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Household Water-use Behaviors in Rural Limpopo Province of South Africa

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Abstract

Population growth and climate change increasingly threatens water security in rural areas of South Africa such as in Limpopo province. The severe drought experienced by Limpopo province also impacted the agricultural sector hence resulting in reduced **food security**. Polokwane District depends on the Olifants River to get water, other areas depend on stored water in dams, borehole water and rain harvesting. This study examines household consumption behaviors and knowledge of Limpopo water saving policies. The study used surveys and interviews to collect data from 4 villages namely Kgopaneng, Makubu, Malokela and Ga-Phala. A regression model was developed to analyze the data collected. The results show that while most rural households depend on ground water, they do not practice saving water policies. The results also show lack of education regarding reuse of domestic wastewater in agriculture. Recycling household water back to agricultural use was recommended. The study suggests water-saving policies such as reusing domestic water for irrigation in water-scarce communities.

Keywords
Water, household, Limpopo, water-use-behavior, water policy.

1. Introduction
Shortage of water is starting to be the cause of many problems in the world. The water demand continues to increase with increase in population. Urban development and expansion of business activities are contributing factors to the water shortage. At the same time climate change and drought also affect the water resources (Murwirapachena 2021). Water scarcity, poverty, and a high unemployment rate are the other problems that are currently facing Limpopo province in South Africa. This has affected majority of people's ability to protect their living. Limpopo is South Africa's food engine, approximately 33% of households in Limpopo are regarded as Agricultural households (PI & Mpandeli 2016). Water supply is a major concern in Limpopo province more especially in rural areas than Urban Areas (Matji M.P 2003). Schools, clinics, and households rely mainly on boreholes for water supply, rivers, and dams. It has been recognized that the health benefits of improved water quality and increased water use (Nations 2015). A meta-analysis of the results of water supply interventions on diarrhoeal diseases among young children around the world found that improvements in water availability, improvement in water quality does reduce diarrhoea by 37% as shown in Figure 1 (Tamason et al.2016)

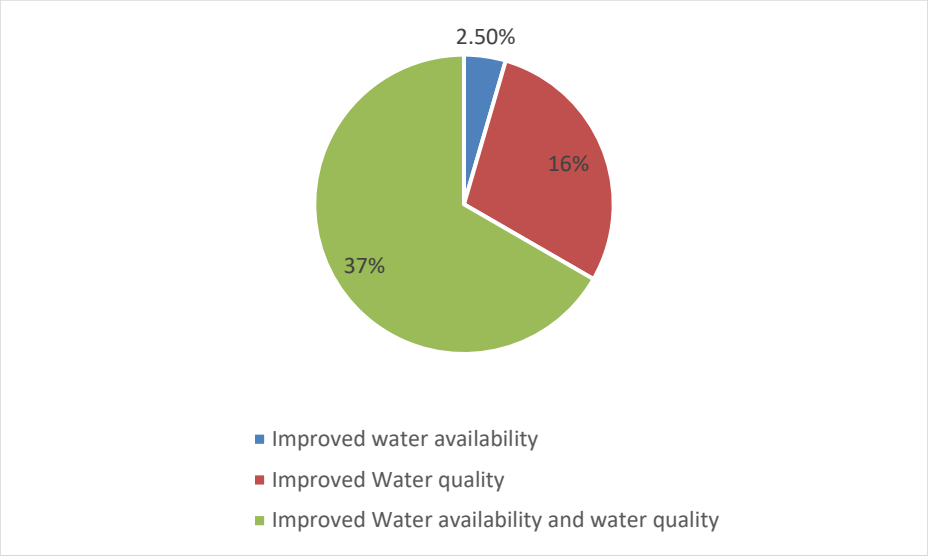

Figure 1. Water supply interventions on diarrhoeal diseases (Tamason, et al., 2016).

