AN EVALUATION OF WATER NEEDS IN SOUTH AFRICAN COMMUNITIES

A Thesis

by

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ABSTRACT

The purpose of this descriptive, qualitative study was to assess water supply and demand constraints amongst two tribal communities in South Africa to determine opportunities for needs to be met. A snowball sampling method was utilized to locate and identify twenty survey participants (N = 20) to reach saturation of data. Ten survey participants (N = 10) from each community were interviewed. A semi-structured interview process was employed with participants to help achieve the study's objectives in two communities. Ajzen's theory of planned behavior was used to frame this study.

The study showed that the primary barriers which exist in both communities to increase water availability are due to deficiencies in conservation practices, funding, competent employees, leadership accountability, and security enforcement. The Makgato and Welverdiend communities held parallel water saving and transportation practices, consisting of jerry cans, tubs, storage tanks, wheel borrows, small trucks, mules and manual labor. Overall, attitudes expressed by survey participants show that community members were mindful that change needs to be directed from the community level in order to improve current water conditions. The majority of participants were hopeful that their community could create progress in the future by using the powers that they currently hold to influence necessary changes.

Competent and effective Extension Systems are needed to assist farmers in tribal communities to acquire and conserve water. Governmental and non- governmental Extension organizations can work with farmers to reduce barriers regarding the access of

water through the promotion of community involvement and responsibility. Training is needed to enable community members to manage and repair water technologies. Extension personnel can better foster an understanding of the innovations to conserve water for farm and family use to aid in the battle against food security.

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NOMENCLATURE

BMP	Best Management Practices
DWAF	Department of Water and Affairs and Forestry
FAO	Food and Agriculture Organization
MEGA	Mpumalanga Economic Growth Agency
MIG	Municipal Infrastructure Grant
NGO	Non-Governmental Organization
SADC	Southern Africa Development Community
UNESCO	United Nations Educational, Science and Cultural Organization

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CHAPTER I

INTRODUCTION

By 2050, the world population is expected to rise by two billion, bringing the total population to 9.4 billion (Folly, 2011). In Sub Saharan Africa, the population is estimated to surge from 850 million to approximately 1.7 billion by 2050 (Hachigonta et al., 2013). Southern Africa alone will make up around 14 percent of the African population and close to 3 percent of the world's population in 2050 (Hachigonta et al., 2013).

Meeting food demands in a sustainable manner will be an enormous challenge. Today, approximately one billion people are undernourished, 578 million being from Asia and 239 million from Sub-Saharan Africa (Food and Agriculture Organization [FAO], 2011). Agricultural growth is imperative in developing countries to produce enough food to ensure security in the future and at present. An expected rise in population will require an increase in agricultural output. Such demands will substantially increase water consumption and water competition on a global scale (FAO, 2006).

Several variables exist and have an effect on meeting food production demands as the global population rises to 9.4 billion (Nelson et al., 2010). The following figure 1.1 represents specific variables that have significant effects on Food Security by 2050. This study in particular targets the topic of water as it relates to global food security.

Figure 1.1. Variables Affecting Food Security by 2050 (Food and Agriculture Organization [FAO], 2009)

Water Impact on Agriculture

Water is essential for maintaining an adequate food supply and an environment for population growth (Pimentel at el., 2004). Humans obtain the vast majority of their nutrients from livestock and crops. Both of these nutrient sources require water and land for production (Pimentel et al., 2004). Over the past 20 years, food supplies per capita have declined by 17% due to the increase in population and restricted availability of

cropland and water (FAO, 2002). Food supply shortages have contributed to the major global problem of more than 3 billion malnourished people (World Health Organization [WHO], 2004).

Population growth and increased water demand will result in increasing water shortage and create biodiversity stress in the global ecosystem (Pimentel et al., 2004). Furthermore, serious difficulties exist for equitably allocating the world's limited freshwater resources within and amongst countries. This leads to escalating conflicts amongst the agricultural, industrial and development sectors of society (Pimentel et al., 2004).

Water used for food production is one of the greatest pressures to freshwater resources. Approximently 30% of all fresh water is stored as groundwater and most groundwater has accumulated over millions of years in aquifers, which are replenished through rainfall. Aquifers provide close to 23% for water used by society (USGS, 2003). Irrigation for agriculture relies predominantly on groundwater (Pimentel et al., 2004). The irrigation sector uses approximately 50 percent of the amount of water which is consumed (Sibanda et al., 2013, p. 193). Ground water irrigates about 24 percent of the irrigable land, whereas surface water irrigates around 76 percent (Sibanda et al., 2013, p. 192). Compared to the groundwater recharge rate, the overdraft of global groundwater is much higher.

Agricultural demands contribute to approximately 70% of freshwater withdrawals globally (United Nations Educational, Science and Cultural Organization [UNESCO], 2013). In Africa, the total amount of water withdrawn from groundwater

for the use of agriculture is about 85% (United Nations Water/Africa Agency, 2009). Agriculture is a primary source of income and employment for the majority of tribal populations in the Southern Africa Development Community (SADC). SADC member countries consist of: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia, and Zimbabwe.

Climate Change

The challenge of meeting future food demands may become even more enormous and challenging when one takes in to the effect of climate change for food production. Climate change variables effecting food production include higher temperatures, shifting seasons, extreme weather events, and drought (Sibanda et al., 2013). Extreme weather events negatively affect agriculture everywhere, including Africa, for example (Sibanda et al., 2013). Crop yields are reduced by high temperatures as soil moisture content is reduced (Sibanda et al., 2013), and Nelson (2009) suggests that greater variations in precipitation patterns increase crop failures and damages production in the long run.

There is a concern that climate change will intensify current agricultural challenges in developing countries, due in part to communities who are directly dependent on the natural environment and lack the resources to effectively adapt to extreme climate changes (Meinke et al., 2006; Ziervogel et al., 2008). This is mostly true for communities who are subsistence farmers or rely on rain fed agriculture. Because agricultural production is dependent on and affected by precipitation and local temperature conditions, any changes require farmers to adapt, and adaptation requires

resources (IFPRI, 2013). Smallholder farmers with limited resources account for the majority of agricultural production in Southern Africa (Sibanda et al., 2013). This makes the agricultural sector very vulnerable to climate change impacts (Sibanda et al., 2013). Rapid population growth results in even more pressure on regional water resources.

Water Sustainability

Maintaining water sustainability in sub-Saharan Africa is a goal for reducing poverty and hunger. Africa holds about one-third of the world's major international water basins (United Nations Environment Programme [UNEP], 2010), and has an abundance of water resources, including large rivers, lakes, and widespread ground water resources. Yet, despite this abundant water supply, more than 300 of the 800 million people in sub-Saharan Africa live in water scarce environments (New Partnership for Africa's Development [NPAD], 2006). Furthermore, Africa faces several socio-economic challenges that call for action in order to counteract current poverty and underdevelopment trends. The role of water to accomplish needed socio-economic development goals is becoming increasingly apparent (United Nations Water/Africa Agency, 2009).

South Africa has three main river drainage basins: the Vaal, Orange, and Limpopo. Many irrigation schemes have been developed along or near these major rivers and their tributaries and approximately 1.5 million hectares are under irrigation (Sibanda et al., 2013, p. 15). However, water resources are limited due to natural and human-induced threats. Human threats include: inappropriate institutional arrangements and governance directed towards managing water basins; reduction of clean water resources

due to pollution, deforestation, and environmental degradation; lack of investment to further develop and protect resources; and unsustainable financing for water supply (United Nations Water/Africa Agency, 2009).

The vast majority of Africa's water basins are international and water resource management is difficult without partnership and cooperation between countries (United Nations Water/Africa Agency, 2009). Conflicts between countries have expanded and could intensify as water scarcity increases (Schreiner & Hassan, 2011). While laws exist to deal with water conflicts at the national and local levels. Current international laws are inadequate to address conflicts between countries (United Nations Water/Africa Agency, 2009).

The South African Development Community (SADC) on Shared Watercourse Systems established a model to predict what could be achieved when countries cooperatively manage shared water resources. Water projects occurring between countries are positive examples of cooperation at the regional level. These projects include the Lesotho Highlands Water Project, shared by South Africa and Lesotho, and the Kornati Basin Project, which is held between South Africa and Swaziland (United Nations Water/Africa Agency, 2009).

Water Supply Problem

Municipal water management and government disconnects provide communal water supply and demand constraints in the Limpopo and Mpumalanga provinces of South Africa. Municipal water service management is critical for development and national water security (Schreiner & Hassan, 2011). Sustainable water services greatly

depend on local government authorities to ensure the basic needs of communities are met. During 2009, water service failures in the Limpopo region of South Africa increased as a result of unsafe delivery of unsafe water, or no service at all from municipalities. Local water supply failures had intensified due to ongoing poor maintenance of pump stations, untreated borehole water, contamination, and sewage spills (Benson, 2009).

In 1994, the Department of Water and Affairs and Forestry (DWAF) published a White Paper on Water Supply and Sanitation. The goal of the policy was aimed at insuring that all South Africans have access to essential basic water supply at a cost which is affordable to households and the country as a whole (RSA 1994). The White Paper emphasized international experience and the failure of technicist supply- driven approaches as it relates to infrastructure delivery (Schreiner & Hassan, 2011).

To counteract issues of water insecurity, reforms were implemented amongst South Africa's water services and were established to focus on the development of new infrastructure and capital projects. In 2009, an approach was endorsed in South Africa to drive a comprehensive plan to strengthen governance and accountability (Schreiner & Hassan, 2011). Since that time, every municipality was required to devise a strategy to solve issues within its jurisdiction area. However, service delivery lacked focus on local people to secure operation and maintenance, partially due to pressures on municipalities to meet government goals and absorb funding (Harvey & Reed, 2006). Meeting these goals narrow the scope for local civic engagement directed towards defining community needs, responsibility, priorities and options (Schreiner & Hassan, 2011).

Government efforts, gaps and disconnects are common issues affecting water access in tribal communities in South Africa. Several failures amongst water service delivery have created opportunities for local South Africans to reflect upon their relationship with government, what powers they hold or no longer have, and how water supply can be increased within the community to meet demands (Schreiner & Hassan, 2011). Locally derived insights within communities provide value for understanding the nature of water management in specific locations which help to identify the conditions and constraints on effective water management (Ivey et al., 2004).

Local Government Structure

There are three broad types of municipality tiers: metropolitan, district and local (Schreiner & Hassan, 2011). Metros have the most resources and largest degree of autonomy. The two-tier system of local government is composed of five to eight local municipalities under one district municipality. This type of system incorporates a wide range of functions and powers (Schreiner & Hassan, 2011). In some areas of South Africa, the district municipality is the dominant authority and has primary responsibilities for the provision of services, while in other areas, district municipality functions and powers are limited and the responsibility for service delivery rests around decision-making authority and allocation of resources.

