Solutions to Water Resource and Environmental Challenges: Perspectives from the Agricultural Community in the Crooked River Watershed

by
Brytann Busick

A THESIS

submitted to

Oregon State University

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Abstract approved:

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Edward Weber

This research explores how an agriculture-based community in the Crooked River Watershed of Central Oregon responds to a series of water resource and environmental challenges, some associated with projected climate change, amid increasing pressure to change management practices to better accommodate environmental needs. A key part of this research assesses the collaborative capacity of the community to work together toward solutions to these challenges. This semi-arid watershed is vulnerable to a changing climate, with current climate models predicting significant changes in seasonal flows that will negatively impact existing water and agricultural systems and management practices. In addition, the agriculture community in this area is currently struggling to deal with a multi-year drought situation and is under pressure from regulators and other Central Oregon stakeholders to change their management practices to better accommodate environmental needs. This research addresses the following questions: How is the agricultural community in this area responding to these challenges? What are their ideas for responding to the challenges such that the agriculture community maintains, or even improves, its viability, productiveness, and integrity of its values, while also balancing its needs against societal demand for stronger environmental protection?

Key Words: Environment, Agriculture, Practice Based Knowledge, Collaborative Governance, Crooked River Watershed.

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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

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Introduction

The Crooked River Watershed of Central Oregon is faced with a series of water resource and environmental challenges, some associated with projected climate change, amid increasing pressure to change agricultural and water management practices to better accommodate environmental needs. At the same time, this semi-arid watershed is vulnerable to a changing climate, with current climate models predicting significant changes in seasonal flows that will negatively impact existing water and agricultural systems and management practices. In addition, the agriculture community in this area is currently struggling to deal with a multi-year drought situation.

Currently, as is typical in watersheds throughout the American West, water resources in the Crooked River watershed are over allocated, as many competing interests, including agricultural, recreational, environmental, and municipal, vie to use the available water. Of these, the agriculture community in the area receives the largest portion of water from the Prineville and Ochoco Reservoirs. And although recent federal legislation has guaranteed first fill rights for irrigators, many in the community are concerned that the presence of threatened and endangered fish species will affect their water security in the future. Environmental interest groups and those concerned about local fish populations and riparian zone health are looking to secure more water for in stream flows. The questions for this thesis are: How is the agricultural

community in this area responding to these challenges? What are their ideas for responding to the challenges such that the agriculture community maintains, or even improves, its viability, productiveness, and integrity of its values, while also balancing its needs against societal demand for stronger environmental protection? The concern is that traditional policy solutions prescribed by national environmental laws such as the Clean Water Act or the Endangered Species Act, for example, might not be able to solve these challenges by creating effective, long term water resource management solutions, in part because despite trying to balance tradeoffs, they often offer either-or solutions which do little to balance the competing demands and the complexities involved in any socio-ecological setting such as the Crooked.

Instead, this thesis focuses on the potential for problem-solving derived from the growing evidence that (1) practice-based knowledge, or expertise, and (2) collaborative governance, can be central to resolving complex wicked problems such as that found in the Crooked River watershed today (Ansell and Gash 2007; Weber et al. 2014; James Scott 1998 book *Seeing Like a State*). More specifically, I hypothesize that the agriculture-based community in the Crooked River Watershed of Central Oregon is likely to offer innovative solutions to the water resource and environmental challenges facing their watershed. Further, I explore the agricultural community's perspectives on collaborative governance and hypothesize that individual support for collaborative governance options will likely vary based on the perceived "depth," or severity of the threat to their

agricultural interests by these same water resource and environmental challenges.

Research Methods

Research methods included an analysis of appropriate secondary literatures on agricultural and irrigation practices, natural resource and water resources policy and management, and collaborative governance, as well as a review of primary documents from relevant group and government sources. In addition, the research involved semi-structured, open-ended interviews with 13 key informants that were selected by purposeful sampling, and based on membership and leadership in the Crooked River watershed agricultural community. This meant talking to a diverse array of agriculturalists, including a Crook County Soil and Water Conservation District employee, a Northwest Farm Credit Services employee, an Oregon Department of Agriculture Water Quality Specialist, a longtime ranching family, a 4th generation producer who sits on the Ochoco Irrigation Board of Directors, a Rancher from above the Prineville Reservoir, an employee of the Ochoco Irrigation District, a Bureau of Land Management Fish Biologist, a Crooked River Watershed Council employee, a Crooked River Watershed Council Water Monitoring Specialist, a Crook County Extension Agent, and a small irrigator. The sample size and methods for

recruiting participants were in line with peer-reviewed literature on qualitative methods and non-probabilistic sampling.

Each interview lasted between 60 – 75 minutes, but interviewees had the freedom to determine the amount of time they wished to devote to being interviewed. With interviewee consent, interviews were audio recorded for accuracy and transcription purposes using a small hand held digital recorder. Written notes were also taken during the interview. (Appendix A at the end of the thesis contains the interview format.)

Background: The Crooked River Watershed

The Crooked River is a tributary of the Deschutes River and subsequently the Columbia River, located in Central Oregon. The 125-mile long river and its watershed are "located in the South Central Oregon climatic zone; a semi-arid area of high desert prairie punctuated by small mountain ranges and isolated peaks" (Whitman 2012). In total, the watershed encompasses just under three million acres, or approximately 4,500 square miles, and includes a wide range of ecological conditions, from desert to moist forest. Landforms include a mix of valleys, plains, foothills, the Maury and Ochoco mountain ranges, headwaters, and downstream watersheds. Juniper trees, sagebrush, and rocky hillsides cover the semi-arid landscape, where the average annual precipitation ranges between 8 and 10 inches per year at lower elevations, and 30-40 inches at higher elevations (falling primarily as snow in the winter) (Whitman 2012).

According to the Crooked River Watershed Council, the watershed cuts across parts of 7 counties in Central Oregon, including the Crook, Deschutes, Grant, Jefferson, Harney, Lake, and Wheeler counties. Crook County is located in the geographic center of Oregon and constitutes 64 percent of the land within the Crooked River Watershed with 1,843,932 acres. In addition, nearly 60 percent of the Crooked River Basin is in public, primarily federal ownership. For example, the Bureau of Land Management (BLM) manages over 35 percent of the watershed (1,023,215 acres), while the United States Forest Service manages 22.8 percent (463,587 acres in the Ochoco National Forest; 172,136 acres in the Deschutes National Forest; 27,365 acres in the Crooked River National Grasslands, and 75 acres in the Malheur National Forest). The remaining 26,650 acres of public lands are owned by the State of Oregon, while private ownership covers 41 percent of the Crooked River Basin, or 1,193,570 acres (Whitman 2012).

In terms of the economy, rangeland and grazing constitute the main use (73 percent of the land), with forests and forest products involving 21 percent of the watershed's acreage, 4 percent devoted to irrigated agriculture, and 2 percent to urban and other uses (Whitman 2012). Forest products, agriculture, livestock production and recreation/tourism services constitute Crook County's total economy.

Historically, and much like other semi-arid regions around the Western U.S., the basin's water management focused on mitigating the effects of natural hydrological phenomena-- drought and floods—and, by extension, providing a

sustainable water source for irrigated agriculture. Major water diversion projects on the Crooked River began in the 19th century. The purpose of such projects was to provide water for irrigation and flood control, while also adding a new element--fish and wildlife management and preservation. The original Ochoco Dam was privately built in 1920 and impounded the Ochoco Creek just 6 miles east of Prineville--this formed the Ochoco Reservoir. In 1949, the US Bureau of Reclamation, in order to fix chronic leaking, replaced the dam. Currently the dam is 152 feet high and the reservoir stores 39,000 acre-feet of water. In 1961, the US Bureau of Reclamation built the Bowman Dam on the Crooked River, 14 miles southeast of the city of Prineville. The dam created the Prineville Reservoir, which holds just over 150,000 acre-feet of water. These dams changed the timing of peak flows in the Crooked River. Before construction of the dams, 75 percent of the average flow of the Crooked River occurred in March, April, and May. Natural seasonal flow patterns are altered below both dams, with high flows during the irrigation season when water is released, and lower flows while water is stored for the next irrigation season. Altered stream flow has resulted throughout the basin from the numerous public and private reservoirs created for water storage. Post-reservoir characteristics below large reservoirs such as Ochoco and Prineville include: reduced annual maximum mean flow, elimination of peak high flows, reduction in late winter and early spring flows, and an increase in summer and fall flows. Agriculture in the Crooked River Basin depends almost totally on storage from behind dams. (Crooked River Agricultural Water Quality Management Area Plan 2010).

Oregon Water Law

Under Oregon water law, all water is publicly owned. However, under some circumstances a permit or a license can be obtained from the Water Resources Department to use water from any source. Oregon's water laws are based on the principle of prior appropriation. "In Oregon, the prior appropriation doctrine has been law since February 24, 1909, when passage of the first unified water code introduced state control over the right to use water" (Water Rights in Oregon 2012). The prior appropriation doctrine states that water rights are determined by priority of beneficial use. This means that the first person to use water or divert it for a beneficial use can acquire individual rights to the water. Therefore, "the first person to obtain a water right on a stream is the last to be shut off in times of low stream flows" (Water Rights in Oregon 2012). During times of water shortage, the water right holder with the oldest date of priority can demand the quantity of water specified in their water right because it is senior to those filed after it. If there is a surplus, the water right holder with the next oldest date can take what is available to fulfill their needs.

The Oregon Water Code governs water in the state of Oregon. It has four fundamental provisions: beneficial purpose without waste, priority, appurtenancy, and must be used. Beneficial use states that surface or groundwater may be legally diverted for use only if it is used for a beneficial purpose without waste. The most common beneficial use in the Crooked River

Watershed is irrigation. Overall, however, the law favors consumptive uses because they help to achieve the goal of returning water to the watershed while putting natural resources to work for the greater benefit of humankind. The Priority of a water right is determined by date and determines who gets water in a time of shortage. The rule, "first in time, first in right," applies. Appurtenancy determines that a water right is attached to the land described in the right, as long as the water is used. Therefore, if the land is sold, the water right goes with the land to the new owner. Finally, once a water right is established it must be used at least once every five years. "A water right remains valid as long as it is not cancelled and beneficial use of the water is continued without a lapse of five or more consecutive years" (Water Rights in Oregon 2012).

Oregon law provides a method for obtaining permission to divert and use water for a short-term or fixed duration. Under current law, certain types of uses can be allowed using a "limited license," provided that water is available and the proposed use will not injure other water rights. These authorizations allow landowners and developers to use water for purposes that do not require a permanent water right. These are considered "junior" water rights because they are subject to revocation at any time and there is not guarantee that water will be available to fulfill the right. Generally, irrigation uses are not allowed under a limited license except for a crop that does not require irrigation once established. A water right may be transferred temporarily or permanently, transferred to another district, transferred or leased for in stream uses, transferred permanently to in stream use or for a specific period of time, or

leased in stream. Within the Crooked River Watershed, all water rights are currently allocated. Therefore, in order for a new irrigator or user to get water a transfer would have to be created. With the current shortage of water and a high demand for it, the value of transferred water is expected to be very high.

