Willingness to Pay for Re-engineered Sanitation Systems by Households:
A market trend analysis

Final Report
to the Water Research Commission

by

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EXECUTIVE SUMMARY

South Africa is facing chronic water shortages and future estimates show that if no changes are implemented towards saving water, the demand will soon exceed supply. Households could be the starting point for water saving initiatives by reducing water withdrawals from their highest water consuming activities. The Green Cape Intelligence Report identified toilet flushing as the highest household water use activity, consuming about 30% of household water. Several re-engineered toilet facilities have been investigated and research has shown that these toilets or toilet systems such as urine diversion/separation or composting toilets can contribute immensely towards reducing water consumption. However, despite the extensive research and development and great exploration by government, private sector and civil society, the adoption rate by households remains minimal, with only 0.3% of households having adopted these re-engineered water-saving toilet systems while domestic water usage remains high.

This study's aim was to solicit households' willingness to pay to change to using water saving sanitation technologies.

The objectives of this study were therefore to:

i. create awareness and predict changes in demand for re-engineered sanitation systems;
ii. use the Stated Preference approach to measure and compute the household's willingness to pay to switch to these re-engineered sanitation systems;
iii. identify strategies and actions for improved sanitation demand among households; and
iv. develop guidelines to regulate the use of re-engineered sanitation systems and inform future strategies and policies.

The study used the Stated Preference model to measure and compute the household's willingness to pay to switch to these re-engineered sanitation systems. A regression analysis was conducted to establish the probability that the household will be willing to pay to change and use the new re-engineered sanitation systems. Three dependant variables were used, these were Awareness of the Necessity to Switch (NSNW); Willingness to Switch to High Efficiency System (WTS); Amount Willing to Pay (WTP). These were tested against various independent variables such as income, knowledge of sanitation systems, current condition of toilet, amount spent on water bill, perceived benefit and perceived risk.

There were 312 fully completed questionnaires and the results of the study show that 49% of the respondents were female-headed households, whilst 51% were male. The largest proportion of the respondents (41%) were between 30 and 44 years of age. Most of the participants were highly educated, with 60% having a tertiary qualification, with a small number of households (18%) earning above R50 000 monthly. All the respondents still use the full waterborne sanitation system. On average these households use between 6 to 13 litres of water per flush, depending on the age of the toilet. However, most of these respondents (48%) are not sure how old their toilets are and a small fraction of the participants (1%) have a dual flush system. About 40% of the households have not been exposed to re-engineered toilet systems that can be used at home. In most cases, their understanding is that these systems are only suitable for mobile features such as airlines or trains. These households were spending on average R400 a month on the water bill, and most households think the amount they spend on water is not reasonable and rather too expensive. A larger number of the participants (36%) however do not think their toilets are wasting water, whilst about 26% agreed that their toilet system wastes a lot of water. Out of these households 41% has had water leakages, spending anything between a R1 000 and

R10 000 to repair. To solicit user's willingness to adopt the new re-engineered water saving toilet systems, participants of the study were asked if they think it is necessary to switch to the water saving system and if they were willing to switch to a high efficiency toilet system (described as flush once with minimal water). About 53% of the respondents thought it was necessary to switch systems, and 68% were willing to switch to a highly efficient water saving toilet. These households were however willing to pay an increment to change to these water saving sanitation technologies. The statistically significant variables for the three WTP regression models were income, the toilet system, toilet efficiency, water bill, perceived benefits and perceived risk.

The aims of the study were all achieved. However, because of the COVID-19 pandemic and the lockdown regulations/restrictions, the study had to change the planned enumeration method. The initial plan was to do a face-to-face interview, however because of these limitations the study had to procure the SurveyMonkey instrument.

Overall, results confirm that water saving is important to Cape Town households, which are willing to pay for incremental changes in sanitation service levels. This provides scope to improve sanitation services in Cape Town at an even higher water price. More precisely, the estimates of WTP obtained in this study indicate the possibility of introducing a demand-driven program to expand the coverage of re-engineered sanitation systems that can save water.

Recommendations

A few recommendations have been made as follows:

i. There is need to validate the results with a survey from another city or province. This is important to create a more in-depth picture of a research problem and validate research findings by ensuring that the research phenomenon produce the same results, interrogating inconsistencies and data that are not expected to align.
ii. Extensive awareness campaigns are required to raise overall public awareness, stimulate private sector interest in the sanitation market, as well as advocate to decision makers in the public, private and civil sectors.
iii. There is a need to develop specific targeted and tailored strategies for each group in order to reach different communities and their different needs. The current norms and standards for water and sanitation have, over the last few decades, inadvertently focused on addressing water services and backlogs, unintentionally overlooking the effects this type of sanitation has on the long-term sustainability of water. The study could also be extended to rural areas and engage Traditional Leaders in communities to teach people about water saving through these new systems. Also of utmost importance are sectoral industries that are involved in the sanitation value chain, especially manufacturing and recycling. Such alliances could facilitate collaborations with marketing departments from these industries, who may already have budgets for marketing. School children could also be taught about such initiatives and may help to disseminate such information to their families.

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ACRONYMS & ABBREVIATIONS

CE	Choice Experiment
CS	Cluster Sampling
CV	Contingent Valuation
CVM	Contingent Valuation Method
DWS	The Department of Water and Sanitation
HSRC	The Human Science Research Council
NOAA	National Oceanic and Atmospheric Administration
NSNW	Awareness of the Necessity to Switch
RS	Random Sampling
SP	Stated Preference
SRS	Systematic Random Sampling
USAID	United States Agency for International Development
WRC	Water Research Commission
WTA	Willingness to Accept
WTP	Amount Willing to Pay/Willingness to Pay
WTS	Willingness to Switch to High Efficiency System

INTRODUCTION

South Africa is considered a water-scarce country, based principally on physical descriptors like climatic conditions and escalating water demands. The water demand is generally higher than the capacity of available water sources with high density population areas more susceptible to severe physical water scarcity and low availability of freshwater. Increasing population levels places more pressure on the amount of water physically available, leading to per capita water shortages. The current annual water supply is estimated at about 15 billion cubic meters (about 50% of the world average), severely constrained by low levels of seasonal rainfall, insufficient aquifers, and a high dependency on water transfers between basins from other countries[1] (Lombard, 2020). Projections for 2030 indicate that household demand will account for 3.6 billion cubic meters and the total water demand will reach 17.7 billion cubic meters, with the wealthiest quintile of the population accounting for half of the total withdrawals (Green Cape, 2019). Based on the current usage trends, if the current rate of water consumption continues, the demand is likely to exceed supply and availability of water resources in the near future. Water conservation and demand management policies are therefore critical in response to future water scarcity problems.

Households could be the starting point, with the major focus being on the highest household water-consuming facilities. The Green Cape Intelligence Report (2017), identified toilet flushing as the highest household water use activity (Green Cape, 2017). The current South African sanitation systems depends on flush toilets that are connected to public sewerage systems to a large extent. These waterborne sanitation systems consume large quantities of water (between 6 - 13 litres per flush) depending on the design and model, with older toilets consuming more water. Toilet flushing contributes to around 30% of household water use. These flushing toilets are mostly found in urban areas with richer provinces such as the Western Cape (89.1%) and Gauteng (88.6%) having a higher proportion compared to poorer provinces like Limpopo (26.5%). Poorer provinces generally have a large number of households using pit latrines with or without ventilation pipes, whilst approximately 188 000 households (1.1%) claimed to still be using bucket toilets supplied and cleaned by their local municipalities. A limited number of households (0.3%) in the urban areas use the new re-engineered toilets such as urine diversion/separation or composting toilets (Stats SA, 2016a) .