Location Profile

South Africa is located at the southern tip of Africa and is composed of approximately 1,214,470 square kilometers of land (Central Intelligence Agency [CIA], 2013). The population of South Africa is estimated to be 51.8 million (CIA, 2013), of

which about 8.5 million people are directly or indirectly dependent on agriculture for income or employment (Hachigonta et al., 2013). Agriculture contributes to about 3 percent of South Africa's GDP (South Africa, GCIS 2009). Agricultural activities range from intensive export production (fruit, wine, and field crops) to cattle and sheep farming. South Africa possesses an agricultural system consisting of well-developed commercial farming and subsistence production in rural areas (Hachigonta et al., 2013).

The most important limiting factor in agricultural production is water availability. Approximately 50 percent of South Africa's available surface water is used for agricultural purposes (Hachigonta el al., 2013). Current issues affecting water availability consist of extensive water conservation and control measures for rivers and lakes; water usage outpacing supply; pollution; soil erosion; and desertification (CIA, 2013).

The Limpopo providence is South Africa's northernmost province. Its total area is 125,755 square kilometers and is home to a population of 5.5 million people (South African Yearbook [SAY], 2012). The capital city, Polokwane, is one of the fastest growing cities in the Southern Hemisphere (SAY, 2012). The Limpopo is located within the savanna biome consisting of mixed grassland and trees, which is locally often referred to as bushveld. Named as the "garden of South Africa," the Limpopo produces the majority of South Africa's horticultural products which consists of mango, papaya, avocado, and tomatoes (SAY, 2012). Commercial agriculture and subsistence farming is the mainstay of the tribal population.

Mpumalanga province lies in the northeast of South Africa and holds a human population of 4.2 million (SAY, 2012). Its total area is 76,495 square kilometers (CIA, 2013). Mpumalanga contains the southern half of Kruger National Park and it transitions from the high plateau grasslands of the Middleveld and to the savannas of the Lowveld. Mpumalanga produces about 80 percent of the country's coal and remains the largest production area for agriculture and forestry as well as horticultural crops (SAY, 2012). Agriculture consumes about 68 percent of the land in the province (Mpumalanga Economic Growth Agency, [MEGA], 2014).

During the months of July and August 2014, the researcher was based at Ivy Safaris and the Wits Rural Facility. Ivy Safaris is located in Munnik, Limpopo, South Africa. Wits Rural Facility is located in Acornhoek, Mpumalanga, South Africa. The two locations were selected for logistic reasons and due to connections with the Makagto and Welverdined communities.

Local translators were available to help the researcher communicate with the local communities for interviews. The primary language spoken in the Makgato community is Sotho while the dominant language spoken in the Welverdined community is Shangaan.

Need for Study

South Africa is a water scare country with a rapidly growing population (Schreiner & Hassan, 2011). Water supply and demand constraints present major challenges for local governments to provide effective services to communities. Amongst rapid population growth, many municipalities have not appropriately resourced water

services and have major municipal skills gaps (Schreiner & Hassan, 2011). Water losses associated with neglected maintenance have created supply bottlenecks and have significantly raised the cost of water provision (Schreiner & Hassan, 2011). In response to inadequate services, corruption and unresponsive municipal councilors, social protests has pushed government to provide and implement a turnaround strategy to strengthen service delivery performance by local municipalities level. However, the more services are upgraded and expanded, the greater the need for communal involvement to help implement strategies effectively (Schreiner & Hassan, 2011). The DWAF/UNESCO/ WMO (1998) suggest that unless stakeholders are directly engaged, the chance for failure of water supply systems is increased. Thus, empowering and involving individuals is a cornerstone to stakeholder-driven approaches (DWAF/UNESCO/WMO, 1998). Improved water service management is imperative to enable the inclusive agricultural growth and development South Africans need to reduce poverty.

This study responds to the need to better understand what barriers and opportunities exist to increase water access in South African tribal communities and what powers community members hold to impact and influence change. Understanding the communal challenges that exist towards increasing water delivery and access in what ways community members influence water related decisions, can open doors to help create sustainable solutions. The theory of planned behavior and the diffusion of innovations were employed to meet the needs of this study.

Extension Systems

The role of Extension Systems can impact farmers' water usage and the extent homeowners conserve water within their households. Hanson (1995) suggested that extension officers should assist farmer's adoption of water technology to help food production while conserving water. Extension personnel can help farmers decide how much water is needed for agricultural production in the respective farm operation (Tyndall & Roesch, 2014). Extension officers can also work with farmers to develop Best Management Practices (BMP) in order to more efficiently and effectively utilize water for agricultural production (Mangiafico et al., 2010). Additionally, farmers can be accurately informed by extension officers about the impact of nonpoint source water pollution from indiscriminate use of fertilizers and how to reduce this problem (Shepard, 1999). Extension personnel can also help homeowners conserve water and inform homeowners which floras in the landscape are less dependent on water for survival (Brown, 2009). Bakacs, Obropta, Rossi, and Barnett (2013) indicated that extension staff played the primary role in homeowners adopting water conservation technologies. Finally, Extension officers need program evaluation training to help them implement evaluation techniques to assess Extension water conservation programs (Shepard, 2002).

CHAPTER II

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Theory of Planned Behavior

Ajzens' (2005) theory of planned behavior is utilized to fame this study. Ajzen (2005) defines attitudes as the disposition to respond favorably or unfavorably to an object, person, institution, or event. This theory states that attitude toward behavior, perceived behavioral control, and subjective norms will shape an individual's behavior and intention to perform a given behavior (Ajzen, 2005). Intentions are understood to capture the motivational factors which influence a behavior (Ajzen, 2011). Intentions are indicators of the amount of effort an individual is willing to exert in order to perform. Thus, when the intention is strengthened, performance will also be stronger. However, this does not necessarily predict actual behavior.

Beliefs of a culture or individual reflect on the information people have in relation to the performance of a particular behavior (Ajzen, 2011). Behavior is said to be reasoned or planned when subjective norms and perceptions follow consistently from the beliefs of an individual (Ajzen, 2011). In the Theory of Planned Behavior, affect and emotions serve as background factors which influence normative or control beliefs (Ajzen, 2011). Attitudes have an effect on evaluations and how a person perceives a situation. Individuals in a positive state, for example, will often evaluate events more favorably as they occur (Ajzen, 2011). Attitude, perception, subjective norm, and intention each reveal a separate aspect of behavior (Ajzen, 1991). Knowing and understanding such beliefs serve as a point of attack in attempts to change (Ajzen, 1991).

The theory of planned behavior has been used in many studies to examine the role and influence of background factors, motives, individual differences, and intentions. Background factors are most relevant to this study. These factors include; life values and personal nature; demographics such as gender, income, education, and age; and exposure to sources of information (Ajzen, 2011). Factors are expected to directly influence intentions and behavior indirectly (Ajzen, 2011).

Predicting Intentions

The theory of planned behavior holds three independent determinants of intention (Ajzen, 1991). These determinants include; attitude toward the behavior, subjective norm, and perceived behavioral control. Attitude towards the particular behavior refers to the degree which a person has favorable or unfavorable evaluation of the particular behavior in question. The second determinant, subjective norm, refers to the perceived social pressure to perform or not perform a particular behavior. The third determinant of intention, perceived behavioral control, refers to the perceived difficulty or ease of performing a behavior. The behavior is thought to reflect past experiences in addition to anticipated obstacles (Ajzen, 1991). Using the theory of planned behavior can help to understand how extension services can be better implemented in South African communities through the involvement of local farmers and community members.

Change Agents and Opinion Leaders

Rogers (2003) identified opinion leaders as members who exert influence within a social system and earn leadership based on technical competence, social accessibility,

and conformity to the system's norms. Opinion leadership serves as an apt model for innovation behavior and may influence other individuals' attitudes or behavior in a desired way. Change agents are individuals who influence a clients' innovation-decision in a direction deemed desirable by the change agency (Rogers, 2003). Change agents are often professionals in a technical field and typically seek to obtain the adoption of new ideas, or conversely they may attempt to prevent or slow down the adoption of undesirable innovations. Opinion leaders are used by change agents to act as their lieutenants in adoption diffusion campaigns (Rogers, 2003).

Innovative opinion leaders and leaders who are against change can exist in any system (Rogers, 2003). Influential individuals can help in the effort to spread new ideas, or they can chief an active proposition. Rogers (2003) suggested that the main characteristic of opinion leaders is their unique and influential position within the communication structure. Opinion leaders are at the center of the communication network which consists of interconnected individuals who are joined by flows of information (Rogers, 2003). Thus, the interpersonal network of an opinion leader allows him or her to serve as a social model.

Innovation Diffusion Theory

Rogers' (2003) diffusion of innovations theory defined rate of adoption as the relative speed an innovation is accepted through a social system. The diffusion of innovations is the evolution in which an innovation is communicated through certain channels over time by members of a social system (Rogers, 2003). Innovation is an idea, practice, or object perceived as being new by an individual.

Rogers (2003) designed a five- stage model to illustrate the process of the innovation- decision. The second stage, persuasion, is when a positive or negative perception is developed towards the innovation. Rogers (2003) identifies five perceived attributes of an innovation, which help to determine an innovation's rate of adoption. These five attributes are (a). Relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability.

The first attribute, relative advantage, refers to the extent in which an innovation is perceived as more advantageous than the past method (Roger, 2003). Social status and economics are examples of motivations that have the power to influence an innovation's relative advantage. Relative advantage is one of the best indicators of an innovation's rate of adoption (Rogers, 2003).

The second perceived attribute, compatibility, is the extent to which an innovation is consistent with existing needs and values of fellow adopters (Rogers, 2003). An innovation's compatibility produces a sense of understanding and compatibility for the potential adopter. In fact, Rogers (2003) suggested individuals will not adopt an innovation if the innovation is not familiar. As the compatibility of an innovation increases, the more likely the adoption will take place because the innovation requires less of a change in behavior than the previous approach (Rogers, 2003).

The complexity of an innovation is negatively associated with the rate of adoption. Complexity is the extent to which an innovation is thought or perceived to be difficult to comprehend and implement (Rogers, 2003). Innovations can often be

confusing and unclear to potential adopters. In fact, Rogers (2003) suggests that complexity is the strongest barrier to an innovation's rate of adoption.

The fourth stage, trialability, is the extent to which an innovation may be used for a limited time (Rogers, 2003). Innovations which can be tested have a higher rate of adoption than those which cannot be. According to Rogers (2003), early adopters perceive trialability to be more important than late adopters. Trials help potential adopters to learn how an innovation operates within their own environment and is a way to dispel uncertainty about the new idea (Rogers, 2003).

