Tying water to land--supported by Colorado Open Lands |
| Infrastructural | Water storage shortage, Evaporation from ditches, Mechanized irrigation | Gated pipe irrigation, fix Sanchez Reservoir dam |
| Institutional | Water management institutions complicate traditional acequia power structures (one-farmer-one-vote) | None recorded |
| Legal | Colorado state law, Principle of Prior Appropriation, Trans-basin diversions | 2009 Acequia Recognition Law, Incorporating ditches and writing bylaws, Acequia Assistance Program, Campaign for instatement of acequia protection similar to New Mexico's protection laws |
| Cultural | Some ditches no longer have annual spring cleanings, Competition among farmers for limited water, Loss of cultural practices | Cultural Heritage Center, Costilla County Conservation District Learning Library, K-12 Curriculum Update |
| Out Migration | Younger generation leaving San Luis/no longer learning acequia farming practices | None recorded |

Table 1: Chart depicting types of pressures experienced by acequia farmers in San Luis, examples of these pressures, and related future goals. Detailed descriptions of the pressure are found below.

Environmental and Economic Pressures: And then came 2002...

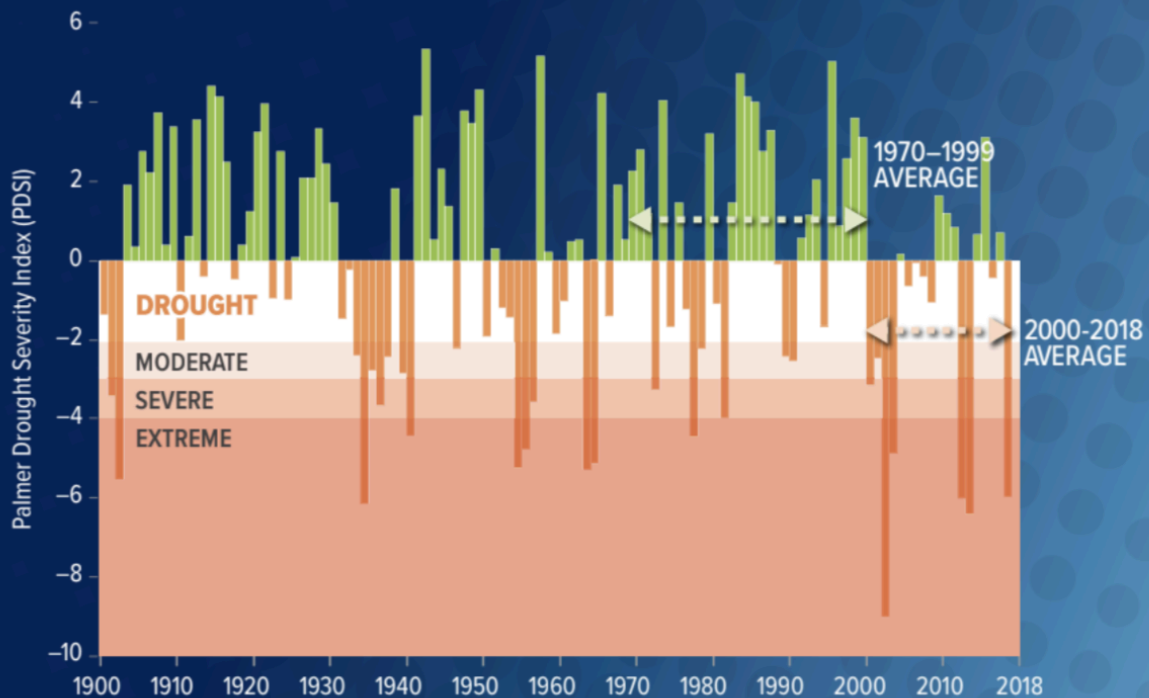
Drought is not only a threat to natural resources, but a stress-tester for sociopolitical systems, as the availability of water depends on complex interactions among geography, weather, laws, and

regulations, all of which influence how much water is available for ‘beneficial uses’. Drought functions to reveal vulnerabilities within systems--what survives in the face of stress and what is forced to evolve. Climate scientists have labeled the Southwestern drought that has occurred throughout the first two decades of the twenty-first century as an emerging megadrought, with 2000-2021 being the driest 22 year period since 800 CE. (USDA Climate Hubs, 2023).

The San Luis acequia farmers reported 2002 as the driest year in community memory (*figure 10*). The Parrot, as the farmers call the snowfield on the East slope of Culebra peak, is the source of Culebra Creek. Farmers in San Luis make water allocations based on the length of The Parrot’s tail. The length of the parrot’s tail is remembered as different lengths throughout history, but it had never before been absent until the drought of 2002.

Colorado July Palmer Drought Severity Index, 1900–2018⁶

The Palmer Drought Severity Index uses temperature and precipitation data to estimate relative dryness and quantify long-term drought. The 1970–1999 average was +0.9, or wetter than normal, while the 2000–2018 average is –1.7, or drier than normal.



Source: Adapted and updated from Lukas et al., *Climate Change in Colorado*, 2014;
Data: NOAA NCEI; <http://www.ncdc.noaa.gov/cag/>

Figure 10: Colorado’s July Palmer Drought Severity Index supports that an anomalously severe single-year drought occurred in 2002 (Colorado Water Conservation Board, 2023).

Prior to 2002, the acequia infrastructure depicted in my *Literature Review* provided farmers considerable resilience to the persistent aridity of the San Luis Valley. Community members remember drought years, but they “never had much concern for water” (Valdez, personal communication, 2023). When asked what extremely dry years he remembers, Julian Taylor, who irrigates off of the San Francisco Ditch responded “only 2002, there were other dry years in the past but never extreme enough to remember which years.”

In 2002, many farmers economically struggled to survive. Many farmers sold their cattle because they could no longer afford the upkeep and needed an immediate cash source. Those I interviewed used heads of cattle sold during 2002 as a metric of the economic toll of the year (*figure 11*). Others began selling off equipment. These economic forces struck the heart of the San Luis acequia community (*table 2*). Without the equipment and livestock that they used to make money, they could not continue living like they had been for generations. They had sold their means to financially survive 2002 and many farmers are still reeling from this single year today. In the following years, the San Luis acequia community's vulnerability to both environmental and other modern pressures increased, and the farming practices and their associated cultural practices have evolved in response.

DISASTER DESIGNATION

Secretary of Agriculture has declared the entire state as a disaster area due to drought conditions. This designation allows affected producers to apply for Emergency Loans through the Farm Service Agency. The following is a clarification of the Program and how the FSA loan programs might be able to help.

To qualify for FSA loans, applicants must meet basic eligibility requirements, have adequate security and show the ability to repay the loan.

For qualifying losses (losses to the crop for this year), you must demonstrate a minimum of 30% loss from normal production in a single crop. With the current conditions throughout the valley, it is apparent that there will be losses which meet this threshold, especially for those who have only surface water to irrigate with and for pasture. At this time the losses have not actually occurred. It will be fall before most producers can document losses which qualify for this program.

