

Public perception of drought and climate change in southeast England

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Droughts occur as a natural feature of many climates. Several southern areas of the UK experienced water stress during 2004–2006 because of low water availability and high water demand. Climate change scenarios suggest that drought frequency could increase here in the future. This will increase the competition for water across all sectors. Understanding people's perceptions of drought and climate change is likely to be an important factor for sustainable water management by pointing to barriers to behavioural change. A mixed methodology study using questionnaires and focus groups was conducted in the Anglian and southern regions of the UK to explore public perceptions of drought and climate change. Respondents attributed the 2004–2006 regional drought to lower than average rainfall. Water-intensive lifestyles, a growth in population, increasing housing developments, leaking pipes and the privatization of water companies were also implicated. The majority of respondents claimed to change their behaviour to conserve water during 2006. Regarding the future, and under a number of different scenarios, people were more inclined to accept restrictions than agree to pay more to ensure the supply of water. They were concerned about climate change and recognized that more frequent water shortages may be one of the impacts, but this concern did not necessarily translate into action. Barriers to engagement with climate change and water-efficient behaviour included a lack of accessible information, a lack of knowledge regarding the integration of environmental spheres, a lack of resources, and a perceived lack of institutional engagement. The barriers identified appear to pose a major challenge to successful adaptation to climate change.

Keywords: adaptation; behaviour; climate change; drought; perception; United Kingdom

1. Introduction

Managing water resources to meet the needs of society, the economy and the environment is a difficult task. The impacts of anthropogenic climate change, naturally variable rainfall and the changing demands of society mean that water resources are increasingly managed under conditions of considerable uncertainty.

The United Kingdom's (UK) climate is naturally capricious, with droughts an inherent feature of the climate system. Notable droughts since 1920 include the periods 1921–1922, 1933–1934, 1959, 1975–1976, 1990–1992, 1995–1997 and

the recent 2004–2006 rainfall drought (Marsh et al., 2007). Droughts in the UK tend to differ across scales of space and time, owing to significant differences in rainfall patterns, storage capacity, geology, water demand and land use. The southern region of the UK was primarily affected by the 2004–2006 drought, which resulted in eight of the private water companies instituting restrictions and compliant domestic consumers helping to reduce demand by about 10 per cent (OFWAT, 2006). Hot weather and dry soils can however trigger substantial increases in water demand, for example for garden watering, which may overstretch local water distribution systems.

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An increase in demand from growth in population and expanding housing developments has increased the risk of water shortages in certain regions in England, including the southern region where high demand and low resource availability already exist. In addition to public and commercial water supply, the natural environment also places demands on the water resources available. In order to secure environmental standards set by the European Union in the Water Framework Directive and Habitats Directive, more water will need to be allocated to the environment (EA, 2006a; WFD/EUWI, 2007).

Anthropogenic climate change could exacerbate water resource problems (Arnell, 1998). The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report states that 'it is very likely that areas affected by droughts and warm spells will increase' (IPCC, 2007, p. 5). Climate change scenarios suggest that the UK will experience frequent hot, dry summers potentially leading to more droughts (Hulme et al., 2002). In the context of climate change impacts, Wade et al. (2006a, p. 14) indicate that a recurrence of prolonged drought would have 'far greater impacts than droughts in the twentieth century'. The largest changes in precipitation may occur in the eastern and southern parts of England. In the southeast there is the potential for extreme drought conditions every two years in three by the 2080s, with short-duration droughts occurring up to three times as frequently in the 2020s compared to the 1961–1990 period (Wade et al., 2006b, p. 18).

The Government's water strategy highlights the importance of reduced household demand and more efficient water use. Public engagement is recognized as essential in developing an increased resilience to climate change (Defra, 2008). People's behaviour in response to the impacts of drought and climatic changes and their actions to mitigate future changes are therefore fundamental in determining the long-term impacts of drought events. A better understanding of the impacts of droughts and climate change and the changes domestic consumers

consider acceptable to ameliorate the risks can only be achieved through knowledge of the attitudes and behaviour of the public in their roles as both observers and participants (Palutikof et al., 2004).

Public views on environmental issues have been of interest to researchers for several years (McDaniels et al., 1996; Langford et al., 2000; Palutikof et al., 2004). Research has been conducted into people's attitudes and behaviour towards water use following the 2006 water shortages (Medd and Chappells, 2007). Gilg and Barr (2006) concluded that water consumption behaviour is complex and often based on habit, making it difficult to influence behaviour. In the 2006 Consumer Council for Water study, people recognized their personal responsibility for efficient water management but were disinclined to change their behaviour because water companies were not perceived to be playing their part (Christensen and Kowalski, 2006).

People's perceptions of climate change have been extensively researched (Bord et al., 1998; Leiserowitz, 2005; Lorenzoni and Pidgeon, 2006). Recent research on perceptions of climate change found that people were aware of climate change and the majority accepted anthropogenic influences (Futerra, 2005). Previous research had similar findings to the MORI survey of 2007, where people cited more extreme weather events as the main impact of climate change but remained unsure of its causes, often confusing this with other environmental issues such as depletion of the ozone layer (BMRB, 2007).

There appears to be little or no research that links perceptions of both climate change and drought. For a relevant exception see Meze-Hausken (2004), who compared people's perceptions of climate change and drought with observed measurements of rainfall in northern Ethiopia. The objective of the research reported here is to gain a greater understanding of people's perceptions of drought and of climate change, with particular reference to the UK drought in 2004–2006, and how people's perceptions of these issues affect – or might affect – their water consumption behaviour.