Oregon Water Law and its Application in the Crooked River Watershed

The water developments within the Crooked River Watershed and the security that Oregon Water Law and the Prior Appropriation Doctrine provide allow agriculture to be, by far, the industry that has the greatest impact on water usage within the Crooked River Watershed**.** According to the Crooked River Watershed Council, the top 5 agricultural commodities in the Basin include cattle and calves, misc. crops, hay and grass seed, wheat, and vegetables. From early settlement cattle ranching has been one of the primary industries of the county, with huge herds grazing the countryside beginning in the 1880s. "During the early-twentieth century, a large influx of new settlers came to Central Oregon. As more people poured into the area, irrigation became indispensable for ranchers who could no longer graze cattle openly throughout the region and for homesteaders who were attempting to farm in the arid climate" (Cohen 2008). Irrigation still remains the most essential component to farming and ranching in the Crooked River Basin.

Today, agriculture accounts for 99 percent of total water use according to the Crooked River Watershed Council. "Dams, storage reservoirs, canals, and

pumping plants as well as acts of drainage, channelization, and biological management characterize the Crooked River and its tributaries today" (Cohen 2008). They form the intricate network that allows for large-scale agriculture production and irrigation intensive crops. Currently, irrigation diversions during the summer remove most of the Crooked River's flow below Prineville. This provides the irrigation necessary to raise hay, grain, mint, potatoes, and seed in the Crooked River Watershed. However, in the recent past, other interests and organizations have challenged the agriculture community with competing visions for the use of the water impounded behind dams in the Crooked River watershed

The initial purpose of the dam construction was to provide water for irrigation and agriculture uses as well as flood mitigation, however, beginning in the early 1970s, the Reclamation Bureau set out to manage the Crooked River and Prineville Reservoir for uses beyond irrigation and flood control. "The impounded river spawned tourism, recreation, and retirement industries, which opened the way for a variety of users, not simply irrigators, to lay claim to the river" (Cohen 2008). Therefore, the reservoir became one of the most popular recreation and fishing locations in the state. It was then proposed that nearly half of the reservoir's water should be reallocated for recreational and fish and wildlife purposes. This sparked concerns within the agriculture community. "The Prineville Reservoir holds approximately 160,000 acre-feet of water, but irrigators had only contracted for about 70,000 acre-feet" (Cohen 2008), prior to 2014 when new legislation allocated this unclaimed water. Therefore, prior to

2014, unallocated water was left to flow downstream and into the Deschutes. However, some years, the reservoir does not fill to capacity. “Irrigators worried that designating half of the reservoir's water for recreational and fish and wildlife purposes would cause problems during dry years” (Cohen 2008). Agriculturalists feared that it would negatively affect their ability to secure their irrigation water. Today, this concern still permeates relations between the agriculture community and those who value the reservoir for recreation even though the Prineville Reservoir is primarily an irrigation storage water body, with secondary objectives of Crooked River flood control and public recreation.

Challenges to Water Use and Scarcity

The Crooked River Watershed has endured harsh drought conditions in recent years. A scarcity of water has led to an increased demand from various stakeholders to secure their share of the unpredictable water supply in the Prineville Reservoir. Many of these stakeholders have competing interests. Native fish populations have declined, the environmental movement has continued to gain steam, and there has been an overall increased demand to retain water for in stream flows, which would subsequently decrease the agriculture industry’s share of water. Agricultural practices continue to come under scrutiny from an uninformed public and from special interest groups and organizations that do not support many of their practices and uses of water. The allocation of the region’s most scarce resource—water—remains uncertain.

There is also the challenge to the watershed and water resources from the expected effects of climate change. “Projections show that it will alter environmental conditions across the Pacific Northwest and affect the natural resource base and change habitat for fish and wildlife. Changes in the seasonality and variability of temperature and precipitation have important consequences for the regional economy because of their potential impacts on irrigated agriculture, hydropower generation, floodplain infrastructure, municipal water supply, natural systems, and recreation (Climate Change in the Northwest 2013) Irrigators within the Crooked River Watershed depend on the storage of peak winter flows to be released from the reservoir during the summer months. Current climate projections show that “snowmelt dominant watersheds, with average mid-winter temperatures close to freezing, are particularly sensitive to the trend of increasing temperatures that shift winter precipitation toward more rain and less snow” (Climate Change in the Northwest 2013). Given the likelihood of increased winter air temperatures, snowmelt dominant and mixed rain-snow watersheds are projected to gradually trend towards mixed rain-snow and rain-dominant, respectively. The shift from snowmelt dominant to mixed rain-snow conditions will result in reduced peak stream flow, increased winter flow, and reduced late summer flow in these watersheds. The Crooked River Watershed depends on a robust snow pack. Climate change will likely reduce snowpack and substantially shift stream flow seasonality. Seasonal peak runoff will likely shift, with more runoff occurring in late winter rather than during the spring. This will produce lower summer flows.

"Currently, water management regimes and water allocation are designed around the historical seasonal timing of snowmelt runoff and the ability of the snowpack to act as a natural reservoir by storing water during the cool season and gradually releasing it in the spring and early summer" (Climate Change in the Northwest 2013). This is the water that most recreation users and all irrigators depend on. The primary use of the Bowman Dam and the Ochoco Dam is flood prevention. The ability of the reservoirs to "capture earlier peak season runoff is limited by available storage space and the requirement for flood control operations" (Climate Change in the Northwest 2013). Therefore, the impacts of climate change on the region will create a difficult challenge for managers who will have to navigate a difficult balance between storing as much water as possible to satisfy warm season water demands and maintaining enough space in the system to capture flood waters and minimize flood risk downstream. Overall, projections show an increase in extreme weather conditions, drought and floods, compared to the historical record.

These climactic changes will have a profound impact on irrigated agriculture production. Higher temperatures during the summer months will increase the demand for irrigation water. "Recent studies also indicate that a warming climate with an earlier loss of snow cover and a projection of at least 20 more days in the annual frost- free season in the region would increase the length of the growing season, which could increase agricultural consumptive water use and thus water demand" (Climate Change in the Northwest 2013). An increase in demand and a decrease in supply of irrigation water will overall

reduce the value of both agricultural production and agricultural lands in the region.

Many wonder if the agriculture community will be able to withstand these outside challenges, weather persisting drought conditions, and maintain viable operations in the future. Despite these daunting conditions, the agriculture community in the Crooked River Watershed possesses many characteristics that are commonly found within agriculture and will serve as assets to them as they tackle persisting challenges. Pride in ownership, a deep connection to the land and it's resources, appreciation for the value of community, a hard work ethic, and adaptability are some of the characteristics that agriculturalists commonly possess. One of the most important goals for any agriculturalist is their ability to continue their family's legacy and pass on their farm or ranch to the next generation. The uncertainty surrounding the allocation of water will be the greatest challenge that this generation of agriculturalist in the Crooked River Watershed will need to address in order to make that goal a reality.

Description of Water Resource and Environmental Challenges

Concerns have been raised from agriculturalists and environmentalist alike regarding the water quality and temperature of the Crooked River, the presence and effects of threatened and endangered species within the watershed, land management and fire suppression, and the overall impacts that climate change and persisting drought conditions are presenting within the

basin. These challenges, coupled with the increasing demand from water users to capture their share of a finite resource for often competing uses, has created an unsteady and uncertain future for the Crooked River Watershed. The water resource and environmental challenges that are present in the watershed are far reaching and have direct impact on many people's lifestyles and livelihoods. Water is one of the greatest influencers on Earth. This fact is acutely felt in the semi-arid climate of Central Oregon. The ability of the local community within the Crooked River Watershed to find solutions to persisting environmental and resource challenges and to mitigate their effects will likely determine success or will present even greater challenges than those being faced today.

Water quality within the watershed has been steadily decreasing since early settlement. Significant loss of riparian vegetation including distribution, diversity, age and class has occurred since the 1800's. "Much of the Crooked River Basin is dominated by soils vulnerable to erosion due to steep slopes, high clay content, and poor vegetative cover. Timber harvest, fire suppression, and livestock grazing have occurred throughout the basin and have impacted basin hydrology" (USDA FS 1998b). Approximately 2/3 of the total annual precipitation comes in the form of snow during the months of October through April. Therefore, "flow in the streams of the Crooked River Basin is relatively low. The streams possess characteristics of a semiarid climate, with low precipitation producing low runoff" (Whitman 2012). With recent changes in timing and levels of peak flow, channel and riparian conditions, particularly those downstream of major reservoirs, have been impacted. This makes the

watershed extremely vulnerable to land use practices and outside influences. "Land use practices that potentially influence water quality include water storage and diversion, agricultural and livestock runoff, failing septic systems, wastewater treatment and other discharges, toxic spills, soil erosion, and degraded upland and riparian vegetation conditions" (Whitman 2012). It is important to maintain water quality because without it ecosystems collapse and beneficial uses are no longer provided.

The Crooked River Basin's provides beneficial uses such as public and private domestic water supply, salmonid fish rearing and spawning, anadromous fish passage, boating, hydropower, wildlife and hunting, livestock watering, irrigation, and aesthetic quality. Fish have been one of the most effected beneficial uses that has negatively been impacted by poor land management. Historically, waterways within the Crooked River Watershed were major spawning ground for anadromous fish such as spring Chinook salmon, steelhead trout, and Pacific lamprey. "Fish populations began to drop in the early 19th century due to irrigation withdrawals" (Whitman 2012). Today, the species still believed to be present in the basin include spring chinook salmon, summer steelhead, bull trout and redband trout. However, these species are highly vulnerable to land management decisions, water allocation decisions, and climate variability because the natural ecosystems must be intact for them to survive.

A stream must possess many characteristics to properly support natural ecosystems and also provide beneficial use. Water temperature is one of the

greatest water quality characteristics that is generating concern within the basin. “Elevated water temperature is detrimental to cold-water fish species and other aquatic life” (Whitman 2012). Warmer temperatures increase susceptibility to disease, inability to spawn, reduced survival rate of eggs, reduced survival and growth rates of juveniles, increased competition for limited habitat and food, and reduced ability to compete with other species. On the Crooked River, surface water temperatures have increased as a result of water diversion, reservoir storage, reduced riparian shade, and altered stream channel morphology.

Increased water temperature is only one concern of several characteristics that are necessary for a healthy waterway. The Crooked River and the reservoirs are commonly used for recreation; bacteria most directly affects this beneficial use. “Possible sources of bacterial contamination can include: wastewater treatment plant discharges, failing septic systems, urban runoff, and livestock wastes” (Whitman 2012). In addition, flow and habitat modification on the Crooked River has created conditions in some locations that are insufficient to support aquatic life because of detrimental changes to the resident biological community. The beneficial uses of resident fish and aquatic life and salmonid spawning and rearing are negatively affected by these alterations. The Crooked River is not known to have any detrimental effects from inadequate concentrations of dissolved oxygen, a lack of nutrients, inadequate pH concentrations, insufficient turbidity, harmful toxic substances, or point source pollution, although some sites are listed as hazardous.