For those individuals who need money to buy feed or to pay pumping bills in the immediate future FSA does have the Operating Loan program which may be able to assist by provided operating money for the summer. For this program, you would still need to meet the basic eligibility requirements, have security and show the ability to repay the loan.

figure 11: Article titled "Disaster Designation" in the Costilla Free Press advises farmers on how to take out agricultural loans to support their farms during the 2002 drought (Costilla Free Press, 2002).

| Community Member | # of Cattle Prior to 2002 | # of Cattle after 2002 |
|-------------------------|----------------------------------|-------------------------------|
| Julian Taylor | 40 | 17 |
| Delmer Valpedo | 20 | 8 |
| Ronda Lobato | 200 | 0 |
| Earl Valdez | 150 | 100 |

Table 2: Chart depicting the number of cattle sold by individuals in San Luis during the 2002 drought according to interview data.

Infrastructural Pressures: Adapting Flood Irrigation for a More Arid Future

With flood irrigation, each individual irrigation requires enough water that it can flood an entire field of crops. With increased water scarcity, higher demands for the water in the Culebra Creek watershed, and new water management practices, farmers are often only granted one or two chances a season to irrigate their fields. They have also noticed an increase in evaporation of water out of the ditches. In response to these threats, acequia farmers have adopted new infrastructural mechanisms to decrease the amount of water they need to meet crop production demands.

“Just meet me behind the visitors center, we don’t really have addresses in this town and I don’t want you driving off the face of the Earth trying to find me. What do you want to talk to me about again?” Anthony Mondragon, a 4th generation acequia farmer, insisted over the phone. I had gotten his number from his mother, who was a town librarian.

“Uhh... the acequias...Tree rings...I’ll explain it tomorrow,” I stuttered back.

The next morning, I sheepishly parked my 2016 Chevy Bolt behind the Visitors Center. I was not from here, everyone could tell. When I got out of the car, Mondragon did not miss a beat. He made fun of me for my Amazon-ordered cowboy boots, told me that I was going to get nowhere in my low-clearance electric vehicle, and opened the passenger door of his truck. First, I explained that I just wanted to learn about acequias from him.

“Great, I’m irrigating today. I’d love an extra hand.” I hopped in.

Over the summer, I came to lean into the fact that I was a little ridiculous by San Luis standards. I was a petite female eager to exchange physical labor for knowledge about acequias. Yes, I was easy to tease for my car and my ignorance, but I learned to love being humbled in this way. It shifted the power out of my hands. Hands empty, hypotheses abandoned, an eager student, we (my interviewees and I) settled into mutual trust.

After a short ride to his property, Mondragon and I wandered through the mud up to his acequia. He had offered me rain boots multiple times before we went out into the field, but my pride had held me back from taking them. Now, boots, socks and feet all soaked, I cursed my pride.

“Ok so when you say flood, you mean it,” I joked as I tramped through the alfalfa-field-turned-bog. He had to store the water somewhere and the ground was as good a place as any, he explained to me. With flood irrigation, the water permeates about six feet into the soil. Instead of storing water in reservoirs, water is stored directly in the soil. Flood irrigation is the primary reason why the landscape around is so strikingly green compared to the rest of the valley. The water not only irrigates the agricultural field but the entire ecosystem. For that reason, flood irrigation has been practiced historically in arid landscapes as humans can foster an entire ecosystem within a desert landscape (Arellano, 2014).

It is an effective practice, but, compared to the modern mechanized irrigation, not an efficient one. It uses more water than central pivot irrigation, which is the mechanized irrigation used by most of the rest of the valley (Peña, personal communication, 2023). Flood irrigation waters less land more slowly. Costilla County Conservation District employees Ronda Lobato and Earl Valdez both argue that installing central pivot irrigation or other forms of mechanized irrigation could protect the San Luis acequia system from the effects of drought. The case for central pivot irrigation is, on the surface, quite convincing: Increase water efficiency and protect the agricultural economy and irrigated acres. Permeating only 6 inches into the ground, though, the water from central pivot irrigation permeates just beneath the surface of a field. This lack of water deeper in the soil leads to the mineral imbalances and greater overall aridity that plagues the rest of the valley (Peña, personal communication, 2023).

When Mondragon and I finally won our uphill, muddy battle, we arrived at a small ditch running along the top edge of his field. In the ditch was an orange tarp where water was pooling before it overflowed into the field below (*figure 12*). This, Mondragon explained to me, was called

tarp irrigation. Tarp irrigation works well historically, but with a more arid climate, every drop of water must be preserved. The open pool of water left the valuable resource exposed to the sun and atmosphere, which meant that some was lost to evaporation.



Figure 12: Tarp irrigation leaves the water exposed to sun and atmosphere, which increases evaporation.

As we wandered back along the ditch towards the larger river where the water was being sourced, I noticed white piping where the water would be flowing (*figure 13*). Gated pipe irrigation, as this strategy is called, is now used by many San Luis acequia farmers in place of tarp irrigation to mitigate evaporation (Mondragon, personal communication, 2023). Holes are poked along one edge of the tubing to allow small amounts of water to run downward into the fields. The pipe is then placed

into the irrigation ditch and the water is funneled through it, protected from the sun and atmosphere. Gated pipe irrigation is increasingly popular among acequia farmers with less economic capital as dry years and extreme precipitation variability become more common. It is low cost and maintains the integrity of the acequia system. With new irrigation strategies, the San Luis acequia community seeks to balance efficiency and ecosystem health. But ultimately, not even gated irrigation can provide the buffer of surface water storage to provide the year to year variability that has grown increasingly common. Because acequia farmers historically rely on annual precipitation, they do not have surface water storage systems embedded in their infrastructure, leaving them vulnerable to unpredictable precipitation. There has been more variability in precipitation timing and volume following the 2002 drought.



Figure 13: Gated pipe irrigation is used to reduce evaporation during the irrigation process.

“It seems like recently the weather has shifted over by a month. December and January are warmer than March and April,” Earl Valdez told me. Many farmers mentioned two types of variability: extremely dry years followed by extremely wet years, and years that were super wet but the rain fell too late to be usable for spring irrigation.

“What changed was mechanization changing the scale of agriculture,” Steven Romero once told me. Romero believes that mechanized irrigation is partially to blame for the acequias being at risk in the first place. Between 1940 and 1960, central pivot irrigation skyrocketed in popularity in the San Luis Valley (BLM Cultural Resource Series, 2008). With more land irrigated with less water, the San Luis Valley’s farmers shifted from primarily subsistence agriculture to producing food for the rest of the state and the country. In the place of subsistence food crops, alfalfa, hay, and other “cash crops” now make up the majority of the agricultural output in the San Luis Valley (BLM Cultural Resource Series, 2008).

“An alfalfa and beef economy has emerged in the past twenty years,” Jock Jacober told me during our first ever phone call. “People here no longer produce food, they produce crops to be exported.” Alfalfa is commonly grown in San Luis in response to drier and more arid conditions because its deep taproots make it more resistant to drought. It also can easily be irrigated using central pivot irrigation because it requires less water (Devon Peña, personal communication, 2023).