Michaels (2000, p. 224) defines perception as 'the detection of information'. Information is gained through different pathways of knowledge and concepts of trust, responsibility and agency (Lorenzoni and Langford, 2005). People's behaviour towards an action is, in part, a result of their interpretation of the situation in which the attitude object is situated. For instance, factors such as knowledge, media coverage, local weather patterns and perceptions of the responsible organizations are used by people to create their personal views of reality. It is this reality that people use to shape their understanding and behavioural responses rather than on the basis of the objective possibilities (Russell and Hampton, 2006).

But people's perceptions and attitudes can also be incongruent with their behaviour (Axelrod and Lehman, 1993). The difference between intentions and behaviour is referred to as a value-action gap (Barr et al., 2005; Lorenzoni et al., 2007). Literature on environmental behaviour highlights incentives and barriers to actively engaging with environmental issues (Stoll-Kleemann et al., 2001; Jackson, 2005; Lorenzoni et al., 2007). Barr et al. (2005) place barriers to energy conservation behaviour into two groups: habitual behaviour and purchase-related behaviour. Habitual behaviour is the result of actions that are below the level of consciousness and therefore difficult to change (Spaargaren and van Vliet, 2000). Purchase-related behaviour is related to conscious choices; for example, a lack of resources or access to resources hinders active engagement. Barr and Gilg (2005) placed variables offering incentives or barriers to environmental behaviour into two groups: situational variables, such as sociodemographics, and physiological factors, such as effectivity of individual behaviour, influence of society, perceived difficulty of behaviour and perception of a threat. They suggest, however, that knowledge has an overarching influence, a lack of knowledge being an impediment to active engagement.

Lorenzoni et al. (2007) also recognized the importance of knowledge as a determinant of

active engagement with climate change. They grouped barriers and incentives to engaging with climate change into two integrated levels: social and institutional. The social level included knowledge of individuals, information and equipment available to individuals. The institutional level was linked to the perceived will of institutional bodies to engage with environmental issues.

In this context, this paper examines the barriers and incentives to engaging with water conservation and climate change with regard to three integrated groupings: informational, societal and structural (cf. Adger et al., 2009). Informational aspects include the manner in which information is acquired and the perceived integrity of the sources of information. Societal aspects include habitual behaviour and the access to resources. Structural aspects include the perceptions of the institutions involved.

2. Methodology

The research methods in this study follow from a mixed methodological approach, both qualitative and quantitative, as used in previous studies examining public perceptions of environmental issues (McDaniels et al., 1996; Langford et al., 1999, 2000; Lorenzoni and Langford, 2001; Lowe et al., 2006). The regions where this study was conducted are described first.

2.1. Study locations (see Table 1 and Figure 1)

The regions where research was carried out were, first, St Edmundsbury in the Anglian region where a 'moderate' water stress classification (i.e. low resource availability and low demand) was given by the Environment Agency (EA, 2007a) and, second, the Sevenoaks District in the southern region where the water status was categorized by the EA as 'serious', low resource availability and high demand (EA, 2007a). The two sites were selected because of their different experiences of water restrictions during 2006 to test the hypothesis that experience of drought

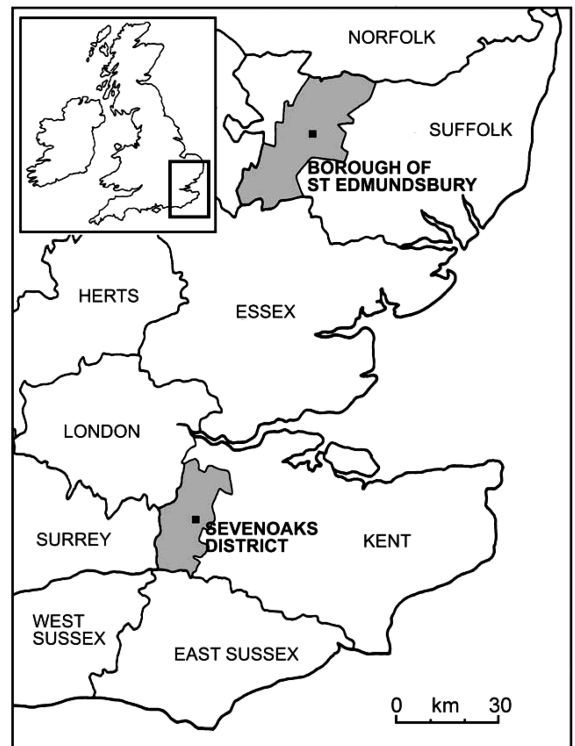
TABLE 1 Characteristics of the Anglian and southern regions

	The Anglian region	The southern region
Water status	595 mm of rainfall per annum. The largest amount of non-tidal abstractions (53%) are utilized in the domestic sector.	800 mm of rainfall per annum. The largest amount of non-tidal abstractions (70%) are utilized in the domestic sector.
Water companies	Anglian Water.	South East Water (SEW), Mid Kent Water, Southern Water and Portsmouth Water.
Population	Current population: 6 million and has the fastest growing population in the UK. 23,900 dwellings are to be built per annum. Domestic water consumption is 140 l/c/d.	Current population: 4.6 million. 28,900 dwellings are to be built per annum. Domestic water consumption at 160 l/c/d is higher than in any other region.
Agriculture	The agricultural sector is an important user of water.	Agriculture uses only 2% of total abstraction. This is mostly in the summer when river flows may be low.
Environment	Sites of international and national importance, many of them wetlands.	Sites of international and national importance, many of them wetlands.
Security of supply	Groundwater accounts for 40% of water supply. Most water comes from pumped surface water storage reservoirs. A marginal deficit against target headroom during critical periods.	Groundwater provides 70% of the water supply; the remaining 30% comes from reservoirs or river abstractions. A significant deficit against target headroom during critical periods.

