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A COMMUNITY-BASED BEHAVIOURAL MODEL FOR WATER CONSERVATION: MITIGATING CLIMATE CHANGE IMPACTS IN LOW-COST HOUSING COMMUNITIES IN SOUTH AFRICA

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Abstract:
Effective community engagement and behavioural change are critical in addressing water scarcity exacerbated by climate change in low-cost housing (LCH) communities. This paper presents a community-based behavioural model for water conservation, developed using insights from a study conducted in the eThekwini Municipality, South Africa. The study applied the Theory of Reasoned Action (TRA) and Nudge Theory to understand and influence water usage behaviour among residents of the Waterloo community, north of Durban, South Africa. Data was collected through semi-structured interviews, focus groups, and surveys involving over 300 participants, ensuring a comprehensive analysis of the factors influencing water consumption.

Findings revealed that while residents possessed knowledge of conservation practices, this did not consistently translate into behaviour. Key barriers included a lack of incentives and limited community involvement in conservation initiatives. The proposed model integrates three strategic pillars: (1) community education on the environmental and economic importance of water conservation, (2) engagement through participatory decision-making and localized interventions, and (3) the application of nudge techniques such as default options and targeted reminders to promote behavioural shifts.

This framework offers practical guidelines for policymakers and municipalities to foster sustainable water usage in resourceffff-scarce settings. The research highlights the importance of aligning conservation efforts with cultural and social norms, leveraging behavioural science to drive long-term adaptation and mitigation in the face of climate change. The proposed model has broader applicability for water-stressed regions globally, offering a scalable approach to community-driven environmental sustainability.

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1.0 INTRODUCTION

Water scarcity has become a major global issue in the face of climate change that increases vulnerabilities in low-income contexts. This global crisis can be seen in places such as South Africa, where persistent drought, rising demand, and failures of infrastructure exacerbate the pressure on already strained water resources. In this sense, climate change has challenged water resources considerably through changes in precipitation, increased temperatures, and extreme climate events such as droughts and floods[1]. South Africa, classified as a semi-arid country, faces heightened vulnerability due to its low annual rainfall (450 mm compared to the global average of 860 mm) and increasing water demand from urbanisation[2] .In urban areas within the eThekwini Municipality in KwaZulu-Natal, water demand has surged due to population growth and inefficient infrastructure, leading to 40% of treated water being lost[3]. Policies such as the Free Basic Water Policy (FBWP) ensure access to vulnerable communities but inadvertently contribute to wastage due to behavioural and systemic factors[4].

Low Cost Housing (LCH) communities, who are recipients of the 9kl free water allocation as part of the FBWP, face additional challenges, including financial constraints, infrastructure limitations, and social norms discouraging conservation[5]. Traditional supply-side solutions, such as

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[1] Yildiz, Veysel, Murat Ali Hatipoglu, and S. Yurdagül Kumcu, 'Climate change impacts on water resources', *Water and wastewater management: global problems and measures* (Springer 2022).

[2] du Plessis, Anja, and Anja du Plessis, 'Evaluation of Southern and South Africa's freshwater resources' (2019) Water as an Inescapable Risk: Current Global Water Availability, Quality and Risks with a Specific Focus on South Africa 147.

[3] Thabo Ncala, 'Cost Recovery Strategies for Non-revenue Water at EThekwini Municipality' (University of KwaZulu-Natal, Westville 2020).

[4] Richard Adom, *Analysis of public policies and programmes to water security in post-apartheid South Africa* (University of the Witwatersrand, Johannesburg (South Africa) 2020).

[5] Rookmoney Thakur, Stanley Onwubu and Geoffrey Harris, 'Exploring the Knowledge and Practice of Water Conservation Measures: A Case of Low-Cost Housing Setting in South Africa' (2021) 3 African Journal of Inter/Multidisciplinary Studies 252.

reservoir expansion, are financially unsustainable, necessitating demand-side management strategies[6].

Despite widespread awareness of the need for water conservation, behavioural change remains a significant challenge in LCH communities[7]. Therefore, behavioural science provides an effective lens through which water conservation behaviour can be understood and influenced. This study applies two widely recognised frameworks. The Theory of Reasoned Action (TRA)[8] asserts that behavioural intentions are influenced by attitudes and subjective social norms. Within the context of water conservation, individuals are more likely to adopt sustainable behaviours if they perceive conservation as a socially desirable norm[9]. The Nudge Theory[10] proposes that subtle modifications to decision-making environments can positively influence behaviour without restricting choices.

This study seeks to develop a Community-Based Behavioural Model for sustainable water conservation that integrates education, community engagement, and behavioural nudging strategies. Key research questions include, 1) what are the primary behavioural barriers to water conservation in LCH communities? 2) how do social norms and municipal policies influence water consumption behaviours? and 3) which interventions can encourage long-term water conservation in LCH communities?

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[6] Odangowei InetiminebiI Ogidi, 'Strategies of Sustainable Management of Water Resources in the Global South', *Water Crises and Sustainable Management in the Global South* (Springer 2024).

[7] Manfredo MJ and others, 'Social value shift in favour of biodiversity conservation in the United States' (2021) 4 Nature Sustainability 323.

[8] Martin Fishbein, 'In M. Fishbein, and I. Ajzen' (1975) Belief, attitude, intention and behavior: An introduction to theory and research.

[9] Icek Ajzen, 'The theory of planned behavior' (1991) 50 Organizational behavior and human decision processes 179.