In addition to water quality concerns there are other barriers that have severely influenced fish populations within the basin. Fish passage barriers are a major resource problem within the Crooked River Basin. So much so, in fact, that anadromous fish have been eliminated from the basin because of fish passage barriers. Other dams, diversions, and culverts within the basin have created additional passage barriers. Currently, the existing redband trout population is fragmented into small populations that now have a greater risk of extinction than a large, connected population would be.

The greatest factor, however, that affects fish populations in the basin is water quantity as it influences numerous water quality, habitat and fish passage variables that can be severely limited. "Fish abundance is directly related to volume of water available in streams, which affects all life stages including spawning, incubation, rearing, and migration" (ODFW 1996). Overall, reservoirs for irrigation and hydroelectric production have created artificial habitats for native and introduced fish species. "Habitat limitations for reservoir fisheries include seasonal and daily water level fluctuation or drawdown, water temperature, low minimum pool levels, turbidity, poor riparian conditions, and a limited amount of fish holding structure" (ODFW 1996). Many argue that a solution to this problem is to increase in stream flows by reallocating water previously set aside for irrigation and agricultural uses. In the meantime, however, proper management solutions are being sought for the total of 42 species that are listed as threatened, endangered or special status species in the Crooked River Basin by either the federal or state Endangered Species Act

Listing. “Listed species include 2 amphibians, 11 birds, 1 fish, 4 mammals, 2 invertebrates, and 22 plants” (ONHP 1998) Many species were not placed on this list solely because of poor aquatic habitat. The encroachment of invasive species and poor fire management has greatly influenced the habitat of species within the basin.

Historically, the Crooked River Watershed’s forests were characterized by an open, park-like structure at lower elevations, maintained by frequent ground fires. They were filled with large trees that were mostly fire-resistant ponderosa pines at lower elevations. Therefore, these trees often prevented fires at cooler and higher elevation sites and overall, fires were less frequent. When a fire did go through these areas it would burn a high percentage of the trees. However, “decades of fire prevention and suppression have allowed shade-tolerant tree species to grow in, creating dense, closed stands of even aged trees. The once available mosaic of habitat types has been greatly reduced and the risk of damage from fire, insect, and disease has increased” (Whitman 2012). This resulted in an extensive spread of western juniper and exotic grasses and forbs in riparian shrub lands that is negatively impacting riparian vegetation communities.

The expansion of western juniper within the basin and into rangelands is a primary watershed health concern. Junipers possess several characteristics that enable them to thrive and outcompete most vegetation within their habitat. “The juniper canopy intercepts rain and snow, keeping it from reaching the ground thus making it unavailable for plant growth, stream flow, or

groundwater recharge; and they consume large amounts of soil moisture" (Deboodt 2008). Many farmers and ranchers within the basin observed that small streams often would dry up completely when a stand of junipers established itself in the area. "Based on water use models for individual trees, the U.S. Forest Service estimated that mature western juniper tree densities, ranging from 9 to 35 trees per acre, are capable of utilizing all of the available soil moisture on a given site in a 13 inch precipitation zone (Gedney et al. 1999). In addition to removing water from the natural system, juniper expansion has completely changed vegetation communities and reduced forage for livestock and wildlife. "Juniper expansion has reduced ground cover, contributing to increased overland flow, loss of topsoil, and sedimentation of streams during high intensity precipitation events" (Deboodt 2008). Junipers have created a challenging management issue that has only exacerbated existing water resource challenges already present in the basin. "The Bureau of Land Management is involved in an aggressive juniper control program utilizing cutting and burning methods and many private landowners are also involved in control programs (hundreds of acres per year)" (Deboodt 2008). There is a huge demand for a cost effective solution to this problem but despite efforts to find one, juniper populations continue to increase and to outpace all efforts to reduce their size and impact within the basin.

Oregon is perceived as a water rich state. However, persisting drought conditions have had a large impact on the Crooked River Watershed and reduced the quantity and quality of water in the basin. This is a reality that most within

the Crooked River Watershed can agree on. Climate change, however, remains a controversial idea to many in the community. Whether the recent changes in climactic patterns are viewed simply as persisting drought conditions or as climate change, the effects they are having are widespread and severe. "Water is a primary medium through which climate change will have an impact on people, ecosystems and economies" (Sadoff and Muller 2009). Although many do not support climate change, "the Pacific Northwest in not immune from climate change impacts. Already the effects of climate change are evident, particularly in regard to observed winter snow packs. As temperatures rise in the region, reduced winter snow pack and longer summers will greatly alter the timing and volume of runoff throughout the year" (Graves and Chang 2007).

The impacts of climate change and persisting drought conditions have not only stressed the local environment and waterways but also incited concerns regarding water allocation within the basin. There are many competing interests for a stressed and finite resource. Tensions are building among competing stakeholders as they work to secure their water rights. A common trend, given the struggling fish population, is a shift in support towards the increased allocation of water for in stream flows. This shift would be necessary for increased water in stream because, "surface water resources have been fully appropriated in the entire Deschutes Basin for many years, and stream flows below legally set minimum limits occur locally" (Gorman 1999). Therefore, surface water rights are unavailable and all new water development relies on groundwater resources. Currently, "over 99% of the water allocated in the

Crooked River Basin is used for agriculture and approximately 95% of total water use (agriculture, domestic, and commercial) comes from surface water" (OWRD 1999). In order to increase water in stream for struggling fish populations, it would need to be reallocated. Plainly put, the Crooked River Watershed's demand for water is far exceeding its supply. Traditional solutions to this problem have been implemented and played out in this area over the past few decades. Many wonder if these traditional methods to solving challenging resource issues will provide the kind of support and influence that this community desperately needs.

Traditional Solutions to Challenges

The call for wildlife conservation in the United States began in the 1900s after the near-extinction of the bison and the loss of the passenger pigeon. A shift in environmental values caught fire by the late 1960s and 1970s as the American people recognized that the natural systems that we depend on were at risk and that plants and animals worldwide were disappearing. During this time period people recognized the need to work together to protect and restore species that were most at risk of extinction as well as their habitat. The environmental movement came into focus and in response passed many top down, one-size-fits-all, federal environmental laws, including the Endangered Species Act, Clean Water Act, and the Federal Wild and Scenic Rivers Act. These federal laws as well as the recent legislation passed by U.S. Representative Greg Walden (R-OR) all play a vital role in the management of the Crooked River Watershed. There are concerns, however, that the traditional top-down,

command and control, “one-size fits all,” approach of these policies might not offer the most efficient, equitable, or effective solutions (Weber 1998, 2000). Yet, these laws are part of the policy mosaic that governs the Crooked and necessarily play a large role in water management, as well as in future management and/or collaborative efforts to make improvements and to solve the challenges facing the agricultural community.

The Endangered Species Act came into effect in 1973. It was designed to protect critically imperiled species from extinction. The Act is administered by two federal agencies, the US Fish and Wildlife Service and the National Oceanic and Atmospheric Administration. It lists species that are at or below critical levels of population viability as either threatened or endangered. “An endangered species is defined as any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (Nielsen-Pincus 2008). According to the ESA, a species can be endangered or threatened by any of the following: the present or threatened destruction, modification, or curtailment of its habitat or range; over-utilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or man-made factors affecting its continued existence. The ESA must follow these guidelines and cannot decline to list a species for economic or other public interest reasons.

One of the main goals of the Endangered Species Act is to provide a way for the ecosystems in which the endangered species and threatened species depend to be conserved. The government is required to use the best scientific data available to determine if the listed species is dependent on critical habitat for survival. "The ESA defines critical habitat as those areas with particular physical or biological features essential to a listed species that may require special management and protection if the species is to survive and recover" (Matsumoto 2003). Therefore, critical habitat is also incorporated into ESA's control and monitoring. It is important to also note that private land can be designated as part of a species' critical habitat. After the species and its associated habitat are listed a recovery plan is enacted. Recovery plans are blueprints designed to guide the government in bringing listed species to a self-sustaining level. They include site-specific management plans, a recovery objective i.e. a target population number, a prioritized schedule of tasks, and cost estimates. A species is considered recovered when it no longer needs the protection of the ESA and is therefore "delisted," or taken off of the Endangered Species List. It is also possible for a species to move from the endangered to the threatened status. After the species is removed from the list, the ESA requires that the federal government monitor its health for five years.

The Crooked River Watershed historically sustained a diverse population of resident and anadromous fish species, with the McKay Creek tributary having historical significance as "the" primary Chinook salmon nursery habitat within the entire Deschutes River Basin. However, decreased water quality and

quantity have diminished populations. Currently, within the Crooked River Watershed the summer steelhead trout and bull trout are both listed as threatened under the Endangered Species Act. In addition, "Redband trout are a species of concern for fish habitat and management due to a depressed population that has resulted from degraded habitat and water quality" (Nielsen-Pincus 2008). The Endangered Species Act governs the ways in which these species are reintroduced and managed. Currently, the federally threatened anadromous mid-Columbia summer steelhead are being reintroduced within the watershed.

A specific component of the Endangered Species Act, the "experimental" designation status listed under Section 10(j), has had a large impact on the management and monitoring of species listed within the Crooked River Watershed. Section 10(j) allows the Secretary of the Department of Interior to designate a reintroduced species as threatened, while not triggering the protections that normally apply to species that are threatened and giving the agency flexibility and discretion in managing that species. The goal of this legislation was to decrease the political and social opposition to the reintroduction of threatened or endangered species. It lessens the restrictions on private landowners and land use practices within the area of reintroduction. This rule helps to include stakeholders from within the community in the solutions and programs that are implemented to insuring the success of the threatened species.

The renewed presence of anadromous species will likely change the dynamics between many stakeholders within the region and create widespread impacts. Reintroduction introduces a level of uncertainty to landowners and managers due to the currently unknown implications of the presence of ESA listed fish. This uncertainty stems from their lack of inclusion and involvement in decisions made regarding how the reintroduced species and its habitat will be managed. Plainly put, local communities are often left out of the loop in the ESA's listing process. "Local citizens and irrigation districts are concerned that the reintroduction will trigger increased regulation of land use practices under the ESA. Reintroduction requires regulatory compliance and necessary infrastructure such as fish screens and passage at irrigation water diversions in order for the reintroduction to succeed. This requires the agriculture community to take part in the reintroduction and for people to lend their time, energy, and effort to it. Some might view this as an opportunity because of the financial resources provided to improve natural resource conditions that will both improve the potential for a successful reintroduction and assist landowners in implementing best management practices on their lands but others see it as a burden that they are forced to comply with.