Such extensive use of water by these toilets will ultimately become an unsustainable option. More compounding is the expected positive correlation between increased water access and amplified water wastage (Strydom et al., 2009). Even though households (compared to other users such as agriculture and industry) currently have the lowest share of water consumption (Dean et al., 2016), they can contribute a lot towards water saving in the country (Management 2020). Considering South Africa's chronic water shortages, the extensive use of waterborne sanitation will ultimately become infeasible and will need to be replaced with water-efficient sanitation systems. Research has shown that improved sanitation strategies at household level have the potential to save a lot of water. With the current water challenges escalating at an alarming rate, it is therefore extremely critical to investigate ways in which water can be saved, particularly by households and focusing on households' highest water consuming activities, and in this instance, sanitation.

Current solutions to South Africa's water challenges mainly focus on the overall increase in the quantity of surface water through large infrastructure projects such as the construction of

[1] For example, South Africa purchases nearly 25% of its total water supply from nearby Lesotho.

new dams. Research has shown that such strategies, in the absence of demand constraints, even when implemented on time and scale are not sufficient to meet growing water needs (Donnenfeld et al., 2018). Policies and strategies that will incentivise water use efficiency and bring demand in-line with available water supply are critical. The success of household water demand management strategies and subsequently reducing the water demand by improving the efficiency of water use necessitates an understanding of how these households use water and in what ways water savings can be realised (Maas et al., 2017). This involves a deeper understanding of current household water use, perceptions of water use and the drivers of household water use behaviour (Jacobs-Mata et al., 2018). The understanding of households' attitude and behaviour is key for developing new technologies, strategies and policies (Wehn and Montalvo, 2018a and 2018b).

New re-engineered toilets such as urine diversion/separation or composting toilets can contribute immensely towards reducing water consumption. These sanitation technologies with water-saving or water-recycling features are water efficient and have the potential to reduce the waste of water from full flush toilets that are linked to sewer and latrine-based systems. However, despite the extensive research and development and great exploration by government, private sector and civil society, the adoption rate by households remains small, with only 0.3% of households using these re-engineered water-saving systems , while domestic water usage remains high (Gibberd, 2018; Rhodes and McKenzie, 2018).

> "We must introduce new technologies that appreciate that water is a scarce resource and as such provide solutions to dispose of effluent via alternative methods. It's not all about flushing [...] We must begin by challenging the property development sector through regulation and licensing requirements to invest itself in developing properties less reliant on water for sanitation in order to ensure we introduce the alternative solutions to low, middle and high income areas" (Media statement by The Minister of Water and Sanitation, Ms Nomvula Mokonyane, National Sanitation Indaba, 2015).

There is therefore a need to transform people's view of human excreta and sanitation processes, particularly the view that waterborne sanitation is the best solution regardless of the scarcity of available water resources. Any positive change in household behaviour that has the potential to reduce household water consumption needs to be explored. However, assuming 'rational behaviour', consumers only change behaviour if the change is to their benefit (Bair, 2018). Households will therefore only change behaviour if aware of available water-saving options and the benefits thereof. Moreover, water conservation remains a collective effort and more apparent when individuals believe that water is scarce and perceive that other consumers are also conserving it (Lede and Meleady, 2019).

1.1 Adoption and Use of New Technologies

User acceptance is required for the successful adoption and use of new technologies (Mudombi et al., 2018). Households need to be aware of the personal benefits of the change and the availability of products and services before they even contemplate the decision to switch. This is important because a change to new technology, in this case sanitation, will require choosing a technology that will fit the household's budget and lifestyle. Therefore user awareness, positive perception and acceptance should be the initial steps in rolling out new technologies (Thakur and Srivastava, 2014). There are three stages a consumer may pass through before accepting or adopting a new technology. These are preference, intention and choice as shown in Figure 1.

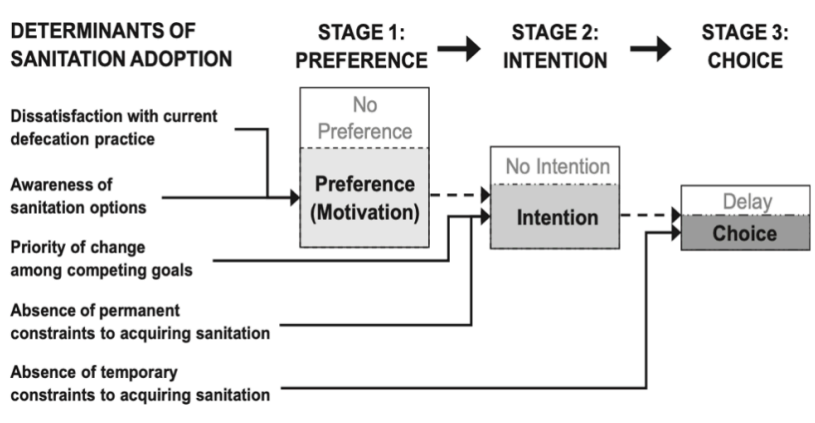


Figure 1: Adoption decision stages and determinants of new sanitation demand (Jenkins and Scott, 2007)

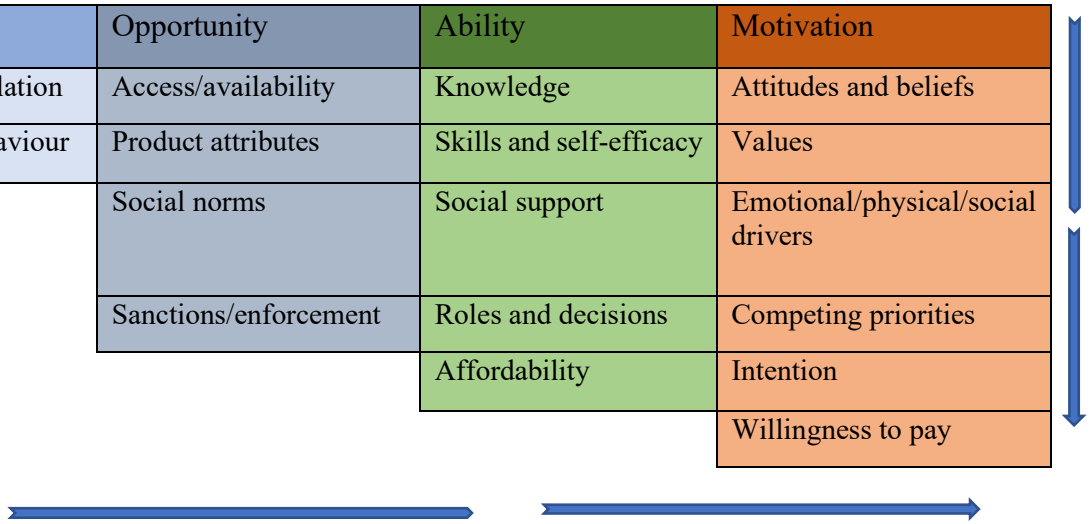
The switch to a new system may be driven by dissatisfaction with the current system or awareness of other systems with more potential benefits (Haines et al., 2019). Soliciting consumer choice and preference therefore becomes the starting point towards the adoption of a new technology. Collated information will be used to understand existing household sanitation behaviours and adoption decisions in ways that inform the development of specific cost-effective marketing strategies to increase adoption (Coffey et al., 2017; Chunga et al., 2016). A behaviour change framework (Table 1) was therefore developed to guide attributes of the study.

