

AN INVESTIGATION OF WATER USAGE IN CASUAL DINING RESTAURANTS IN  
KANSAS

by

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B.S., Kansas State University, 1995

M.A., Emmanuel College, 2008

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Hospitality Management and Dietetics  
College of Human Ecology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

2011

## Abstract

Water is essential for many aspects of daily life including restaurant operations and is necessary for generation and service of properly produced, safe food. However, water is becoming more scarce and expensive due to climate change, infrastructure needs, governmental budget constraints, and shifting water sources. The purpose of this study was to develop benchmarks for water usage and costs for casual dining restaurants (CDRs) in Kansas and identify demographics that may impact water usage and costs.

The population for the study was the 952 CDRs in Kansas. Stratified random sampling selected 60 restaurants from five Kansas demographic regions. Data were collected from the local municipal water utilities, Kansas Department of Revenue, Google's Place Page, and through telephone or on-site interviews with a manager.

Results for 221 of 300 (74%) CDRs that responded indicated that on average 1,766 gallons of water were used each day per restaurant, 12.79 per gallons per day for each seat, 68 gallons per employee, and 0.73 gallons per interior square foot. These results were as much as 69% lower than those from a 2000 study conducted by Dziegielewski et al. Significant demographics that impacted water consumption were season of year, population ( $F= 9.763$ ,  $p \leq .001$ ), menu ( $F= 2.921$ ,  $p \leq .035$ ), type of ownership ( $F= 56.565$ ,  $p \leq .000$ ), water source ( $F= 10.751$ ,  $p \leq .032$ ), irrigation ( $F= 46.514$ ,  $p \leq .001$ ) and days open ( $F= 6.085$ ,  $p \leq .000$ ). A stepwise linear regression model ( $F= 33.676$ ,  $p \leq .000$ ) found ownership ( $\beta= -.329$ ,  $p \leq 0.000$ ), irrigation ( $\beta= -.290$ ,  $p \leq 0.000$ ), and population ( $\beta= -.176$ ,  $p \leq 0.003$ ) impacted water consumption.

For water costs, CDRs paid an average of \$6.54 per 1,000 gallons of water consumed and had mean annual expenses of \$5,026 on revenues of \$2,554,254 which was the equivalent of a water cost percent of 0.42. Demographics that impacted water costs were season of year, region

( $F = 3.167$ ,  $p \leq 0.015$ ), and water source ( $F = 4.692$ ,  $p \leq 0.032$ ). However, a stepwise linear regression model ( $F = 4.485$ ,  $p \leq 0.036$ ) found only water source ( $\beta = -.152$ ,  $p \leq 0.036$ ) was an indicator of the percentage of revenues related to cost of water.

This study did identify benchmarks for water consumption and water costs that can be used in the future by restaurateurs. The primary limitations of the study were that results can only be generalized to casual dining restaurants in Kansas. Future studies can be conducted with different types of restaurants in Kansas and with CDRs in other areas.

**Keywords:** *water usage, casual dining, water cost, water benchmark, restaurant*

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Major Professor  
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This study did identify benchmarks for water consumption and water costs that can be used in the future by restaurateurs. The primary limitations of the study were that results can only be generalized to casual dining restaurants in Kansas. Future studies can be conducted with different types of restaurants in Kansas and with CDRs in other areas.

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## ACKNOWLEDGEMENTS

Completing a PhD has been the most difficult task I've ever undertaken that I can say I have accomplished. I am very thankful to have the support system that I have. I want to thank my wife Abby who has been a constant, a friendly ear and calming smile that would soften the discouraging times; my Mom and Dad for patience and constant encouragement in the endeavor. If it weren't for my parents, Abby, my family, and Abby's family then I would not have finished my PhD.

Dr. Betsy Barrett has been my lighthouse throughout the process. She has been the one to keep me on task; asking questions that allow me to answer my own questions, pushing deadlines, and being an incredible mentor as I learn to write academically. Without her this dissertation would not have been possible. Thank you to my committee who have been supportive, accessible, and mentors. Dr. Gould, Dr. Roberts, and Dr. Niehoff: Thank you!

The HMD faculty and fellow graduate students have been positive role models throughout the process. I am thankful for all their help, calming abilities, and ability to make situations manageable and humorous when sharing time in Justin 152. Jayne, Jesi, Kelly – thank you for your ears, the coffees, and letting me throw a lot of frustration at you.

To Mr. Pesci and Dr. Gould – both of you are huge parts of where I am today. Your ability to push me, guide me, hound me, and expect so much more from me as one of your undergraduate students has shown me that I am capable and can accomplish anything I attempt. Mr. “you can do better” Pesci, I am proud to say that I was your flavor of the month for at least a full year of my undergraduate experience at KSU. Thank you both.

## CHAPTER 1 - INTRODUCTION

Fresh water is necessary for all aspects of human life (Centers for Disease Control and Prevention [CDC], 2010; 2011a; 2011b). Approximately 2.5% of the water found on Earth is considered fresh water, of which 66% is frozen in arctic poles and glaciers throughout the world (National Geographic, 2010). Only 0.3% of the total water on Earth is available for human use (Hughes, 2009) and this is obtained from the Earth's surface in the form of rivers, lakes or as groundwater from wells (United States Environmental Protection Agency [EPA], 2011d; 2011e).

Water is not only essential for human life, it directly affects a people's economic and environmental health. Available water resources permit sustainable agriculture, industrial development, and electrical generation. These economic factors create jobs and higher standards of living (World Water Assessment Program, 2009).

### *Water Usage in the United States*

In 2005, 410 billion gallons of water were used each day in the United States, 11% of which went to supply the public. This amount remained constant from 1995 to 2005 even though the population grew (Kenny et al., 2009).

Climate can affect water availability by regions. In the U.S. the Eastern, Midwestern, and Northwestern states have plentiful surface and groundwater resources (Bullock, Cosgrove, van der Hoek, & Winnepenny, 2009). However, by 2050, access to water is expected to be challenging and water supplies for Southern California, Arizona, the Florida panhandle, and the Mississippi river valley through Arkansas are expected to be severely impacted (Nelson, Schmitt, Cohen, Ketabi, & Wilkinson., 2007; Spencer & Altman, 2010). Other areas affected by groundwater levels are a concern because water levels in aquifers, the primary water sources for

Nebraska, Kansas, Oklahoma, Texas, and Eastern New Mexico, are decreasing (Kansas Water Office, 2010a; Opie, 1993). The High Plains aquifer, supplying more than 77% of Kansas' water (Kenny et al., 2009) and includes the Ogallala, Equus Beds, and Great Bend Prairie, has declined by more than 150 feet in three Kansas counties and more than 100 feet in 16 counties between the 1930's to 2000 (McGuire, 2007).

Another concern is the cost of water. In the last five years, the cost of water has increased faster than inflation (National Restaurant Association [NRA], 2011a) and is expected to continue to rise (EPA, 2003, 2010f). Factors impacting the future cost of water include decreasing access to water sources (Kansas Water Office, 2010b; Opie, 1993) causing source shifts (Gleick & Adams, 2000), the replacement and expansion of water infrastructure (EPA, 2003), climate change effects (Nelson et al., 2007; Spencer & Altman, 2010), the shift to actual cost pricing (EPA, 2003), and the increasing cost of electricity (EPA, 2011c; U.S. Energy Information Administration, 2010). Nelson et al. (2007) argue that climate change effects increase when change in water use is combined with factors such as land-use changes, water contamination, environmental protection, and population changes. The economics of the available supply of water versus expected demand indicate the price for water will continue to increase.

Water infrastructure in much of the U.S. is nearing, or has passed, its useful life (EPA, 2003). The EPA (2002) found a shift of water pipe age moving from 60% being rated better than fair in 2000 to only 44% in 2020. This is expected to become worse because many waste treatment plants were constructed in the 1970's and are nearing the end of their budgeted lives (EPA, 2002). Additionally, a United States General Accounting Office 2002 report found that only 15% of the drinking water utilities and 14% of wastewater utilities anticipated adequate funding to meet deferred maintenance needs after their 2001 budget year. The costs of increased



infrastructure requirements are expected to be passed along to the end consumer (EPA, 2003). In Manhattan, Kansas, for example, water rates increased 29% in the past three years in order to pay for infrastructure replacement and expansion (Hayan, 2010; Pugh, 2010).

### ***Water Usage in Kansas***

In Kansas, groundwater, water from aquifers and wells, accounted for almost 78% of the 3.79 billion gallons of water used each day and irrigation of 3.12 million acres required at least 2.74 billion gallons of water per day (Kenny et al., 2009). Kansas municipal water supplied 403 million gallons of water per day for residents and businesses (Kenny et al., 2009). In Eastern Kansas, surface waters (i.e. rivers, reservoirs, and lakes) are the primary sources of water (Kansas Water Office, 2010a). For Western and South-central Kansas, the High Plains aquifers supply the regional economy enough water for irrigation, drinking water, cattle operations, and industrial purposes (Kansas Water Office, 2010a, 2010b).

With the expected climate change and the amount of water withdrawals, only 16 of Kansas's 105 counties are predicted to have adequate water supplies by 2050 (Spencer & Altman, 2010). Of primary concern are the western two-thirds of Kansas which help sustain 25% of U.S. farming production (Gurdak, McMahon, Dennehy & Qi, 2010) and rely almost completely on aquifers.

### ***Water Usage in Restaurants***

Water is essential for a restaurant's preparation, production, sanitation, service, and cleaning. Dziegielewski et al. (2000) reported that restaurants use an average of 16 gallons of water for each meal served. According to the NRA (Riehle, Grindy, & Altman, 2010) there were approximately 47.45 billion customers in America's restaurants in 2010. Understanding and

decreasing water consumption in restaurants offers potential water savings for municipalities and water expenses for the operations themselves.

There is little research on water usage in restaurants (Alonso, 2008; Alonso & Ogle, 2010; Revell & Blackburn, 2007). One study that was conducted for the American Water Works Association analyzed the amount of water used in restaurants (Dziegielewski, et al., 2000). In researching 87 operations from California, Colorado, and Florida, Dziegielewski et al. found, on average, each restaurant used more than 2.8 million gallons of water annually; translating to 7,700 gallons daily. When not including the water used for irrigation restaurants consumed 7.64 gallons of water for each meal served.

Gleick, Srinivasan, Henges-Jeck, and Wolff (2004), in a segmented meta-analysis of water use throughout California, indicated that 6% of total water usage in the commercial and industrial sectors was in kitchens, with restaurants being the largest user in this sector. This water was designated only for preparation, cooking, and sanitation and did not include water for serving to customers, bathrooms, or outdoor use. Dziegielewski et al. (2000) found the areas of largest use were sanitation (approximately 50%), followed by preparation, cooking, and ice machines. Gleick et al. (2004) posits that implementing water efficiency techniques could save 37% from the 53.1 billion gallons used in California kitchens and restaurants in 2000, more than 19.54 billion gallons of water.

The cost of water for restaurant operation is relatively unknown compared with other operating costs. The NRA's Conserve website (2011b) estimates that energy is 30% of a building's yearly operating costs and that restaurants use 500% more energy per square foot than a normal commercial building and 2500% more per square foot in the kitchens. Energy use is directly correlated with the amount of water consumed (American Hotel and Lodging

Association, 2001; NRA, 2011a; EPA, 2011f). Costs include heating water, chemicals, and sanitation. The California Energy Commission states that the true cost of supplying water requires more than 19% of the state's electricity, 30% of the state's natural gas, and upwards of 88 million gallons of diesel fuel (Nelson et al., 2007). Governments and municipalities subsidize these costs or they are passed directly to the consumer (Björklund et al., 2009)

## **STATEMENT OF THE PROBLEM**

The increasing cost of water is a growing concern for the NRA because water rates increased faster than inflation in the last five years and are forecasted to continue to increase (2011a). In order to combat increasing water costs, areas of water consumption are becoming scrutinized by the industry (American Hotel and Lodging Association [AHLA], 2006, 2009) and by water efficiency programs such as WaterSense and Energy Star (EPA, 2011b, 2011f, 2011h). However, the amount of water used in restaurants today is unknown. The last and only study analyzing restaurant water use was published in 2000 (Dziegielewski et al., 2000). There is anecdotal evidence that water use has decreased with the introduction of water reducing aerators, sprayers (EPA, 2011g), and heavy equipment such as dishwashers and steamers (EPA, 2011a). Beyond the introduction of water saving equipment there is no current data discussing actual water consumption or savings in restaurants.

## **JUSTIFICATION**

In-depth research is required to understand how much water is used in restaurants. The development of water use benchmarks and the influences of demographic variables allow operations to define characteristics of their water use. This information can assist restaurateurs to develop effective and efficient water reduction methods, thereby reducing their water related

expenses. Understanding benchmarks and using them to reduce water consumption will create long-term cost savings, implement greater efficiencies, preempt possible government regulation, and better prepare operations for the possibility of increased water scarcity.

Casual dining restaurants (CDR's) were the focus of this study because they use more water than quick service restaurants (Dziegielewski et al., 2000). They also comprise 38.5% of the restaurant population and are responsible for 44.4% of the foodservice segment's annual sales (United States Census Bureau, 2007).

## **PURPOSE**

The purpose of this study was to develop benchmarks for water usage and costs in casual dining restaurants in Kansas.

## **OBJECTIVES**

The research objectives were:

1. Develop benchmarks for water usage in casual dining restaurants.
2. Identify demographic characteristics that correspond with water use.
3. Determine if there are differences in water use based on operational demographics.
4. Explore how demographics influence water use.
5. Develop a benchmark for water costs as a percent of revenues.
6. Identify demographics that impact percent water expense.

## **RESEARCH QUESTIONS**

The following research questions addressed were:

1. What is the average water used, in gallons, for each dollar of revenue?
2. What is the average water used, in gallons, for each restaurant seat?

3. What is the average water used, in gallons, for each restaurant employee?
4. What is the average water used, in gallons, for each interior square foot?
5. What is the average water used, in gallons, for each dollar spent on water and sewer?
6. What is the average percent water expense for casual dining restaurants in Kansas?

Each benchmark was further studied to determine if there were differences based on eight demographic variables. The following demographic variables were compared to more thoroughly explain water usage in casual dining restaurants in Kansas.

- D<sub>1</sub>: Season
- D<sub>2</sub>: Region within Kansas
- D<sub>3</sub>: Metropolitan, micropolitan, or other location
- D<sub>4</sub>: Menu type/style
- D<sub>5</sub>: Ownership
- D<sub>6</sub>: Water source (aquifer/surface)
- D<sub>7</sub>: Irrigated landscaping
- D<sub>8</sub>: Days open
- D<sub>9</sub>: Water reduction equipment
- D<sub>10</sub>: Manager knowledge of water expenses

### **LIMITATIONS OF STUDY**

Only CDR's in Kansas were used for this study. Results cannot be generalized to other types of foodservices including quick service, fine dining, bars, or cafeteria style operations. Additionally, results cannot be generalized outside of the state of Kansas. This study only attempted to determine the amount of water used versus specific benchmarks and did not attempt to determine methods to reduce water consumption in operations.

This study was designed utilizing the only published research on water use in restaurants. Additional benchmarks, not yet determined, may be better able to explain water use.

## **SIGNIFICANCE OF STUDY**

This study continued Dziegielewski and other's (2000) analysis of water usage in restaurants by focusing on the casual dining segment. This study expanded and updated the knowledge on how much water is used in restaurants. To determine effective methods for significantly decreasing water usage in CDR's, we must first understand how much water is used.

Costs associated with water in the U.S. are expected to increase due to climate change, actual cost pricing, source shifting, infrastructure requirements, and increasing energy costs. More than 85 Kansas counties are forecasted to suffer from moderate to severe water stress by 2050 (Spencer & Altman, 2010). This study created a foundation from which the measurements of effective water reduction, thereby cost reduction methods are possible. Only with this foundation can it be determined if equipment, education, supervision, or other methods are able to significantly decrease water use in casual dining restaurants.

## **DEFINITION OF TERMS**

**Aquifer:** An aquifer is an underground deposit of permeable sediment that water is able to be pumped in measureable quantities (Kansas Geological Survey, 2007).

**Casual Dining Restaurant:** A restaurant when table service is provided, alcohol is available, and the average check is between \$10 and \$20 per person (McClosky, 2010).

**Groundwater:** Water that occurs below the ground and is brought to the land surface by wells or springs (Viessman, 2010).

**Surface Water:** Water that remains on the Earth's surface, such as streams, lakes, and wetlands (Viessman, 2010).

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## **CHAPTER 2 - REVIEW OF LITERATURE**

Water is a necessity in the generation and service of properly produced, safe food (Lifewater International, 2010). Often considered as a cost of doing business, water has become more expensive (National Restaurant Association [NRA], 2011c) and future costs are expected to continue to increase (Gleick & Adams, 2000; U.S. Environmental Protection Agency [EPA], 2011i). The objectives of this study were to: develop benchmarks for water usage in casual dining restaurants; identify demographic characteristics that correspond with water use; determine if there were differences in water use by demographics; explore how demographics influence water use in CDR's in Kansas; and create a new benchmark based on revenues and water expenses. This review of literature discusses water as an integral element throughout the world, water usage in the United States, Kansas, hospitality, and restaurants, the importance of sustainable water use, why the cost of water is increasing, and relevant findings.

### **WATER**

Water, as comprised of the elements of two parts hydrogen and one part oxygen, has value beyond its scientific name. It comes in solid form as ice, liquid as water, and gas as vapor (Department of Atmospheric Science, 2010). Water is found naturally on the Earth as salt water, acidic and alkaline water, and fresh water. The hydrologic cycle allows water to constantly replenish itself (United States Geological Survey [USGS], 2011b) making it, theoretically, always available (Hughes, 2009). Water is a resource which can be recycled many times before it is released into rivers.

Fresh water is necessary for all aspects of human life (Centers for Disease Control and Prevention, 2010). Approximately 2.5% of the water found on Earth is considered fresh water, of

which 66% is frozen in arctic poles and glaciers throughout the world (National Geographic, 2010). Only 0.3% of the total fresh water on Earth is available for human use (Hughes, 2009) and is obtained from the Earth's surface in the form of rivers, lakes or as groundwater from wells (USGS, 2011b).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) states that there is a correlation between the availability of water and access to sanitary living conditions, stability of the political infrastructure, capacity of industrial development, access to education, job creation, and regional agricultural sustainability (World Water Assessment Program, 2009). UNESCO directly correlates access to clean water with the ability of a population to sustain itself in a healthful manner (World Water Assessment Program, 2009). The availability of fresh water resources is dependent on several factors including geographic location, landmass features, regional climate, population density, pollution controls, and typical water usage (Connor & Rast, 2009b).

## **GEOGRAPHY**

Geographically, countries located closer to the Northern and Southern polar ice regions and countries found at high altitudes contain more water on a per-person basis. These countries include Canada, Iceland, New Zealand, and Bhutan where the colder climate and altitude allows for freshwater to be held in the form of ice. Additionally, due to their locations, these countries have a smaller population because the climate is prohibitive to many people's lifestyles (Vörösmarty, 2009). Conversely, countries with a mild or moderate climate are more likely to have a larger population or a higher population density increasing the possibility of water stress. This is evident in sub-Saharan Africa and South Asia where the freshwater available is less per-person (Björklund et al., 2009c).



Geographically, there are many places in the world that do not have enough freshwater (Bullock, Cosgrove, van der Hoek, & Winnpenny, 2009). Much of Africa, Australia, India, Arabia, and Southwestern North America suffer water stress due to desert-like climates. China, Southeast Asia, and the Korean peninsula experience water concerns because of pollution and population density. Europe and regions containing population and industrial centers may have water stress occur due to population density.

Climate affects the availability of water regionally across larger countries. In the U. S., for example, the Eastern, Midwestern, and Northwestern states have plentiful surface and groundwater resources for their populations (Bullock et al., 2009) yet the Southwestern and desert areas of Nevada, Arizona, New Mexico, Utah, and Texas, and urban areas such as Los Angeles must import water to satisfy their needs. In countries located within a similar climate, such as Congo, Belize, or Vietnam, the climate is such that there is enough surface (river) water available to meet the population's requirements (Molle & Vallée, 2009).

## **WATER AND THE SOCIAL ENVIRONMENT**

Mohamed Bouguerra (2005) discusses the significance of water in Islam, Christianity, and Judaism as a purification or cleansing instrument used for prayer, baptism, and/or ritual purification. Ancient Greek society considered water one of the primary elements of the universe and it remains a symbol used in many current customs (Bouguerra, 2005). The United Nations, too, recognizes that water is essential for human life, sanitation, and is a key ingredient in the elimination of poverty (Inter-Agency Task Force on Gender and Water [GWTF], 2006; World Water Assessment Program, 2009).

The United Nations considers access to enough fresh water a basic human right (World Water Assessment Program, 2009). Approximately one-fifth of the world's population lives in

areas where the availability of fresh water is limited (World Health Organization, 2007). The means to get fresh water is correlated with increased capacity for development. Access to fresh water allows for better sanitation, more affordable food (Connor & Rast, 2009b), decreased environmental degradation, and increased quality of life for women, girls, and families (GWTF, 2006).

For this to occur in some countries, the water laws and rules may need to change. The GWTF asserts that globally, many countries require a citizen to own land before they have the right to access ground and/or surface water (2006). Property rules are especially evident in developing countries and are correlated with the ability of a family to feed itself (GWTF, 2006) through agricultural means.

