



Public Perceptions and Responses to Water Resource Issues over the Last 35 Years in Idaho, USA

Robert L. Mahler^{1*}, Nav Ghimire²

¹ Department of Soil and Water Systems, University of Idaho, Boise, Idaho 83702, USA

² Department of Extension Administration, University of Idaho, Boise, Idaho 83702, USA

Corresponding Author Email: bmahler@uidaho.edu

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ABSTRACT

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Over the past 35 years, Idaho has implemented a comprehensive water outreach program aimed at addressing water resource challenges. This study employs a repeated measures survey strategy to assess the program's effectiveness. Initiated in 1987, a mail-based survey was designed to investigate various aspects, including water issues, satisfaction with drinking water, consumer observations of surface and groundwater quality, voluntary actions taken to protect and conserve water, and sources of water resource information accessed by Idaho citizens. The survey, featuring consistent questions, has been administered at five-year intervals (1992, 1997, 2002, 2007, 2012, 2017, 2022) to a sample of over 2,000 Idaho residents. The resulting 35-year longitudinal dataset provides valuable insights into key water issues within the state. Significant findings include a high level of satisfaction with drinking water among Idahoans, a substantial increase in voluntary actions to protect water quality (from 12.6% in 1987 to over 63% in 2022), and a growing adoption of voluntary actions to conserve water quantity (from 16.4% in 1987 to 64% in 2022). The study recognizes the success of citizen-led efforts to protect water resources and utilizes this extensive dataset to inform future water education priorities in Idaho.

1. BACKGROUND

Water is Idaho's most important natural resource. Compared to other western states, Idaho's water supply is adequate; however, water needs continue to increase. From a population standpoint Idaho is one of the three fastest growing states in the USA [1]. In 1980 less than 1,000,000 people lived in Idaho. Since 1980 the state's population has doubled to more than 1,870,000. Although Idaho appears to currently have adequate water resources this population growth will require Idahoans to make increasingly difficult decisions about water use priorities. Per capita water use in Idaho is the highest in the USA. This high per capita water use is in large part due to over 2,500,000 ha of irrigated farmland compared to a relatively small state population. Traditional water resource allocations may need to be adjusted to meet the needs of population growth. Town hall meetings have shown that the public is also concerned about general water quality, drinking water quality and water conservation. Consequently, it is important to understand historical, current and projected future public attitudes and priorities for water use.

2. INTRODUCTION

Idaho is geographically diverse. Forest and grassland biomes cover about 60% of the state, while desert biomes cover most of the southern part of the state. Annual precipitation generally provides adequate water resources in forest and grassland biomes. Much of the freshwater used in the drier part of the state originates as mountain snow that

accumulates in the colder months of the year. This water is stored as snowpack in the winter and when temperatures warm in late March through June, it melts and flows down rivers where it can be captured to support economic activity in the desert part of the state. This snowpack, through rivers and indirectly through groundwater recharge, provides irrigation water for over 1,700,000 ha of agricultural land [2]. Agriculture is Idaho's largest industry as it produces 75 major crops and is one of the three major dairy states in the USA. Agricultural products from Idaho are exported to six continents. This abundant water resource was responsible for attracting many pioneers to settle in Idaho and up to 70 years ago was the major cause of population growth in the state. Unlike other western states, Idaho has adequate water resources. However, with the influx of people moving from other states the population has doubled in last 37 years resulting in an awareness that the water resources may soon become limited.

The public in the four Pacific Northwest states (Alaska, Idaho, Oregon, Washington) consider both environmental protection and water resources important issues [3]. Since the Clean Water Act (CWA) was passed by Congress in 1972, many laws have been enacted at the federal and state levels to address water resources [4-7]. These laws have been targeted at surface and groundwater quality and quantity, ensuring safe drinking water for the public and the safe disposal of wastes that could negatively impact the quality of water resources. Previous studies have shown that political inclinations impact public views on water and the environment [8]. Several studies in the USA have shown that governmental efforts to protect water and the environment are often insufficient [9]. There is

also evidence to suggest that an entirely regulatory approach to protect water resources is often poorly received by clientele. Conversely, a voluntary approach which relies on public education often is well-received and results in better water quality protection. In many cases, public opinions about water issues appear to drive environmental policy. Surveys have been widely used to track public perceptions of water issues [10-13], however, many of these surveys are based on a single point in time rather than trends. Most recent public opinion surveys about water in the USA cover a single point in time and are targeted at drought conditions and or climate change [14, 15]. Long-term public surveys about general water issues are lacking.