1.2 The behaviour change framework table

The behavioural change framework helped to identify key behavioural determinants for sanitation. This framework is critical as it gives a holistic approach to the attributes required by households when making a change decision. The framework showed that improving knowledge alone, for example through information, education, and communication, is often insufficient to stimulate household behaviour change. Other factors, identified through research, needs to be targeted (Table 1).

Table 1: The behavioural change framework

Focus	Opportunity	Ability	Motivation
Target population	Access/availability	Knowledge	Attitudes and beliefs
Desired behaviour	Product attributes	Skills and self-efficacy	Values
	Social norms	Social support	Emotional/physical/social drivers
	Sanctions/enforcement	Roles and decisions	Competing priorities
		Affordability	Intention
			Willingness to pay



1.3 Aims and objectives of the study

This study proposed a model to solicit user decision towards using re-engineered sanitation technologies that save water consumption by households. This was achieved through the following:

1. create awareness and predict changes in demand for re-engineered sanitation systems;
2. use the Stated preference (SP) approach to measure and compute the household's Willingness to Pay (WTP) to switch to these re-engineered sanitation systems;
3. identify strategies and actions for improved sanitation demand among households; and
4. develop guidelines to regulate the use of re-engineered sanitation systems and inform future strategies and policies.

1.4 Summary of work to date

Table 2 and Table 3 summarises the work to date, revised due dates and deliverables submitted thus far.

Table 2: Work completed to date

No.	Task	Summary of work to date
1	Literature Review: Experimental Program with Literature	Complete
2	Workshop for Data Enumerators Training (Facilitate training of data enumerators tools)	Complete
3	First draft report	Complete
4	Final draft report	Complete

Table 3: Deliverable due dates and deliverables submitted to date

No.	Deliverable	Status	Due date
1	Literature Review: Experimental Program with Literature	Complete	01/Jul/2020
2	Workshop for Data Enumerators Training (Facilitate training of data enumeration tools)	Complete	30/Oct/2020
3	Report 1: Preliminary Market Analysis	Complete	18/Dec/2020
4	Progress Report 2: Market Analysis	Complete	31/Mar/2021
5	The first draft report	Complete	29/Oct/2021
6	Final report and editing	Complete	17/Dec/2021

POLICY AND LEGISLATIVE FRAMEWORK

The right of access to sufficient water is enshrined in the Constitution – section 27(1)(b). This requires the state to take reasonable and other measures within available resources to ensure the progressive realisation of the right to water by all. Sanitation has no direct provision in the constitution, even though it is catered for in the Bill of Rights including the right to a healthy environment, health and dignity. The following policies and legislation have been enacted to guide the water and sanitation sector in the country and are relevant in guiding this project:

Water Services Act 108 of 1997: Interprets section 27 of the Constitution and provides for the right of access to basic water supply, the right to basic sanitation necessary to secure sufficient water, and an environment not harmful to human health and well-being; the setting of national standards and norms; the preparation and adoption of water services development plans; and the promotion of effective water resource management and conservation.

Local Government Municipal Systems Act, 32 of 2000: The Local Government Municipal Systems Act entrenches an obligation for the delivery of basic services to all. The Act enables municipalities to progressively work towards the social and economic upliftment of communities through the provision of basic services (defined as a municipal service necessary to ensure an acceptable and reasonable quality of life and, if not provided, would endanger public health or safety or impact on the natural environment). A basic service would include access to water and sanitation.

National Water Policy Review (2013): This policy focused on water challenges faced by the country and potential solutions to improve access to water, efficiency, equity and sustainability.

National Water Resources Strategy (2013): This strategy focused on water economies to support development and the elimination of poverty and inequality; water contribution to the economy and job creation. The emphasis was on water protection, usage, conservation, management and control, sustainably and equitably.

National Sanitation Policy (2016): Provides for the right of access to basic sanitation for all and that basic sanitation services should be prioritised to unserved households and vulnerable people. The Policy has defined the minimum acceptable basic level of sanitation as appropriate health and hygiene awareness and behaviour; at the lowest cost with appropriate systems for disposing of human excreta and which considers resource constraints, is acceptable and affordable to the users and is safe for children, is hygienic and easily accessible and which does not have an unacceptable impact on the environment; a toilet and handwashing facility for each household and considers water wastage and can use greywater.

THE EXPERIMENTAL DESIGN

1.5 Awareness and demand for re-engineered sanitation systems

Public awareness on current and anticipated chronic water shortages, available water-saving strategies and technologies as well as sustainable sanitation are important if formidable advances to increase the efficiency and sustainability of sanitation improvements are to be achieved. Raising public awareness should however be parallel to increased sanitation marketing. This will provide critical tools and best practice examples to researchers, policymakers and those who wish to disseminate up-to-date information on sustainable sanitation.

There are four key approaches to raising public awareness. These include

1) raising overall public awareness;
2) professional marketing of sanitation to those lacking access;
3) stimulating private sector interest in the sanitation market; and
4) advocating decision makers in the public, private and civil sectors (Andersson et al., 2016).

This project focused on raising awareness to the general public through educating the sampled households. The awareness campaign managed to:

- raise awareness about chronic water shortages in the country and
- inform the public about re-engineered toilets and their capability to save water.

The key messages for the campaign included the following:

- water plays a critical role in inclusive economic growth, poverty reduction and the significant reduction of inequality in South Africa;
- water saving technologies (re-engineered toilets) have the potential to contribute to water security in South Africa; and
- let us protect, conserve and use water in a sustainable manner.

1.6 Stated Preference (SP) approach and household's Willingness to Pay (WTP)

The project used the SP approach to measure consumers' appetite and WTP to change their sanitation systems.

1.6.1 History of Stated Preference

Stated Preference has been widely used since around the 1980s (McFadden 1986; Mitchell, Carson, 1989). Two decades later the interest on SP had surged with at least 7 500 published articles (Johnston et al., 2017). Mitchell and Carson (1989) published *Using Surveys to Value Public Goods: The Contingent Valuation Method (CVM)* as the first detailed guide for the design and implementation of SP methods (Mitchell and Carson, 1989). In the mid-1990s, the National Oceanic and Atmospheric Administration (NOAA) Panel produced a set of guidelines for conducting SP (Arrow et al., 1993; Conway et al., 1994). These guidelines spurred research to advance the validity and reliability of SP methods and were an indirect impetus for its extensive use in research. Several articles and books have subsequently been published on the subject, with some focusing on the reliability and validity of resulting value estimates along with articles summarizing SP methods in different areas of economics (Carson and Czajkowski,

2014). More recently, contemporary best-practice recommendations for SP studies intended to inform decision-making for policy and strategy directives were proposed (Johnston et al., 2017). These recommendations recognised that SP results are often used and reused (benefit transfers) by government agencies, non-governmental organisations and others, and that all such uses must be considered. The experimental design of this project, therefore, followed these recommendations in conjunction with other peer reviewed guidelines.

1.6.2 Choice-Based Stated Preference

Different sanitation techniques may be equally acceptable from a health, social, technical or institutional point of view. However, the final choice between different techniques is often made based on preference and depends on affordability, convenience and attractiveness (Niroomand and Jenkins, 2020). Several studies have used choice-based SP methods to systematically elicit preference weights representing the values of society for consideration in priority-setting decisions (Johnston et al., 2017). SP valuation are techniques that use individual respondents' statements about their preferences to estimate the change in utility associated with a proposed increase in quality or quantity of ecosystem service or bundle of services (Bateman et al., 2006). The societal value of such goods is considered passive, a term used to describe the economic value arising from a change in environmental quality (or any other situational change) that is not reflected in any observable behaviour or tangible product (de Bekker-Grob et al., 2012).

