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Rural and Urban Difference in the Acceptance of Alternative Water Management Strategies: Case Study of Idaho Residents

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Abstract

Idaho is one of the fastest-growing states in the U.S. The stressors of population growth and climate change are increasing the strain on its water resources, emphasizing the need for water management strategies. Public support, however, can vary by a range of factors, including geography. This study aims to assess the rural and urban distinctions of support for water resource management. In 2014, 401 people from Idaho's general public responded to an online survey, with 375 of the respondents georeferenced into three groups: urban areas, urban clusters (small towns), and rural. The responses showed similarities in support among the groups; however, there were some notable differences. Water conservation received the most support for all groups, but there was a significant difference around land use regulations. The majority of respondents supported land use regulations, with urban clusters having the highest level of support. These findings can assist water managers throughout the U.S. with respect to recognizing the preferences of the public in different geographies of residence.

KEY TERMS: Water management; rural-urban; community planning; climate change

Practical Applications

The findings from this study are relevant to water managers and decision makers as they develop strategies to address water shortages. Results show that individuals in rural and urban communities alike share strong support for water conservation, including the reuse of water. Land use planning and regulation can be controversial, however there is support to regulate development in order to protect water resources. Elected officials, decision makers, and managers should understand that on the surface it may appear there is strong support for the development of new infrastructure, including dams and pipelines, but the results here show that support all but dries up when these efforts involves moving water from one community to another. Overall, this study showed that individuals in rural and urban communities support water conservation, and land use planning to address water shortages. They do not, however, support the transfer, sale or movement of water from one area to another. This is relevant as water transfers are increasingly used in the West to address water shortages. Most importantly, water managers and elected officials need understand that, when it comes to water, rural and urban communities are more alike than different.

Introduction

Water is a natural resource that is growing in scarcity as the population grows and the climate changes (Feldman 2017). In parts of the United States (U.S.) the pressures that climate change and population growth place on water systems are of great concern. Agricultural communities are heavily dependent on water and at risk of changes to the hydrologic regime, including the timing and flow of water, while urban areas need reliable water sources to address growth. In this context, the management of water resources is of keen interest.

Government and water managers use numerous policy tools to address water concerns, which fall into four broad categories: engineered solutions, conservation, land-use management, and water transfers. People have competing values and interests about environmental issues, which is a key consideration for policy makers when they prioritize water management tools (Rice and McCool 2021; Wittenberg 2019), and a range of factors, including socio-economic status, political ideology and geography, may influence these values and interests.

In this paper, we focus on how the preferences of residents of rural areas, urban clusters (small towns), and urban areas differ around water management strategies by asking, "When water is limited, what is the public's level of agreement with water management strategies?" and, "How does this vary by rural and urban residence?" We locate this study in Idaho, a state where climate change and rapid population growth are influencing water availability, quality, and management (Humes et al. 2021). Idaho is a state with both explosive population growth, as well as a legacy and economic attachment to agriculture, which is the largest consumptive water user, making it an ideal location for this research.

The literature for water resource management is broad, however, much of it focuses on different strategies for maximizing its efficient and beneficial use (NRCS 2019). Watershed management research has focused on public participation (Duram and Brown 1999) and collaboration among stakeholders (Leach and Pelkey 2001). Less attention has been paid to public attitudes, preferences about water management policies, and how different communities may *accept* government policy tools to ensure water security (Garcia-Cuerva et al. 2016). In particular, how rural communities, relative to urban communities, view water resource management has not been given adequate attention. Pahl-Wostl et al. (2010) argue that understanding geographic and social context is crucial and must be analyzed when studying water governance. Recognizing community differences and similarities provides water managers an opportunity to use policy tools that are more likely to be accepted across geographic boundaries (Wolters and Hubbard 2014). Furthermore, understanding the ways in which different communities perceive problems and how they believe such issues should be addressed are important for guiding the planning and implementation of programs and policies that work to address issues (de França Doria 2010; Hubbard 2020a). Within the U.S., addressing such potential differences is essential since public support is a prerequisite for the government and scientists to address issues (Anderson 2014).

In the remainder of this article, we first discuss the four broad categories of tools used to address water issues. We then review literature on urban-rural differences as it relates to water resource management. From there, we discuss the methods of data collection and analysis, followed by a presentation of the findings. We conclude by discussing the findings and how water managers throughout the U.S can use them.

Background

Fresh surface and groundwater account for 83% of the water withdrawals in the U.S. (Dieter et al. 2018). Water planning activities, therefore, are centered on the supplies, infrastructure, and operations needed to manage customer water demand (Quay et al. 2018). As managers anticipate and deal with stressors, including climate change and population growth, they will need to evaluate the use of alternative water supplies. Sometimes called auxiliary or augmentation, alternative supplies are used to supplement and diversify the traditional water supplies during times of scarcity (Fedak et al. 2018). Below, we examine four categories of management tools to augment traditional water supplies.

Water Conservation

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Conservation is often the most politically acceptable way to address water scarcity. In a study with Colorado residents, conservation won the plurality of support over a wide range of options to solve water quantity and quality concerns (BBC Research 2013). However, in the U.S. public knowledge about water use and conservation is often inaccurate (Hubbard 2020b). A 2013 online national survey of 1,020 adults suggests that Americans use twice as much water as they think they do; on average underestimating their water use by a factor of two (Attari 2014). Despite this, most consumers are conscious of water scarcity and actively try to conserve.

Pricing and restrictions are two tools used to promote conservation. Public support for both varies. Previous studies have found the public is willing to pay to conserve or support incentives that lead to conservation (Awad et al. 2021; BBC Research 2013). Restricting access to water, such as lawn water moratoriums, however, does not share the same support. A study focused on inland Pacific Northwest residents found respondents were more supportive of incentive programs than restrictions (Awad et al. 2021).