Public opinion trends toward environmental issues including water between 1965 and 1990 were found to follow three distinct time trends [16, 17]. In the first time-period in the 1960s public concern about the environment rapidly increased and peaked with the first Earth Day in 1970. In the 1970s public concern substantially declined; however, it was still important. In the third time-period beginning in the 1980s public concern about the environment rebounded and steadily increased into the 1990s. Public education about water issues has been documented to be important to increasing public concern and environmental support [14, 17, 18].

In 1987 the University of Idaho developed an extensive long-term water outreach program to address water needs, water education and to quantify actions the public voluntarily took to address important water resource needs in Idaho. A long-term survey study was initiated to document program successes and failures. Consequently, the objective of this paper was to determine if public literacy about water resources had improved, at least in part, because of this university-led extensive water outreach program. To evaluate this strategy a long-term repeated measures survey strategy was developed to quantify program successes and failures. A mail-based survey was developed in 1987 to address: (1) the importance of water issues, (2) satisfaction with drinking water quality, (3) consumer observations about both surface and groundwater quality, (4) voluntary actions taken by the public to protect water quality and to conserve water, and (5) sources of water resource information used by the Idaho citizens. This survey was first sent to Idaho citizens in 1987 and then the same survey questions were again asked of Idahoans in five-year intervals (1992, 1997, 2002, 2007, 2012, 2017, 2022). This article presents the findings of this 35-year-long study which provided relevant information about opinions of water in Idaho.

3. METHODS

A survey instrument was developed to determine public attitudes and perceptions about water and consequent voluntary actions taken by citizens to protect water resources in Idaho. The first survey in 1987 contained 60 questions and it was sent to over 600 residents. The seven follow-up surveys (1992, 1997, 2002, 2007, 2012, 2017 and 2022) contained 30 questions that were identical to the 1987 questions and 20 additional questions that were tailored to specific water issues at the time. Because of space limitations the actual 50 survey questions are not repeated in this text but can be found in referenced articles in the initial survey years [19-23]. This paper presents the results of identical questions that were asked of Idahoans in eight surveys. The water topics evaluated

in this study were based on survey questions that were designed to answer the following:

- The importance of water issues
- Satisfaction with drinking water provided by the household faucet
- State of surface water quality
- State of groundwater quality in
- Voluntary actions taken by the public to protect water quality
- Voluntary actions taken by the public to save water (water quantity)
- Sources of water resource information used by the public

The target audience for the survey was a representative sample of the 1,300,000 adult residents of Idaho. In addition, data related to demographic information including community size, gender, age, educational level and geographical location within Idaho were also collected.

The survey was developed using the Dillman methodology and was delivered to clientele via the United States Postal Service [24, 25]. A sufficient number of completed surveys was the goal to result maintain a sampling error of 3 to 5% [26]. The survey process was designed to receive a completed survey return rate more than 50% for each survey year. Addresses were obtained from a professional social sciences survey company (SSI, Norwich, CT). Over 800 surveys were sent out in each mailing event. Four mailings were planned to achieve the 50% return rate. The mailing strategy used was identical to other surveys that had been routinely conducted in the region [24, 25]. It only took three mailings to achieve the target return rate of 50% in 1987, 1997, 2002, 2012 and 2017. Conversely, it took four mailings to achieve the 50% return rate in 1992, 2007 and 2022.

The surveys used in this study were mail-based because this was the predominant delivery of survey instruments used in 1987. For future statistical comparisons the later seven survey instruments were also mail-based. This study stayed with the mail-based survey delivery method so that the collected data from this 35-year study could be correctly statistically compared.

Survey answers were coded and entered into Microsoft Excel. Missing data were excluded from the analysis. The data were analyzed at two levels using SAS [24]. The first level of analysis generated frequencies, while the second level evaluated the impacts of demographic factors. Significance ($P < 0.05$) to demographic factors was tested using a chi-square distribution [25, 26]. Since similar response rates were observed in all survey years the data analysis procedures were identical for each sampling.