SP studies are an established tool for assessing values for non-market goods, both for weighing the cost and benefits for new public projects, and for assessing damages when public goods are harmed (Czajkowski et al., 2016). In SP studies, respondents are provided with information about the public good, project or resource under consideration. Respondents are presented with one or more hypothetical project scenarios that lead to a specified environmental change compared to a baseline situation, in this case 'change in the household's current sanitary system to a re-engineered toilet system that has the potential to save tons of water (Witt, 2019; Mitchell and Carson, 1989). The SP will therefore assess peoples' preferences and WTP for the change in the sanitary system, whose benefit will be realised in the long run from the water saved and ultimately sustainable future water access for coming generations.

SP methods of non-market valuation development employ different formats that present each respondent with multiple valuation tasks (Carson and Hanemann, 2005). The most common elicitation method is the two-alternative Contingent Valuation Method (CVM) (Niroomand and Jenkins, 2020). Other SP presentations are also possible. An extension or variant of the CVM traditional approach is the Choice Experiment (CE) which is an attribute-based valuation methodology (Weng et al., 2017). CVM's holistic approach has been shown to avoid problematic issues such as separability and collinearity (Willis and Garrod, 1993), because the CVM can take into account the whole bundle of varying attributes in a spatial area and measure both their use and non-use value (Langford and Russell, 2017). Moreover, the CVM focuses on a precise scenario and attempts to gather information about the respondent's choice regarding this precise scenario (Hynes et al., 2011).

1.6.3 Stated Preference Application

The World Bank and the United States Agency for International Development (USAID) funded a series of Contingent Valuation (CV) studies to estimate households' WTP for improved water services, both from public taps and from private water connections (Whittington, 2010). The switching of households from contaminated existing sources to public taps and private

connections was perceived to provide both health and non-health benefits. Stated Preference has also been extensively used to estimate the demand for improved sanitation services (Whittington et al., 2009). Stated Preference has been used in other sectors such as estimating household demand for the generation of new vaccines (Sarker et al. 2020), nature conservation programmes (Nabangchang et al., 2008) and cultural heritage preservation (Whittington and Pagiola, 2012).

1.6.4 Potential Bias for Stated Preference

A lingering concern for SP is whether respondents truthfully reveal their preferences, which poses a challenge regarding the surveys' external validity (Ryan et al., 2017; Czajkowski et al., 2017). For instance, values derived from CVM can be affected by the current household situation, such as sustainable water availability to the household, current sanitation conditions as well as the changes proposed through the introduction of the re-engineered toilet systems (Rolfe et al., 2018; Niroomand and Jenkins, 2020). There is also a possibility of respondents inflating their WTP estimates because they will not be faced with an actual budget constraint – referred to as hypothetical bias. Respondents may too easily agree just to please the interviewer (enumerator bias). However, there have been arguments against this notion with Carson in 1996 concluding that there is no statistically significant difference between SP and revealed preference estimates (Whittington, 2010).

However, it is still very critical to circumvent the risk of bias. With questions identified to carry a potential risk, respondents were presented with the valuation question and given more time to respond, thus allowing respondents more time to think about their choice (maximum of 24 hours), as well as reflect on the available choices (with the possibility to discuss with family or a spouse). Respondents were also allowed to revisit sections they may want to amend. This approach was intended to (a) eliminate an instinctive (knee-jerk) 'yes' answer, (b) allow the respondent to discuss the choice with other household members, and (c) permit the respondent to consider more carefully the household's budget constraint(s) (Whittington et al., 2009).

1.6.5 The Contingent Valuation Method Approach

Contingent valuation, a survey-based method of determining the economic value of a non-market resource, is used to estimate the value of resources and goods not typically traded in economic markets (Whittington et al., 1993). The approach asks people to directly report their WTP to obtain a specified good, or Willingness to Accept (WTA) to give up a good, rather than collecting the data through observed behaviours in regular marketplaces (Randall et al., 1974). It is an evaluation instrument for public goods based on the attitude and preference of consumers. Because it creates a hypothetical marketplace in which no actual transactions are made, contingent valuation has been successfully used for commodities that are not exchanged in regular markets, or when it is difficult to observe market transactions under the desired conditions (Cameron, 1992). For instance, results of a CVM have been used to predict the number of connections to water supply systems at improved conditions, and the resulting revenue for the local water authority, making it possible to study the feasibility of such improvements and various financing schemes. This study used the CVM to estimate the indifference curves of switching to re-engineered toilet systems. The value of such a switch was estimated based on the people's evaluation of re-engineered toilet systems and reflected by consumer's WTP for the switch. The statistical software called Statistica was used to carry out the statistical analysis.

1.6.6 Willingness to Pay

The goal of a CVM is to measure the compensating or equivalent variation for the good(s) in question (Hoehn and Randall, 1987). Compensating variation is the appropriate measure when the person must purchase the good, which in this case is an improvement in their toilet system. Equivalent variation is appropriate if the person faces a potential loss of the good, as it would be the case if South Africa runs out of water and reaches day zero. Both compensating and equivalent variation were elicited by asking the consumers to report an amount they are willing to pay (WTP). For instance, the consumers were asked to report their WTP to obtain the good, or to avoid the loss of the good. Formally, WTP is defined as the amount that must be taken away from the person's income while keeping their utility constant.

The purpose of the payment question was to obtain information about the consumer's WTP amount (Waliczek et al., 2020). The WTP responses were statistically analysed to obtain an estimate of mean WTP, which was multiplied by the size of the cluster population that can be potentially affected by water scarcity, to produce total WTP. Total WTP was then compared with the cost of changing the toilet systems to determine whether the proposed change passes a benefit-cost test. For the open-ended payment questions, the WTP figures reported by the respondents were simply averaged to produce an estimate of mean WTP.

1.7 Identification of strategies and actions for improved sanitation demand

Research has shown that one-size-fits-all sanitation strategies do not necessarily work. To reach different communities and their different needs, there is a need to develop specific targeted and tailored strategies for each group. This is important to ensure resources are not being wasted on installing facilities that are later misused or never used because they do not meet the local demand. Understanding the demand for improved sanitation in the local context is therefore critical if facilities are to be continually used and valued. A multi-disciplinary research approach is necessary for assessing demand for improved sanitation if sound strategies and actions are to be developed. This is the core purpose of this study.

METHODS AND PROCEDURES

1.8 Population of Interest

The study focussed on high- and middle-income communities in Cape Town. These were specifically chosen as they are perceived to be communities that can financially afford to make the switch to the newer toilet systems. According to the 2016 community survey, there was a population of 4 005 015 in Cape Town and a number of 1 264 950 households (Stats SA, 2016b). The Gini coefficient was 0.58 and the human development index was 0.67, showing high inequality between the rich and the poor. Access to water and sanitation for rich and poor communities was 98.4% and 92.8% respectively (SA, 2017). The socio-economic profile study on the city listed drought as the number one risk, which led to severe water crises between 2016 and 2018. The study interviewed only the head of households from owned properties. Data from the 2016 Stats SA *National Household Survey* presents the number of owned households, and further identified those with access to piped water and toilet facility in Cape Town (see Tables 4, 5 and 6) (Stats SA, 2016a; Stats SA, 2016b).