[10] Richard Thaler and Cass Sunstein, *Nudge: Improving decisions about health, wealth and happiness* (HeinOnline 2008).

This study presents new insights by bringing together behavioural science and community engagement into a model of sustainable water use in low-cost housing that supports both SDG 6 (clean water and sanitation) and the overall sustainable development agenda.

Building on this integrated approach, the findings of this study have critical policy implications, particularly for municipalities seeking to optimize water conservation efforts in resource-scarce settings. By shifting conservation strategies from top-down enforcement to community-driven participation, this study proposes a scalable and cost-effective model for sustainable water management.

This article is organised as follows: Section 2 provides a conceptual clarification and review of relevant literature; Section 3 outlines the methodology; Section 4 presents and discusses findings; Section 5 offers recommendations and policy implications; and Section 6 concludes with key insights and areas for future research.

2.0 CONCEPTUAL CLARIFICATION AND REVIEW OF RELEVANT LITERATURE

2.1 Climate Change-Related Global and Local Water Scarcity Issues

Water scarcity is a critical global challenge that is projected to worsen due to climate change, rapid population growth, and unsustainable consumption patterns. According to the United Nations World Water Development Report[11], nearly 2 billion people currently experience water stress, with projections estimating that 50% of the world's population will live in water-scarce regions by 2050. Climate change exacerbates water scarcity by altering precipitation patterns, intensifying droughts, and reducing freshwater availability, particularly in semi-arid and arid regions such as sub-Saharan Africa[12].

[11] UNESCO, *The United Nations world water development report 2021: valuing water* (United Nations 2021).

[12] Samuel A. Ofori, Samuel J. Cobbina and Samuel Obiri, 'Climate change, land, water, and food security: Perspectives From Sub-Saharan Africa' (2021) 5 Frontiers in Sustainable Food Systems 680924.

South Africa ranks among the 30 driest nations globally, receiving an average annual rainfall of 450 mm, significantly below the global average of 860 mm[13]. The country's water crisis is driven by prolonged droughts, inefficient water management, and infrastructure deficits, which disproportionately impact urban low-income communities[14]. In the eThekwini Municipality, rapid urbanisation and population growth have intensified water demand, yet approximately 40% of the total municipal water supply is lost due to aging infrastructure, leaks, and unauthorized connections[15].

While municipal policies such as the FBWP allocate 9 kilolitres of free water per household per month, studies indicate that this policy has unintended consequences, such as overuse and financial sustainability concerns[16]. Moreover, behavioural factors—rather than limited access—exacerbate excessive water use in LCH communities, necessitating innovative, behaviourally-driven conservation interventions[17].

2.2 Overview of Current Community Engagement Models for Environmental Sustainability

Community engagement is integral to environmental sustainability, particularly in water conservation efforts. Several participatory models emphasise collaborative decision-making, localized initiatives, and behavioural change interventions to drive sustainable conservation practices.

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[13] Thendo Sikhwari, 'Variability and long-term trends of climate extremes over the Limpopo, South Africa' (2019).

[14] du Plessis, *Evaluation of Southern and South Africa's Freshwater Resources* (n 1) 150.

[15] Thakur, Onwubu and Harris, 'Water Conservation Measures' (n 2) 258.

[16] Anthony Kaziboni, *Exploring hydropolitics and expressions of citizenship: Three communities in Madibeng, South Africa* (University of Johannesburg (South Africa) 2022).

[17] Ehret PJ and others, 'Systematic review of household water conservation interventions using the information–motivation–behavioral skills model' (2021) 53 Environment and Behavior 485.

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2.2.1 Co-Management Models

The co-management model fosters shared governance between municipal authorities and local communities, ensuring that water users actively participate in conservation strategies. For example, Brazil's River Basin Committees involve government officials, civil society organizations, and water users in collaborative decision-making[18]. Similarly, South Africa's Catchment Management Agencies (CMAs) aim to decentralize water governance and involve community stakeholders, although implementation remains inconsistent[19].

2.2.2. Participatory Education and Awareness Programs

Public education campaigns play a crucial role in influencing conservation behaviour. In Singapore, the Water Efficient Homes Program has successfully reduced domestic water consumption through financial incentives, awareness campaigns, and conservation education in schools[20]. However, in South African municipalities, public conservation initiatives often fail to achieve lasting behavioural change due to poorly tailored messaging, inadequate community engagement, and a lack of incentive structures[21].

2.2.3 Incentive-Based Water Conservation Approaches

Economic and social incentives have proven effective in promoting sustainable water consumption. Countries such as Australia and Germany implement tiered water tariffs, charging higher rates for excessive

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[18] Lemos MC and others, 'Building on adaptive capacity to extreme events in Brazil: water reform, participation, and climate information across four river basins' (2020) 20 Regional Environmental Change 1.

[19] Victor Munnik, 'The reluctant roll-out of catchment management agencies' (2020) Water Research Commission Research Report .

[20] Chindavone Sanlath and Nicodemus M. Masila, 'Water demand management: What lessons can be learned from Singapore's water conservation policy' (2020) 26 Water Utility Journal

[21] Lorraine Gerrans, 'Green nudges: Exploring the use of behavioural insights to accelerate the transition to sustainable development in South African municipalities' (Stellenbosch: Stellenbosch University 2020).

consumption to encourage conservation[22]. South Africa's Inclining Block Tariff (IBT) system follows a similar model but faces enforcement challenges in LCH communities due to non-payment and policy inconsistencies[23].

