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Abstract

Demand-side measures are thought to be a sustainable approach to meeting the future supply-demand balance. We assess the uptake of domestic demand-side measures and assess potential factors that may promote the uptake of water efficiency devices. Fifty one face-to-face questionnaires were carried out to collect demographic, water use, current water efficiency measures in place and housing characteristics data. We use descriptive statistics and univariate models using Pearson's chi-squared tests and logistic regression models to assess factors promoting water efficiency. Fifty one adult participants aged between 30-64 years provided data on water consumption and efficiency. Investigating water saving solutions and home owners were more likely to utilise water efficiency devices (OR 9.75; 95% CI 1.64-51.29 and OR 7.18; 95% CI 1.38-37.31, respectively). Targeting factors shown to promote consumer up-take of water efficiency measures and the use of combined strategies utilising low-cost efficiency devices provide a cost-effective means to reduce water consumption.

Key words

Water efficiency, domestic water consumption, South West of England

Abbreviations:

PPC per capita consumption

SW South West

SWW South West Water

Introduction

Forecasting water consumption is essential to manage the supply demand balance, which is compounded by a number of uncertainties. These include the extent of demand management measures in place, socio-economic factors, population growth, rising per capita consumption (PCC), and climate change risks (Guarnieri and Balmes, 2014), making water scarcity a real issue (Tompkins, 2008). This has led to an increasing trend towards water supply managers investigating demand management initiatives through promoting more efficient use of water. Demand management provides a sustainable alternative to other more traditional approaches to meeting the supply demand balance (Sandifer et al., 2015), as well as reduce the sectors carbon footprint (Greening et al., 2000). However, there is limited evidence to quantify the current uptake of household water efficiency, consumer awareness and the potential long-term impact of efficiency strategies on domestic demand.

There are many facets that regulate water use including water price, income and household composition, which are crucial determinants of residential consumption (Millock and Nauges, 2010). Water demand management initiatives employ various techniques for conserving and making more efficient use of water. Water efficiency measures include household metering/charging strategies, use of appropriate technologies (e.g. retrofitting toilets and showers with water efficiency devices), the application of standards for water-using technologies in new builds, collection of rain water/grey water and educational programmes (Sandifer et al., 2015).Water efficiency strategies have had mixed success, for example promoting the adoption of voluntary water efficiency measures show more variable results when compared mandatory restrictions (Hensher et al., 2005). Pricing and alternative demand management policies are effective in reducing demand, however, the magnitude of the reduction in consumption varied among policy instruments (Olmstead and Stavins, 2009).

Little is known about how people in rural and regional areas use water, their use of water-saving measures or their barriers to adoption (Hensher et al., 2005). The following study focuses on households located in the South West of England (SW), which is a predominantly rural county, home to some of Europe's most deprived communities, and influenced by a strong maritime climate that is dominated by mild temperatures, strong wind speeds and wet winters (Sharpe et al., 2014). The county has a population of 530,064(Sharpe et al., 2014) who rely on predominantly surface water abstractions from the Colliford strategic supply area (SSA) (Soth West Water, 2009). The following study aims to assess the uptake and potential benefits resulting from methods such as toilet cistern devices, rainwater harvesting and use of low volume shower/tap flow devices because they are believed to be the most effective options for domestic water efficiency schemes (Marshallsay and Mobbs, 2006).

Method

This cross sectional study was conducted in collaboration with SWW and focuses on a population residing in Cornwall, SW of England. It utilised a convenience sampling frame based on friends and family of the principle investigator (RS) to maximise response rates. The study was designed using previous best practices and considered a suitable methodology (Wilson, 2003) given the study, time and resource constraints. Data was collected via face-to-face questionnaires (Appendix 1), which was designed using the standard template from SWW. Questionnaires were designed to collect data on participant demographics, housing characteristics, fixtures and appliances, uptake of water efficiency measures, opinions on water use and purchasing preferences. A total of 60 questionnaire forms were hand-delivered to participants residing in Cornwall, SW of England during October 2006, with a response deadline of the 30th November 2006. To maximise our response rate, participants were contacted once by telephone as a reminder to complete the survey. In accordance to our study ethics protocol, we assigned a unique ID to each respondent to ensure the confidentiality of those participating in the study. A study ethics protocol was submitted and accepted by Staffordshire University.

Per Capita Consumption

The UK has one of the highest per capita water consumption rates in the world, which consists of a number of components contributing to the total household demand. These include personal washing, toilet flushing, clothes washing, washing and cleaning, garden watering, drinking and cooking, car washing and other water use (33.7%, 28.1%, 13%, 8.6%, 6.6%, 3.4%, 0.5% and 6.1%, respectively) (Defra, 2008). We adopted the average UK PCC of 154 litres per head per day (l/p/h/d) (Defra, 2011) in our water consumption calculations because it is still relevant for normal year forecasts.