Table 4: Cape Town tenure status by ethnic group

Tenure System	Cape Town		South Africa	
Do not know	9 109	0.7%	15 221	1%
Occupied rent-free	109 558	8.7%	192 880	9.7%
Other	45 939	3.6%	94 492	6.1%
Owned and fully paid off	663 828	52.5%	992 344	54.1%
Owned, but not yet paid off	204 956	16.2%	266 413	10.9%
Rented from others (incl. the municipality and social housing)	43 344	3.4%	73 700	2.7%
Rented from a private individual	186 399	14.7%	296 679	15.6%
Unspecified	1 817	0.1%	2 147	0.1%

Source: Community Survey, 2016

Table 5: Cape Town access to piped water

Access type	Cape Town		South Africa	
Borehole in the yard	2 506	0.1%	861 663	1.5%
Borehole outside the yard	386	0%	830 812	1.5%
Flowing water/stream/river	163	0%	2 632 668	4.7%
Neighbour's tap	8 341	0.2%	1 063 867	1.9%
Other	2 865	0.1%	327 185	0.6%
Piped (tap) water inside the dwelling/house	3 216 323	80.3%	23 571 808	42.4%
Piped (tap) water inside the yard	428 063	10.7%	16 523 269	29.7%
Piped water on community stand	280 550	7%	5 116 890	9.2%
Public/communal tap	64 451	1.6%	2 550 910	4.6%
Rainwater tank in the yard	357	0%	625 667	1.1%
Spring	208	0%	318 633	0.6%
Watercarrier/tanker	586	0%	1 117 194	2%
Well	218	0%	113 088	0.2%

Source: Community Survey, 2016

Table 6: Cape Town toilet facility

Facility type	Cape Town		South Africa	
Bucket toilet (collected by municipality)	123 730	3.1%	598 182	1.1%
Bucket toilet (emptied by household)	19 410	0.5%	433 056	0.8%
Chemical toilet	45 041	1.1%	2 786 090	5%

Ecological toilet (e.g. urine diversion)	362	0%	198 599	0.4%
Flush toilet connected to a public sewerage system	3 709 571	92.6%	31 166 983	56%
Flush toilet connected to a septic tank or conservancy tank	67 645	1.7%	1 401 181	2.5%
None	28 160	0.7%	1 332 582	2.4%
Other	7 766	0.2%	948 024	1.7%
Pit latrine/toilet without ventilation pipe	2 267	0.1%	8 250 950	14.8%
Pit latrine/toilet with ventilation pipe	1 064	0%	8 538 007	15.3%

Source: Community Survey, 2016

1.9 Sampling

The study used a multi-stage sampling procedure that combined Cluster Sampling (CS) and Random Sampling (RS) for selecting the participants for the study. Cluster Sampling was used to break the population down into clusters of both high- and middle-income areas. Geographical location was used as the main determinant for these households. Random Sampling was then used for randomly identifying the households from each cluster.

1.9.1 Cluster Sampling (Estimation of a population total)

The first step in the CS process was to develop a point estimate for the total population, this was calculated as follows:
f = n/N where:
f = sampling fraction
n = sample size
N = mother population

1.9.2 Random Sampling

The original plan was to combine the CS with Systematic Random Sampling (SRS). The SRS is a type of probability sampling method in which sample members from a larger population are selected according to a random starting point but with a fixed, periodic interval (the sampling interval), suitable for selecting households for a face-to-face interview. However, because of COVID-19, it was impossible to follow this sampling so households were randomly selected from the clustered areas, whilst ensuring reasonable representation of households.

1.10 Data collection

Data was collected using a structured questionnaire. Questionnaires were administered by data enumerators using the SurveyMonkey online data collection platform. The data enumerators were responsible for sending out questionnaires in their respective areas, monitoring responses and cleaning up data from returned questionnaires. Postgraduate students were recruited and trained in enumeration and recording the data appropriately. The questionnaires designed for the study were subjected to a validation process for face and content validity. For validation of the instrument, copies of the questionnaire and copies of the research questions were given to economists experienced with market trends and CVM analysis. These experts ensured the appropriateness and adequacy of the instrument, and any recommendations were factored in.
Once validated, a pilot test was carried out on ten households. This was done to ascertain:

- how the subjects will react to the questionnaire;
- whether the items are clear enough and easily understood;
- whether there is the need to include more items in certain areas; or
- whether there are some items to which they would not like to respond; as well as

- to determine the workability of the proposed method of data analysis for the study.

1.11 Ethics Approval

The Human Science Research Council (HSRC) ethics committee approved the ethics for this project.

1.12 Data Analysis

The data collected from the field was analysed using TIBCO software from Statistica. A combination of dichotomous choice approach questions, open-ended and closed-ended questions (Yes or No) were used in answering the research questions.

RESULTS

1.13 Sample

From a population of 233 843 urban households, a sampling fraction equal to 0.0016, leading to a total sample size of 374 was adopted. A total of 400 questionnaires were sent out (to cover 400 households), however only 350 were completed and returned, making the response rate 87.5%. However, 38 of these cases were responses from rented properties so they were removed from the sample, leaving a total of 312 fully completed questionnaires. Of these 312 households, 127 were from middle-income areas and 187 from high-income areas.

1.14 Procedure

Upon ethical approval by the HSRC the questionnaires were disseminated using the SurveyMonkey platform, targeting sampled areas. The use of the platform made it easy for households to be selected according to the sampling criteria, based on area of jurisdiction (middle- to high-income areas) and income bracket. The use of income bracket ensured the elimination of households who may not be able to afford changing even if they wanted to.

A brief introductory explanation and scenario about water scarcity, as well as the amount of water used by the different sanitation systems were provided to the respondents before determining their levels of WTP for the change. The concept of saving water by using water saving or waterless sanitation systems and its attributes were explained before starting the bidding game. This was part of the awareness campaign.

The questionnaire started off by asking demographic and socio-economic questions, then participants' value orientations, awareness of current water and sanitation challenges, perceived benefits and risk, as well as their willingness to change to a more water efficient system. The questionnaire had a brief description of the project and its importance including an explanation of the process. The questionnaires had both open-ended and closed-ended questions.

1.15 Measures

A regression analysis was conducted to establish the probability that the household will be willing to pay to change and use the new re-engineered sanitation systems. Three dependant variables were used – two as dummy dependent variables (1 for Yes and 0 for No), and the other as a categorical dependant variable. A set of other variables was introduced as the explanatory variables as shown in Table 7.

Table 7: Variable of the CVM

	Dependent variable	Independent variable
1	Awareness of the necessity to switch (NSNW)	Income, knowledge of sanitation systems, current condition of toilet, amount spent on water bill, perceived benefit, perceived risk.
2	Willingness to Switch to High Efficiency System (WTS)	Income, knowledge of sanitation systems, current condition of toilet, amount spent on water bill, perceived benefit, perceived risk.

3	Amount Willing to Pay/Willingness to Pay(WTP)	Income, knowledge of sanitation systems, current condition of toilet, amount spent on water bill, perceived benefit, perceived risk.

1.16 Characterisation of the respondents

From the sample (n=312), 51% were male household heads with the remaining 49% being female. The largest proportion of the respondents were between 30 and 44 years of age (41%), followed by an age range between 45 and 60 years (28%) (Table 8).