2.2.4 Behavioural Science Interventions

Recent studies suggest that behaviourally-driven conservation strategies—such as social norm feedback, default conservation settings, and choice architecture—can be more effective than traditional enforcement methods[24]. Integrating Nudge Theory with the TRA provides a strong foundation for community engagement models that emphasize habit formation and social accountability[25].

2.3 Theoretical Frameworks

2.3.1 TRA

The TRA explains how attitudes and social norms shape behavioural intentions[26]. In water conservation, individuals are more likely to adopt sustainable practices if they perceive them as socially or economically beneficial. Social influence plays a crucial role, as people tend to conserve less if wasteful behaviours are common in their community. Changing attitudes and reinforcing social norms through public commitments, community-led initiatives, and peer comparisons can encourage conservation[27].

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[22] Xavier Leflaive and Hjort Marit, 'Addressing the social consequences of tariffs for water supply and sanitation' (2020)

[23] Dale Whittington and Celine Nauges, 'An assessment of the widespread use of increasing block tariffs in the municipal water supply sector', *Oxford Research Encyclopedia of Global Public Health* (2020)

[24] Thaler and Sunstein, *Nudge* (n 2) 89.

[25] Ajzen, 'Theory of Planned Behavior' (n 2)

[26] Fishbein and Ajzen, *Belief, Attitude, Intention and Behavior* (n 2)

[27] Ajzen, 'Theory of Planned Behavior' (n 3)

2.3.2 Nudge Theory

The Nudge Theory suggests that small environmental cues can influence behaviour without restricting choices[28]. Effective nudging techniques include social norm feedback, where comparative reports on household water use encourage conservation. Choice architecture, such as pre-installed water-efficient appliances, has successfully reduced consumption in cities like Singapore and Melbourne[29]. Incentive-based nudges, like rebates for reduced usage, reinforce positive habits. Simple visual reminders near taps, such as "*Saving Water Helps Your Community*," have been shown to decrease consumption by 10-15% in Melbourne[30]. These strategies make conservation easier and more habitual, promoting long-term sustainable behaviour.

Existing literature underscores the importance of behaviourally based approaches to water conservation, as traditional supply-side solutions fail to address increasing demand. While co-management models, participatory education programs, and incentive structures have shown promise in other regions, there is limited research on their application in South African LCH communities. Moreover, studies focusing on TRA and Nudge Theory in water conservation remain largely theoretical, with insufficient empirical evidence on their practical implementation in urban low-income settings.

3.0 METHODOLOGY

This study employs a sequential mixed-methods approach to investigate water conservation behaviour in LCH communities in eThekwini Municipality, South Africa. A two-phase design was used: qualitative research (semi-structured interviews and focus group discussions) explored behavioural, structural, and policy-related factors, while quantitative research (structured surveys) validated and generalized these findings. This approach ensured a comprehensive understanding of conservation barriers and informed the development of the Community-Based Behavioural Model for Water Conservation.

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[28] Thaler and Sunstein, *Nudge* (n 3) 89

[29] Sanlath and Masila, 'Water Demand Management' (n 2)

[30] Leflaive and Hjort, *Addressing the Social Consequences of Tariffs* (n 2)

The research was conducted in Waterloo, an LCH community within eThekwini Municipality, selected for its reliance on municipal water supply, persistent water management challenges, and existing conservation initiatives. The study focused on households receiving free basic water, targeting adult residents responsible for household water use, as well as community leaders, municipal officials, and water experts. A simple random sampling strategy ensured representative participation across different household structures.

Semi-structured interviews were conducted with eight key informants, including community leaders, municipal officials, sustainability experts, and ward councillors, to examine conservation awareness, behavioural barriers, and policy effectiveness. Additionally, four focus group discussions (FGDs) with 22 community members explored social norms and challenges in adopting conservation behaviours. Data were recorded, transcribed, and analysed to capture contextual insights.

A structured survey, grounded in TRA and Nudge Theory, assessed demographics, awareness, self-reported conservation behaviours, and social influences. The sample included 304 randomly selected households. A pilot study refined the questionnaire for clarity and relevance. Surveys were administered through face-to-face interviews, with data recorded digitally to ensure accuracy.

Thematic Content Analysis (TCA) was employed using NVivo 12 software, following a structured coding approach. Open coding identified themes related to conservation behaviours and barriers, axial coding grouped themes into broader categories, and selective coding extracted key findings aligned with TRA and Nudge Theory. Intercoder reliability was established through independent coding and consensus discussions.

3.1 Quantitative Analysis

Data were analysed using SPSS (Version 25) to identify trends in conservation behaviour. Descriptive statistics summarized knowledge, attitudes, and behaviours, while t-tests and ANOVA examined demographic differences. Regression analysis and Structural Equation Modeling (SEM) assessed relationships between awareness, social norms,

incentives, and conservation behaviour. Cronbach's alpha (≥ 0.70) confirmed the reliability of survey measures.
Ethical clearance was obtained from Durban University of Technology, with municipal permissions secured. Informed consent ensured voluntary participation, and confidentiality was maintained by anonymizing data. Secure storage protocols were followed to protect participant information. To enhance validity and reliability, qualitative findings were cross-referenced with survey results. Self-reported conservation behaviours were compared with municipal water usage data for verification. This triangulation minimized biases and strengthened the study's conclusions.