The 1987 survey instrument was developed using a seven-stage process. This included pretesting the survey instrument with focus groups to prevent the use of ambiguous statements and potential answers. The pretesting groups resulted in satisfactory questions that were not confusing to the majority of the general public.

4. RESULTS AND DISCUSSION

When this survey was first initiated in 1987 the population of Idaho was approximately 980,000 [1]. However, by 2022 Idaho's population had grown to over 1,870,000. This 98%

population increase resulted in Idaho becoming more urban and people more concentrated in communities with more than 40,000 people over the 35-year study period.

The goal of greater than a 50% survey response rate was achieved for all surveys, resulting in a sampling error of less than 5%. There were several instances in this survey study where the demographic factors of gender, age, education level, community size and geographical location in Idaho impacted respondent answers. These instances will be discussed in the following sections.

4.1 Importance of water issues

The importance of water issues to Idahoans was tracked over the 35-year survey period (Table 1). In 1987 over 90% of Idahoans considered the water issues of drinking water and groundwater as very important. Conversely, drinking water, groundwater and mountain snowpack were considered very important by over 90% of survey respondents in 2022. Trends in the importance of drinking water, groundwater and water use by industry were not observed during the 35-year survey. However, the issues of aquatic habitat, power generation from water, recreation, river/lakes (surface water), snowpack and wetlands became more important over time to Idahoans (Table 1). Conversely, irrigation for agriculture became less important over time.

The lowering of the very important response for irrigation for agriculture from 70.1% in 1987 to 52.3% in 2022 was probably due to changing demographics in Idaho’s population as the population increased from 960,000 in 1987 to 1,900,000 in 2021. This 98% increase in population was largely found in the more urban areas of Idaho. Consequently, the large urban influx of people has less familiarity with agriculture and irrigation. Mountain snowpack (45%), water for recreation (33%) and water for power production (12%) had the largest percentage increase in responses of very important between 1987 and 2022. The data show that statistical differences for the importance of seven water issues in the 1987-2022 period and five water issues in 2012-2022 period were evident.

It is interesting to note that the issues that changed the most as very important (irrigation for agriculture, water for recreation, mountain snowpack and water for power generation) have been heavily covered by the state and local media in the last ten years. For instance, the public is literate about the importance of water for hydro power production and the importance of the mountain snowpack for both surface and groundwater resources when the snow melts in the spring. Many Idahoans also recreate with water-related activities and irrigation of agricultural produce greatly contributes to the state’s economy. The answers obtained from this survey question indicate that Idahoans are both literate and involved water-related issues.

Table 1. The percentage of Idahoans listing 10 different water-related issues as very important over the 35-year survey study based on eight survey years in Idaho between 1987 and 2022

Water Issue	1987 %	2022 %	35-year Trend	Significance 1987 vs 2022	Significance 2012 vs 2022
Aquatic habitat	64.2	73.8	up 9%	**	
Drinking water	97.5	98.1	flat	NS	
Groundwater	92.4	94.1	flat	NS	
Industry	35.6	36.1	flat	NS	
Irrigation (agriculture)	70.1	52.3	down 18%	****	****
Power generation	70.2	82.1	up 12%	**	**
Recreation	27.8	61.1	up 33%	****	**
Rivers/lakes	75.4	80.2	up 5%	**	**
Snowpack (mountain)	48.3	93.1	up 45%	****	***
Wetlands	60.4	63.6	up 3%	**	NS

Note: **, *** and ****=significant at the 95, 99 and 99.9% levels of probability within a water issue, respectively; NS=not significant.

4.2 Satisfaction with drinking water

A large majority of Idahoans were satisfied with the drinking water supplied to their home faucets (Figure 1). Even though most consumers were satisfied there was a significant 35-year trend that indicated that their level of satisfaction with drinking water declined over time. In 1987, 94.7% of survey respondents were satisfied with their home drinking water; however, this satisfaction level fell to 84.2% by 2022. This drop in drinking water satisfaction over time was probably not due to an actual reduction in the quality of drinking water. Rather, it was likely related to the increased varieties of water filters on the market and associated advertising targeted at home consumers in the last 20 years. These filters have been marketed to remove unhealthy chemicals from drinking water; however, based on federal water standards enforced in municipalities, these after-market filters do little to make drinking water safer. Unfortunately, this is a case where consumer perceptions based on advertising have become a reality in many homes.