*Continued***TABLE 1** Continued

Water situation in 2004–2006	River flows and groundwater levels were lower than average. Reservoirs were within their normal range. No water restrictions in 2004–2006.	River flows and groundwater levels were lower than average. SEW had full hose-pipe bans during 2004/05 and 2005/06.
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Source: Data from AW (2006), EA (2006b, 2007a), EERA (2005), Kent Partnership (2007), SEW (2006) and WRSE (2006).

**FIGURE 1** Map of Southeast England showing the borough of St Edmundsbury and the Sevenoaks District (both in grey)

should lead to behavioural change; people in Kent should have changed their behaviour more than in the Anglian region because they experienced drought and restrictions.

St Edmundsbury

The borough of St Edmundsbury is situated in West Suffolk in the Anglian region. It covers an area of 658 km², being predominantly rural (SEBC, 2004). The borough has a mixed economy, including manufacturing and agriculture-related industries. In 2005 there were 100,500 people resident in the borough (SEBC, 2006, p. 13). The number of households in the borough is projected to increase by 8,000 between 2001 and 2021 (SEBC, 2004, p. 4). The water supply company is Anglian Water. Residents of the town of Bury St Edmunds and the village of Horringer were surveyed.

Sevenoaks District

The Sevenoaks District is situated in West Kent in the southern region and covers an area of 368 km². Much of the area is rural in nature (SDC, 2003). The borough's economy is primarily centred on financial, retail and service industries. In 2005 there were 109,305 people resident in the borough (Smith et al., 2005). The water supply companies are South East Water and Mid Kent Water. Residents of the town of Sevenoaks and the village of Otford were surveyed. The study was conducted over a 3-month period, from June to September 2007.

2.2. Focus groups

Our focus groups consisted of seven people from various age brackets (Table 2). The focus group in Horringer consisted of two females and five males, and in Otford three males and four

females participated. In Horringer two participants had not undertaken tertiary education, and in Otford only one. Neither group is a representative sample. The group discussions provided insight into the language people use when discussing environmental and water resource issues as well as how drought and water consumption practices are framed. This insight informed the structuring and wording of the survey questionnaires. The qualitative component also allowed for an in-depth exploration of participants' perceptions of water resources, including attitudes to the use of water and more sustainable alternative practices, how information about water resources is gained, who is deemed trustworthy to provide accurate information, where the responsibilities for water management are perceived to lie, the acceptability of further price increases or more frequent restrictions and views on climate change. The participants are identified by a letter referring to their name followed by BE for those from Horringer or SO for those from Otford. The focus groups in Horringer and Otford took place on 21 June and 26 June 2007, respectively.

2.3. Survey questionnaire

Time constraints and a lack of resources did not allow for a full, stratified random sample to be taken. After piloting the questionnaire, a random sample of streets was selected and all the houses there were given a questionnaire in June/July 2007, during a period of exceptionally heavy rainfall. A door-to-door method of contacting the respondent and leaving the survey with them to return in a pre-paid envelope was implemented. Of the 225 questionnaires distributed, 102 were returned giving a response rate of 46 per cent, which is reasonable for an unsolicited survey. Of the 102 respondents, 53 were from St Edmundsbury and 49 were from Sevenoaks District.

Respondents were questioned about their attitudes to climate change and their personal views on drought, how they had modified their

TABLE 2 Age distribution of focus group participants

Age distribution of participants					
Age range	26–35	36–45	46–55	56–65	66–75
Number of participants in Horringer	0	1	2	1	3
Number of participants in Otford	2	1	3	0	1

TABLE 3 Age distribution of survey respondents ($N = 102$).

Age distribution of respondents							
Age range	Under 25	26–35	36–45	46–55	56–65	66–75	76–85
Respondents	1	15	20	12	19	21	14

behaviour in response to the water situation in 2006 and how they thought their behaviour might change if water shortages become a more frequent occurrence. Respondents were asked to identify who they believe to be trustworthy sources of information and who should be accountable for managing water resources. The respondent's willingness to pay more for water or accept restrictions was then explored and demographic data were collected (e.g. Table 3); the sample is not representative as retired people are overrepresented. In the statistical analyses, a 95 per cent confidence level was sought. The Mann–Whitney U test was used, unless otherwise stipulated.

It is important to note that self-reported behaviour was analysed in the research, and this may not reflect the practices actually undertaken. Various reasons account for this: respondents believe they undertake particular actions but may not do so as often as they suggest; they may want to undertake certain actions but are constrained by lack of choice or habitual behaviour; or they want to portray themselves as 'environmentally friendly'. To overcome inaccuracies in self-reporting, respondents' actions could be observed over a period of time, but this was not attempted due to time constraints and monitoring difficulties. The behaviour reported in this paper may, therefore, be intentional rather than actual behaviour.

3. Results

3.1. Perception of the water situation in 2006

The respondents in the Sevenoaks District were significantly more likely to give the seriousness of the

water situation a higher rating than those from St Edmundsbury ($p = 0.005$; see Figure 2), which is consistent with the EA's scientific assessment. In response to an open question, the respondents mainly attributed the water shortages of 2006 to reduced rainfall (64 per cent). Other reasons included leaks from main water pipes (20 per cent), poor storage facilities (8 per cent), increased housing developments (5 per cent) and increased demand (3 per cent). The results did not vary significantly between the regions.

In the focus group, reasons given for the water shortages in 2006 ranged from a lack of rainfall, overconsumption by the public and increased demand due to more housing. The participants in Otford mentioned leaking pipes as a contributing factor while those in Horringer identified privatization of water companies. The general comments about the risks posed by the water shortages in England were that, compared to water shortages in other countries, they were more of an inconvenience than a serious problem. The reasons expressed for future droughts echoed the reasons given for the water shortages in 2006, although climate change was also mentioned by a couple of participants.