4.0 RESULTS AND DISCUSSION

This study identified key barriers to water conservation, including infrastructure inefficiencies, policy shortcomings, and behavioural resistance. The discussion integrates these findings leading to the proposed Community-Based Behavioural Model for Water Conservation, which is grounded in the (TRA and Nudge Theory. The proposed model provides a structured approach to understanding and influencing community water conservation behaviour, emphasizing education, engagement, and incentives.

4.1 Interpreting Barriers to Water Conservation: Implications for a Community-Based Behavioural Model

The in-depth interviews with the eight key stakeholders, including two community leaders, two academics, two government officials from the eThekwini Water and Sanitation Department, and two ward councillors provided a detailed understanding of the structural, policy, and behavioural barriers affecting water conservation efforts in LCH communities, as shown in Table 1 below.

Table 1: Structural, Policy, and Behavioural Barriers

Barrier Category	Key Issues Identified	Stakeholder Insights
Structural Challenges	-Aging infrastructure leading to frequent leaks	**Municipal Official:** "*We have a backlog of leak repairs because of resource shortages. By the time we*

	-Delayed municipal response to reported leaks	*fix one, another one is reported."* **Community Leader:** *"Even if we report leaks, nothing happens. So why should people care about saving water?"*
Policy Barriers	-Free Basic Water Policy (9kl/month) encourages wasteful consumption -Non-payment culture reduces accountability	**Government Official:** *"Households that could afford to pay don't because they know they get free water. It creates a mindset of entitlement rather than responsibility."* **Community Leader:** *"People use up their 9 kilolitres no matter what. Even if they don't need it, they won't let it go to waste."*
Behavioral Barriers	-Social norms discourage conservation, as people feel their individual efforts won't make a difference -Resistance to habit change, particularly for conservation practices that require effort or inconvenience	**Ward Councillor:** *"A household can try to save water, but if their neighbor is washing their car with a running hose every day, they feel like their efforts don't matter."* **Academic Expert:** *"We need to treat water conservation like recycling—it should become a social expectation rather than an individual choice."* **Resident:** *"Flushing less often is unhygienic, and using a bucket for car washing is too much work."*

Aging infrastructure and delayed municipal responses to leaks significantly undermine water conservation efforts[31]. The community leader's perspectives indicate that residents lack trust in the municipality's ability to manage water infrastructure effectively, leading to a sense of futility in household conservation efforts. When leaks persist for weeks or months without repair, residents see little value in saving water at an individual level, as large-scale municipal wastage continues unchecked.

[31] Thakur, Onwubu and Harris, 'Water Conservation Measures' (n 3) 255.

This finding emphasizes the urgent need for a rapid leak reporting and repair system to ensure that municipal inefficiencies do not counteract community conservation initiatives.

The FBWP has unintended consequences that discourage water conservation. The municipality representative indicated that the policy fosters a culture of entitlement, where households consume their full allocation regardless of necessity. The absence of financial consequences for excessive use creates wasteful consumption patterns. Furthermore, the non-payment culture reinforces the perception that water is a free, unlimited resource rather than a scarce commodity[32]. The interpretation here suggests that restructuring the policy through tiered pricing and incentive-based conservation rewards could align financial incentives with responsible water use.

Social norms and peer influence play a crucial role in shaping water conservation behaviours[33]. The interviews reveal that many residents believe their individual conservation efforts are insignificant if others in their community do not adopt similar practices. This perception discourages proactive conservation and highlights the need for community-wide engagement strategies that reinforce conservation as a collective responsibility rather than an individual choice.

In addition to social norms, habit resistance presents a major obstacle to conservation practices that require behavioural changes. Respondents acknowledge knowing water-saving techniques but often resist implementing them due to convenience factors. Practices like flushing sparingly, turning off taps, or using buckets instead of hoses are perceived as inconvenient or unhygienic, which limits widespread adoption. This finding reinforces the importance of behavioural nudging techniques, such as visual reminders, real-time water usage feedback, and social accountability measures, to encourage habit formation and long-term conservation compliance.

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[32] Claudia Díaz-Combs, '" When the water stops but the bills never do": Contentious water politics and collective action in El Salvador' (Syracuse University 2024).

[33] Ajzen, 'Theory of Planned Behavior' (n 4).

Community-based conservation programs could help shift behaviours by reinforcing peer accountability. Strategies such as Water Champions programs and comparative household usage reports can normalize conservation efforts and encourage broader community participation[34].
The stakeholder interviews provide critical insights into the barriers preventing effective water conservation. Structural challenges, policy-related inefficiencies, and behavioural obstacles all contribute to low compliance with conservation practices. Addressing these issues requires a comprehensive, multi-level approach that integrates financial incentives, improved municipal efficiency, and community-driven conservation initiatives[35].

The Community-Based Behavioural Model developed from these findings offers a practical, scalable solution to promote long-term sustainable water management in low-cost housing communities.

4.2 Barriers to Water Conservation: Insights from Community Perspectives

The qualitative data from focus group discussions (FGDs) provided deeper insights into why certain conservation practices are not consistently followed. The themes that emerged emphasized barriers to conservation, social norms, and infrastructure inefficiencies and is illustrated in Table 2 below.