The demographic factors of gender, age, education level,

community size and the geographic location of the consumer in the state impacted consumer satisfaction with drinking water (Table 2). Males were more satisfied with home drinking water than females. Adults older than 70 years old were most likely to be satisfied with their home drinking water, while respondents less than 30 years old were least likely to be satisfied with their drinking water. Idahoans with 3+ years of college were most satisfied with their home drinking water, while residents without a high school diploma were least satisfied. Residents of communities with between 20,000 and 40,000 people were most satisfied with their drinking water, while residents of Idaho’s two communities of more than 100,000 people (Boise, Meridian) were the least satisfied. Geography was also important as residents of northern Idaho were most satisfied with their drinking water, while residents of southwestern Idaho were the least satisfied. It should be emphasized that the demographic groups that were least satisfied with their drinking water still had a sizable majority of people that had significant satisfaction with the drinking water supplied to their home faucets.

DRINKING WATER, % satisfaction

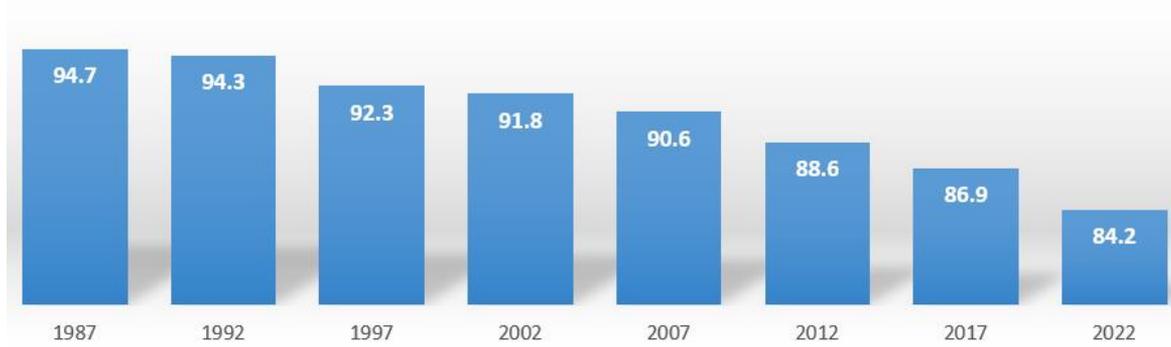


Figure 1. Satisfaction with drinking water obtained from the faucet in Idaho homes based on surveys conducted in 1987, 1992, 1997, 2002, 2007, 2012, 2017 and 2022

Table 2. The impact of demographic factors on Idahoan satisfaction with drinking water quality (DW satisfaction), surface water quality (Surface WQ) and groundwater quality (Groundwater) based on surveys conducted in 1987, 1992, 1997, 2002, 2007, 2012, 2017 and 2022

Water Issue	Demographic Factor	Best	Worst	Sign.
DW Satisfaction	Gender	Male	Female	**
	Age	>70 years	<30 years	**
	Education	3+ years college	< HS diploma	**
	Community size	20,000 to 40,000	>100,000	**
	Part of state	North	Southwest	***
Surface WQ	Gender	Male	Female	**
	Age	>60years	<40years	**
	Education	2+ years college	< HS diploma	**
	Community size	> 40,000	<3,500	**
	Part of state	North	Southwest	***
Groundwater	Gender	Male	Female	**
	Age	>60 years	<30 years	**
	Education	3+ years college	< HS diploma	**
	Community size	>40,000	<3,500	**
	Part of state	North	Southwest	***

Note: ** and ***=significant at the 95, and 99% levels of probability within a water issue, respectively.

4.3 Surface and groundwater quality

The percentage of Idahoans that considered surface and groundwater quality to be good or excellent are shown in Figure 2. In general, trends indicated that the public believed that surface water quality improved over 35-years, while groundwater quality declined. Both the surface and groundwater quality observation trends were significant. Unlike with drinking water, the public was divided about their responses as there was never a majority of Idahoans who considered surface water quality good or excellent. Individual comments by survey respondents indicated that surface water quality ratings were often based by observations made by looking at rivers while crossing bridges while in motor vehicles. Consequently, rivers were considered to be the most important sources for observing surface water quality. On the other hand, public impressions about groundwater quality were more complicated. Because the public could not actually visualize groundwater to form an opinion about groundwater quality, they had to rely on media reports and coverage about environmental hazards such as leaking underground storage tanks. Also, depending on survey year between 10 and 24% of survey respondents had no opinion about groundwater quality. This contrasts to surface water quality ratings where less than 7% of the public did not have an opinion.