We use the above PPC to calculate water consumption in the study population for each of the main water using activities, along with the total potential savings in water consumption and cost based on water efficiency devices being rolled out to the total housing stock, as described in (Sharpe, 2008). We also compare the cost of devices and potential household savings per house, payback period based on the market reported savings per device (percent of savings in water consumption) and the length of pay back in terms of comparing product cost against the cost of water saved.

Data analysis

Descriptive statistics were used to describe demographic and housing characteristics of participating homes. We used behavioural, built environment and survey data collected from our household questionnaire, which are described as dichotomous variables influencing water use and uptake of water efficiency measures. Pearson's chi-squared tests were used to assess whether occupant behaviours and housing characteristics were associated with the uptake of water efficiency measures, which was defined by any device, excluding water efficient white goods and dual flushing/low volume cisterns. We then conducted univariate analyses using our dichotomous behavioural and housing characteristic variables in unadjusted logistic regression models to calculate odds ratios and confidence intervals. We multiplied cases and controls by a factor of 10 to account for the lack of power in some analyses, and used the *csi* command in stata to estimate odds ratio's and confidence intervals.

Results

The study achieved an 85% response rate, which included 51 adult participants who provided data on behalf of the household (Table 1). Majority of participants were aged between 30 and 64 years (56%) and had an average occupancy of 2.4 persons per household (SD ± 1.3). Majority of properties were connected to the public water supply (92%), with an average annual water bill of £414.6 (SD ± 212.0). A total of 49% of participants used some kind of water efficiency device and/or water saving product (excluding toilet water saving devices and efficient white goods).

Factors influencing the uptake of water efficiency

Eighty two percent of participants who had actively researched water efficiency options had then installed a device/s (P=0.00) in our univariate analyses (OR 9.75; 95% CI 2.31-41.14). Participants owning their home were also more likely to uptake water efficiency devices (59% of home owners) to reduce water consumption (P=0.01) in our unadjusted model (OR 7.2; 95% CI 1.4-37.3) (Table 2). We identified a number of other potential behavioural and built environment factors promoting the use of water efficiency devices. However, none of these models were statistically significant (P>0.05), which is likely to be a result of our small sample size.

To explore this further we modelled an increase in sample size by multiplying each variable by a factor of 10 (Table 3). In this model we found that signing up to the SWW maintenance contract (OR 0.49; 95% CI 0.32-0.76), employment (OR 0.44; 95% CI 0.25-0.77) and living in buildings constructed after 1970 (OR 0.8; 95% CI 0.26-0.56) lowered the uptake of water efficiency measures in participating households. Participants were more likely to take up water efficiency measures if the total number of occupants exceeded three people (OR 2.22; 1.52-3.26), and if they received promotional material/advice or had investigated water efficiency options (OR2.86; 95%

CI 1.99-4.11, and OR 9.76; 95% CI 6.20-15.35, respectively). Other factors included home owners (OR 7.19; 95% CI 4.29-12.04), and those that were resident for >5 years (OR 1.74; 95% CI 1.22-2.46), had water bills costing more than £400/year (OR 1.55; 95% CI 1.02-2.34), and actively water the garden during the summer months (OR 2.57; 95% CI 1.78-3.71). Built environment factors promoting the uptake of water efficiency included living in a detached building (OR 2.44; 95% CI 1.69-3.49), larger properties (>2 bedrooms) (OR 2.57; 95% CI 1.78-3.71) and having an aging toilet cistern (OR 3.25; 95% CI 2.10-5.04).

Current Household water efficiency

The reported use household appliances (Table 4) and water efficiency measures (Table 5) were used to assess current household water consumption and potential savings. Promoting water efficiency devices could save between 0.74 and 23.05 Ml/d (or 3.92 to 95.50 l/house/d) and can achieve a cost-effective solution to reducing consumption, with the exception of promoting the replacement of white goods (Figure 1A). Figure 1B illustrates that the price range of individual water efficiency devices (excluding white goods) are within the upper limit of the amount of money participants were willing to spend on water efficiency options (£43.07) (Table 6). Based on cost, pay back and potential savings in water consumption, these results support low-cost combined strategies (such as cistern devices, and more efficient shower heads, tap aerators and Ecosave low frequency sound analyser for water leaks). These could deliver annual savings of £117.58 to £129.86 in the average household bill (Figure 2). Metering, water audits, variable water prices, product exchange programmes and use of grey water offer alternative solutions to promote the efficient use of water due to participant interest in these options.