Table 2: Key Themes from the FGD

Themes	Key Finding	Participant Quotes
Lack of Motivation Due to	The perception that water is free discourages	"*I know I should turn off the tap while brushing,*

[34] Shane M. White, 'The Water That Will Be: A Qualitative Look Into the Effects of Visual Imagery on Participation in Water Conservation Initiatives' (University of Arkansas 2024)
[35] Nehmat Singh, 'Promoting Multi-stakeholder Collaboration for Nature-Based Sustainable Development', *Nature-Based Solutions in Achieving Sustainable Development Goals: Harmonizing Nature and Progress* (Springer 2024)

Free Basic Water Policy	conservation efforts.	*but water is free anyway, so I don't think about it.*"
Role of Social Norms and Peer Influence	Conservation efforts are less likely to be adopted if others are not doing the same.	"*If no one else is saving water in my area, why should I? It won't make a difference.*"
Inconvenience and Habit Resistance	Practices requiring behavioural changes face significant resistance.	"*Flushing less often is unhygienic, and using a bucket for car washing is too much work.*"
Municipal Infrastructure Inefficiencies	Leaks, delayed repairs, and aging infrastructure discourage conservation efforts.	"*Even if I save water, leaks in my area waste more than I ever could.*"

One significant barrier identified is the lack of motivation due to the FBWP. Many respondents expressed that the municipal provision of 9 kilolitres of free water per household per month reduces the urgency for conservation. The perception of water as a free and unlimited resource discourages residents from actively reducing consumption. This finding highlights how policy structures can inadvertently encourage overuse. Instead of promoting conservation, fixed allocations create a sense of entitlement to water use, regardless of necessity. Reforming this policy to introduce tiered allocations or incentive-based conservation rewards could help shift behaviours toward more sustainable practices.

Another key factor influencing water conservation is the role of social norms and peer influence. Respondents frequently reported that individual efforts felt ineffective when their neighbours did not adopt similar conservation behaviors. This finding aligns with the TRA, which emphasizes that social influences shape individual decision-making. Without community-wide reinforcement, conservation behaviours are less likely to be sustained. This highlights the need for collective action strategies within communities and publicly displaying comparative water usage to promote accountability.

Resistance to behavioural change also emerged as a notable barrier, particularly regarding convenience-based habits. Many respondents expressed reluctance to adopt conservation practices that require extra effort, such as flushing sparingly or using a bucket for car washing. This response illustrates how habitual resistance plays a critical role in conservation behaviours. While knowledge of conservation techniques is widespread, implementing these practices often requires breaking ingrained routines. To address this, nudging techniques, such as visual reminders near taps and real-time feedback on water usage, can help reinforce conservation behaviours without imposing additional inconvenience[36].

Infrastructure inefficiencies further undermine conservation efforts, as many respondents questioned the value of saving water when municipal leaks and poor maintenance result in significant water loss. This sentiment reflects a lack of trust in municipal water management, which demotivates residents from engaging in conservation efforts. Without a reliable infrastructure system, household-level conservation appears futile and inconsequential. Strengthening municipal responsiveness, implementing real-time leak reporting systems, and engaging communities in infrastructure monitoring could help restore public confidence in conservation efforts[37].

4.3 Knowledge-Behaviour Gap

The findings from the survey, as shown in Table 3, indicate a high level of awareness regarding common water conservation practices, with over 95% of respondents recognizing the importance of actions such as turning off taps, fixing leaks, and reusing water. This suggests that educational campaigns have been effective in disseminating conservation knowledge. However, awareness of certain practices was comparatively lower, with

[36] Bradley V. Warren, 'Investigation into a smartphone application for household water data management as a tool to improve conservation efforts' (Stellenbosch: Stellenbosch University 2021).

[37] Prasann Kumar and Debjani Choudhury, 'Innovative Technologies for Effective Water Resources Management' (2024) Water Crises and Sustainable Management in the Global South 555.

78% of respondents acknowledging the use of a glass of water while brushing teeth and 89.5% recognizing the importance of reducing flush frequency. These lower awareness levels may be attributed to cultural norms or a lack of emphasis in conservation messaging, leading to uncertainty or resistance in adopting these behaviors.

Table 3: Knowledge and Awareness of Water Conservation Practices

	Knowledge and Awareness	**Yes (%)**	**No (%)**	**Not sure (%)**
1	Tightly close taps to avoid dripping	(100%)	(0%)	(0%)
2	Turning tap water off during tooth brushing	(97.7%)	(0.3%)	(2.0%)
3	Repairing leaking pipes or reporting them to landlords	(99.0%)	(1.0%)	-
4	Use water in a glass during tooth brushing	(78.0%)	(9.8%)	(12.1%)
5	Turning the showers off while soaping	(95.7%)	(3.0%)	(1.0%)
6	Save water when washing a car: by using a bucket or putting spray nozzle on the end of your hose to prevent the hose from continuously releasing water	(97.0%)	(1.0%)	(2.0%)
7	Washing vegetables using water put in a basin or sink rather than under flowing tap water	(95.7%)	(2.3%)	(2.0%)
8	Reusing water: for example, watering plants with used water	(97.4%)	(2.0%)	(0.7%)
9	Collecting rainwater for use around the house	(96.4%)	(1.3%)	(2.3%)
10	Watering gardens or plants during the evening or night	(92.1%)	(2.3%)	(5.6%)
11	Flush sparingly; for example, after urinating one does not have to do the whole flush.	(89.5%)	(5.2%)	(5.2%)

The survey data presented in the Table 4 highlights the self-reported frequency of household water conservation practices, revealing a noticeable gap between awareness and actual behaviour as reported in Table 3 above.