3.2. Information

The most common sources from which survey respondents obtained information about the water situation in 2006 were television, newspapers and radio, with only 8 per cent of people naming water companies (Figure 3). No one

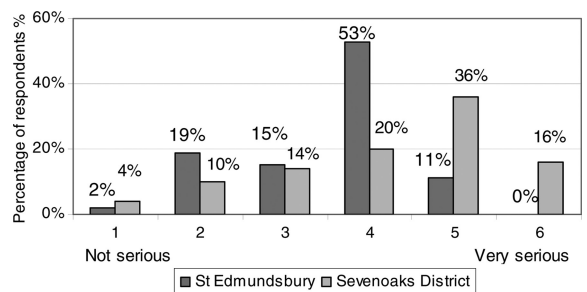


FIGURE 2 Respondents' opinions of the seriousness of the water situation in their locality in 2006. The scale used is from 1 (not serious) to 6 (very serious)

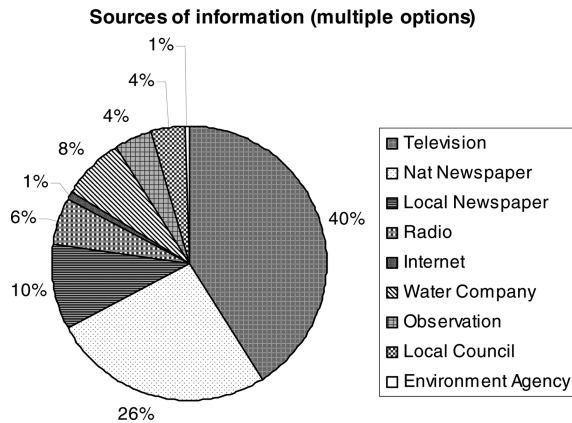


FIGURE 3 Sources of information for the water situation of 2006

from the focus groups recalled seeing anything from the water companies. The media campaign in 2006 did increase people’s awareness of the importance of water conservation.

JSO: ‘Yes, I do try and make a conscious decision about the water we are using. I would probably not have thought about it but because of the advertising campaign and the awareness of it because of the water shortages.’

Survey respondents rated the reliability of various sources of information, where 1 was not very reliable and 6 very reliable. Average rankings of the sources in order of most trusted to least trusted were as follows:

1. The Environment Agency ($M = 4.3, \sigma = 1.24$).
2. OFWAT¹ ($M = 4.1, \sigma = 1.37$) and environment organizations ($M = 4.1, \sigma = 1.27$).
3. Broadsheets ($M = 4.0, \sigma = 1.28$) and radio ($M = 4.0, \sigma = 1.15$).
4. Television ($M = 3.9, \sigma = 1.21$).
5. Internet ($M = 3.7, \sigma = 1.30$).
6. Government ($M = 3.5, \sigma = 1.36$).
7. Water companies ($M = 3.3, \sigma = 1.32$).
8. Friends ($M = 3.0, \sigma = 1.20$).
9. Tabloids ($M = 2.8, \sigma = 1.29$).

Although the EA was recognized as the most reliable source of information, it was the source

that was consulted the least for information regarding the drought of 2006, at least directly. Information from the EA was printed in newspapers and on news websites during the 2006 period. Focus group participants agreed that they were sceptical of information they received from water companies and the government.

SSO: ‘I think you are probably more likely to trust something you hear on the news than the company’s own literature.’

The conflicting information in the media also served to confuse participants and resulted in scepticism.

SBE ‘How do we get to know whether there is actually a threat of water shortages. We started off talking about information which we do not totally trust but you do read different opinions from different people...’

3.3. Behaviour

Survey respondents were aware of which activities use the most water in the home. Most people (62 per cent) did alter their behaviour to conserve more water during 2006 (Table 4). The practices identified by respondents were similar to those mentioned in the *Beat the Drought* campaign, such as shower instead of bath, use washing machines and dishwashers with a full load, etc. (OFWAT, 2006).

TABLE 4 Water conservation practices that respondents undertook during 2006

If you did change your practices to conserve water, what did you do? (open question)	%age of times practice mentioned
Used grey water to water the garden	14
Obtained a water butt	13
Did not leave taps running	13
Showered instead of bathed	12
Used the washing machine only when it was full	12
Took shorter showers	7

Of the 62 per cent who did change their practices, 81 per cent are still undertaking these practices. Of the 38 per cent who did not change, 82 per cent claimed to already engage in water conservation practices in their homes. Significantly more respondents in the Sevenoaks District as compared to St Edmundsbury claimed to have changed their behaviour to conserve water during 2006 (chi-square test for association: $df = 1$, $p = 0.001$, $\chi^2 = 11.546$). A positive correlation was found between respondents changing practices and how serious respondents believed the water shortages were ($p = 0.000$).

In terms of future water conservation, grey water recycling was mentioned most often when asked about what activities could be undertaken if water shortages were to become more common. Rainwater harvesting, compulsory metering and compulsory fitting of dual flush toilets were also cited. The main reasons given for not undertaking the various activities identified in the future were expense and lack of equipment, although 18 per cent of respondents admitted that nothing was preventing them.

When discussing what could be done to adapt to or mitigate water shortages if they became more prevalent, both focus groups first suggested installing dual flush toilets. Using grey water for the garden was also seen as a good concept; however, participants were unwilling to install recycling systems if they were complicated or expensive.

YBE: 'The water that comes out the bath and the shower we ought to be able to collect that and use that to water the garden... the only gadgets I have seen are terribly complicated ... we (need) something that is easy, then people would use it.'

Other methods to mitigate water shortages included a national water grid and desalination.