Discussion

Our results indicate that consumers and future water efficiency campaigns need to focus on the adoption of combined low-cost water efficiency devices, which should include cistern devices, and more efficient shower heads, tap aerators and low frequency sound analyser for water leaks. This would provide a cost-effective approach to demand management measures because the penetrations of these devices were found to be low in participating homes. A high proportion of participants were interested in receiving more information about water efficiency options, and were not opposed the compulsory metering or variable pricing structures, which provides an opportunity for future water efficiency campaigns. Focusing on behavioural and built environment factors promoting the uptake of water efficiency measures may help improve demand management measures. These need to be delivered along-side initiatives to foster positive water conservation attitudes (Willis et al., 2011), improved information (Doron et al., 2011) and develop a comprehensive framework to evaluate alternative measures (Smith et al., 2014) to overcome the limitations of previous water conservation projects (Howarth and Butler, 2004). Future work should also consider the complexity of consumer attitudes towards conservation and water consumption such as differences in socio-demographic composition of households in different dwellings, as well as cultural, behavioural and institutional aspects of consumption (Randolph and Troy, 2008).

Synthesis with existing literature

Our results support the promotion and adoption of low-cost combined water efficiency strategies, which could deliver annual savings of £117.58 to £129.86 and corresponds to previous findings (Environment Agency, 2015b, House of Lords, 2015, Institute for Public Policy Research, 2015). Other factors to consider include an increase in the penetration of SWW maintenance contracts and leakage devices that could save

0.96 Ml/d, which is supported by (Defra, 2011). Around 40% of households are currently metered (OFWAT, 2015), which corresponded to our findings and supports further adoption of increased meter penetration. However, increased metering raises issues around the affordability of metered water supplies in low income populations (Environment Agency, 2015b). This is important to consider because we observed no association between metering and an increase in the uptake of water efficiency devices, which is in contrast to previous findings (Millock and Nauges, 2010). Millock and Nauges (2010) found that environmental attitude (e.g. participants actively investigating water efficiency) and ownership status were strong predictors of adoption of water efficient equipment, which may explain our findings.

Also supporting the role of fiscal incentives includes Olmstead and Stavins (2009) who assessed price-based approaches. These need to be considered along-side customers willingness to pay for water services, what is considered good value for money (Hensher et al., 2006, Hensher et al., 2005) and a better understanding of perspectives on water consumption (UKWIR, 2015). For example utilising more efficient white goods provide an effective option based on fixed consumption rates (Environment Agency, 2015a), however, replacing white goods cost more than participants were willing to spend on water efficiency and will require subsidised initiatives. We found that focusing on water efficiency devices within the region respondents were willing to pay for could save between 0.74 and 23.05 Ml/d (or 3.92 to 95.50 l/house/d), if applied to the total housing stock without water efficiency. This corresponds to the findings of Conlan et al. (2015) who concluded that average savings of 20.8 l/house/d (saving £14.20/year) were achievable.

Cistern displacement and retrofit devices offer savings of 30% and 50%, respectively, although potential reductions in water consumption requires careful consideration about potential adverse effects such as low water volume on the effective of sewerage systems (Sharpe, 2008). Combined water efficiency strategies could also benefit both SWW and the environment by reducing the amount of surface abstractions. A review of abstractions in the Colliford SSA found that savings of between 1.19Ml/d and 11.59Ml/d could be achieved, which may alleviate supply-demand pressures, or periods of low flows / periods of high water stress, however, it may not be sufficient to off-set climate change risks (Sharpe, 2008). While these efforts contribute towards sustainable water management practices (Ashley et al., 2004), Water UK (2015) have questioned how far demand management measures can meet rising consumption patterns. The pursuit of sustainable practices must be supported by research into long-term efficiency solutions before customer-side options are considered on an equal footing to supply-side measures (Marshallsay and Mobbs, 2006). Marshallsay and Mobbs (2006) reported that the most sustainable options are dual flushing WC retrofits, low flush WCs, rainwater harvesting and washroom retrofits, which also supports our findings.

Future work should focus on recruiting a larger sample frame to improve confidence in these results and help identify the potential impact of the Hawthorne Effect and the potential direct and indirect rebound effects (Druckman et al., 2011) following any drive for water efficiency. For example, any gains in water consumption will result in an effective reduction in the per unit price of water. As a result, consumption of water should increase (i.e., “rebound” or “take-back”), partially offsetting the impact of water efficiency measures, which is a concern in energy policy (Greening et al., 2000).

Strength and Limitations

Strengths of the study included our adaptation of South West Water's domestic questionnaire and our high response rate, which may prevent the inclusion of systemic bias (Rönmark et al., 2009). When comparing responses and omitted questions, we found that the results were of relatively high quality responses, and were representative of the South West Water data on participating households. However, some limitations exist. The cross sectional study design and small sample size may not be representative of the population of Cornwall as a whole, and there may also be the potential systemic error resulting from selection and information bias. A small sample size also meant that we were unable to adjust for potential covariates when assessing factors promoting the update of water efficiency devices. Also modelling an increased sample size may not be representative of current water consumption and water efficiency in a larger population residing in the SW of England, and requires further research.

