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## Priority Drinking Water Issues in Hawaii

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## Priority Drinking Water Issues in Hawaii

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**Abstract:** Information that can be used to develop relevant drinking water Extension programs for Hawaii residents was collected in a 2010 survey. The major findings were: (1) over 85% of survey respondents feel that their home drinking water is safe for consumption, (2) 84% obtain their drinking water from public water suppliers while 12.2% rely on bottled water, (3) 72% are satisfied with their drinking water, and (4) drinking water quality is not uniform across the state as significant numbers of Maui residents either use bottled water or are dissatisfied with one of more aspects of their potable water.

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### Introduction

Drinking water and human health is one of seven priority Extension programming areas of the

national water resources program that has been funded by USDA-NIFA. In fact, water resources faculty at land-grant institutions are currently developing an eXtension set of modules that will provide significant drinking water outreach to the American public. Consequently, it is important for Extension professionals to have an understanding of drinking water issues from the consumer perspective. To be effective, drinking water educational programs need to have a basis in actual public perception and needs (Mahler, Simmons, Sorensen, & Miner, 2004).

Since 2000, USDA-NIFA has placed an increased emphasis on outcome-based Extension programming in water resources. In order to document actual outcomes instead of traditional outputs, it is important that baseline consumer knowledge be established at the beginning or early in the educational programming process. In addition, it is important to document information sources and learning opportunities that consumers want early in the educational process (Mahler, Gamroth, Pearson, Sorensen, Barber, & Simmons, 2010). In 2004 a needs assessments survey was conducted about water issues in Hawaii by the University of Hawaii with the purpose of understanding public awareness, attitudes, and actions about water resource issues and to provide baseline data for future needs (Castro, 2005). This article covers a 2010 follow-up survey that expanded on the original drinking water issues raised by Hawaii clientele in the last 6 years.

## Materials and Methods

A 57-question survey was designed in 2009 to assess public attitudes about water issues in Hawaii based on a model developed in the Pacific Northwest in 2002. The survey was designed to measure change in responses to questions included in the original 2004 Hawaii survey and to address additional issues. Seven survey questions about drinking water were used to evaluate the following: (1) primary source of drinking water, (2) use of in-home water treatment devices, (3) perception of home drinking water safety, (4) perception of home drinking water satisfaction, (5) common problems with home drinking water, (6) use and perceptions of bottled water, and (7) frequency of home drinking water testing. In addition, the following demographic information was collected from survey respondents: age, gender, community size, formal education level, island of residence, and length of time having lived in Hawaii.

Based on Experiment Station statistical advice, a target of 480 residents of Hawaii was set as the sample size population. Random residential addresses were obtained for the study.

Surveys were actually sent to 525 residents; however, 45 were returned by the post office as being undeliverable. Consequently, the actual sample population was the target of 480. The survey process was designed to receive a completed survey return rate in excess of 50%. If more than 240 surveys were returned completed, then sampling error could be assumed to be less than 5% (Dillman, 2000; Salant, & Dillman, 1994). Three mailings over a period of 2 months were used to achieve this return rate (Mahler, Simmons, Sorensen, & Miner, 2004).

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 (SAS, 2004). 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 (Babbie,

1983).

Where appropriate, answers to identical survey questions in the 2004 and 2010 surveys were compared. In these comparisons answers that varied by four% or less were considered statistically similar (Castro, 2005).

## Results and Discussion

The water issues survey achieved a return rate of 53.8% (258 out of 480). Seventy percent of the survey respondents were male. Forty percent of respondents lived in cities of 100,000 people or more, 28% in cities of between 25,000 and 100,000, 20% in towns between 7,000 and 25,000, and 14% lived in towns with less than 7,000. Approximately 50% of respondents reported living in Hawaii for their entire lives, 40% lived in Hawaii for more than 10 years, and 10% had lived in Hawaii for fewer than 10 years. One percent, 5, 11, 24, 27, and 32% of responding residents were between the ages of 15 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69 and more than 70, respectively. Ninety-six percent of respondents had received at least a high school diploma or its equivalent, with 50% claiming at least one college degree. The island distribution of the completed surveys was as follows: O'ahu- 69%, Hawai'i- 15%, Maui- 11%, Kaua'i- 4%, and Moloka'i- 1%.