Table 8: Socio-economic characteristics of respondents

Variables	Frequency	Percentage (%)
Gender		
Male	158	51
Female	154	49
Age		
19-29	61	20
30-44	128	41
45-60	87	28
>61	36	11
Monthly Income		
Below R1 000	96	31
Between R10 001-R30 000	25	8
Between R30 001-R50 000	105	34
Between R50 001-R100 000	56	18
Above R100 001	30	9
Education		
Primary	33	11
Secondary	30	9
Matric	64	20
Tertiary	185	60

Most of the participants are highly educated, with 60% having a tertiary qualification, 20% having completed Matric, 9% having secondary education, and 11% having primary education. The highest number of participants (34%) earns between R30 001 and R50 000 monthly, 31% earns below R1 000, and 18% earns above R50 001, with only 8% earning between R10 001 and R30 000.

1.17 Toilet systems

All the respondents still use the full waterborne sanitation system. The toilets are connected to sewer and treatment works systems that use a lot of water. The water is used to flush the excreta from the toilet pan and convey it in underground pipes to a sewer treatment works that is some distance from the households. On average these households use between 6 and 13 litres of water per flush, depending on the age of the toilet. While a substantial number of respondents (48%) are not sure how old their toilets are, 18% have relatively new toilets that are between 0

and 10 years old, 13% have toilets that are between 10 and 30 years old, and 5% have toilet systems installed more than 30 years ago. A small fraction of the participants (1%) have a dual flush system.

Of note, a high number of the participants (40%) have not been exposed to re-engineered toilet systems that can be used at home. In most cases, their understanding is that these systems are only suitable for mobile features such as airlines or trains. A small fraction of these participants are, however, aware of the low efficiency levels of their toilet systems (described as number of flushes >1 use per person). However, even though their systems were not highly efficient in flushing out excreta, they were still reluctant to change the system.

1.18 Water Spend

The largest proportion of households (26%) spend between R100 and R400 per month, whilst 21% spend between R400 and R600 a month. Only 16% had a high expenditure on water which was above R600, and most households think the amount they spend on water is not reasonable but rather too expensive. A larger number of the participants (36%) do not think their toilets are wasting water, whilst about 26% agreed that their toilet system wastes a lot of water. Out of these households, 41% has had water leakages, spending anything between R1 000 and R10 000.

1.19 The Contingent Valuation Method

Three regression analyses were done to establish the probability that the household would be WTP to switch to a water-saving sanitation technology being the dependent variable for the first regression. The second regression was the probability that the household would be WTP to switch to a water efficient toilet, and the third regression was the amount households would be willing to pay. Probability of WTP was then related to a set of explanatory variables, including variables on demographic characteristics, socio-economic characteristics and water use of the surveyed households. In estimating the determinants of WTP to change the sanitation system, some of the variables were not statistically significant, hence the decision to drop them from all three regression models. The statistically significant variables for the three WTP regression models were income, the toilet system, toilet efficiency, water bill, perceived benefits and perceived risk.

1.20 Willingness to Pay (WTP)

The main aim of this study was to elicit the households' willingness to pay and switch to the new re-engineered water saving sanitation systems. One of the specific objectives of the study was to investigate the possible factors determining WTP for the households to switch to water saving toilet systems.

1.20.1 Estimating the WTP to switch to a more water efficient toilet system

To solicit users' willingness to adopt the new re-engineered water saving toilet systems, participants on the study were asked if they:

1. think it is necessary to switch to the water saving system; and
2. were willing to switch to a high efficiency toilet system (described as 'flush once with minimal water').

About 53% of the respondents thought it was necessary to switch systems and of those, 68% were willing to switch to a high efficient water saving toilet (Table 9).

Table 9: Willingness to switch and pay for re-engineered toilet system

		Percentage
Do you think it is necessary to switch?	Yes	53
	No	47
Willingness to switch to High Efficiency System?	Yes	68
	No	32

Further to this, the respondents were asked how much they were willing to pay for the switch to waters saving sanitation systems. About 48% were willing to pay an amount below R1 000, whilst 45% were willing to pay an amount between R1 001 and R5 000. Only 6% were willing to pay an amount above R5 001 (Table 10).

Table 10: Frequency of amount participants are willing to pay

Category	**Frequency table**	
	Count	**Percentage**
Below R1 000	150	48%
Between R1 001-R5 000	143	45%
Above R5 001	19	6%
Total	312	100%

1.20.2 Non-Willingness to Pay

As has been noted there is still a significant number of respondents who were not willing to switch to using re-engineered toilets systems or a high-efficiency water saving toilet. In most cases, a respondent's refusal was usually associated with lack of interest in the topic of the survey (Stephens and Hall, 1983). Therefore, it seems reasonable to assume that people who are less interested in the 'good' will value it differently from their more interested counterparts.

1.20.3 Mean and standard deviation of key variables

Means, standard deviation and correlation results of the nine key variables in the CVM model are reported in Table 11 below. As expected, the standard deviation from this study was not large. This shows that the individual values did not deviate much from the mean – an indication that most of the respondents held relatively similar views.

The mean monthly income is R29 835.44 (R29 098.05), and the amount they are willing to pay to switch to a new water saving sanitation system on a monthly average is R1 000 (R1 389.30). The water bill for these households on a monthly basis averages at R336.75 (R261.53).

Table 11: Means, standard deviation and Pearson correlation of the CVM model

Variable	Correlations: Marked correlations are significant at p<0,05000 N=312										
	Means	**Std. Dev.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Income (1)	29 794.87	28 920.72	1.00	-0.05*	-0.34*	0.19	0.22	0.05**	-0.08*	0.06**	0.00
Sanitation system (2)	1.59	1.07	-0.05*	1.00	-0.5*	0.00	0.02*	-0.01*	0.00	-0.16	0.00
Toilet efficiency (3)	1.53	0.81	-0.34	-0.05	1.00	-0.19	-0.14*	-0.02*	0.02*	-0.05	0.04*
Water bill (4)	336.58	260.94	0.19	0.00	-0.19*	1.00	0.08**	0.10	-0.10*	-0.11*	0.17
Perceived benefit (5)	1.40	0.49	0.22	0.02*	-0.14*	0.08*	1.00	0.06**	0.07**	-0.01*	0.06**
Perceived risk (6)	1.45	0.50	0.05**	-0.01*	-0.02*	0.10	0.06	1.00	-0.01*	-0.03*	-0.07*
Willingness to Switch to new system (7)	1.47	0.50	-0.08*	0.00	0.02*	-0.10	0.07**	-0.01*	1.00	0.09**	-0.11
Willingness to Switch to high efficiency (8)	1.32	0.47	0.06**	-0.16	-0.05*	-0.11	-0.01*	-0.03*	0.09**	1.00	-0.27
Amount Willing to Pay (9)	1 006.41	1 395.89	0.00	0.00	0.04*	0.17	0.06**	-0.07*	-0.11	-0.27	1.00

Note: One or two asterisks (*) means significance at the 5% level and 10% levels respectively
NB: Toilet efficiency measured by the number of flushes required to clear out excrement

Important to note was that income had no correlation with the amount the participants were willing to pay (β=0), and neither was the type of toilet the household had. However, income was positively correlated with the level of awareness of the efficiency of the toilet system – meaning the higher the household income the more they are willing to switch to a high efficient toilet system (β=0.04:P<0.05).

Income was also positively correlated with perceived benefits and negatively correlated with perceived risk (β=0.06:P< 0.1) and (β=-0.07:P<0.05). This means that households with higher income perceived the benefit of switching their current sanitation systems, although they did not perceive the risk of not switching as that important.

The sanitation system was positively correlated with perceived benefit (β=0.02:P<0.05), meaning that the household's current sanitation system have a positive bearing on how they view potential benefits of changing. There was also a negative but significant correlation of perceived benefit and toilet efficiency (β=-0.14:P<0.05). Households with a high efficiency toilet did not see the benefits of changing, whilst those with low efficiency toilets perceived the benefits of changing. These households also had a negative correlation with willingness to switch to a high efficiency toilet (β=-0.05:P<0.05), meaning the higher the toilet efficiency, the lower the need or willingness to change.