Another form of water conservation is to “reclaim” or “recycle” wastewater into potable water. While technology exists for this form of conservation, its use is reliant on public support (McClaran et al. 2020). Previous studies found a willingness to use recycled water for non-human contact, such as watering lawns, but a reluctance for anything that involved direct contact, including food crops (Hou et al. 2021; Rozin et al. 2015). Public acceptance of recycled water is influenced by trust, risk perception, and an emotional reaction related to its use (Smith et al. 2018). A study in Nevada found that geography may have an influence as well, with residents in suburban areas more likely to drink reclaimed water than residents in rural or urban areas (Redman et al. 2019). McClaran et al. (2002) found that terminology can influence public’s perception with the term “recycled” having a greater level of acceptance than “reclaimed.”

Water Transfers

The reallocation of water from one use or location to another is increasingly being considered by water managers as a tool to address scarcity. Often viewed as interchangeable, water transfers and water markets are in practice different. According to Keenan et al. (1999), "water transfers refer to various methods of reallocating or exchanging water from one region to another, or from one user type to another" (280). Water markets, however, "requires that rights to water become vested property rights, the units of which sellers and buyers may trade freely at prices allowable by the market" (280). Economists have long encouraged water markets as a tool to promote efficiencies and to direct water resources to their highest valued use (Leonard et al. 2019). Even with their appeal, water markets are rare, highly localized, and controversial (Leonard et al. 2019). Transaction costs, economies of scale, and diversity in states' water rights frameworks are identified barriers to their use (Womble and Hanemann 2020).

While water transfers may make economic sense, public and political support can act as barriers. In the western U.S. irrigation accounts for an estimated 81% of water withdrawals (Dieter et al. 2018) which has made agriculture a primary source of water transfers. In Colorado, for instance, 75% of water trades consisted of agriculture to urban transfers (Womble and Hanemann 2020). While permanent water transfers from agriculture may appear to make sense, it may not be the primary goal for citizens, particularly in rural communities. Public opinion studies show resistance to the selling of water, especially if the water is transferred out of its watershed area (Keenan et al. 1999). In a choice experiment study of Colorado residents, researchers found that "most Coloradoans are hesitant to allow market-based water transfers to municipal use that would result in fallowing of significant acreage of agricultural land, despite the sizable costs required to keep agricultural land in production" (Stone et al. 2018, 418).

Increasing irrigation efficiency to reallocate water "savings" to another use may appear the most efficient solution to address water needs, but doing so is complicated. Irrigation efficiency rarely delivers the benefits of increased water availability and can have unintended impacts to the local environment and communities (Grafton et al. 2018). In the West an estimated 62% of irrigation water is consumed in the form of evaporation, evapotranspiration, or incorporation into the crop (Dieter et al. 2018). The remaining flows to surface water bodies or groundwater where it is re-used elsewhere in the watershed.

Engineering Solutions

The use of engineering and technology can also be a politically popular solution to address water challenges. Techno-optimism, which is the belief that technology, engineering, and human ingenuity can solve current and future environmental problems (Gardezi and Arbuckle 2020), influences beliefs about solving environmental challenges. Studies on climate change, for example, have found that over half of Americans believe that technological solutions will solve environmental problems (Pew Research Center 2016). However, there are conflicting support levels when an engineered solution, including pipelines, canals, and dams, is used for water management. General investment in infrastructure, even if it means higher water bills, can be politically popular. This was demonstrated in 2014 when California passed a $7.5 billion bond with 67% of Californians' support; much of the bond is directed to infrastructure improvements (Jezdimirovic and Hanak 2016). A study of Idaho and Washington inland residents also found support for increased storage infrastructure even when it increases water bills (Awad et al. 2021). However, the Southern Nevada Water Authority's proposed 300-mile pipeline to transfer groundwater from five rural water basins to supply the Las Vegas metropolitan area met strong resistance. Nevada's rural communities and neighboring Utah feared the project would destroy their communities' social and environmental resources (Welsh and Endter-Wada 2017).

Further, while investments in infrastructure may be popular, raising dams may not be so. Take Shasta Dam, where The U.S. Bureau of Reclamation (2020) is conducting feasibility and impact studies to determine whether or not to raise it to provide additional storage capacity. While irrigation districts and farmers are supportive of this project, environmental groups and tribal entities are strongly opposed (Tavlian 2020). Opinion polls from the Pacific Northwest similarly highlight a schism between public opinion on dams and reservoirs. A poll of voters in Washington state, for example, claims that 53% of respondents support removing dams to protect salmon (Metz and Everitt 2018). However, in a discrete choice experiment of inland Pacific Northwest residents, 93% of respondents supported developing a new reservoir (Awad et al. 2021). Results from the same study also "suggest a strong desire to include considerations like wildlife habitat, recreation, and energy requirements in these investments" (04021007-6).

Land Use

Land use and cover are important factors in the hydrological processes. As land becomes more urbanized, there is a loss of 'green space' and an increase of impervious surface area. This impacts stream hydrology, reduces groundwater recharge, and ultimately reduces clean water availability (Rohatyn et al. 2018). However, there is a historic disconnect between land and water planning. Bates (2012) describes this as a "governance gap" and is due to the lack of integration in planning processes and failures to examine impacts of both land use and water choices at national and subnational governments. Previous studies have identified factors impacting integration, including shortfalls in management capacity (Braga 2001), lack of knowledge (Fedak et al. 2018), institutional arrangements (Fedak et al. 2018), and an absence of clear goals (Slocombe 1998). However, the key barriers are time and geography; water and land planning differ with respect to relevant time scales and differences in cultural practices of the planning agencies. The implementation of land use regulation occurs in short time frames, often over months, and primarily at the local level, while water planning occurs over years and decades at the state or regional level (Gober et al. 2013). As failures are becoming more apparent, efforts to coordinate land use and water management are increasing (Quay et al. 2018).

Urban-Rural Differences

People's views on water resource management tools may vary based on a range of structural, demographic, and cultural factors. Geography, including location on the urban-rural spectrum, may be a particularly important consideration for the study of public attitudes related to water management. Where you live often influences how you think about land-use change (Crowe 2011). This may in part be connected to dependence, livelihoods, and investments. For instance, rural residents are more likely to be directly dependent on natural resources for their livelihoods, and have made physical and social investments in landscapes dominated by natural resources (Moroney and Som Castellano 2017). These are all factors that could influence how a person feels about natural resource use and changes in resource use.