Socioeconomic status, geography, and agricultural philosophies have dictated whether the farmers in San Luis have followed the rest of the valley in switching to cash crops or remained as subsistence farmers. “Mechanization will probably come to pass for acequia farmers who are large enough to produce alfalfa,” Devon Peña told me. Mondragon explained that he used to grow malt, wheat, potatoes, and cauliflower on his land. In recent years, however, his production has shifted to alfalfa and hay, which he sells to buyers outside of the San Luis Valley. As he puts it, “this changed because I had to make a living and support my family.”

Institutional Pressures: Conservation and Power in Conversation

The devastation of the 2002 drought launched a new era of resiliency planning and collaboration in Colorado that led to the creation of many of the state’s grassroots water stakeholder groups, as well as other water conservation organizations (anonymous source, personal communication, 2023). In San Luis, many contemporary institutions were created for water

conservation following 2002, but the resulting power structures undermine the traditional democratic model of acequias (*ibid*). In the name of conservation, many more positions of power now exist. Changes in how power over water management is structured has resulted in uneasy and divergent feelings about the motivations of those in charge.

Acequia farming communities have historically created structures of equality among the farmers' voices, no matter where they are along the river. The only traditional power position is the *mayordomo*, who manages the logistics of the ditch. This position is supposed to be rotated through the acequia water right holders over the years (Romero, personal communication, 2023).

Today, however, there is no longer an accessible, reliable and predictable form of power sharing among acequia farmers. "The mayordomo is no longer picked by the farmers, it is picked by county water managers," a longtime acequia farmer who asked not to be identified by name disclosed. In actuality, I found that the elections, ditch cleanings, and other decisions about the acequias varied greatly depending on the ditch. The Sangre De Cristo Acequia Association, Costilla County Conservancy District, the State of Colorado, Colorado Open Lands, Sanchez Ditch and Reservoir Company, and Cielo Vista Ranch are a few examples of external institutions working directly with the acequia farmers. All of these institutions have their own power structures. Many of these institutions have goals to conserve land and protect the acequia system and the power to apply for grants and easements, tie water to land, incorporate ditches, etc. For example, Colorado Open Lands is aiming to help acequia farmers keep their water from being sold to other municipalities.

"Power is a dark cloud that sits over the acequia association," griped my same anonymous source.

"Costilla County Conservation District is just becoming a real estate agency buying and selling land for water rights," piped in a second farmer, who also asked that this statement remain anonymous.

Legal Pressures:

One Farmer-One-Vote vs. First-in-Time-First-in-Right

Western Water law and traditional acequia water principles conflict in San Luis, where farmers with higher priority according to Colorado law are relying on that protection and abandoning the traditional acequia water sharing principles. Acequias are legally treated as a typical water right within the prior appropriation system in Colorado, but their governance system is distinctive

(Colorado Water Conservation Board, 2023). With the drought in the Southwestern US deepening, acequia farmers in San Luis are abandoning this distinctive governance system and relying instead on the Western Water model of Prior Appropriation, which leaves those with lower priority suddenly without water. The Colorado water law grants priority in order of when water rights were established with the state following a principle called Prior Appropriation and nicknamed “first-in-time, first-in-right” (*Figure 14*). This principle is directly at odds with the acequia principle of “one-farmer-one-vote” (Haines, 2023). Colorado water law is based on seniority, while acequia water allocation is based on equity, need, and seniority. The function of acequias relies on the shared philosophy that “water is so essential to life that it is a communal resource, one which must be shared (Colorado Water Conservation Board, 2023).”

THE PRIOR APPROPRIATION SYSTEM

The prior appropriation system can be simply described by breaking it down, word by word:

Prior: In times of short supply, those who establish a water right earlier are permitted to divert and use their water before those who establish one later; this is the essence of the “prior appropriation system,” often described as “first in time, first in right.”

Appropriation: Appropriation is the act of placing available surface water or tributary groundwater to a beneficial use at a specified location and in a specific amount appropriate to the need and use; lacking such specifics, the claim is considered speculative and is not allowed.

System: Colorado has seven water courts across the state, with jurisdiction over all water matters within their assigned drainage basin boundaries. Water rights are property rights, and may be sold, inherited, or used as collateral for a loan. A right’s place of use, point of diversion, or type of use may be changed in a process overseen by the water court to ensure that other water rights are not injured.

Prior appropriation allocates water during times of scarcity, is predictable and provides certainty to water users, and establishes the ability for flexibility. The prior appropriation doctrine has proven that it can stand the test of time.

Figure 14: A summary of the prior appropriation system as it functions in the state of Colorado (Colorado Water Conservation Board, 2023).

“Everyone throws around ‘one farmer, one vote,’ but there are a lot of things not worked out,” Steven Romero told me over the summer during an interview. He is the mayordomo of the San Luis People’s Ditch, the largest ditch in the Culebra Creek watershed. The mayordomo is the ditch manager. They are elected by the farmer along the ditch (Romero, personal communication, 2023). They ideally work to ensure equitable water distribution. But the ideals of shared and equitable water rights have not persisted into the complications of modern life.

“I bought rights on the People’s Ditch because then I would make sure I had a crop,” Romero told me. The People’s Ditch has first priority in the Culebra Creek watershed, according to state law.

Romero used to live on the Rito San Francisco, but he moved after he realized how often it would run dry. “Today, decision making is a question of who has priority and who gets the water first,” said Romero.

“I laugh because people will write articles saying that acequias are harmonious environments, but in reality the first 5-6 priority get the water and the rest of the ditches are dry,” said Robert Quintana, the mayordomo of San Acacio acequia.

Quintana and I are leaning against his pick up truck in the early afternoon sun. The heat is abrasive, reflecting off the loose dirt and the metal of our vehicles. Even the sparse sagebrush seems to wither. The San Acacio creek trickles past us, its high banks a reminder of its former volume.

“The word *Acequia* means water in commune, so hypothetically we all own the water in the ditches,” said Quintana. He was reminiscing about a time when the ideals of the acequias actually informed the practice.

Protecting Asset-in-Place in the Age of Trans-Basin Diversions

Front range municipalities and investors looking to buy and sell water for a profit have been scouting Culebra Creek’s watershed, upsetting residents of San Luis. According to the Colorado Water Conservation Board (2023), the purchase and permanent transfer of agricultural water rights – widely known as “buy and dry”—is increasingly common in the San Luis Valley. Both private and municipal water purchases occur because water access is not evenly distributed across the state. The western side of the Continental Divide, where the San Luis Valley is located, receives most of the precipitation in Colorado (80%); however, nearly 90% of the state’s population lives on the eastern side of the Continental Divide. There are complex and vast networks of reservoirs, pumps, tunnels, and ditches to store and move water known as transbasin diversions. These projects divert water across watershed boundaries, allowing front range municipalities and private buyers to purchase water from the West of the Continental Divide and move it across the mountains. In Colorado, 27 diversions transport approximately 580,000 acre-feet of water annually from one of the state’s four major river basins to another. These projects, known can have extreme basin-of-origin impacts, including increased water scarcity.

