Community knowledge about water and engagement in waterway protection in south east Queensland

Abstract

Protecting waterway health requires active community support where individuals act to protect waterways and support new policies or investment. A critical first step in engaging with communities is to identify community knowledge about water. This study examined water-related knowledge using a survey of 807 residents of south east Queensland. This knowledge was assessed by 15 questions on the impact of household activities on waterways, the urban water cycle and water management. Engagement in waterway protection was assessed via household pollution-reduction behaviours, support for raingardens, and willingness to pay for waterway protection. Findings suggest that while most people know that household actions influence the health of waterways, less than one third understand that stormwater is not treated before entering waterways. Greater knowledge was associated with greater uptake of pollution-reduction behaviours, greater support for water sensitive urban design (raingardens) and greater willingness to pay for waterway protection. These findings highlight both the importance of water-related knowledge in the community and fostering that knowledge when planning community engagement that aims to change behaviour or build support for integrated water management initiatives.

Keywords: citizenship, behaviour, sustainable urban water management, policy support, water sensitive, community engagement, water quality, stormwater pollution

Introduction

Water quality in Moreton Bay is influenced by diverse land-use practices across its upper and lower catchments. Increasing urbanisation, and the accompanying increase in the area of impervious surfaces across urban catchments, increases flow of stormwater pollutants into waterways and coastal areas. This has adverse effects on water quality. Urban stormwater pollutants include heavy metals, nutrients, sediment, pathogens and gross pollutants such as plastics (1-4).

It is increasingly recognised that urban water management paradigms must address environmental outcomes. These approaches are variously referred to as ‘integrated urban water management’, ‘sustainable urban water management’, ‘water-sensitive cities’, or ‘total water cycle management’ (5, 6). Within these frameworks, water management goals extend beyond ensuring water supply and sanitation to include enhancing waterway health. To achieve positive environmental outcomes, stormwater pollutants that degrade waterways and coastal ecosystems must be managed effectively (2, 7).

Pursuing waterway health within sustainable urban water management requires diverse solutions that span new technologies, investment approaches and policies (5, 6, 8). For example, water sensitive urban design initiatives — also referred to as green infrastructure — involve installing biofiltration systems within urban environments. Biofiltration systems such as raingardens or wetlands can reduce stormwater flows and reduce stormwater pollutant loads (6, 7). In order to improve outcomes, some argue that new approaches to water management must also consider the sociocultural context in which these solutions are implemented (9). An important element of any strategy to manage stormwater pollution is building community support and acceptance of changes in policy, practice and technology (6, 9, 10). Therefore, a critical element of promoting waterway health is fostering an engaged citizenry. Engagement in water-related issues is multifaceted and incorporates (i) cognitive engagement – knowledge and awareness, (ii) emotional engagement – concern and supportive attitudes, and (iii) behavioural engagement – adoption of civic and household behaviours that promote sustainable water management (9). Within this framework, engaged citizens are those that understand, value and actively support the necessary changes in technology, investment and policies associated with sustainable water management.

Community actions have a significant impact on water demand, water quality, and potentially, the political will of governments to make significant changes to water policy and infrastructure (11). Community opposition to potable recycled water initiatives and the subsequent derailing of recycled water schemes (12) illustrates the importance of fostering community support for new water schemes. Much research has examined the determinants and importance of pro-environmental attitudes and behaviours in the community (13-15). Even though knowledge is considered a necessary precursor to environmentally friendly behaviour, there is relatively less research assessing that community knowledge. Therefore, the aim of this study was to assess water-related knowledge of south east Queensland residents, examine social factors associated with this knowledge, and explore the relationship between knowledge and support for sustainable urban water management initiatives relevant to water quality in Moreton Bay and the waterways of south east Queensland.