Table 4: Practicing Water Conservation at Home

Do you practice the following in your home to save water	**n**	**Likert scale**					**Mean**	**Std.**	**T-test value**	***P*-value**
		Always	**Very often**	**Sometimes**	**Rarely**	**Never**				
I make sure that the taps in my house do not drip	304	75.7%	22.0%	2.3%	0.0%	0.0%	1.27	0.492	44.858	0.000
I turn the tap water off while brushing my teeth	304	48.0%	16.8%	32.9%	1.3%	1.0%	1.90	0.972	34.167	0.000
I repair leaking pipes or	304	69.7%	23.0%	6.9%	0.3%	0.0%	1.38	0.628	38.267	0.000

report them to landlord or municipality										
I use water in a glass or cup while brushing my teeth	304	40.1%	11.8%	39.1%	4.6%	4.3%	2.21	1.150	33.523	0.000
I turn the shower off while soaping	304	52.0%	10.9%	33.9%	0.3%	3.0%	1.91	1.065	31.338	0.000
I save water when washing my car: by using a bucket or putting a spray nozzle on the end of your hose to	301	61.5%	15.3%	22.9%	0.0%	0.3%	1.62	0.857	32.870	0.000

prevent the hose from continuously releasing water										
I wash my vegetables using water put in a bowl or sink rather than under flowing tap water	305	56.7%	17.4%	24.9%	0.0%	1.0%	1.71	0.908	32.920	0.000
I re-use water: for example, watering plants with used water	303	53.8%	17.2%	26.4%	1.0%	1.7%	1.80	0.975	32.041	0.000
I collect rainwa	305	57.0%	18.7%	21.6%	1.6%	1.0%	1.71	0.927	32.194	0.000

ter for use around the house e.g. washing the yard, carpets, watering the garden										
I water my garden or plants during the evening or night	300	52.7%	15.0%	26.3%	2.3%	3.7%	1.89	1.098	29.862	0.000
I flush my toilet sparingly; for example, after urinating one does not have to do the whole flush	305	57.0%	23.3%	15.4%	0.7%	3.6%	1.70	0.996	29.901	0.000

Certain conservation practices that require minimal effort or habit change demonstrate higher compliance rates. For instance, 75.7% of respondents always ensure taps are fully closed, with an additional 22.0% doing so very often (Mean = 1.27, Std. = 0.492). Similarly, 69.7% of respondents consistently report or repair leaks (Mean = 1.38, Std. = 0.628), and 61.5% use a bucket or spray nozzle while washing a car (Mean = 1.62, Std. = 0.857). These findings suggest that when conservation efforts require little behavioural adjustment, they are more likely to be practiced consistently. Conversely, behaviours require a deliberate shift in routine exhibit lower compliance rates and greater variability. Only 40.1% of respondents consistently use a cup of water while brushing their teeth, with 39.1% doing so only sometimes (Mean = 2.21, Std. = 1.150). Similarly, 52.0% of respondents always turn off the shower while soaping, while 33.9% do so sometimes (Mean = 1.91, Std. = 1.065). Practices such as flushing sparingly show moderate adherence, with 57.0% of respondents consistently following this measure; however, 15.4% report doing so only sometimes, and 3.6% never adopt this behavior (Mean = 1.70, Std. = 0.996). The higher standard deviation values (above 1.0) for these behaviors indicate significant variability, suggesting stronger resistance to conservation efforts that disrupt convenience.

Additionally, social norms and cultural preferences influence the adoption of certain water-saving behaviours. Turning off taps while brushing teeth is consistently practiced by only 48.0% of respondents, while 32.9% do so sometimes (Mean = 1.90, Std. = 0.972). Similarly, 52.7% of respondents always water their gardens at night to reduce evaporation, whereas 26.3% report practicing this only sometimes (Mean = 1.89, Std. = 1.098). The reuse of water for non-drinking purposes follows a similar pattern, with 53.8% consistently doing so, while 26.4% adopt this measure only occasionally (Mean = 1.80, Std. = 0.975). These findings suggest that conservation habits that lack strong social reinforcement tend to have lower compliance rates, underscoring the need for community-based reinforcement strategies.

The statistical significance of these findings is confirmed by p-values (0.000) across all water conservation behaviors, reinforcing the measurable gap between knowledge and action. The finding demonstrates that while

conservation habits requiring minimal effort, such as closing taps, show consistent adherence, practices that demand habitual changes, such as reducing flush frequency, are adopted less consistently. Social reinforcement and perceived convenience also play a crucial role in shaping conservation behaviours, highlighting the necessity for behavioural interventions, nudging strategies, and policy incentives.

The persistent gap between knowledge and behaviour in water conservation highlights a critical need for a Community-Based Behavioural Model for Water Conservation. While awareness of conservation practices is high, the inconsistency in translating this knowledge into sustained action, especially for behaviours requiring habitual or lifestyle changes, demonstrates the limitations of traditional awareness campaigns. This underscores the urgency of implementing targeted, community-driven interventions that address behavioural barriers and reinforce long-term conservation habits.