Lastly, observability is the extent to which the innovation's outcomes are observable to others (Rogers, 2003). Even though some innovations are easier to observe than others, an innovation that is highly observable holds a greater chance of adoption than an innovation not easily observed by potential adopters (Rogers, 2003). The observability of an innovation is positively related to the rate of adoption.

Planned Behavior and Innovation Diffusion Theories in Practice

The theory of planned behavior and the diffusion of innovations has been used in several extension education and international agriculture studies to better understand and identify the rate adoption in agricultural settings.

The theory of planned behavior was applied in a study conducted in China in order to better understand the purchase intentions of agricultural machinery (Feng, Zheng, Mu, 2010). Fielding et al. (2008) conducted a study on social identity of farmers while using the theory of planned behavior to explain decisions of agricultural practices. Lynne et al. (1995) used the application of the theory of planned behavior in the study of

water saving technology adoption and investment behavior for Florida strawberry farmers. The theory of planned behavior was also used in a study by Lam (2006) to predict people's intentions to save water in Taiwan. In Brazil, researchers studied farmers' decisions and behavior by employing the theory of planned behavior to analyze factors that affect the adoption of natural grassland improvement (Borges et al. 2014).

The diffusion of innovations theory has been widely implemented across the globe to gain a better understanding of farmer's adoptions of agricultural innovations. Wynn, Coppedge, and Strong (2013) utilized the diffusion of innovations to scaffold a study centered on farmer's adoption of Integrated Pest Management practices in Trinidad and Tobago. In a similar study, Mugonola et al. (2012) used the diffusion of innovations to study the adoption of soil and water conservation technologies in south western Uganda. The diffusion of innovations was also used as theoretical framework in a study on agricultural innovation in Guatemala (Oleas, Dooley, Shinn, & Giusti, 2010). Silberg, Murphrey, Wingenbach, and Lombardini (2013) utilized the diffusion of innovations to frame a study on the adoption of agricultural innovations in Guatemala. Strong (2013) used the diffusion of innovations to frame a study on agricultural loan distribution to Mexican farmers. On a more local level, the diffusions of innovations was also used by Dridi and Khanna (2005) to determine water technology adoption and gains from water trading under asymmetric information in the United States.

Numerous factors that influence the adoption or non-adoption of an innovation amongst groups in sub-Saharan Africa, were revealed through literature review by researchers. Lack of assets, such as equipment or education, greatly limited adoption

rates of new innovative technologies (Muzari, Gatsi, & Muvhunzi, 2012). Farmers who were provided with financial, educational, and facility assistance by local institutions exhibited positive influence on the farmers' adoption of new technologies (Muzari et al., 2012). Muzari et al. (2012) supported Abdulai and Huffman's (2005) findings which suggest access to education and contact with extension agents positively affect adoption rates.

Chi and Yamada (2002) found that farmers chose to adopt or not adopt a technology based on their perception of its usefulness in reference to their circumstance. If improved outputs were demonstrated, farmers demonstrated positive perceptions about the technologies. Word of mouth and demonstrations helped to diffuse and increase adoption rates (Chi & Yamada, 2002). This study aligns with Rogers (2003) findings that given an innovation exists, communication must take place if the innovation is to diffuse. Diffusion is a significant part of the adoption process because it is tied with the information exchange which relies on communication channels (Rogers, 2003).

Educational and Extension Services

Extension personnel are responsible for helping target audiences in order to foster a change in behavior respective to the innovation extension is promoting (Battel & Krueger, 2005). The diffusion of innovations can help extension services determine why target audiences chose to adopt or reject an agricultural innovation (Hubbard & Sandmann, 2007). For years, educational and agricultural extension services have been used in sub – Saharan development. These services can be focused on several aspects,

such as assisting farmer groups, production improvement, farmer training, and partnering with agencies and service providers for additional work (Davis, 2008). In some cases, the impacts of educational services may be difficult to measure. However, they have generally proved to have positive effects on production, knowledge, and adoption of technology (Davis, 2008).

McCole et al. (2014) studied the role the diffusion of innovations played on the challenges of extension services in Uganda. Genius et al. (2013) use the diffusion of innovations to frame their study of technology adoption and extension services for olive farmers in Greece. Poolsawas and Napasintuwong (2013) employed the diffusion of innovations to investigate farmers' adoption of a maize variety due to their participation in a Thai extension program. The lack of professional development for extension personnel in Sierra Leone hindered farmers' adoption of agricultural extension programs (Moriba, Kandeh, & Edwards, 2011).

Researchers have used the diffusion of innovations to examine farmers' adoption of extension programs in the United States too. Battel and Krueger (2005) applied the diffusion of innovations to examine farmers' adoption of a manure management extension program in Michigan. Peterson, Cassman, and Cantrell (2002) implemented the diffusion of innovation to study farmers' adoption of transgenic crops in Nebraska. Through the implementation of the diffusion of innovations, cotton farmers in the Southeastern United States reported an increase in participation in an extension precision farming program (Velandia et al., 2010).

Extension and educational services would include conservation practices, water infrastructure maintenance, supply management training, and business leadership accountability to help improve water reliability and services within communities. Limited water access and supply can be attributed to several factors including poor maintenance and management from service providers (Schreiner & Hassan, 2011).

The social, cultural, and economic variability of Africa can make it difficult to identify effective local solutions without active and early involvement of local farmers and communities (Barrett, 2002). According to Barrett (2002), individuals invest only when adequate information supports the conclusion that the investment will have payoffs within the related planning horizon and when individuals have the confidence in the organizations which ensure they will reap benefits. Agricultural and development communities have embraced participatory approaches in the past, however, there remains little institutional structure to increase participation to scales beyond intervention sites (Barrett, 2002).

Extension and educational services could help to eliminate water supply and demand constraints in South African communities. There is opportunity for tribal communities to better their water services and supply, especially with increased training and education. Agricultural and extension education researchers offer special services and connection by communicating information from Ministries of Agriculture and various groups to agricultural lending institutions (Strong, 2013). By improving water services and supply, it is possible to have a greater impact by improving health and reducing poverty.

CHAPTER III

PURPOSE, OBJECTIVES AND METHODOLOGY

The purpose of this study is to assess water supply and demand constraints amongst two tribal communities in South Africa to identify needs for water and potential opportunities to better meet these needs. The research objectives sought to:

1. Examine barriers to water availability and possible opportunities to increase access within the South African communities;
2. Determine South African community adoption of water saving methods for transportation and/or agricultural purposes (Ex: field leveling, furrow, flood, and drip irrigation, channeling, plastic film, field leveling, sprinkler systems, and drought resistant seeds);
3. Describe attitudes of community leaders, consumers, and users within each community towards ownership of water supply infrastructure and water management; and
4. Assess the impact attitudes of community members have on ability to increase water access (supply) and reduce water use (demand) within the communities.

Research Design

A descriptive and fundamental qualitative research design (Creswell, 2009) was used to conduct this study. Methods were chosen in order to describe the sample and identify potential relationships amongst selected variables of interest (Franekel & Wallen, 2009). According to Creswell (2009), qualitative data analysis provides depth to look beyond ranks and counts by recording attitudes, feelings, and behaviors. Qualitative

data encourages people to expand responses and can open up new topics for inquiry not initially considered by researchers. In addition, qualitative data simulates individual experiences by allowing participants to provide a detailed picture of why people act in a specific was and how they feel about a given action (Creswell, 2009). In comparison to quantitative analysis, qualitative research is typically less easy to generalize due to smaller and potentially less representative samples (Creswell, 2009). Compared to quantitative data acquisition, obtaining high quality qualitative data may be more time consuming and dependent on the researcher's observational, interview, and meeting management skills (Franekel & Wallen, 2009).

Qualitative research has been used in several agricultural studies on local and global scales. For example, Zarafshani (2002) used a descriptive qualitative research design in a study to identify opportunities for sustainable rural development for farmers with a watershed in Iran. The same research method was also utilized in a case study conducted in South Africa to understand perceptions amongst farmers and agricultural extension officers about agricultural policies (Tobin, Bruening, Brennan, & Olson, 2012). Moore (2012) employed a qualitative approach in a study to investigate perceptions for extension and advisory services in the Caribbean. Using qualitative methodology, researchers performed a study in Cyprus to determine practices of communication information amongst farmers and the local Department of Agriculture to strengthen Extension Service (Snow & Ingram, 2011). On a local level, researchers used a qualitative design to examine farmer perceptions of agro-ecosystem research projects in Nebraska (Wortman, Christiansen, & Glewen, 2005).

Qualitative research on adoption has also been utilized in several agricultural studies to determine methods and practices. Knowler and Bradshaw (2007) used qualitative research to study farmers' adoption of conservation agriculture. A qualitative study was employed to understand the adoption and use of agricultural decision support systems in the Australian cotton industry (Mackrell, Kerr, & Hellens, 2009). Researchers used Rogers (2003) innovation-decision model to determine that participants who achieved high levels of implementation success were resourceful in adapting technology to their changing needs. Feder and Umali (1993) implemented qualitative research to understand the adoption of agricultural innovations and the impact policy interventions holds on technology adoption. Qualitative research was used to determine the adoption of agricultural management practices amongst watersheds in Indiana (Reimer, Weinkauf, & Prokopy, 2012). Andersson and D'Souza (2014) also used qualitative methods in their research to understand the adoption of conservation agriculture amongst smallholder farmers in southern Africa. Grabowski and Kerr (2013) used qualitative methods to study resource constraints and adoption of conservation agriculture by farmers in Mozambique. Qualitative methods were employed to evaluate the barriers to adoption of sustainable practices (Rodriguez et al., 2009). A qualitative research study was utilized to determine the role of communication and co-operation in the adoption of precision farming in the Czech Republic, Denmark and Greece (Kutter et al., 2009). Adesina and Forson (1995) conducted a qualitative study in West Africa to examine the perceptions and adoption of new agricultural technology. Batjes (2014)

used qualitative methods in a study to interpret the adoption of soil and water conservation practices in Kenya.

Study Area Description

The study is located in South Africa, which has an estimated population of 54,002,000 people (CIA, 2014), and it is ethnically very diverse. According to Fraenkel and Wallen (2009) the population of a study is the group in which the results should be generalized. This study was based on two communities in northern South Africa. During the apartheid era in South Africa, which started when the Nationalist party came to power in 1948 and lasted until the establishment of majority rule in 1994, small areas of the country were designated as homelands for the various native tribal entities. In northern South Africa, these included Gazankulu, KaNgwane, Lebowa, and Venda. Today these former homeland areas are included in the Mpumalanga and Limpopo provinces (two of nine of South Africa's provinces). One community from each of these provinces and that were formerly part of Gazankulu and Lebowa homelands were selected for the study.

The Makgato community is located in the Limpopo province of South Africa. The population of Limpopo was approximately 5,630,500 (CIA, 2014). The population of the Makgato community was about 4,328 (CIA, 2014). The Welverdiend community is located in the Mpumalanga province of South Africa. The population of Mpumalanga is 4,039,939 (Welverdiend, 2014). According to the Welverdiend Census (2014), the total population in the Welverdiend community is 7,601.