The role of water-related knowledge

Knowledge and understanding of water issues in the community are considered essential ingredients for solving water-related problems. There are several types of knowledge of particular relevance here: declarative knowledge, which refers to general awareness about an issue; procedural knowledge, which encompasses how to achieve a particular goal; and effectiveness knowledge, referring to understanding the relative effectiveness of different actions (16). Some researchers argue that knowledge is a core component of water-related engagement (9), environmental citizenship (17, 18) and environmental literacy (19).'Water literacy' integrates knowledge about water with the capacity to apply this knowledge to decision making (20). The emerging emphasis on sustainable water management suggests that important areas of water knowledge for individuals should include the urban water cycle and impacts of urbanisation on waterway health via stormwater pollution, in addition to issues related to water demand, supply and treatment (6). Assessing community knowledge about water is important for a number of reasons. Community engagement initiatives are thought to be more effective when targeted to, and aligned with, existing knowledge within the community (21, 22). In addition, identifying strengths and weaknesses in community knowledge about water provides an important foundation for initiatives that aim to increase community knowledge.

Research about determinants of environmental behaviour highlights the importance of knowledge, suggesting that knowledge is a necessary, although not sufficient, ingredient to influence behaviour (16). Knowledge is one of many factors that can influence diverse pro-environmental behaviours (11, 23, 24); others include demographics, social context, psychological factors (e.g. environmental identity, social norms and values) and economic factors (e.g. pricing schemes) (11, 14, 25, 26). Research also highlights the importance of knowledge as a component of building community support for policies related to water conservation (27), waterway protection (28-30), water sensitive urban design (31) and alternative water sources (32).

The current study

Existing research suggests that community knowledge about water management may be poor, both among south east Queensland (SEQ) residents (33) and at a national level (34). Despite the important role that knowledge may play in driving water-related behaviour change or policy support, there is scant research focusing on water-related knowledge and its relationship with outcomes such as adopting individual behaviours or support for policies related to waterway health. A sample of adults residing in SEQ was surveyed to gauge community knowledge about water-related issues and assess support for water-related policies and adoption of behaviours related to water quality.

Specifically, this chapter will address the following questions: (i) how does knowledge vary across different water-related issues, (ii) what characteristics are associated with water-related knowledge, and (iii) is water-related knowledge associated with individual behaviours and support for policies related to waterway health? Taken together, the findings will identify strengths and weaknesses in water-related knowledge, and enable water practitioners to more effectively design and target a range of engagement initiatives, from information campaigns to participatory initiatives.

Methods

Participants and procedure

A total of 807 adults in SEQ were recruited (as part of a larger study of Australian residents, N=5194) using an online panel provided by a social research company. All eligible panel members were invited to participate via email and offered the standard compensation (points and entry into a bimonthly cash prize draw). The 25-minute, online survey was administered during February–March 2014. Institutional ethical clearance was obtained prior to study commencement.

Measurement of water-related knowledge

Water-related knowledge was assessed using 15 items about the influence of household activities on water quality, catchments and the urban water cycle, and water treatment (Table 1). These items were adapted from a previous study (33) that included items based on what Australian water professionals identified as important for individuals to know about water. Fourteen items were rated on a 5-point Likert scale (1=*strongly disagree* to 5=*strongly agree*). A *don't know* option was also included. Eight items were framed such that the correct response was *agree/strongly agree*; six items were worded such that the correct response was *disagree/strongly disagree*. Neutral responses (*don't know* or *neither disagree nor agree*) were coded as incorrect. Finally, one item used a multiple-choice response: 'Which of the following options best represents your understanding of what a catchment is?' Response options were: (a) The area that retains water like a wetland or a marsh, (b) All of the land area that drains to a specific river or waterway (*correct*), (c) A reservoir that serves as a water source, (d) A small building where water is stored, (e) None of these, and (f) Don't know. A water knowledge index was calculated based on the number of correct responses (range 0–15).

Participant characteristics

The survey also measured the following factors (see full report for details (34)):

- socio-demographics, cultural background, and household characteristics
- information about water – recent sources of information about water (9 items)
- experience of water restrictions and whether behaviour had changed during restrictions (2 items)
- waterway use – frequency of local waterway use for diverse social activities (14 items)
- social capital – membership or participation in community organisations (11 items)
- household environmental identity – the degree to which the respondents see their household as environmentally sustainable (3 items).

The full methodology is reported elsewhere (34).