To effectively bridge the Knowledge-Behaviour Gap, the proposed model should incorporate three key intervention strategies. First, nudging and behavioural reminders can reinforce conservation habits through visual cues, such as placing stickers near taps with messages like *"Every Drop Counts"* and providing real-time consumption feedback to households. Evidence from Melbourne shows that such interventions can reduce water consumption by 10-15%, highlighting their effectiveness in promoting behavioural change. Second, community accountability and social reinforcement play a crucial role in shaping conservation behaviours.

Initiatives such as neighbourhood water conservation challenges and household water usage rankings, modelled after Cape Town's successful public leaderboard system, have proven to significantly reduce household water use[38]. Finally, incentivised conservation strategies offer a tangible way to encourage sustained behavioural shifts. Financial rewards for reduced water consumption and the widespread adoption of low-flow appliances—demonstrated by Costa Rica's 6-10% reduction in household

[38] Marius Van der Merwe, 'The role of open-access hydrological information systems in water security risk assessment in Cape Town' (Cape Peninsula University of Technology 2021)

water usage through incentive programs—have shown measurable success[39].

However, despite this widespread awareness, the qualitative interviews and focus group discussions (FGDs) revealed a significant gap between knowledge and actual behaviour. Some participants expressed a perception of water as an unlimited resource, reducing their motivation to conserve: *"I know we should turn the tap off when brushing our teeth, but I don't see the need because water always comes out."* Others highlighted the role of convenience in shaping behaviour, as one respondent noted: *"We know about reusing water, but it's easier to just open the tap instead."* Additionally, infrastructure inefficiencies emerged as a significant barrier, with a many participants questioning the impact of individual conservation efforts when municipal leaks persist unfixed: *"Even if we save water, the municipality doesn't fix leaks quickly, so what's the point?"* These insights underscore the importance of addressing both behavioural and structural challenges to enhance water conservation efforts in the community.

Proposed Model

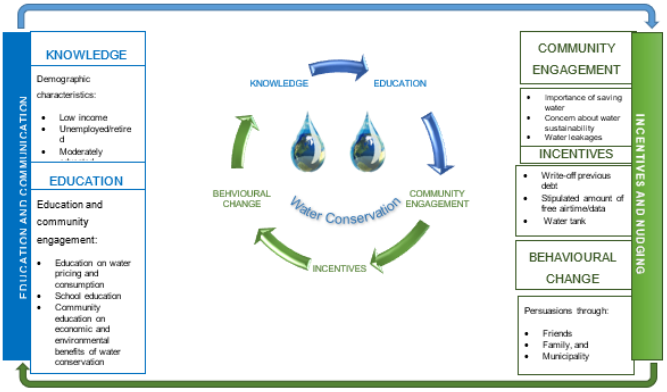


Figure 1: Community-Based Behavioural Model for Water Conservation

[39] Bernedo Del Carpio, María, Francisco Alpizar, and Paul J. Ferraro, 'Community-based monitoring to facilitate water management by local institutions in Costa Rica' (2021) 118 Proceedings of the National Academy of Sciences e2015177118

The Community-Based Behavioural Model for Water Conservation, as illustrated in the provided figure, is directly informed by the qualitative and quantitative findings of this study. The model highlights the interconnected roles of education and communication, community engagement, incentives, and behavioural nudging in driving sustainable water conservation practices.

4.4 Discussion of Findings in Relation to the Model

A. Knowledge and Education: Addressing Awareness Gaps

The survey results indicated that while awareness of water conservation practices is relatively high, there remains a significant gap between knowledge and actual behavior. Qualitative insights from focus group discussions reinforce this, with participants acknowledging the importance of conservation but expressing uncertainty about how to apply it consistently.

The model emphasises education and communication as a foundational component of water conservation. Specifically, education on water pricing and consumption and community-driven initiatives are crucial in shifting attitudes and promoting behavioural change. The inclusion of school-based education programs in the model aligns with findings that early exposure to conservation concepts can foster long-term sustainable habits. Moreover, community education on the economic and environmental benefits of conservation ensures that residents not only understand water-saving practices but also recognize their long-term impact.

B. Community Engagement: Strengthening Social Influence

The study findings indicate that social norms significantly impact water usage behaviors. Respondents in interviews and focus groups often cite the perception that individual conservation efforts are ineffective if neighbours do not participate. This aligns with the model's community engagement component, which highlights the importance of promoting collective responsibility for water conservation.

The model suggests that raising awareness about water sustainability and leakages is key to fostering an engaged community. When residents see tangible examples of successful conservation efforts, such as public

conservation initiatives or visible reductions in municipal water wastage, they are more likely to participate actively. This supports the introduction of community-based water champions and peer-led conservation programs to enhance local accountability and peer influence.

C. Incentives: Overcoming Policy and Economic Barriers

Findings from the quantitative survey suggest that economic incentives play a crucial role in encouraging conservation behaviors. Many respondents reported that the current Free Basic Water Policy does not motivate conservation, as residents tend to use their full allocation regardless of need. Additionally, the non-payment culture in some areas has led to reduced responsibility in water usage.

The model addresses this by incorporating incentives for conservation, including:

I. Debt write-offs for previous non-payment, encouraging households to start fresh with responsible water use.
II. Provision of free mobile data or airtime for households that reduce their consumption, leveraging non-monetary rewards to incentivize behavioural change.
III. Access to water storage solutions, such as water tanks, allowing communities to better manage their consumption during shortages.

These strategies align with behavioural economics principles, which suggest that positive reinforcement is more effective than punitive measures in driving sustainable consumption patterns.