Income was however negatively correlated with willingness to change systems (β=-0.08:P<0.05), meaning the higher the income the lower the household was willing to change. This could be explained by the fact that such households could afford paying the water bill with ease, whilst low-income households would be struggling with the water bill and thus willing to change to a more efficient system. The only significant correlation with the water bill was the perceived benefit (β=0.08:P<0.1). The water bill did not significantly influence most of the variables – an expected reaction from households as it was relatively lower than the amount households were willing to pay to change.

Household's willingness to switch to a new system was positively correlated with the household's willingness to switch to high efficiency systems (β=0.09:P<0.1). This is an important observation because if these households do switch, they only switch to high efficiency toilet systems. The positive correlation of perceived value with the sanitation system (β=0.02:P<0.05); water bill (β=0.08:P<0.1); willingness to change the system (β=0.07:P<0.05); and amount households are willing to pay (β=0.06:P<0.1) are very important observations. Overall perceived value can be described as a subjective construct that will differ between consumers, cultures and over time. Perceived value has also been acknowledged in market research as central to the understanding of consumer behaviour. The positive correlation in this case is therefore a good indicator of the positive value consumers have towards saving water.

The purpose of the payment question was to obtain information about the consumer's WTP. The WTP responses was statistically analysed to obtain an estimate of mean WTP. The mean WTP was then compared with the cost of installing a new toilet. The Department of Water and Sanitation (DWS) has estimated that providing a dry sanitation solution can cost up to R11 500 per toilet, whilst the participants WTP mean was R1 000. This result explains why even when they understand the perceived benefits of changing, most households do not change.

1.20.4 Logistic regression model

A logistic regression model with three dependant variables was used and is shown in Table 12. This was important in testing the significance of each of the independent variables which are key for the CVM.

Table 12: Results of the regression analysis for NSNW, WTS and WTP

Dependant variable	Independent variable	Intercept (β)	Coefficient-(β)	R^2	Adjusted R^2	P-value
NSNW	Income	2 123	-0.092976	0.579	0.459	0.03479**
	Toilet system		-0.012295			0.82873
	Toilet efficiency		-0.019988			0.74372
	Water bill		-0.096744			0.04867**
	Perceived benefit		0.093860			0.10811
	Perceived risk		-0.003703			0.94821
WTS	Income	1 619	0.054263	0.475	0.357	0.375944
	Toilet system		-0.163923			0.033705*
	Toilet efficiency		-0.069090			0.252691
	Water bill		-0.132663			0.022041**
	Perceived benefit		-0.012001			0.834768
	Perceived risk		-0.025968			0.644543
WTP	Income	1 219	-0.018211	0.049	0.031	0.154431
	Toilet system		-0.001127			0.766368
	Toilet efficiency		0.078572			0.983974
	Water bill		0.195898			0.193742
	Perceived benefit		0.068011			0.000774*
	Perceived risk		-0.094459			0.237978

Note: One or two asterisks (*) means significance at the 1% and 5% levels respectively

With regards to willingness to switch to a new sanitation system, only income and the amount spent on water were significant at $p<0.05$, with coefficients of ($\beta=0.03$ and $\beta=0.048$). The R^2 however is 0.579, meaning only 58% of the willingness to switch sanitation system is significantly explained by these variables, an indication of robust analysis and results.

With regards to willingness to switch to a water efficient toilet (toilet system), the household toilet system and water bill were significant ($\beta=-0.16$ and β-0.02) at $p<0.05$. The R^2 is 0.475, meaning only 47.5% of the independent variables significantly explains the willingness to switch to high efficiency toilet.

With regards to the amount participants are willing to pay to switch, only the perceived benefit variable was statistically $p<0.001$ ($\beta=0{,}000774$). The R^2 is 0.049, meaning only 4.9% of the participants are willing to pay to switch. This variable is explained by the perceived benefit variable.

DISCUSSION

The main aim of the study was to solicit household's willingness to pay for changing their current sanitation systems towards using water saving sanitation technologies. This was achieved through the following aspects:

1.21 Create awareness and predict changes in demand for re-engineered sanitation systems

Most people who have access to water and have never experienced drought may not be aware or fail to understand the significance of saving water in socio-economic development. Therefore, a stronger appreciation of the variety of society-wide benefits of water saving sanitation infrastructure is required. To promote water saving practices at the household and community level and to create sustained behavioural change, professional marketing or specific water saving campaigns, which is a common activity in the commercial sector, will be needed. This should be supported by an enabling environment with political responsibility and the will to create a legal framework that furthers sanitation initiatives. Such initiatives would enhance the lobbying of policy makers who will be armed with relevant facts and arguments, and it will also allow them to grasp the many cross-sectoral and economic gains sanitation brings, thus allocating resources and creating policies and strategies that strengthen public and private capacity to provide and manage sanitation services.

There are four key approaches to raising awareness. These include:

1. raising overall public awareness;
2. professional marketing of sanitation to those lacking access;
3. stimulating private sector interest in the sanitation market; and
4. advocating to decision makers in the public, private and civil sectors.

Raising awareness will help to:

1. create public and political awareness;
2. initiate public and policy discussions; and
3. generate an enabling environment and policy changes that lead to action.

This study has revealed that income, the amount spent on the water bill and perceived benefits influence the household's decision to change. Therefore, this means a strategic approach towards increasing the awareness of perceived benefits is required. The low score for perceived benefits is an indication of the consumers' lack of awareness on how the change to a water efficient sanitation system can benefit them, hence the importance of raising public awareness and sanitation marketing to increase the efficiency and sustainability of sanitation improvements.

The study may have been piloted in an urban area, but it is recommended that rural areas be included in future studies. These areas are usually the most affected by the lack of water from time-to-time and could benefit from waterless sanitation infrastructure. Rural residents can be accessed through their Traditional Leaders or traditional authorities.

1.22 Use the Stated Preference (SP) approach to measure and compute the household's Willingness to Pay (WTP) to switch to re-engineered sanitation systems

This study used the Contingent Valuation Method to analyse the determinants of Cape Town households' willingness to pay to switch to a new sanitation system to save water. Participants were given an option to choose whether they will be willing to change their entire sanitation system or just change the toilet currently used to a high efficiency toilet. The study used three dependant variables being (1) willingness to switch to a new sanitation system; (2) willingness to switch to using a high efficiency toilet; and (3) the amount the consumer is willing to pay for the switch.

1.22.1 Household income

Income was the most statistically significant criterion to explain both the probability that consumers will be willing to switch the entire sanitation system, or just switch and use a high efficiency toilet system. The study confirmed the hypothesized causal relationship between income and household's willingness to switch to a new sanitation system, as well as willingness to change the toilet to a high efficiency toilet. Households with high income had a negative relationship to willingness to switch their sanitation system as they can afford to pay the bill without issues more often. However if they switched, they would choose a high efficiency toilet. Household income also had a positive relationship to perceived benefit, and negatively affects households' perceived risk. Ironically, one would have expected households with lower income to highly perceive the benefits of switching to a new sanitation system that would save them water and ultimately save on the water bill. However, the negative relationship between income and perceived risk means households with higher income did not regard their reluctance to change their sanitation or toilet systems as posing risk towards the future sustainability of water. The reverse being that those with lower income perceived the risk associated with not switching their current sanitation system, however, were still not willing to switch. The reason for not changing was not clear.