Population and Sample

The population for this study was all members of the Makgato and Welverdiend communities who had access to the community water supply and consumed it for agricultural and/or domestic purposes. The sample for the study was selected from residents of the Makgato and Welverdiend community.

This was a descriptive study which consisted of twenty participants ($N = 20$) to reach saturation of data. Ten participants ($N = 10$) from each community were interviewed. The study sample consisted eight ($n = 8$) woman and twelve ($n = 12$) men. The majority of participants were black, South Africans who were 21 years or older. Of the twenty participants interviewed, (13) were farmers, (6) school teachers, (9) community business leaders, (7) municipality workers, and (5) communal water specialists. Three (3) research participants held a form of higher education beyond primary school.

Data Collection

A snowball sampling method was utilized because it allowed the researcher to identify respondents by asking previous participants and locals who to interview (Babbie, 2012). Snowball sampling provides comprehensive characterizations of unknown populations and is often more directed and purposeful than other non- random sampling techniques (Babbie, 2012). The primary advantage to snowball sampling is its success in identifying individuals from large and unknown populations (Coleman, 1958). The strategy allows qualitative researchers to establish a set of potential contacts in a timely and cost effective manner (Coleman, 1958).

Several researchers have used snowball sampling to conduct similar studies. For example, Carolan (2006) used snowball sampling in a study to determine social change and adoption in regards to sustainable agriculture. Snowball sampling helped link the researcher to study participants. Bugri (2008) also used snowball sampling to meet the needs of a study conducted in Ghana in order to understand the dynamics of agricultural production and environmental degradation. In a comparative study to determine value of home gardens in a South African rural village, High and Shackleton (2000) also used the snowball sampling method conduct research interviews.

A semi-structured interview process (Cohen & Crabtree, 2006) was employed with participants to help reach the study's objectives. Semi-structured interviews allow the researcher to have flexibility during the interviews and provide an opportunity to identify new ways of understanding the topic (Cohen & Crabtree, 2006). The researcher used notes and audio recorders during interviews to record data. According to Witzel (2000), tape recording of an interview allows for precise and authentic records throughout the communication process. Thus, the interviewer is able to focus on the discussion and observe nonverbal expressions. Denzin and Lincoln (2008) indicated a semi- structured interview guide allows researchers with opportunity to ask questions related to the objectives of the study while allowing respondents to share extra data that may uncover facets researchers have yet to consider in the study. Study participants were interviewed in a setting that was appropriate and comfortable for them. The interview process for each participant took approximately one hour to conduct. During this time, the researcher sought answers to interview questions and further questions were asked

throughout the interview to probe the subject for richer information. Questions were designed to fit the purpose and objectives of the study.

Semi- structured interviews have been used in similar studies. Reid and Vogel (2006) used semi-structured interviews in a study conducted in South Africa to determine existing stressors amongst small-scale farmers. Dovie, Witkowski and Shackleton (2003) used semi- structured interviews amongst South African farmers to determine value of smallholder crop production. Semi- structured interviews were also used by researchers to understand farmer adaptation to climate change in South Africa (Thomas, Twyman, Osbahr, & Hewitson, 2007).

The interviews for this study were conducted during the month of July and August of 2014. Prior to the individual interviews, the researcher was introduced to the Makgato and Welverdiend communities with the guidance of Ivy Safaris and the Wits Rural Facility. This is a necessary process to develop rapport with the participants so that they are more open and forthcoming when working with someone they know (Rogers, 2003). Subject names and identifying information were changed in the study to ensure participant confidentiality. An official informed consent form was given to the participants before proceeding with interviews. This study was reviewed and approved by the Institutional Review Board in compliance with Texas A&M University's Human Subject Research requirements (IRB2014-0335D).

Data Analysis

Observations and interviews from the dataset were triangulated to achieve trustworthiness (Lincoln & Guba, 1985). Lincoln and Guba (1985) suggest that

triangulation involves using multiple data sources in an investigation to increase and produce understanding. By comparing different information on the same topic, Lincoln & Guba (1985) suggest that triangulation is a check on trustworthiness. Triangulation can also be used as a method to corroborate findings and test for validity (Lincoln & Gubs, 1985). Interviews were conducted with audio recordings, note taking, reflection, pictures and observation in this qualitative data analysis.

Trustworthiness is the level of confidence the results represent both the context of the study and the respondents (Dooley, 2007). Krunz, Moran, and Kastelle (2013) used triangulation in a study conducted to implement an integrated approach to water management by matching problem complexity with management responses. Triangulation was used throughout the interview process to help create the trustworthiness necessary to meet the studies objectives. Another example would include a study by Torres (2003), who employed triangulation throughout interviews and observations to determine linkages between tourism and agriculture in Mexico.

Common themes amongst each objective were found based on the responses from the twenty survey participants during the interview process. Themes were determined based on the constant comparative method (Grove, 1988). Glaser and Strauss (1967) describe the constant comparative method as a way to identify a setting of interest by examining local concepts, principals, and structural features of the experience. The researcher makes decisions regarding the collection of the data based on his or her understanding of the phenomenon (Glaser & Strauss, 1967).

Study Limitations

This study was limited by its small sample size. The sample size could have been expanded by including more tribal communities which may have allowed for a greater generalization of water supply and demand constraints in the tribal communities of northern South Africa. Additionally, more contact between the researcher and the target sample before arriving in the country would have allowed the researcher to identify a wider range of survey participants at the community level in and individuals who were employed by the local municipality.

CHAPTER IV

FINDINGS

The purpose of this study is to assess water supply and demand constraints to determine opportunities for needs to be meet. The research objectives sought to 1). Examine barriers towards water availability and possible opportunities to increase access within the South African communities; 2). Determine South African community adoption of water saving methods for transportation and/or agricultural purposes; 3). Describe attitudes of community leaders, consumers, and users within each community towards water management and ownership of water supply infrastructure; and 4). Assess the impact attitudes of community members have on ability to increase water access (supply) and water use (demand) within the communities.

Objective 1: Examine barriers towards water availability and possible opportunities to increase access within the South African communities.

Munnik, Limpopo, South Africa – Makgato Community (Sotho Tribe)

Funding Shortage

During the months of July and August 2015, the community was operating on three functional boreholes. Twenty one boreholes were drilled by the municipality and left empty without pumps to retrieve any water. According to Participant 2, the municipality claimed that "they did not have enough finances to fund the pumps and more money was needed in order to move forward." The cost of one machine is about R30,000 ($3,000). P2 stated that "Even with three boreholes, there is still a shortage of water."

P3 mentioned the "local government had promised over one year ago that they would get pumps into the boreholes within two months." P10 added, "The municipality is the one who is responsible. We need to get more pumps but the municipality cannot fund the projects. It is not an easy process."

Leadership Accountability

Both tribal and municipal leadership challenges were mentioned by the participants.

P7 said, "They could do a better job of serving us. They must listen and represent our problems because we are the ones who suffer. We have heard excuses and broken promises for years." P4 added, "Our committee must address these problems we have. They have no one to make sure they are doing their job and they do not always reinforce issues we have within the community."

P6 mentioned, "The pump gets broken and needs to be replaced but no one shows up. There is nobody making sure they are doing their work or their tasks. They are not properly supervised. They tell me and give me excuses about why things do not get done. We are told that financially the municipality is not able to fund a water project. Supervisors need to be hands on and make sure that the workers are doing their work. Supervisors are not hands on so the workers are too relaxed."

Lack of Management and Employment

Boreholes, pumps, tanks, and taps are all managed and funded by the municipality. One individual is hired to maintain the systems and switch the water on or off to selected areas of the community. Researchers visited the main storage tank inside

the community and the communal pump switch which turns the taps on or off. The tank was leaking water from four areas at a constant drip. All ten survey participants from the community acknowledged the importance of saving water for agricultural or personal use.

P2 indicated,"This is normal. We have problems like this all the time. This problem won't get fixed because it may take too long to get parts and the municipality will have to contract out to fix the leaks. Our current water manager cannot fix this on his own."

P4 said, "Water is valuable to us and yet it is wasted every day in our community. Maintenance takes time and money. The community can complain to the committee and water counselor but then [the counselor and committee] must take that to the municipality. From there we have no control."

P5 mentioned, "Once a part or system breaks down, several months could pass before the part is ever replaced or fixed. It could even take years."

P7 said, "The municipality hires workers to maintain the systems based on political support. Employment is not based on how much you know. It is not based on experience. What matters is political support and votes. Hiring is political. Sometimes you vote for someone because they may hire you later on. It is just how it works."

Limited Security

The stealing of transformers was an unanticipated barrier that hindered the increase of water supply in both communities. Very little to no security reinforcement in the area gave access to robbing systems and parts for profit. P6 stated, "Throughout my

life here several transformers have been stolen or misplaced. Pumps are not properly monitored or supervised and it is too easy to take." P9 added, "Yes, even if we had machines in all our boreholes, the risk is greater so that they can be stolen. It would take more money and more time for replacement."

Acornhoek, Mpumalanga, South Africa- Welverdiend Community (Shangaan Tribe)

Limited Security

It is important to note that the acting NGO in Welverdiend is an informal NGO who is mainly reliant on one single donor with the exception of other smaller donors. The role of this NGO is to increase water supply by increasing boreholes, pumps, and taps within the Welverdiend community.

Much like the Makgato community, Welverdiend holds limited security to secure technology within the community. According to community members and leaders, the municipality frowned upon the efforts of the NGO because the government experiences profit loss once water is provided by the NGO. Before the NGO began work in Welverdiend in 2003, the local government would contract tanker trucks to deliver water in to the community. The trucks would fill storage tanks with water and receive around R85, 000 ($8,500) per month to deliver water to the communities. According to four participants, trucks were owned by people within the local government. Once the NGO began work in Welverdiend, transformers were stolen at the pump houses. The NGO began installing alarm systems inside every pump house. When the doors were opened or broken in to, the alarms would activate.

P13 mentioned, “I was working on a broken pipe at one of our sights. The municipality came with twenty or more and they tried to stop me. They asked me who had me to do these jobs. I said the community did and they called me a liar. I called the crisis committee from the community and they came to show their support for us. People from the municipality backed off.”

P11 said, “Cables get stolen easily. They have a lot of copper in them and they steal them right from the transformer down. That puts a lot of boreholes out.” P15 added, “We know that they stole the transformers because of the way they interacted with us. The work that we are doing was not wanted by them.”