The demographic factors of gender, age, education level, community size and the geographic location of the consumer impacted opinions about surface and groundwater quality in

Idaho (Table 2). Demographics impacted survey respondent views on groundwater and surface water quality similarly. First, males thought that surface and groundwater quality was better than females. Second, residents that were at least 60 years old thought that surface and groundwater quality was better than younger people did. Third, people living in communities with more than 40,000 people thought that surface and groundwater quality was highest, while respondents in towns of less than 3,500 thought that both surface and groundwater quality was the poorest. Fourth, northern Idaho residents thought that both surface and groundwater quality was the best, while the fewest people in southwestern Idaho thought that surface and groundwater quality was good or excellent. Residents with 2+ years of college education thought that surface water quality was the best, while residents with 3+ years of college found groundwater quality superior to people without high school diplomas.

4.4 Actions to protect water quality and quantity

The Extension water resources program in Idaho placed an emphasis on public education to support voluntary citizen efforts as a mechanism to improve water resources. In every survey year voluntary efforts to protect water quality and water quantity were compiled.

Examples of voluntary actions citizens could take to protect water quality included: (1) better disposal of hazardous

household/yard wastes, (2) improved use of fertilizers/pesticides in the yard or chemicals in the home, (3) reduction in outside watering practices to prevent chemical leaching or runoff, and (4) proper disposal and use of automobile/truck used oil products. Trends related to voluntary actions to protect water quality are shown in Figure 3. In 1987 only 12.6% of Idahoans used an identified practice to protect water quality; however, by 2022 over 63% of surveyed respondents had voluntarily used one or more practices to protect water quality. This increasing trend to protect water quality by taking voluntary actions between 1987 and 2022 was statistically significant.

Demographic factors also impacted the frequency of taking voluntary actions to protect water quality (Table 3). Females were 1.5 times more likely than males to use a best practice to protect water quality. Idahoans less than 30 years old were most likely to use one or more practices to protect water quality, while residents older than 70 were least likely to take proactive action to protect water quality. Residents without exposure to college were least likely to take voluntary actions, while those with 2+ years of college were most proactive towards protecting water quality. Idahoans living in mid-sized communities (25,000 to 50,000) took the most voluntary actions, while residents of communities with less than 7,500 were least likely to take action. Northern Idaho residents were most likely to implement practices to protect water quality, while southeastern Idaho residents were least likely to use

voluntary practices to protect water quality.

Examples of voluntary actions residents could take to save water resources included: (1) installing in-home water-saving devices, (2) reducing water use in the home, (3) reducing outside (yard) water use, and (4) reducing water use when washing motor vehicles. Trends in the use of voluntary actions to save water are shown in Figure 4. In 2022 64% of Idaho residents had voluntarily used at least one water-saving practice compared to only 16.4% in 1987. The increasing trend to save water using voluntary practices between 1987 and 2022 was significant.

The demographic background of respondents impacted the frequency of taking voluntary actions to save water (Table 3). Females were much more likely to save water than males (52 vs 30%). Idahoans less than 30 years old were most likely to use one or more practices to save water, while residents older than 70 were least likely to take proactive action to save water. Residents that had attended college for 3+ years were most likely to save water. Conversely, residents with no college experience were least likely to implement practices to save water. Respondents living in mid-sized communities (25,000 to 50,000) took the most voluntary actions, while residents of communities with less than 7,500 were least likely to take action to save water. Northern Idaho residents were most likely to implement practices to save water, while southeastern Idaho residents were least likely to use voluntary practices to save water.