Conclusion

Home owners and participants stating they had actively investigated water efficiency options were more likely to adopt devices to reduce water consumption in their home. A combined strategy utilising low-cost water efficiency measures (cistern devices, and more efficient shower heads, tap aerators and low frequency sound analyser for water leaks) provides a sustainable opportunity to meeting the future supply-demand balance. Future work should consider other behaviour and perception factors thought to influence water consumption, in particular the rebound effect and energy use.

Paper length

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Conflict of Interest

We declare that none of the authors involved in writing this paper have any conflict of interests with respect to the content of this article.

References

Ashley, R., Blackwood, D. & Butler, D. 2004. *Sustainable Water Services – A Procedural Guide,* Milton Keynes, IWA Publishing

Conlan, K., Wade, T., Ormerod, S., Lane, S., Durance, I. & Yu, D. 2015. *Preparing for climate change impacts on freshwater ecosystems (PRINCE)* [Online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291081/scho0507bmoj-e-e.pdf [Accessed 09/02/2015.

Defra. 2008. *Future water -the governmentis water strategy* [Online]. HM Government. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69346/pb13562-future-water-080204.pdf [Accessed 12/01/2015.

Defra. 2011. *Water for Life* [Online]. Available: http://www.official-documents.gov.uk/document/cm82/8230/8230.pdf [Accessed 23/11/12.

Doron, U., Teh, T., Haklay, M. & Bell, S. 2011. Public engagement with water conservation in London. *Water and Environment Journal,* 25**,** 555-562.

Druckman, A., Chitnis, M., Sorrell, S. & Jackson, T. 2011. Missing carbon reductions? Exploring rebound and backfire effects in UK households. *Energy Policy,* 39**,** 3572-3581.

Environment Agency. 2015a. *Conserving Water in Buildings* [Online]. Available: http://www.elementalsolutions.co.uk/wp-content/uploads/2012/08/conserving-water-in-buildings.pdf [Accessed 09/02/2015.

Environment Agency. 2015b. *Impact of household water metering in South East England* [Online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291586/scho0709bqsp-e-e.pdf [Accessed 09/02/20115.

Greening, L. A., Greene, D. L. & Difiglio, C. 2000. Energy efficiency and consumption—the rebound effect—a survey. *Energy policy,* 28**,** 389-401.

Guarnieri, M. & Balmes, J. R. 2014. Outdoor air pollution and asthma. *The Lancet,* 383**,** 1581-1592.

Hensher, D., Shore, N. & Train, K. 2005. Households' willingness to pay for water service attributes. *Environmental and Resource Economics,* 32**,** 509-531.

Hensher, D., Shore, N. & Train, K. 2006. Water Supply Security and Willingness to Pay to Avoid Drought Restrictions*. *Economic Record,* 82**,** 56-66.

House of Lords. 2015. *Science and Technology - Eighth Report* [Online]. Available: http://www.publications.parliament.uk/pa/ld200506/ldselect/ldsctech/191/19102.htm [Accessed 09/02/2015.

Howarth, D. & Butler, S. 2004. Communicating water conservation: how can the public be engaged? *Water Science & Technology: Water Supply,* 4**,** 33-44.

Institute for Public Policy Research. 2015. *Water companies save just a mug of water per customer* [Online]. Available: http://www.enviro-solutions.com/dailynews/ippr-water.htm [Accessed 09/02/2015.

Marshallsay, D. & Mobbs, P. 2006. *Sustainability of water efficiency measures,* London, UK Water Industry Research Limited.

Millock, K. & Nauges, C. 2010. Household adoption of water-efficient equipment: the role of socio-economic factors, environmental attitudes and policy. *Environmental and Resource Economics,* 46**,** 539-565.

Ofwat. 2015. *Water meters –your questions answered - Information for household customers* [Online]. Available:

http://www.ofwat.gov.uk/mediacentre/leaflets/prs_lft_101117meters.pdf [Accessed 09/02/2015.

Olmstead, S. M. & Stavins, R. N. 2009. Comparing price and nonprice approaches to urban water conservation. *Water Resources Research,* 45**,** W04301.

Randolph, B. & Troy, P. 2008. Attitudes to conservation and water consumption. *environmental science & policy,* 11**,** 441-455.

Rönmark, E. P., Ekerljung, L., Lötvall, J., Torén, K., Rönmark, E. & Lundbäck, B. 2009. Large scale questionnaire survey on respiratory health in Sweden: Effects of late- and non-response. *Respiratory Medicine,* 103**,** 1807-1815.

Sandifer, P. A., Sutton-Grier, A. E. & Ward, B. P. 2015. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem Services,* 12**,** 1-15.

Sharpe, R. 2008. *A Review and Assessment of the Sustainability of Household Water Efficiency Strategies – South West Water, a Colliford Strategic Supply Area Perspective* Masters, Staffordshire University.