Three participants, P6, P9, and P3 mentioned that transformers and copper wire has been stolen from the pump houses by members who reside in the community who are connected to the municipality. According to the three participants, no action was taken by the community leaders to reprimand or prevent this from happening again besides the NGO installing alarm systems. The alarms installed in the pump houses acted as an extra hurdle for theft and created a comotion if pump houses were burglarrized. Six of the ten survey participants in the Welverdiend community believed that the alarm systems helped to reduce theft of pump systems.

Politics, Leadership, and Employment

Participants who were employed by the NGO held years of experience managing and installing bore holes, pumps, security systems and taps. However, participants suggested the municipality does not necessarily hire based on knowledge and experience with water management. Instead, political leverage is perceived by communal members

to often hold greater leverage than education or experience when it came to local government employment. P6 stated, "The municipality will only hire you if you have a certificate or if you are under their political party. They will not hire you based on your experience." P4 mentioned, "Employment from the municipality is tricky because politics does come in to play. When they hire, it is not always for the best benefit but often for the benefit of themselves."

P8 included, "I am not always pleased with the work that they are doing. They have to listen to what the community wants and cannot come up with a solution on their own." P2 added, "The big problem is that they are not always listening to the community and what the community wants. It is difficult to make progress with such leadership."

Conservation

Water conservation in the Welverdiend was seen as a sound way to reduce the demand for water. All ten survey participants in Welverdiend acknowledged the importance of saving water for agricultural use and/or personal consumption. However, not all users practice water saving techniques efficiently, most often due to neglect or forgetfulness.

P17 indicated, "People tend to waste water in homes if they have their own tap. They may go out and water their garden and go in their house to take a nap and forget about turning off their water. Each and every community meeting, we may mention something about conserving water and they listen to us. We must keep educating."

P15 added, “People with taps do not have to pay for how much water they use so that it is easy to forget about turning off your water sometimes. It is important to tell people to conserve water so we do not run out.”

P16 said, “I try to conserve my water. It was not very long ago that I have to take my wheel borrow to fetch water from the nearest tap.” P18 mentioned, “Our water system is managed by them [NGO] so we do not have leaky pipes or broken systems. That we can be glad of. If something does happen, it usually gets fixed very quickly.”

Objective 2: Determine communal adoption of water saving methods for transportation and/or agricultural purposes.

Munnik, Limpopo, South Africa - Makgato Community (Sotho Tribe)

One communal storage tank is stationed at the entrance of the Munnik community and enclosed by a high fence. The pipes attached to the tank leaked water in several areas at a constant drip. To use the wasted water more efficiently, two communal farmers planted crops directly under the tank within the enclosed area so the crops could benefit from the leaks. By far, these crops appeared to be the healthiest in the community.

Water is fed to the community taps every two days to conserve the supply. Because not every household owned their own tap or lived near one, residents would mainly use jerry cans to deliver water back to their households. Jerry cans hold around 40 pounds of water when full and are often placed in wheel barrows or vehicles to transport back to homes. Livestock farmers, such as cattle and goat raisers walk herds to the nearest open water source near the community while community members with

household gardens would water plants by hand with containers. Some residents owned 50–250 gallon water storage tanks which would be placed beside or on top of homes to capture and store rainfall. Storage tank water would be used for personal and agricultural purposes.

Adopted Water Saving and Transportation Practices

Tribal residents in Makgato community adopted simplistic practices to save and transport their water for personal and agricultural use. Containing water was done through the use of jerry can containers, tubs, and storage tanks. Methods to transport water was done with the help of wheel borrows, trucks, mules, or manual labor.

P2 mentioned, "I use 4 jugs to carry my family's water when the taps are turned on." P3 added, "Three jugs are used to carry water to my house but it isn't enough. We make it work by rationing until taps are turned on again. " P6 concluded, "My sons and daughters push a wheel borrow to go fetch our water in jugs. I use to do that when I was their age. Maybe one day their children will not have to do that."

P8 stated, "This large rain container stores water when it rains. I use that water for cooking, washing, and sometimes my crops. Most of the time, I try to collect water from the taps and maybe for crops."

Acornhoek, Mpumalanga, South Africa- Welverdiend Community (Shangaan Tribe)

Welverdiend had twenty boreholes with functioning pumps producing about 132,000 gallons per day in total. One main storage tank was stationed in the community along with several 50- 250 gallon storage tanks placed throughout the community.

Agriculture appeared to be more prominent in Welverdiend compared to the Makgato community, likely due to the increased access to water from the NGO. One communal farmer was able to expand a two acre crop farm and significantly increase profits after a tap was placed near the operation; the produce was sold to the local grocery store. The farmer planned to use the profits to purchase a drip irrigation system for crops. In the meantime, the farmer hand watered crops with a hose which was connected to a personal well and tap provided by the NGO.

Government funded projects allowed livestock access to open water sources. Water supply was accessed to herds by open ponds and one windmill which provided water to a trough.

Adopted Water Saving and Transportation Practices

Welverdiend residents also adopted simplistic practices to save and transport their water for personal and agricultural use. Hippo Rollers was the only method that was different in the Welverdiend community versus the Makgato community. Hippo Rollers are a NGO project designed to carry twenty-four gallons of water inside a rolling wheel. Weight is transferred to the ground so users can push or pull the roller instead of having to lift or carry heavy tubs.

Containing water in the Welverdiend community was done through the use of jerry can containers, Hippo Rollers, tubs, and storage tanks while water was transported with the help of wheel borrows, trucks, mules, or manual labor.

P11 mentioned, “I use a hose which is connected to my holding tank to water my crops. P14 added, “I have two taps beside my home so I can use a hose. One year ago, I

could not do that." P13 stated, "Most of the water here has been from the NGO. I get water from my tap and water my crops myself with tubs." P17 included, "I use jugs to transport water every other day. I have done this for years and this is the way it has been for several years." P15 concluded, "I am lucky because our cattle can go drink at the water beside the windmill. I could not have this many cattle years ago. Where would I let them drink?"

P18 mentioned, "People from the U.S. came in to give us Hippo Rollers. That is what I use to move my water. I hope that our lives will improve in the future and so that we can all have our own taps."

Objective 3: Describe attitudes of community leaders, consumers, and users within each community towards water management and ownership of water supply infrastructure.

Munnik, Limpopo, South Africa – Makgato Community (Sotho Tribe)

P2 mentioned, "I think that the people would be better off if the municipality was left out of it. We have the ability to create a new system and take action for ourselves. We would have new challenges but maybe we would see more rewards too."

P9 indicated, "We could manage and own our water supply but we would need to gather the funds to do it. We need to have more consistent support than we do now if we were to increase machines and improve the water supply."

P4 stated, "I do think that if the community owned the water supply our leaders would have a better grasp of what is going on and we could do a better job of increasing our supply from the boreholes. I just worry we would not have the money for this."

P8 also included, “The people may be more engaged and responsible for projects. Maybe if we have more ownership, this could help reduce stealing of transformers. A system would need to be in place so we could gather money to sustain projects and manage them ourselves.”

P5 said, “As it is now, all we hear is promises to the community from the municipality. If we had ownership and management of our own supply, we would be able to appoint everyone necessary to be in charge of the management. We could raise or charge a little bit of money from people who use the water. That could pay for maintenance and maybe even the people to be employed.”

P10 stated, “I do not think it would make a difference if the community had ownership. Look at it now. They do not take care of things now so how can we expect them to care later. Where would they get the funds? How would they know how to fix water leaks and breaks? How would they get the equipment to operate this maintance? You see, sometimes a well-intended plan does not make things easier.”

P3 also added, “I’m not so sure the community would benefit. If a strong structure was not in place to control and watch over the water supply, we could be shooting ourselves in the foot. The money we would have or raise to maintain could be easily mismanaged.”

P1 mentioned, “Something needs to change. The municipality and our leaders are not taking action. They are making empty promises and I have not seen much improvement in years. I have lived here my whole life. If we changed this structure to us

operating and having control, maybe there would be improvements. I guess it is worth maybe trying."

P4 said, "I would like to own and have my own tap in my home. Everyone would. Yes, let's get water to everyone. The system we have is too complicated now. We need change but changing everything could cause more of a mess than it already is."

P6 mentioned, "When the people are in control and it suddenly has an effect on them, then they will take better care of what is provided to them. When it is someone else's responsibility to maintain and provide services such as the municipalities, then why should the people care want to be involved. When people have to rely on each other is when the community may be more engaged."

Acornhoek, Mpumalanga, South Africa – Welverdiend Community (Shangaan Tribe)

In comparison to the Magato community, attitudes and responses from participants within the Welverdiend community reflect a greater understanding of maintaining and operating communal water supply without the sole reliance of the municipality. Nine out of the ten participants interviewed had lived in Welverdiend their entire life and had witnessed the difference in water supply management by the municipality versus the NGO. Eight participants suggested that the community would be better off if the management of water supply was the responsibility of the community and/or NGO.

Note: Once water was delivered to the community or to the taps, water was thought to be owned by whoever retrieved the water. Participants felt ownership of the

water they received no matter who supplied the water or maintained the boreholes, taps, pipes, and pumps.

P16 indicated, “I hope everyone will have their own taps someday. I don’t think that will get done with the municipality in control. If the community has control, then it could be achieved. We would see achievements but it could take years.”

P17 said, “Taps have been increased since when I was a child. I see improvements and most of these improvements have been made within the last ten years when [NGO] came in to help us. The municipality did not do this. I think that this is an example showing us that if we want to improve something, we need to take matters in to our own hands to accomplish them. It’s as simple as that.”

P19 also indicated, “Recent improvements have been made all around us compared to 10 or 20 years ago. Some projects are from the municipality, but most are from [NGO]. We know [NGO] and we know what he is doing. We don’t always know the end plan of the municipality even though we hear big promises. If the community wants something done, we have the power to do it.”

P13 mentioned, “The municipality has the power to improve our water condition. But why would they when [NGO] is here and is backed by the community? He is doing all the work and has improved many lives. The responsibility should stay in his hands instead of the municipality. We trust him but what will happen when he is gone? Then we need to find a way to manage and take action ourselves.”

P12 also added, “Of course [municipality] could do a better job of taking care of all the communities. They don’t always take care of what is needed first. [NGO] takes

care of us so we do not have to rely solely on getting water service from municipality. I do believe that we are stronger if the community is involved in the progress being made."

P14 also included, "I want to have my own tap one day and I think that we could take responsibility for our own supply. [NGO] has been expanding work in the community so we are not as concerned as we once were. The community should be involved at all times because then we have more of an understanding of what is going on."

P19 indicated, "We should have control of our taps and boreholes. We should be able to have a say in what happens. We should work to have water all the time instead of getting it turned on and off. It would be better if we maintained and operated our own systems instead of the municipality because it affects us directly and immediately."

P11 added, "It is important for people in the community to know how to fix something when it breaks or when something needs to be replaced. When the municipality is in charge, these things take days or weeks before they even get to it. I can see the benefits if the community had control."