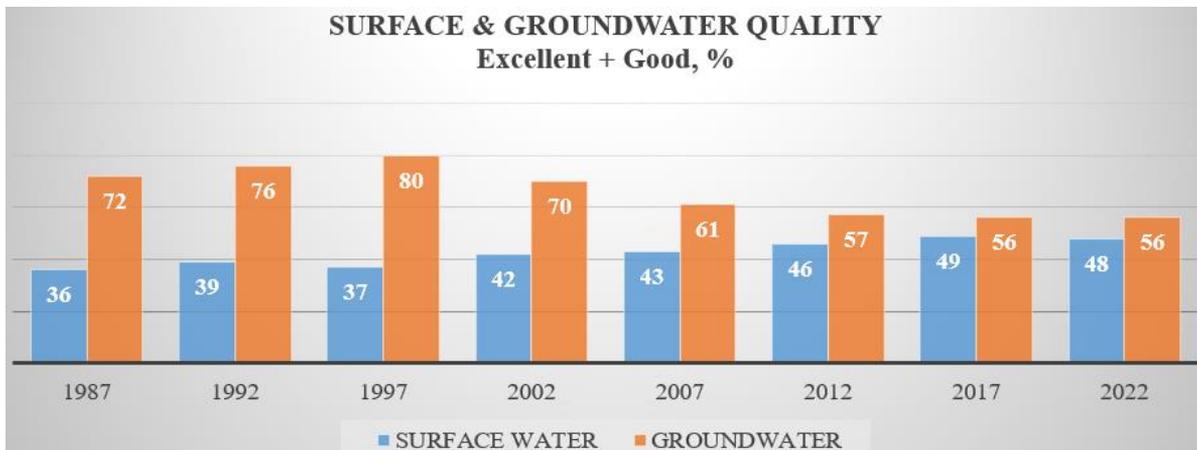


Figure 2. The percentage of Idahoans that found surface water quality and groundwater quality to be excellent or good based on surveys



Figure 3. The percentage of Idaho residents that took voluntary actions to protect water quality based on surveys conducted in 1987, 1992, 1997, 2002, 2007, 2012, 2017 and 2022

Table 3. The impact of demographic factors on Idahoans taking voluntary action (VA) to protect water quality (W QUAL) and water quantity (W QUANT) based on surveys

Water Issue	Demographic Factor	Most Action	Least Action	Sign.
VA- W QUAL	Gender	Female	Male	***
	Age	<30 years	>70 years	**
	Education	2+ years college	No college	**
	Community size	25,000-50,000	<7,500	**
	Part of state	North	Southeast	***
VA- W QUANT	Gender	Female	Male	**
	Age	<30 years	>70 years	***
	Education	3+ years college	No college	**
	Community size	25,000-50,000	<7,500	**
	Part of state	Southeast	North	***

Note: ** and ***=significant at the 95, and 99% levels of probability within a water issue, respectively.

4.5 Water resource learning opportunities

Information sources used by Idahoans over the last 35 years are shown in Table 4. These major water information resources have changed significantly since 1987. In 1987, newspapers (70%) and television (62%) were cited by respondents as major sources of water information in Idaho. However, by 2022 the Internet was the most water information source in Idaho, while the importance of newspapers (10%) and television had drastically declined. The trend of increasing Internet use for water resource related information over the last 35 years is significant. Conversely, the downward trend in the use of newspapers and television is also significant.

The use of fact sheets containing water-related information

was popular with at least half of Idahoans between 1987 and 2012; however, fact sheet use declined to one-third survey respondents since 2017. This observation is complicated by the fact that many people find information on the internet then download and print it – so in reality the Internet actually functions as a source of fact sheets.

It is interesting to note that public meetings and workshops were never significant sources of water-related information for Idahoans (Table 4). University of Idaho Extension has not historically had the reach that the Internet, newspapers and television had with survey respondents; however, Extension’s information reach is very strong with rural residents of the state.

Table 4. The percentage of Idahoans using learning opportunities about water resources over the 35-year survey study based on eight survey years in Idaho between 1987 and 2022

Learning Opportunity	1987	1992	1997	2002	2007	2012	2017	2022	Sign.
Newspapers	70	68	64	60	57	36	16	10	****
Television	62	59	57	52	48	44	19	16	***
Fact Sheets	50	50	46	57	59	50	36	35	**
Extension	22	20	21	22	16	18	13	14	**
Workshops	4	6	6	7	5	4	3	3	NS
Public Meetings	4	3	6	2	4	3	3	2	NS
Internet	2	6	8	12	16	34	60	71	****

Note: **, *** and ****=significant at the 95, 99 and 99.9% levels of probability within a learning opportunity, respectively; NS= not significant.