Sharpe, R., Thornton, C. R., Nikolaou, V. & Osborne, N. J. 2014. Higher energy efficient homes are associated with increased risk of doctor diagnosed asthma in a UK sub population. *The British Society for Allergy and Clinical Immunology.* Telford, England.

Smith, N. J., Mcdonald, G. W. & Murray, C. F. 2014. The costs and benefits of water demand management: evidence from New Zealand. *Water and Environment Journal***,** n/a-n/a.

Soth West Water. 2009. *Water Resources Plan 2010-2035* [Online]. Exeter: South West Water. Available: http://www.southwestwater.co.uk/media/pdf/g/a/WRP_Final.pdf [Accessed 09/01/2015.

Tompkins, J. 2008. Programmes et recherche d'utilisation efficace de l'eau domestique au Royaume-Uni. *La Houille Blanche***,** 41-47.

Ukwir. 2015. *Traces of Water: Developing the social science of domestic water consumption* [Online]. Available: http://www.lancaster.ac.uk/lec/sites/cswm/Traces.php [Accessed 06/02/2015.

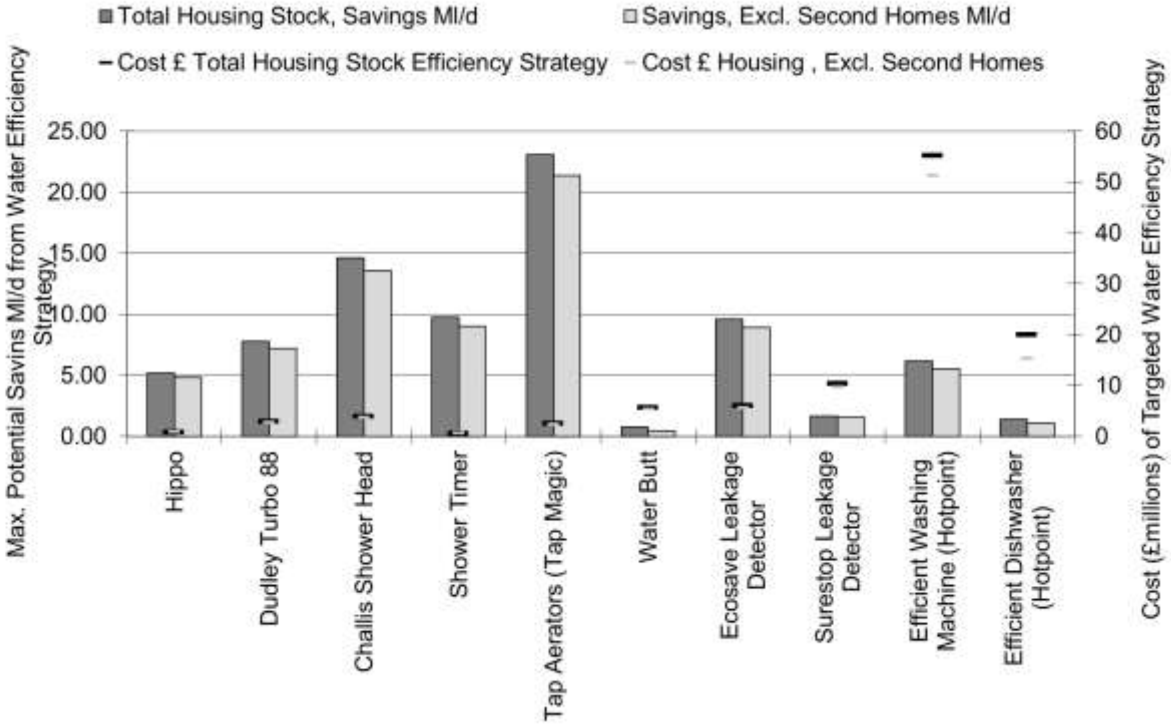
Water Uk. 2015. *Policy* [Online]. Available: http://www.water.org.uk/policy [Accessed 10/02/2015.

Willis, R. M., Stewart, R. A., Panuwatwanich, K., Williams, P. R. & Hollingsworth, A. L. 2011. Quantifying the influence of environmental and water conservation attitudes on household end use water consumption. *Journal of environmental management,* 92**,** 1996-2009.

Wilson, A. 2003. *Marketing research – An integrated approach,* Essex, Pearson Education Limited.