Demographic responses, not including gender and age, were consistent with US Census data from 2000 (US DOC). Because of this, when considered with the low sampling error, respondents to this survey should be considered reflective of the residents of Hawaii. It should be noted that approximately 50% of the surveys were addressed to female residents even though males responded at a much higher rate. This same observation has been made in the other 41 states where similar surveys have been conducted.

### Primary Drinking Water Source

Eighty-four percent of survey respondents identified public water sources (county, city, or municipal) as their primary drinking water source. Another 12.2% indicated that bottled water was their primary source of drinking water. Over 2.4% of respondents used private supplies (catchment, ponds, streams), while three respondents did not know their source of drinking water.

The demographic factor of island of residence did have an impact on the primary source of drinking water in Hawaii (Table 1). Over three quarters of the respondents on all islands rely on public water supplies for drinking water; however, some island-to-island differences are apparent. First, on the two least populated of the islands evaluated, Kaua'i and Moloka'i, 100% of the residents rely on public supplies as drinking water sources. Second, private water supplies provided drinking water only on the island of Hawai'i, and then to only 13.8% of residents. The large rural population on this island with individual rainwater catchment systems, and ponds on private property accounts for this. Third, bottled water is popular or a necessity on some parts of the three most populated islands —O'ahu, Hawai'i, and Maui. Maui residents are almost twice as likely to use bottled water as are residents of the other two highly populated islands.

**Table 1.**

The Impact of Island of Residence on Primary Drinking Water Source Based on the 2010 Water Issues Survey Conducted in the State of Hawaii

Island of residence	Drinking water source			
	Public	Bottled	Private	Don't know
	%			
O'ahu	87.5	11.9	0.5	1.7
Hawai'i	75.0	11.1	13.8	0.0
Maui	80.0	20.0	0.0	0.0
Kaua'i	100.0	0.0	0.0	0.0
Moloka'i	100.0	0.0	0.0	0.0

## Drinking Water Safety and Satisfaction

Over 85% of surveyed residents thought that their home drinking water was safe to drink. Island of residence affected residents' perception of safe drinking water (Table 2). Residents of the more populated islands of Maui, Hawai'i, and Oah'u were more likely to think their drinking water was not safe to drink than residents of the smaller, less populated islands of Moloka'i and Kaua'i. This observation explains the relatively high use of bottled water on certain Hawaiian islands (Table 1). In fact, Maui, with the highest use of bottled water (20%), has the lowest percentage of people who think that their home drinking water is safe (68%).

**Table 2.**

The Effect of Island of Residence on Identifying Home Drinking Water Is Safe Based on the 2010 Water Issues Survey in Hawaii

Island of residence	Drinking water is safe, %
O'ahu	87.9
Hawai'i	81.6
Maui	68.0
Kaua'i	100.0
Moloka'i	100.0

Based on this 2010 survey, over 72% of residents are satisfied with their drinking water; however, at

least 14% indicate significant dissatisfaction. Even though almost three quarters of respondents were satisfied with their home drinking water, almost 40% have a home water filter (primarily on their sink). Another 6.6% of respondents have a separate home water treatment system. The demographic factor of respondent age affected the use of in-home water filters (Table 3). Respondents less than 50 years old were most likely to have a home water filter. Conversely, the use of an in-home water filter decreased with increasing consumer age.

**Table 3.**

The Effect of Respondent Age on the Use of an In-home Water Filter to Improve the Quality of Drinking Water based on the 2010 Water Issues Survey in Hawaii

Age of respondent	Using a home water filter, %
Less than 30	33.7
30 to 39	50.0
40 to 49	59.2
50 to 59	47.4
60 to 69	41.1
70 or older	26.5

### Bottled Water vs. Tap Water

Over 38% of Hawaii residents indicated they sometimes or often use bottled water for drinking purposes. Conversely, 22.5% of respondents never buy bottled water. People between the ages of 40 and 60 were more likely to use bottled water than respondents less than 30 or more than 60 years old.