JSO: 'Get a water pipe from the north.'

ASO: 'That is right a national grid like electricity... I think that is a good idea.'

3.4. Responsibility and service

The majority of survey respondents believe that the responsibility of water resource management lies with water companies. Almost half of the survey respondents and the majority of focus group participants think the responsibility should lie with the government (Table 5). Overwhelmingly, participants were annoyed at the privatization of water.

YBE: 'In my opinion the supply of water should be a matter for central government. It should never have been privatized... But given that it is now privatized it still seems to be to me the responsibility of central government to see that there is adequate supply provided by private companies and to ensure it is kept up to snuff...'

Very few survey respondents saw individuals as responsible for managing water resources. Focus group participants were ambivalent about their actions making a difference. Participants agreed that the actions, when combined, would have an effect.

TBE: 'Well you know, the average family if there is one, when talking about their water and turning the tap off when they brush their

TABLE 5 Responsibility for water resource management (open question)

	Who is responsible for managing water resources? (%)	Who should be responsible for managing water resources? (%)
Private water companies	42	11
The government	14	46
Do not know	20	14
The Environment Agency	11	18
OFWAT	10	3
Individuals	3	4
Other	2	3

teeth, that does not make a lot of difference at all but when you multiply it by thousands it starts to add up.'

Overall, however, they felt powerless in the face of high levels of leakage that water companies seemingly fail to address and the lack of government legislation on the issue of water conservation. The consensus was that although most participants felt an obligation to act, the water companies and government should set the example first.

KBE: 'I think we are all fairly conscious of it in the back of our minds, I think we all turn the tap off when we are brushing our teeth and we don't use too much water when watering the garden but how much further do you take it before it filters through from higher powers...'

Overall, the majority of survey respondents rated the service they had received from their water companies as good (a rating of 4 out of 6 where 1 = poor and 4 = excellent). Trustworthiness of water companies was more divided, with just under half respondents giving the lower ratings of 3 and below and just over half giving ratings of 4–6 (1 = low and 6 = high). There was no significant difference here between the two regions.

3.5. Demand

In response to an open question, people from both regions cited domestic users as primary agents in increasing water demand in their area most often. In order of frequency cited, agricultural demand (17 per cent), growing populations (11 per cent) and increased housing (11 per cent) were also recognized. Focus group participants linked increases in domestic demand for water with the increase in houses being built and people's consumptive lifestyles.

NBE: 'In our village... there are more and more... houses. There are four of us in our house my wife myself and our two kids and the water consumption we go through with our garden, hanging baskets or watering the garden or splash balls, and that is just us and

if that is multiplied by all. I think the demand must be so great.'

There was a general consensus among participants that domestic demand could be better regulated by improved legislation on the water efficiency of newly built houses.

NBE: 'Why can't they pin this on the construction industry and say there is water saving and this is what you have got to do.'

Survey respondents were asked to rank nine factors that could contribute to future water shortages. The overall rankings given in descending order of perceived responsibility were as follows:

1. Poor management by water companies ($M = 2.50$, $\sigma = 1.89$).
2. Badly managed by consumers ($M = 4.10$, $\sigma = 1.96$).
3. Poor government policy regarding water ($M = 4.30$, $\sigma = 2.20$).
4. Too many new houses being built ($M = 4.60$, $\sigma = 2.58$).
- 5/6. Related to climate change ($M = 4.70$, $\sigma = 2.61$) and a variable rainfall year, unrelated to climate change (and $M = 4.70$, $\sigma = 2.60$).
7. Privatization of water companies ($M = 5.40$, $\sigma = 2.64$).
8. Too much used in industry ($M = 6.1$, $\sigma = 1.91$).
9. Farmers use too much ($M = 7.6$, $\sigma = 1.67$).

A correlation was found between level of trust in the water company and citing poor management by water companies as the main factor contributing to future droughts ($p = 0.049$).

3.6. Water pricing and restrictions

The majority of survey respondents (65 per cent) thought the price they pay for water is fair. The average cost of water cited by respondents in St Edmundsbury was slightly lower than the average combined water and sewerage bill there, and in the Sevenoaks District the average given by respondents was higher than

the average water bill (Table 6). Respondents were overestimating the cost of water per litre by three orders of magnitude (more so in St Edmundsbury than in Sevenoaks District). There is no correlation between what respondents report as the cost of water per litre and their average annual water bills. Domestic consumers in the UK use an average of 151 litres per capita per day (EA, 2007a, p. 10). By inference of the fact that they are overestimating the cost per litre, they are vastly underestimating the volume of water used. Most of our respondents understood their total annual water monetary costs.

The inconsistencies between the cost of water and annual water bills cited by respondents indicate that respondents are unaware of the amount of water they consume daily. In the focus group, not one participant knew how much they paid for water. Water consumption practices are so closely tied to other activities such as cooking that the habitual nature of these tasks may render the use of water invisible. Furthermore,

TABLE 6 Average annual water bill and cost of water per litre cited by respondents as compared to regional averages

Region	Average annual water and sewerage bill	Average annual water bill	Average annual cost cited in survey	Standard deviation
St Edmundsbury	£318.00	£141.00	£292.10	£134.31
Sevenoaks District	£310.00	£156.00	£188.24	£89.47
		Average cost of water per litre	Average cost of water per litre cited in survey	
St Edmundsbury		0.001p	5.61p	9.42
Sevenoaks District		0.001p	2.17p	5.50

Data: OFWAT (2006, 2007).

household water consumption occurs as a consequence of accomplishing different types of practices rather than for its own sake; this may influence the amount of water people perceive they use (Medd and Shrove, 2005). Both these factors could partially account for the lack of awareness (cf. UKWIR, 2007).