D. Behavioural Change and Nudging: Encouraging Habit Formation

The qualitative insights indicate that habitual resistance is a major barrier to conservation. Many respondents admitted that while they understood the need for conservation, they found it inconvenient or unnecessary to change daily habits. Statements such as *"Flushing less often is unhygienic"* and *"Using a bucket for car washing takes too much effort"* illustrate this resistance.

The model suggests behavioural nudging techniques as a means to gradually shift social norms and conservation habits. Persuasion through friends, family, and municipal authorities is identified as a key factor in reinforcing conservation messages at the community level. Furthermore, interventions such as placing visual reminders near water sources, providing real-time usage feedback, and publicly recognizing households with sustainable water use can make conservation a more socially accepted and normalized practice.

5.0 LEGAL APPROACHES FOR ADDRESSING CHALLENGES: RECOMMENDATIONS

5.5.1 Policy Revisions

To alleviate policy constraints, this study proposes amending the FBWP to include formal incentives for water conservation. A tiered allocation system could be established, which rewards households with offerings of additional non-monetary benefits or credits if they have accrued a history of sustained conservation. Water saving would be encouraged without jeopardising equitable access.

Policy revision should address cultures of non-payment that may arise in the context of free water by tying free water allowances to the successful involvement of residents within their communities to conserve precious water, effectively holding communities, and members of them, accountable and responsible for their water use. Evidence from other water-scarce areas indicate that incentive-based policy mechanisms have been successful in other areas of the world and could be similarly applicable in South Africa's low-cost housing a community[40].

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5.5.2 Institutional Frameworks

Creating institutional frameworks is an important one of the essentials of meaningful water resource management at the community level. CMAs need to be adequately resourced and legally enabled to address leaks as

[40] G K Letley and J K Turpie, *Designing Viable Strategies and Financing Mechanisms for Securing Hydrological Ecosystem Services in South Africa: A Review, Investigation and Decision Support Framework* (Water Research Commission 2023).

soon as they occur, enforce conservation policies, and communicate with stakeholders transparently. Clear legal directives can clarify the municipal roles, and direct CMAs on aligning and coordinating with local government and residents. The ability to coordinate institutions should also be able to coordinate and share data, monitoring, and deliver behavioural changes. The ability of other functionally capable CMAs has suggested, without clear institutional mandates or resources, sustainable water management efforts will not be successful[41].

5.5.3 Mechanisms for Community Governance

Water User Associations (WUAs) can serve as a valuable venue for more grassroots-level engagement with water management in low-cost housing communities. Providing a formalized channel for residents' voices in the decision-making process, WUAs can encourage participatory planning, grow organizations' capacity to engage in conservation behavior, and mediate water use-related conflict. If WUAs are legally recognized and provided applicable foundational guidelines for its formation, maintenance, and oversight, the resident and community ownership of local water resources will be strengthened and will promote cooperative behavior related to conservation. The recent literature reflects the potential benefit of local, community-level governance structures in supporting collective action and building resilience to climate-related water scarcity[42].

5.5.4 Public Accountability and Engagement

Public accountability and engagement are important elements for long-term water conservation. The law should require that municipalities publicly report on their water loss, leaking repair, and conservation program outcomes so that community members can track progress and hold them accountable. Community monitoring mechanisms like publishing average household water use would promote transparency and spur peer-oriented conservation. All aspects of the public participation

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[41] J Douwes, M McKenzie, I Preston, N Mncube and U Earth, *Strengthening the Community of Practice Working on the Integration of Water-Related Ecological Infrastructure and Built Infrastructure in South Africa's Water Management Areas* (2025).

[42] G Amarnath, C Mweemba, E Manishimwe and B van Koppen, *Locally Led Climate Action for Sustainable Community Resilience* (2023).

exercise, especially women's input and that of marginalised groups, should require inclusivity so that there is equitable and culturally sensitive conservation efforts. International examples have shown that the presence of public accountability requirements in legislation enhances the effectiveness and legitimacy of local water governance[43].

5.5.5 Alignment with Sustainable Development Agendas

Lastly, all legal and policy reform must be aligned with the national and global sustainable development agenda, and in particular Sustainable Development Goal 6: Ensure availability and sustainable management of water and sanitation for all individuals. The community-based behavioural model should be coordinated with South Africa's National Water and Sanitation Master Plan, as well as relevant climate adaptation strategies to ensure consistency, sustainability and scale. Engagement with peer-reviewed public policy research and guidelines published by the United Nations and other multilateral organizations and adapting best practice and promoting South Africa's commitment to environmental sustainability[5] is also advisable.

These recommendations, overall, provide different dimensions for overcoming the study's identified legal, institutional, and behavioural barriers. Combining policy reform, institutional strengthening, community governance, public accountability, and sustainable development goals would provide a municipality and channel stakeholders towards a more sustainable, participatory water conservation culture in low-cost housing communities.

6.0 CONCLUSION

The study highlights that while awareness of water conservation is high, behavioural barriers hinder adoption. Structural inefficiencies, policy limitations, and social norms must be addressed through a comprehensive community-based approach. The proposed model integrating education, engagement, incentives, and nudging provides a scalable solution for water

[43] G Fontaine, C Carrasco and C Rodrigues, 'How transparency enhances public accountability: The case of environmental governance in Chile' (2022) 9 *The Extractive Industries and Society* 101040.

conservation in LCH communities. Future research should explore its application in other water-stressed regions globally.