The Sangre de Cristo Acequia Association and Colorado Open Lands are leading an effort to keep the water within the Basin by “encouraging the ditches to legally tie their water to the land

(Valpedo, personal communication, 2023). The hope is that this effort will protect the water from being sold to front range municipalities, keeping it instead in the Culebra Creek watershed. “There isn’t only drought here, but also water being transferred out,” said Delmer Valpedo, a sixth generation acequia farmer who was raised on Culebra Creek. We were seated across from each other at his kitchen table. To legally tie the water to individual ditches, the ditches must first be recognized by the state as acequias.

In Colorado, the 2009 Acequia Recognition Law, which was amended in 2013, allows acequias to continue to exercise their traditional roles in governing community access to water, and also strengthens their ability to protect their water (Jensen et al. 2016). This should allow for the acequias to legally protect the water in their ditches from being moved over the mountains to the front range. The legal processes to realize the benefits of this law, however, requires the writing of bylaws, incorporating ditches and retroactively reconstructing documentation of water use back hundreds of years. This process often requires legal support, is riddled with bureaucratic roadblocks, and takes a significant time surplus that farmers in San Luis do not usually possess.

If incorporated, though, acequias may raise the funds to purchase water rights so that the water in the Culebra Creek watershed can not be taken by the state. said Delmer Valpedo. “We want to keep our water in the valley. We don’t have too much to begin with. When they take our water, the culture will dry up too,” said Delmer. Modern technological advancements that result in the possibility of moving water hundreds of miles from its source has put pressure on the traditional acequia system that relies on water staying within its own watershed.

Cultural Pressures: “The cooperative element of the water use has been by in large lost”

Modern pressures have far-reaching impacts on the cultural basis of acequias because historically, acequia farming was the primary mechanism of survival. To maintain the acequia system by providing labor and fostering reciprocal relationships of support within the community benefited the individual farmer. Throughout history, farmers have lived dependent upon the rest of their community, the water, and the land. Today, however, the opportunities of younger generations to move away from acequia farming, cheap labor, and water ownership conflicts has made them separate, which disrupts their cultural norms and traditions.

“What I’ve observed is that the cooperative element of the water use has been by in large lost because it was applicable at a period of time when a large component of the agricultural activity was sustaining people, so people worked together because that was the whole basis of the acequias ideal all the way to the Arabian peninsula to the Iberian,” Jock Jacober, the president of the SdCAA told me.

I remember reading about spring cleanings early in my study of acequias (Lamadrid & Rivera, 2023). In May, when the literature said the spring cleaning would take place, I was eager to lend a hand, if possible. I called every contact I knew in San Luis. Very few picked up. Those who did were vague about the dates and unenthused by my offer of free labor. I later learned that some of the local ditches still do communal ditch cleanups, but on the People’s Ditch, every farmer is in charge of cleaning their own ditch (Peña, personal communication, 2023). There is no more annual spring cleanup to bring together the whole community.

On the San Acacio ditch, “we pay \$50 each and hire people to clean out our ditches,” Robert Quintana told me when I asked him what the date of their spring cleaning was. He chuckled at my eagerness to lend a hand. The tradition, a day of labor followed by a community meal, that I had read as foundational to the acequia institution was merely a memory along the San Acacio Ditch and The People’s Ditch. Culture is created and maintained by human interactions, and when community events like spring cleaning become obsolete, so do the means of cultural creation and renewal.

Out-Migration Pressures: “None of My Kids Want To Do This”

San Luis residents report an increase in younger people moving out of the town to seek employment and educational opportunities not offered in the town. In Costilla County, the median household income is \$34,578, compared to the state average of \$87,598. Data shows the county's poverty rate is 22.5% (Costilla County Census Data, 2024). According to state test scores, 10% of students are proficient in math and 10% in reading, some of the lowest scores in Colorado (Centennial School District R-1 in San Luis, CO, 2021). In response, people who have the financial resources to move elsewhere when their kids are old enough to attend school, often do. This leaves very few younger people to inherit the acequia farming practices that have been passed down for generations.

“Now you don’t have 13 kids that are going to pick cauliflower. If you look at the acequia farmers, they are all in their 60s and 70s,” Romero told me. We were sitting on plastic chairs and coolers in his driveway. Romero and I were joined by two of the students from the Climate and Human Behavior course at Colorado College. I had invited them to join me in San Luis for a portion of my ethnographic fieldwork because they both expressed interest in learning more about the “Human Behavior” side of the course. The other students and I were sitting, but Romero was busily fussing with the underside of his tractor as he spoke to us.

“Looking back in time, there was a democracy much more related to agriculture because everyone was a farmer, and they needed to farm to survive,” said Romero. In his mid 40s, Romero was the youngest farmer I had spoken to. Many of the others told me about their grandchildren and children, but primarily the stories were about how the younger generations of their family were no longer around. Most had left the town for more lucrative employment options or a better education for their kids. It was often with a mix of pride and grief that the older farmers told me that their children and grandchildren did not practice acequia farming because they left to get educated elsewhere: Pride in their kids for seeking educational and economic opportunities that they never had, grief for a perceived loss of the lifestyle that they spent their entire life practicing and had no one to pass it on to (*Figure 15*).



Figure 15: Centennial High School class of 1973. Centennial High School is the only high school in San Luis, CO.

Capturing the Present for Future Generations

In this section, I respond to the question: *What goals does the San Luis community have for the future of the acequia system?* Some farmers I spoke to wanted to link central pivot irrigation to the acequia ditches, which would reduce the overall water consumption of the system. Some used tubing with holes to reduce evaporation. Others, still, believed that both of those undermined the integrity of the acequia systems and would “irrigate like their dads did because it was the only way they knew.” Still others, almost too old to continue farming with no family to inherit the practice, were planning to sell their land and water rights and move to urban centers where their families now reside. Yes, the San Luis acequia community is deeply tied to land and water in ways that are hundreds of years in the making. In the hundreds of years that have passed, though, the social and infrastructural systems employed to manage the water have evolved.

“You will bring up sustainability and people around here will say ‘I don't know what you guys are talking about. I don't even know what sustainability is. This is what I was taught, this is what my grandparents and my parents taught me and so I'm doing it like them.’” said Romero.

‘But things are changing’, they will tell you. Things are always changing.” Romero added. Change is inevitable and resisting change in the face of modern pressures puts the farmers at risk of turning their traditional irrigation system, and its associated community and culture into a one lost to history.

The future of the system is uncertain, but the present culture and community still exists today. I found that the goal of many community members was for the system to be documented as it currently functions for future generations. Each of these following stories focuses on how a single San Luis acequia community member hopes to capture the system for the younger San Luis residents to learn about their history (*figure 16; figure 17*).