In developing countries, the U.N. is focusing on the role of women in society. Women provide a central role in family survival. GWTF maintains that in poor and developing regions women are responsible for producing upwards of 80% of their family's food (2006). Further, GWTF asserts that improving access to water allows more opportunities for women and girls to pursue education and to better provide for the family (2006).

## **WATER AND THE ECONOMIC ENVIRONMENT**

Water is not only essential for many aspects of daily life, it directly affects a people's economic and environmental health. Available water resources permit sustainable agriculture, industrial development, and electrical generation which, in turn, create jobs and higher standards of living (World Water Assessment Program, 2009). Essential to water and the economy is its infrastructure and its impact on industry, agriculture, and power generation.

## ***Infrastructure***

Infrastructure plays a key role in providing water. Drought conditions can be abated when the proper infrastructure to import water is able to satisfy a region. Water infrastructure requires engineering capacity and the equipment to develop, install, and operate components. Countries which have this ability have a high correlation with water availability in homes and businesses (International Institute for Population Sciences, 2009). In the U.S., for example, more than 99% of households have water pumped into their homes (USGS, 2011c; EPA, 2011f). India, in contrast, has approximately 25% of households plumbed for water (International Institute for Population Sciences, 2009).

Water availability for populations and for industry is more efficient through a developed infrastructure (Björklund et al., 2009a). The ancient Greeks recognized this and built aqueducts to move water to where it would create the most benefit (Bouguerra, 2005).

Moving water is expensive even after the infrastructure has been developed. The U.S. Environmental Protection Agency (2011g) suggests that almost 4% of the electricity generated in the United States is used to clean and transport water. This cost allows for the encouraging and attracting of new industry and helps to improve efficiency of current operations (Jordan, 2011).

However, many developing countries do not have adequate financial or technical expertise for conventional infrastructure resources such as building dams or drilling wells (Viessman, 2010). For these countries, the World Bank has required that the water supply, including infrastructure, be privatized (Interlandi, 2010).

## ***Industry***

According to Jordan (2011) of Waterencyclopedia.com, water is critical for industrial and manufacturing development within a regional economy. Water, as a component in

manufacturing, may be used as an ingredient, lubricant, cleanser, sanitizer, solvent, transporter, or to assist with pollution control during the manufacturing process (Alliance for Water Efficiency, 2010; Kenny et al, 2009). Additionally, because water is the key ingredient in facility heating and cooling systems, lack of water for industrial functions restricts the capacity for additional job creation and development.

It is common, during early industrial development, for factories to locate close to an ample water supply (Jordan, 2011). Specific industries, which are heavy water users, include the production of chemicals, metals, and food, and in the refinement of petroleum products (Kenny et al, 2009). Access to fresh water is necessary for an industrial base to lower overall production costs (Jordan, 2011).

Today, corporations which depend heavily on freshwater have developed methods for increasing their efficient use of water. For example, Pepsi bottling plants have decreased overall water usage by more than 30% over three years. Pepsi no longer uses water to sanitize its bottles, instead using heated air (PepsiCo, 2010).

Beyond manufacturing, the structures to heat and cool buildings are integrating closed loop water systems (Dziegielewski et al., 2000). The same water is recycled with only evaporated loss being replenished. This introduction of more efficient equipment is decreasing water usage exponentially.

### ***Agriculture***

Water is a basic requirement for agriculture. When water is available countries are able to support themselves agriculturally (Connor et al., 2009). The ability of a population to feed itself lowers food related costs and increases quality of life. This allows populations to focus on developing other industries (Connor, et al., 2009). Agricultural needs in developing countries

may account for more than 80% of water use causing increased hardships and a lower quality of life (World Health Organization, 2007).

Efficiencies in agriculture continue to be developed. In industrialized countries rainfall is commonly monitored preventing over-irrigation. Kent Askren (personal communication, June 8, 2010) of Kansas Farm Bureau discussed several ways Kansas farmers are decreasing their water usage per acre harvested. Drip and subsoil irrigation is occurring in coordination with no-till farming practices. Spray irrigation has evolved so the sprayer heads are much closer to plants decreasing evaporation and the amount of pumped water. Methods continue to be investigated to increase efficiency. This includes farmers weighing the benefits of applying additional water versus the change in yields of crops (Askren, 2010).

### ***Power Generation***

Water is essential for the generation of electricity (Connor & Rast, 2009a). Water is heated and the steam produced is used to power turbines which, in turn, generate electricity. The principle is the same whether the fuel heating water is coal, nuclear, trash, or gas. The ability of a country to supply itself with electricity is critical in the development and running of industry (Connor & Rast, 2009a). Power plants are responsible for 49% of water consumption in the U.S. Water, in this process, is considered once-through (Kenny, et al, 2009) meaning after going through the generation process it is diverted back into local surface waters.

## **WATER AND THE POLITICAL ENVIRONMENT**

Water influences the stability of political and institutional environments of governments. Providing water inexpensively and continuously is associated with opportunity (World Water Assessment Program, 2009). When basic human needs such as food, shelter, and water are not

being met there is often political instability. This has been evident in Haiti. Even before the January 2010 Haitian earthquake, lack of water availability was considered an issue for the government (Guy, 2004).

The form and strength of a local or national government may be associated with the accessibility of water. The World Health Organization (2007) suggests water availability in developing parts of the world may be a source for greater amounts of political instability. Bullock et al. (2009) discussed the stabilization of situations in Somalia once broken irrigation infrastructure was replaced in 2006. This was also evident in Haiti prior to the recent earthquake in January of 2010 (Andrus, 2010). Uniquely, the type of government, i.e. democratic, communist, dictatorial, does not matter as long as the fundamental need for water is being met.

Governments which invest in developing local freshwater sources increase the likelihood of decreased health risks (Björklund et al., 2009a), poverty, and increase a population's security (World Water Assessment Program, 2009). It is common practice, worldwide, for water to be subsidized by governments because water is an essential ingredient in home life (Björklund et al., 2009d). The actual cost of supplying water is typically more than what is charged the final consumer. Moving towards charging the actual cost for sourcing and processing and passing the cost to the consumer may generate further turmoil for those who cannot afford it (Björklund et al., 2009b).

### ***Governmental Regulation***

#### ***Pollution***

Pollution, wastewater or runoff containing hazardous chemicals or pollutants, is capable of destroying water. Water containing too many chemicals, heavy metals, or pollutants prevents recycling and reuse. The United Nations states that countries may not utilize water in a manner

that interferes with the ability of another country to use it (Eckstein, 2010). Additionally, governments of most industrialized countries are mandating that water used in production be filtered and released into rivers meeting minimum standards (Björklund et al., 2009b). Those standards in the United States (EPA, 2011h; Environmental Quality Improvement Act of 1970, 91<sup>st</sup> Congress. 1970), Australia, and most of Europe requires water to be reused downstream as a fresh water source.

In countries which share water resources, such as the former Yugoslavia, ownership and water pollution are issues (Björklund et al., 2009b; 2009c). This may be the creation of a new type of drought, where water is plentiful, but contaminated to the point it cannot be made potable. Debates continue concerning water standards and quantities as it flows across borders into contiguous countries. Does Serbia, in the case of the former Yugoslavia, have a responsibility to provide treatable water before it crosses its national border into Bulgaria? Efficient usage of water in addition to water pollution influences the availability of water for population and industry within a geographic location.

### ***Government Standards***

In 1989, the Netherlands became the first national government to initiate comprehensive environmental legislation including pollution, water, and electricity controls in an attempt to limit environmental degradation (Bennett, 1991). The Dutch government chose to develop a holistic plan which included the participation of every sector of the national government and spread the implementation costs among industry, agriculture, consumers, and the government (Bennett, 1991). The goal of the Netherlands National Environmental Policy Plan (NEPP) was to decrease many types of pollution by more than 70% while expanding their economy (Steffan & AtKisson, 1995).

The NEPP created an environmental law police force with dedicated courts and prosecutors. NEPP made industry responsible for products brought to the market and mandated integrated lifecycle management, holding producers responsible for the remains of their products and the packaging after the end-user has finished with them (Steffan & AtKisson, 1995). It also required energy conservation, government investment into green technologies (especially wind), and a focus on public education programs. Steffan & AtKisson (1995) found the Dutch government creation of an MTV® (Music Television) style education program developed a brand more recognized than the most popular beer.

NEPP integrated industry into the national plan by giving companies targets and allowing them to decide how to reach them. This was very effective and the industrial sector responded approvingly to this method rather than government regulation determining how and when targets would be met. The industrial sector had met most of their targeted goals by 1995 (Steffan & AtKisson, 1995).

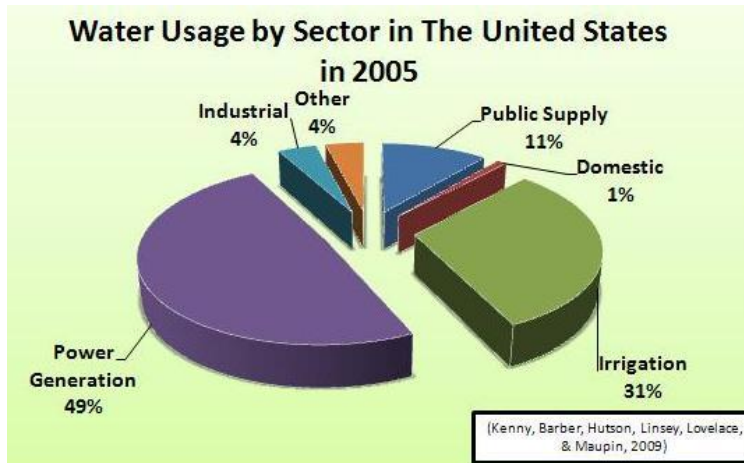
Following the Netherlands' program other European countries developed their own national plans. These included Belgium in 1989 and, in 1990, France and Great Britain (Bennett, 1991). In 1993 Europe developed a continental plan. This was prior to the creation of the European Union (Bennett, 1991). National plans have moved beyond Europe to Australia and New Zealand. The United States, at this point, does not have a national policy. Instead it mandates environmental controls from several federal agencies including the Environmental Protection Agency, Department of Energy, Department of Agriculture, and Department of Homeland Security (Environmental Quality Improvement Act of 1970, 91<sup>st</sup> Congress. 1970).



## WATER IN THE UNITED STATES

Daily water consumption in 2005 for the U.S. was 410 billion gallons (Kenny et al., 2009). The 2005 population of the United States was 301 million (U.S. Census Bureau, 2011c) translating into more than 1,362 gallons of water used for each American resident. The majority, 49%, of this water was for power generation, approximately 32% for agriculture, 11% for public water supply, and 8% for others (Kenny, et al., 2009) (Figure 2-2). Each resident uses an average of 100 gallons daily for personal use (National Geographic, 2010).

**Figure 2-1: Water usage in the United States in 2005**



### ***Government Oversight***

Institutionally the United States has multiple agencies at all levels which govern the safe supply of water to homes and businesses. The U.S. Environmental Protection Agency is the federal agency tasked with ensuring safe, potable water is available for Americans in homes and businesses. The EPA creates mandates that must be followed by states and municipalities regarding the minimal quality standards for drinking water and for water released back into the country's surface waters (EPA Office of Water, 2009). The EPA also sponsors education,

research, training, and grants geared at decreasing the use of water and maintaining water quality (EPA, 2011e).

Other federal agencies have responsibility for water including the U.S. Department of Agriculture and its National Water Management Center (NWMC) (2010). One of the NWMC's primary functions includes water resource planning and development of more efficient means of production (National Resource Conservation Service [NRCS], 2010). The USDA, in conjunction with the agricultural sector, assists with the maintenance and standards for the water runoff from irrigation (NRCS, 2005). The U.S. Department of Energy (DOE) monitors water for the production of electricity in the United States (DOE, 2010). The U.S. Army Corps of Engineers (ACE) oversees movement of commodities on America's waterways, building and maintaining the country's infrastructure, and protecting environmental sites along waterways (ACE, 2010). The ACE maintains many of America's reservoirs and uses that water allowing navigational rivers to remain open for barge traffic.

Although the EPA creates and regulates the minimum standards of water quality for consumers it is not responsible for processing and delivery of water to citizens (EPA Office of Water, 2009). Water supply and waste removal is delegated to states, tribes, and municipal districts. Should questions of water quality arise the state water office would be involved first, followed by review from the Environmental Protection Agency (EPA Office of Water, 2009).

### ***Water Law***

Water laws within the United States fall into four general categories of: Riparian; prior appropriation, absolute ownership, and combinations of these (Fort, 2010). Each state determines the laws governing water use but there are similarities based on geographic location (Pearson Prentice Hall, 2010).

Riparian water law states that water is allocated to owners via systematic means when they own land that water either flows through or next to (Fort, 2010). Its origins are in English Common Law and, geographically, it is the predominate law throughout the original colonies and along the Atlantic coast and Adirondack mountain range. Riparian water law is inclusive of both surface waters and ground waters.

Prior appropriation states that the first person who uses water for beneficial means has first rights to that water in the quantity they used (Fort, 2010). Water use under prior appropriation is not connected to land ownership with the water treated as a commodity which can be sold or mortgaged (Fort, 2010). Users with the earliest appropriation dates are able to take their full appropriation. This continues until all appropriators are satisfied or there is no more water available (Fort, 2010). Prior appropriation water law is found primarily in the Western United States from New Mexico northward and westward (Pearson Prentice Hall, 2010).

Many mid-continental states, primarily Oklahoma and Arkansas northward, are governed by water law which is a mixture of riparian and prior appropriation (Pearson Prentice Hall, 2010). This includes Kansas in which water is controlled through the Kansas Water Appropriation Act (Kansas Water Office, 2010a). Water in Kansas is governed principally by prior appropriation. This applies to agricultural, livestock, and large industrial users. These users are required to obtain a permit and report how much water they use annually. In Kansas, if not enough water is available, the state will not issue new permits. New permits are required to dig deeper wells, meaning if your well is dry you are not allowed to dig deeper (Barfield, 2010). Water generally supplied through municipal means does not apply to prior appropriation and a permit is not required (Barfield, 2010).

Absolute ownership is the law for the state of Texas. It states that all surface water is owned exclusively by the state of Texas. All groundwater is owned exclusively by the person who owns the land above it. Landowners are allowed to pump as much water from the ground as they would like even if it has negative consequences for the surrounding water table or communities. (Texas A&M, 2010)

### ***Drought***

The Palmer Drought Severity Index (PDSI), created by Wayne Palmer and used by The National Oceanic and Atmospheric Administration (NOAA) (2010), is an instrument used to map long term drought, or expected drought over many months. NOAA (2010) measures both meteorological and hydrological drought for the contiguous United States. According to the PDSI much of the Central Southwest and Gulf Coast, the Southwest, California, and the Pacific Northwest experienced drought like conditions from July 2009 through October of 2010 (NOAA, 2010). Areas affected include much of the desert Southwest, California, Texas, and inland from the Pacific in Northwestern United States.

Drought severity is influenced by the demand within a given area and whether enough water is available to serve the needs of that population. Although none of the United States could be classified as in a socioeconomic drought, many population centers struggle with enough accessible water. Areas such as Atlanta, Georgia; Las Vegas, Nevada; and Los Angeles, California suffer from trying to find a balance to serve the needs of the public, industry, and agriculture (Fishman, 2011).

Spencer and Altman (2010) maintain that expected changes in the climate within the United States will create a situation of moderate to severe drought affecting roughly 70% of the country before 2050. The portions of the United States minimally affected include the Northeast,

Mid-Atlantic, and the coastal Pacific Northwest. Availability of water to effected regions is forecasted to outstrip supply based on climate change, population density, and industrial and agricultural demand (Spencer & Altman, 2010).

### ***Infrastructure***

Water is at the center of the social environment in the United States. Water brings communities together in times of play, religious services, athletics, and entertainment (Bouguerra, 2005). The supply of water is rarely in question; when one turns on the faucet it is readily available. More than 99% of the Americans have water pumped directly into their homes of which more than 90% are served by municipal facilities (EPA, 2011f; USGS, 2011c). The infrastructure required to supply clean water and to process the returned grey and black water stretches for more than 1 million miles throughout North America (Brzozowski, 2010).

Water infrastructure in the United States is typically paid for on the local level by governments through no or low interest loans from the federal government, or by issuing state or municipal bonds (EPA, 2003). Because most water is provided through public local utilities, the primary responsibility for forecasting and infrastructure building takes place on the local level. This includes some municipalities that source water from private companies or wells (USGS, 2011a).

The U.S. is facing infrastructure needs in the next 50 years, upwards of \$465 billion according to the EPA's *Summary of Water Infrastructure Forum* (2003). However, according to Brzozowski (2010), the American Society of Civil Engineers expects America's water infrastructure to require more than \$2.2 trillion, or more than \$7,300 for each U.S. citizen, in new and replaced water conveyance equipment. The financial climate found in many municipal

districts has caused rating agencies to lower municipal debt ratings (Barringer & Henriques, 2010) creating higher costs associated with borrowing money for infrastructure.

The U.S. has the capability to replace infrastructure. However, there is doubt surrounding accessibility to low or no-cost funding for projects. Funding sources will continue to be available from federal grants or loans, public bonds, and by the water and sewer rates charged to households and businesses. It is this third option that concerns municipalities (EPA, 2003). Capital improvements in aged equipment and the expansion of current operations are becoming the financial responsibility of the end consumers and this amount is expected to continue to increase (NRA, 2011c; EPA, 2003). According to the National Restaurant Association's Conserve website (2011c) water rates have been increasing faster than inflation from 2005 to 2010. In Manhattan, Kansas, for example, water rates increased 15% in 2008, then an additional 7% in January of 2009 and 2010 and have been a common topic on the City Council's agenda for the past year (Hayen, 2010; Pugh, 2010).

### **Conservation in the United States**

The U.S., as a government, began increasing its concern for the environment in the late 1960's. The U.S. Environmental Protection Agency officially opened its doors in late 1970 and started mandating water requirements in 1972 under authority granted by Congress (EPA, 2011d). The environmental movement in the U.S. began prior to the formation of the EPA from grassroots campaigns throughout the 1960's (Freudenberg & Steinsapir, 1992) and continues today. EPA's targets included safe drinking water, wastewater release, acid rain, and resource conservation which kept hazardous waste from water sources (EPA, 2011e). The EPA continued to develop water priorities and requires minimal standards for the country by controlling

watersheds, source waters, non-point pollution sources, and assisting other federal, state and local agencies with managing land and water uses (EPA, 2011e).

The Environmental Protection Agency continues to be at the forefront of the federal government's response toward conservation. The EPA is the primary sponsor of WaterSense (2011k), a partnership between the EPA and water equipment manufacturers, users, and providers. The EPA certifies equipment or services and allows for the label to be used as a marketing instrument. Additionally, WaterSense is an educational tool for children of all ages (EPA, 2011j).

Energy Star, a joint program offered by both the EPA and the U.S. Department of Energy, is an educational and marketing tool focusing on the electrical and water usage of equipment, buildings, and homes (EPA, 2011a). Originally created with a focus on the electricity savings, it now includes water usage. The inclusion may be due to the use of fossil fuels and electricity required to heat water for commercial operations. According to the *Energy Management and Conservation Guide* (2001) from the American Hotel and Lodging Association (AH&LA), as much as 90% of fossil fuel use in a hotel may be from heating water.

The United States Green Building Council (USGBC), an independent foundation, offers Leadership in Energy and Environmental Design (LEED) certification (2010). According to the USGBC (2010), LEED is the creation or retrofitting of buildings meeting specifications for energy, atmosphere, materials and resources used, site planning, indoor environmental quality, and water efficiency. The certification is granted by meeting a minimum number of points on a 100 to 110 point possible scale (USGBC, 2010). Certification occurs at 40 points and ranges to platinum certification if more than 80 points are received.

LEED certification is an instrument that is driven by public perception and the ability for companies to market the certification toward potential customers and generates a return on investment in the potential future energy and water use within the building (USGBC, 2010). The new 2009 standards have a minimum specification of 20% less water usage over building to normal codes. Additionally buildings can expect to use an average of 26% less energy versus normal building and systems (USGBC, 2010).

From a public perspective, environmental movements continue to gain strength. There are many organizations which promote living in a more sustainable manner or ask for government to become more involved. Groups similar to The Sierra Club (Sierra Club, 2010), Friends of the Earth (Friends of the Earth, 2010), Greenpeace (Greenpeace.org, 2010), and others act as small communities for more sustainable living in the United States. The above groups act on water issues including cleanliness, quality, quantity, and how the resource is used.

## **WATER IN KANSAS**

### ***Kansas Aquifers***

The *Kansas Water Plan* focuses on three primary objectives: Implementation of stronger water management to reduce the level the High Plains Aquifer water is falling; developing sustainable yield management practices for areas outside of at-risk regions; and meeting minimum flow rates for the rivers Kansas shares with contiguous states (Kansas Water Office, 2010b).

According to the Buddemeier, Macfarlane, & Misgna (2010) an aquifer is an underground deposit of permeable sediment where water can be withdrawn in measureable quantities. The High Plains Aquifers hold water that has fallen as precipitation for thousands of



years and are considered fossil aquifers, a primarily non-renewable water source (Opie, 1993). The level of water in High Plains Aquifer has declined by more than 150 feet in three Kansas counties and more than 100 feet in 16 counties (McGuire, 2007). Of the water withdrawn from the aquifer, approximately 9% is replenished each year through naturally occurring precipitation (McGuire, 2007).