P20 stated, "We could maintain and take care of our own water. I just do not know if we could receive the funding to do it." P15 said, "I don't think that we as a community need to get involved in maintaining our water supply. The municipality or [NGO] has done so in the past so there really isn't a need right now."

Objective 4: Assess the attitudes and impact community members have on ability to increase water access (supply) and water use (demand) within the communities.

Munnik, Limpopo, South Africa - Makgato Community (Sotho Tribe)

P3 mentioned, "Our community can improve their lives. The tribal office needs to ask and make demands to the municipality. Right now they are the ones who implement procedures. If they can do these tasks and be more responsible then I am hopeful that our future will be much brighter." P4 also included, "The community members are the ones who must improve the situations because they are the ones suffering. We have to do something ourselves. We need to be community led but we need the support from the municipality to do it so we can improve."

P7 stated, "Our community and the leaders have the power to make changes. It is the community's responsibility to make sure we are getting our needs met. The traditional members in the office are elected by us and they have a job to make sure that the municipality workers are doing their jobs." P10 said, "We cannot expect people to give us money for things that we do not look after. When we look after our own intentions than we can move forward and establish good change."

P6 stated, "Since we have nothing to ensure that everyone involved is doing their work, nothing may get implemented. This is why we need hands on solution. We as a community have the power to push for this improvement and change."

P8 claimed, "When we asked the municipality questions why nothing is getting done, they always have excuses. What they must do is to go out and look for sponsors if

they need funds. We are not paying for this water we are getting so they have to fund it themselves."

P9 said, "They do not spend their money wisely. If the municipality could spend their money wisely, it would be better than now. I do not believe the municipality will get better either They will get worse and things will get worse but we as a community could make better things happen. The question may be, who is going to start this push and how can we all get on the same page. That is what I do not know."

Acornhoek, Mpumalanga, South Africa- Welverdiend Community (Shangaan Tribe)

P11 stated, "it takes roughly two weeks for one borehole project to be done from start to finish. Not every borehole will be the same though depending on the contract. Project supplies are purchased locally."

After inquiring about community involvement when members wish to have a tap installed at their house, P11 responded, "I require that the people put in sweat equity in to the project themselves. When you see them digging in their yards for the standpipes, they are doing that themselves. Nobody is paying them. They pay R200 for the standpipe. It costs me over R300 so it really only costs me R100 per standpipe."

P19 stated, "Our demand can be met if we can work together. We have many challenges in our current leadership and with our representatives but I think it is possible to eventually have our demand met." P15 said, "Demand is high right now. Meeting the local demands and even the demands of the entire country would require everyone to be on board and to work together. Yes, it is possible. It just may take years to get it done."

P13 added, “We believe there is hope. There is always that hope swimming amongst the barriers we have against us to get water service from the municipality.”

In reference to a better solution to increase access provided by the municipality, P12 said, “These people can talk about what they want to do. They can talk the talk but they can’t walk the walk. They say what great things they are going to do but there are no facilitators to actually accomplish those things. On the local level we need local facilitators. There is no tax to help with schools or get water. Tax at the local level would certainly help but it wouldn’t be possible with the current incomes. We need facilitators.”

P14 claimed that “The government’s plan is to use water from the dam to get water to this side. They have storage tanks in place but it’s been just empty promises for years. The government put in a pipeline by a contractor but there is still no water. Somebody benefits from these contracts but not us. Not the communities.”

P15 added, “I question the local counselor. Almost one million people live in this municipality. I’m not sure of the figures but I know there is not near that amount of water to supply the communities from the dam alone. We live on the end of the pipeline so who knows if they actually start pumping water if it will actually get here.”

P16 said, “In terms of long term supply from the municipality, it will never be enough. We need twice the amount of water we have now. That’s the thing the local government doesn’t realize. If they do, they don’t care.”

P18 added, “They [municipality and community leaders] must listen to what issues we have to conclude and the power structures are not doing that.”

P14 mentioned that, "When we relied on the municipality for water, we use to walk 10k going and 10ks coming back to get water. Now of course, it is much better. The whole community has the ability to pressure the municipality in getting what we need but we must all work together to get that done. We have lots of structures in the community but they can push the upper structures to get things done."

CHAPTER V

IMPLICATIONS, CONCLUSIONS, AND RECOMMENDATIONS

Objective 1

The first objective sought to examine the barriers towards water availability and possible opportunities to increase access within South African communities. The findings of objective one indicate that the primary barriers which exist to increase water availability in communities are due to lack of conservation practices, project funding, competent employees, leadership accountability, and security. Politics and corruption were also noted to be barriers towards efficient management and leadership practices in both the Makgato and Welverdiend communities.

Conservation

All twenty participants in this study acknowledged the importance of water conservation for agricultural and/or personal use. Both communities held areas in which water supplies could be more efficiently maintained by service providers and community members. Water loss was prevalent at communal storage tanks, pipe lines, pump houses, and at communal and personal taps.

Water leaks and losses linked with neglected maintenance create supply bottlenecks and increase provision costs. Thus, improved management from both the supplier and consumer level would enable the development needed to help lift poverty within communities (Schreiner & Hassan, 2011).

Employment and Funding

Eleven out of the twenty survey participants in both communities expressed that politics often plays a greater role in the hiring process than formal education or experience. According to Schreiner and Hassan (2011), widespread corruption in municipalities are related to the abuse of political office and employment status for personal gain. Municipal accountability systems creates a widespread culture of ineffective patronage which leads to a lack of citizen trust and confidence (Schreiner & Hassan, 2011).

Six out of ten survey participants in the Makgato community mentioned lack of funding from the local government was one of the main reasons why no pumps were installed or properly maintained. Five out of ten participants in the Welverdiend community believed lack of funding from the local government was one of the main reasons why pumps systems were not efficiently maintained by the local government.

Municipalities receive significant funding to address infrastructure backlogs and support service provisions to poor households (Schreiner & Hassan, 2011). Municipalities receive funding from two significant sources; the Equitable Share and the Municipal Infrastructure Grant (MIG). The Equitable Share is intended to cover costs of providing basic services to poor households while the MIG is intended to cover capital costs of infrastructure for basic services for poor households. Such funds may enable rapid infrastructure development, but also create rapid measurable spending rather than ensuring positive outcomes (Schreiner & Hassan, 2011). As a result, poorer municipalities are prone to extend coverage to service poor households, which increases

the need for more revenue. Increased funding does not necessarily mean that issues will be resolved in the absence of financial management and accountability systems. Moreover, increased funding would need to be met with highly skilled political leadership and management structures.

Current costs to sustain water provisions in communities represents a need that must be met in order to maintain structures and services. However, enormous investments in water services and infrastructure does not always indicate improved service delivery (Schreiner & Hassan, 2011). Institutional continuity is critical for service provision within communities, as it can take years to develop plans and experience needed to deliver efficient services. Individual staff turnover is high and disruptive in South African municipalities because it takes years for individuals and managers to build the knowledge base and experience needed to perform water service tasks (Schreiner & Hassan, 2011).

Leadership Accountability and Security

Tribal leadership structures in tribal communities hold significant leverage to create and push for change. Contrary to urban areas, tribal communities often enforce laws themselves without a police involvement unless called upon. Reports of stolen supplies such as transformers, pumps, and copper wires and parts were noted in both communities. Twelve of the twenty participants mentioned that little to no measures were taken to increase security or reprimand thieves.

Due to several theft incidences, alarm systems were placed in pump houses by the NGO in the Welverdiend community. Six of the ten participants in Welverdiend

believed that the alarm systems helped to reduce theft of pump systems. Since the alarm systems were installed, theft seemed to have significantly dropped according to participants.

Leadership members in a community act as opinion leaders within a community and can enforce or encourage change within the tribal communities and help to create better security. According to Rogers (2003), opinion leaders are members who influence a social system. Opinion leadership has the power to influence individuals' attitudes and behavior within the culture (Rogers, 2003).

Opportunities

There are many barriers towards increasing water supply although they differ slightly between the two communities. These barriers represent a need and opportunity to increase access to local communities in the long term. Competent and excellent Extension Systems are needed to assist farmers in tribal communities to acquire and conserve water. Governmental and non- governmental Extension organizations can work with farmers and community members to reduce barriers regarding the access of water and provide opportunities to increase supply to communities.

Examples of institutions serving in South African tribal communities include; University of Witwatersrand; local government municipalities, and international NGO's who are project based. NGO's are often funded by outside sources, private donors, foundations, businesses, and governments. Extension Systems, in conjunction with NGO's and municipalities, could offer services based on needs assessment which focus

on education. Educational services would include conservation practices, water infrastructure maintenance, supply management, business and leadership responsibility.

Recommendations for Future Researchers

Welverdiend appeared better off than the Makgato community in the short run in terms of water supply and management due to the persistence and involvement of a foreign NGO. Even though Welverdiend was better off in the short run, long term sustainability is questionable. The NGO will unlikely be present in the community indefinitely but the municipal government will be. If the government is not effectively engaged in the development and maintenance of water systems by the NGO, challenges may arise if the NGO should withdraw or if community members are not fully prepared to manage and operate water projects themselves.

Further research on NGO involvement with water affairs would help researchers and practitioners to understand the long and short term role and effects of NGO involvement has on communities. Understanding the long and short term effects will help to identify ways NGO's can more efficiently train, educate and involve community members to engage in projects aimed at increasing water supply and meeting demand. Researching in various South African regions with larger NGO sample size could provide a more comprehensive profile of the role, effectiveness and long and short term effects of such organizations.

According to the theory of planned behavior, affect and emotions serve as background factors which influence normative or control beliefs (Ajzen, 2011). Thus, behavior is thought to be reasoned or planned when subjective norms and perceptions

follow in accord to the beliefs of an individual (Ajzen, 2011). These factors which influence behavior can be used in future qualitative studies to understand how tribal leaders can increase security enforcement within community. Research on communal security enforcement should be expanded on to develop a greater understanding of enforcement measures taken at the tribal level. Doing so, could aid in the effort to secure water technologies and supplies in the future with the help of the community.

Recommendations for Practitioners

In the effort to identify problems and implement solutions within South African communities, practitioners must look beyond the scope of projects and in to a broader and more complex social analysis involving the devolution of economic and political power (Hendry, 2009). An effective new law, plan, or reform should seek to recognize existing social norms and give voice to the members of the community (Hendry, 2009). Doing so, could help lessen project failures by governmental or non-governmental organizations.

Objective 2

The second objective sought to determine communal adoption of water saving methods for transportation and/or agricultural purposes. The two communities exhibited several similarities in terms of water saving and transportation practices. Common methods to transport water was done with the help of wheel barrows, trucks, mules, or manual labor. Jerry can containers, tubs, and storage tanks are the common containers tribal communities used to help store water. Seventeen out of twenty participants mentioned using at least one of the above listed methods to contain and/or transport

water to their homes for personal or agricultural use. The remaining three participants had taps inside their homes and had no need to transport water.