Water quality is being worsened and declined by pollutants from land-based sources such as municipal wastewater and contaminated urban run-off. Water needs careful management and protection because of its weakness in overuse and pollution. The National Water Resource Strategy (NWRS) states that minimizing water use at the source is the priority, followed by maximized re-use and recycling (DWAF 2004). This study collected the behavior of water re-use and water cycling using qualitative data. Five households were monitored over a period of 10 days, the results are shown in the regression model graph with made conclusions and recommendations from an analysis of this graph.

2. Literature Review

The Department of Water and Sanitation's (DWS) legislative mandate intends to safeguard. the country's water resources, protect, manage, develop, conserve and control sustainable for the benefit of all people and the environment. While government is committed to introducing policies, regulations, and strategies to reduce water demand. On the other hand householders can play a significant role in lessening overall water demands. This study compares the existing water saving policies to the people's behaviour to conserving water at home. The Theory of Reasoned Action (TRA) is a cognitive theory that helps psychologists understand human behavior in specific contexts (Nickerson 2023). This theory was developed by psychologists Martin Fishbein and Icek Ajzen in 1975, originally as an improvement to the information integration theory (Nickerson 2023). In this study, TRA is helpful because it allows us to identify beliefs and attitudes, as well as social norms and perceived control, in connection to rural areas water conservation behaviour.

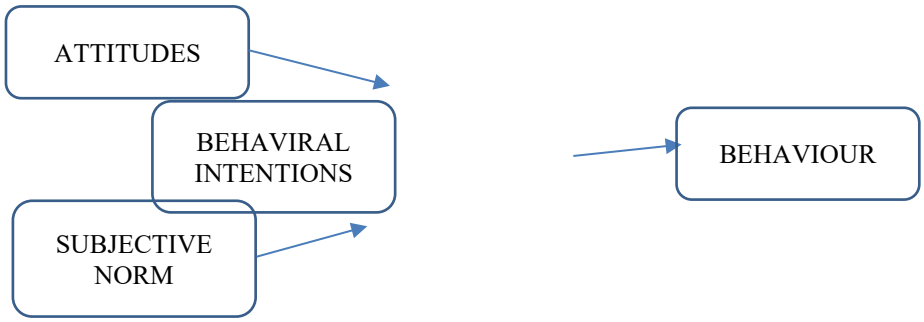

Figure 2. The Theory of Reasoned Action (Nickerson, 2023).

Figure 2 clearly shows that human conduct is the results of the thoughts, and its roots can be traced in number of circumstances that happened in history (Marandu, Moeti, N, & Joseph, H, 2010). If water conservation behaviour for the rural areas of Limpopo can be understood, intervention measures can be done to help individuals to be more aware of good water consumption behaviours. Theory of reasoned action and water conservation cannot be

separated, more especially that they are the main factors affecting economic development (Martos, Pacheco-Torres, Ordóñez, J, & Jadraque-Gago, 2016).

3. Study Area

The study area focusses on Limpopo province's villages in the Greater Tubatse municipality. The villages are Kgopaneng, Makubu, Malokela and Ga-Phala. Limpopo is a South African province bordering Botswana, Zimbabwe and Mozambique. It's known for bushveld and wildlife reserves, including part of Kruger National Park. Figure 3. These villages are located at the Northwestern side of Greater Tubatse District. Table 1 shows the population of the villages.\

Table 1. Population and Area of Kgopaneng, Makubu, Malokela and Ga-Phala (Matlakala & Vandi Von Kallon, 2021)

Local Municipality	Population	Area km^2
Kgopaneng	1610	2.44
Makubu	2826	4.61
Malokela	1676	1.91
Ga-Phala	1188	3.06
Total	7300	12