The High Plains Aquifers include the Ogallala, Great Bend Prairie, and Equus Bed aquifers and are located in south-central, southwestern, and northwestern Kansas (Kansas Geological Survey [KGS], 2007). These aquifers supply more than 77% of the annual water consumed in Kansas. Approximately 88.9% of the water drawn from the aquifers is used for agricultural purposes, followed by 5.4% for public supply, and 2.8% for livestock use (KGS, 2007).

### ***Kansas Surface Waters***

Kansas suffers water stress in different parts of the state from different water sources. The Neosho and the Marais des Cygnes River basins are approaching the point of demand going beyond supply in 2017 and 2012 respectively according to the Kansas Water Office (2008, 2010b). Water agreements with contiguous states allow Kansas to use only so much of the rivers' water.

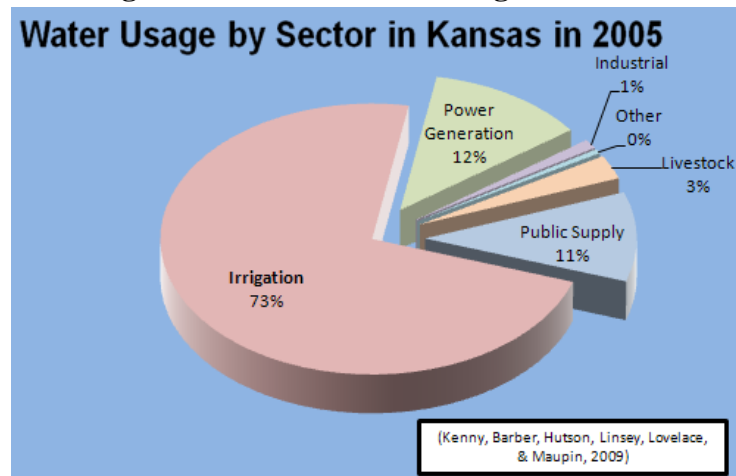
With the expected climate change and the amount of water withdrawals, only 20% of Kansas's 105 counties are predicted to have adequate water supplies by 2050 (Spencer & Altman, 2010). Approximately 85 Kansas counties will have water supply concerns with 60% predicted to have great difficulty in meeting water demand (Spencer & Altman, 2010). Of primary concern are the western two-thirds of Kansas which helps sustain 25% of United States farming production (Gurdak et al., 2010) and relies almost completely on aquifers.

## ***Water Sector Usage***

In 2005, the 2.74 million Kansas residents consumed an average of 3.79 billion gallons of water each day (Kenny et al., 2009). Groundwater, water from aquifers and wells, accounted for almost 78% (Figure 2-2) and surface water accounted for approximately 22% (Kenny, et al, 2009).

Irrigation of 3.12 million acres throughout the state required more than 2.74 billion gallons of water daily in 2005. The USGS (Kenny, et al, 2009) *Estimated Use of Water in the U.S. in 2005* asserts that this accounts for more than 72% of the water used in Kansas (Figure 2-

**Figure 2-2: Kansas water usage in 2005**



2). The Kansas Department of Agriculture (2008) estimates the average amount of water applied for irrigation was 85% of total water used in 2007. Of the 2.74 billion gallons of daily water consumed for irrigation, more than 2.6 billion gallons came from groundwater sources. More than 95% of this was from the High Plains Aquifers (Kenny, et al, 2009).

In Eastern Kansas the main source of water is from surface waters, (i.e. rivers, reservoirs, and lakes). For Western Kansas the primary source of water are the High Plains aquifers supplying the regional economy enough water for irrigation, drinking water, cattle operations, and industrial purposes. In the past 12 years water levels for the Ogallala High Plains aquifer

have fallen more than 40 feet for a significant part of Southwestern Kansas (Kansas Water Office, 2010b). Slowing the decline in water levels is a high priority for the Kansas Water Office and conservation programs for this part of the state are in place (Kansas Water Office, 2010a).

Municipal water in Kansas may be segmented into three different user segments: residential use, commercial and institutional use, and industrial use. Commercial and institutional use can be further divided into: institutional, office, and other which includes retail and restaurant operations (Kenny, et al, 2009; Gleick & Morrison, 2006; Gleick et al., 2004).

Kansas municipal water supplied more than 403 million gallons of water per day for residents and businesses in 2005. An additional 14.9 million gallons per day was supplied through private wells. Kansas residents consumed, on average, 81 gallons per day for personal use (Kenny, et al, 2009). Of the 403 million gallons of water processed by public utilities, 55% was for personal use. Kansas municipalities supplied over 181 million gallons of water to local businesses (Kenny, et al, 2009) including restaurants and hotels.

## **WATER IN HOSPITALITY**

The United States Census Bureau (USCB) combines food services and accommodations under similar definitions using the North American Industry Classification System (NAICS) (2011b). This includes full and limited service hotels, boarding houses, and food outlets ranging from restaurants, caterers, and bars (USCB, 2011b). Water usage has been analyzed in hotels including studies in Hong Kong (Chan, 2005; Deng & Burnett, 2002) due to population density, Australia (Alonso & Ogle, 2010; Alonso, 2008) because of the dry climate, and the United States (Butler, 2008) analyzing the benefits of LEED certification.

## Energy Usage

The lodging industry is recognized as a high user of energy and water when compared to businesses similar in size. Alonso & Ogle (2010), Paton (2008), the AH&LA's *Energy Management and Conservation Guide* (2001), and Deng & Burnett (2002) recognize hotels as high water consumers using an average of 209 gallons of water for each room night sold in the United States (Brodsky, 2005). The 2000 study: *Commercial and Institutional End Uses of Water* studied 93 hotels and found the average water use was 162 gallons per available room (Dziegielewski, 2000). Of the energy use in a hotel, 25% may be used to heat water for the HVAC system and, overall, 50% to 90% may be consumed to heat and move water throughout the operation (AH&LA, 2001). Decreasing the amount of water needed in a lodging operation directly impacts the energy consumed.

Laundry and kitchen environments are the highest electrical and fossil fuel users within a hotel according to AH&LA's *Energy Management and Conservation Guide* (2001). Approximately 40% of water in hotels is used in the back of house operations (Brodsky, 2005). In Deng and Burnett's (2002) study of water use in hotels in Hong Kong, 30% of water was for rooms and floors in operations with laundry facilities and 44% in operations without laundries. This supposes that laundries account for a significant portion of water used in hotels. Due to kitchen and laundry areas requiring hot water for cleaning and sanitation purposes higher energy consumption is exhibited (AH&LA, 2001).

The lodging industry has displayed reluctance to change the attitude about energy and water usage for various reasons. When choosing to review the data on customer preferences operators found customers to be very apathetic toward water consumption when they choose to stay at a hotel (Alonso & Ogle, 2010). Customers expect enough water to be available to satisfy

their needs. Alonso (2008) found that there is no consensus on exactly what water conservation is from a customer's point of view. Alonso & Ogle (2010) discuss the relevance that no studies linking customer perspective on the importance of water conservation in the service sector, including hotels and restaurants, have been conducted.

Further reasons may include the perception that water and energy are considered inexpensive and a cost of doing business. According to the North Carolina League of Municipalities and the University of North Carolina Finance Center (Eskaf & Nida, 2010), the water charges for North Carolina water districts range from \$1.40 to \$21.60 for every 1000 gallons based on the 10,000 gallon commercial rate structure. The wastewater rates for the same districts ranged from \$1.87 to \$19.40 per 1000 gallons (Eskaf & Nida, 2010) and these costs were based on the amount of water used by the commercial operations (Hughes, 2005). The average for 1,000 gallons of water consumed is approximately \$4.50 and for wastewater is about \$6.00 throughout North Carolina (Eskaf & Nida, 2010). For the hotel industry each 1000 gallons serves approximately 5 sold rooms meaning costs would average \$2.10 per room sold (Brodsky, 2005). This charge may be considered minimal when, according to STR Global, the average room rate in the United States was \$99.31 in September of 2010 (Smith Travel Research, 2010).

## **Sustainability**

Hotels may decide not to integrate water conserving technologies for their own reasons. Alonso and Ogle (2010) contend that the eco movement has more to do with recycling and reusing commodities versus reducing consumption. Additionally, hospitality operations tend to be reactive to situations instead of proactive (Revell & Blackburn, 2007) when discussing aspects of environmental management. In general, operators are known to be reluctant to change and may rarely display eco-conscious leanings when making decisions (Revell & Blackburn,

2007). Operators have been reluctant because it is difficult to pass along additional costs commonly associated with eco-conscious behaviors (Revell & Blackburn, 2007). Finally, Butler (2008) submits that hotel operators move slowly because their customers have not been demanding environmentally friendly operations.

Even Revell and Blackburn's 2007 findings may be considered outdated. AH&LA's annual forecasts have been modified between 2006 and 2008 to include questions about retrofitting shower heads for water conservation and whether hotels now track their monthly energy and water consumption (2006; 2009). Linen and towel reuse programs, now considered normal in lodging, increased 16% between the 2006 and 2008 surveys and is in practice at more than 87% of AH&LA's members (AH&LA, 2006; 2009). The AH&LA survey affirms that 69% of the 2010 survey respondents have initiated a water saving program in their properties.

The change to a more environmentally friendly operation does generate opportunities for reducing the consumption of water, electricity, and the generation of waste. The linen and towel reuse programs, commonly found in many operations, are capable of saving a minimum of 81,000 gallons of water per year for every 100 rooms (Brodsky, 2005). Hilton Worldwide decreased water usage 2.4% in 2009 saving enough water to fill 650 Olympic size swimming pools (Clausing, 2010).

Hotel operations have expanded their perception of how to influence water use. AH&LA found hotel operations switching to less toxic, yet just as effective, chemicals for use within operations (2008). Using chemicals which are less toxic for the environment demonstrates an awareness of environmental programs related to water.

Deng and Burnett (2002) believe that a 15% reduction in water usage is possible in hotels through training and integration of better cleaning strategies. Training is believed to be an

important component and to be effective (AH&LA, 2008; Hampton, 2010a; Paton 2008; & Singh, 2010).

### **Environmental Certifications**

LEED (Leadership in Energy and Environmental Design) developed by the United States Green Building Council (USGBC) decreases the environmental footprint of the properties (USGBC, 2010). Marriott International had 5 LEED certified properties in 2009, 50 properties registered with the USGBC in 2010, and expects to operate more than 300 by 2015 (Clausing, 2010; Hampton, 2010b). Butler (2008) found that LEED certified properties use up to 40% less water than non-LEED properties.

AH&LA (2011) does not mandate or suggest certifications. Instead the lodging association suggests 11 minimum guidelines to follow before considering marketing your establishment as an environmentally friendly operation. Guidelines impacting water usage include:

- Monitoring energy and water performance;
- Implementing environmental teams, towel reuse programs, and recycling;
- Installation of digital thermostats, efficient lighting, and 1.6 gallon or dual flush toilets; and
- Purchasing Energy Star qualified products when replacing equipment.

## **WATER IN RESTAURANTS**

Water usage in restaurants is an area that has not been studied academically (Revell & Blackburn, 2007; Alonso & Ogle, 2010). Restaurants typically are a small segment of the population of water users in the commercial and industrial segment (Gleick, et al, 2004) and are

segmented into categories dependent upon the style of service, per-person check average, whether alcohol is available, what percentage of sales are derived from beverage sales, and other's (Riehle, Grindy & Altman, 2010). The focus for this research is casual dining restaurants. The definition of a "casual dining restaurant" for the purpose of this study is one in which table service is provided, alcohol is available, and the "average check (is) between \$10 and \$20 per person" (McClosky, 2010). Examples of these restaurants are Chili's, Olive Garden, Longhorn Steakhouse, and include independent restaurants.

Dziegielewski, et al. (2000), performing a study for the American Water Works Association, discussed a thorough analysis of the amount of water used in restaurants. In analyzing 87 operations from California, Colorado, and Florida, Dziegielewski et al. (2000) found, on average, each restaurant used more than 2.8 million gallons of water annually. This translated to 7,700 gallons daily and 16 gallons for each meal served. When only using indoor water sources, discounting water used for irrigation, Dziegielewski et al. (2000) established that 7.64 gallons of water were used for each meal served. The study found that Asian restaurants consumed more than 15,000 gallons per day and quick-service operations, 4,000 gallons per day (Dziegielewski, et al., 2000).

In a segmented analysis of water use throughout California it was found that 6% of total water usage in the commercial and industrial sectors took place in kitchens with restaurants being the largest user (Gleick, et al., 2004). This is water designated only for preparation, cooking, and sanitation (Dziegielewski, 2000) and does not include water for serving to customers or bathrooms. Dziegielewski et al. found the areas of largest use were sanitation, approximately half, followed by preparation, cooking, and ice machines (2000). Restaurants in California used 53.1 billion gallons (201 million cubic meters) of water in 2000 and



implementing water efficiency techniques could save 37% or more than 19.54 billion gallons (74 mcm) each year (Gleick, et al., 2004).

## **Conservation**

Prior to 2005 the development of eco-conscious restaurants had not been dramatic. Revell and Blackburn (2007) found that operators were not easily convinced of the merits of becoming a more environmentally friendly operation. They argued that restaurant managers were cognizant of the waste, energy, and water used in the day-to-day operation but were unable or unwilling to commit to change due to the hectic pace of managing restaurants. Even though water rates have increased 18% from 2003 to 2008 in the United Kingdom, Paton (2008) found operators unconcerned about the amount of water consumed by their restaurants. Water appeared to remain insignificant when compared to other costs.

Since 2005 many different restaurant organizations have begun to analyze their water and energy usage. A primary component of the Energy Star program was the decrease in footprint of heavy energy consumptive equipment (EPA, 2011a). Energy Star considers restaurant and foodservice facilities important enough to merit their own section (EPA, 2011b), and over the past two years Energy Star (EPA, 2011c) has increased its focus on the water use of appliances and created limits for water use for different commercial equipment such as dishwashers, steamers, ice machines, etc.

The NRA's Conserve website (2011b) estimated that energy is 30% of a building's yearly operating costs and that restaurants used five times as much energy as a normal building and 25 times more when focusing on the kitchen area. Decreasing the amount of water used, whether it be through training or new equipment, is directly correlated with decreasing utility costs (AH&LA, 2001; NRA, 2011c; 2011k).

## **Government**

According to Revell and Blackburn (2007), Alonso (2008), and Alonso and Ogle (2010) change may occur via government interventions. Revell and Blackburn (2007) found restaurateurs unconcerned about whether the government expects operations to change their environmental behaviors simply because it is better for business. Alonso and Ogle (2010) argued that the best way to influence business is via incentives versus regulation. Revell and Blackburn (2005) disagreed stating the best way to generate change may be through increased regulation or legislation.

No matter the argument, it is known that restaurant managers and owners think of sustainability in monetary terms (Chan, 2005). When decisions are made operators focus on potential monetary savings, not energy measurements, which they might not understand. The National Restaurant Association's Conserve website appears to recognize this. The case studies available via the website typically discuss savings using both ecological and financial methods (NRA, 2011a).

## **RESTAURANTS IN KANSAS**

No studies or data have been found discussing the current amount of water used by the restaurant sector or the 2,053 (U.S. Census Bureau, 2011a) restaurants in Kansas. According to the National Restaurant Association, each American eats away from home 2.97 times per week (Riehle, Grindy, & Altman, 2010). If holding true for the 2.8 million residents of Kansas (U.S. Census Bureau, 2011d) then more than eight million meals are eaten in or taken out of Kansas restaurants each week. Using Dziegielewski, and other's 12.7 gallons used per meal findings, this would equal more than 106 million gallons of water are used (weekly) to prepare and serve customers (2000).

## WHAT HAS BEEN ESTABLISHED

The final cost of water includes a direct correlation with the amount of energy an operation consumes (EPA, 2011k) and the hospitality industry is a large consumer of energy (AH&LA, 2001; Alonso & Ogle, 2010; Paton, 2008; and Deng & Burnett, 2002). One segment of the hospitality industry, restaurants, expended five times more energy per square foot than the average commercial business (NRA, 2011b).

Over the past five years the cost of water to households and businesses has increased faster than inflation (NRA, 2011c). The cost of water is expected to continue to increase due to:

- Changes to actual cost pricing (EPA, 2003)
- Climate change effects (Spencer & Altman, 2010)
- Source shifts (Gleick & Adams, 2000)
- Infrastructure upkeep and expansion required for continued service (Brzozowski, 2010; EPA, 2003)
- Increasing cost of energy (U.S. Energy Information Administration, 2010)

Although there have been many changes in water usage in the restaurant industry and much of this has decreased the amount of water used, there is no research analyzing methods to decrease water usage. The previous research on water usage in restaurants was published a decade ago (Dziegielewski, et al., 2000). There are no current benchmarks on how much water restaurants use. This is important because in the coming years water will become less available and/or will become more expensive, will become more regulated. Hospitality operators, including casual dining restaurants, need to be able to exhibit control over how much water is used in their facilities and have benchmarks for comparing their use.

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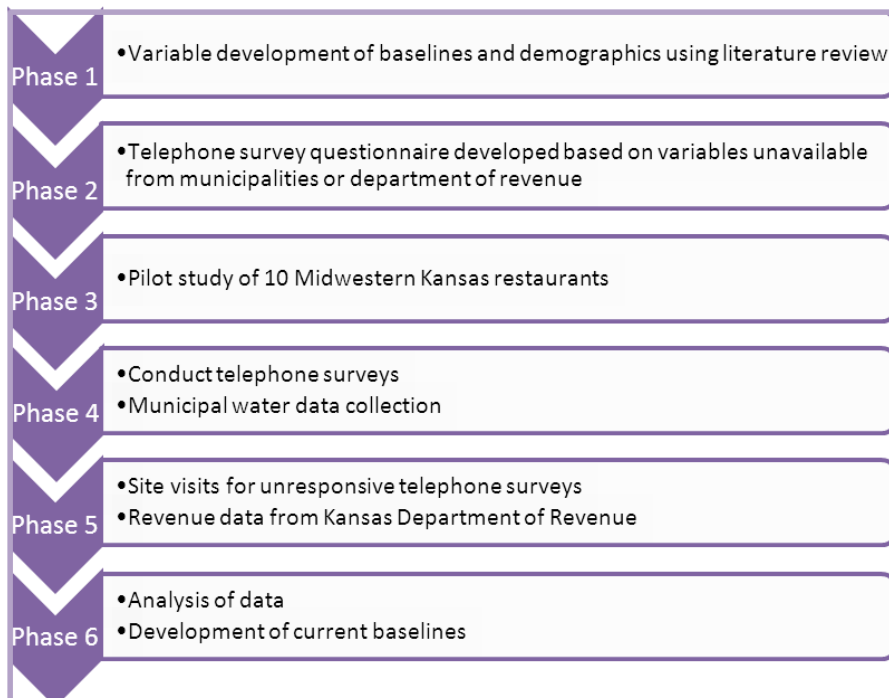
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# CHAPTER 3 - METHODOLOGY

## INTRODUCTION

This chapter discusses the method for data collection to address the research objectives. Water is transitioning from being inexpensive and always available to a commodity whose price will fluctuate based on its demand and the cost to supply it. Changing the way water is thought about in casual dining restaurants will become not only practical, but necessary. Therefore, the purpose of this study was to investigate the amount of water used by casual dining restaurants in Kansas by developing benchmarks for water consumption. Specific objectives included: 1) develop benchmarks for water usage in casual dining restaurants; 2) identify demographic characteristics that correspond with water use; 3) determine whether there are differences in water use based on operational demographics; 4) explore how demographics influence water use in casual dining restaurants (CDR's) in Kansas; 5) develop a benchmark for water costs as a

**Figure 3-1: Research procedures**



percent of revenues and 6) identify demographics that impact percent water expense. Figure 3.1 shows the research procedures.

## **POPULATION AND SAMPLE**

The population for this study was all casual dining restaurants in Kansas. A casual dining restaurant is defined as one that offers table service, alcoholic beverages, and the per-customer check average is between \$10 and \$20 (McClosky, 2010). The population was determined by cross checking 8,006 Foodservice Establishment licenses from the Kansas Department of Agriculture (2010) with 2,307 drinking establishment licenses from the Kansas Department of Revenue (2011). Additionally, more than 1,100 operations were examined using Google’s Place Page (Google, 2011) verifying that operations met the CDR definition. Place Page displayed if the operation sold alcohol, their operational status, and additional information such as the menu type. After removing CDRs that did not meet the criteria (banquet facilities, golf clubs, or restaurants that had counter service), the final population was 952.

Stratified random sampling was used to select 300 restaurants, 60 from each of the five Kansas geographic regions: Western, Northeast, North-central, South-central and Southeast (figure 3.2, Appendix A). This ensured that CDRs in lower populated regions of the state were

**Figure 3-2: Kansas geographic regions**



*Courtesy of Fort Hays State University's Sternberg Museum*

represented in the study. After stratification, the CDRs were chosen for participation based on a random number generator (Random.org, 2011).

## **DATA COLLECTION**

### ***Municipal Water Data***

Municipal water utilities maintain records of water use and costs for casual dining restaurants. This secondary data is available using the Freedom of Information Act (FOIA) (U.S. Department of State, 2011) and the Kansas Open Records Act (KORA) (2002). Restaurant water consumption and water and sewer charges were obtained by calling each city's clerk or the appropriate rural water district.