South African communities could benefit from water saving methods to help reserve personal water supply, especially in cases where taps are not turned on every day. For instance, schools within the communities had gardens used to teach students how to grow crops. Large water containers were used to capture and store rain water for the gardens. However, agricultural projects were noted to often be neglected due to lack of water to crops.

Recommendations for Future Researchers

Researching more communities and using a greater sample size within each community could help increase the understanding of communal adoption characteristics for improved water use in agriculture. Investigating individual adoption motivation and characteristics could also help current and future practitioners to implement and diffuse water saving technologies and/or educational extension services and to further apply the theory of planned behavior.

Recommendations for Practitioners

Organizations working to increase access or provide water services for communities are faced with several challenges to properly implement and sustain projects. Enormous investments in water services and infrastructure does not always indicate sustainable improvements (Schreiner & Hassan, 2011). Operating and maintaining a project takes time and strategic planning ensure its sustainability after the NGO withdraws from a community or sight. Projects tend to fail or become neglected

once an organization leaves due to the institutionalization of training and support structures set in place within the community (Schreiner & Hassan, 2011). Thus, it is crucial that organizations actively monitors projects to maintain rapport with tribal communities and to confirm that the organization's involvement is creating a sustainable and positive and sustainable impact within the community. If projects fail due to unanticipated barriers, it is recommended that organizations make note as to why and in what ways these failures could be avoided in the future.

Objective 3

The third objective sought to describe the attitudes of community leaders, consumers, and users within each community towards water management and ownership of water supply infrastructure.

Members in the Makgato community had diverse opinions on the subject of management and ownership of water supply infrastructure. All ten participants in that community indicated that they wanted the number of taps and water supply increased. However, when the interviewer asked the participants' opinion on management and ownership of the water supply infrastructure, six participants mentioned the uncertainty of funds if the community was in control. Two participants were opposed to leaving management and ownership in the hands of the community. One participant was indifferent to change while seven participants suggested that they were open to the idea of community management and ownership of water supply infrastructure. The majority of participant attitudes indicated that members were mindful that change needs to be driven by the community in order to improve the current conditions.

In comparison to the Makgato community, attitudes and responses from participants within the Welverdiend community reflected a greater understanding of the maintenance and operation of communal water supply without the reliance of the municipality. Nine out of the ten participants interviewed had lived in Welverdiend their entire life and had witnessed the difference in water supply management from the municipality compared to the NGO. Eight participants suggested that the community would be better off if the management of water supply was the responsibility of the community and/or NGO without municipal government involvement.

Note: Once water was delivered to the community or to the taps, water was thought to be owned by whomever retrieved the water. Participants felt ownership of the water they received no matter who supplied the water or maintained the boreholes, taps, pipes, and pumps.

Recommendations for Future Researchers

Underlying reasons for inadequate service delivery of water to tribal communities creates a valuable opportunity for South Africans to reflect upon their relationship with municipal, provincial and national government in order to explore new possibilities to re-create relationships between citizens and government so that service provision and democracy can be strengthened (Schreiner & Hassan, 2011). When the citizens' role is only to demand accountability and services from the government, they hold rights without reciprocal responsibilities (Mathekga & Buccus 2006; Nemeroff 2006). However, when the roles of the government and citizens are more balanced, elected officials and representatives can be held more accountable by citizens.

Additionally, citizens can make a larger contribution to servicing their water supply by reporting leaks, paying for services, shaping local planning and improvements, and not contributing to theft of water supply infrastructure. A new social compact is needed between the local citizens and government where officials, politicians, and citizens from diverse constituencies can collaborate (Schreiner & Hassan, 2011). Local dialogue can be leveraged to increase understanding of the reasons for issues and strategize ways to address them (Galvin, 2009).

This study found that fifteen out of twenty participants indicated they were open to the idea of the community management and ownership of water supply infrastructure. If Extension and outreach services were to be implemented in communities to help provide better water services, enhance education about water supply and use and increase sustainability, further research on the opinions and perspectives from both the communal and municipality standpoint could help implement more effective water supply services. More research into the motivation and characteristics of ownership should also be conducted to increase the understanding of community participation in regards to the involvement in developing countries. A larger sample of participants is recommended to provide a greater representation of the affected population. Research in various regions of the country could provide different perspectives and enhance comparisons between groups since communities differ due to factors such as politics, education, beliefs, history, economic status's, and demographics.

Recommendations for Practitioners

Development should be stakeholder-driven and unless stakeholders are directly engaged, the prospect of failure is increased (DWAF, 1994). Empowering and involving individuals is a cornerstone to stakeholder-driven approaches to solving natural resource management challenges (RSA 1994).

Schreiner and Hassan (2011) suggested that when communities expect an outside agency to be responsible for the supply of resources such as water, they lose leverage, ownership, and control over the process. When this occurs, accountability and responsibility for maintaining the service is absent. The White Paper argued that services should be paid for and provided in a way that would not require continuing government funds to sustain the services (Schreiner & Hassan, 2011). With the exception of poor communities who are unable to afford basic services, the government would subsidize the cost of construction of basic minimum services but not the operating, maintenance or replacement costs (Schreiner & Hassan, 2011).

This study indicated that participants in the Welverdiend community held a greater understanding of maintaining and operating water supply without relying on the municipality. Welverdiend participants were more actively engaged in the service projects due to the involvement of the NGO. In reference to the Theory of Planned Behavior, Ajzen (2011) mentions that attitudes have an effect on how a person perceives a situation and will often reflect how individuals are involved in events. This concept can be applied to the community engagement and participation within Welverdiend. The Welverdiend community played an active role in helping implement taps, pumps, and

boreholes with the help of the NGO. Due to years of invested time within the community, the NGO had developed positive rapport and support amongst tribal leaders, farmers, educators, politicians, and even children.

The concept of NGO involvement in tribal communities should be expanded on to provide a greater understanding of sustainable measures through community involvement. Better understanding beliefs from the communal and NGO standpoint could help serve as a basis to implement change (Ajzen, 1991). Enlisting NGO's to assist in the delivery of water could increase access to the communities in the short term. However, exclusive reliance on NGOs to deliver water to the communities and maintain services could lead to negative long term effects in the communities and within the local government if a strategic plan to sustain the operations supported by the NGO is not developed and properly implemented.

Objective 4

The fourth objective sought to assess the attitudes and impact community members have on ability to increase water access (supply) and water use (demand) within the communities.

The Makgato community faced several barriers towards increasing water access and even maintaining the current supply. Despite those barriers, seven of the ten community participants were hopeful that together their community could create progress in the future by using the powers that they currently hold. However, overall attitudes towards future improvements of the community's water supply were negative if conditions and management were left in the current state. Powers held by members to

push and encourage change which impact water supply delivery remain within the tribal leadership structure, which is composed of communal citizens who are voted in by the community. Members inside the community hold voting power during elections. However, it is not uncommon for tribal leaders or community members to also work for the local municipality, resulting in conflicts of interest.

Attitudes in the Welverdiend community showed that nine of the ten participants were hopeful for increased water supply as their demand increased due to the effective operation of the local NGO. Eight out of ten participants suggested that they believed the communities demand could be met in the future by the NGO and municipality despite the many obstacles. However, the overall attitudes towards future improvements of the community's water supply were negative if water conditions and management were solely in the responsibility of the municipality. Opinions and attitudes expressed by participants showed that community members believed they held the power to create progress and influence the municipality to provide the needed service to meet their demands in the future.

Water Supply

Welverdiend was better off than the Makgato community in terms of their present water supply. Work was being done each day by the "NGO" to install taps in homes. Around 800 taps have been installed in the last eleven years the NGO has been present in the community. During the last two weeks of the researchers visit, around 40 additional taps were installed along with four boreholes and pumps. Members in the Makgato community, however, did not show rapid improvement. During the researchers

visit, twenty-two boreholes were drilled sat empty outside of the community without pumps. The boreholes had been empty for over 8 months and awaited pumps which were to be issued by the local government.

Water Demand

The demand for improved water supply and services is high in both the Makgato and Welverdiend communities and continues to grow due to rising population growth. Demands for water is increasing in the communities to not only maintain current conditions but to meet needs for domestic and agricultural purposes. Meeting these demands requires effective communication and cooperation between citizens and municipality. The "go-between" to communicate these concerns is the ward committee. Ward committees are established at the sub-municipal level in South Africa. The wards primary role is to communicate between the public and municipality. However, the ward committees are often dysfunctional and even discredited. Furthermore, ward councilors are often unresponsive to issues raised by the citizens, which fuels frustration within the communities (CGTA, 2009a). Thus, this disconnect creates another barrier meeting communal water demands.

Even though members in both communities held the power to encourage improvement or change, researchers found that participants often felt that their needs were often not met by the municipality. This perspective was due to past experiences, which include delayed responses or empty promises. These circumstances developed a sense of uncertainty and mistrust towards the municipality. Between the Makgato and

Welverdiend communities, twelve participants mentioned that they felt their voices were not being heard and their needs were not being met.

Recommendations for Future Researchers

This study showed that communities believe in the powers they hold to create change despite the lack of confidence and uncertainty with the local municipality. When speaking with community educators, farmers, politicians, and leaders who expressed their opinions on the challenges of increasing water supply, this researcher found underlying reasons for the lack of confidence in the local government. Many challenges municipalities face are due to structural weaknesses. These challenges arise from decades of neglected investment, development, management, and inadequate resources to support functions the local government needs to perform (Schreiner & Hassan, 2011). Poor management capacity in municipalities suggests a greater challenge than a shortage of funds to provide services needed to tribal populations (Schreiner & Hassan, 2011). Corruption in municipalities and using political status for personal gain also puts a strain on effective services to support communities (Brown, 2009). Thus, ineffective municipal accountability leads to a lack of citizen confidence and trust in localized systems.

Additional personal conversations with community members and participants could allow researchers illuminate ways to strengthen accountability structures amongst tribal leadership and within the municipality. Variables such as motivation, adoption, diffusion, cultural norms, leadership, and access to and usage of water should be studied further. For future research, the sample size should be expanded to incorporate more diverse communities and to enable a quantitative analysis representation. Increasing the

demographic variety could also provide different perspectives, to expand the implications of such research, and to generalize the findings to a broader population.

A greater depth of information may have been obtained by conducting focus groups compromised of participants within the communities. Discussion could include one topic per group meeting, in which each topic area could have been the main focus of discussion such as communal security enforcement, water conservation and management, current water services, and leadership accountability. Focus groups could also enable researchers to conduct group interviews and gain greater understanding of how multiple individuals perceive circumstances and how they believe negative situations could be resolved. This method could have added important qualitative data and greater insight into thoughts and opinions of multiple opinion leaders within the community.