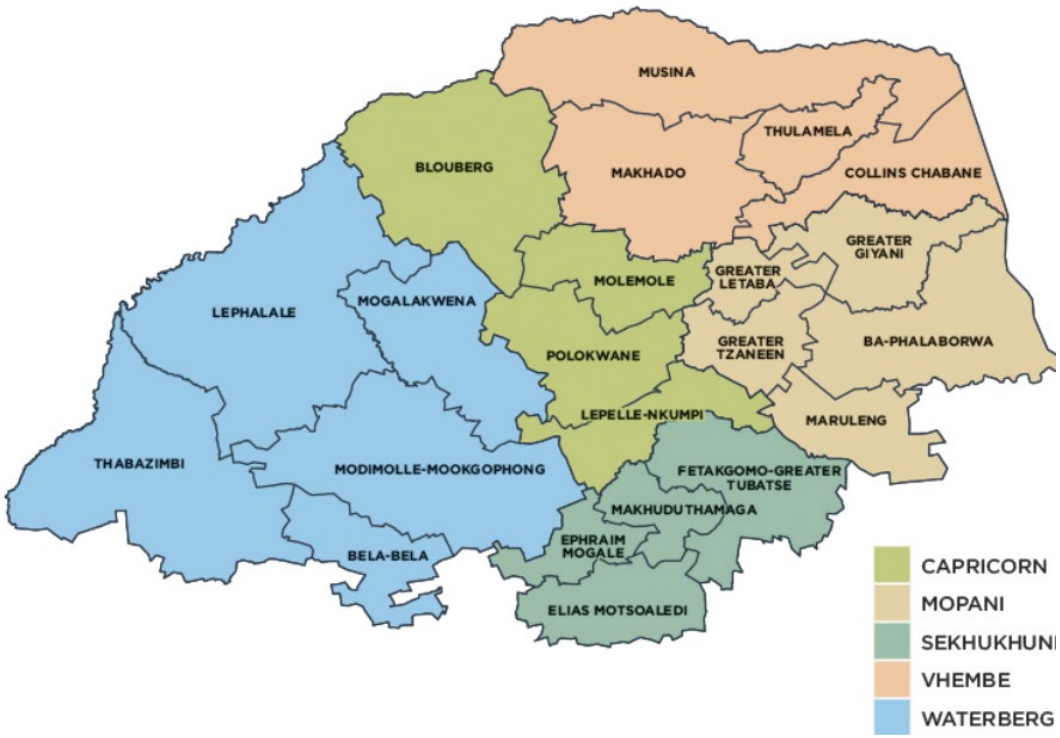

Figure 3. Limpopo, South Africa's northernmost province (municipalities.co.za, n.d.).

The study Areas depend more on boreholes and rain to get water services (Matlakala & Vandi Von Kallon, 2021). This research is based on a questionnaire survey, analyses factors that affect the water conservation behavior of study area. Different age groups were interviewed regarding the source of water they use in different communities. Table 2 shows the survey that was sent to the study areas.

3.1. Research and Method

3.1.1 Study setting

Dwellers of the 4 different villages that are located at Tubatse Municipality were interviewed. These villages are beneficiaries of the government's free water policy. Their attitudes toward water saving, perceptions and their willingness to recycle the water affects how water is managed.

3.1.2. Methodology

In each Village 5 residents were selected depending on the age group. The 5 residents were from different households. Their gender or racial belongings were not recorded. Questions regarding water saving techniques were prepared and Respondents residing within the selected villages were randomly selected.

3.1.3. Study instrument

The list of questionnaires was used as the study instrument to provoke responses from the participants about water conservation behaviour. The questionnaire was divided into three sections
Section A- knowledge of water-saving technique, with a response category of "yes",
"no", "unsure"
Section B – behaviour towards water-saving techniques, with a response category of scale range from 5 to 1. 5 is very good and 1 is very bad
Section C – attitude towards water conservation, with a response category of scale range from '5 – Strongly disagree' to '1 – strongly agree'.

3.1.4. Data analysis

regression analysis was performed to establish the factors that predict water conservation.
Ethical consideration
Before the collection of data, ethical approval was obtained from the University of Johannesburg and the permission was sought from the councillor in the study area. The questionnaire was anonymised and distributed to the respondents. The consent form was in the first page of the survey to indicate willingness of the participants for this study.