Some scholars have expressed concern with dichotomizing rural-urban differences (Qviström 2007), yet others have argued for the consideration of rural-urban differences in research (Bell 1992). One concern here is overgeneralization of rurality in the U.S., which is problematic given that rurality can be experienced differently across subnational scales (Mayer et al. 2017). For instance, a rural, amenity-based community such as Jackson, Wyoming can have different cultural, economic and social dynamics than a declining agricultural-based community in the Midwest. Nevertheless, there are often material and ideological differences between those who reside in rural and urban places (Lobao 2004). And these differences may influence how people residing in different geographies think about water resource management.

As noted above, from a material standpoint, people residing in rural areas are often more directly reliant on water resources for livelihoods. For instance, in Idaho, over 62% of the state's farms rely on irrigation water (U.S. Department of Agriculture 2019). Thus, while people in rural places may be more physically and socially distanced from other people and institutions, they are more proximate to a resource such as water that is being highly contested. This proximity can shape how people believe such resources should be managed. Moreover, poverty has been consistently found to be higher in rural areas (Brown and Schafft 2011). In addition to resource dependence, resource constraints, including being in poverty, may influence how people think that water should be managed. For example, if a person has lower socio-economic status, they are likely less able to adapt to changing natural resource conditions, such as by finding a different job or moving to a new community.

Ideological differences may also influence preference for water management strategies between rural and urban residents. Popular culture asserts that there are distinct differences between urban and rural communities, and the ways in which they view the governance of environmental resources. Further, research suggests that people with more liberal political ideology are more likely to view water issues as important, worry more about water issues, support the science behind water issues, and are more likely to change their behavior to address water issues (Callison and Holland 2017). While the general classification of rural areas as more conservative and urban areas as more liberal holds true in much research, the correlation between urbanization and ideology is nuanced. Large metropolitan areas and their immediate suburbs, along with smaller metropolitan areas hold liberal ideology on a number of issues (Scala and

Johnson 2017). Even so, not all rural communities can be grouped together. In rural communities based on farming, political views tend to be more conservative, whereas residents of counties with a recreation-based economy tend to be more liberal (Scala and Johnson 2017). Collectively, this research suggests that while geography may matter, it may not be the dominant factor at play; rather, it may be political ideology or the primary economic driver in a community that shapes attitudes about natural resource management.

Ideology is made up of a host of issues, indicating there may be areas where rural and urban values significantly intersect or diverge. Rural people are often stereotyped as wanting the government out of their lives. And while this doesn't always hold in research, some findings support this. For instance, some research has found that farmers do not want government action on climate change but would rather see individuals and businesses solve environmental problems (Pidgeon and Fischhoff 2011). On the other hand, many farmers assert the importance of regulation and support government programs that protect and support agriculture (Pidgeon and Fischhoff 2011).

Some have suggested that it is essential to further consider the growth rate of a given county when examining resource use change. For instance, Hamilton et al. (2010) found that people in counties with rapidly growing populations are more likely to perceive benefits from environmental rules that restrict development. In contrast, people in countries with shrinking populations see fewer benefits.

Together, this literature suggests that it is worth considering the differences between urban and rural residents regarding water resource management. Yet, little research has been done on the issue. To help fill the gap, this research examines differences in acceptance of water resource management strategies by geography. We hypothesize that rural residents will have a lower level of agreement with management strategies than residents in urban areas and clusters.

Methodology

Research Location

The focus of this research is the State of Idaho's general population. In 2014, at the time of the study, Idaho had a population of 1,634,464 with a population density of 20 people per square mile (Idaho Division of Public Health 2016). In 2017 and 2021 Idaho was the fastest growing state in the nation (U.S. Census Bureau 2017, 2021). The U.S. Census Bureau delineates urban communities into two categories: Urban areas of 50,000 or more people, and urban clusters of at least 2,500 and less than 50,000 people. The remaining individuals are considered rural (Ratcliffe et al. 2016). In 2010, 51% of Idaho's population lived in urban areas, 21% in urban clusters, and the remaining resided in rural areas (U.S. Census Bureau 2012).

Data Collection

This study used data from an electronic survey to assess the Idaho residents' perceptions concerning the state's water resources. The development of the survey questionnaire stemmed from previous scholarly research on water management and Idaho-specific issues. The questionnaire was pre-tested with a convenience sample of over 100 residents over a series of four rounds to ensure respondents' ability to understand the questions; these individuals were not included in the survey sample. In July 2014 a post-card was mailed via the U.S. Postal Service to a random sample of 3,900 of Idaho's 585,259 housing units (U.S. Census 2014). The sample was provided by Survey Sampling Incorporated (SSI). To gain a balanced distribution between the rural and urban population, the sample was stratified equally between the Office of Management and Budget (OMB) designated non-metropolitan and metropolitan counties. The postcard directed a household member 18-years or older to fill out the survey online with Qualtrics. The post-card also provided recipients an option to receive a hard-copy via the U.S. Postal Service. Non-respondents were mailed a postcard reminder three-weeks after the first mailer. Completed questionnaires were obtained from 401 respondents yielding a 9.3% response rate, which accounted for the known 172 undeliverable post-cards and ten non-participants. Of the 3,317 non-respondents, 67% were from OMB metropolitan counties.

Variables Measured

Independent Variable

This research aimed to assess the influence of geography on public acceptance of water management schemes. For this study 375 of the 401 survey responses were georeferenced into the U.S. Census Bureau's urban area, urban cluster, and rural classification and used in the analysis (Table 1). Despite the oversampling of non-metropolitan counties, the distribution among the three areas was skewed with 54% of the respondents classified in urban areas, 20% in an urban cluster, and 26% rural. Due to the number of respondents the data was not weighted thereby not allowing the results to be representative to the state population.

Dependent Variables

The respondents' acceptance of water management strategies was measured using 16 individual water management options (See Table 2). These were gained from previous research and management options suggested by other states (e.g., OWRD 2012). Respondents were asked to state their level of agreement with the 16 options and provided a five-point scale of 1 "strongly disagree," 2 "disagree," 3 "neutral," 4 "agree," and 5 "strongly agree." A principal component exploratory factor analysis with Varimax rotation was performed to identify underlying dimensions and groupings of the 16 options. The analysis reduced the 16 variables to four factors that explained 59% of the variance.