The Endangered Species Act is considered one of the most powerful pieces of legislation influencing nature in the world; however, it is notably flawed piece of legislation. One of the greatest challenges to actually implementing the legislation is to navigate the vague parameters that describe the listing requirements of a species as threatened or as endangered.

“Classifications include terms that lack precise legal or biological meaning, for example, 'in danger of', 'likely' and 'foreseeable future'. The resulting legal wrangling costs too much time and money” (Matsumoto 2003). The ESA’s track record does not proclaim resounding success either. Critics of the Endangered Species Act argue that with over 2,000 endangered species listed, and only 28 delisted due to recovery, the success rate of 1% over nearly three decades proves that there is a need for serious reform. In addition, the Endangered Species Act has been criticized for mandating protection of individual species rather than of ecosystems.

The Federal Clean Water Act (CWA) was established in 1972. “It requires states to establish water quality standards to protect beneficial uses of the state’s waters” (Nielsen-Pincus 2008). This legislation is enforced by the Environmental Protection Agency and overseen by the Oregon Department of Environmental Quality. The Clean Water Act regulates water quality with the objective “to protect and maintain the chemical, physical, and biological integrity of the nation’s waters” (Nielsen-Pincus 2008). It is tasked with assessing both water quality as well as the habitat necessary to support fish and other aquatic organisms. The management of streams, riparian areas, and uplands directly impacts beneficial uses water. This component of the legislation is acutely important within the Crooked River Watershed because “salmonids, resident fish, and aquatic life are the most sensitive beneficial uses for a number of water quality parameters (including temperature, sedimentation, turbidity, nutrients, pH, and dissolved oxygen)” (Nielsen-Pincus 2008). Therefore, the

implementation of the CWA within the watershed serves as an integral component of the management of threatened and reintroduced species within the basin.

Persistent drought conditions and water scarcity coupled with the challenge of many competing uses the water is greatly limiting in stream flows within the Crooked River Watershed. In Oregon, "section 303(d) of the Clean Water Act sets criteria for assessing whether specific stream segments are water quality limited. Listing a stream segment as water quality limited requires the state to prepare a Total Maximum Daily Load (TMDL) plan, or a water quality management plan, that will function as a TMDL plan for nonpoint sources (e.g., forestry, agriculture, grazing, and untreated urban stormwater runoff)" (Nielsen-Pincus 2008). TMDLs describe the amount of each pollutant a water body can receive without violating water quality standards. This goal is largely achieved through the use of, "Statute ORS 568.900-.933, which gave the Oregon Department of Agriculture (ODA) the authority to develop Agricultural Water Quality Management Area Plans and Rules where required by Federal or State law" (Nielsen-Pincus 2008).

The goal in the creation and implementation of the Agriculture Water Quality Management Area Plan is to prevent and control water pollution from agricultural activities and soil erosion through education and voluntary implementation. This is accomplished through the formation of a Local Advisory Committee that consists primarily of landowners in the affected area that assist the Oregon Department of Agriculture in the development of the Area Plan and

rules. “The plan characterizes the management area, offers discussion on water quality and watershed health, identifies beneficial management practices, and develops rules and enforcement mechanisms for protecting water quality” (Nielsen-Pincus 2008). The agriculture industry generates some of the largest impacts on waterways in the basin. The management plan seeks to support the proper management of croplands and irrigation as well as livestock and grazing. The most significant rule protecting water quality and watershed health requires that “agricultural management allow establishment, growth, and active recruitment of streamside riparian vegetation” (Nielsen-Pincus 2008). This requires cooperation and collaboration between landowners and government officials.

The successful application of the Clean Water Act depends upon the inclusion and help of local stakeholders in the area. “Landowners have flexibility in choosing management approaches and practices to address water quality issues on their lands. Landowners may choose to develop management systems to address problems on their own, or they may choose to develop a voluntary conservation plan (e.g. an NRCS-approved farm plan) to address applicable resource issues” (Crooked River Agricultural Water Quality Management Area Plan 2010). This allows for the input, support, and inclusion of those in the area whose lives and livelihoods depend upon water resources to have a stake in solving challenges.

Historically, due to the security that the Oregon Water Code and the prior Appropriation Doctrine provide, agriculturalists have received first dibs on

water from the Prineville Reservoir for irrigation. However, with continuing drought conditions and water scarcity a greater demand has been placed on the need to leave a greater amount of water in stream. The water in the Prineville Reservoir was never fully allocated. This left the door wide open for competing users to try to secure their share of the remaining water. This prompted the creation of additional legislation to more formally allocate water within the basin and to authorize the release of the unallocated water behind the Bowman Dam. Representative Greg Walden serves Oregon's 2nd District. On July 10, 2013 he introduced the Central Oregon Jobs and Water Security Act (HR 2640) into the United States House of Representatives during the 113th United States Congress. The goal of the legislation was to deliver improved water certainty and a stronger foundation for economic growth and job creation in Central Oregon. Congress unanimously approved this legislation that included plants to implement a collaborative vision for water management along the Crooked River. A major component of this legislation was the amendment to the Wild and Scenic Rivers Act to modify the boundary of the Crooked River.

The Federal Wild and Scenic Rivers Act was created in 1968 to balance development near rivers and streams with the conservation of river and stream corridors. To accomplish this goal, Congress created the National Wild and Scenic Rivers System. Then, the Oregon Omnibus Wild and Scenic Rivers Act of 1988 was passed and "designated 40 river segments in Oregon for inclusion in the wild and scenic rivers system and directed the United States Forest Service (USFS) and the Bureau of Land Management (BLM) to develop management

plans for each designated river (USDI BLM, 1992a)." Originally, within the Crooked River Watershed a total of 8 river miles from Bowman Dam to State Scenic Highway 27, mile-marker 12 were designated as Wild and Scenic. This segment of the river provided scenic and recreational benefits as well and fish resources. "The fisheries resource in this section of the Crooked River was determined to be an outstanding remarkable value based on its genetic diversity and adaptability of redband trout to a wide variety of habitats" (USDI BLM, 1992a). However, a clerical error led to the boundary line of the Crooked River Wild and Scenic Area being drawn down the middle of Bowman Dam. In addition, a total of 9.8 river miles from the National Grasslands Boundary to Opal Springs in the Lower Crooked River Watershed are designated Wild and Scenic. This river segment provides the benefits of recreation, scenic views, geology, wildlife, and hydrology.

The Central Oregon Jobs and Water Security Act provided the congressional action necessary to correct the incorrect boundary line on the Crooked River that designated an 8-mile stretch as Wild and Scenic. The legislation moved the boundary line from the top of the dam, ¼ mile downstream. Previously the designation prevented efforts to retrofit the Bowman Dam so that it could generate clean hydroelectric power. Now new legislation allows a small-scale, private hydropower facility at the base of Bowman Dam to be constructed. The bill authorized an increase (from 10 to 17 cubic feet per second) in the minimum release that must be maintained from the Prineville Reservoir for the benefit of downstream fish life. It requires that 7

of the 17 cubic feet per second release to serve as mitigation for the city of Prineville groundwater pumping, as determined necessary for any given year by the city. In addition, Walden's bill allowed for water to be released from the Bowman Dam to help maintain a healthy steelhead, salmon, and trout fisheries, created a process that helps to plan for dry years and to minimize the impact on fish habitat and fishing, and it allotted water for the city of Prineville so that it can meet the municipal water needs and attract new businesses like data centers.

As stated previously, agriculture constitutes the greatest water use within the basin. Arguably the greatest impact that the Central Oregon Jobs and Water Security Act had was the provision of first fill rights for the agriculture community and irrigation. This guarantees the storage and release from the Reservoir as "an additional: (1) 68,273 acre feet of water annually to fulfill all 16 Bureau of Reclamation contracts existing as of January 1, 2011; (2) 2,740 acre feet of water annually to supply the McKay Creek land; (3) 10,000 acre feet of water annually, first to the North Unit Irrigation District and subsequently to any other holders of Reclamation contracts existing as of January 1, 2011, pursuant to Temporary Water Service Contracts, upon request; and (4) 5,100 acre feet of water annually to mitigate Prineville groundwater pumping pursuant to the release schedule developed pursuant to this Act. Requires water stored that is not called for and released by the end of the irrigation season to be: (1) carried over to the subsequent water year; and (2) accounted for as part of such first fill storage quantities of the subsequent water year" (H.R.2640).

The legislation implements the collaborative water management vision developed by local stakeholders in Central Oregon, including the city of Prineville, Crook County, the Confederated Tribes of the Warm Springs, American Rivers, Deschutes Basin Board of Control (representing the seven major irrigation districts in Central Oregon), NW Steelheaders, Ochoco and North Unit Irrigation Districts, Portland General Electric, Trout Unlimited, WaterWatch, and Central Oregon Flyfishers. This represented a solid example of the dynamic solutions that can be achieved when cooperation and collaboration is at the foundation of policy creation. This legislation produced results that were mutually beneficial to stakeholders across the board. However, communities within the basin are concerned that the legislation might have left the door open for competing interest to lay claim to the over allocated water within the reservoirs. The agriculture community is looking for potential strategies or solutions to this challenge and there is strong support for a collaborative effort.

In recent decades social science scholarship has learned that with complex natural resource problems, practice based knowledge and collaborative governance can help us to manage and resolve challenges. In this research, the potential for the use and value of each of these tools is being assessed within the Crooked River Watershed. Therefore, it is important to have a full sense of what literatures on both Practice Based Knowledge and Collaborative Governance have to offer. Following is a brief summary of the leading thoughts and applications of each of these relevant resources.

Practice-Based Knowledge

As the complexity of natural resource issues continues to increase and gain public attention and participation, the legitimization and use of practice-based knowledge as a resource when involving diverse stakeholders in various problem-solving forums has greatly increased. “There is growing recognition that policy decisions bereft of experiential, practice-based knowledge increase the likelihood of suboptimal decisions and policy failure” (Weber et al. 2014). Practice-based knowledge is one of the traditional sources of knowledge that comes from building experience, trial and error, and authority. It is a well-known fact that advancement and expertise gained in everyday life often outpaces research. By acknowledging and utilizing practice-based knowledge we can better our comprehension and management of dynamic social and ecological systems while creating the potential for contributions to theory. Practice-Based Knowledge does not seek to replace but to complement scholarly works and to add a new perspective and dimension into the ways in which we can view and analyze complicated natural resource issues. It helps to legitimatize civic science and include it as a resource in solving such issues.