In the first story, *From a 6th Generation Acequia Farmer to The 7th*, I depict a day creating a short film with Steven Romero. Throughout the story, Romero’s reflections on the value of raising his daughter to understand how generations of acequia farming has fostered deep familiar ties to land and water. In the second and third stories, *Sculpting a Water-Based Culture* and *The Next Generation*, I depict how a grandfather and a grandson, Huberto Maestas and Amayas Maestas, both aim to capture the acequia system using different mediums. Huberto Maestas is a sculptor working on creating an artistic rendition of the acequias he grew up around. Amayas Maestas is a young farmer who is studying agriculture with the intent of adapting the San Luis acequias to address modern pressures while still incorporating elements of their fundamental form. By documenting these stories, I center the goals of the community for their own future with the aim of making this work valuable for the community.



Figure 16: Jordin Portillo, a young resident of San Luis, CO performs during the 2023 Fiesta de Santa Ana.



Figure 17: Young resident of San Luis rides his bike during 2023 Fiesta de Santa Ana.

From a 6th Generation Acequia Farmer to The 7th: Steven Romero

As Reign, Jamie, and I fumble out of the car, we run through our day 1 filming checklist. Camera? Check. Disclosure forms? Check. Long underwear? Check. Warm hats? Jamie looks sheepishly at me and I pull my extra beanie out of my backpack. I had worked with him long enough to come strapped with an extra. He pulls it on tight over his ears, the December San Luis Valley wind was as violent as we remember it in August, but now it has an ally in the chilly temps (*figure 18*).



Figure 18: Steven Romero walking around his farm.

We walk towards Romero, also bundled, fumbling, and running through his checklist.

“Welcome to my little farm in this corner of the universe. It’s cold as shit out here. I hope you are wearing long johns,” was Romero’s hello. We laughed, and piled into his pickup to capture a day in the life of a 6th generation farmer.

We are bumping over the uneven fields when he stops suddenly, throwing Reign forward. Reign is perched in the back of the pickup. She loses her grip on the camera, but it keeps rolling. Romero drives like he drives alone most days of his life. In fact, he does. He does a majority of the work to maintain the farm on his own. The fact that we are along for the ride makes him giddy and gracious to share. We are here because he asked us to be. I had interviewed Romero over the summer and was taken aback by the blame that he placed on policy, economy, and development.

I was down in San Luis in December because I had received a text from Romero at 2am on a Friday last semester asking me if I had interest in shooting a short film with him in which he captured his love for the acequia system in a letter for his daughter.

YES! I responded eagerly

A week later, the team was assembled, Jamie Harvie and Reign Le France, both Colorado College students, drove down to San Luis for our first day of shooting.

We spent the day driving around the farm with Romero watering the cows, moving hay, and mostly listening to him tell his story.

At one point later in the day, Romero pulls the truck onto a dirt road that I knew so well from my summer spent there. I felt like I was becoming part of the shared memory of this land. Then, Romero says he wants to show us something and pulls over abruptly to the edge of an acequia. There is a small concrete bridge over it. Romero brushes away the fallen leaves to reveal an etching (*figure 19*).

Great spirits protect this land and water. May it remain for 7 generations.

“That’s my daughter,” Romero remarks, “She is the 7th generation. She will be deciding whether this history is just a story or if it is something more.”



Figure 19: Inscription on acequia that reads ‘Great spirits protect this land and water. May it remain for 7 generations’.

“What does the future of the acequias look like?” was always my final interview question when talking to farmers along Culebra Creek. It is a question that I have asked Romero a handful of times since I met him. His answer changes with the season like everything in this valley (*figure 20*).



Figure 20: Jamie Harvie and Cecilia Timberg interviewing Steven Romero on his farm along The People’s Ditch.

Today, his answer is “My third great grandfather inherited the first water right on this land when Mexico became Colorado in the late 1800s. They registered the water rights because they knew they needed protection under the new laws because it’s a new country with new rules. It’s not any old farm, we have this lineage and this place in history.

“Water in our day and age is just a commodity, something you can buy, sell, trade, pipe from one side of the state to the other. It goes to the highest bidder. When our ancestors worked this land, water was life. The way you survived was to be self-sustaining. Teaching my daughter about her history is teaching her that water is more important than money. It is part of history and gives us everything we have right now. What is the water worth? In our day and age it’s invaluable.”

We continue our tour of Romero’s daily life, loading a jug of water onto the bed of his truck to water the cows.

“I’ve felt like I am one of the happiest guys in the world for most of my life. Shitt!!” he exclaims as we drive up to the cow pen to find one of the calves trapped in the metal bars of the feed tray (*figure 21*).

In a panic, he jumps the fence into the pen and spends multiple minutes yelling and shaking the metal enclosure until we can dislodge the calf.



Figure 21: Romero and Cecilia contemplate how to release the cow from its feeding tray.

As it shakes free, we break into subtle, then rolling laughter.

“Imagine if we had just...

Rolled up here and there was just a...

Upside down calf...

dead ...

And I was just tell you how beautiful my life is,”

Steven chokes out between fits of laughter.

When we finally regain our breath, he catches my eye, and smiles.

“See this. This is why I came back here after graduating from Colorado College. We grow up, forget what it is like to be a kid and have a childlike connection to the world. When I started this farm, it was from the spirit of a child. I want it to be remembered that way.”

“ I am at the nexus where I see the past and the work it took to maintain this land. With surface water rights, you only get to use what nature gives you in a year, so that is as far into the

future as I can really know. I love the land, but how do I show my daughter how to love it in the same way? ”

He, too, wanted to capture the practice of acequia farming for his daughter. He wanted her to know for 7 generations, through 8 droughts her family had farmed this little farm in the corner of the universe.

Sculpting a Water-Based Culture: Huberto Maestas

In June 2023, after a month living with and interviewing members of the San Luis acequia community, I reflected in horror at my notes as I walked down Main Street, warm latte from the San Luis Coffee Company in hand. The truth as it was being told to me was so far removed from its romantic depiction in literature that I could not believe I was writing about the same system I had read about in enchantment weeks before. *Was I studying a ghost?*

Dismay and disillusion clouded my vision as I fixed my eyes on my shoelaces to brace myself from bursting into tears right then and there. I didn't know that, in doing so, I was blind to the clues: the cultural source of this town was its water. Eyes down, I walked past The People's Ditch historical plaque, past the spring flowing from the roots of a willow that kids played in.

I walked right underneath Sierras y Colores, a mural painted by Carlos Sandoval in 1986. According to the state tourism office, the mural walks onlookers through the history and culture that created the town of San Luis. Each panel tells a different story, from honoring the Ute people as the town's first residents to highlighting the religious conquest of the area. Water flows through each panel.

Eyes lowered, I dipped into a newly opened art gallery on mainstreet, seeking air conditioning and privacy for my thoughts, but I was quickly greeted at the door. A tall, unshaven man filled the entrance, and I raised my eye sight line reluctantly to match his. Instantly, I noticed a mischievous glimmer in his eyes that reminded me of my grandmother's---a mouth half open, always ready to launch into a story. He reached out his hand to shake mine. They were covered in paint. I took it.