The four factors were developed into indices (Table 3). To address missing data respondents were required to answer at least two of the questions to be included in an index. The first index contained five variables related to water conservation and produced a Cronbach alpha reliability coefficient of .71. The second index contained four variables on land use regulations (alpha = .72). However, if the variable "placing restrictions on farmland for development of subdivisions" was removed, the alpha would increase to .75. Since the alpha reliabilities were not substantially different, and the variable theoretically fit, it was included in the index. The third index, called "water transfers," included four variables related to the use of water designated to agriculture (alpha = .65). The final index contained two variables related to engineering solutions (alpha = .60). The variable "limiting water used by industry" was not compatible in the engineering and technology group, and removed from analysis.

This study utilized a chi-square test to compare respondents' acceptance of the remaining 15 individual water management tools and four indices (Table 2). To determine acceptance in the chi-square, responses originally measured on a 5-point scale of 1 "strongly disagree" and 2 "disagree" were recoded as "disagree," and 4 "agree" and 5 "strongly agree" were recoded as "agree." One-way analysis variance (ANOVA) tests retained the original 5-point scale and assessed the differences among the three geographic groups with their acceptances of the four categories: water conservation, land use, water transfers, and engineering solutions. Kruskal-Wallis nonparametric tests assessed the significance among the three geographic groups.

Results

Table 2 summarizes how the three geographic groups compared with the 15 individual management strategies the state of Idaho can use to ensure water security. At 97%, the three groups and all of the respondents agreed that the reuse of treated wastewater on lawns and landscapes is the preferred option. Limiting personal water use also had high support among all respondents (84%). However, only 39% of the respondents agreed with increasing the cost of water. Concerning land use regulations, 73% and 72% of the respondents agreed with regulating development and controlling urban development. This level of support dropped to 53% when asked if the government should regulate development.

The three groups' agreement varied on nine of the 15 variables (x^2 = 5.87 to 37.15, *P* = .053 to .001). The effect sizes of these nine variables ranged from *V* = 0.14 to 0.35, indicating "small" or "minimal" to "medium or "typical" differences. Of the three water conservation management tools, "limiting water use by those who live in the city" showed a "medium" to "moderate" (*V* = 0.23) difference among the three groups, with respondents in the urban cluster showing the most support (91%) and the rural respondents the least (58%). However, 71% of urban cluster respondents were less supportive of limiting personal water use, while urban area respondents were the most supportive (87%).

The four variables in the land use regulation index "regulate development" and "restrictions on farmland for development" were significantly different, with a "small" to "minimal" difference (*V* = 0.14 to 0.16) among the groups. The majority of all groups agreed with regulating development, yet 91% of the urban cluster respondents had the highest level of support. The majority of rural (58%) and urban cluster (63%) respondents agreed with restrictions on developing farmland. While the majority of the urban clusters agreed with three of the four land use regulation variables (63% - 91%), only 40% supported the variable "government should regulate development."

Within the engineering solutions index, both variables showed a significant difference based on geography. The water management variable “build dams and reservoirs” had a “medium” difference ($V = 0.29$) with 74% of the urban cluster respondents showing support, which is more than double than the urban area respondents (35%), and 14% more than the rural residents. The use and development of pipelines to bring water from other regions of the state did not share the same level of support; only the urban cluster had a majority of support at 51%.

The use of water transfers received the least amount of support by all three groups. Of note was that 23% of the urban cluster respondents agreed that water rights should be transferred from agriculture to urban areas, compared to just 1% of rural and 2% of urban area respondents.

The next area examined was the ranking of the four management categories by the three geographic groups (Table 3). Of the four, all but the land use regulations index were statistically significant ($F = 8.63$ to 7.78, $p = .001$). The effect size ($\eta = 0.222$ to 0.228) for the three significant factors suggests a “typical” or “medium” (Vaske 2008) relationship between groups. The index “water conservation” was the most appealing ($M = 3.75$), with all three geographic-groups stating they “agree” with this management scheme ($M = 3.52$ to 3.85). The level of agreement for the engineering solutions index averaged between “neutral” to “agree,” with urban clusters the highest ($M = 3.62$) and the urban areas the lowest ($M = 3.12$). The final significant category, “water transfers,” was the least acceptable overall. All three groups stated that they “disagree” ($M = 2.40$ to 2.76) on its use to address water security.

Discussion and Conclusion

The state of Idaho is growing rapidly, and in 2021 it was again the fastest growing state in the U.S. (U.S. Census Bureau 2021). As with neighboring states, climate change will impact Idaho’s water resources, including the amount, availability, and quality of water supplies (Humes et al. 2011). A clearly structured approach to planning for water resources problems is necessary and valuable (Lund 2021). Policy makers and water managers will need to look at alternative water supplies to diversify communities' future water portfolios, yet doing so requires collaboration with land-use planners and consideration of residents' support. Place based research has important local relevance, particularly as it relates to management and policy decisions focused on a single natural resource issue (Flint et al. 2017).

The goal of this study was to focus on a specific natural resource issue (water) in a specific region (Idaho) to understand the potential differences in perceptions regarding water management among rural and urban residents. To accomplish this, we examined the level of acceptance of various water management strategies among residents in urban areas, urban clusters (small towns), and rural communities throughout Idaho. Importantly this research focused on household residents, as opposed to a particular user group, such as farmers or conservation professionals.

Acceptance of Water Management Options

Four general water management areas were examined: water conservation, land use regulations, engineered solutions, and water transfers. The results found that water conservation received the greatest amount of support among the three groups. Of the five conservation options, only "increase the cost of water" did not receive the majority of support from either group, which conflicts with previous research that found the public is willing to pay for conservation (Awad et al. 2021). Water reuse, however, received overwhelming support (97%) from all groups. While this finding may seem surprising, given the lack of popularity found in earlier studies (e.g. Rozin et al. 2015; Smith et al. 2018), it corresponds with recent studies (Hou et al. 2021; Redman et al. 2019). Our study asked participants about their acceptance of "reusing treated wastewater on lawns and landscapes," it did not, however, ask about human use or contact. Hou et al. (2021) also found a willingness to use recycled water for non-human contact, such as watering lawns. The word "reuse" may also explain the high level of support we found, and supports the findings from McClaran et al. (2020) around terminology. Understanding these nuances can be helpful in framing and developing solutions to overcome public attitudes as a potential barrier to effective water conservation (Smith et al. 2018). The findings here support previous research (e.g. Redman et al. 2019) which finds that conservation can be one of the most acceptable ways to address water scarcity among the public.