When asked to compare bottled water with tap water, over 52% of respondents indicated no differences between them (Table 4). Proponents of bottled water over tap water cited safety (16.7%), quality (17.0%), and taste (27.1%) considerations. Similarly, proponents of tap water over bottled water also cited safety (8.1%), quality (6.6%), and taste/smell (7.4%) considerations.

**Table 4.**

Comparison of Bottled Water to Tap Water as a Drinking Water Source Based on the Water Issues Survey in Hawaii Conducted in 2010.

Comparison	Frequency, %
There are no differences between tap and bottled water	52.7
Bottled water tastes/smells better than tap water	27.1
Bottled water is of higher quality than tap water	17.1

Bottled water is safer than tap water	16.7
Tap water is safer than bottled water	8.1
Tap water tastes/smells better than bottled water	7.4
Tap water is of higher quality than bottled water	6.6

The demographic factors of age, length of residence in Hawaii, and island of residence had an effect on answers to bottled water questions. Older respondents (60 or older) were more likely to consider tap and bottled water to be similar (63%) than residents younger than age 50 (23%). This also explains why older residents are less likely to use bottled water.

Respondents who have been Hawaii residents for fewer than 5 years were more likely (72.7%) to say that bottled water either tasted or smelled better than did long-time Hawaii residents (24.8%). Island of residence also had an effect on how people compared bottled and tap water for drinking purposes. Respondents from the less populated islands of Kaua'i and Moloka'i universally indicated there was no difference between tap and bottled water. However, residents of other islands often indicated that bottled water tastes and/or smells better than tap water. Bottled water tasted/smelled better than tap water 24.0, 38.5, and 44.4% of the time on O'ahu, Hawai'i, and Maui, respectively. Again, this dissatisfaction translated into significant use of bottled water on these three islands, particularly on Maui.

## Water Testing and Contaminants

About 11.5% of survey respondents have actually had their own drinking water tested. Because of the Safe Drinking Water Act (SDWA) administered by the US Environmental Protection Agency, all drinking water from public supply sources in Hawaii is regularly tested. When the residents using bottled water (12.2%) are added in, virtually 98.8% of drinking water in the state has been tested and contains safe levels of microorganisms, inorganic chemicals, organic chemicals, radionuclide's, and suspended solids that are regulated by the SDWA.

When asked about the importance of certain aspects of their drinking water not regulated as primary standards, over 90% of residents thought taste, smell, appearance, and convenience, in addition to health concerns were important or very important (Table 5).

**Table 5.**  
Importance of Taste, Smell, Appearance, and Health Concerns when Choosing a Drinking Water Source based on 2010 Water Issues Survey in Hawaii

Parameter	Importance*			
	Very	Important	Somewhat	Not important
Taste	64.8	28.7	4.1	0.4

Smell	66.8	28.3	4.1	0.4
Appearance	65.9	29.3	2.9	0.8
Convenience	46.5	42.5	6.1	1.6
Health concerns	83.8	12.2	1.2	0.8
* Note: rows do not add to 100% because of some no opinion answers.				

When asked which characteristics respondents had experienced with their home drinking water in the past year, over 56% observed no objectionable traits (Table 6). Of the characteristics cited, unpleasant taste and hard water or mineral deposits were experienced most often. Unpleasant taste was not influenced by demographics; however, age did have an impact on experiencing hard water and/or mineral deposits. Here respondents less than 60 years old were two to three times as likely to be annoyed with hard water or mineral deposits than residents younger than age 50.