“Huberto Maestas, it's nice to meet you. This is my studio, I just opened it this week. Care for a tour?”

In an attempt to escape the looming despair of disillusion, I had practically walked straight into Huberto Marstas, a sculptor whose family had been living on the acequias for generations. I had met Huberto Maestas in passing, but had him on my list of *people to talk more to*:

Now, my latte sat cold in the windowsill of the small, intimate gallery space. It had only taken a couple leading questions for Huberto Maestas to sink into the role of teaching. He told stories in the form of lessons.

He told me about the printing press and movie theater that used to be on Main Street, how they used to pull the people out of the hillsides on weekends for a little bit of fun. He talked to me about his daughter who went to Colorado College and his grandson who, after growing up learning to farm on the acequias, was continuing the family tradition. But more than anything else, he talked about water. I really did have to go, but I wanted to listen to Huberto Maestas tell one last story.

“When I was a little kid, I had gone as a representative for my family to clean our ditch one year. I was up there, doing my thing, when I saw a man carving wood. I had never seen anything like that before. I asked him to teach me, so he did. This was when I first learned the art of sculpting. My art form, too, originated from the acequias.

“I hate to farm. I sold our farm because I hated it so much, but that doesn’t mean the acequias are any less valuable to me. My grandson, Amayas, has the green thumb I never had. He is out there in the field and I am in my studio carving sculptures of acequias. Telling the story of the acequias through my carving is my new big project. Amayas’ tool is a shovel and mine is a butter knife, but we both worship the acequias”

This story exemplifies a theme that reemerged throughout my ethnographic study: the acequias in San Luis are adapting, but the associated culture is so deeply embedded in the roots of this town, it is worth remembering, whether through art, storytelling, or the adopting of the practices by younger generations

The Next Generation: Amayas Maestas

Amayas Maestas seemed almost like folklore in San Luis: The embodiment of hope for the future. He was the grandson of Huberto Maestas, so he was the star of many of the stories Huberto Maestas told me when I would run into him in the gallery or spend the afternoons on a stool in his sculpting studio. He would invite me to come by and listen to him rave about Amayas Maestas,

showing me photos of his agricultural college in Vermont. He dreamed out loud about when Amayas Maestas would return and start his own little farm here in the valley.

Amayas Maestas came back to San Luis once while I was there and I regret that I missed him, but his schedule was crowded with making up for lost time with grandparents and building a greenhouse on Huberto's land.

It was with great relief that, when we were able to connect over the phone, Amayas Maestas affirmed that his grandfather was not spinning tales: He was coming back to San Luis. He wanted to continue acequia farming but not let tradition stand in the way of resilience. I imagined him on the other end with a baby face and bowl cut, his grandfather's mischievous eyes and deep-cut grin. Even from just his voice, I was struck by how simultaneously humble and optimistic Amayas Maestas sounded. I would have crumbled in his position, painted as a beacon of hope for an entire system. But he seemed eager and borderline giddy to rise to the occasion.

“It's good to keep traditions but we also need to move forward. We must help build a more resilient community to incorporate scientific knowledge.” He told me about his dream: a small farm in the San Luis Valley that can act as a model for how sustainability and science are not at odds with community and tradition.

“People get older. In San Luis, they don't have a younger generation and they don't have water rights but still they don't want to change because in the past we have not had the resources or education to enact change. I have that education now. I can be someone [the other farmers] trust to show them how progress can be productive and not destructive.”

Prior to talking to Amayas Maestas, I had begun to wish I had picked an archeological research project. I was craving the concreteness of an archaeological study's conclusion, informed by only the material skeleton of a culture. I'd only be able to make educated guesses. Instead, I had decided to tell a story without a known end.

“I wish people didn't see water as ownership but a resource used for everyone. Modifications need to be made, like reditching and cleaning out ditches, having ditch meetings about water capacity, how water flows, at what gates, and understanding what headgates need to be replaced (most headgates are 200 years old)....”

As I listened to him speak, I became incredibly grateful for the open-ended nature of this research. It meant people like Amayas Maestas existed. Switching him to speakerphone, I flipped through my interview notes from the months prior, reading not for problems but solutions. I found

that, along with stories and loss and laughter and frustration about the San Luis acequia system, farmers had also shared with me concrete goals for the future:

“The modern agricultural movement has focused on how small farms can be economically viable and sustainable. Sure, sometimes it is a little romantic but I see that applied in New England and I want to apply that to the San Luis valley. We could move from alfalfa to a small 5-10 acre farm.” -Amayas Maestas

“With conservation easements, we would make it impossible for the state to take our water”-Robert Quintana

“The Sanchez dam is the largest in the San Luis Valley, but it's at 20% capacity because the dam has a crack in it. If we were able to fix it, we could store more water over multiple years.”-Steven Romero

And so on. I found hope for some form of future recorded on virtually every page.

The next generation of farmers and ranchers are facing unprecedented aridity that will require creativity and new investments to address. This may include relying more on protected agriculture (e.g., greenhouses), more efficient irrigation, renewable energy, alternative crops (e.g., hemp, quinoa), drought-resilient animals, and innovative technologies (Colorado Water Conservation Board, 2023). Disenchantment with the system in its present state was widespread but there was also hope for its future. As is common in social systems at risk, the future goals expressed by farmers were diverse and often divergent. Nonetheless, it displayed a universal goal for some sort of future for the system. Sometimes, that hope was just that it would not be forgotten.

“Unless you keep reminding people of acequias and their systems, people are bound to forget,” Arnie Valdez told me as we moved slowly along the rows of his expansive garden pulling weeds. The future is uncertain but the present can still be captured.

Conclusion

The preceding ethnographic documentation of the San Luis acequia system is intended to address community members' request to have the system documented in its current state to counter its widespread romanticization by outside sources. This report does not aim to prescribe solutions to sustain the acequia system or study it to inform water management decisions. Instead, my results use vignettes from my year spent studying the acequias of San Luis to catalog the modern pressures experienced by the San Luis acequia community and the diversity of responses that exist within the community to respond to those pressures. The intended audiences for this study are the residents of San Luis, CO and anyone else curious about the acequias of San Luis. This work could also serve as a potential blueprint for academics studying traditionally climate resilient communities.

Although there are nearly 1000 acequias still being managed communally in Southern Colorado and New Mexico today, the results of this study only apply to San Luis, CO. Many acequias are suffering from threats of modernization that are specific to their ditches and vary depending upon the individual community and context. For example, Colorado and New Mexico provide completely different legislative protection of acequias. The core social and physical infrastructure of community-managed, hand-dug acequias are similar across the Southwestern US, but each system is different and should be documented by anthropologists in response to the goals of the community.