Measures of support for pollution-reduction behaviours and policies

Three variables were created that assessed respondents' engagement in pollution-reduction behaviours and support for policies related to water quality:

- *pollution-reduction behaviours* – mean frequency of performing seven pollution reduction behaviours (e.g. preventing animal waste from entering waterways, putting rubbish in the bin) (range 1–5, Cronbach's $\alpha=0.69$)
- *support for raingardens* (definition provided) – willingness to install a raingarden on their property (yes/no), and support a raingarden in their street (yes/no)
- *willingness to pay for waterway protection* – amount willing to pay in their household rates to improve health of their local waterways such as creeks, rivers and bays (coded as willing yes/no).

Statistical analysis

Predictors of water-related knowledge and the relationship between water-related knowledge and pollution-related behaviours and policy support were identified using linear regression for continuous dependent variables (knowledge, pollution-reduction behaviours) and logistic regression models for dichotomous dependent variables (support for raingardens, willingness to pay for waterway protection). The initial stage of analysis examined determinants of water-related knowledge using linear regression analysis. All demographic, household and geographic characteristics, water information sources, life experience and psychosocial factors were included as independent variables. No interactions were examined. The second stage of analysis examined whether water-related knowledge was associated with the following: (i) uptake of pollution-reduction behaviours, (ii) support for raingardens, and (iii) willingness to pay for waterway protection. For each outcome a stepped regression analysis was conducted:

- Step 1 quantified the unadjusted influence of knowledge on each outcome
- Step 2 adjusted for socio-demographics (age, sex and education, income and home ownership)
- Step 3 adjusted for socio-demographics plus social capital, waterway use, environmental identity and information exposure.

Where analysis examined a binary outcome (i.e. for support for raingardens and willingness to pay for waterway protection), logistic regression was used. This generates an odds ratio as a measure of association between knowledge and the outcome of interest. All models were checked to ensure assumptions of normality and homogeneity were met.

Results

Participant characteristics

The mean age of respondents (N=807) was 48.7±16.2 years, and 55.1% were female. The majority of respondents lived in urban centres (90.1%), had qualifications beyond high school (65.2%) and were employed (50.6%). The most commonly cited sources of water-related information were water utility bills (25.0%) and television (25.0%). Approximately half the sample (50.7%) reported no exposure to water-related information in the previous six months.

Water-related knowledge

The mean number of questions answered correctly was 8.66 (SD=3.84, range 0–15, 8.66 is equivalent to a score of 58%). One in four respondents (n=202) scored 80% or above, and only 1.9% of respondents (n=15) answered all items correctly. More than three-quarters of respondents knew that household actions can reduce urban water use and influence the health of waterways, whereas only about one-third correctly identified that domestic wastewater is treated prior to entering waterways, that urban stormwater is not treated and that these are carried via different pipes (Table 1).

Table 1. South East Queensland residents were provided with the following statements about water management and asked to rate their agreement with each statement on a 5-point scale, as an indicator of water-related knowledge. Most items were worded

such that the correct response was ‘agree’ or ‘strongly agree’. Items 6, 9, 13, 14 and 15 were worded so that the correct response was ‘disagree’ or ‘strongly disagree’. Item 10 was a multiple choice question.

	Knowledge statements	**% Correct (n)**
1.	Water conservation actions by householders can significantly reduce the amount of water used in urban areas	79.2% (639)
2.	What individual residents do in their home and garden has consequences for the health of waterways and coastal bays	75.5% (609)
3.	Planting native plants along a waterway’s bank improves the health of waterways	73.1% (590)
4.	The fertilisers that individual householders use in their garden can have a negative impact on the health of waterways	72.6% (586)
5.	Waterways can be damaged by stormwater flows	71.6% (578)
6.	Soil erosion from urban areas does not affect the health of waterways *	66.8% (539)
7.	The pesticides that individual householders use in their garden have no negative impact on the health of waterways *	63.3% (511)
8.	I know where my household drinking water comes from (e.g. dam, groundwater, desalinated water etc.)	61.8% (499)
9.	Waterways can cope easily with large amounts of sediment (i.e. eroded soil suspended in the water) *	57.2% (462)
10.	A catchment is the total land area draining to a specific waterway **	55.9% (451)
11.	I know what catchment my household is part of	40.5% (327)
12.	The amount of water available for use is finite	39.5% (319)
13.	Stormwater from roofs and roads is treated to remove pollutants before entering the waterways *	36.1% (291)
14.	Domestic wastewater and stormwater are carried through the same pipes *	34.0% (274)
15.	Wastewater from domestic bathrooms and laundries receives little or no treatment before entering waterways *	27.6% (123)