Respondents' willingness to pay or accept restrictions was explored in a series of four questions (Table 7). The data were analysed using Newcombe's method for paired samples (Newcombe, 1998, 2000). The results reveal that environmental demand for water is an important factor in the perceived acceptability of water restrictions or increased cost of water. Respondents are more willing to accept restrictions or an increase in costs to protect the environment and deal with the impacts of climate change than for the maintenance of infrastructure or to support the building of homes². They were least inclined to accept restrictions in water use or increased payment to support the building of new homes. With the proposal to build 28,900 new dwellings in the southeast where water resources are scarce and demand is already high, the perceived acceptability of incentives to use less water is important. Our respondents were more prepared to accept restrictions under all four scenarios than to accept an increase in cost of water ($p = -0.0985$, 95 per cent CI: -0.1426 to -0.0538). Given the potential physical limits of securing more water for the southeast, this is an important finding.

The focus group participants were generally against increasing the price of water as a disincentive for overuse. One reason for this was a lack of equity.

ABE: 'It will hit the parents of the children who can't afford it.'

RSO: 'For lots of people in the southeast money is not really an issue for them. ... (people here think), well, so a hundred extra quid (£100) a month.'

Leaking pipes were another reason why participants were reluctant to pay more for water.

TABLE 7 Respondents' willingness to pay or accept water restrictions under various scenarios

Given that the government plans to build 23,900 and 28,900 new homes per annum in the Anglian and southern regions, respectively, would you			
pay more to ensure there is enough water for everyone?		accept more frequent water restrictions to ensure there is enough water for everyone?	
Yes	No	Yes	No
31%	69%	53%	47%
Given the Water Framework Directive calls for more water to be kept to protect the natural environment, would you			
pay more to ensure there is enough water for the environment?		accept more frequent water restrictions to ensure there is enough water for the environment?	
Yes	No	Yes	No
65%	35%	77%	23%
Given models for climate change predict drier summers and increased frequency of water shortages, would you			
pay more to ensure there is enough water for everyone?		accept more frequent water restrictions to ensure there is enough water for everyone?	
Yes	No	Yes	No
58%	42%	75%	25%
Given that the infrastructure for the provision of water may need repairing and continued maintenance, would you			
pay more to ensure this is done?		accept more frequent water restrictions to ensure peak demand and therefore peaks of leakage is decreased?	
Yes	No	Yes	No
53%	47%	65%	35%

Participants were generally disgruntled at the perceived disjuncture between a lack of investment in infrastructure by water companies and the large bonuses paid to employees. Participants did suggest a willingness to pay more if the

water companies first showed they were investing in the infrastructure. Water companies may need to better communicate on how they are utilizing their financial resources.

The restrictions during 2006 did lead to people being more aware of the amount of water they used. However in Horringer, where there were no restrictions, a minority opinion was that since there was no ban there was a plentiful supply of water.

TBE: 'I remember my wife saying to me: turn that tap down as you clean your teeth. I said I have a water meter, I am paying for it and there is not a ban. And there wasn't. There was plenty of water.'

3.7. Perceptions of climate change

Generally, respondents believe that the rainfall in their area remains unchanged (48 per cent). The majority of people have noticed changes in the pattern of seasons, with milder winters and an increase in water shortages (Table 8).

Significantly more respondents in the Sevenoaks District, as compared with St Edmundsbury, noticed more water shortages (chi-squared test for association: $df = 2, p = 0.0015, \chi^2 = 11.558$). This is expected since the drought was more severe in the Sevenoaks District with restrictions in place. People's awareness of water shortages or their understanding of the impacts of climate change seems to have little bearing on their willingness to accept incentives to use less water. No statistically significant relationship was found between people noticing more water shortages and their willingness to pay more for

TABLE 8 Respondents' perceptions of changes in the weather and water shortages

Have you noticed the following (closed question)	Yes (%)	No (%)	Don't know (%)
Changes in the pattern of seasons	80	16	4
Milder winters	87	7	6
More water shortages	57	35	8

water ($df = 2$, $p = 0.320$, $\chi^2 = 0.958$) or accept water restrictions to mitigate the effects of climate change ($df = 2$, $p = 0.131$, $\chi^2 = 2.689$). This suggests that awareness or experience of water shortages and drought does not galvanize individuals to respond to climate change (cf. Whitmarsh, 2008).

The majority of respondents believe that climate is changing (86 per cent) and that the effects of human activities cause greater changes in the climate than the natural variation that occurs (78 per cent). Their views reflect those of UK respondents in the MORI survey (2007): our respondents' understanding of the effects of climate change is consistent with the literature. However, although respondents generally rated climate change as an important issue for the UK (Figure 4), they attributed greater importance to other issues such as illegal immigration (Figure 5). This concern for other issues is in line with research by Bord et al. (1998) and Poortinga and Pidgeon (2003).

Personally respondents were 'concerned' to 'very concerned' about climate change, with over 75 per cent giving ratings of 4–6 (Figure 6). But no statistically significant correlation was found between how concerned people are about climate change and their willingness to pay more for water ($p = 0.797$) or accept water restrictions to mitigate the effects of climate change ($p = 0.701$). No correlation was found between those who cited climate change as the most important issue facing the UK and a willingness to pay more for water under conditions of climate change ($p = 0.483$). No correlation was found between

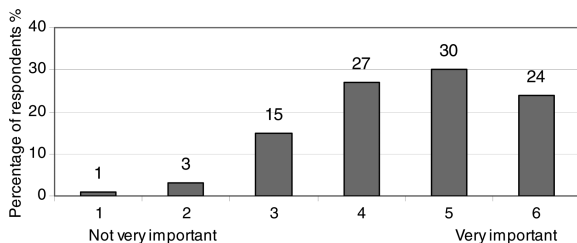


FIGURE 4 Respondents' rating of the importance of climate change in the UK. The scale used was from 1 (not very important) to 6 (very important)