The use of practice-based knowledge as a credible and functional source of information began to emerge within hybrid governance institutions such as collaboratives, adaptive governance, voluntary environmentalism, and community- based natural resource management programs. Recognition that serious natural resource issues or “wicked” problems demand participation from both users and managers has increased. These issues are extremely complex and

therefore can only be successfully addressed using a diversity of perspectives, including from those who often have been confronted with the challenge over a large time scale and possess experiential-based insights into interactions between the community and the environment. In many communities the "experts" on human-nature interaction are those whose families have made their home and living in the area for generations or whose occupation or expertise allows them direct contact with a large time frame in which they interact with the resources of the area. "The added complexity of uncertainty brought on by climate change or global social-economic integration also means it is harder for disciplinary-based scientists to understand the degree and kind of intricate relationships between and among all the pieces of the puzzle" (Weber et al. 2014). Therefore, many involved in the policy making process are turning to those whose practice based knowledge might provide unique insights and facets into how to best tackle challenging resource issues. Through this interaction "it is now generally accepted that these hybrid governance institutions, which often cut across state, market, and civil society actors, are likely to be central to maintaining and improving environmental policy successes for decades to come" (Weber et al. 2014). With this knowledge we have a greater chance of solving resource issues with creativity and efficiency.

As the complexity of resource issues and "wicked" problems increases so does the understanding that the persistent and widening gap between science and practice cannot be solved by better or more focused science. In order to achieve resources solutions efficiently and creatively we must recognize that

“there is no unified platform from which all knowledge can be gathered and integrated into a single understanding. Rather, by comprehending the world from multiple, competing vantage points the pluralistic view enriches each perspective and reveals assumptions that otherwise may have remained hidden-particularly to those playing dominant roles in producing knowledge” (Hayles, 1995). Here is where many are finding immense value for the support and use of practice based knowledge. The use of practice-based knowledge within collaboratives is “based on the premises that local populations have a greater interest in the sustainable use of resources than does the state or distant corporate managers; that local communities are more cognizant of the intricacies of local ecological processes and practices; and that they are more able to effectively manage those resources through local or "traditional" forms of access” (Brosius 1998). Therefore, by involving stakeholders in the policy making process we are able to tap into a source of knowledge that was previously unavailable and has a degree of importance and value that scientific based information simply cannot have.

In order for the use of practice-based knowledge to be successful participants must recognize that knowledge is often nested in a context of time and local circumstance. Gaining the trust and involvement of those who possess experience and expertise in a community is one of the most important components to the success of practice-based knowledge. Their participation allows for the “positive virtues of institutional diversity, wider public participation, and enlarged social capacity and flexibility to respond to

unplanned change" (Stewart 2013). Practice-based knowledge allows for local stakeholders to have greater influence in the creation of solutions to the resource issues that affect them. "Local, practical knowledge can also provide an important source of alternative, competing explanations and interpretations of natural phenomena in technical decision arenas typically reserved for "technical expert" assessments and conclusions" (Weber et al. 2014). One of the greatest challenges in this process, however, is the translation of information from one party to the other. Local stakeholders possess unique backgrounds and place based knowledge that is often time challenging to convey to policy makers or scholars in a meaningful or accurate way. "Practice-oriented stakeholders, especially leaders, serve as "translators" of knowledge applicable to their situations into effective on-the-ground practices for their governance effort/ community" (Gootee et al. 2010) However, through the establishment of trusting relationships with leaders within the communities information can be relayed accurately and used as information for the creation of a solution. By involving local knowledge of natural resources we are enhancing the collaborative potential in the policy making process.

Many believe that community groups are incapable of solving their own resource issues and are dependent upon government agencies or scholars to provide the necessary information and policy to properly manage. However, "communities and groups of interdependent actors can and often do succeed in governing without resorting to the creation of governments in the conventional sense" (Ellickson 1991; North 1990; Young 1996, 247). The use of practice-

based knowledge is often the link that makes a more localized approach a possibility. Many of the most complicated and challenging resource issues involve stakeholders such as agriculturalists, business people, and indigenous groups that many researchers have no experience with. “Only through the explication of specific histories and political dynamics can we begin to address the problems and prospects of community-based resource management” (Brosius 1998). Therefore, it is through collaboration and shared knowledge that policy makers and stakeholders can work together to solve challenging resource issues.

One of the greatest challenges when enacting a natural resource based policy is the acquisition of the necessary funding and resources to monitor the policy’s outcomes. When local stakeholders and their practice-based knowledge are involved in the policy creation and implementation process, the issue of insufficient monitoring can often be alleviated because of the vested stake that the stakeholders ultimately have in the success of the project or policy. The takeaway is that often formal government institutions are not the only means by which policy an effective substitute or supplement in formal government. Often, it is the members of the communities themselves who possess unique backgrounds and skill sets, who are able to recognize the failures in the prescribed policies and also possess ideas for alternative solutions. In the future, through the use of practice-based knowledge, effective policy creation has the potential to increase due to the involvement of local stakeholders.

The role of practice-based knowledge in the policy creation and implementation process for challenging natural resource issues or "wicked" problems is likely to increase in the future as consumers' access to information and drive to participate in the policies that affect their scarce resources increases.

"The knowledge and wisdom required to manage complex social-ecological systems is not likely to emerge solely out of top-down, expert-driven knowledge systems (which become too unwieldy and expensive), but through the combined and less formally coordinated efforts of more embedded practitioners (managers) learning though their own local efforts" (Stewart 2013). When tackling challenging natural resource or "wicked" problems, using practice based knowledge, we can better form solutions using the bottom-up engagement approach in which practitioners play a more prominent role in the production and validation of knowledge.

Collaborative Governance

Environmental and natural resource issues are far reaching and affect each and every member of society. The air we breathe, the water we drink, and the resources we need for our daily lives connect us and make each one of us a stakeholder. The traditional top-down, one size fits all, coercive, "let us tell you what to do" policies do little or nothing to include all stakeholders in environmental and natural resource policy creation or decision-making. A new approach that has gained traction over the past 25 years, however, seeks to find

and implement cooperative solutions to resource and pollution dilemmas. Collaborative governance and other related processes including adaptive management, integrated water resources management, watershed management, and community-based environmental protection, manage resources according to ecological boundaries, encourage broad participation from local stakeholders, emphasize voluntary actions, seek consensus decisions, build trust based policy networks, and integrate science into policy decisions. The design, formation, and implementation of collaborative governance is a challenging process but it is one that perhaps offers the best hope of accomplishing community based solutions to complex resource issues (Salmon 2007a; Weber 1998).

Collaborative governance utilizes a broad policy focus by including environment, economy, and community. It goes beyond traditional jurisdictional boundaries and includes both ecological and social boundaries. "The collaborative governance model involves shared authority for decisions, the ability to recognize and respect diverse interests and needs, an openness to different forms of knowledge, reliance on a consensus decision rule, and a focus on the production of mutual gain (win-win-win) outcomes (versus win – lose in adversarial settings)" (Salmon 2007a, 2007b; Scholz and Stiftel 2005; Weber 2003). When practicing collaborative governance, scientific expertise is critical but also practice-based and cultural expertise is also needed for long-term solutions where the traditional model sees scientific expertise as authoritative and dominant. "Collaboration is posited as a highly interactive and adaptive process that is capable of transforming social relations by creating new

knowledge networks among interdependent actors and interests" (Fish 2009, pg. 5625). Collaboratives seek to maximize the use of all available information and resources when tackling challenging resource issues.

Collaboratives have robust public participation where there is co-decision making and deliberative forums that include all stakeholders whereas the traditional model of policy creation tends to have limited and directed public engagement and participation that is often controlled by government officials. "A ''stakeholder'' refers both to the participation of citizens as individuals and to the participation of organized groups" (Ansell & Gash 2008). In collaborative governance, government experts are among many stakeholders that are integrally involved in the decision making process in collaborative governance and consensus decision is rule. Collaboratives "create a supportive climate for implementation, and can reduce litigation, and the associated uncertainty, delay and cost for investors because it gives more people a voice (empowerment) in decisions and this translates into ownership of results. This also leads to more durable policy solutions able to weather changes in government given the broad consensus-based support" (Salmon 2007a; Weber 1998). Collaboratives focus on results where the traditional consultation model focuses primarily on rules and proxies. The fact that collaboratives work to build relationships and to develop long-term problem solving capacities is a large benefit over the traditional consultation model because it only focuses on short-term problem solving.

The use of collaborative governance as a tool is commonly needed and utilized in situations where there are many competing interests for a scarce or

finite resource. They form the pathways in which different stakeholders can develop new networks and reciprocal relationships among the participants. These interactions foster out-of-the-box thinking and creativity, which enables stakeholders to better troubleshoot large challenges when otherwise new ideas or unfamiliar strategies might be cast aside more easily because of the lack of mutual trust and understanding. Collaborative governance "increases the capacity of units involved in public problem solving by leveraging and catalyzing the resources of many different interdependent organizations" (Weber 1998). This allows participants to contribute their best skill sets, resources, and input in the collaborative process. The principle of credible commitment is an important factor to the success of a collaborative. "Credible commitment to the collaborative institution means that participants willingly direct their power and resources to cooperate in good faith toward mutually agreeable decisions and then to promote, protect, and enforce such deals" (Weber 2013, pg. 12). This combination of willing and diverse participants allows the collaborative approach to illicit efficient solutions to complex resource issues.

One of the greatest challenges in implementing a successful collaborative governance project is the scale. Many are concerned that collaboratives will not be successful at the scale of major ecosystems and think that they are only viable at the level of small watersheds, where cooperation may be easier to achieve among smaller networks of policy makers where relationships built on trust might be more easily created. Whether the project is designed for a large or small-scale resource issue, the complexity of a collaborative usually creates

"increased transaction costs due to the number of actors involved and the added complexity of decision-making" (Fish 2009, 5627). Another challenge is the changing political climate and the dependency of political support. Political support and resource commitment from federal government agencies and programs can be a crucial accelerator of collaborative programs.

Additionally, many support the idea that collaborative governance is better matched to complex, or "wicked" problems such as sustainability than the traditional model is. "There is a growing recognition that natural resources users and managers find themselves facing complex conditions and "wicked" management predicaments requiring different perspectives, including from those who often have access to longer time scales and experiential-based insights into human-nature interactions. The added complexity of uncertainty brought on by climate change or global social-economic integration also means it is harder for disciplinary-based scientists to understand the degree and kind of intricate relationships between and among all the pieces of the puzzle" (Weber 2014). This shows that collaborative governance might actually be suited for large-scale conflicts in addition to smaller ones.

The use of collaborative governance as a means to solve resource issues has become more common. However, there is strong argument that collaborative governance might hinge heavily upon the selection of the community experiencing the resource issue or on a set of existing conditions and that there are many barriers to successfully forming a collaborative. Often, present conditions include relationships between opposing viewpoints that are

hostile or competitive and involve strong imbalances of power or influence. "If some stakeholders do not have the capacity, organization, status, or resources to participate, or to participate on an equal footing with other stakeholders, the collaborative governance process will be prone to manipulation by stronger actors" (Ansell & Gash 2008.) Additional barriers could arise if, "important stake- holders do not have the organizational infrastructure to be represented in collaborative governance processes" (Ansell & Gash 2008), or if stakeholders do not have the necessary time, energy, or liberty to participate freely in the collaborative process. These factors could make the achievement of success on the long-term horizon difficult to accomplish.