** multiple-choice question* reverse scored items where the correct response is *disagree* or *strongly disagree*

Factors associated with water-related knowledge

Regression analysis indicated that water-related knowledge was higher in males ($p<0.01$), older respondents ($p<0.001$) and in those currently studying ($p<0.01$) or with greater education ($p<0.01$) (Table 2). A northwest European ancestry ($p<0.05$) was associated with greater water-related knowledge, whereas speaking a language other than English at home ($p<0.001$) was associated with lower water-related knowledge. Those renting accommodation exhibited poorer water-related knowledge ($p<0.05$).

Higher levels of water-related knowledge were associated with experience of water restrictions ($p<0.001$), social capital ($p<0.05$) and household environmental identity ($p<0.001$). Respondents reporting more sources of water-related information in the previous six months also reported greater water-related knowledge ($p<0.01$) (Table 2).

Table 2. Regression model examining what individual characteristics are significantly associated with water-related knowledge (R^2=0.33).

	Nonstandardised coefficient (B)±SE	95% confidence interval	t	Standardised coefficient
Age	0.85±0.16	0.54, 1.15	5.44	**0.22** ***
Sex (male)	0.90±0.26	0.39, 1.41	3.49	**0.12** **
Education	0.44±0.17	0.12, 0.77	2.68	**0.09** **
Currently studying	–0.45±0.15	–0.75, –0.15	–2.93	**–0.10** **
Unemployed	0.00±0.16	–0.25, 0.26	0.03	0
Household income	0.02±0.14	–0.26, 0.30	0.17	0.01
Language other than English at home	0.55±0.15	0.25, 0.85	3.59	**0.12** ***
Northwest European ancestry	–0.33±0.13	–0.59, –0.06	–2.44	**–0.09** *
Currently renting	–0.31±0.13	–0.57, –0.05	–2.38	**–0.09** *
House with garden	0.11±0.13	–0.15, 0.36	0.81	0.03
Waterway use	0.10±0.1\5	–0.20, 0.40	0.65	0.02
Experienced water restrictions	–0.67±0.16	–0.96, –0.37	–4.45	**–0.15** ***
Social capital	0.32±0.16	0.01, 0.63	2.01	**0.07** *
Environmental identity	1.03±0.14	0.76, 1.30	7.52	**0.26** ***
Information exposure	0.33±0.13	0.08, 0.58	2.63	**0.09** **

† For significant findings, a positive coefficient reflects a positive association between the ‘predictor’ variable and water-related knowledge. Conversely, a negative coefficient reflects a negative association between the ‘predictor’ variable and water-related knowledge $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Significant findings are highlights in bold.

Pollution reduction behaviours

The most frequently endorsed pollution reduction behaviours were ‘putting rubbish in the bin’, 89% of respondents indicated they always did this, followed by keeping the car well maintained (58.1% responded ‘always’) and disposing of chemicals through council transfer stations (41.8% ‘always’). Water-related knowledge was significantly associated with uptake of pollution reduction behaviours (p<0.001), even after controlling for socio-demographics and psychosocial factors (Table 3).

Willingness to support raingardens

One-third of respondents (33.2%, 268/807) indicated that they would be willing to install a raingarden on their property, and more than half (56.6%, 457/807) indicated that they would support the installation of a raingarden on their street. Water-related knowledge was associated with a significant increase in the likelihood of supporting private (p<0.001) or public (p<0.001) raingardens (Table 3).