Figure 1 Cost and potential savings of water efficiency devices

A) Maximum Savings V's Total Cost



B) Cost of Device & Average Savings

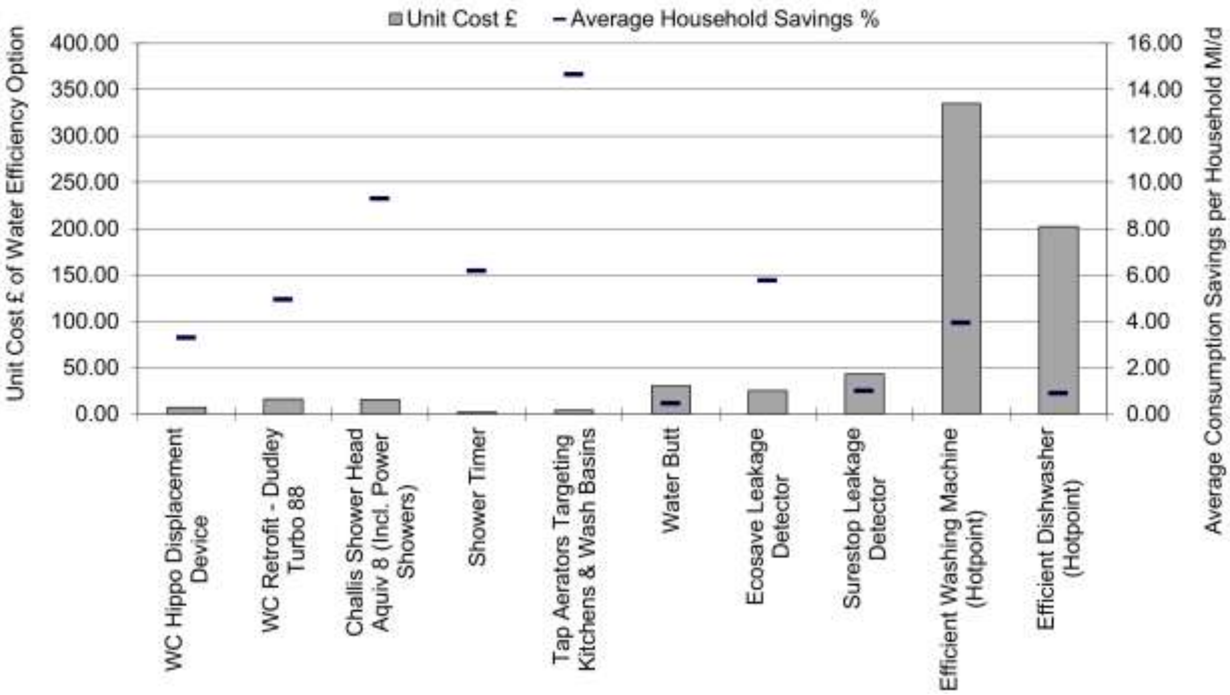
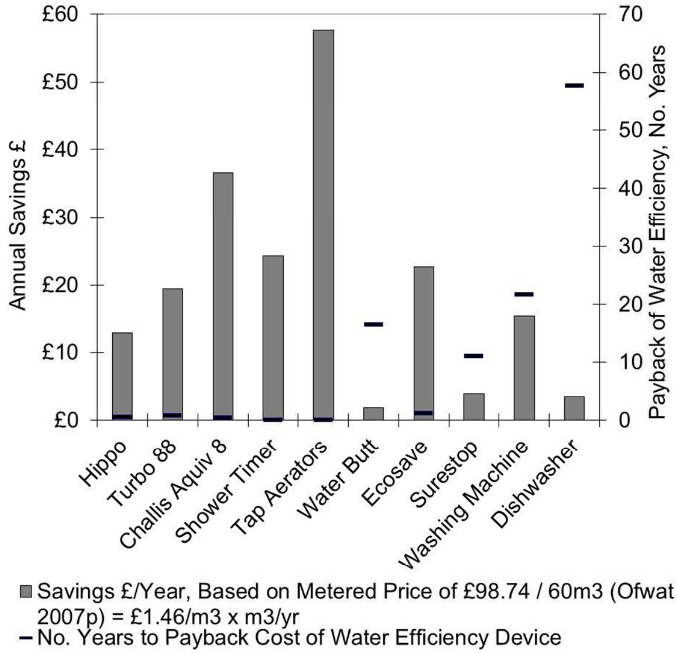