The design of a successful collaborative has key factors that allow a diverse group of stakeholders to create an environment in which collaboration is possible. "Often, collaboration is initiated as a result of several factors, such as a perceived environmental threat or crisis, a new legal mandate, or the availability of financial incentives" (Fish 2009, pg. 5626). Once the 'problem-setting' phase begins stakeholders with legitimate stakes in the issue are identified and the main components of the shared problem is further discussed and articulated. The goal of this process is for the stakeholders to recognize their interdependence and that it is in the best interest of efficiency and effectiveness to work together. During the 'direction-setting' phase, stakeholders begin to determine the desired outcome of the collaborative and the shared values, beliefs, and priorities the different stakes have that will ultimately help to guide the collaborative towards its joint goal. This phase is followed by, "a 'structuring

phase' in which specific goals and objectives are established, programs of activity are designed, and roles and responsibilities are assigned to the various participating organizations and groups (Fish 2009, 5626)." Strong leadership is required in order to facilitate collaboration. "Facilitation is the least intrusive on the management prerogatives of stakeholders; a facilitator's role is to ensure the integrity of the consensus-building process itself" (Ansell & Gash 2008). Leadership provides the structure, ground rules, and formation of trust that is necessary for the embracement and involvement of all stakeholders.

The use of collaborative governance will likely play a large role in future environmental policy issues. As the Grass Roots Ecosystem Management Movement plays out and serious water scarcity issues continue, collaborative governance will help to dissolve partisanship in environmental issues and allow stakeholders to build trusting, productive relationships that will create solutions to environmental problems from the local, national, and even global level. Collaborative governance will increase the amount of perspectives involved and therefore will allow policy makers to better predict outcomes, incomes, and potential harms. This will create policies that will be cost saving and more impactful. By practicing collaborative governance we will be able to tap into a greater wealth of knowledge and have more people invested in issues. This will create a more connected, educated, and productive society, one that is better prepared to effectively address policy issues concerning our most precious resources.

Research Findings

As a part of this research, interviews were conducted with stakeholders in the Crooked River Watershed agricultural community to assess their viewpoints on the issues surrounding persisting drought conditions, climate variability, and production challenges. Agriculture is the leading economic driver within the basin and has the greatest impact on the watershed. One rancher noted that "agriculture is king"(7/16/15) in the basin, while another interviewee stated that "You can't be here in this community without developing some kind of 'ag' tie." (7/14/15) This is because ranchers have the largest portion of the land in the Crooked River Watershed, but, at least according to most interviewees, ranchers do not always have the greatest power and influence on decisions regarding water allocation." All the same, the future of the industry in this area will depend on how the agriculture community responds to the many challenges they now face and their ability to take part in the decision making process. There are many stakeholders within the basin that also hold a responsibility to the watershed. However, agriculturalists are concerned that other stakeholders and competing uses will threaten their already uncertain water supply. This research explores the power dynamics within the basin and assesses the barriers and potential for a collaborative approach to solve this problem. It shows ways in which producers are adopting new production practices and innovative solutions in order to mitigate the effects of challenges

and areas where improvements can be made. In addition, the research assesses the impact that communication with the public has on the overall issues within the basin.

Agriculture is a unique industry, as President John F. Kennedy said, " The farmer is the only man in our economy who buys everything at retail, sells everything at wholesale, and pays the freight both ways." Many factors influence an agriculturalists' success or failure that are outside of their control including weather, market prices, public perception, and policy. It is their ability to adapt and respond to challenges that ultimately determines their success or failure. Many of the producers within the basin have had family farming and ranching continuously since the early 1800s. Generations of agriculturalists have worked the land, adapted to changes, and produced the food and fiber that helped to settle the west and provide for our society. The agricultural legacy is something that is passed down through hard work, practice based knowledge, and passion. When asked what drives them to be successful a longtime ranching family in the basin responded, "The agricultural lifestyle and our ability to raise our family in a productive lifestyle, our ability to give back to the land and to be able to give consumers what they want, and our ability to use the land in a productive way and to make the land better for the next generation." (7/14/15) This legacy is one that is passed on generation to generation within the agriculture community and serves as the backbone for the industry. Farmers and ranchers within the basin are confronted with severe challenges that threaten their livelihoods and

lifestyle however the commitment to continuing success for the next generation is what drives them to create solutions to these challenges.

Responses to the Problem of Water Scarcity

"It was always my life's goal to return to the family ranch and continue the legacy of farming and ranching in the Prineville area," (7/16/15) stated a rancher from the basin. When asked what he saw as major factors to his future success and his ability to continue his family's legacy he answered, "water." In fact, according to the interviewees, most farmers and ranchers in the basin think about water scarcity every single day. The major factors that producers within the watershed feel will determine future successes or failures are largely centered around water scarcity and producers' ability to receive their irrigation water.

A common public perception of agriculturalists is that they typically do not perceive recent climactic changes and drought conditions to be the results of climate change. Within the Crooked River Watershed, producers feel the effects of a changing climate acutely. They live on and work the land each and every day. In order to realistically tackle water scarcity issues it is important that the agriculture community prepare long-term for their effects. A Crooked River Watershed Council employee said, "Climate change is accepted here…people feel that it's cyclical…predictions for next year are worse than in the past." (7/17/15) Within the community, producers know that the persisting drought conditions

and water scarcity are not conditions that will change within the next few years. There is an overall understanding that changes within the basin will continue and that they are facing new, long-term, climactic trends. “Overall, people are aware of the water shortage—but I have seen both positive and negative reactions to the situation,” explained a Monitoring Specialist with the Crooked River Watershed Council (5/21/15). The general consensus is that there will be warmer temperatures, less snow pack, more rain will come later in the spring, and storage will be an issue because of the timing of peak flows. When asked about the fear associated with persisting drought conditions a farmer said, “Yeah there is climate change and there is less water, but are you going to respond in fear? Or are you going to respond in a constructive way?” (7/16/15)

Responses within the agriculture community to water scarcity are varied. This year the reservoirs within the basin did not fill to capacity and new releases for in stream flows for fish populations have created an uncertain future for irrigators. In addition, groundwater resources are limited and too deep to be economically viable for agricultural uses. Producers are reacting to this situation by participating in conservation efforts, becoming more efficient, switching crops, producing on less acres, and even taking some arguably drastic measures to maintain viable. Agriculturalist within the basin are “totally, 100% dependent on Prineville and Ohoco Reservoirs for water,” stated a rancher in the basin (7/16/15). Therefore, their ability to adapt to climactic variability and drought is critical. A monitoring Specialist with the Crooked River Watershed Council stated, “When water is abundant people get in the habit of being wasteful and

when it's scarce people take time to adapt to the new reality of water including residential, commercial, and agriculture users." (5/9/15) However, within the basin, time is not on the side of the agriculturalists. They must adapt and implement new solutions now in order to remain viable.

Within the Crooked River Watershed a decrease in the quantity supplied of water and an increase in water use demands will likely also increase the price of water within irrigation districts in the Crooked River Watershed. This is because an increase in demand coupled with water scarcity will lead to higher prices and a greater incentive to adopt efficient on farm practices and technologies. This has led irrigators within the basin to be as efficient with their irrigation systems as possible. Historically, flood irrigation was used within the basin however, most agriculturalist within the basin have shifted to more efficient irrigation techniques. Those irrigators who have not shifted are in the minority. An OSU extension agent explained that, "flood irrigation is still used because the cost of power is so high that it is often cheaper to use and the current cost of water is not high enough to provide incentive to reduce costs, however, an increase in water scarcity will increase interest in water savings."(5/21/15) The extension agent further explained that, " most producers have figured out that they can reduce their water usage and their power bill with increased irrigation efficiency." (5/21/15) Currently within the basin the energy costs to irrigate are higher than the water costs themselves. "Therefore, continued the extension agent, "the motivation to switch to use more efficient irrigation systems like circle pivots, is mostly to reduce power costs which is

what's most expensive so usually you can kill two birds with one stone, decreased power costs and water usage by increasing efficiency." (5/21/15)

According to an employee of the Crooked River Watershed Council, 90% or more producers use pivot irrigation systems within the basin. The center-pivot irrigation system is considered to be a highly efficient system, which helps conserve water. Center pivot irrigation typically uses less water compared to many surface irrigation and furrow irrigation techniques, which reduces the expenditure of and conserves water. It also helps to reduce labor costs compared to some ground irrigation techniques such as wheel lines, which are often more labor-intensive. Circle pivots are initially expensive to purchase and install however, there are many grant programs that can help farmers afford them. When asked about the use of circle pivots on their ranch, a large ranching family said, " by switching to more drought tolerant crops, using circle pivots and installing more efficient pumps we only need to water once or twice which really reduces our costs." (7/14/15)

A common reaction to water scarcity is for farmers to switch to crops that require less water, drought tolerant crops, or non-irrigated crops such as alfalfa or dry-land wheat. These crops tend to be less profitable overall. Instead of producing row crops such as carrot seed, potatoes, or mint, farmers are shifting to drought tolerant crops, according to a Crooked River Watershed employee. Producers did not share their financial reasons for shifting to the production of these crops. The important thing to note however is that the perceived threat of water scarcity was enough for producers to alter their farming practices. A

rancher in the basin said, “We will have less water to farm, so now we are raising more alfalfa seed because it takes less water.”(7/14/15) In fact, one rancher claimed that they shifted to the production of alfalfa because it required about half the amount of water compared to crops they had previously been producing. Many producers, in addition to shifting crops, are reducing the total acreage they are farming in response to water scarcity. A small irrigator from the basin said, “Producers are now having to prioritize their most valuable crop. Mostly perennial crops are being kept while farmers let other acres go fallow.” (7/18/15) This is because when a crop is dependent on irrigation water that is not guaranteed within a growing season, producers have to prioritize water for highest value crops when they know they will not receive their full allocation of irrigation water. The decision to reduce farmed acreage is largely tied to the farmer’s ability to take a crop out of rotation and let it go fallow. Their reaction time often depends on if it is an annual crop or one that must be established for a few years before harvest. When irrigation water is not a guarantee it is a challenge for producers to plan out their crops and production in advance and to turn a profit each year. Reducing total acreage in order to still turn a profit is a solution for many farmers during times of water scarcity.