For each municipality the utility was contacted by telephone until the appropriate person who could respond to the request was identified. An email was then sent asking for the 2010 water and sewer statements, the location, and the current address (Appendix B). These monthly statements included amount of water used, cost for the water and sewer, and other expenses such as special taxes.

Water consumption and charges were available for 242 of the 300 sample population. Reasons water data was unavailable for the entire sample included: restaurant was on a meter attached to other businesses (38), researcher was unable to contact rural water district (4), and refusal of the city clerk to release information (2).

### ***Revenue Data***

The Kansas Department of Revenue (2011) could not furnish revenue data for individual restaurants because the data is proprietary and not included in the FOIA. They agreed to provide 2010 monthly sales data in groups of five. Groups were determined by the Kansas Department of

Revenue. They were mixed and did not contain commonalities such as all from the same region or same type of ownership. Franchised operations that reported revenue with more than one location had revenue averaged for the selected locations.

### ***Survey Instrument***

The demographic information utilized was developed based on a study by Dziegielewski et al. (2000), recommendations from the Kansas Water Office, and the literature review. The survey was developed based on the information that was not available from the Kansas Department of Revenue, municipal water providers, and Google Place Page. The survey (Appendix C) asked menu type, how many days the operation is open, ownership (independent, chain or franchise), restaurant square footage, number of seats, number of employees, if the operation irrigated, whether the manager knew last month's water bill, and if the operation had any water saving devices installed. The demographic variables created comparisons to explain water usage in CDR's in Kansas.

**Menu type:** Dziegielewski and other's 2000 study inferred there to be a difference in water consumption based on menu, stating Asian restaurants used more water, on average, than others. Menus were classified into seven categories including combination (Applebees, Chilis, a comprehensive menu), American (steaks, burgers, BBQ menu), Mexican, Asian, Italian, Pizza, and other.

**Ownership:** Restaurants were categorized into independently owned and corporate or franchise operations.

**Primary water sources:** How each county in Kansas received the majority of its water determined if it was grouped as fossil aquifer or surface water. Water in the aquifer category

applied only to the High Plains aquifers which included the Ogallala, Equus Beds, and the Great Bend Prairie.

**Irrigation:** Irrigation asked if a casual dining restaurant irrigated the landscaping immediately surrounding the restaurant.

**Days open:** Operations were categorized based on how many days they were opened each week.

**Water reduction equipment:** Restaurants were asked if water reduction equipment was installed in their operation. When unsure what type of equipment this included the researcher offered: Low/no flow urinals or toilets, aerators installed on sinks, automatic/foot water sensors, steamer, dishwasher, or ice machine less than 2 years old, and garbage disposal permanently removed/turned off.

**Manager knows water expenses:** Knowledge of monthly water expenses was asked to determine if water consumption was tracked.

Other demographic variables included:

**Seasons:** Consumption was stratified into seasons based on the Merriam-Webster online dictionary (Autumn, 2011; Spring, 2011; Summer, 2011; Winter, 2011) using the following guidelines: Spring(March, April, May), Summer (June, July, August), Autumn (September, October, November), and Winter (December, January, February).

**Regions:** Kansas was stratified into five regions: Northeast, Southeast, North-central, South-central, and West and included rural areas of the state.

**Populations:** Operations were segmented into metropolitan, micropolitan, and rural areas based on the U.S. Census Bureau (2011) and Office of Management and Budget (OMB) (2000) definition. Metropolitan is a status given to the county or a city of 50,000 or more and

micropolitan, a population minimum of 25,000 but less than 50,000. For the purposes of this study those not meeting either definition were classified as rural.

### ***Pilot Testing***

Pilot testing was conducted with ten CDR's in a micropolitan Midwestern community. Water consumption and billing data were obtained for each month of 2010 from the city clerk's office. Initial telephone interviews resulted in one response. In-person interviews were then conducted to obtain restaurant demographics. Annual sales data in aggregate form was obtained from the Kansas Department of Revenue for the ten locations.

Changes in the research methodology resulted from the analysis of the pilot study. Instead of recording data on paper during the telephone interviews the data was directly entered into the Axio Survey System (2011). The initial introduction and wording of the telephone interview was edited for clarity and brevity (Appendix C). The restaurants used in the pilot study were not used in the final study.

## **SURVEY ADMINISTRATION**

The 300 locations were telephoned using the internet program Skype (2011) because it was easier for the caller and less expensive. Call sheets (Appendix D) were generated and each operation was telephoned a maximum of six times before being placed into a personal visit category. Notes were made detailing who should be contacted or the best time to call. Calls were conducted Monday through Saturday in the morning from 10:00 to 11:30, afternoon from 1:30 to 4:30, and evening from 7:15 to 9:30. College students were employed and trained to call the selected locations.

For CDR's that did not complete the telephone survey, on-site visits by the researcher occurred. On-site surveys were in-person and a letter of introduction was given (Appendix E) to the manager on duty.

Each respondent was offered a copy of the final research upon completion (82 accepted). Responses were entered into the Axio Survey System (2011) and uploaded into an Excel (2010) spreadsheet. Data was then inserted into the Statistical Software Package for the Social Sciences (SPSS) version 19.0 (IBM, 2011).

### *Use of Human Subjects in Research*

The Kansas State University Institutional Review Board approved the research protocol prior to beginning the study. The IRB letter of approval is located in Appendix F.

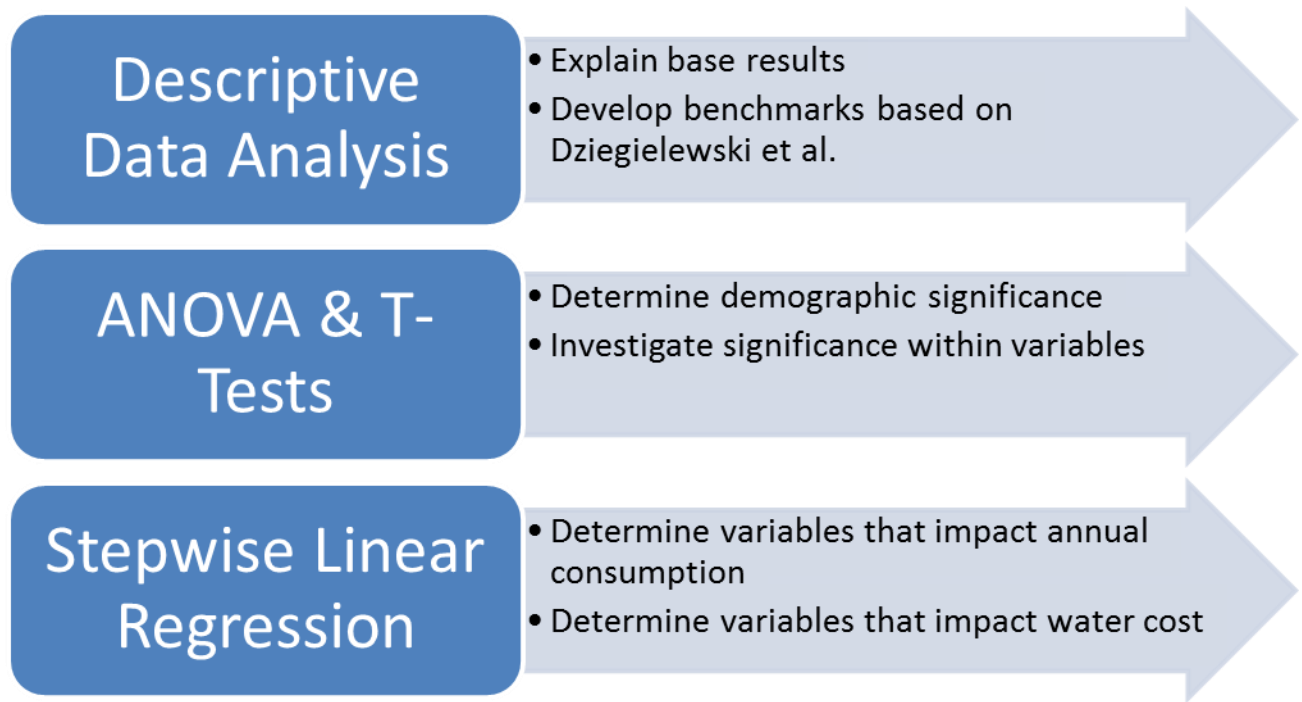
### *Statistical Analysis*

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) (version 19.0, 2010, IBM Corporation, Somers: NY). Figure 3.3 contains a summary of the data analysis.

Descriptive statistics included means, frequencies, and standard deviations for the seven benchmarks. The means, frequencies, and standard deviations found explained the base results for the research questions. The eight demographic variables were analyzed using benchmark data. Statistical tests included T-Tests, paired T-Tests, ANOVA and stepwise regression.



**Figure 3-3: Data Analysis Procedures**



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# **CHAPTER 4 - AN INVESTIGATION OF WATER USE IN CASUAL DINING RESTAURANTS IN KANSAS**

## **ABSTRACT**

Water is essential for many aspects of daily life including restaurant operations. It is necessary for generation and service of properly produced, safe food. However, water is becoming more scarce and expensive due to climate change, infrastructure needs, governmental budget constraints, and shifting water sources. The purpose of this study was to develop benchmarks for water usage for casual dining restaurants (CDRs) in Kansas and identify demographics that may impact water usage.

The population for the study was 952 CDRs in Kansas. Stratified random sampling selected 60 restaurants from each of five Kansas demographic regions. Data were collected from the local municipal water utilities, Google's Place Page, and telephone or on-site interviews with a manager.

Results for 221 of 300 (74%) CDRs that responded indicated that on average 1,766 gallons of water were used each day per restaurant, 12.79 per gallons per day for each seat, 68 gallons per employee, and 0.73 gallons per interior square foot. These results were as much as 69% lower than those from a 2000 study conducted by Dziegielewski et al. Significant demographics that impacted water consumption were season of year, population ( $F= 9.763$ ,  $p\leq.001$ ), menu ( $F= 2.921$ ,  $p\leq.035$ ), type of ownership ( $F= 56.565$ ,  $p\leq.000$ ), water source ( $F= 10.751$ ,  $p\leq.032$ ), irrigation ( $F= 46.514$ ,  $p\leq.001$ ) and days open ( $F= 6.085$ ,  $p\leq.000$ ). A stepwise

linear regression ( $F= 33.676, p \leq 0.000$ ) found ownership ( $\beta= -.329, p \leq 0.000$ ), irrigation ( $\beta= -.290, p \leq 0.000$ ), and population ( $\beta= -.176, p \leq 0.003$ ) impacted water consumption.

This study did identify benchmarks for water consumption that can be used in the future by restaurateurs. The primary limitations of the study were that results can only be generalized to casual dining restaurants in Kansas. Future studies can be conducted with different types of restaurants in Kansas and with CDRs in other areas.

**Keywords:** *water usage, casual dining, water benchmark, restaurant water consumption*

## INTRODUCTION

Water is essential for human life (Centers for Disease Control and Prevention, 2010; 2011a; 2011b) and is found naturally on the Earth as either salt, acidic, alkaline, or fresh water. Water for human consumption, which is fresh water, is found as surface water in rivers, lakes, and the water table or from aquifers, underground bodies of water in porous rock or sediment. Currently, only 0.3% of the water available on Earth is fresh water (Hughes, 2009).

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) states that there is a correlation between the availability of water and access to sanitary living conditions, stability of the political infrastructure, and access to education (World Water Assessment Program, 2009). UNESCO directly correlates availability to clean, fresh water with the capacity of a population to sustain itself in a healthful manner (World Water Assessment Program, 2009). Fresh water resources are dependent on several factors including geographic location, landmass features, regional climate, population density, pollution controls, and typical water usage (Connor & Rast, 2009).

Water is not only essential for many aspects of daily life, but available water resources permit sustainable agriculture, industrial development, and electrical generation which, in turn, create jobs and higher standards of living (World Water Assessment Program, 2009). Essential to water and the economy is its infrastructure which directly impacts industry, agriculture, and power generation.

Additionally, water is a necessity in the generation and service of properly produced, safe food (Lifewater International, 2010). Often considered a cost of doing business, water is becoming more expensive (National Restaurant Association [NRA], 2011c) and availability due

to climate change and increasing infrastructure needs will create uncertainty (Spencer & Altman, 2010) which will directly impact restaurants in the future.

## **REVIEW OF LITERATURE**

Water consumption in the United States is based on the requirements of regional and local populations rather than the quantity of water available. Traditional water sources may become unavailable due to c expected changes in the climate within the United States. Moderate to severe droughts affecting roughly 70% of the country may occur before 2050. Availability of water to effected regions is forecasted to outstrip supply based on climate change, population density, and industrial and agricultural demand (Spencer & Altman, 2010).

The Palmer Drought Severity Index, an instrument used to map long-term drought or an expected drought over six months, found that much of the Central Southeast and Gulf Coast, the Southwest, California, and inland Pacific Northwest experienced drought like conditions from July 2009 through October of 2010 (National Oceanic and Atmospheric Administration [NOAA], 2011). Also, socioeconomic drought, when human consumption outpaces water supply (Wilhite, 2011), remains an increasing possibility for many population centers including Atlanta, Georgia; Las Vegas, Nevada; and Los Angeles, California. Multiple cities are finding it difficult to obtain a balance between serving the needs of the public, industry, and agriculture (Fishman, 2011).

In all, the U.S. used 410 billion gallons of water each day in 2005 (Kenny et al., 2009). Homes, restaurants, and other publicly supplied businesses are responsible for 11% of water used. The majority, 49%, was for power generation and 32% for agriculture use (Kenny, et al., 2009). Taking into account the United States' 2005 population, this translates into each American using more than 1,362 gallons of water daily (U.S. Census Bureau, 2011b).



Besides climate change, a second concern with water availability is America's water infrastructure. Water supplied for public use is required to meet specific standards set by the United States Environmental Protection Agency to be considered potable, or safe for human consumption. A massive infrastructure is essential for this water to reach consumers. For U.S. citizens, water supply is rarely in question; when one turns on the faucet it is readily available and safe to drink. More than 99% of Americans have water pumped directly into their homes and approximately 90% of these are served by municipal facilities (EPA, 2011c; United States Geological Survey [USGS], 2011). Without infrastructure, this would not be possible. Infrastructure required to supply clean water and to process the returned grey and black water stretches for more than 1 million miles throughout North America (Brzozowski, 2010).

The concern is that the U.S. is facing daunting infrastructure needs within the next 50 years, almost \$465 billion of repairs according to the EPA's *Summary of Water Infrastructure Forum* (2003). However in 2010, Brzozowski stated that the American Society of Civil Engineers expects America's water infrastructure to require more than \$2.2 trillion, or \$7,300 for each U.S. citizen, in new and replaced water conveyance equipment by 2050.

Water infrastructure in the United States is typically funded by local governments, which receive low interest loans from the federal government or they issue state or municipal bonds (EPA, 2003). For local municipalities, the current budgetary and tax climate found in many municipalities has created increasing costs (Barringer & Henriques, 2010). The interest rates charged on the bonds and loans for infrastructure upkeep and improvements are producing higher costs associated with water expenses. Municipalities are becoming concerned that these costs will have to be passed on to customers (EPA, 2003). Capital improvements in aged equipment and the expansion of current operations are becoming the financial responsibility of

the end consumers and this amount is expected to increase (EPA, 2003) due to a shift toward actual cost pricing in which municipalities reduce or eliminate subsidies for their water systems (EPA, 2003). According to the National Restaurant Association's (NRA) Conserve website (2010) water rates have increased faster than inflation from 2005 to 2010. In Manhattan, Kansas, for example, water rates increased 15% in 2008, then an additional 7% in January of 2009 and 2010 and have been a common topic on the City Council's agenda for the past year (Pugh, 2010).

Similar to much of the U.S., Kansas exhibits parallel symptoms with water sourcing and supply. Kansas consumed almost 3.8 billion gallons of water each day in 2005 with 403 million gallons of drinking water provided by municipal utilities for residential and commercial customers (Kenny, et al, 2009). Climate change coupled with the expected water consumption leads to the forecast that 85 of Kansas' 105 counties will suffer from moderate to severe water stress by 2050 (Spencer & Altman, 2010). This may lead to source shifting, which is when water is not available from one source the users will shift to a different source (Fishman, 2011). For much of north-central and eastern Kansas the principal water sources are rivers, reservoirs, and lakes. As surface water declines, users are expected to shift to aquifers as their primary source (Gleick & Adams, 2000).

The High Plains Aquifers, an underground deposit of permeable sediment where water can be withdrawn in measureable quantities, include the Ogallala, Great Bend Prairie, and Equus Beds (Buddemeier, Macfarlane, & Misgna 2010). These aquifers supply more than 77% of the annual water used in Kansas (Kansas Geological Survey [KGS], 2007) and are considered fossil aquifers, a primarily non-renewable water source (Opie, 1993) which have declined by more than 150 feet in three Kansas counties and more than 100 feet in 16 counties in the last twelve

years (McGuire, 2007). On average, only 9% of removed water is replenished each year through naturally occurring precipitation (McGuire, 2007).

Because of these impending concerns with water, restaurants in the U.S. should be knowledgeable about sources of water, water usage, and costs of water. Water is essential for preparation, production, sanitation, service, and cleaning in restaurants. Reducing water consumption lowers an operation's water and energy expenses (NRA, 2011c). Restaurants, a large portion of commercial foodservice operations, are heavy consumers of energy using five times more energy per square foot than the average commercial operation and have higher energy costs (NRA, 2010a). Unfortunately, the cost of electricity from 1998 through 2009 has increased more than 68% in the U.S. and is forecasted to continue to increase (U.S. Energy Information Administration, 2010).

Conservation and sustainability are developing into more defined concepts within the industry. The National Restaurant Association (2010) maintains a web resource addressing water conservation. Their resources are focused on improving the restaurant industry's environmental impact through voluntary practices and business growth. There remains uncertainty of how much this information is utilized. One reason may be that restaurant managers are responsible for so many day-to-day operational details that sustainability and water costs are not important until faced with the issues.

Water consumption in the foodservice industry is something that is relatively unknown having not been studied academically in the past (Alonso, 2008; Alonso & Ogle, 2010; Revell & Blackburn, 2007). The last investigation of water usage in restaurants was conducted in 2000 for the American Water Works Association (AWWA). This study identified the water usage of 87 restaurants in California, Colorado, and Florida and found that each consumed more than 2.8

million gallons of water annually. This translated to 7,700 gallons daily and 7.64 gallons per meal served (Dziegielewski et al., 2000). Since the study was released, the Environmental Protection Agency and National Restaurant Association have provided anecdotal evidence that water usage can and has decreased with the introduction of water reducing aerators, sprayers, and commercial equipment such as ice machines, steamers, and dish machines (EPA, 2011b; NRA, 2011b; 2011c). But there remain no measurements of actual water consumption in restaurants beyond the AWWA's study.

Therefore, the purpose of this study was to develop benchmarks for water usage in casual dining restaurants in Kansas and compare these with the 2000 study. Specific objectives included: 1) identifying demographic characteristics that correspond with water use, 2) determining if there are differences in water consumption based on operational demographics, and 3) explaining which demographics have the most impact on water usage in casual dining restaurants in Kansas.

## **METHODOLOGY**

The population for this study was all casual dining restaurants (CDR) in Kansas. A casual dining restaurant is one that offers table service, alcoholic beverages, and the per-customer check average is between \$10 and \$20 (McClosky, 2010). CDR's comprise 38.5% of the United States' restaurant population and are responsible for 44.4% of the foodservice segment's annual sales (U.S. Census and Bureau, 2007). The population was determined by cross checking 8,006 Foodservice Establishment licenses from the Kansas Department of Agriculture (2010) with 2,307 drinking establishment licenses from the Kansas Department of Revenue (2011) to determine the initial population. Additionally, more than 1,100 operations were examined using Google Place Page (Google, 2011) verifying that operations met the CDR definition. Google

Place Page displayed if the operation sold alcohol, their operational status, and additional information such as the menu type. After removing CDRs that did not meet the criteria (banquet facilities, golf clubs, or restaurants that had counter service), the final population was 952.

Stratified random sampling was used to select 300 restaurants, 60 from each of the five Kansas geographic regions: Western, Northeast, North-central, South-central and Southeast (Figure 4-1, Appendix A). This ensured that CDR's in lower populated regions of the state were represented. After stratification, sampled CDRs were randomly chosen utilizing Random.org (Haahr, 2010).

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Insert Figure 4-1

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## **DATA COLLECTION**

Data was collected from two secondary sources: municipal water utilities within the state of Kansas (Kansas Municipal Utilities, 2011) and Google's Place Page (2011); and one primary source: restaurant managers who were either telephoned or visited on site. Municipal water utilities maintain records of water use for commercial businesses. This data was available using the Freedom of Information Act (U.S. Department of State, 2010) and the Kansas Open Records Act (2002). Restaurant water consumption for 2010 was obtained by calling the corresponding city's clerk or water district. An email was then sent (Appendix B) asking for the 2010 water and sewer statements for each restaurant. Monthly statements were emailed or faxed to the researcher and included the amount of water used and costs associated with water usage.

Demographic data was obtained either through a telephone or in-person interview with a manager from each selected restaurant. Questions asked included menu type, how many days

the operation was open, whether the operation was independent or franchise (ownership), restaurant square footage, number of seats, total number of employees, days open, irrigation status (yes or no), the manager's knowledge of the water bill for the previous month, and if the operation had any water saving devices installed. Responses were entered into the Axio Survey System (2011) and uploaded into an Excel (2010) spreadsheet. Data was then inserted into the Statistical Software Package for the Social Sciences (SPSS) version 19.0 (IBM, 2011). The research protocol was approved by Kansas State University's Institutional Review Board (Appendix F).