Figure 2 Pay back of water efficiency devices

A) Efficiency Saving/Payback Period Using 2007 Metering Data



B) Average Annual Water Bill, Cost of Water Efficiency & Payback / Savings

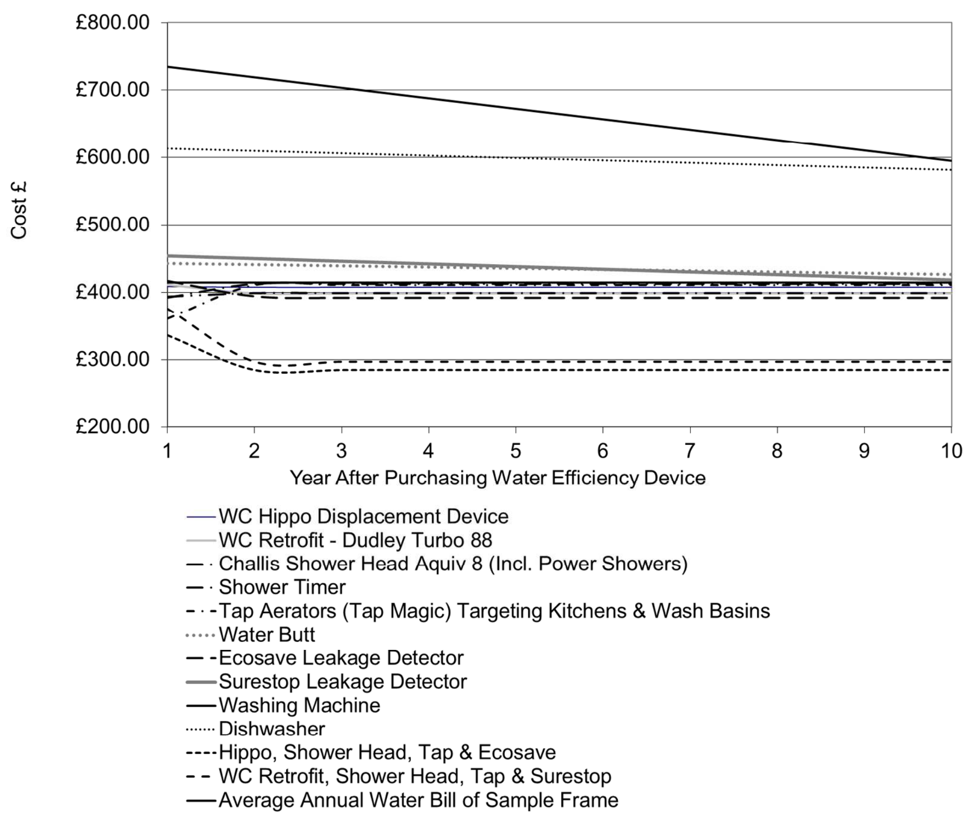


Table 1 Summary of demographic data of participant households (N=51)

Variable	Participating households				
	(%)	N	mean	range	SD
Average number of permanent occupants		51	2.4	1-7	1.3
Average residency period in current property		51	10.3	0.25-50	11.7
Participant owns their property; No	24	12			
Yes	76	39			
Participants said they had previously investigated water efficiency options; No	67	34			
Yes	33	17			
Date participant homes were built;					
1600-1920	36	115			
1921-1973	31	13			
1974-2005	33	14			
Properties connected to the public water supply; No	8	4			
Yes	92	47			
Type of property; Bungalow	14	7			
Detached	41	21			
Flat	10	5			
Semi-detached	27	14			
Terraced	8	4			
Property has a meter; No	47	24			
Yes	53	27			
Average number of rooms/property		51	6.4	2-12	2.3
Average cost of household water bill		34	414.6	100/850	212.0
Participant uses water saving devices, but excluding dual flushing / low volume cisterns and efficient white goods; No	51	26			
Yes	49	25			

Table 2 Summary of factors increasing the uptake of water efficiency measures (N=51)

Factors influencing uptake of water efficiency measures	Percent (n/d)	P Value	Uptake of water efficiency measures Unadjusted		Strength & direction of association
			OR	95% (CI)	
Investigated water efficiency options; No	32 (11/34)		Ref		↑
Yes	82 (14/17)	0.00	9.75	1.64-51.29**	
Home owner versus rented accommodation;					↑
No	17 (2/12)		Ref		
Yes	59 (23/39)	0.01	7.18	1.38-37.31*	

* 0.01≤p<0.05, ** 0.001≤ to <0.01 & *** p<0.001

Table 3 Model assessing the uptake of water efficiency measures (x10 multiplication)

Factors influencing uptake of water efficiency measures	Percent (n/d) model x10	Uptake of water efficiency measures Unadjusted∞		Strength & direction of association
		OR	95% (CI)	
Occupancy; 1-2 persons 3-7 persons	43 (150/350) 63 (100/160)	Ref 2.22	1.52-3.26***	↑
Participant read water efficiency promotions or SWW caravan or helpline; No Yes	38 (110/290) 64 (140/220)	Ref 2.86	1.99-4.11***	↑
Investigated water efficiency options; No Yes	32 (110/340) 82 (140/170)	Ref 9.76	6.20-15.35***	↑
Participants have SWW maintenance contract; No Yes	54 (210/390) 36 (40/110)	Ref 0.49	0.32-0.76**	↓
Water bill costs >£400/year; No Yes	47 (80/170) 58 (110/190)	Ref 1.55	1.02-2.34*	↑
In employment / self-employed; No Yes	67 (40/60) 47 (210/450)	Ref 0.44	0.25-0.77**	↓
Work/hobbies influenced decision to adoption water efficiency options: No Yes	43 (130/300) 57 (120/210)	Ref 1.74	1.22-2.49**	↑
Home owner versus rented accommodation; No Yes	17 (20/120) 59 (230/390)	Ref 7.19	4.29-12.04***	↑
Residency period; ≤ 5 years > 5 years	42 (110/260) 56 (140/250)	Ref 1.74	1.22-2.46**	↑
Waters the garden during the summer; No Yes	35 (70/200) 58 (180/310)	Ref 2.57	1.78-3.71***	↑
Property built age; <1970 ≥1970	64 (140/220) 40 (80/200)	Ref 0.47	0.31-0.69***	↓
House has a water meter; No Yes	46 (110/240) 52 (140/270)	Ref 1.27	0.89-1.80	-
Lives in a detached house; No Yes	40 (120/300) 62 (130/210)	Ref 2.44	1.69-3.49***	↑
Number of bedrooms/property; ≤2 2-5	35 (70/200) 58 (180/310)	Ref 2.57	1.78-3.71***	↑