Sometimes, when immediate solutions to water scarcity cannot be achieved, producers will sell their land and the senior water right attached to it. A 4th generation farmer who has farmed and ran cattle for over 35 years recently had to downsize from 1500 acres to about 700 acres. His family has been farming within the Crooked River Watershed since the early 1800s and

therefore he holds senior water rights. He said, "we used to run cattle on a property that had 1800s water rights, then it got picked up by a water right guy for leasing who wanted the water for in stream uses for the DRC, so that property brought more for the water right than it did to raise cattle on it." (7/16/15) When water scarcity or other production challenges persist that prevent producers from making a profit or a viable living, selling out is an option that provides a short term solution to a long term issue. Often when water is scarce the value of the water itself is worth more than agricultural production can generate on the land. This rancher is concerned because, "If what happened to our ranch happens to other property in the valley and the land come out of production and instead goes into residential or commercial use its gone for good." (7/16/15) If this trend continues the effects will influence water prices within the basin. Within irrigation districts the overall price of water will increase if more irrigated land goes out of production because, "it will raise the price of water for cost of service for the rest of the 'ag' community, its basic supply and demand," stated the rancher. (7/16/15) Essentially, if less acres are irrigated the costs to irrigate within a watershed will be spread across a smaller number of producers who will each be required to pay more. A Monitoring Specialist with the Crooked River Watershed Council said, "Its important to remember that something so essential as water is still a commodity." (5/21/15)

Responses to the ESA and Other Environmental Challenges

Prior to 2014 a supply of unallocated water within the basin's reservoirs raised alarm within the agriculture community as competing interests began to try to lay claim to it. A rancher shared, "Well, we started to get pretty nervous because under Section 7 of the ESA they'll come and take your water. We tried to be proactive and our intent was to get a first fill guarantee." (7/16/15) This would mean the irrigators would receive the first block of water released from the reservoir for irrigation, ahead of other uses. They were worried though because Section 7 of the Endangered Species Act "directs all Federal agencies to insure that any action they authorize, fund, or carry-out does not jeopardize the continued existence of an endangered or threatened species or designated or proposed critical habitat (collectively, referred to as protected resources)." The presence of threatened and endangered species within the basin put agriculturalists water at risk because of this rule. The agriculture community, with the help of their legislators, was able to be proactive and address this issue. Many feel that Representative Greg Walden's bill which allocated previously unallocated water behind the Bowman Dam and secured first fill rights for agriculturalist was a positive step towards water security. However, with persisting drought conditions and competing uses lobbying for water, agriculturalists are aware of the increasing demand for water. When asked about the community response towards the passage of the Central Oregon Jobs and Water Security Plan a rancher said, "environmental groups are not pleased and its not going to satisfy them. We're in this drought and they are already trying to get more water. They are using up their water faster than they should."

(7/16/15) Essentially, environmentalist groups who wish to add additional water back to the river systems for in stream flows are depleting their supply of water because their demand for it is perceived to be so high.

Within the Crooked River Watershed there are undoubtedly severe environmental challenges to address. Producers within the basin are working to change production practices to be better stewards of the environment and to contribute to the overall health of the watershed. It is in their own best interest to have a healthy watershed because they rely solely on water storage from within the basin for production. However, agriculturalists often feel that they do not always reap the benefits of their efforts. A rancher from the basin stated, "Conservation, it's always good, it's excellent. It just seems that it's always for someone other than agriculture even though agriculturalists are often those who foot the bill for the projects**.** We have to pay for the efficiencies and new technology to save and conserve water but then have pass the water along." (7/16/15) Many within the basin feel that agriculturalist are often responsible for funding and facilitating conservation and water saving efforts but that the benefits of the additional water are not retained within the agriculture community. Despite this, a Crooked River Watershed Council employee shared that, "most landowners in the watershed are doing everything they possibly can to improve their property."(7/17/15)

Riparian fencing and planting are practices that help to create healthy riparian zones, increase bank stability, reduce waterway contamination, and cool water temperatures. A longtime rancher in the area began fencing his

waterways over a decade ago because he understood that keeping his cattle out of the waterway and riparian zone created benefits to the natural habitat. Now, in areas that previously had unstable creek banks and eroding soil, there is lush vegetation and bank stability that not only contributes to a healthy waterway but also serves as a thriving wildlife habitat. Simply because he fenced off the creek and replanted native plants. A Crooked River Watershed Council employee said that, "land owners are fencing riparian areas much more often now." (7/17/15) However, riparian fencing is not yet a common practice within the basin. The addition of this land management practice will be crucial to increasing overall watershed health and productivity and help to combat water scarcity.

The encroachment of juniper trees remains a large issue in the management of lands and the overall deficiency of water in the Crooked River Watershed. "Juniper is a demonized tree. It is native, but land management practices have led to its encroachment," explained a Crooked River Watershed Monitoring Specialist. (5/9/15) Each of the producers who were interview for this research expressed that juniper cutting and management was a key component to their overall land management plans. Land managers, landowners and public land management agencies through the application of management plans, impact vegetation's ability to buffer precipitation inputs and aid in the watersheds ability to capture, store and safely release water. Agriculturalists on private land are constantly trying to manage natural lands in a way that is product for their operations. A ranching family shared that each year they cut as many as 900 acres of junipers on their land. They explained that, for their ranch,

cutting juniper is a mutually beneficial practice. It increases the quantity and quality of land available for forage for cattle and also increases the quantity of water that is put back in stream. This is because juniper's water uptake and aspiration prevents water from entering waterways. By cutting large acreages of junipers, and still leaving adequate wildlife habitat—especially for mule deer, producers can greatly influence the health of the watershed. Ranchers also expressed that their cutting of juniper cuts also help to suppress the risk of wildfire.

Increasing Water Storage Capacity

A common response to climate change and water scarcity is an expressed need to increase water storage capacity. This is a controversial topic that often sparks strong opinions. During this research however, not a single member of the Crooked River Watershed agricultural community listed additional storage as a potential solution to water scarcity issues. However, an employee of the Ochoco Irrigation District and an individual who is important to the agriculture community expressed a strong opinion in favor of increasing the watershed's storage capacity. A possible explanation for the lack of interest from within the agriculture community could be attributed to the controversial history surrounding unallocated water within the basin. Following the passage of the Representative Walden's bill in 2014 the agriculture community was allocated

first fill rights and gained a greater confidence in their water security. The increase of storage in the reservoir would lead to another section of unallocated water within the basin. During this research the agriculture community expressed a general fear to participate in policy creation or government programs because of the perception that their water could potentially be taken from them. Now that their water is secured, the addition of unallocated water could, in essence, "open up a can of worms" or "Pandora's box" within the Crooked River Watershed and therefore prevents agriculturalists from considering the pursuit of additional water storage as a viable solution to water scarcity.

The Ongoing Tension between Competing Uses

There are many land management practices and resources that agricultural producers within the Crooked River Watershed have adopted or could adopt in response to challenges that arise as a result of persisting drought conditions and water scarcity. These practices can help to mitigate negative impacts and allow the agriculture industry to remain viable. However, these practices do not offer solutions to the overarching concern regarding water in the basin—allocation. Water, after all, is the most valuable resource in the Crooked and it is a finite resource. Therefore, many competing uses and special interest groups continue to try to lay claim to their share of it, which leaves the future of water uncertain. Land management and production practices do

nothing to contribute to solutions surrounding disagreements in the policy realm regarding the allocation of water within the basin. However, the very presence of competing interests suggests the potential of collaboration and cooperation when creating and implementing solutions to problems created by water scarcity. A Crooked River Watershed Council employee said, "it can't be us against them, we need to create solutions that are win-win solutions." (7/17/15) This is a viewpoint that was supported by agriculturalists that were interviewed as a part of this research.

Collaborative governance could be a resource to the agriculture community in the future as issues surrounding water scarcity and allocation continue in the Crooked River Watershed. The success of a collaborative depends heavily on the characteristics and attitudes of the stakeholders involved in the process as well as the degree to which good science based information is used as the foundation for discussion. Collaborative decisions are based on consensus. This means that those involved must be willing to see the things from another's point of view, to understand the tradeoffs, and to be willing to compromise when determining solutions. Within the Crooked River Watershed there are many stakeholders who have opposing viewpoints on how water should be used and allocated that greatly affect the agriculture industry. The agriculture industry currently uses the greatest share of water but has not had a guaranteed role in the policy creation process. With many competing interests for a finite resource, who are the stakeholders that should have an influence on future decisions made regarding how water is used and allocated? Undoubtedly,

the future success of the agriculture industry will likely depend on its ability to create solutions and to partner with competing interests whose goals might differ from their own.

Throughout time, senior water right holders in the Crooked River Watershed are the individuals who have played the most active role in developing solutions to water allocation within the basin. A Monitoring Specialist with the Crooked River Watershed Council when asked about the health and management of the watershed said, "Who knows it better than the landowners?" (5/9/15) The perception within in the Crooked River Watershed is that agriculturalists, specifically senior water rights holders, have the greatest influence and power regarding water allocation in the basin and therefore should have a "seat" at the decision making table. "Ranchers have the largest portion of land and at this time cattle is the largest producing components of the industry," shared a Monitoring Specialist with the Crook County Soil and Water Conservation District. (5/9/15) In order for the agriculture community to accurately be represented within a collaborative approach the diversity of agriculture producers, in addition to cattle ranchers, within the basin must also be represented. These producers include hay producers, row crop farmers, and producers involved with forestry who all are greatly influenced by the availability of water. For a true representation, there should be producers from different sizes of operations. Agriculturalists within the basin live and work on the land and see the effects of changes everyday. Their voice and contribution to

the decision-making process will undoubtedly bring innovative solutions to the table.

The agriculture community expressed that in addition to having a full diversity of farmers and ranchers from the basin involved with the decision making process that there were several other agriculture based entities whose roles currently influence the watershed and therefore should also have a seat at the decision making table. These organizations include the Irrigation Districts, the Oregon Department of Agriculture, the Oregon Department of Fish and Wildlife, the Crooked River Watershed Council, Extension Agents, the Bureau of Land Management, and the Water Resources Department. Each of these entities currently has a stake and influence regarding water use within the basin. The general sentiment from the agriculture community is that the involvement and participation of these organizations or groups is crucial in the decision-making processes because they each have a direct relationship with the agriculture industry and have power within the basin.

Outside of the agriculture community, recreation is perceived to have a great amount of influence and impact on water in the Crooked River Watershed. Recreation is a growing industry within Crook County that relies on the availability of water. Therefore, water allocation for recreation is a competing use to water allocated for irrigation. A Crook County Soil and Water Conservation District Water Monitoring Specialist said, “People forget why the Bowman dam was built, it wasn’t built so people could go waterskiing.” (5/9/15) This may be true but it doesn’t change the fact that many people highly value

recreation in the watershed and that recreation plays a large role in the overall economy within the basin. A small irrigator said, “Power comes from recreation-- they have more voices and the money that it generates feeds the local economy.” (7/18/15) Therefore, agriculturalists feel that it is important to have recreational interests represented as a part of a collaborative process because recreation is a vital part of the local economy even though it represents a competing use.