Other demographic variables included seasonality, location within Kansas, population area, and water source. Population was segmented into metropolitan, micropolitan, and rural areas based on the U.S. Census Bureau (2011a) and Office of Management and Budget (OMB) (2000) population definitions. Metropolitan status applied to counties containing a population of 50,000 or more and micropolitan, 25,000 but less than 50,000. For the purposes of this study those not meeting either definition were classified as rural. Menus were organized into seven categories including combination (Applebees, Chilis, a comprehensive menu), American (steaks, burgers, BBQ menu), Mexican, Asian, Italian, Pizza, and other. Water source was either aquifer or surface water.

### ***Pilot Study***

A pilot study was conducted using ten CDRs in a micropolitan Midwestern city. Water consumption and billing data were obtained for each month of 2010 from the city clerk's office. Initial telephone interviews resulted in one response.. In-person interviews were then conducted to obtain restaurant demographics for all 10 restaurants.

Changes in the research methodology resulted from the analysis of the pilot study. Telephone interview responses were directly entered into an Axio Survey System (2011) which tabulated data automatically (Appendix C). The initial introduction and wording of the telephone interview was edited for clarity and brevity. Telephone calls for interviews were increased from two to six attempts for each location with the addition that the manager could choose to refuse to participate. In-person interviews were conducted after six failed telephone calls.

### *Statistical Analysis*

Statistical Software Package for the Social Sciences (SPSS) version 19.0 (IBM, 2011) was used for analyzing results. Descriptive statistics included means, frequencies, standard deviations, minimums and maximums. ANOVA, T-Tests, and paired T-Tests were used to determine whether significant differences existed between water consumption and demographic variables. Tukey HSD was used to explain differences within significant ANOVAs. Stepwise linear regression was performed to determine which demographic variables influenced annual water consumption.

## **RESULTS**

### *Response rates*

Response rates are displayed in Table 4-1. Of the 300 sampled restaurants, 221 (73.7%) responses were obtained for the variables explaining region, population, menu type, ownership, and primary water source. Response rates for region, population, menu type, ownership, source, and irrigation were higher than days open, reduction equipment, knowledge of water expenses, seats per restaurant, employees, and interior square footage. Menus were initially segmented into

seven options; however, there were few responses in the pizza, BBQ, Asian, and Italian categories so these responses were collapsed into the other category.

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Insert Table 4-1

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***Annual use***

CDRs had a mean consumption of 1,980 gallons of water per day for 2010 versus a mean of 7,700 gallons (74% lower) consumed daily in the 2000 study (Dziegielewski et al., 2000). Table 4-2 shows water consumption and illustrates differences between the Dziegielewski and other's (2000) study and the current findings. The 2010 data indicate daily water consumed for each seat dropped to 12.79 gallons (69% lower), 67.77 gallons (60% lower) for each employee, and 0.73 gallons (29% lower) for each interior square foot.

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Insert Table 4-2

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Table 4-3 shows the water usage by seasons. Summer (June, July, and August) consumed the most water with a mean of 207,302 gallons for each casual dining restaurant and winter (December, January, and February) the least, using 156,513 gallons.

For statistical differences, Table 4-3 shows the results for gallons water used by season. Paired T-Tests were run among all seasons and significant differences were found between winter and all the other seasons. (spring,  $F = 79.038$ ,  $p \leq 0.000$ ; summer,  $F = 64.808$ ,  $p \leq 0.000$ ; autumn,  $F = 80.801$ ,  $p \leq 0.000$ ). Additionally, spring use was significantly different from summer ( $F = 27.932$ ,  $p \leq 0.001$ ) and autumn ( $F = 9.847$ ,  $p \leq 0.000$ ). There were no significant



differences between summer and autumn ( $F = 1.765, p \leq 0.133$ ). Higher seasonal water use is found in the summer and autumn months when irrigation and higher customer counts might add to total water consumed.

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Insert Table 4-3

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Table 4.4 shows results for other demographic variables. Restaurants in the Northeast consumed the most water, averaging 893,835 gallons annually, with Western restaurants using the least with a mean of 495,888 gallons annually. For population density, those CDR's in counties containing or supporting a metropolitan area had a mean consumption of 916,746 gallons for 2010 compared to micropolitan counties mean water use of 600,108 gallons. Those CDR's with combination menus averaged 901,924 gallons compared to an American menu which only consumed 580,374 gallons per year. Corporate or franchise owned CDR's averaged 1,201,318 gallons versus a mean use of 526,585 gallons for independently owned restaurants. For water source, casual dining restaurants located in counties not using fossil aquifer water consumed a mean of 807,484 gallons versus 463,692 for those located in aquifer areas.

Operations that irrigated had a mean water use of 1,338,490 gallons while those that did not consumed 592,365 gallons. Restaurants open seven days a week used a mean of 816,311 gallons compared to 425,795 for those open for six days. Those CDR's that had installed water saving equipment had a mean use of 846,476 gallons while those that had not averaged 737,459 gallons. The operations where the manager knew the previous month's water expenses had a mean use of 741,938 gallons while those who did not had a mean of 767,260 gallons.

There were significant differences ( $F = 9.763, p \leq 0.000$ ) in annual water consumption between metropolitan and micropolitan ( $p \leq 0.005$ ) and rural ( $p \leq 0.000$ ) areas but no significance ( $p \leq 0.463$ ) between micropolitan and rural populations (Table 4-4). Therefore those restaurants in larger population areas use significantly more water than those in less populated areas. For menu type, a significant difference ( $F = 2.921, p \leq 0.035$ ) was found in water usage with the “other” category using more gallons annually than the American and combination menus ( $p \leq 0.037$ ). For type of ownership, independently owned casual dining restaurants used significantly smaller quantities of water ( $F = 56.565, p \leq 0.000$ ), than franchises and/or corporate locations. This difference may be explained by the size of typical corporate/franchise locations versus those of an independent operation. A significant difference ( $F = 10.751, p \leq 0.001$ ) was found between aquifer and surface water sources. Similarities are evident between the mean for aquifer use and the means for the western region and the rural population category. The High Plains aquifers are located in western and south-central Kansas which is primarily rural.

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Insert Table 4-4

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Whether a casual dining restaurant irrigates was found to have a significant difference ( $F = 46.514, p \leq 0.000$ ) in the quantity of water consumed. Operations that irrigate consume more than double the water for restaurants that do not irrigate. Irrigation also may influence the quantity of seasonal water used. More than 77% of the casual dining restaurants in the sample are open seven days each week. A significant difference ( $F = 6.085, p \leq 0.003$ ) was found between the means of water consumed and those restaurants open seven, six, and five days with

Tukey HSD finding significant differences between those open six and seven days ( $p \leq 0.005$ ), but not between those open seven and five days. Therefore, those restaurants open five days each week consume more water than those open six days.

Stepwise regression was run to determine which demographic variables had significant contributions to water usage and to address collinearity among the variables (Table 4-5). The model ( $F= 33.676$ ,  $p \leq .000$ ) found ownership ( $\beta= -.329$ ,  $p \leq 0.000$ ), irrigation ( $\beta= -.290$ ,  $p \leq 0.000$ ), and population ( $\beta= -.176$ ,  $p \leq 0.003$ ) significantly impacted water consumption.

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Insert Table 4-5

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## **DISCUSSION**

The purpose of this study was to develop benchmarks for annual water consumption for CDR's in Kansas and to compare these results with Dziegielewski and other's 2000 study. The current study found water consumption in casual dining restaurants in Kansas had a mean of 725,040 gallons for 2010 (Table 4.2). In comparison, Dziegielewski and other's 2000 study found restaurants used an average of 2,823,600 gallons per year. Annual water consumption for restaurants in Kansas in 2010 was almost 75% less than what was found in 2000 and was lower for all other variables studied which included number of seats, employees, and interior square footage. Water consumption for each seat dropped 69% and 60% for each employee. This reduction in water use may be explained by the fact the U.S. population has increased 36% (U.S. Census Bureau, 2011b) during the same period yet overall water consumption has remained constant (Kenny et al, 2009). Another reason for the differences may be that water reduction

equipment has become standard. When equipment is replaced, newer equipment will use less water. Additionally, education about water consumption has been readily available through the National Restaurant Association (2011a; 2011c), Energy Star (EPA, 2011a) and WaterSense (EPA, 2011d). Other possible explanations may be that several different restaurant styles were included in the previous study (casual dining, quick service, buffet, and fine dining) whereas this study only researched casual dining restaurants in Kansas. Likewise, operations from the 2000 study may have been from metropolitan areas and 50% of the Kansas sample was comprised of rural and micropolitan restaurants. Also, some of this decline can be interpreted as efficiency measures that have evolved between 2000 and 2011. Restaurants may be operating with fewer staff and turning over tables more quickly in the same space.

A second purpose was to determine how demographic variables impacted water consumption. It was found that season, region, population, type of menu, ownership, water source, irrigation, and days open significantly impacted water consumption throughout casual dining restaurants in Kansas. However, when stepwise linear regression was conducted, only type of ownership, whether the operation irrigated, and population impacted water consumption. Franchise and corporate operations had significantly higher water usage than independent restaurants. This may be due to the fact that franchised and corporate locations were typically found in the metropolitan and micropolitan areas and had combination menus. As such, these operations were larger, with more seats, employees, and interior square footage. They were predominantly located in the Northeast and South-central regions of Kansas, counties that contained larger populations, used surface water, and were open seven days a week. Franchised or corporate owned operations may have systems or standards in place that required more water

in day-to-day operations. Additionally, they were more likely to irrigate the surrounding property, accounting for greater water consumption.

## **CONCLUSION**

In conclusion, the current study found that less water was being used by restaurants in 2010 than was reported by Dziegielewski et al.(2000) study. The percent decrease was a surprising finding and the researchers are not sure why the large reduction in water consumption. It could have been due to restaurant sizes, better, more effective equipment, locations of restaurants, type of restaurant or more efficient methods of operation by restaurants. However, because of climate change, infrastructure concerns and increasing costs of water, restaurants in the future are going to need to reduce their water consumption. So the findings of this study are positive for the restaurant industry.

The benchmarks developed from the study included daily water consumption of 1,980 gallons, and 12.79 gallons for each seat, 67.77 for each employee, and 0.52 gallons for each interior square foot. These results were as much as 69% lower than those from a 2000 study conducted by Dziegielewski et al.

What the current study did find is that the most significant impact on water usage was ownership type, if the operation irrigated, and the population of the location's county. Therefore, those operations that were franchises used more water than independently owned restaurants; those located in metropolitan areas used more water those located in micropolitan and rural areas; and CDR's that irrigated used more water than those that did not. Another issue may be that water is not really a major cost issue for franchises so those restaurant managers are not concerned about water usage. In the future, however, availability of water could be limited

which would raise the cost. Attributable to their size, franchise operations may consider development of water saving strategies and improving water usage.

Restaurants have several options rather than using water intensive landscaping. Because grass requires significant amounts of water, restaurants instead could utilize xeriscaping with plants native to the area, dryscaping that uses rock gardens, or hardscaping, developing outdoor public areas. Traditional landscaping may also be used and employ smart water meters, rain-catching cisterns, grey water recycling, and other methods that will decrease potable water usage.

There were several limitations to this study. The first was that only casual dining restaurants in Kansas were studied and results cannot be generalized to other types of restaurants in the state or to CDRs not in Kansas. A second limitation was that this study did not analyze where water consumption occurs in casual dining restaurants and should not be used to explain areas of water usage. A third limitation is that the data collected covered a period of economic downturn. Actual water consumption may differ versus what would be available prior to or after 2010. A fourth limitation is that this study did not establish the minimum amount of water necessary for operational purposes.

Finally, the study found that the total water used in casual dining restaurants is significant and should be studied beyond the states of Kansas, California, Colorado, and Florida. For states such as California and Florida, where water is of current concern, and in Kansas where water is foreseen to be a concern it would be wise for restaurants to investigate efficiencies through education and equipment.

Therefore, future research should be conducted to determine water consumption in quick-service, buffet, and fine dining restaurants. Water consumption research could also expand to non-profit foodservices such as healthcare, K-12, university, and long-term care foodservices.

Of importance to the author is the consumption of water in central kitchen facilities providing food for meals on wheels programs or airlines.

The study analyzed consumption in Kansas. Future studies could analyze consumption in other states, geographic regions, or countries and may determine whether differences exist in how water is consumed. This may comprise comparisons of areas suffering from long-term water stress including Las Vegas, Nevada or Atlanta, Georgia.

The introduction of new benchmarks would assist in the measurement of consumption in other commercial industries including lodging, retail, and other tourism facilities. The return on investment based on water use may be developed as a benchmark for future study due to expected increases in water expenses.

Additional research may include how much water is required for specific areas within the foodservice industry. This may include sanitation, preparation, serving, irrigation, and bathrooms. Research also is needed to understand the behaviors and decision-making behind water use in the restaurant industry. The potential for increasing water efficiency is possible through changing how it is used in operations. It remains uncertain whether changes would be less costly and more efficient through equipment or behavior modification. Questions remain as to the effect education has on efficient water use in restaurants.

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**Figure 4-1: Kansas Geographic Regions**



*Courtesy of Fort Hays State University's Sternberg Museum*

**Table 4-1: Response Rates for Demographic Variable**

Demographic factors:	<i>Number of Restaurants</i>	<i>% of total sample (221)*</i>
<b>Region:</b>		
Northeast	47	21.3%
South-central	47	21.3%
North-central	44	19.9%
West	43	19.5%
Southeast	40	18.1%
<b>Population:</b>		
Metropolitan	108	48.9%
Micropolitan	69	31.2%
Rural	44	19.9%
<b>Menu Type:</b>		
American	91	41.2%
Combination	49	22.2%
Mexican	46	20.8%
Ethnic (Other)	35	15.8%
<b>Ownership:</b>		
Independent	156	70.6%
Franchise/Corporate	65	29.4%
<b>Primary Water Source:</b>		
Surface	168	76.0%
Aquifer	53	24.0%
<b>Irrigated Landscaping:</b>		
NONE	180	81.4%
YES	39	17.6%
<b>Days Open:</b>		
Seven	168	76.0%
Six	36	16.3%
Five	13	5.9%
<b>Water Reduction Eqpt:</b>		
NONE	137	62.0%
YES	33	14.9%
<b>Know Water Expenses:</b>		
NO	112	50.7%
YES	58	26.2%
<b>Baselines:</b>		
Seats	174	78.7%
Employees (Total)	171	77.4%
Interior SQ Foot	147	66.5%

\*% may not = 100 due to non-responses



**Table 4-2: Benchmark Consumption Comparison**

Benchmark:	2010				2000			
	<i>n of rest.</i>	<b>M</b>	<b>SD</b>	Daily gallons consumed	<i>n of rest.</i>	<b>M</b>	<b>SD</b>	Daily gallons consumed
Annual Use (kgal)	221	725.0	680.1	1.98	85	2,823.6	1,795.9	7.70
Seats (gallons)	174	162.2	99.7	12.79	85	189.9	24.2	40.74
Employees (gallons)	171	30.8	28.7	67.77	85	46.0	29.3	168.17
Interior SQ Foot (gallons)	147	3,943.6	1,852.1	0.52	87	10,653.7	9,484.4	0.73

*Use courtesy of Dziegielewski et al., 2000 (Appendix G)*

**Table 4-3: Seasonal Water Consumption**

Seasonal Consumption (in gal)	Spring* 2, 3, 4	Summer* 1, 4	Autumn* 1, 4	Winter* 1, 2, 3
	165,059	207,302	196,162	156,513
Std. Dev.	152,988	206,195	206,271	151,454

\* Significantly different among: 1) Spring, 2) Summer, 3) Autumn, 4) Winter ( $p < 0.05$ )

**Table 4-4: Differences in Water Consumption Based on Demographic Variables**

Demographic factors:		Mean gals/year	SD	Min gals/year	Max gals/year	F	Sig.
<b>Region:</b>							
1	Northeast	893,835	918,133	64,900	3,555,316	2.380	0.053
2	North-central	807,071	745,371	43,900	3,115,000		
3	South-central	765,708	564,995	56,000	2,322,750		
4	Southeast	635,003	524,051	24,700	2,712,500		
5	West	495,888	473,231	40,500	2,015,000		
<b>Population:</b>							
1	Metropolitan <sup>2,3</sup>	916,746	793,961	43,900	3,555,316	9.763	0.000
2	Micropolitan <sup>1</sup>	600,108	524,011	42,460	2,712,500		
3	Rural <sup>1</sup>	450,385	411,317	24,700	1,644,965		
<b>Menu Type:</b>							
1	Combination <sup>4</sup>	901,924	785,859	24,700	3,382,000	2.921	0.035
2	Ethnic (Other)	845,887	902,632	40,500	3,555,316		
3	Mexican	730,838	602,287	56,000	3,285,000		
4	American <sup>1</sup>	580,374	517,935	42,460	2,966,946		
<b>Ownership:</b>							
	Franchise/Corporate	1,201,318	877,473	56,000	3,555,316	56.565	0.000
	Independent	526,585	451,492	24,700	2,784,100		
<b>Primary Water Source:</b>							
	Surface	807,484	721,518	24,700	3,555,316	10.751	0.001
	Aquifer	463,692	439,885	40,500	2,015,000		
<b>Irrigated Landscaping:</b>							
	YES	1,338,490	930,038	62,500	3,555,316	46.514	0.000
	NONE	592,365	53,532	24,700	3,285,000		
<b>Days Open:</b>							
1	Seven <sup>3</sup>	816,311	733,979	42,460	3,555,316	6.085	0.003
2	Five	472,952	483,606	24,700	1,644,965		
3	Six <sup>1</sup>	425,795	288,390	40,500	1,174,000		
<b>Water Reduction Equipment:</b>							
	YES	846,476	732,360	111,000	2,840,000	0.713	0.400
	NONE	737,459	649,059	24,700	3,382,000		
<b>Manager Know Water Expenses:</b>							
	NO	767,260	713,417	24,700	3,382,000	0.055	0.815
	YES	741,938	565,896	43,900	2,840,000		

<sup>1, 2, 3, 4</sup> Means in the same row with different superscripts (1, 2, 3, 4) differ significantly by Tukey's post hoc test (p ≤ 0.05)

**Table 4-5: Stepwise Linear Regression Model for Demographic Variables Based on Annual Water Consumption**

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	3.39E+13	7	4.85E+12	15.219	.000
Residual	6.72E+13	211	3.18E+11		
Total	1.01E+14	218			
Standardized Coefficients					
Model	Beta		t	Significance	
(Constant)			11.684		.000
Ownership		-0.449	-7.404		.000
(Constant)			12.468		.000
Ownership		-0.354	-5.882		.000
Irrigation		-0.312	-5.190		.000
(Constant)			13.059		.000
Ownership		-0.329	-5.522		.000
Irrigation		-0.290	-4.880		.000
Population		-0.176	-3.052		.003

# **CHAPTER 5 - AN INVESTIGATION OF WATER EXPENSES IN CASUAL DINING RESTAURANTS IN KANSAS**

## **ABSTRACT:**

Water is becoming more scarce and expensive due to climate change, infrastructure needs, governmental budget constraints, and shifting water sources. However, water is essential for restaurant operations. It is necessary for generation and service of properly produced, safe food. The purpose of this study was to develop benchmarks for water costs for casual dining restaurants (CDRs) in Kansas and identify demographics that may impact water costs.

The population for the study was the 952 CDRs in Kansas. Stratified random sampling selected 60 restaurants from each of five Kansas demographic regions. Data were collected from the local municipal water utilities, Kansas Department of Revenue, Google's Place Page, and through telephone or on-site interviews with a manager.

Results for 190 of 300 (63%) CDRs that responded indicated that on average CDRs paid \$6.54 per 1,000 gallons of water consumed and had mean annual expenses of \$5,026 on revenues of \$2,554,254. The equivalent water cost percent was 0.42. Demographics that impacted water costs were season of year, region ( $F = 3.167, p \leq 0.015$ ), and water source ( $F = 4.692, p \leq 0.032$ ). A stepwise linear regression model ( $F = 4.485, p \leq 0.036$ ) found only water source ( $\beta = -.152, p \leq 0.036$ ) was an indicator of the percentage of revenues related to water expense.

This study did identify benchmarks for water costs that can be used in the future by restaurateurs. The primary limitations of the study were that results can only be generalized to casual dining restaurants in Kansas. Future studies can be conducted with different types of restaurants in Kansas and with CDRs in other areas.

**Keywords:** *water usage, casual dining, water cost, water benchmark,*

## **INTRODUCTION:**

The United Nations Educational, Scientific and Cultural Organization (UNESCO) states that there is a correlation between the availability of water and the ability of a population to sustain itself in a healthful manner (World Water Assessment Program, 2009). The accessibility to fresh water resources is dependent on geographic location, landmass features, regional climate, population density, pollution controls, and typical water usage (Connor & Rast, 2009). Water is not only essential for many aspects of daily life, but also fresh water permits sustainable agriculture, industrial development, and electrical generation which, in turn, create jobs and higher standards of living (World Water Assessment Program, 2009).