∞ Unadjusted Odds Ratios calculated by the *csi* command and multiplication by a factor of 10
* 0.01≤p<0.05, ** 0.001≤ to <0.01 & *** p<0.000

Table 4 Household fixtures, appliances and use of water efficiency devices (N=51)

Variable	Participating households				
	(%)	N	mean	range	SD
Toilet; Mean frequency of use / week		40	29.05	6-60	10.48
Toilet has a dual flow cistern		51			
Toilet has a low volume cistern	17	51			
Use of cistern device e.g. Hippo	22				
Shower; Frequency of use / week		27	3.87	0-20	5.01
Use of basins / sinks;					
Frequency of use – wash basins / sinks / week		38	33.45	0-210	40.87
Frequency of use - kitchen sinks / week		37	15.35	0-40	9.93
Bath; Frequency of use / week		49	2.49	0-21	3.75
Washing machine;					
Frequency of use – full load / week		50	4.01	0-14	3.30
Frequency of use – half load / week		50	0.43	0-7	1.25
Dishwasher; Frequency of use / week		50	2.21	0-7	2.74
Wash car at home; No	63	32			
Yes	37	19			

Table 5 Uptake of water efficiency measures (N=51)

Variable	Participating households				
	(%)	N	mean	range	SD
Interested in receiving more information if not using water efficiency devices; No	35	17			
Yes	65	32			
Interested in purchasing water saving devices and installing them yourself; No	47	23			
Yes	53	26			
Average amount participants willing to spend on water efficiency		23	£49.57	0-200	51.92
Participants interested in water efficiency if SWW provided free devices, with free installation	16 84	7 37			
Use of water efficiency devices					
Cistern device e.g. Hippo bag; No	86	44			
Yes	14	7			
Low volume shower head e.g. “low flow” aerated shower or flow restrictor; No	98	50			
Yes	2	1			
Reduced flow shower system; No	98	50			
Yes	2	1			
Aerated shower head; No	100	51			
Yes	0	0			
Shower timer to reduce length of shower; No	98	50			
Yes	2	1			
Tap Aerator; No	100	51			
Yes	0	0			
Tap insert device e.g. washer to restrict flow; No	100	51			
Yes	0	0			
Tap flow restrictor immediately before the tap; No	100	51			
Yes	0	0			
Water saving garden hose trigger gun; No	78	40			
Yes	22	11			
Leakage detector and alarm fitted to water supply pipe; No	100	51			
Yes	0	0			
Water Butt to collect rain water; No	82	42			
Yes	18	9			
Water efficient washing machine; No	21	4			
Yes	79	15			
Water efficient dish washer; No	46	6			
Yes	54	7			

Table 6 Factors influencing the uptake of water efficiency devices (N=51)

Variable	Participating households				
	(%)	N	mean	range	SD
Opposed to compulsory metering if not on a meter; No	74	23			
Yes	26	8			
Opposed to a decision to make water prices variable according to the amount of water you use; No	84	41			
Yes	16	8			
Use any household systems for reusing wastewater e.g. use old washing water for toilet flushing; No	88	43			
Yes	12	6			
Interested in the reuse of wastewater for secondary uses such as toilet flushing; No	25	11			
Yes	75	33			
Object to recycling of wastewater discharged from a sewage treatment works to meet future water demands; No	53	26			
Yes	47	23			
Interested in SWW home water audits; No	48	24			
Yes	52	26			
Believe greater regulation is required to save water; No	14	7			
Yes	86	42			
Visit from SWW representative would influence decision to use a meter and or efficiency devices; No	57	28			
Yes	43	21			
Influenced by water efficiency when buying a new product; No	20	10			
Yes	80	41			
Would you consider exchanging current water using products for a more water efficient system; No	40	20			
Yes	60	30			
Subsidised product exchange system that reduced product cost would help influence your decision to purchase a more water efficient product; No	18	9			
Yes	82	40			
Amount participants willing to spend for a more water efficient product		31	£43.07	0-150	43.46