This project is still in progress. I am working with San Luis residents to get this research cataloged and accessible on paper, online, and in their cultural heritage museum (*figure 22*). I am also collaborating on a film project at the request of Steven Romaro, who is writing the script of the film as a letter to his daughter. Additionally, I will be providing the USGS with a report that will inform how they present newly generated paleoclimate data of the area to the San Luis acequia community.



Figure 22: San Luis Cultural Heritage Museum.

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Appendix

My appendix consists of supplementary material that provides a more comprehensive understanding of the project for those who are looking for further detail. This includes reflections on the research process, details on the methods and design of the research, and an in depth human history of the San Luis Valley.

Appendix 1: Researcher Reflection: “Ahorita”

As the summer deepened, both my external and internal relationship with my research evolved. Instead of introducing myself as a budding dendrochronologist trying to inform future decision making, I was a student: eager to learn more about not only the history of the acequias and the institution as it was created hundreds of years ago, but how that institution interfaced with the contemporary world.

I was constantly reminded during my time in San Luis that I lived disconnected from the land that fed me and the water that made me. This disconnect informed everything, even my perception of time. While in San Luis, I would call farmers and ask them if they had time to talk time to chat with me about their farming practices. They used to tell me that they would be happy to “Ahorita.” San Luis, CO’s population is majority Hispano, and they often speak a blend of Spanish and English.

Google translate defines “Ahorita” as Now, so you can imagine my confusion when they immediately hung up.

It took me checking my pride and asking whoever would answer about the meaning of these strange goodbyes to get a fuller definition.

Ahorita: Now, in an hour, in a day, sometime soonish, never.

It meant, as I came to learn, “when you are my priority.” It felt rude at first. Why couldn’t they just set a time. Maybe 2pm tomorrow? As weeks become months of living and working with this community, though, I came to find comfort in the phrase. Of course talking to me was less important than fostering the land that fed them, taking their cows to graze, and taking their children to school. I wouldn’t want it any other way. It meant, also, that when they called me hours, days, or months later, talking to me was their priority.

Conducting interviews “ahorita”, when talking to me was the priority of the interviewee, meant that the farmers were present with me in a way I had rarely experienced. Often, we would

spend hours walking along their irrigation ditches, or pulling weeds, or sitting in their dining room looking through old photos, as they told me about the acequias.

They wanted to be talking to me. As an undergraduate student, I was used to being scheduled into a 30 minute block of someone else's time. This was not the case with the farmers. They wanted to share their history, and a history 7 generations deep took time to tell.

Appendix 2: Original Research Goal and Design

Like many of those who have written about acequias in the Southwestern US, I originally designed this research with the intent of documenting the drought resilience strategies utilized by the San Luis acequia community and understand its implications for water management both within the community and across arid landscapes.

I designed a study that examined a system to understand its sustainability strategies, but failed to consider the possibility that sustainability of the acequia system in its traditional form is not always the goal of farmers. Despite their historic resilience to drought over the last two centuries, acequia communities in the Southwestern US are subject to the same pressures of modernization as the rest of the region. Varied legislative protection, introduction of mechanized irrigation, larger-scale farms, urbanization, deepening drought, and depopulation threaten the future of these irrigation systems. The future of acequias in the Southwestern US is uncertain. My original intention was to support sustainability efforts for residents and water management within the San Luis acequia community, as well as inform sustainability efforts across arid landscapes.

In response to feedback from San Luis acequia community members, I shifted the goal of my research from analyzing drought resilient techniques for their implications for future sustainability to documenting the system as it currently functions. I would no longer consider this research one as work that supports sustainable development.

Appendix 3: Interview Questions

1. What is your relationship to Culebra Creek?
 - a. Has your relationship with it changed over time?
 - b. Do you rely on anything related to the creek for your livelihood or lifestyle?
2. From your perspective, what are the different ways that members of your community use water from the creek?

- a. What about groundwater?
3. What changes have you noticed in the creek over this time?
 - a. Quality of water?
 - b. Quantity of water?
4. What extremely wet or dry years do you remember?
 - a. What was your experienced impact of those years?
5. What are the biggest challenges you face related to water?
 - a. What tools do you have to address these challenges?
 - b. What tools do you wish you had?
6. What are the biggest challenges the members of the Culebra Creek community face related to water?
 - a. What tools does the community have to address these challenges?
 - b. What tools do you wish the community had?
7. Would a centuries-long, pre-instrumental streamflow record help you address these challenges?
 - a. How so?
 - b. How would this knowledge help you with decision making?
8. What do you predict the future of Culebra Creek will look like?

Appendix 4: Human History of the San Luis Valley

The San Luis Valley has a rich human history, which began at least 12,000 years ago with “residentially mobile” Indigenous groups hunting and gathering in the Valley (Mitchell & Krall 2020). The land has been seized, ruled, and traded by many different sovereigns in its long history of human residence.

Ute Land Was Seized By Spanish Settlers

According to Mitchell & Krall (2020), archeological records suggest that Indigenous groups, including the Jicarilla Apaches, Utes, Navajos, Kiowa, Comanche, and several Pueblo tribes, have been living in the San Luis Valley for at least 12,000 years. The strategies Indigenous groups used to subsist in the desert’s cold desert environment adapted overtime depending upon environmental

change and technological advancements. Early occupants (~12,600- ~11,650 years ago) were primarily residentially mobile. About 11,650 years ago, there is evidence of sustained, full-time occupancy of the Southern Rocky mountains correlating with drier climates. Archeologists predict that this longer term settlement was due to Indigenous groups creating technology and adopting diets that were specific to the arid landscape of the San Luis Valley.

According to Jiménez (2016), after early scouting missions in the Southwestern US, the Spanish government was interested in the potential of what was then generally called 'the north'. Following the successful settlement of Mexico and Peru, Spain began trying to settle northern New Spain. The Coronado excursion of 1540-1542 was the first officially authorized attempt to conquer the north. Coronado marched north to the Rio Grande valley, now called the San Luis Valley, encountered many Indigenous groups, but found no silver or gold, as Coronado had hoped. Yet the Spanish king still believed that the Southern Rockies had mining potential and began settling.

By the 1600s, the San Luis Valley was inhabited both by Ute people and Spanish settlers. Metal artifacts predating the Old Spanish Trail suggest that Ute people established regular trade relationships with Spanish colonists by the mid 18th century (Mitchell & Krall, 2020).

Spanish colonial settlement in the following two centuries suppressed Native religion in the name of the Church and conflict between Native groups and settlers grew increasingly common (Mitchell & Krall, 2020). As Spanish population numbers rose, Indigenous population numbers plummeted due to newly introduced disease and removal of Indigenous people by European settlers (Mitchell & Krall, 2020). Today, however, over 1,000 Indigenous people still live in and around the valley (San Luis Valley Development Resource Group & Council of Governments, 2023).