**Table 6.**

The Incidence of Experiencing Characteristics Regulated by Secondary Standards in Home Drinking Water by Hawaii Residents in the Previous Year Based on the 2010 Water Issues Survey in Hawaii (all public system responses)

<b>Parameter</b>	<b>Frequency, %</b>
No problems experienced	56.2
Hard water / mineral deposits	24.8
Unpleasant taste	17.1
Sediment	9.7
Unpleasant smell	6.6
Rusty color	5.4
Other contaminants	3.9

### **Comparison of 2004 and 2010 Survey Responses.**

Based on statistical advice, when comparing the survey response data for identically worded questions from 2010 to that obtained in 2004, numbers that differed by less than four response points were considered statistically identical. In 2004 and 2010, 89 and 85% of survey respondents considered their home drinking water safe to consume, respectively. Because the two values did not differ by more than 4% the drinking water safety, response answers were similar in both years.

Only a portion of the drinking water questions contained in the 2010 survey was identical to

questions in the 2004 survey. However, questions posed about specific home drinking water systems were identical, and thus the answers could be compared over time (Table 7). Using the 4% guideline for comparison a majority of answers about home drinking water systems did not change in the last 6 years. There are three differences, however. First, the use of in-home water softeners has increased from 2 to 7%. Second, the use of in-home water filters (primarily on the sink) has increased from 28 to 40% of homes. Third, fewer people are dissatisfied with their home drinking water in Hawaii today (20 vs. 14%). Based on the comparison of 2004 and 2010 answers, the only significant change that has taken place in 6 years is that the public is more likely to have home treatment devices (softeners, filters) today.

**Table 7.**  
Comparison of 2004 and 2010 Survey Answers about In-home Drinking Water Systems in Hawaii

Parameter	2004	2010
	%	
I have a water treatment system (water softener)	2	7
I have a water filter (sink)	28	40
I purchase 5 gallon containers of drinking water	6	5
I often use bottled water for drinking purposes	40	38
I never buy bottled water	21	23
I am satisfied with my home drinking water supply	74	72
I am not satisfied with my current drinking water	20	14
My drinking water is separate from my water supply system	4	5

## Conclusions

Respondents overwhelmingly indicate that drinking water is important, so programs addressing drinking water should be well received. Effective programs will have to take into account local scientific data about drinking water in addition to perceptions found in our survey to effectively address educational needs. The key findings of this survey are as follows.

- Over 84% of Hawaii residents get their drinking water from public sources.
- 12.2% of Hawaii residents rely on bottled water for drinking purposes; Maui residents are twice as likely to use bottled water as residents of other islands.
- 85% of Hawaii residents feel that their water is safe to drink; Maui residents rate water safety

the lowest, at 68%.

- Over 72% of Hawaii residents are satisfied with their drinking water.
- 38% of Hawaii residents sometimes use bottled water; however, 52.7% see no difference in quality between tap water and bottled water.
- 11.5% of Hawaii residents have had their drinking water tested; however, when public supplies and bottled water are taken into account over 98% of drinking water has been tested.
- Most residents have no complaints about their drinking water; however, 24.8% cite hard water and 17.1% cite bad taste as problems.
- Based on the comparison of 2004 and 2010 answers to identical survey questions, the only change that has taken place in 6 years is that the public is more likely to have home treatment devices (softeners, filters) today.

An important finding of the survey reported here is that drinking water quality, whether perceived or real, is not uniform across the five major islands of Hawaii. Based on survey results, the limited amount of educational resources available to Extension should be focused on drinking water quality on the island of Maui. Many of the other Extension drinking water needs could perhaps be met by placing specific information on the new eXtension website.

In addition to these important findings for the state, Hawaii is one of 42 states and six territories that have conducted Extension-led water issue surveys of the general public since 2002. Hawaii is one of the first states to report on survey results conducted over a 5-year period (2004 and 2009). This data should be of tremendous importance to water educators at land-grant institutions across the U.S. This Hawaii data can be compared with data from other states, and the lessons learned in Hawaii may help improve drinking water educational efforts elsewhere. Consequently, the results of this article may have a significant national impact.

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