The amount of water available on Earth is the same today as it was during the time of dinosaurs. Fresh water is found as surface water in rivers, lakes, and the water table or from aquifers, underground bodies of water in porous rock or sediment (U.S. Geological Survey, 2011). Potable water in the United States is rarely in question; when one turns on the faucet it is readily available. More than 99% of Americans have water pumped directly into their homes of which more than 90% are served by municipal facilities (U.S. Environmental Protection Agency [EPA], 2011a). The infrastructure required to supply clean water and to process the returned grey and black water stretches for more than 1 million miles throughout North America (Brzozowski, 2010).

Water is an essential ingredient in commercial operations and provides safe and sanitary food and facilities for restaurants. It is utilized in a restaurant's preparation, production, sanitation, service, and cleaning. As a requirement it is often considered as a minor cost of doing business and little thought has gone into the expenses associated with its use; however, that perception is changing. Over the last five years the cost of water in the United States to

households and businesses has increased faster than inflation (National Restaurant Association [NRA], 2011d). Additionally, the cost of water is expected to continue to increase due to:

- 1) Changes in actual cost pricing (EPA, 2003);
- 2) Decreased supply due to climate change (Spencer & Altman, 2010);
- 3) Source shifts based on demand from public and private users (Fishman, 2011; Gleick & Adams, 2000);
- 4) Infrastructure upkeep and expansion required for continued service (Brzozowski, 2010; EPA, 2003); and
- 5) Increased energy costs for processing water (American Hotel and Lodging Association, 2001; U.S. Energy Information Administration, 2010).

Changes in pricing will occur because governments and municipalities which typically subsidize water costs have found that the costs for treating, consuming, re-treating, and releasing water have become higher (EPA, 2002; 2003) and are realizing they are not charging consumers enough for water usage. The California Energy Commission stated that the true cost of supplying water requires more than 19% of the state's electricity, 30% of the state's natural gas, and 88 million gallons of diesel fuel (Nelson et al., 2007). According to the North Carolina League of Municipalities and the University of North Carolina Finance Center the water charges for North Carolina water districts for commercial operations varied from \$1.40 to \$21.60 for each 1000 gallons while wastewater rates ranged from \$1.87 to \$19.40 per 1000 gallons (Eskaf & Nida, 2010; Hughes, 2005).

The EPA, in response to 2002's *Clean Water and Drinking Water Gap Analysis*, held a public meeting to discuss how to reduce the difference between what users pay for water and what is charged (2003) and one suggestion was to increase the price consumers pay. Brzozowski



(2010) discussed that the current economic borrowing climate and local budget shortfalls may correspond with the increasing costs associated with supplying water. Costs for infrastructure repairs and replacement, water treatment, energy to process water, and the sourcing of water, will be passed on to the end consumers.

The National Restaurant Association's Conserve website (2011c) states that water rates have increased faster than inflation from 2005 to 2010. This, in effect, has been occurring on local levels. In Manhattan, Kansas, for example, water rates increased 15% in 2008, an additional 7% in January of 2009, 2010, and 2011 (Hayen, 2010; Pugh, 2010). Eskaf & Nida (2011) also found that 55% of North Carolina municipal utilities increased their water rates in 2010.

Climate affects the availability of water regionally across larger countries which, in turn, impacts water rates and expenses. In the U. S., the Eastern, Midwestern, and Northwestern states have plentiful surface and groundwater resources (Bullock et al., 2009), yet the Southwestern and desert areas of Nevada, Arizona, New Mexico, Utah, and Texas must import water to meet their needs. Drought severity is influenced by the demand within a given area and whether enough water is available to serve that population. Although none of the United States could be classified as in a socioeconomic drought, many population centers struggle with adequate accessible water. Areas such as Atlanta, Georgia; Las Vegas, Nevada; and Los Angeles, California are trying to balance the needs of the public, industry, and agriculture (Fishman, 2011).

Spencer and Altman (2010), of the Natural Resources Defense Council, stated the expected changes in the climate within the United States will create a moderate to severe drought affecting roughly 70% of the country before 2050. The portions of the United States minimally

affected include the Northeast, Mid-Atlantic, and coastal Pacific Northwest. Availability of water to effected regions is forecasted to outstrip supply based on climate change, population density, and industrial and agricultural demand (Spencer & Altman, 2010).

Another area of concern for water rates is the shift in water resources. The total annual amount of water consumed in the U.S. from 1990 to 2005 has remained flat even with an increased population (Kenny, et al, 2009). Even though less water is used today per person than in 1995 shifts in demand have occurred (Fishman, 2011). These shifts from one source to another will continue to occur as areas that do not have water available will obtain their water from areas that do. This is evident in Las Vegas, Nevada where the city government has purchased groundwater rights from outlying areas (Fishman, 2011).

The Kansas Department of Agriculture (2008) estimated the average amount of water used for irrigation was 85% of total water expended in 2007. Daily, 2.74 billion gallons of water were consumed for agricultural purposes with 2.6 billion gallons of this coming from the High Plains aquifers (Kenny, et al, 2009). Climate change will increase water consumption from the High Plains Aquifers due to less availability of surface water. This change will further deplete fossil aquifers that replenish less than 10% of water removed annually (McGuire, 2007).

The Ogallala aquifer's water levels have fallen, on average, almost 9% since 1996 (Kansas Geological Survey, 2007) causing rural Kansas water consumers to dig deeper wells to source their water. Expenditures, such as digging new and deeper wells, will increase the costs passed on to the end consumer (Gleick & Adams, 2000). In populated areas, such as Los Angeles California, costs will include the cost of water, infrastructure, and energy which will lead to a higher supply cost.

The fourth major issue to affect water costs in the U.S. is water infrastructure where local governments pay for their specific needs through no or low interest loans from the federal government or by issuing state municipal bonds (EPA, 2003). These local municipalities have the primary responsibility for forecasting and infrastructure. The concern is that water infrastructure in much of the United States is nearing or has passed its useful life (EPA, 2003). The EPA (2002) found a shift of water pipe age moving from 60% being rated better than fair in 2000 to 44% in 2020. This is expected to become worse because many waste treatment plants were constructed in the 1970's. Additionally, a United States General Accounting Office 2002 report found that only 15% of the drinking water utilities and 14% of wastewater utilities anticipated adequate funding to meet deferred maintenance needs after their 2001 budget year.

The U.S. is facing immense infrastructure needs within the next 50 years, upwards of 465 billion dollars according to the EPA's *Summary of Water Infrastructure Forum* (2003). The American Society of Civil Engineers expects America's water infrastructure to require more than \$2.2 trillion, or \$7,300 for each U.S. citizen, in new and replaced water conveyance equipment by 2050 (Brzozowski, 2010). Additionally, the current budgetary and tax climate found in many municipal districts has created higher costs associated with borrowing money for infrastructure due to lower municipal debt ratings (Barringer & Henriques, 2010).

The U.S. has the capability to replace infrastructure. However, there is doubt surrounding accessibility to low or no-cost funding for projects. Funding sources will continue to be available from federal grants or loans, public bonds, and by the water and sewer rates charged to households and businesses. It is this third option that concerns municipalities (EPA, 2003). Capital improvements in aged equipment and the expansion of current operations are becoming the financial responsibility of the end consumers and this amount is expected to continue to

increase (EPA, 2003). Additionally, due to the U.S. financial climate, many municipalities will incur increasing costs associated with borrowing money, further escalating the costs passed on to the end consumers (Barringer & Henriques, 2010).

The price of electricity required for sourcing, treating, and delivering of water will continue to increase. The cost of electricity from 1998 through 2009 increased more than 68% in the United States and is forecasted to continue to increase (U.S. Energy Information Administration, 2010). As stated previously, 19% of California's electricity consumption is for the sourcing and transportation of water (Nelson et al., 2007).

Additionally, energy use is directly correlated with the amount of water consumed in hospitality operations (AH&LA, 2001; EPA, 2011a; NRA, 2011d). Restaurants are understood to be heavy consumers of energy using five times per square foot more than the average commercial operation (NRA, 2011c).

### ***Water in Restaurants:***

Water usage in restaurants is an area which has not been studied academically in the past (Alonso & Ogle, 2010; Revell & Blackburn, 2007). In a segmented analysis of water use throughout California it was found that 6% of total water consumed was in the commercial and industrial segments with restaurant kitchens being the largest user (Gleick, et al., 2004). This is water designated only for preparation, cooking, and sanitation (Dziegielewski, 2000) and does not include water for serving to customers or bathrooms. Restaurants in California used 53.1 billion gallons (201 million cubic meters) of water in 2000 and implementing water efficiency techniques could save 37% or more than 19.54 billion gallons (74 mcm) each year (Gleick, et al., 2004).

Decreasing the amount of water consumed, whether it be through training, equipment, or other means is directly correlated with decreasing utility costs (AH&LA, 2001; NRA, 2011d; EPA, 2011a). The NRA's Conserve website (2011c) estimates that energy is 30% of a building's yearly operating costs and that restaurants use five times as much energy as a normal building and 25 times more in the kitchen. Water contributes to energy usage by having to be heated or treated prior to use and is required for some equipment to function.

No matter the argument it is well known that restaurant managers and owners think of sustainability in monetary terms (Chan, 2005). When decisions are made operators focus on potential monetary savings, not energy measurements, which they do not understand. (EPA, 2011a). However, in the future, restaurant managers and owners may expect to pay more for water and sewer expenses if they do not decrease the amount of water consumed. Due to the expected increases in water related expenses it may be beneficial to introduce different methods for accounting for an operation's water use.

At this time no studies have researched water expenses in restaurants. Water will become less available and/or will become more expensive in the near future and will likely become more regulated. Hospitality operations, including casual dining restaurants, are able to control water used; however benchmarks are needed to determine what water expenses are and what is causing their water expenses to increase. The introduction of the new benchmark would allow for consistent analysis and measuring of the return on investment that water provides the operation.

## **PURPOSE OF STUDY**

Water is transitioning from being inexpensive and always available to a commodity whose price will fluctuate based on its demand and the cost to supply it. Changing the way water is thought about in casual dining restaurants will become not only practical, but necessary.

The purpose of this study was to develop benchmarks for water expenses as a percentage of revenues in casual dining restaurants in Kansas. The objectives included 1) determining water expenses and total revenues for casual dining restaurants in Kansas, 2) developing new benchmarks based on percent water expenses, 3) identifying demographic characteristics that influence percent water expenses, and 4) determining if demographic characteristics significantly affect water expenses as a percent of revenue.

## **METHODOLOGY**

Casual dining restaurants (CDR) in Kansas comprised the population for this study. A casual dining restaurant is one that offers table service, alcoholic beverages, and the per-customer check average is between \$10 and \$20 (McClosky, 2010). Kansas Department of Agriculture's (2010) 8,006 Foodservice Establishment licenses and Kansas Department of Revenue's (2011) 2,307 drinking establishment licenses generated more than 1,100 operations that were issued both. These operations were examined using Google Place Page (Google, 2011) verifying that operations met the CDR definition. Google Place Page indicated whether alcohol was sold, if the operation was open, and their type of menu. After CDR's that did not meet the criteria (banquet facilities, golf clubs, or restaurants that utilized counter service) were removed, the final population was 952 restaurants.

Restaurants were stratified into five geographic regions within Kansas. A random number generator using Random.org (Haahr, 2010) randomly selected 60 restaurants from the population within each region: Western, Northeast, North-central, South-central and Southeast (Figure 5-1). This ensured that CDR's in lower populated regions of the state were represented in the study.

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Insert Figure 5-1

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## **DATA COLLECTION**

Data was collected from three secondary sources: municipal water utilities within the state of Kansas (Kansas Municipal Utilities, 2011), Kansas Department of Revenue, and Google (2011); and one primary source: sampled restaurants. Primary demographic data was obtained by calling the randomly selected restaurants or by visiting the operation.

Utility records for commercial businesses are considered public record through the Freedom of Information Act (U.S. Department of State, 2010) and the Kansas open Records Act (2002). Restaurant water consumption for 2010 was gathered by calling the corresponding restaurant's municipal water utility which was then sent an email asking for the 2010 monthly water statements for the selected restaurants. The monthly statements included amount of water used and the amount paid including water, sewer, specials, and taxes.

The Kansas Department of Revenue (2011) could not furnish revenue data for individual restaurants because it is proprietary and is not included in the FOIA. They agreed to provide 2010 monthly sales data in groups of five. The restaurants included in each group were determined by the Kansas Department of Revenue. They were mixed and did not contain commonalities such as all from the same region or same type of ownership. Franchised operations with more than one location had revenue averaged for the randomly selected locations.

Demographic data was obtained through telephone or on-site interviews with a manager from each selected restaurant. The interview questions asked menu type, how many days the operation

was open, whether the operation was a chain or franchise, restaurant square footage, number of seats, number of total employees, days open, whether the operation irrigated, whether the manager knew last month's water bill, and if the operation had any water saving devices installed. Each CDR's interview was recorded on an interview sheet, which was then entered into an Excel spreadsheet. The research questions were approved by Kansas State University's Institutional Review Board (Appendix F).

Other demographic variables included seasonality, region within Kansas, population area, menu type, and water source. Population was based on the U.S. Census Bureau (2011) and Office of Management and Budget (OMB) (2000) population definition and segmented into metropolitan, micropolitan, and rural areas. Metropolitan status applied to counties containing 50,000 or more residents and micropolitan was those areas with a population of 25,000 but less than 50,000. For the purposes of this study those not meeting either definition were classified as rural. Menu was divided into seven categories including combination (Applebees, Chilis, a comprehensive menu), American (steaks, burgers, BBQ menu), Mexican, Asian, Italian, Pizza, and other. Ownership referred to whether the casual dining restaurant was owned or operated as a franchise or corporate versus independent. Water source was either aquifer or surface water. Irrigation applied if the CDR was responsible for an irrigation system immediately surrounding their building's footprint. Due to 20% of the sample located in rural areas, number of days open per week was determined.

Management was asked if any water reduction equipment, including low/no flow urinals or toilets, sink aerators, automatic/foot water sensors, steamer, dishwasher, or ice machine less than 2 years old, was installed in their operation. Additionally, management was asked if they knew their water expenses for the previous month.



### ***Pilot Study***

A pilot study was conducted using ten casual dining restaurants in a Midwestern micropolitan area. Water consumption and billing data were obtained for each month of 2010 from the city clerk's office. Initially telephone interviews were attempted resulting in an initial 10% response rate. In-person interviews were then conducted to obtain restaurant demographics generating a 100% response rate.

The research methodology changed based on analysis from the pilot study. Originally data was recorded on paper, but to save time and improve reliability, the data was entered directly into the Axio Survey System (2011) system. The initial introduction and wording of the telephone interview (Appendix C) was edited for clarity and brevity. Telephone calls for interviews were increased from two to six attempts for each location with the addition that the manager could completely refuse to participate. Additionally, in-person interviews were added in response to the low participation rate from pilot study telephone interviews.

### ***Statistical Analysis***

The Statistical software package for the Social Sciences (SPSS) version 19.0 (IBM, 2011) was used to analyze data. Each casual dining restaurant's water expenses were compared with their 2010 revenues creating the percent water expense variable. Descriptive statistics calculated included means, frequencies, standard deviations, minimums and maximums. ANOVA and T-Tests determined whether differences within demographic variables occurred with percent water expense acting as the dependent variable. Tukey HSD was used to explain differences within significant ( $p \leq 0.05$ ) variables. Paired T-Tests were used to examine seasonal differences. A stepwise regression was performed to identify which demographic variables influenced water costs.

## RESULTS

### *Response rates*

Demographic variable responses are displayed in Table 5-1. Of the 300 sampled restaurants, 193 (64%) responses were obtained for the variables explaining region, population, menu type, ownership, and primary water source. Regional response rates varied from 42 (70%) for the Northeast, to 37 (62%) for Southeast. Complete information was not available for the demographic variables: irrigation (191), days open (189), water reduction equipment (153), and knowledge of water expenses (153). Menus were initially segmented into seven options; however, there were few responses in the pizza, BBQ, and Italian so they were placed them into the other category.

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Insert Table 5-1

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### *Water expenses as a percentage of revenues*

Casual dining restaurants included in the study had average revenues of \$2,554,254 during 2010 and spent a mean of \$5,026 for water expenses. Table 5-2 illustrates the average water use per dollar. Slightly more than \$3.33 in sales was generated for each gallon of water consumed. Restaurants spent \$6.54 for every 1,000 gallons of water consumed which included delivery, sewer, and taxes.

Revenue and water expense variables were used to generate the variable for water expenses as a percentage of total revenues. Table 5-2 displays the percent water expenses found in this study. As a percentage of revenues, 0.42% of each dollar in revenue generated was spent on

water. Restaurant managers are aware of water expenses and they can commonly be found on operating reports as both a dollar amount and a percentage of revenues.

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Insert Table 5-2

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Table 5-3 shows that seasonally, the percent water expenses fluctuated. Restaurant water expenses accounted for the greatest percentage of revenues during autumn (September, October, November) equaling 0.49%. This occurred because the quantity of water consumed was similar to summer, but reported revenues decreased. It was lowest during the winter (December, January, February) when 0.37% of revenues were spent on water expenses.

Table 5-3 shows the average water expenses as a percentage of sales based on seasons. Paired T-Tests were run among all seasons and significant differences were found between spring and summer ( $p = 0.000$ ) and autumn ( $p = 0.000$ ). Significant differences were found between summer and winter ( $p = 0.001$ ) and autumn and winter ( $p = 0.000$ ). There were no significant differences between spring and winter ( $p = 0.683$ ) and summer and autumn ( $p = 0.515$ ).

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Insert Table 5-3

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Regionally, northeastern restaurants exhibited the highest water expenses as a percentage of sales and the western region the least with 0.62% and 0.30% respectively (Table 5-4). Metropolitan areas spent a greater portion on revenues (0.49%) and rural areas the least (0.32%). Water expense percentages differed based on menu with a 0.52% cost for Mexican restaurant

revenues and 0.35% for American menus. For ownership, independent restaurant revenues had slightly more (0.42%) than franchise and corporate operations (0.40%).

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Insert Table 5-4

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Casual dining restaurants located in counties using surface water generated a mean of 0.46% in water expenses and those located in fossil aquifers had a mean of 0.28%. Operations that irrigated had expenses of 0.51% of revenues in 2010 while those that did not had 0.39%. Restaurants open seven days had a mean of 0.43% of revenues versus 0.35% for those open six days a week. Those restaurants that had installed water reduction equipment had water expenses totaling 0.45% of revenues and those with none, 0.44%. Operations where the manager knew the previous month's water expenses spent 0.48% cost of water versus 0.42% for those that did not.

Significant differences in the percentage of revenues spent on water were found by region ( $F = 3.167$ ,  $p = 0.015$ ). Tukey HSD was utilized to determine the significant differences and found significant differences between the northeastern and south-central regions ( $p = 0.034$ ) and the northeastern and western regions ( $p = 0.024$ ).

For water source significant differences were found between surface and fossil aquifers ( $F = 4.692$ ,  $p = 0.032$ ). The region and source results are similar because the south-central and west regions utilize aquifers primarily and the northeast region's source is surface water.

Stepwise regression was run to determine which demographic variables had significant contributions toward percent water expenses based on annual revenues. The model ( $F = 4.485$ ,  $p \leq 0.036$ ) found only water source ( $\beta = -.152$ ,  $p \leq 0.036$ ) significantly impacted percent water expenses based on annual revenues (Table 5-5).

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Insert Table 5-5

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## **DISCUSSION**

A purpose of this study included the development of benchmarks to determine water consumption in casual dining restaurants using water expenses as a percentage of revenues. The mean annual water expenses for CDR's were \$5,026 and the mean annual revenues were \$2,554,254. This study found that, on average, casual dining operations in Kansas paid \$6.54 for every 1,000 gallons consumed. This compares with an average of \$9.00 in North Carolina and approximately \$9.45 in Los Angeles, California (City of Los Angeles Bureau of Sanitation, 2011; Los Angeles Department of Water and Power, 2011). Water may be more easily sourced in Kansas than the east and west coasts, leading to lower prices.

For water expenses as a percent of revenue, this study found that casual dining restaurants in Kansas spent 0.42% of total revenues on water. However, no other studies have analyzed water expenses as a percentage of revenues so these results can be a benchmark for future studies. The cost of water, accounting for less than 1/200<sup>th</sup> of total revenues in 2010, is insignificant as compared to food, labor, and overhead costs and, as such, managers will not be concerned about these costs. But access to inexpensive water is forecasted to change. The National Restaurant Association, representing more than 380,000 businesses (2011a), recognizes that the cost of water has and will continue to increase (2011c). Costs are expected to increase because of climate change, infrastructure requirements, decreased subsidizing, changes in sourcing, and increasing electricity costs (Barringer & Henriques, 2010; EPA, 3003; Fishman, 2011; NRA, 2011c; Spencer & Altman, 2010).

Another objective was to identify what demographic characteristics affected percent water expenses. Significant differences were found for season of year, region in Kansas, and source of water. Autumn had the significantly higher percent water expenses because of high water use in warmer months and a decrease in revenues. Significant differences were found between the northeast and the west and south-central regions. Water may cost more in the northeast, a largely metropolitan area, because of infrastructure costs. In addition, a significant difference was found between surface and fossil aquifer water sources. Fossil aquifer water may be easier to source making it less expensive. Stepwise regression supported that water source did impact the percent water expense based on annual revenues (Table 5-5).