1.22.2 Water bill

The amount households spend on water bills was significant with both willingness to change the sanitation system and willingness to change to a high efficiency toilet. However, it was not significant with the amount households were willing to pay to change. The water bill had a negative relation with these variables though, an indication that the higher the water bill, the lower the probability they would change. However, the average amount these households spend on water is minimal, explaining why the water bill is less likely to push households towards changing their sanitation system.

1.22.3 Perceived benefit

The perceived benefit of the change was significant with the amount households were willing to pay to change. The R^2 is low though (R^2=0.049), which means only 4.9% of the amount consumers are willing to pay is explained by their perceived benefit. The perceived benefit had a positive correlation with the type of toilet the household is currently using, the amount spent on water, perceived risk of not changing, willingness to change the entire sanitation system and the amount the household is willing to spend to change. This presents a positive outlook by the households regarding willingness to make an effort to save water through sanitation. The R^2 may be low for this variable, but it is a positive start. However, it had a negative relationship with the efficiency of the toilet currently used by the household and willingness to change to a

high efficiency toilet. This means households that had a high efficiency toilet did not see benefits of changing – an expected result as their current toilet is already saving water. But suffice to say there is still a possibility that this could be due to the lack of awareness of perception of how the new system functions.

1.23 Identify strategies and actions for improved sanitation demand among households

Research has shown that one-size-fits-all sanitation strategies do not necessarily work. To reach different communities and their different needs, there is a need to develop specific targeted and tailored strategies for each group. This is important to ensure resources are not being wasted on installing facilities that are later misused or never used because they do not meet the local demand. Understanding the demand for improved sanitation in the local context is therefore critical if facilities are to be continually used and valued.

Current sanitation systems are inherently limited in their ability to address the new challenges for (waste) water management that arise from the rising demand to save water. These challenges include the installation and use of highly efficient and water saving infrastructure and water (re)use. New opportunities to address these challenges arise from the new, re-engineered sanitation systems, a system innovation that combines elements of source separation, local treatment, reuse, and less use of water. This new sanitation is available, but not yet widely adopted. Implementation was hindered amongst other things by the lack of insight into the general public's willingness to engage in new sanitation, and the resulting uncertainty about this among decision makers and other stakeholders in wastewater management, as well as the public's minimal knowledge on the systems for them to understand the potential benefits attached.

Water and sanitation project planners and or manufacturers also need to take into consideration that sanitation responsibilities span multiple stakeholders and cannot just be improved by the distribution of a product. So unlike other issues, tackling sanitation requires generating a significant amount of support from a political, financial, cultural and socio-economic perspective. It is also important to understand what underlies household behaviour as the first point, then focus on what the impact of that behaviour is on themselves, on the environment, on those they care about. There are cultural, social, religious norms that underlie behaviours around sanitation that also need to be understood.

1.23.1 Dissemination of information

Sufficient information should be provided in accessible and culturally appropriate ways. Providing timeous information about benefits and disadvantages of an initiative allows people time to think about the issues, consider implications, and formulate their views. An informed public will understand the trade-offs, be able to contribute meaningfully, and have greater trust with the project proponent. Several methods will be used to disseminate information from this study. This includes but is not limited to:

i. the use of reputable water and sanitation magazines;
ii. sharing information with relevant district/local municipalities;
iii. presentation in conferences; and
iv. publication in journals.

This report has already been presented to the Women in Water conference hosted by the WRC.

1.24 Develop guidelines to regulate the use of re-engineered sanitation systems and inform future strategies and policies

The current norms and standards for water and sanitation have, over the last few decades, inadvertently focused on addressing water services and backlogs, unintentionally overlooking the effects this type of sanitation has on the long-term sustainability of water. Several strategies and guidelines have been developed towards giving direction on different elements in water and sanitation. These were either developed by the Department of Water and Sanitation, Department of Local Government and Traditional Affairs or Department of Human Settlement. An extensive consultation process is an integral part of the guideline development process and is mostly required to ensure inclusivity of all relevant stakeholders. Most importantly was determining why the guidelines are necessary, which this study has attempted to justify. However, an extensive consultation process will ensure that such guidelines meet a national need, have a public health perspective and does not duplicate existing resources. Also, the consultation process will determine if the guidelines are of an urgent need should they be developed into a strategy or policy. Relevant bodies like the WRC can lead such a dialogue and process. The dialogue should also address issues such as compensation or possible incentive for change by sanitation consumers.

CONCLUDING REMARKS AND RECOMMENDATIONS

Overall, results confirm that water saving is important to Cape Town households, which are willing to pay for incremental changes in service levels. There is, therefore, scope to improve sanitation services in Cape Town even at a higher water price. More precisely, the estimates of WTP obtained in this study indicate the possibility of introducing a demand-driven programme to expand the coverage of re-engineered sanitation systems that can save water. This is important because household water and sanitation services are an individual household responsibility and must be demand responsive. For users to benefit maximally, they must also understand the link between their own health, good hygiene and toilet facilities. However, the way in which sanitation services are provided must consider the growing scarcity of good quality water in South Africa. Sanitation services must be sustainable in terms of both capital and recurrent costs. A multi-disciplinary research approach is necessary for assessing demand for improved sanitation if sound strategies and actions are to be developed.

In summary, income, amount spent on water bills and type of toilets currently used by households, amongst other factors, matter in people's choice or willingness to pay premiums, as well as the amount they are willing to pay for changing their entire sanitation system or just the toilet facility. Of interest was the fact that perceived risk or perceived benefits did not influence participants' willingness to change. One would have assumed that the risk of running out of water in the city would influence the decision of households to use water saving technologies, more especially after the city experienced a recent drought. However, it is important to note that if the household is not convinced that they have control over the risk, they will most likely not be motivated to do anything about it, unless if households are panelised for wasting water. Also, assuming rational behaviour, consumers only change behaviour if the change is to their benefit. Households will therefore only change behaviour if they are aware of available water saving options and the benefits thereof. Moreover, water conservation remains a collective effort and more apparent when individuals believe that water is scarce and perceive that other consumers are also conserving it.

The findings of this study also buttress the fact that due to contextual differences, formative research and evidence is critical in informing successful planning, designing, and implementation of sanitation facilities. The water and sanitation regulatory agencies in South Africa should put in place awareness strategies to sensitise households and/or individuals on the benefits of using water saving sanitation systems (or at least changing to a water saving toilet) and explore innovative mechanisms to ensure that these systems are sustainable.

1.25 Validation and triangulation of results

Triangulation is a technique used to analyse results of the same study using different methods of data collection or different samples. It is used for three main purposes: to enhance validity, to create a more in-depth picture of a research problem, and to interrogate different ways of understanding a research problem. Most often, triangulation helps validate research findings by checking that different methods or different observers of the same phenomenon produce the same results. It can also be used to interrogate inconsistencies and data that are not expected to align. It is recommended that this study be extended to two more provinces or cities with completely different dynamics to Cape Town and the Western Cape. The suggestion is that it be extended to Durban (KwaZulu-Natal) and Pretoria/Johannesburg (Gauteng). This will provide a more representable sample at national level.

The study could also explore the response from other industries that stand to benefit from such initiatives. For instance, the agricultural industry can use the faecal waste to make fertiliser, a composting toilet, for instance, may provide the needed resource for that. When extending the project to other provinces, it may help to also include these industries. There is also a need to engage with other players in the sanitation food chain like the toilet manufacturing industry, to understand from their perspective this kind of market, as well as expectations from this market.

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