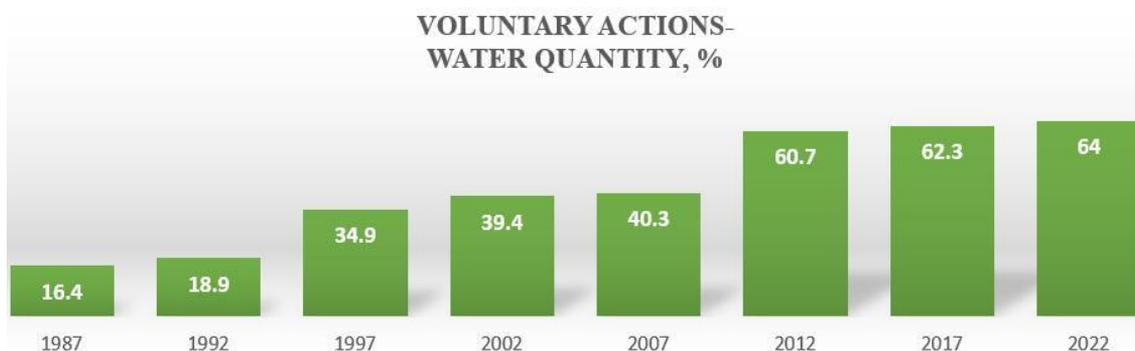


Figure 4. The percentage of Idaho residents that took voluntary actions to protect water quantity based on surveys conducted in 1987, 1992, 1997, 2002, 2007, 2012, 2017 and 2022

5. CONCLUSIONS AND RECOMMENDATIONS

This 35-year survey study showed that Idahoans are interested and involved in their water resources. The simple fact that over 50% of surveys that were mailed out to the public

were returned completed for each of the eight survey periods indicates a high level of public interest in water. The trends observed about responses to these issues over time reflect both increased public education about water resources and concern about how water resources are so essential for daily life in

Idaho. Most Idaho citizens would agree that water is the state's most important natural resource.

In 2022, over 98, 94, 93, 82 and 80% of Idahoans considered drinking water, groundwater, mountain snowpack, water for power generation and rivers/lakes (surface water) respectively, as very important issues. The public has considered these five issues as high priority for 35 years, however, mountain snowpack was viewed as more important in 2022 than in 1987. Conversely, water for power generation and water for agriculture have become less important over time. The quick pace of urbanization in Idaho over the last 20 years is probably related to this change in the public view.

A large majority of Idahoans were satisfied with the drinking water coming out of faucets in their homes. Satisfaction approached 95% in 1987, but declined to 84.2% by 2022. The fact that over 84% of Idahoans are satisfied with their home drinking water is excellent. The public is proud of drinking water protection and the relatively low level of water treatment in addition to what the Clean Water Act requires indicates that drinking water quality in the state is not a problem.

The percentage of Idahoans that took one or more voluntary actions to protect water quality increased from 12.6% in 1987 to over 63% in 2022. This is an excellent accomplishment that is largely related to school and adult education. The use of voluntary actions to improve water quality may be the most important accomplishment of this 35 years water outreach education program. The public is only luke warm about regulations to protect water quality; however, Idahoans have a strong belief in voluntary actions to protect water quality.

The percentage of Idahoans that took one or more voluntary actions to save water (water quantity) increased from 16.4% in 1987 to 64% in 2022. Because Idaho is a water-rich state, there has traditionally been little voluntary support for voluntary water conservation. Rapid population growth in the last decade has caused this voluntary shift that promotes water conservation and saving water.

Primary water information sources used by Idahoans have significantly changed since 1987. In 2022 the dominant information sources were the Internet (71%) and fact sheets (35%) written by the educational arms of public and private organizations. Public water information about water transformed from traditional agency publications to the Internet. Unlike in 1987 the public now knows how to find water information on the Internet.

From a demographic factor standpoint, Idaho males were more likely than females to say that they were satisfied with their drinking water and that surface and groundwater quality was good. Conversely, over the 35-year survey study Idaho women were more likely to take one or more voluntary actions to protect water quality and to save water.

This survey study was important because it allowed educators to understand public perceptions of water needs in Idaho. The survey results will help educators direct their water education efforts in Idaho over the next 10 years.

ETHICAL CLEARANCE

Ethical Clearance - The survey questions and surveys were approved by the University of Idaho Institutional Review Board.

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