Spain became Mexico

According to Linder (2013), San Luis, CO was part of the million-acre Sangre de Cristo Land Grant of the 1840s. After Mexico obtained independence from Spain in 1821, it established land grants in what is today northern New Mexico and southern Colorado. The Sangre de Cristo Grant was established in 1841 and commenced from the ridgeline of the Culebra Range and extended westward to the San Luis Valley to the Rio Grande. After the Mexican-American War, the area became more protected against Ute raids. Hispanic settlers from northern New Mexico immigrated to the land grant and settled in small plaza-centered villages.

The majority of land grants were communal lands. This pattern of granting common lands to settlers conformed to the Hispanic tradition which evolved in Europe during the 12th Century

(Garcia, 1995). It also mirrored the system of communal lands which dictated land tenure patterns of Native Mexico (Garcia, 1995).

Mexico Became Colorado

The question of who owned the common lands of the Spanish and Mexican land grants became an important one once the United States of America gained sovereignty over the northern territory (Garcia, 1995).

According to Simmonds (2021), the original Sangre de Cristo land grant resembles the current borders of Costilla County, a county rich in history, traditions, and natural resources. As of 2019, the population stood at 3,625, with more than 60 percent of citizens claiming Hispano heritage. Inhabitants preserve a Spanish-influenced culture with unique food, music, folklore, and art. La Vega, adjacent to the town of San Luis, is Colorado's only communal pasture and still used by descendants of the original settlers.

Established in 1851, the Town of San Luis is the oldest continuously inhabited town in the state of Colorado. The population of San Luis today is predominantly Hispanic, with strong ties to Spain's religious, cultural and artistic traditions (Town of San Luis Staff, 2018). A handful of the current San Luis residents are descendants of the Spanish who settled the land in the early 1800s, meaning that their lineage has lived on the land as the border fluctuated around it. Considered citizens of Spain, Mexico, and then Colorado, many of the residents have a much stronger affinity to the landscape than they do to nationality. Once a part of four Spanish land grants, the town retains the historical and cultural influences of Spain, which shaped the early communities of southern Colorado (Town of San Luis Staff, 2018).

Appendix 5: Can The Past Inform the Future?

The first ever class I took at Colorado College was called AN208: Collapse and Sustainability. It was taught over Zoom by Scott Ingram. Four years later, Scott is now my academic advisor, a coauthor of this research, and the only person in this world harder on me than I am on myself. The syllabus for the course read:

This course investigates social and environmental collapse and sustainability in the past and future. We will examine if and how we can employ knowledge of the human past in our efforts to understand and achieve sustainability. Modern sustainability studies often rely on data representing

*recent time periods of short duration. Using archaeological case studies from around the world (e.g., Maya, Rapa Nui, Greenland) we consider long periods of social and environmental stability and change and ask, “What can be learned; **can the past inform the future?**”*

The Collapse and Sustainability course was my first introduction to concepts that have emerged repeatedly throughout this study. Mitigation. Adaptation. Resilience. Vulnerability. Sustainability. Systems thinking.

Academic literature, I learned, is evolving to focus not only on climate change mitigation and adaptation but also on climate resilience, a concept which unites the two critical aspects of climate change measures, adaptation, and the capacity of the social-ecological systems to renew, learn, and transform in response to disturbance. Although humankind has always been living with and adapting to a changing climate, the current Southwestern US drought is unparalleled in paleoclimate records of the area (Brice, personal communication, 2023).

As a final reflection for my Climate and Human Behavior Course four years ago, I was assigned a paper on the question: *Does the Past Inform the Future?* Looking back at my response, it feels almost like the future (my research in San Luis) informed the past (my answer four years ago). It is hauntingly relevant to the conclusions of this paper:

“There is a treacherous romance to studying the past. It has the seductive property of being unknown but knowable. The search for unknown knows lies perfectly within humanity’s ambitions: it is challenging enough that it is worth the time and accessible enough that it is worth the money. The danger, though, arises when the past is scoured for answers on how to approach the future.

The past does not inform the future because the people of the past lacked the technology, science, and global perspective that allow us to fairly accurately predict the future.

The past does hold lessons for the future in the form of cautionary tales. It is valid and useful to study the past to build a mosaic of morals to be held and mistakes to be avoided. In this form of historical study, the past's events must be held at arm's length away from the present, such as we hold the magic of fairy tales away from reality to avoid the danger of children leaping from bunk beds convinced that they can fly. Human rights principles, technology, and globalization have evolved so drastically that although we stand on the same Earth, we live in a vastly different world. For example, if one were studying the Kualong people of New Guinea as a means to informing the future of sustainability, they could arguably draw the conclusion that the strangling of widows was a factor in the people's ability to sustain their society and we should consider if it may be necessary for a mass strangling of widows to occur to bring us one step closer to a sustainable future.

The validity of studying the past to inform the future, thus, crumbles when history is treated as the future reflected in the rearview mirror. This is a common theme in the study of history. "History Repeats Itself" was written in big bold letters in virtually every history classroom in my middle/high school. This oversimplification not only leaves us vulnerable to the human rights conflict mentioned above, but it also gives space for the dismissal of a future that does not mimic the past. As of today, we can model CO₂ trends, population growth, ocean acidification, and much more. All show that we are heading towards grave danger and imminent collapse if we do not make a sweeping, substantial change. Historical societies facing collapse did not have the same warning signs that we do and therefore do a poor job of informing our future.

Although the models used to predict the future tend to be strikingly accurate, the acceptance of these models is far from universal. This is because the models predict that a vast reordering of our current global systems is necessary for us to sustain our current sociopolitical complexity.

Historical study provides refuge from those big scary necessary next steps we must take in the present to protect our future. It allows us as humans to continue sifting through the knowable unknowns of our past for an answer unfit for our present and to turn a blind eye to the terrifying known knowns of our future.

If we continue to treat the past as a tool to inform the future, we as a global society will ignore the advantages we have over past societies facing collapse and suffer the same fate."

I have grown deeply uncomfortable with the word *collapse* through my past year of research. I understand the utility of studying post-collapsed societies through the lens of *collapse* and failed efforts of *sustainability*, but neither word seems to fit what I observed occurring in San Luis. Both provide a sense of finality that is impossible to place on a present system with an uncertain future. If I argued that the San Luis acequia community was doomed to collapse, I would be extending the scope of my research beyond documentation to prediction. I would also be removing the autonomy of the individuals within the community to address the threats I have identified and evolve in response. If I argued that the San Luis acequia community is the hallmark of sustainability, I would be furthering the romanticization of traditional agriculture that I seek to critique in this research.

Instead, I document the system as it currently functions using the framework of systems thinking. I identified vulnerabilities, resilience strategies, pressures, causes and effects present in the San Luis acequia system. The intended audience for this research is the San Luis, CO acequia community because it is an invitation. I documented how the legal, social, economic, and environmental variables presently interact in the San Luis acequia system. History makes one thing abundantly clear: This system is not rigid. It has changed over its history. Human behavior has changed in response. It will change in the future. Human behavior will change in response.

The primary variable I hope to introduce through this research is awareness. I seek to provide awareness of the system as it functioned as of August 2024. I now call on those within the system to manipulate the variables to meet their goals of the future.