Recommendations for Practitioners

If water services are a responsibility of the municipality, then effective municipalities are a prerequisite for adequate services. Effective structures consist of good leadership, skills, communication strategies, sound management and accountability systems. However, since one solution is not universally effective and differentiated procedures may be needed to recognize strengths and weaknesses amongst communities and institutional structures (Schreiner & Hassan, 2011). This objective gave insight to the complexity that lies within supplying water to communities to not only meet increasing demands but to regain the confidence of local citizens.

Listening to the needs, opinions, and concerns of community members is critical to create sustainable solutions for better service delivery. Doing so, will help to understand why projects have failed in the past and what approaches could be established to generate productive outcomes. According to Ajzens Theory of Planned Behavior, behavioral expressions can be a result of the changes produced by intervention. For instance, when community members realize that promised changes do not materialize or referents do not really expect them to perform a behavior, or that they do not necessarily have the skills and resources to perform a task, intentions and behavior will often revert to the way they were prior to intervention (Gollwitzer, 1999).

The Role of Extension

Extension serves as a channel of information amongst government agencies, local stakeholders, and farmers by educating each on the needs of the others (Mangiafico et al., 2010). Extension can help to educate regulators to develop rational water policies which impact consumers. Such Extension services and practices typically involve program delivery and an evaluation of program effectiveness, which is critical for assessing conservation efforts (Mangiafico et al., 2010). Technology, adoption, research, and regulation are effective components to Extension service to improve agricultural practices once information is extended to farmers, homeowners, stakeholders, and agencies.

Extension services can influence the adoption of conservation technologies and methods that effect communal water supply through education and training. Specific adoption of technologies and methods could include: small-scale irrigation technologies,

water drainage methods, tillage practices, crop choice, and even land-use and livestock practices. Agricultural Extension agents extend technical assistance to farmers and ranchers who are often characterized by inadequate financial resources to upgrade production systems technology (Tyndall & Roesch, 2014). Extension agents are typically institutionally linked to progressive farm organizations such as crop or management, and farm business management associations (Tyndall & Roesch, 2014).

Adoption of practices, methods, and technologies may require time to diffuse in to a particular social system. Rogers' (2003) diffusion of innovations theory affirms that the diffusion of an innovation is a process which takes place over a period of time as an innovation is communicated through channels of a social system. Communication channels, cultural sensitivity, social beliefs, and unanticipated consequences are factors that Extension Systems would need to take into consideration to help diffuse an innovation or practice in to South African tribal communities. Barrett (2002) believes that individuals will invest only when adequate information supports the conclusion that the investment will have payoffs within the related planning horizon and when individuals have the confidence in the organizations which ensure they will reap benefits. The theory of planned behavior supports the idea that current behavior is a reflection of past experiences and helps to prepare for unanticipated obstacles (Ajzen, 1991).

Hanson (1995) suggests that steps can be taken by Extensionist to target typical farmers or ranchers that comprise a hard-to-reach audience. These steps include: actively assisting farmers in sequential adoption of new technology and management methods;

addressing supply bottle necks through workshops with farmers; identifying financial incentives; providing follow-up with active workshops; and listening to needs and experiences of farmers (Hanson, 1995). Such involvement with South African community farmers, stakeholders, and homeowners could create opportunities to substantially increase agricultural output, food security, and livelihoods. It is essential for Extension Systems, agencies, institutions, and NGO's to provide the education and training services needed to help reduce water supply and manage demand in South African communities. Helping improve water services and supply can not only impact food security, but also increase community development and well-being by re-creating relationships between citizens and government so that service provision and democracy can be strengthened (Schreiner & Hassan, 2011).

Summary

This study found that water supply was not meeting demands in two South African tribal communities due to lack of conservation practices, project funding, competent employees, leadership accountability, and security. Communities could benefit from water saving methods to help reserve personal water supply for domestic and agricultural purposes. Community members indicated that they were open to the concept of increased community management and ownership of water supply infrastructure. Opinions and attitudes expressed by participants showed that community members believed they hold the power to create progress and influence the municipality to provide the needed service to meet their water demands in the future. Thus, extension systems could assist community members in South African communities to reduce

barriers and increase water supply and manage water demand through education and training services.

Personal Reflection

The month before I arrived in South Africa of July 2014, I was reading four different books at the same time regarding the agricultural industry, history, and cultural diversity of South Africa. I wanted to be prepared to start my research as soon as I arrived. But despite all my obsessive pre- planning, I simply failed to realize that no matter how much planning one attempts to do before starting research in South Arica, you can never plan for the unexpected.

Africa runs at its own pace. Planning meetings and interviews took a considerable amount of time. I often humored myself by sitting around all day to meet with a survey participant who would casually show up the next day. Patience is most definitely a virtue and I learned quickly that the first ingredient needed to being remotely successful in the communities is planning flexibility. I recall several times when I needed to wrap up a conversation with a community member so that I could meet with my next survey participant. Before I did, the participants would insist that I go to visit their garden so that I could take back some produce. I certainly did not expect this kind of generosity and I was very grateful for the acts of kindness.

In both communities, I was very welcomed and found that most community members were anxious to be a part of the study. I was fortunate to be able to meet tribal leaders when I was first introduced into the two communities as this enabled me to then speak freely with the community members. However, I greatly underestimated the

intense political dynamics and corruption from the tribal leadership to the national government level. I was able to meet the objectives of this study by asking questions I had pre-planned; however, the richness of information came from simply listening to the voluntarily communicated stories of the survey participants. Tribal members wanted to share their experiences, beliefs, and life aspirations, which helped me better understand the social dynamics and culture of the communities.

Throughout my study, I became increasingly intrigued by the work of NGO's. Over 47 different NGO's had left their mark, not always positively, on the Welverdiend community within the last ten years. During my visit with local tribal members, I learned that several international NGO's came in to the community with a project agenda and quickly left the community within a few days. Organizations would come to build a well, school bathroom, swimming pool, or even a kitchen because they felt that there was a "need" within African communities. Little did these organizations realize that when they left, their projects immediately failed. For example, they did not not leave funds for repairs, or inform the community residents how service pumps when they broke down, or train anyone how to fix a toilet when it did not flush, or realize that local women preferred to cook the traditional way instead of on an unknown electric stove. Multiple NGO groups created the perception within Welverdiend that foreign assistance consisted of meaningless projects. Listening to the community members had not been the first priority for previous NGO groups. These organizational groups did not realize that other groups before them had poisoned the well in terms of a training package without supporting financial or training assistance.

Understanding these situations throughout this study has convinced me that in order to create sustainable solutions, especially in developing countries, there is a need to get local people on board in a way that empowers them to make the change within the community. I am also convinced that all the energy and good intentions in the world cannot and will not trump cultural disconnects. In order to be effective, we (philanthropists, institutions, foreign assistance, non- profit organizations, and profit organizations) need to ask the right questions and listen to the responses before acting instead of arriving with preconceived answers. Above all, I believe that we need to listen to the people affected by what we do. Once we have listened, then we can begin to develop a plan while keeping flexibility in our approach.

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APPENDIX A

INTERVIEW QUESTIONS

The following in a list of questions that were asked during the interview.

1. Why are you satisfied or not satisfied with your current water supply within the community?

2. What are some current barriers that hinder the process of increasing water access?

3. How has the supply of water in the community changed in recent years? Give an example of this change.

4. How could the local municipality increase water services to meet the agricultural needs in the community?

5. Do you feel the community should have ownership and management of the water supply? (Pumps, pipes, wells, cost, etc.) Why or why not?

6. In what areas do you think you could use water more efficiently? Give an example(s) of how you could do this.

7. In what areas do you believe the community as a whole could improve current practices to utilize water more efficiently? Give an example(s) of how the community could do this.

APPENDIX B

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM CONSENT FORM

Project Title: An Evaluation of Water Needs in South African Communities

You are invited to take part in a research study being conducted by Robert Strong, a researcher from Texas A&M University. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will NOT lose any benefits you normally would have.

Why Is This Study Being Done?
The purpose of this study is to evaluate the water needs in South African Communities by locals within the communities.

Why Am I Being Asked To Be In This Study?
You are being asked to be in this study because you reside in the South African community and water access plays an important role in your daily life.

How Many People Will Be Asked To Be In This Study?
A maximum amount of 20 participants will be in this study.

What Are the Alternatives to Being in this Study?
None. The alternative to being in the study is not to participate.

What Will I Be Asked To Do In This Study?
You will be asked to answer interview questions to determine your relationship with water access. Your participation in this study will last up to one hour in length and include one visit.

Are There Any Risks To Me?
You will not be involved in no more risks than what you would come across in everyday life. You do not have to answer anything you do not want to. Your name and private information will be protected.

Will There Be Any Costs To Me?
Aside from your time, there are no costs for taking part in this study.

Will I Be Paid To Be In This Study?
You will not be paid for being in this study.

Will Information From This Study Be Kept Private?
The records of this study will be kept confidential. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only Robert Strong and Laura Brainard will have access to the records.

Information about you will be stored in computer files protected with a password.

Information about you will be kept confidential to the extent permitted or required by law. People who have access to your information include the Principle Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A&M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.

The supporting institution for this study, Wits Rural Facility, may also see information. Any information sent to them will not contain your name so they will not be able to tell who you are. If there are any reports about this study, your identifying name will not be in them. Information about you and related to this study will be kept private to the extent permitted or required by law.

Who May I Contact for More Information?
You may contact the Principal Investigator, Robert Strong, Ph.D., to tell him about a concern or complaint about this research at (979) 845-6296 or r-strong@tamu.edu. You may also contact the Protocol Director, Laura Brainard at (830) 688-2982 or brainard@tamu.edu.

For questions about your rights as a research participant; or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Subjects Protection Program office at (979) 458-4067 or irb@tamu.edu.

What If I Change My Mind About Participating?
This research is voluntary and you have the choice whether or not to be in this research study. You may decide to not begin or to stop participating at any time. If you choose not to be in this study or stop being in the study, there will be no effect on your employment or livelihood.

Permission to be Recorded
Audio recording and photographs are tools that will be used by the researcher. Recordings and photographs are optional for this study. If you do not wish to be recorded or photographed, you can still participate in the interview. If you have your photograph taken and have been recorded, you may still withdraw from this study at no cost.

_____ I give my permission for [photographs/audio recordings] to be made of me during my participation in this research study.

_____ I do not give my permission for [photographs/audio/video recordings] to be made of me during my participation in this research study.

STATEMENT OF CONSENT

I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want and there is no harm if I stop participating in this study. A copy of this entire consent form will be given to me.

_____ _____

Participant's Signature Date

_____ _____

Printed Name Date

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM
CONSENT FORM

I have carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, benefits, and risks involved in his/her participation.

_____ _____

Signature of Presenter **Date**

_____ _____

Printed Name **Date**