Even so, variability was found among percent water expenses. Water rates are not controlled by the state; instead are set by the municipal governments. The variability of water rates, annual revenues, and the demographic variables may have been the cause of 80% of the standard deviations exhibiting larger sizes than their associated means. Also, there is variability because no two CDR's are the same with differences in footprint, revenues, water expenses, and dissimilar in management, policies, and procedures. For example, for seasonal revenues the standard deviations were at least 124% greater than the associated mean.

A more effective way of utilizing percent water expense is as an internal efficiency measure. To account for the variance throughout the industry, using the measure against one's own operation would allow for better measurement and may lead to more efficient water consumption.

Spencer and Altman (2010) forecasted that climate change will decrease water supply to the point that moderate to severe water stress for most Kansas' counties will occur. Moreover, increased infrastructure will be required to transport water from plentiful areas to places of need.

This is in addition to the current infrastructure maintenance. Also, the cost of energy required to process water for use in operations increased 68% in the last 11 years (U.S. Energy Information Administration, 2010) and is predicted to continue to increase (AH&LA, 2001). Finally, the cost of water will increase as municipalities discontinue the subsidizing of water. All of these factors, plus the fact the industry recognizes water rates have increased faster than inflation over the past five years, indicate that the current costs will increase the percent of revenues spent on water.

These costs associated with water consumption do not cover the complete cost of water expenses in casual dining restaurants. At present, it would be difficult to determine the costs associated with the energy required to prepare water for preparation, cooking, sanitation, or serving purposes. Equipment such as booster heaters, dishmachines, ice machines, steamers, and cooking equipment all utilize energy to prepare water for use. Quantifying the energy consumed in the preparation of water would be difficult but these costs could be considered part of an operation's water expenses.

## **CONCLUSION**

In conclusion, the study found that restaurants spend less than 1/200<sup>th</sup> of their revenues or 0.42% of total revenue, for water consumed as compared to 33% food cost (Riehle & Grindy, 2008) and 33% labor costs (NRA, 2010). Water is a commodity that most people give little thought to. Foodservice managers are taught management by exception which gives little thought to water expenses except when they dramatically increase (Dopson, Hayes & Miller, 2008) Municipalities have become effective at delivering water inexpensively creating a climate where restaurant operators do not consider the role water and its related expenses play in the daily operations. Nevertheless, due to climate change, infrastructure upkeep and development, and changes to actual cost pricing, water sourcing and increasing energy costs, restaurants will have

to use water more efficiently. This research has provided a benchmark restaurant managers can use for self-monitoring and increasing water efficiency.

The study affirmed that the restaurant industry is one of tremendous variability even within the casual dining segment. Even though significance was found within the season of year, region in Kansas, and water source, only water source significantly explained water expense percentage. The development of water efficiency benchmarks are important and may lead to better water management practices in the future. It remains to be seen how high the price of water needs to go before the restaurant industry actively seeks to control their consumption behaviors.

Limitations to this study included that only casual dining restaurants in Kansas were studied and results cannot be generalized beyond this restaurant segment or to states other than Kansas. A second limitation was that municipal water and sewer rates are controlled by local water districts and fluctuated throughout the state of Kansas. This fluctuation increased variability within water expenses. A third limitation is that revenues for restaurants were obtained in groups of five with the average applied to each casual dining restaurant in the group. A fourth limitation was that standard deviations for 23 of the 29 demographic segments were greater than the means. This variability contributed to unpredictability and questionable results. Another limitation was that the data collected covered a period of economic downturn. Water expenses and/or revenues may differ from those available prior to or after 2010. A sixth limitation is that the study did not establish a minimum water expense for operational purposes. Finally, the study did not analyze how much energy is used to process water for use in CDR's to understand the full cost of consuming water. Energy consumed for water may fluctuate



depending on region within the United States, menu, and/or primary equipment used in the operation.

Therefore, future research should be conducted to determine whether the percent water expense variable is an effective efficiency self-measure within restaurants. Research should also determine whether the measure is effective in quick-service, buffet, and fine dining.

The percent water expense should continue to be studied beyond the state of Kansas. Areas of the United States, where water usage and supply is of concern, and in Kansas where water is foreseen to be a concern, it would be wise for restaurants to investigate efficiencies through education and equipment. This could include areas suffering from long-term water stress versus areas of plentiful water. Additionally, percent water expense may be compared with operations from high per-gallon consumption expenses versus operations with low and moderate per-gallon expenses.

Research also is needed to understand the behaviors and decision-making behind water use in the restaurant industry. This would include whether there is a percent water expense threshold before management is willing to implement water efficiency benchmarks. In addition, studies could determine whether changes would be less costly and more efficient through equipment or behavior modification. Questions remain as to the effect education has on efficient water use in restaurants.

At this time the results of the study indicated that water is obtained at low cost for restaurant operations. However, the cost of water is increasing and is expected to continue to increase. There are multiple methods for implementing water efficiency in hospitality operations, but the variability of the industry makes it difficult to determine benchmarks that apply to multiple operations. Because of this, the percent water expense variable may be a way to

increase water efficiency when applied to past measures of restaurant water consumption. As such, it is a measuring tool that can determine whether water efficiency is occurring.

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**Figure 5-1: Kansas Geographic Regions**



*Courtesy of Fort Hays State University's Sternberg Museum*

**Table 5-1: Demographic Variable Response Rates**

Demographic factors:	<i>number of restaurants</i>	<i>% of total sample (193)*</i>
<b>Region:</b>		
Northeast	42	21.8%
South-central	41	21.2%
North-central	35	18.1%
West	37	19.2%
Southeast	38	19.7%
<b>Population:</b>		
Metropolitan	91	47.2%
Micropolitan	64	33.2%
Rural	38	19.7%
<b>Menu Type:</b>		
American	78	40.4%
Combination	47	24.4%
Mexican	40	20.7%
Ethnic (Other)	28	14.5%
<b>Ownership:</b>		
Independent	129	70.0%
Franchise/Corporate	64	30.0%
<b>Primary Water Source:</b>		
Surface	148	76.7%
Aquifer	45	23.3%
<b>Irrigated Landscaping:</b>		
NONE	152	79.6%
YES	39	20.4%
<b>Days Open:</b>		
Seven	147	77.8%
Six	31	16.4%
Five	11	5.8%
<b>Water Reduction Eqpt:</b>		
NONE	120	78.4%
YES	33	21.6%
<b>Know Water Expenses:</b>		
NO	101	66.0%
YES	52	34.0%
<b>Baselines:</b>		
Seats	157	81.3%
Employees (Total)	154	79.8%
Interior SQ Foot	134	69.4%

\* % may not = 100 due to non-responses

**Table 5-2: Average Restaurant Water Use per Dollar of Expenses and Revenues**

Baseline:	<i>number of restaurants</i>	<b>M</b>	<b>SD</b>	Gallons consumed per dollar
Water Expense (per dollar)	193	\$5,026	16,422	152.90
Annual Revenues (per dollar)	193	\$2,554,254	3,244,694	0.30

**Table 5-3: Seasonal Water Expenses as a Percent of Revenue**

% water expenses	Spring <sup>2,3</sup>	Summer <sup>1,4</sup>	Autumn <sup>1,4</sup>	Winter <sup>2,3</sup>
	0.38%	0.47%	0.49%	0.37%
Std. Dev.	0.44%	0.63%	0.57%	0.43%

Significantly different among: 1) Spring, 2) Summer, 3) Autumn, 4) Winter ( $p \leq 0.05$ )

**Table 5-4: Differences in Percent Water Expenses as a Percent of Revenue for Demographic Variables**

Demographic factors:	Water Expense as % of Revenue	SD	F	Sig.
<b>Region:</b>				
1 Northeast <sup>4,5</sup>	0.62%	0.73%	3.167	0.015
2 Southeast	0.46%	0.36%		
3 North-central	0.36%	0.34%		
4 South-central <sup>1</sup>	0.32%	0.35%		
5 West <sup>1</sup>	0.30%	0.39%		
<b>Population:</b>				
1 Metropolitan	0.49%	0.57%	2.236	0.110
2 Micropolitan	0.37%	0.38%		
3 Rural	0.32%	0.35%		
<b>Menu Type:</b>				
1 Mexican	0.52%	0.42%	1.221	0.303
2 Combination	0.45%	0.61%		
3 Ethnic (Other)	0.39%	0.59%		
4 American	0.35%	0.35%		
<b>Ownership:</b>				
Independent	0.42%	0.46%	0.117	0.732
Franchise/Corporate	0.40%	0.51%		
<b>Primary Water Source:</b>				
Surface	0.46%	0.50%	4.692	0.032
Aquifer	0.28%	0.36%		
<b>Irrigated Landscaping:</b>				
YES	0.51%	0.37%	2.015	0.157
NONE	0.39%	0.50%		
<b>Days Open:</b>				
1 Seven	0.43%	0.50%	0.260	0.904
2 Five	0.41%	0.47%		
3 Six	0.35%	0.43%		
<b>Water Reduction Equipment:</b>				
YES	0.45%	0.38%	0.021	0.886
NONE	0.44%	0.54%		
<b>Manager Know Water Expenses:</b>				
YES	0.48%	0.39%	0.378	0.540
NO	0.42%	0.56%		

<sup>1, 4, 5</sup>Means in the same row with different superscripts (1, 4, 5) differ significantly by Tukey's post hoc test ( $p \leq 0.05$ )

**Table 5-5: Stepwise Linear Regression Model for Percent Water Expense Based on Demographic variables**

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	.000	1	.000	4.485	.036
Residual	.004	189	.000		
Total	.004	190			
Standardized Coefficients					
Model	Beta		t	Significance	
(Constant)			5.940	.000	
Water Source	-0.152		-2.118	.036	

## CHAPTER 6 - SUMMARY AND CONCLUSIONS

The purpose of this study was to develop benchmarks for water usage for casual dining restaurants in Kansas. The benchmarks were stated as research questions that compared water consumption versus: revenues, water expenses, seats, interior square footage, and employees.

The objectives included:

- 1) Determine water consumption, expenses, and revenues for sampled casual dining restaurants in Kansas.
- 2) Obtain demographic information for the development of benchmarks based on the research questions.
- 3) Develop benchmarks and compare with Dziegielewski and other's 2000 study.
- 4) Identify demographic characteristics that influence water consumption.
- 5) Determine which demographic characteristics significantly affect water consumption.
- 6) Create a percent water expense benchmark and determine whether demographics influence it.

Water consumption was obtained from water municipalities for each sampled restaurant. Demographic characteristics were acquired from each restaurant's management. Annual revenues were obtained from the Kansas Department of Revenue. Water consumed and percent water expenses were the dependent variables for the study.

The cost of water, for the past five years, has increased faster than inflation (National Restaurant Association [NRA], 2011b) and is expected to continue to increase. Factors affecting the cost of water include actual cost pricing (U.S. Environmental Protection Agency [EPA], 2003), predicted climate change (Spence & Altman, 2010), source shifting of water resources



(Fishman, 2011), infrastructure upkeep and development (Brzozowski, 2010; EPA, 2002; 2003), and increased energy costs associated with the processing of water (American Hotel & Lodging Association [AHLA], 2001; U.S. Energy Information Administration, 2010).

Water consumption in the restaurant industry has not been academically studied before (Alonso, 2008; Alonso & Ogle, 2010; Revell & Blackburn, 2007) and analysis was needed to understand current water consumption. The development of water use benchmarks and the influences of demographic variables allow operations to better understand their water use. Development of benchmarks permits more implementing of methods for reducing water consumption. Casual dining restaurants were the focus of this study because they use more water than quick service restaurants (Dziegielewski et al., 2000), comprise 38.5% of the restaurant population, and are responsible for 44.4% of the foodservice segment's annual sales (United States Census Bureau, 2007).

Four of the six research questions were based on Dziegielewski and other's 2000 study of water consumption conducted for the American Water Works Association (AWWA). His study analyzed water usage across 87 restaurants located in California, Colorado, and Florida. Dziegielewski et al. chose to determine water usage in restaurants by comparing the amount of water consumed versus seats, employees, interior square feet, meals, and customers.

This study continues Dziegielewski and other's initial research and creates two other benchmarks for water consumption. New benchmarks introduced include gallons of water consumed and percent water expense based on revenue. Additionally, this study determined whether specific demographic variables significantly impacted water consumption in casual dining restaurants in Kansas.

Initial testing was conducted to determine whether the research would be relevant and number of participants would be significant. A pilot test comprised of ten Midwestern micropolitan casual dining restaurants was completed. The pilot study was used to determine the most effective method for obtaining the demographic data. It was found that personal site visits were more effective than telephone interviews. Additionally, water consumption data was simpler to obtain by calling each municipalities clerk's office.

The population for the study was 952 CDR's in Kansas. The population was stratified into five regions and a sample of 60 restaurants from each region was randomly chosen. Each of the 300 sampled restaurants were called and asked to complete the ten demographic questions. If no-one was available or willing to respond to the telephone survey then an on-site visit was made to the restaurants by the principal researcher. Water consumption was obtained from the municipality or water district for each. Of the sample population, water consumption, water expenses, and demographic information was received for 221 (73.7%); seats for 174 (58%); employees for 171 (57%); and interior square feet for 147 (49%). Annual revenues were obtained for 193 (64.3%) casual dining restaurants.

## **MAJOR FINDINGS**

Descriptive statistics were used to determine the results for the research questions. The research questions in this study were as follows:

- Research question 1: What is the average water used, in gallons, for each dollar of revenue?
- Research question 2: What is the average water used, in gallons, for each restaurant seat?
- Research question 3: What is the average water used, in gallons, for each restaurant employee?

- Research question 4: What is the average water used, in gallons, for each interior square foot?
- Research question 5: What is the average water used, in gallons, for each dollar spent on water and sewer?
- Research question 6: What is the average percent water expense for casual dining restaurants in Kansas?

*Research question 1: What is the average water used, in gallons, for each dollar of revenue?*

Results showed after comparing consumption versus revenues for 193 casual dining restaurants that for every \$3.32 in revenues, one gallon is consumed.

*Research question 2: What is the average water used, in gallons, for each restaurant seat?*

For the 174 sampled casual dining restaurants, 12.79 gallons of water were consumed daily for each seat. This equates to a mean use of 4,668.54 gallons annually for each seat. Results from this study are dramatically different from Dziegielewski et al.'s 2000 study which found that 40.74 gallons per day were consumed for each seat, a 69% decrease in water use.

*Research question 3: What is the average water used, in gallons, for each restaurant employee?*

Results indicated that for each employee in the operation 67.77 gallons of water were consumed per day. Annual consumption per employee averaged 24,736.19 gallons.

Dziegielewski et al. found in 2000 that 168.7 gallons were consumed each day for each employee. The current study represents a 60% decrease in water consumption per employee.

*Research question 4: What is the average water used, in gallons, for each interior square foot?*

Results indicated that for 147 restaurants a mean of 0.52 gallons was used daily for each interior square foot. Dziegielewski and other's (2000) found an average daily use of 0.73 gallons, or a 29% decrease.

*Research question 5: What is the average water used, in gallons, for each dollar spent on water and sewer?*

Results found after comparing consumption versus water expenses for 193 casual dining restaurants that for every dollar in water expenses 152.98 gallons were consumed. The average water yearly expense for casual dining restaurants in the study was \$5,026. There were no similar results found in the literature for comparison.

*Research question 6: What is the average percent water expense for casual dining restaurants in Kansas?*

In 2010, 193 studied casual dining restaurants had average revenues of \$2,554,254 and average expenses of \$5,026 in 2010. As a percentage of revenues, 0.42 was spent on water. Again, there were no studies prior to this one indicating water expense as a percent of revenue.

## WATER CONSUMPTION

### *Demographics:*

Ten demographic variables were examined. Demographic variables were segmented into seasonality, region within Kansas, population area, menu type, and water source. Menu was classified into seven categories including combination (Applebees, Chilis, a comprehensive menu), American (steaks, burgers, BBQ menu), Mexican, Asian, Italian, Pizza, and other. Ownership referred to whether the casual dining restaurant was owned or operated as a franchise or corporate versus independent. Water source was either fossil aquifer or surface water. Irrigation applied if the CDR was responsible for an irrigation system immediately surrounding their building's footprint. Due to 20% of the sample located in rural areas, days open was recorded for each sampled restaurant. Additionally, management was asked if any water reduction equipment was installed in their operation and if they knew their water expenses for the previous month.

### **Season**

Mean annual gallons consumed for seasons was  $181,259 \pm 179,227$ . Summer had the highest consumption with mean gallons consumed of  $207,302 \pm 206,195$ . Paired T-Tests indicated significant differences between winter and spring ( $F = 79.038$ ,  $p \leq 0.000$ ), summer ( $F = 64.808$ ,  $p \leq 0.000$ ), and autumn ( $F = 80.801$ ,  $p \leq 0.000$ ). Significant differences were also found between spring and summer ( $F = 27.932$ ,  $p \leq 0.001$ ) and autumn ( $F = 9.847$ ,  $p \leq 0.000$ ). There were no significant differences between summer and autumn ( $F = 1.765$ ,  $p \leq 0.133$ ).

### **Region**

Gallons consumed based on region was found not to be significant ( $F = 2.380$ ,  $p \leq 0.053$ ) indicating region of the state had no impact on water consumption.

## **Population**

The population variable was found to be significant ( $F = 9.763$ ,  $p \leq 0.000$ ). Tukey HSD was utilized as the post-hoc test to determine significant differences within the variable.

Metropolitan ( $916,746 \pm 793,961$ ) was found to have significantly higher water consumption than both micropolitan ( $600,108 \pm 524,011$ ) ( $p \leq 0.005$ ) and rural ( $450,385 \pm 411,317$ ) ( $p \leq 0.000$ ). Micropolitan exhibited no significant difference with rural ( $p \leq 0.463$ ).

## **Menu**

Menu, based on gallons consumed, was significant ( $F = 2.921$ ,  $p \leq 0.035$ ). Tukey HSD found combination menus, those that include more food options than a themed restaurant, ( $901,924 \pm 785,859$ ) required statistically more water than American menus ( $580,374 \pm 517,935$ ) ( $p \leq .037$ ).

## **Ownership**

Water consumption for franchise or corporate versus independent restaurants was found to be statistically significant ( $F = 56.565$ ,  $p \leq 0.000$ ). Franchise and corporate CDR's expended significantly more water ( $1,201,318 \pm 877,473$ ) than independent operators ( $526,585 \pm 451,492$ ).

## **Water Source**

Primary water source, whether aquifer or surface, was found to be statistically different ( $F = 10.751$ ,  $p \leq 0.001$ ). Fossil aquifer had a significantly lower average ( $463,692 \pm 439,885$ ) than surface water which had a mean of  $807,484 \pm 721,518$ .

## **Irrigation**

Whether a restaurant irrigated or not was found to be statistically significant ( $F = 46.514$ ,  $p \leq 0.000$ ). Restaurants that irrigated had mean water consumption of  $1,338,490 \pm 930,038$  gallons versus those that did not irrigate totaling  $592,365 \pm 53,532$ .

## **Days Open**

The days open variable was found to be statistically significant ( $F = 6.085$ ,  $p \leq 0.003$ ). Restaurants open seven days ( $816,311 \pm 733,979$ ) each week used significantly more water than restaurants open six days ( $425,795 \pm 288,390$ ) per week. Tukey HSD found days open contained significant differences between seven and six days open ( $p \leq .005$ ) but not between seven and five days.

## **Water Reduction Equipment**

No significant differences were found ( $F = 0.713$ ,  $p \leq 0.400$ ) between the 33 restaurants that reported using water reduction equipment versus the 137 restaurants that did not use water reduction equipment.

## **Manager Know Water Expenses**

Whether a manager could or could not accurately recall last month's water expenses ( $F = 0.055$ ,  $p \leq 0.815$ ) had no significant differences on water consumption.

Stepwise regression was run to determine which demographic variables had significant contributions to water usage and to address collinearity among the variables. The model ( $F = 33.676$ ,  $p \leq 0.000$ ) found ownership ( $\beta = -.329$ ,  $p \leq 0.000$ ), irrigation ( $\beta = -.290$ ,  $p \leq 0.000$ ), and population ( $\beta = -.176$ ,  $p \leq 0.003$ ) were the only significant contributors for water consumption.

## **PERCENT WATER EXPENSE**

Percent water expense was developed based on the monthly, seasonal, and annual revenues compared with corresponding water expense. Annual water expenses had a mean of \$5,026 and mean revenues were \$2,554,254. The annual percent water expense was 0.42%, or less than 1/200<sup>th</sup> of a percent of revenues. Percent water expense was utilized as a dependent variable and compared with the ten demographics.

## **Season**

Percent water expenses for seasons contained variability. Spring's percent water expenses were  $0.38 \pm 0.44$ , summer's was  $0.47 \pm 0.63$ , autumn's was  $0.49 \pm 0.57$ , and winter's was  $0.37 \pm 0.43$ . Paired T-Tests indicated significant differences between spring and summer ( $p \leq 0.000$ ), and spring and autumn ( $p \leq 0.000$ ) with spring displaying significantly lower percent water expenses. Winter exhibited significantly lower differences than summer ( $p \leq 0.001$ ) and autumn ( $p \leq 0.000$ ). No significant differences were found between spring and winter or summer and autumn.

## **Region**

Regions were found to be significant ( $F = 3.167, p \leq 0.015$ ). Tukey HSD determined the northeast ( $0.62\% \pm 0.73\%$ ) was significantly higher than the west ( $0.30\% \pm 0.39\%$ ) ( $p \leq 0.022$ ) for percent water expenses.