4. Results

Section A
Figure 4 is for section A researching about knowledge of water-saving techniques. Two age groups were investigated

Table 2. Water Saving Policy Questionnaire

Water Saving Policy	Yes	No
Do you collect water from rain for drinking		
Do you re-use domestic water for irrigation		
Do you use water in glass during toothbrush		
Report or fix immediately leaking pipes		
Put water in a basin when washing vegetables		
Use spray to wash cars rather than bucket		
Tightly close the tap to avoid dripping		

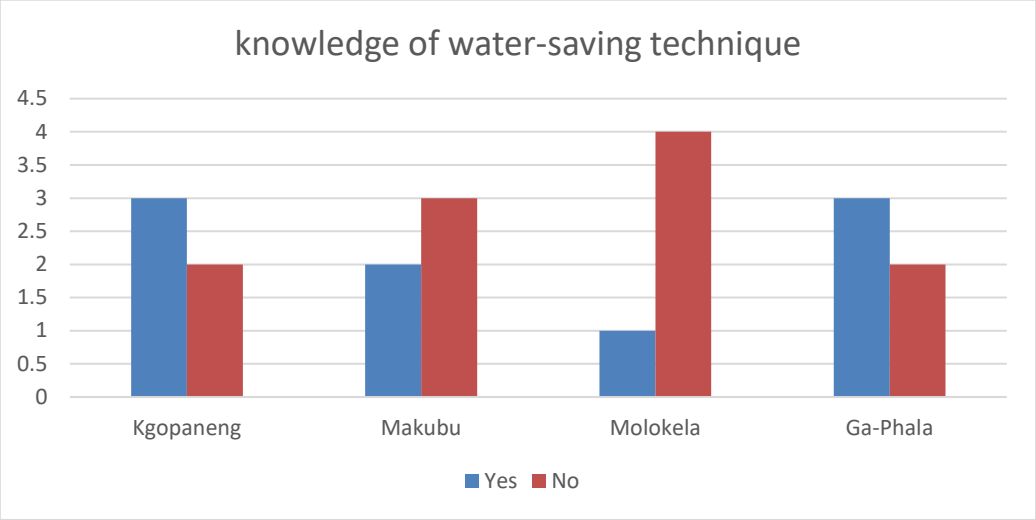

Figure 4. Results for the knowledge of water saving Technique.

Regarding knowledge on water saving policy, Figure 4 clearly shows that 75% of people don't have knowledge about the water saving policy. During the survey it was found that people are not taking seriously the water saving policy.

Section B - Behaviors towards water-saving techniques

Table 3. Questions regarding water-saving techniques.

Behaviour towards water-saving techniques	never	sometimes	always
Turn off tap when washing dishes			
Turn off tap when soaping up			
Wait until a full load before washing laundry			
Use plants that need less water			
Re-use dishwash water when it is still clean			

Water-conservation behaviors need determination but no financial cost, such as water reuse for dishwash when it is still clean. According to the results from Table 3 and Figure 5 respondents need to be educated about water saving policies. They do not regard other policies as important such as waiting for full load before laundry. majority of the respondents report having practiced at least one measure in conserving water.

Differences between knowledge and the behavior

The gap difference between knowledge of water saving policies and the behavior is shown on Table 3. From Figure 5 respondent knowledge about water saving policies is approximately 58% . On the other hand the behavior towards water savings techniques shown in figure 6 that the positive response from respondents is approximately 78%. The four study villages population group was combine when determining the gap difference.