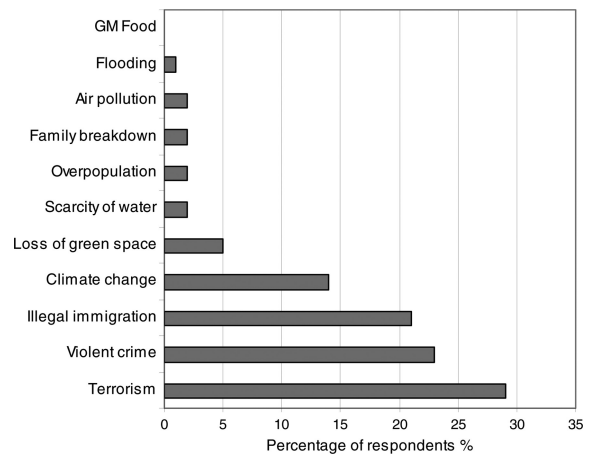


FIGURE 5 %age of respondents who gave the rating as 1 (most important) for given issues facing the UK

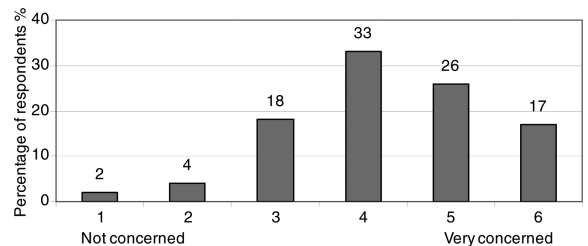


FIGURE 6 Respondents' concerns about climate change. The scale used was from 1 (unconcerned) to 6 (very concerned)

people's concern for climate change and changing water consumption practices during 2006 ($p = 0.705$). These findings indicate that people may not link changes in climate with their personal household water resource situation.

Moreover, our focus group participants were confused about the causes and impacts of climate change. The ozone layer was considered a contributing factor as were carbon emissions and industrialization of countries in the developing world. Industrialization was linked, by participants in both groups, to the consumptive lifestyles of people in developed countries.

There was also confusion about the validity of anthropogenic climate change; a few participants called it the latest 'buzz' and believed that the warmer weather was attributable to natural cycles as occurred in the past. The majority were

bewildered by the conflicting information they had read.

JSO: 'It is hard for me, I do not know enough about it maybe but you watch certain things on television or you hear certain things on the radio, everyone has conflicting ideas. Some people say yes if you look back in history it has definitely all happened before it was warm and then it cooled down again... Who do I believe, is it the big global change is this the beginning of the end or is it just part of the natural history of things?'

Participants agreed that the impacts of climate change in the UK would manifest as irregular weather patterns and more extreme weather events, such as hotter summers and more flooding. Flooding was identified more frequently than drought, but this may be due to the above average rainfall and subsequent flooding that occurred during the month in which the focus groups were conducted.

TBE: 'The one thing I don't think will happen is that it will be systematic...it will fluctuate...As people keep pointing out it will just get wetter perhaps and hotter in patches.'

4. Discussion and conclusions

This study found that the public had a good awareness of the water shortages in 2006. The public perceive water shortages to be the result of a myriad of factors, including water-intensive lifestyles, a growth in population, the increase in housing developments, leaking pipes, the privatization of water companies and a period of lower than average rainfall. The 2006 water shortages were mainly attributed to the last entry.

This awareness could be partly attributed to the publicity campaign launched by water companies and regulators. The most trusted source of information was from the regulators, in particular the EA, but these organizations were also the least sought for information on the water situation. Not one respondent cited the environment as an important element in placing demands on

water in their locality, suggesting that the EA should play a more active role in communicating environmental water demands and behaviour change to the public. By 2010 the Water Framework Directive states that water pricing must take account of the environmental costs (EA, 2007b). Our results show that when presented with a choice people may be more benevolent towards the environmental demand than the water demand due to housing development or maintenance of supply-side infrastructure. The role of the environment in water management may therefore need to be further highlighted, especially in the event of higher future water bills, to ensure public support and compliance. Because the EA received the highest rating for providing reliable information, it may be the EA who is best placed for this communication role.

We found a noteworthy lack of awareness of the cost and quantity of water used among the public. Habituation makes water consumption practices less visible to conscious deliberation, which may partially account for this lack of awareness. The comparison between the two regions demonstrated that experiencing drought and water restrictions elevated people's perception of the seriousness of the water situation and instigated behavioural change to conserve water during the drought. This finding is in line with the hypothesis introduced in Section 2.1 that experiencing drought and water restrictions should lead to behavioural change. Compared with St Edmundsbury, significantly more respondents in the Sevenoaks District noticed the water shortages and claimed to have changed their behaviour to conserve water. People's awareness of water shortages or their understanding of the impacts of climate change seems to have little bearing on their willingness to accept incentives to use less water in both regions under various scenarios. One might expect that the Sevenoaks District respondents would be more inclined to reduce their water consumption outside drought periods than St Edmundsbury respondents given their experience of drought and restrictions, but we did not find any significant difference between the regions. The regional comparison demonstrated

that experiencing drought and restrictions can lead to short-term behavioural change (temporary in nature) but not long-term behavioural change.

These findings suggest that the public is indeed willing to change its behaviour when droughts can be observed or communicated effectively. This may provide some relief to water managers and policy makers seeking to manage near-term droughts. As the last three summers have demonstrated (2007–2009 were particularly wet), natural climate variability may dominate future drought intensity and frequency before anthropogenic climate change can be discerned from the noise. This poses a difficult challenge to science communicators aiming to gather public support for long-term water resources plans that are likely to increase water prices.