The use of agricultural water to ensure water security produced interesting – and conflicting – results among the three groups. Of particular interest are the similarities among respondents in urban areas, including Boise, and rural respondents, and how they conflicted with urban cluster respondents. These respondents were more supportive of buying water from agriculture and permanently transferring water from agriculture to cities. This study cannot ascertain why, but one can speculate that it may be due to the proximity of these urban clusters to agriculture operations. Residents in urban clusters may be more likely to witness first-hand the amount of water used for irrigation, and may view irrigation as wasteful. On the other hand, urban respondents are removed from the day-to-day realities of agriculture. Further, rural respondents may view water as a scarce community resource and, as noted above, are more likely to be dependent on water to support their livelihoods (Moroney and Som Castellano 2017).

The engineering and technology options had mixed support among the three groups, in particular the development of dams and pipelines. The use of dams to increase water storage capacity is well known; however, the costs often do not justify the benefit. In 2008 Idaho passed legislation to study additional Idaho water storage projects, including a study to raise the

Arrowrock Dam outside of Boise. In 2016 the U.S. Army Corps of Engineers (2016) found the benefits of raising the dam did not outweigh the $1.3 billion cost, and suggested that water conservation would produce the best results. Undeterred, in late 2017 the Idaho Legislature committed half of the $6 million required for a second feasibility study to raise three dams operated by the U.S. Bureau of Reclamation (U.S. Bureau of Reclamation 2017). The legislature's tenacity is noteworthy as it conflicts with our findings where only 46% of respondents agreed with the use of developing more reservoirs and dams to address future water needs. Moreover, while some research has found support for increased water storage even when it may lead to increased cost of water (Awad 2021), when the full picture of these proposed projects becomes clear, support for a dam or pipeline may decrease, particularly those in communities where water may be extracted from (e.g. Welsh and Endter-Wada 2017). As our results suggest, Idahoans are not supportive of water transfers. Thus, a "pipeline" that addresses water scarcity in the abstract is one thing, but a proposed pipeline that plans to reallocate water from a rural community to an urban area is another thing. These results suggest a conflict between politicians' preferences for supply side solutions, and the public's preferences for use-end solutions. This is an area that should be examined in future research.

Of the four general water management categories, findings associated with land use regulations were the most surprising. Respondents in urban clusters, or small towns, were the most supportive of land use regulations. An overwhelming 91% of this group believe development should be regulated, and 63% prefer restrictions on farmland development. This represents a greater percentage than the rural respondents. Only the item "government should regulate development" did not receive the majority of support of the urban cluster respondents, which conflicts with their support for regulations in other categories. The overall support for regulations may be in part due to the population growth and rapid development being experienced by these communities. As Hamilton et al. (2010) found, respondents see the benefits in restricting development, but their conservative beliefs do not support government regulations. This raises an important question: if not the government, then who should do the regulating?

Rural – Urban Context

The findings in this study suggest that geography can matter, and that proximity to agriculture may influence views on how water is managed between users. As noted above, rural residents may be unlikely to support the transfer of water from agriculture due to the potential impacts to their communities (such as through the decimation of other supporting economic activities like tractor sale and community services). Those residing in small towns, may be less likely to be directly impacted by such shifts, but may see the degree to which agriculture uses water more vividly. In both cases geography influences understanding of water use, and ideas on how water use should be managed. This finding supports the work of others (e.g. Cattaneo et al. 2021) who have argued that geography should not be considered as an urban/rural binary, but rather on a continuum. While residents in small towns of 2,500 up to 50,000 are labeled as "urban" in some commonly used rural/urban dichotomous definitions, our findings support the use of a more nuanced definitions of rurality, such as those that allow for the recognition of a rural-urban continuum (Cromartie and Bucholtz 2008).

Conclusion

Policy makers and water managers will need to use alternative water sources to augment traditional water supplies to address water scarcity. Of particular interest may be the overwhelming support of water conservation efforts and how it compares to the lack of support for dams and pipelines. This is noteworthy, particularly in Idaho, where great effort and expense have already been used to explore these supply side options for water management. Finally, the support among both urban and rural residents with regards to regulation of land development is also noteworthy for policy makers, particularly given increasing development in rapidly growing places like Idaho.

Limitations of this research include low response rate, skew of the three groups, and lack of weighting of the data. Further, while these findings are useful to policy makers and water managers broadly across the U.S., the generalizability of these findings may be limited, given that this research is focused on Idaho. In addition, it is important to acknowledge that public knowledge about water use and management may be limited (Hubbard 2020b). For instance, while public interest in water conservation is high, the practicalities of water conservation are not always well understood. This is illustrated when considering water conservation strategies in agriculture, where conservation tools such as transitioning from flood irrigation to central pivots may in reality not improve water availability at the scale of a watershed or basin (Grafton et al. 2018). Additionally, the gap between reported preferences and the reality of implementing these is important to note.

The data used in this study stems from a survey distributed to Idaho residents in 2014, and thereby provides a snapshot of the past. The findings, however, address an area of limited study and can act as a data point to evaluate change over time. As the western U.S. continues to experience rapid growth and climate change impacts it is important to gain an understanding of public preferences to manage water. In addition to examining preferences in the abstract, future research should examine scenarios that connect water management tools with their impacts. We further see a need to expand the research from the public, to groups that rely on and are responsible for the management of water, including irrigators, energy providers, and agencies.

Despite these limitations, we believe that this research provides important findings for both theory and practice.

Data Availability Statement

Some data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request (data used in Tables 2 and 3).

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References

Anderson, J. E. 2014. *Public Policymaking*. 8th ed. Stamford, CT: Cengage Learning.