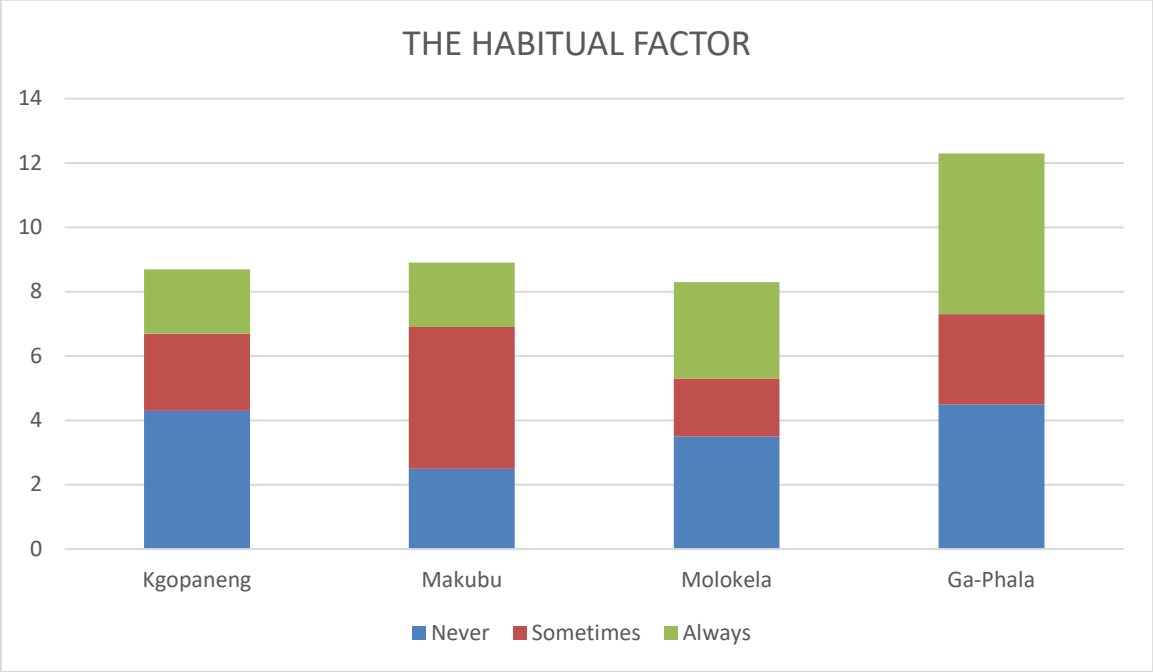

Figure 5. The effect of Habit.

Table 4. Differences between knowledge and the behavior

	Knowledge %	**Behavior %**	**Gap**
Do you re-use domestic water for irrigation	40%	38%	2%
Turn off tap when washing dishes	58%	78%	30%
Turn off tap when soaping up	60%	52%	8%
Do you use water in glass during toothbrush	65%	64%	1%
Put water in a basin when washing vegetables	59%	53%	6%
Use spray to wash cars rather than bucket	20%	28%	8%
Tightly close the tap to avoid dripping	69%	58%	11%
Wait until a full load before washing laundry	75%	71%	4%
Use plants that need less water	22%	20%	2%
Re-use dishwash water when it is still clean	30%	35%	5%
Average Score	**50%**	**49%**	**8%**

The Pearson correlation coefficient was further used to support the results in Table 4. As shown in Table 4, it can be gathered that knowledge of water-saving techniques correlates positively with actual behaviour towards water-saving techniques. This is shown by Multiple R.

Table 5. Summary output of Regression Model

Regression statistics	
Multiple R	0,891695
R Square	0,79512
Adjusted R Square	0,765851
Standard Error	0,095223
Observations	9

Multiple R - It is the Correlation Coefficient that measures the strength of a linear relationship between two variables. When R is positive it means a strong positive relationship. Figure 6 clearly shows that the knowledge of water saving techniques directly influences our behaviors.