## **Population**

No significant differences in percent water expenses were found ( $F = 2.236, p \leq 0.110$ ) between restaurants located in metropolitan, micropolitan, and rural areas.

## **Menu**

No significant differences in percent water expenses were found ( $F = 1.221, p \leq 0.303$ ) based on the menu type.

## **Ownership**

No significant differences in percent water expenses were found ( $F = 0.117, p \leq 0.732$ ) between restaurants owned by a franchise or corporate owner and those who were independent.



### **Water Source**

Primary water source, whether fossil aquifer or other, was found to contain statistically significant differences ( $F = 4.692$ ,  $p \leq 0.032$ ). Fossil aquifer had a mean percent water expense of  $0.46\% \pm 0.50\%$ , significantly higher than surface, that had a mean of  $0.28\% \pm 0.36\%$ .

### **Irrigation**

Whether a restaurant irrigated or not was not statistically significant ( $F = 2.015$ ,  $p \leq 0.157$ ) based on percent water expenses.

### **Days Open**

No significant differences in percent water expenses were found in the days open variable ( $F = 0.260$ ,  $p \leq 0.904$ ).

### **Water Reduction Equipment**

No significant differences were found ( $F = 0.021$ ,  $p \leq 0.886$ ) between restaurants that used water reduction equipment versus restaurants that did not for percent water expenses.

### **Manager Know Water Expenses**

Whether a manager could or could not accurately recall last month's water expenses ( $F = 0.378$ ,  $p \leq 0.540$ ) had no significant differences on percent water expenses.

Stepwise regression was run to determine which demographic variables had significant contributions toward percent water expenses based on annual revenues. The model ( $F = 4.485$ ,  $p \leq 0.036$ ) found only source, whether fossil aquifer or other, ( $\beta = -0.152$ ,  $p \leq 0.036$ ) significantly impacted percent water expenses of annual revenues.

## **RESEARCH CONCLUSIONS**

This study analyzed water consumption for casual dining restaurants in Kansas to determine benchmarks that had not been studied for more than ten years. Water consumption

should be studied because a restaurant's water costs are expected to increase. Additionally, development of future studies analyzing methods of decreasing consumption will require current benchmarks for comparison.

The current study found that less water was being used by restaurants in 2010 than was reported in Dziegielewski and other's research from 2000. The percent decrease was a surprising finding and the researchers are not sure why the large reduction in water consumption. Water consumption in casual dining restaurants in Kansas had a mean of 725,040 gallons for 2010. In comparison, Dziegielewski and other's 2000 study found restaurants used an average of 2,823,600 gallons per year. Water consumption for each seat dropped 69% and 60% for each employee and 29% for each interior square foot. However, exactly why the decrease occurred could not be ascertained. It could have been due to restaurant sizes, better, more effective equipment, locations of restaurants, type of restaurant or more efficient methods of operation by restaurants. Yet, these findings are positive for the restaurant industry.

It was found that season, population ( $F = 9.763, p \leq 0.000$ ), type of menu ( $F = 2.921, p \leq 0.035$ ), ownership ( $F = 56.565, p \leq 0.000$ ), water source ( $F = 10.751, p \leq 0.001$ ), irrigation ( $F = 46.514, p \leq 0.000$ ), and days open ( $F = 6.085, p \leq 0.003$ ) significantly impacted water consumption throughout casual dining restaurants in Kansas. However, when the stepwise regression was conducted ( $F = 33.676, p \leq 0.000$ ), only type of ownership ( $\beta = -.329, p \leq 0.000$ ), irrigation ( $\beta = -.290, p \leq 0.000$ ), and population ( $\beta = -.176, p \leq 0.003$ ) impacted water consumption.

This study found that, on average, casual dining operations in Kansas paid \$6.54 for every 1,000 gallons consumed. The mean annual water expenses for CDR's were \$5,026 and mean revenues \$2,554,254. In addition, this study found that casual dining restaurants in Kansas spent

0.42% of total revenues on water. However, no other studies have analyzed water expenses as a percentage of revenues so these results could be used as a benchmark for future studies.

The study identified demographic characteristics that affected percent water expenses. Significant differences were found in the season, region ( $F = 3.167, p \leq 0.015$ ), and water source ( $F = 4.692, p \leq 0.032$ ) variables. Stepwise regression was run to determine which demographic variables had significant contributions toward percent water expenses based on annual revenues. The model ( $F = 4.485, p \leq 0.036$ ) found only water source ( $\beta = -.152, p \leq 0.036$ ) significantly impacted percent water expenses of annual revenues.

The study affirmed that the restaurant industry is one of tremendous variability. The variability within water expenses ( $M = \$5,654, SD = \$15,409$ ), annual revenues ( $M = \$2,554,254, SD = \$3,244,694$ ), and the demographic variables may have been a cause of 80% of the standard deviations being larger than their means for the water expense variable. There is variability because no two CDR's are the same with differences in footprint, revenues, water expenses, and likely differences from management, policies, and procedures. This inconsistency suggests that water expense percentage may become an effective internal efficiency measure which may lead to more efficient water consumption.

The results of this study can be used by restaurant operations as a starting point for how much water is expected to be consumed by casual dining restaurants in Kansas. The study also may be utilized as an indicator of what demographics contribute to overall water consumption and may help in decisions to implement practices such as irrigation, water efficiency, and menu changes.

## LIMITATIONS

There were several limitations to this study.

1. Only casual dining restaurants in Kansas were studied and results cannot be generalized to other types of restaurants in the state or to CDRs not in Kansas.
2. This study did not analyze where water consumption occurs in casual dining restaurants and should not be used to explain areas of water usage.
3. The data was collected over a period of economic downturn. Actual water consumption may differ versus what would be available prior to or after 2010.
4. The study did not establish the minimum amount of water necessary for operational purposes.
5. Municipal water and sewer rates are controlled by local water districts and fluctuated throughout the state of Kansas. This fluctuation increased variability for water expense.
6. Because revenues for restaurants were obtained in groups of five and the average applied to each casual dining restaurant in the group, irregularities may have occurred for the percent water expense variable.
7. Standard deviations found among 23 of the 29 demographic variables for percent water expense were greater than the means. This variability contributed to unpredictability within each response.
8. The study did not establish a minimum water expense for operational purposes.
9. The study did not analyze how much energy is used to process water for use in CDR's which would assist in understanding the full cost of consuming water.

## **RECOMMENDATIONS FOR FUTURE STUDY**

Water usage in restaurants has not been academically studied in the past. As such the possibilities for future studies are vast. To develop water studies it must first be known how much water restaurants currently consume. With the development of the current information future studies could be:

- Water consumption in different types of foodservice operations including quick service, limited service, buffet, fine dining restaurants, and other foodservices including K-12, college and university, long term care facilities, hospital, and central production kitchens including airlines.
- Water consumption in foodservices beyond the state of Kansas and benchmarks should be updated for the states of Colorado, California, and Florida.
- Where in restaurants water is consumed. Determining how much sanitation, preparation, serving, cooking, and bathrooms consume versus other areas may lead to more effective methods of decreasing water consumption in restaurants.
- Water consumption using benchmarks established in this study and comparing across areas that are water stressed versus those that have plentiful water.
- Water consumption in areas suffering from different types of water stress.
- Energy use in the processing of water in equipment such as ice machines, steamers, dishwashers, and other's.
- The cost effectiveness of grey-water recycling in restaurants.
- The effectiveness of education, equipment changes, or policy changes on water consumption behaviors and total consumption.

- Assessment of how effective percent water expenses is as a self-measure or a measure for similar chain restaurants.
- The minimum amount needed to open a restaurant.
- Assessing the threshold amount or percentage for water expenses before restaurant operations actively seek methods of reducing water consumption
- Identifying how utilizing different production methods improve water consumption.
- Relating the effectiveness of sources available on the internet for ways of restaurants to decrease water and energy consumption. These include Energy Star (EPA, 2011a), WaterSense (EPA, 2011b), and National Restaurant Association's (2011b) Conserve website.
- The continued development of new and or more effective and efficient benchmarks for water use.

In conclusion, the cost of water is increasing and is expected to continue to increase. There are multiple methods for implementing water efficiencies in a hospitality operation, but the variability of the industry makes it difficult to determine benchmarks that apply to multiple operations. For more water efficiency suggestions it is recommended one visit the National Restaurant Association's Conserve (2011a) website at:  
[http://conserve.restaurant.org/issues/water-conservation\\_detail.cfm](http://conserve.restaurant.org/issues/water-conservation_detail.cfm).

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## **Appendix A: Use of Kansas Counties Map**

**K-State Webmail**

mvansche@k-state.edu

± Font Size ±

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**Re: Fw: Map of kansas Counties**

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**From :** TTaggart@fhsu.edu

Tue, Jun 07, 2011 10:55 AM

**Subject :** Re: Fw: Map of kansas Counties**To :** mvansche@k-state.edu

Hi, Matthew...

Reese forwarded me your request. You are welcome to publish the map in your dissertation. I can provide a higher resolution (bitmap or vector) version if needed as well. Just let me know.

Best, Travis

---

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ttaggart@fhsu.edu

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**From:** Reese E Barrick/FHSU  
**To:** ttaggart@fhsu.edu  
**Date:** 06/07/2011 10:04 AM  
**Subject:** Fw: Map of kansas Counties

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----- Forwarded by Reese E Barrick/FHSU on 06/07/2011 10:04 AM -----

**From:** Matthew VanSchenkof <mvansche@k-state.edu>  
**To:** rebarrick@fhsu.edu  
**Cc:** Matthew Vanschenkof <mvansche@ksu.edu>  
**Date:** 06/06/2011 12:00 PM  
**Subject:** Map of kansas Counties

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Reese: my name is Matt VanSchenkof and I am a phd candidate at Kansas State working on my dissertation. Your website: <http://webcat.fhsu.edu/ksfauna/herps/index.asp?page=kansas> has the best map of Kansas counties I am able to find. I am asking for permission to publish the map in my dissertation. If you are not the person to contact for this could you please point me in the right direction?

## **Appendix B: Form Email to Municipalities**

**K-State Webmail****mvansche@k-state.edu**[± Font Size ±](#)

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## Water statements - Open Records Request (KORA)

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**From :** Matthew VanSchenkof <mvansche@k-state.edu>

Tue, Aug 09, 2011 02:01 PM

**Subject :** Water statements - Open Records Request (KORA)**To :** Matthew Vanschenkof <mvansche@ksu.edu>

First, thank you very much.

My name is Matthew VanSchenkof and I am a PhD candidate at Kansas State University studying water usage in restaurants as my dissertation topic.

I would like the 2010 monthly water data (total water consumed and total billed for each month or the base and per 1000 gallon rates for water and sewer) for the following businesses in CITY / COUNTY:

Name of restaurant(s)	Address of restaurants
-----------------------	------------------------

I understand that according to the Kansas Open Records Act, the utility records for businesses, if available from the municipality, should be made available. (Residential records are not covered under KORA or FoIA.) Please let me know if there is anything else I need to do. If charges/fees are necessary then I will have those in the mail as soon as notified.

As my dissertation topic I am studying water use in restaurants throughout Kansas. The study is approved by the Institutional Review Board (IRB) of Kansas State University. If you have any question please direct them to me or my major professor, Dr. Elizabeth Barrett at 785-532-2208 or [ebb@ksu.edu](mailto:ebb@ksu.edu).

My contact information is:  
785-317-8090 (cell phone)  
104 Justin Hall  
Kansas State University  
Manhattan, KS 66506  
[mvansche@ksu.edu](mailto:mvansche@ksu.edu)  
fax: 785-532-5522

Thank you again for your help!

Matthew VanSchenkof  
PhD Candidate  
Hospitality Management  
Kansas State University

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## **Appendix C: Axio Survey**

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**AXIO SURVEY**

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**Water Usage in Casual Dining Restaurants DRAFT 3**

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**Survey Description**

This survey compiles the telephone demographic and background information about each restaurant.

Questions ask you to assign numbers to responses from the restaurant managers. Please do so carefully and accurately.

**Opening Instructions**

**Start here. The verbiage required for the survey begins on the next page.**

Thank you and good luck!

---

**Page 1**

---

This page should be open WHILE the telephone survey is taking place.

Questions ask you to assign numbers to responses from the restaurant managers. Please do so carefully and accurately.

If there are problems or unsure how to answer questions then explain in the comment box which is the last question.

Utilize the following to begin the telephone interview:

Hi, may I speak with the manager please?

My name is \_\_\_\_\_ and I am a student at Kansas State University assisting with a research project on water use in restaurants in Kansas. May I have 2 minutes to ask you 12 short demographic questions about your operation please?

According to Kansas State University requirements all information given by you will be kept private and not be shared with anyone except the principal researcher. It will be reported in aggregate form, NOT individually and will not be able to be traced back to a specific restaurant, city, or town.

**Question 1 \*\* required \*\***

What type of menu/food do you serve?

Select either "Unknown" or "American" if unsure.

- 1 = Combination (Applebees)
- 2 = American (Little Apple Brewery / Longhorns)
- 3 = Mexican (La Fiesta / Carlos O' Kellys)
- 4 = Asian (HuHot / PF Changs)
- 5 = Italian (Olive Garden)
- 6 = Barbecue (Famous Dave's)
- 7 = Pizza/Wings (Pizza Hut)
- 8 = Unknown

Characters Remaining: 2

**Question 2 \*\* required \*\***

Is your restaurant part of a chain or franchise or is it independent?

**1 = Chain/Franchise (4 or more locations available in united States)**  
**2 = Independent**

Characters Remaining: 2

**Question 3**

**How many days each week is your restaurant open?**

**Place whole number in box below.**

Characters Remaining: 1

**Question 4 *\*\* required \*\****

**Is your operation responsible for an irrigation system on property surrounding your restaurant?**

**1 = YES**  
**2 = NO**

Characters Remaining: 2

**Question 5 *\*\* required \*\****

**How many people can your operation seat INSIDE at one time?**  
(What is your seating capacity - BEST GUESS???)

**Do not include outdoor areas or patios.**

Characters Remaining: 6

**Question 6 *\*\* required \*\****

**How many employees do you have including management, full-time, and part-time?**

Characters Remaining: 6

**Question 7 *\*\* required \*\****

**How many employees are full time or work more than 30 hours each week?**

Characters Remaining: 6

**Question 8 *\*\* required \*\****

**What is the total interior square footage of your restaurant including kitchen and storage?**

**NOTE: Do not include decimal points or commas in your response, just numbers.**  
**Expect between 1500 and 7000 to be the response.**

Characters Remaining: 7

**Question 9 *\*\* required \*\****

**Is any water reduction equipment used in your operation?**

**1 = YES**



**2 = NO**

If they answer "YES" then ask what equipment is it and note in the box below.

Characters Remaining: 500

**Question 10** *\*\* required \*\**

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**Do you know what your water & sewer bill was for last month?**

**1 = YES**

**2 = NO**

Characters Remaining: 2

**Question 11** *\*\* required \*\**

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**I understand that sales figures are proprietary. As stated before, all information given by you will be kept private and not be shared with anyone. It will not be reported and will not be able to be traced back to a specific restaurant, city, or town.**

**Would you be willing to share your approximate weekly or annual sales/revenues for 2010.**

**NOTE: Enter a "W" for weekly then type in the number given.**

**If the answer is the annual number then just input the number.**

**If they choose not to share then enter a zero.**

Characters Remaining: 20

**Question 12** *\*\* required \*\**

---

**This is the final question.**

**The research should be available in late June. Would you like to receive a copy of the research upon completion?**

**If so, in what form?**

**Place information needed to send copy in the attached comment box.**

- NOT INTERESTED
- EMAIL
- MAIL
- Other: \_\_\_\_\_

Further comments about your response:

**Question 13**

---

**Thank you very much for your participation in this survey.**

**If you have chosen to receive a copy of the research then it will be sent in late June.**

**Thank you again for participating and if you have any questions or comments you may speak with: Matthew VanSchenk Hof at 785-317-8090**

**-or-  
Dr. Betsy Barrett at 785-532-2208**

**Enter any problems or discrepancies that may have occurred while answering the survey.**

Characters Remaining: 1000

**Question 14** *\*\* required \*\**

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**What is the corresponding sample number for this operation.**

Characters Remaining: 7

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**Closing Message**

**Thank you very much for your participation in this survey.**

**If you have chosen to receive a copy of the research then it will be sent in late June.**

**Thank you again for participating and if you have any questions or comments you may speak with:**

**Matthew VanSchenkof at 785-317-8090**

**-or-**

**Dr. Betsy Barrett at 785-532-2208**

- End of Survey -

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**Appendix D: Restaurant Call Sheet**

County:		South-Central (REGION)									
Restaurant Name	Sam. #	Phone Numbers	Call one date/time	Call two date/time	Call three date/time Refusal	Call four date/time	Call five date/time	Call six date/time	Refusal date/time		
Barton	SC4	Restaurant									
Bulder	SC8	Phone Number									
Bulder	SC13										
Bulder	SC14										
Bulder	SC15										
Cowley	SC20										
Harper	SC29										
Harvey	SC32										
Mipherson	SC40										
Reno	SC50										
Reno	SC56										
Reno	SC57										
Reno	SC58										
Reno	SC60										
Reno	SC62										
Reno	SC63										
Sedgwick	SC75										
Sedgwick	SC80										
Sedgwick	SC84										
Sedgwick	SC87										
Sedgwick	SC91										
Sedgwick	SC92										
Sedgwick	SC93										
Sedgwick	SC94										

## **Appendix E: Letter of Introduction for On-Site Surveys**



Department of Hospitality Management and Dietetics  
104 Justin Hall  
Manhattan, KS 66506-1404  
785-532-5521  
Fax: 785-532-5522

May 16, 2011

Dear Kansas Restaurateur:

My name is Matthew VanSchenkof and I am a PhD candidate at Kansas State University studying water consumption in Kansas restaurants as my dissertation topic. My major professor is Dr. Betsy Barrett, PhD, Associate Professor in the Department of Hospitality Management and Dietetics. The purpose of my study is to develop a baseline for the amount of water used in restaurants and to eventually determine if water usage can be decreased.

Your restaurant has been randomly selected from the 1,000 possible Kansas restaurants. I am here today to collect demographic data about your restaurant. This includes the number of seats, the interior square footage, the number of employees, etc. for your restaurant. We will use this data to compare water usage with other similar operations in the state.

My dissertation study was approved by the Institutional Review Board (IRB) of Kansas State University. All data collected will remain confidential and will only be reported in group statistics. If you have any questions you may direct them to me or my major professor, Dr. Barrett at 785-532-2208 or ebb@ksu.edu. If you are interested in a summary of the dissertation then I will email or mail one to you at your request.

Thank you for your help and participation!

Sincerely,

Matthew VanSchenkof  
PhD Candidate  
Hospitality Management  
Kansas State University

Dr. Betsy Barrett, PhD  
Associate Professor  
Hospitality Management and Dietetics  
Kansas State University


## **Appendix F: Letter of Institutional Review Board Approval**



University Research  
Compliance Office  
203 Fairchild Hall  
Lower Mezzanine  
Manhattan, KS 66506-1103  
785-532-3224  
Fax: 785-532-3278  
[www.k-state.edu/research/comply](http://www.k-state.edu/research/comply)

TO: Elizabeth Barrett  
HMD  
107 Justin

Proposal Number: 5731

FROM: Rick Scheidt, Chair   
Committee on Research Involving Human Subjects

DATE: February 10, 2011

RE: Proposal Entitled, "AN INVESTIGATION OF WATER USAGE LEVELS IN CASUAL DINING RESTAURANTS IN KANSAS"

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 4, 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.



## **Appendix G: Use of Dziegielewski and other's Table**

**K-State Webmail**

**mvansche@k-state.edu**

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## **Re: Water consumption: Commercial and Institutional End Uses of Water, 2000**

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**From :** Benedy Dziegielewski <benedykt@siu.edu>

Tue, Jun 14, 2011 01:16 PM

**Subject :** Re: Water consumption: Commercial and Institutional End Uses of Water, 2000

**To :** Matthew VanSchenkof <mvansche@k-state.edu>

**Cc :** Matthew Vanschenkof <mvansche@ksu.edu>, Elizabeth Barrett <ebb@k-state.edu>

Dear Mr. Vanschenkof:  
You have my permission to use the data (Tables 5.4 and 6.7) from the 2000 AWWARF Report.  
Good luck with your studies.  
Ben Dziegielewski  
Southern Illinois University Carbondale

On Tue, Jun 14, 2011 at 12:08 PM, Matthew VanSchenkof <mvansche@k-state.edu> wrote:

> Dr. Dziegielewski, my name is Matthew VanSchenkof and I am a PhD candidate at Kansas State University studying water usage in casual dining restaurants throughout KS as my dissertation topic. We have found some incredible things. Some of the baselines we used were initially used in your 2000 report.  
>  
> I am seeking permission to utilize a portion of your tables and to add on information that we found when looking at the same baselines. Specifically, tables 5.4 (page 102) and possibly table 6.7 (page 128).  
>  
> I have copied my major professor on the email in case you would like some more information.  
>  
> Thank you and I sincerely appreciate your help and the 2000 report!  
>  
> Matthew VanSchenkof  
> PhD Candidate  
> Hospitality Management  
> Kansas State University  
>  
> "Where all think alike, no one thinks very much."  
> --Walter Lippmann, writer and journalist  
>  
>

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