Attari, S. Z. 2014. "Perceptions of water use." *Proc. Natl. Acad. Sci.* 111 (14): 5129-5134. https://doi.org/10.1073/pnas.1316402111.

Awad, K., Maas, A., & Wardropper, C. 2021. "Preferences for alternative water supplies in the Pacific Northwest: A discrete choice experiment." *J. Water Resour. Plan. Manag. 147* (4). https://doi.org/10.1061/(ASCE)WR.1943-5452.0001342.

Bates, S. 2012. "Bridging the governance gap: Emerging strategies to integrate water and land use planning." *Nat. Resour. J.* 52 (1): 61-97. https://www.jstor.org/stable/24889598.

BBC Research. 2013. *Public Opinions, Attitudes and Awareness Regarding Water in Colorado.* Denver, CO: Colorado Water Conservation Board.

Bell, M. 1992. "The Fruit of Difference: The rural-urban continuum as a system of identity." *Rural Sociol.* 57 (1): 65-82. https://doi.org/10.1111/j.1549-0831.1992.tb00457.x.

Braga, B. P. F. 2001. "Integrated Urban Water Resources Management: A Challenge into the 21st Century." *Int. J. Water Resour. Dev.* 17 (4): 581-599. https://doi.org/10.1080/07900620120094127.

Brown, D. L., and K. A. Schafft. 2011. *Rural people and communities in the 21st century: Resilience and transformation*. Malden, MA: Polity.

Callison, C., and D. Holland. 2017. "Impact of Political Identity and Past Crisis Experience on Water Attitudes." *J. Contemp. Water Res. Educ.* 161 (1): 19-32. https://doi.org/10.1111/j.1936-704X.2017.3249.x.

Cattaneo, A., A. Adukia, D.L. Brown, L. Christiaensen, D.K. Evans, A. Haakenstad, T. McMenomy, M. Partridge, S. Vaz, and D.J. Weiss. 2021. "*Economic and social development along the urban-rural continuum: New opportunities to inform policy.*" Washington, D.C.: The World Bank.

Cromartie, J., and S. Bucholtz. 2008. Defining the" rural" in rural America. *Amber Waves*. 6 (3): 28-35. https://ageconsearch.umn.edu/record/122957/files/RuralAmerica.pdf

Crowe, J. 2011. "Rural perceptions of growth management legislation on rural economic development: Welcoming comrade or hostile foe?" *Soc. Nat. Resour.* 24 (3): 221-241. https://doi.org/10.1080/08941920903580243.

de França Doria, M. 2010. "Factors influencing public perception of drinking water quality." *Water Policy* 12 (1): 1-19. https://doi.org/10.2166/wp.2009.051.

Dieter, C.A., M.A. Maupin, R.R. Caldwell, M.A. Harris, T.I. Invahnenko, J.K. Lovelace, N.L. Barber, and K.S. Linsey. 2018. *"Estimated Use of Water in the United States in 2015."* Reston, VA: U.S. Geological Survey.

Duram, L. A., and K. G. Brown. 1999. "Insights and applications assessing public participation in U.S. watershed planning initiatives." *Soc. Nat. Resour.* 12 (5): 455-467. https://doi.org/10.1080/089419299279533.

Fedak, R., S. Sommer, D. Hannon, D. Beckwith, A. Nuding, and L. Stitzer. 2018. *Integrating land use and water resources: Planning to support water supply diversification.* Denver, CO: Water Research Foundation.

Feldman, D. L. 2017. *Water politics: governing our most precious resource*. Malden, MA: Polity.

Flint, C. G., X. Dai, D. Jackson-Smith, J. Endter-Wada, S. K. Yeo, R. Hale, and M. K. Dolan. 2017. "Social and geographic contexts of water concerns in Utah." *Soc. Nat. Resour.* 30 (8): 885-902. https://doi.org/10.1080/08941920.2016.1264653.

Garcia-Cuerva, L., E. Z. Berglund, and A. R. Binder. 2016. "Public perceptions of water shortages, conservation behaviors, and support for water reuse in the US." Resour. Conserv. Recycl. 113: 106-115. https://doi.org/10.1016/j.resconrec.2016.06.006.

Gardezi, M., and J. G. Arbuckle. 2020. "Techno-Optimism and Farmers' Attitudes Toward Climate Change Adaptation." *Environ. Behav.* 52 (1): 82-105. https://doi.org/10.1177/0013916518793482.

Gober, P., K. L. Larson, R. Quay, C. Polsky, H. Chang, and V. Shandas. 2013. "Why land planners and water managers don't talk to one another and why they should!" *Soc. Nat. Resour.* 26 (3): 356-364. https://doi.org/10.1080/08941920.2012.713448.

Grafton, R. Q., J. Williams, C. J. Perry, F. Molle, C. Ringler, P. Steduto, B. Udall, S. A. Wheeler, Y. Wang, D. Garrick, and R. G. Allen. 2018. The paradox of irrigation efficiency. Science. 361(6404): 748-750. https://doi.org/doi:10.1126/science.aat9314

Hamilton, L. C., C. R. Colocousis, and C. M. Duncan. 2010. "Place effects on environmental views." *Rural Sociol.* 75 (2): 326-347. https://doi.org/10.1111/j.1549-0831.2010.00013.x

Hou, C., Y. Wen, Y. He, X. Liu, M. Wang, Z. Zhang, and H. Fu. 2021. "Public stereotypes of recycled water end uses with different human contact: Evidence from event-related potential (ERP)." *Resour Conserv Recycl.* 168: 105464. https://doi.org/10.1016/j.resconrec.2021.105464.

Hubbard, M. L. 2020a. "The risky business of water resources management: assessment of the public's risk perception of Oregon's water resources." *Hum Ecol Risk Assess.* 26 (7): 1970-1987. https://doi.org/10.1080/10807039.2019.1632167.

Hubbard, M. L. 2020b. "The role of knowledge in water resource management: An assessment of the Oregon general public." *Soc. Sci. J.* https://doi.org/10.1080/03623319.2020.1782635.