Special interest groups whose goal it is to acquire the allocation of additional water for in stream flows to support fish populations are perceived to be the most obvious, vocal, and powerful competing interest as viewed by the agriculture community in the basin. “Ranchers and farmers are so busy working and making a living that it seems like environmentalist are able to have the biggest impact,” shared a Water Quality Monitoring Specialist within the basin. (5/9/15) In recent years, producers within the basin have struggled to maintain their share of irrigation water within the basin and there has been an overall mounting level of interest from individuals outside of the basin to influence water use and allocation. An employee of the Crooked River Watershed Council said, “The environmental groups have the money to promote their agenda, landowners don’t necessarily have that.” (7/17/15) Producers specifically named Water Watch and Trout Unlimited as organizations that have tried to exert their influence and been very vocal about water allocation in the Crooked River Watershed. A rancher said, “Right now fish have the loudest voice and special interest groups are putting the pressure on government to reallocate

water." (7/16/15) With threatened and endangered fish species present within the basin the involvement of these special interest or environmental groups in collaborative decisions is important however the agriculture community is concerned about the power and influence they possess within the community.

An Opportunity for Collaboration?

The future of water allocation within the Crooked River, from the perspective of the agriculture community, will largely depend upon the ability of community members and competing users to work together to create solutions to challenges generated from water scarcity and persisting drought conditions. A Monitoring Specialist with the Crooked River Watershed Council shared, "I think that the biggest issue isn't found in the water, it's found in the ability to work cooperatively, to address whatever the concerns are in the water. The ability of people to respond to challenges in productive way." (5/21/15) There are many challenges to successfully implementing a collaborative within this community but the general feeling within the agriculture community is that collaboration is a viable option for future policy creation and decision-making.

A general theme that was prevalent in this research was the sense of fear and mistrust within the agriculture community of government and policy creation. Producers shared that they felt that their voices and concerns are often ignored in the policy creation process and that despite their strong role in the community and economy that they aren't taken seriously. A Monitoring Specialist with the Crooked River Watershed said, "There is a sensitivity in the

agriculture community that they are being condescended to even when they are not and I can empathize with that." (5/21/15) The Monitoring specialist continued, "It is important to engage landowner in cooperative fashion so you can work with them well," added the Water Monitoring Specialist. (5/21/15) In addition, with many competing interests for a finite resource there is a fear that their water security has and will continue to be threatened. "Farmers and ranchers are often afraid that by participating in a collaborative or cooperative way that they could lose their land or their water," shared an employee of the Crooked River Watershed Council. (7/17/15)

Many people within the agriculture community take issue with those who are not members of the community, who do nothing to better the watershed or to pay for the infrastructure that creates benefits, but would like to determine how water is used for allocated. A rancher from the basin shared," Everyone justifies their own stance and it comes on the back of agriculture." (7/16/15) The use of a collaborative approach would help to address this issue within the community. By using the collaborative approach and determining solutions based on consensus, the playing field is leveled and those who might have a louder voice or a greater financial backing have the same level of influence in the decision making process as the person next to them.

A Monitoring Specialist with Crooked River Watershed Council shared that a factor that drives people away from cooperation or involvement is the presence of, "a lot of regulation and people from the outside wanting to regulate. It creates distrust." (5/21/15) The inability to build trusting relationships within

the watershed is a large barrier to future success. “Landowners have been burnt in the past so it takes a long time to build trust,” said a Crook County Soil and Water Conservation District employee. (5/9/15) With many competing interests for a finite resource there are natural conflicts within the watershed. A rancher shared,“ I think a barrier to collaboration is individual self- interest. I don’t see a lot of that in the agriculture industry, we’ve been coming to the table and trying to cooperate and work through these issues so that we can survive.” (7/16/15) Water is a finite resource that has an uncertain future. Within the watershed, “everyone wants their piece of the pie and each thinks their piece is the highest priority,” Crook County Soil and Water Conservation District employee. (5/9/15)

Communication is perceived to be a large barrier to a collaborative approach to policy creation within the Crooked River Watershed. Communication within the agriculture industry and also within the networks of stakeholders in the basin has traditionally been poor. A good example of this can be found in the communication surrounding the threatened and endangered fish populations that have been reintroduced in the Crooked River Watershed. A BLM Fish Biologist shared, “We just had steelhead and Chinook reintroduced and the regulatory agencies didn’t do a very good job of explaining how it was going to work so a lot of people are scared. Probably the biggest issue is communication.”(5/22/15) The impacts of reintroduction are far reaching and greatly impact the agriculture industry. It is challenging for producers to be supportive of conservation efforts within the basin if accurate and up to date information is not communicated to them.

The Impact of Public Perception

Agriculturalists within the basin feel that a general lack of public knowledge about agriculture has contributed to failures in the policy realm and remains a threat to future success. In the United States, just 2% of our population produces the food, fuel and fiber that we all depend on and most people are 2 generations removed from the farm or ranch. Overall, many people do not understand where their food comes from, how it is produced, or who grows it. This challenge is prevalent within the Crooked River Watershed. A rancher in the community shared, " I think there is a big disconnect between agriculture and the general public. We have generations of misinformation and farmers don't do a good job of selling themselves now, they are too busy working." (7/14/15) Residents within the Crooked River Watershed are voters. This means that if they lack a general understanding of agriculture production and irrigation needs they will have an even greater challenge understanding the effects of water scarcity for producers and this will influence the way they vote. The Urban community within the basin accounts for 98% of the voting population. Their vote undoubtedly has a large impact on the agriculture community.

Environmental groups have been able to capitalize on the lack of agriculture awareness and appeal to community members for the support of additional in stream flows for fish. Agriculturalists feel that this is why environmental and special interest groups have a louder voice and a large

amount of power within the basin. A rancher in the community said, "environmental groups currently have more power at the table but I think that they would have less power if the agriculture community did a better job sharing our story with the general public."(7/14/15) Producers feel that they have not done enough to educate the public about agriculture or to share their story and that the community has a negative perception of agriculture. Now, instead of playing offense, they are playing defense because they have failed at getting out front of the issues and have not been able to accurately educate the public. One rancher shared, " We gave sat back for years doing the right thing and assuming that the public gets it and understands."(7/16/15) However, it can be challenging for farmers and ranchers to find the time or the pathway to do this. The agriculture community has recognized the strong need to become more proactive when communicating with the public.

Conclusion

Climate projections show that persisting drought conditions and water scarcity will continue within the Crooked River Watershed. The agriculture industry constitutes the greatest water use and is the leading economic driver within the basin and therefore has the largest impact on both the health of the watershed and the local economy. In 2014, the Central Oregon Jobs and Water Security Act guaranteed first fill rights for irrigators, however, there are many competing interests for water and the presence of threatened and endangered species leaves the future of the agriculture community's water security

uncertain. The interviews show that agriculturalists believe that in order to maintain viable operations they will need to work with other stakeholders to address challenges that water scarcity has and will continue to present within the watershed and to create innovative solutions to these challenges.

Over time, producers in the basin have adopted more efficient drought and production practices to maximize the benefit of the amount of irrigation water they receive and to minimize power costs. However, even with increased efficiencies and more sustainable land management practices that undoubtedly influence the overall quality of water within the basin, the quantity of water that agriculturalists will be guaranteed in the future remains uncertain and a threat to the overall success of the industry. Agriculturalists within the watershed recognize the need to work with diverse stakeholders to create innovative solutions to solve these severe challenges.

Collaborative governance could be a potential resource to the agriculture community in the future. By participating in a collaborative effort to solve challenging resource issues that are bound to present themselves within the watershed, producers will be able to have a larger voice and greater influence in the solutions that are created. Many producers within the agriculture community do not trust the traditional policy creation process or solutions that are often employed within the basin because they feel that their voice or concerns are not heard. A bottom up approach to policy creation seeks to involve many diverse stakeholders in decision-making processes and helps to build trusting relationships within a community. This will be an asset to producers

going forward. It is not clear, however, that there will be outright winners or losers in a collaborative governance situation because given the inefficiencies and lack of current institutions that would create satisfaction and trust building between different group's interests or goals. The overarching idea is that the use of a collaborative method allows the stakeholders to develop customized or innovation solutions that have the potential to create win-win-win outcomes.

A key component to success will be the inclusion and legitimization of the practice based knowledge that agriculture producers in the basin possess as a resource to the collaborative process. The expertise and knowledge that exists within the agriculture industry of the history of the watershed and the people who have farmed and ranched within it for hundred of years will be crucial to future cooperative efforts. Producers see the changes happening to the land each and every day. By involving them in the process of determining solutions to the challenges that arise, they can help to develop solutions that do not inhibit their ability to maintain their lifestyle or a viable agricultural operation.

This research has been purposely focused on the viewpoints of the 'ag' community in responding to the challenges presented by persisting drought conditions and water scarcity and as such it is not designed to provide "the" answer. Instead, is designed to solicit ideas about possible solutions and governance mechanisms appropriate to the challenges. Ultimate policy solutions for these challenges are likely to benefit from better info on the costs and benefits and the winners and losers, both from a spatial as well as inter temporal perspective for people contemplating future research on such challenges.

In conducting this research I had the opportunity to directly apply material learned in my undergraduate course work at Oregon State University as well as knowledge gained from my own agricultural background. By speaking with producers and hearing firsthand their optimism and insight surrounding a potentially debilitating challenge reaffirmed my commitment to a future role in the agriculture industry. It is important for us all to recognize the crucial role that agriculture producers play in our society and to pursue resources that not only enable them to continue on with their agriculture lifestyle and livelihood but also to be stewards of the environment and our precious natural resources. Legitimizing the value of practice based knowledge and the use of collaborative governance are both resources that can help to achieve this goal.

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Appendix A

Interview Format

1) Please state your name, profession and organizational affiliation and job title for the record.

2) Can you tell me a bit about your background in agriculture and your farm (or ranch)? (i.e., what do you grow? How many head? How long in the area? Etc.)

3) As a member of the agriculture community, what do you value most?

4) How much/little do you use irrigation in your operation?

5) What do you see as the major factors, or challenges and opportunities, affecting your future success?

"I would like to shift gears a bit and would like to hear from you about the possibility that in the future seasonal water flows may likely be less predictable and drought conditions more frequent. At the same time, the demands and restrictions from fish reintroduction and environmental regulations, more generally, are likely to grow. Both cases will impact existing water and agricultural systems and management practices."

6) If these things were to come to pass, what are your ideas for how the agricultural community might respond so that they can maintain, or even improve, viability, productiveness, and a strong presence for the "ag way of life" in this area's communities?

    a. What about ideas for your own farm/ranch management practices and technologies that could help better manage water scarcity?
        i. Of these which are you already using/doing?
        ii. Of those that you are not currently using/doing, which strike you as the most promising and effective?
            1. Are you currently considering and/or planning to use any of these in the near future?

    b. Ideas for the local irrigation district?

    c. Ideas for the larger water system, water laws, etc.

i. Prompt them on OWRD, OWEB, BPA and other government agencies –are there things, or changes, key state and federal government agencies could be doing in order to help if this scenario plays out?

d. Ideas for broader agricultural community responses to these challenges and opportunities?

7) Is a collaborative effort with all stakeholders at the table, so including recreation, environmentalist, other businesses, and government interests too, feasible and/or desirable? Why or why not?

8) What are some of the key barriers that might prevent the different stakeholders in the area from working together effectively?

9) Is there anything else you think I should know?