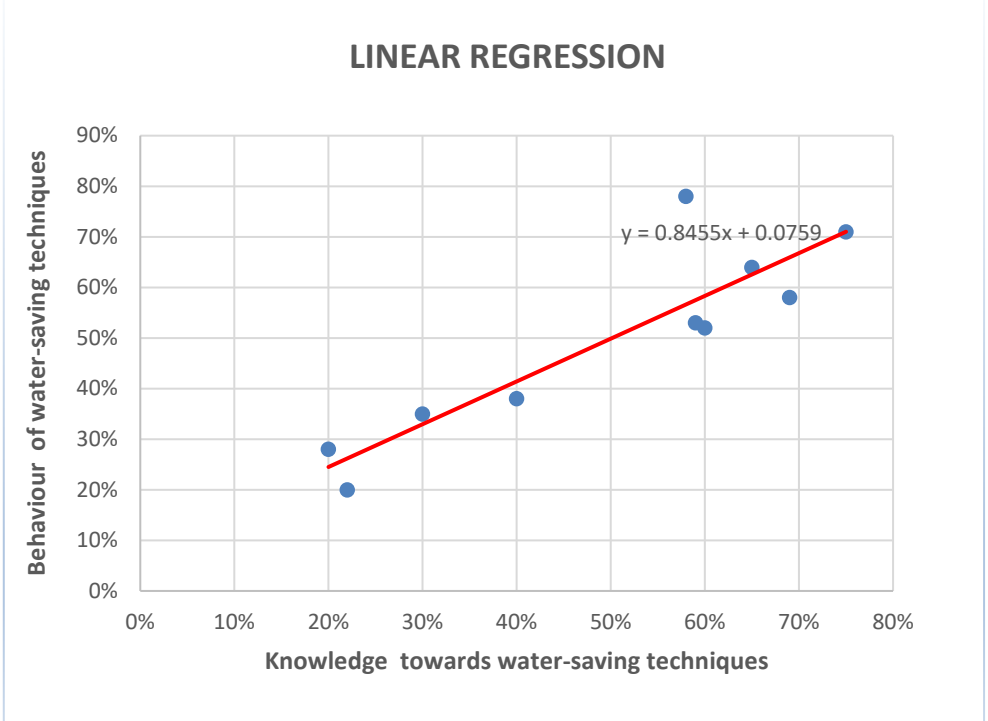

Figure 6. Linear Regression for knowledge versus behavior.

It is notable that knowledge is responsible for the attitudes and behaviors towards water saving techniques. Knowledge sharing on water saving techniques is one of essential activity need to be done to affect the community behaviour. It is important to explore ways to encourage individuals to contribute to water saving techniques. providing water saving tips can induce behaviour change. It is highlighted by Timm and deal (2018) that it is essential to understand consumers beliefs, psychological element such as attitude and social norms before implementing more practicable water saving techniques (Timm & B, 2018).

5. Conclusion

The reuse of domestic water offers a promising solution for water conservation. The reuse of domestic water can in households and communities can significantly reduce water consumption, reduce reliance on portable water and minimize the environmental impact. Strategy for promoting water sustainability need to be implemented.

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Biographies

Mrs Lindelwa Siwisa Lindelwa is a highly experienced mechanical engineer with a Master's degree in Mechanical Engineering and over 15 years of expertise in the wastewater treatment industry. Combining a solid foundation in mechanical design with an extensive background in project management, has made a Lindelwa significant contributor to the design, development, and execution of innovative wastewater treatment solutions. In the last five years, Lindelwa transitioned into project management within the wastewater treatment sector. In this role, she led multidisciplinary teams in the planning, design, and implementation of complex projects,

ensuring that they were completed on time, within budget, and to the highest standards of quality. Lindelwa is currently doing PhD in mechanical engineering at the University of Johannesburg.

Prof Dr Daramy Vandi Von Kallon is a Sierra Leonean holder of a PhD in Computational Mechanics obtained from the University of Cape Town (UCT) in 2013. He holds a year-long experience as a Postdoctoral researcher at UCT during 2013. At the start of 2014 Prof Kallon was formally employed by the Centre for Minerals Research (CMR) at UCT as a Scientific Officer. In May 2014 Prof Kallon transferred to the University of Johannesburg (UJ) as a full-time Lecturer, then Senior Lecturer and later Associate Professor in the Department of Mechanical and Industrial Engineering Technology (DMIET). He currently teaches simulation-based modules at this Department to final year of Bachelors and Honours students and serves as Head of the Quality Assurance Committee of the Department. Prof Kallon has more than twelve (12) years' experience in research and eleven (11) years of teaching at university level, with industry-based collaborations. He is widely published, has supervised from Masters to Postdoctoral and has graduated four (4) PhDs and twenty-five (25) Masters Candidates. Prof Kallon's primary research areas are Acoustics Technologies, Artificial Intelligence, Design and Development, Water Technologies and Energy Technologies.