Hui, I., and B.E. Cain. 2018. "Overcoming psychological resistance toward using recycled water in California." *Water Environ. J.* 32 (1): 17-25. https://doi.org/10.1111/wej.12285.

Humes, K., R. Walters, J. Ryu, R. Mahler, and C. Woodruff. 2021. "*Water Report: Idaho Climate-Economy Impacts Assessment."* Boise, ID: James A. & Louise McClure Center for Public Policy Research.

Idaho Division of Public Health. 2016. *2014 Idaho Vital Statistics.* Boise, ID.

Jezdimirovic, J., and E. Hanak. 2016. *How Is California Spending the Water Bond?* San Francisco, CA: Public Policy Institute of California.

Keenan, S. P., R. S. Krannich, and M. S. Walker. 1999. "Public perceptions of water transfers and markets: Describing differences in water use communities." *Soc. Nat. Resour.* 12 (4): 279-292. https://doi.org/10.1080/089419299279605.

Leach, W. D., and N. W. Pelkey. 2001. "Making watershed partnerships work: A review of the empirical literature." *J. Water Resour. Plan. Manag.* 127 (6): 378-385. https://doi.org/10.1061/(ASCE)0733-9496(2001)127:6(378).

Leonard, B., C. Costello and G. D. Libecap. 2019. “Expanding water markets in the Western United States: Barriers and lessons from other natural resource markets.” *Rev. Environ. Econ. Policy.* 13 (1): 43-61. https://doi.org/10.1093/reep/rey014.

Lobao, L. 2004. "Continuity and change in place stratification: Spatial inequality and middle-range territorial units." *Rural Sociol.* 69 (1): 1-30. https://doi.org/10.1526/003601104322919883.

Lund, J. R. (2021). "Approaches to Planning Water Resources." *J. Water Resour. Plan. Manag.* 147 (9): 04021058-1 - 04021058-8. https://doi.org/doi:10.1061/(ASCE)WR.1943-5452.0001417.

Mayer, A., S.K. Olson-Hazboun, and S. Malin. 2018. “Fracking fortunes: economic well-being and oil and gas development along the urban-rural continuum.” *Rural Sociol*. 83: 532-67.https://doi.org/10.1111/ruso.12198.

McClaran, N., B.K. Behe, P. Huddleston, and R.T. Fernandez. 2020. “Recycled or reclaimed? The effect of terminology on water reuse perceptions.” *J. Environ.Manage*. *261*: 110144. https://doi.org/https://doi.org/10.1016/j.jenvman.2020.110144.

Metz, D., and M. Everitt. 2018. *Washington Voter Views of Wild Salmon and Snake River Dams.* Los Angeles, CA: FM3 Research.

Moroney, J.L., and R. Som Castellano. 2018 "Farmland loss and concern in the Treasure Valley." *Agric. Human Values* 35: 529–536. https://doi.org/10.1007/s10460-018-9847-7.

NRCS (Natural Resources Conservation Service). 2019. "Water management." Accessed November 1, 2021. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/.

OWRD (Oregon Water Resources Department). 2012. *Oregon's Integrated Water Resources Strategy Executive Summary.* Salem, OR: OWRD.

Pahl-Wostl, C., G. Holtz, B. Kastens, and C. Knieper. 2010. "Analyzing complex water governance regimes: The Management and transition framework." *Environ. Sci. Policy.* 13 (7): 571-581. https://doi.org/10.1016/j.envsci.2010.08.006.

Pew Research Center. 2016. *The politics of climate.* Washington D.C: Pew Research Center.

Pidgeon, N., and B. Fischhoff. 2011. "The role of social and decision sciences in communicating uncertain climate risks." *Nat. Clim. Chan.* 1 (1): 35-41. https://doi.org/10.1038/nclimate1080.

Quay, R., K. Lawless, and K. Ryder. 2018. *Assessing the Connection between Land Use Planning and Water Resource Planning.* Tempe, AZ: Julie Ann Wrigley Global Institute of Sustainability.

Qviström, M. 2007. "Landscapes out of order: studying the inner urban fringe beyond the rural–urban divide." *Geogr. Ann. Ser. B.* 89 (3): 269-282. https://doi.org/10.1111/j.1468-0467.2007.00253.x.

Ratcliffe, M., C. Burd, K. Holder, and A. Fields. 2016. *Defining Rural at the U.S. Census Bureau.* Washington, D.C: U.S. Census Bureau.

Redman, S., Ormerod, K. J., & Kelley, S. (2019). Reclaiming suburbia: differences in local identity and public perceptions of potable water reuse. *Sustainability*. 11(3), 564. https://doi.org/10.3390/su11030564.

Rice, M. L., & McCool, D. (2021). Collaboration and the criteria for success: A Case study and a proposed framework for analysis. *Adm. Soc*. https://doi.org/10.1177/00953997211042564.

Rohatyn, S., E. Rotenberg, E. Ramati, F. Tatarinov, E. Tas, and D. Yakir. 2018. "Differential impacts of land use and precipitation on "ecosystem water yield"." *Water Resour. Res.* 54 (8): 5457-5470. https://doi.org/10.1029/2017wr022267.

Rozin, P., B. Haddad, C. Nemeroff, and P. Slovic. 2015. "Psychological aspects of the rejection of recycled water: Contamination, purification and disgust." *Judgm. Decis. Mak.* 10 (1): 50-63. http://journal.sjdm.org/14/14117a/jdm14117a.html.

Scala, D. J., and K. M. Johnson. 2017. "Political polarization along the rural-urban continuum? The geography of the presidential vote, 2000–2016." *Ann. Am. Acad. Political Soc. Sci.* 672 (1): 162-184. https://doi.org/10.1177/0002716217712696.

Slocombe, D. S. 1998. "Defining goals and criteria for ecosystem-based management." *Environ. Manage.* 22 (4): 483-493. https://doi.org/10.1007/s002679900121.

Smith, H. M., S. Brouwer, P. Jeffrey, and J. Frijns. 2018. "Public responses to water reuse: Understanding the evidence." *J. Environ. Manage.* 207: 43-50. https://doi.org/https://doi.org/10.1016/j.jenvman.2017.11.021.