Our results showed that the public is willing to accept more frequent water restrictions compared to paying more for water under a number of scenarios. This demonstrates that policy makers may want to implement water restrictions more frequently despite concerns by water companies and the EA that the application of non-essential water use bans will be perceived by customers to be a result of poor water management (CBEA, 2007; LBAW, 2007). Effective communication with the public is a key issue here.

Water demand and consumption was not linked explicitly by our respondents to contributing to climate change. This is demonstrated by the fact that water transfers and desalination were discussed at length in the focus groups and mentioned on the questionnaires as methods to deal with water shortages. National water transfers and desalination are energy intensive in terms of both their construction and operation. The links between environmental spheres need to be made more visible. A lack of knowledge about the integration of different spheres may create a barrier to engaging with climate change. Demand management generally results in lower energy use and has the potential to reduce carbon emissions and energy pressures in the future (EA, 2006c).

An increase in drought events was recognized as a possible impact of climate change. There was, however, no correlation between concern

about climate change and a willingness to reduce water consumption behaviour. Barriers to continued active engagement with water conservation and climate change include the following.

At the informational level:

- A lack of accessible information on environmental demand for water from a credible source.
- A lack of understanding of the factors causing climate change.
- A lack of knowledge of the interaction of the different environmental spheres.

At the social level:

- A lack of resources. Future research should look at acceptability of grey water to understand the concerns that people have.
- Habitual behaviour.

At the institutional level:

- A lack of understanding between the water industry and the public. Flexible restrictions need to be researched further to understand the concerns that various stakeholders have and their partiality to management options.
- A perceived lack of political will to engage in water conservation. People do not perceive the government or water companies to be exemplifying good water management practice. The government should take a strong leadership role in mitigating impacts of future water shortages to encourage the public to follow.

There was a lack of congruity between people's concerns about the risks of climate change and recognition of warmer, drier summers and their unwillingness to accept measures to mitigate the impacts of climate change that would impinge on their finances or current practices. The lack of desire to change water consumption behaviour to mitigate the effects of climate change may be because the water resources in the home are not directly associated with changes in climate. These results are consistent with those from Whitmarsh

TABLE 9 Summary findings that help or hinder long-term water management

Findings that help long-term water management	Findings that hinder long-term water management
Public behaviour can be influenced by effective communication. The Environment Agency is a trusted source of information.	Water companies are not a trusted source of information. The perception that water companies' poor management is the major contributor to current and future water shortages.
Consumers are more willing to change their behaviour to protect the environment.	Consumers are less inclined to change their behaviour to ensure there is enough water for housing developments or maintenance of supply-side infrastructure.
Consumers are willing to change their behaviour if a threat is obvious.	Long-term behaviour change is not perceived as necessary by consumers.
Consumers recognize that more frequent water shortages are a possible outcome of climate change.	There is a lack of knowledge with regard to the integration between small-scale water use (i.e. in the home) and larger-scale environmental issues.
Consumers are more willing to accept water restrictions than price increases.	Consumers blame, in part, their lack of action to reduce water usage on a lack of resources.
Grey water recycling is viewed as an acceptable method to employ in the event of water shortages.	Consumers do not know how much water they use, nor the cost of water.
	Lack of information.
	Perceived lack of institutional engagement and leadership by water companies and government.
	Most water use is habitual and therefore invisible to consumers.
	Perceived inequity of price increases.
	Confusion about the causes and impacts of climate change.

(2008), who found that flood victims view climate change and flooding as largely separate issues. The risks posed by climate change to water resources may need to be more clearly communicated, highlighting the integration of the weather system, the water cycle, energy and domestic water resources.

Table 9 summarizes the implications of our findings for long-term water management. Notwithstanding a small and somewhat unrepresentative sample, overall our results suggest that people are inclined to take action to adapt to an immediate threat to water availability, such as occurred in 2006, but are disinclined to accept measures that mitigate the long-term impacts of climate change on water resources. People do not appear to link water resource use in the home with larger-scale environmental issues such as climate change.

This represents a serious challenge for this region if successful adaptation to climate change is to be achieved in the future. Further research

into people's perceptions of drought and climate change, drawing on the insights from this research, would serve to confirm our understanding of the barriers and incentives to active engagement in sustainable water management.

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Note

1. The Water Services Regulation Authority (OFWAT) is the economic regulator of the water and sewerage industry in England and Wales.

2. Respondents willingness to pay or accept water restrictions under various scenarios using Newcombe's method for paired samples

Payment	Restrictions	Protect Environment	Maintain infrastructure	Support construction of new homes	Climate change impacts	ρ number	Confidence interval
×		×	×			$\rho = -0.0900$ 99%	CI: -0.2066 to 0.0304
×		×		×		$\rho = 0.0200$ 99%	CI: -0.0840 to 0.1233
×			×		×	$\rho = -0.0550$ 99%	CI: -0.1776 to 0.0700
×				×	×	$\rho = 0.0550$ 95%	CI: -0.0546 to 0.1625
×			×	×		$\rho = 0.0800$ 99%	CI: -0.0613 to 0.2173
	×	×	×			$\rho = -0.2100$ 99%	CI: -0.3196 to -0.0921
	×	×		×		$\rho = -0.1500$ 95%	CI: -0.2310 to -0.0656
	×		×		×	$\rho = -0.2000$ 95%	CI: -0.3116 to -0.0802
	×			×	×	$\rho = -0.1400$ 95%	CI: -0.2226 to -0.0542
	×		×	×		$\rho = -0.0900$ 99%	CI: -0.2210 to 0.0453

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