Stone, J., M. Costanigro, and C. Goemans. 2018. "Public opinion on Colorado water rights transfers: Are policy preferences consistent with concerns over impacts?" *J. Agric. Resour. Econ.* 43: 403-422. https://doi.org10.22004/ag.econ.276502.

Tavlian, A. 2020. "What's happened since Trump visited the Valley? Quite a bit." *The San Joaquin Valley Sun*, March 1, 2020.

U.S. Army Corps of Engineers. 2016. *Boise River Feasibility Study.* Walla Walla, WA. U.S. Army Corps of Engineers.

U.S. Bureau of Reclamation. 2017. "New Boise River system feasibility study launched." Accessed February 18, 2021. https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=60759.

U.S. Bureau of Reclamation. 2020. "Shasta Dam and reservoir enlargement project." Accessed February 18, 2021. https://www.usbr.gov/mp/ncao/shasta-enlargement.html.

U.S. Census Bureau. 2012. *2010 Census of Population and Housing, Population and Housing Unit Counts*. Washington D.C: U.S. Census Bureau.

U.S. Census Bureau. 2014. *2010-2014 American Community Survey 5-Year Estimates.* Washington D.C: U.S. Census Bureau.

U.S. Census Bureau. 2017. *Idaho is nation's fastest-growing state, Census Bureau reports.* Washington D.C: U.S. Census Bureau.

U.S. Census Bureau. 2021. "Estimates Show Slowest Growth on Record for the Nation's Population." Accessed January 5, 2022. https://www.census.gov/newsroom/press-releases/2021/2021-population-estimates.html.

U.S. Department of Agriculture. 2019. *2017 Census of Agriculture.* Washington D.C: U.S. Department of Agriculture.

Vaske, J. J. 2008. *Survey research and analysis: Application in parks, recreation, and human dimensions*. State College, PA: Venture.

Welsh, L. W., and J. Endter-Wada. 2017. "Piping water from rural counties to fuel growth in Las Vegas, NV: Water transfer risks in the arid USA West." *Water Alternatives.* 10 (2): 420-436. https://www.water-alternatives.org/index.php/alldoc/articles/vol10/v10issue2/362-a10-2-12/.

Wittenberg, A. 2019. "Lawmakers spar over Western woes." *E&E News.* April 3, 2019.

Wolters, E. A., and M. L. Hubbard. 2014. "Oregon water: Assessing differences between the old and new wests." *Soc. Sci. J.* 51 (2): 260-267. https://doi.org/10.1016/j.soscij.2013.10.013.

Womble, P., and W. M. Hanemann. 2020. "Water markets, water courts, and transaction costs in Colorado." *Water Resour Res*. *56*(4). https://doi.org/10.1029/2019WR025507.

Tables

Table 1. Characteristics of Survey Population

Demographic Variable	Rural	Urban Cluster	Urban Area	Sample	Idaho[a]
Age (mean)	65	68	63	64	32
Income (≥ $50,000)	57%	67%	68%	65%	48%
Sex (% male)	60%	68%	58%	60%	50%
Education (some college or more)	84%	82%	94%	89%	61%
Conservative ideology	57%	48%	40%	46%	
n	97	77	201	375	
Percent of sample	26%	20%	54%		

a Source: U.S. Census Bureau. 2014. *2010-2014 American Community Survey 5-Year Estimates.*

Table 2. Agreement toward water management strategies by geography

Acceptance of management factors and variables[a]	Percent Agree (%)				χ2-value	*P*-value	*V*
	Rural	Urban Cluster	Urban Area	Total			
Factor 1: Water conservation							
Reuse treated wastewater on lawns and landscapes	97	97	97	97	0.02	0.990	0.01
Limit personal water use	79	71	87	84	6.68	0.035	0.15
Limiting water used by people who live in the city	58	91	78	75	16.65	0.001	0.23
Tax breaks for using less water	69	66	77	74	3.09	0.213	0.10
Increase the cost of water	26	41	44	39	6.80	0.033	0.15
Total	38	37	59	51	12.56	0.002	0.20

Acceptance of management factors and variables[a]	Percent Agree (%)				χ2-value	*P*-value	*V*
	Rural	Urban Cluster	Urban Area	Total			
Factor 2: Land use regulation							
Regulate development	65	91	72	73	7.87	0.020	0.16
Urban development controlled	75	72	70	72	0.55	0.759	0.04
Government should regulate development	51	40	56	53	3.04	0.218	0.10
Restrictions on farmland for development of subdivisions	58	63	45	50	5.87	0.053	0.14
Total	51	34	35	38	5.93	0.052	0.14
Factor 3: Water transfers							
Limit water use by farmers	51	43	46	47	0.71	0.700	0.05
Buy water from farmers to use in cities	35	57	45	44	5.03	0.081	0.13
The State moves water from rural to urban areas	1	9	18	13	13.39	0.001	0.21
Permanently transfer water rights from agriculture to cities	1	23	2	4	37.15	0.001	0.35
Total	0	0	1	1	1.10	0.577	0.60
Factor 4: Engineering solutions							
Build dams and reservoirs	60	74	35	46	25.59	0.001	0.29
Construct pipelines to bring water from other regions	27	51	30	32	7.31	0.026	0.16
Total	25	47	20	25	11.77	0.003	0.20

[a]Responses originally measured on 5-point scales of 1 = strongly disagree and 2 = disagree were recoded as a "disagree" response, and 4 = agree and 5 = strongly agree were recoded as "agree" response.

Table 3. Acceptance of management strategies to ensure Idaho's water security by geography

	Acceptance of management strategies						
Management Action[a]	Rural	Urban Cluster	Urban Area	Total	*F*-value	*P*-value[b]	η
Water conservation	3.52	3.72	3.85	3.76	8.16	.001	0.228
Land use regulation	3.58	3.72	3.63	3.63	0.36	.694	0.049
Engineering solutions	3.18	3.62	3.01	3.12	7.78	.001	0.222
Water transfers	2.40	2.65	2.76	2.66	8.63	.001	0.233

[a]Cell entries are means for composite scales measured on a 5-point scale from 1=strongly disagree to 5=strongly agree.
[b]Kruskal-Wallis test