Willingness to pay for waterway protection

One-third of respondents (33.2%, 268/807) indicated that they would be willing to pay higher rates for waterway protection. Water-related knowledge was associated with a greater willingness to pay for waterway protection at all model steps (p<0.001) (Table 3).

Table 3. Association between water-related knowledge and key outcomes of interest (pollution-reduction behaviours and support for initiatives that promote water quality).

	Pollution-reduction behaviours		Support for raingardens in home		Support for raingardens in street		Willing to pay for waterway protection	
Step	**β**	**R 2**	**Odds ratio**	**95% CI**	**Odds ratio**	**95% CI**	**Odds ratio**	**95% CI**
1	0.24 ***	0.06	1.13 ***	1.08, 1.18	1.11 ***	1.06, 1.15	1.10 ***	1.05, 1.15
2	0.22 ***	0.08	1.17 ***	1.11, 1.23	1.13 ***	1.08, 1.18	1.13 ***	1.07, 1.19
3	0.12 **	0.21	1.15 ***	1.09, 1.22	1.12 ***	1.07, 1.17	1.12 ***	1.04, 1.16

Note: Step 1 = unadjusted effect of knowledge on outcome, Step 2 = adjusted for socio-demographics (age, sex, education, income, and homeownership), Step 3 = adjusted for socio-demographics plus social capital, waterway use, environmental identity and information exposure. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. CI = confidence interval. An odds ratio greater than one indicates that the ‘predictor’ variable increases the odds of the outcome occurring. An odds ratio less than one indicates that the ‘predictor’ variable reduces the odds of the outcome occurring.

Discussion

The study describes the knowledge of SEQ residents about the region's water management and the urban water cycle, and identifies factors associated with this knowledge. The findings can inform community engagement campaigns that seek to improve knowledge about water management and waterway health. Importantly, water-related knowledge was associated with greater adoption of pollution-reduction behaviours, support for policies related to improving waterway health and reducing impact of urban stormwater pollution.

In general, the level of knowledge was low with only one-quarter of respondents correctly answering at least 80% of questions. While this is higher than the national average (34), our findings indicate that certain issues, particularly those that relate to managing urban stormwater pollution, are not well understood by the community. For example, almost two-thirds of respondents did not know that stormwater is not treated prior to entering waterways, and almost half could not correctly identify the definition for 'catchment'. Qualitative research indicates that most community members consider stormwater management to be an issue of flooding and management of excess water, rather than pollutants (35). Stormwater pollutants, especially non-visible pollutants, are not 'top of mind' for most community members (35). Engagement campaigns that seek to build community support for pollution-reduction should not assume understanding of the issue and should incorporate information about the problem and proposed solutions.

The general approach to building awareness and knowledge is through information and education campaigns. While such campaigns may generate modest increases in community awareness (36), it is important to emphasise that knowledge is not simply a result of exposure to information. Individuals with poor topic knowledge may also exhibit characteristics such as poor information-processing skills or low personal interest in the topic. These reduce the likelihood of information detection or retention. As such, engagement initiatives that provide information only and do not address the broader social context or actively target disengaged subgroups may not generate meaningful changes in behaviours or policy support (9, 37). Our findings indicate that knowledge is associated with a range of social and contextual factors. For example, participating in community organisations can generate new opportunities for information exposure or learning by observing others (referred to as 'social learning' in psychological theory) (38, 39). Information and education campaigns may be more effective if they can build on active community experience, or focus on values of the target audience (9, 40). The poor understanding of words such as 'catchment' is a reminder to minimise jargon and technical terms when engaging with communities.

Water-related knowledge was associated with a variety of behaviours and support for policies relevant to promoting waterway health. This is consistent with other research linking greater knowledge with adoption of behaviours and support for policies (11, 24, 27, 29). Knowledge has been conceptualised as a ‘necessary but not sufficient’ ingredient for behaviour change. Knowledge about how to act (procedural knowledge) or the effectiveness of actions (effectiveness knowledge) may have a stronger influence on environmental behaviour than general awareness (declarative knowledge) (16). In practice, environmental behaviours are influenced by many factors, not just issue awareness. These include: (i) costs and benefits, such as physical effort or financial impact; (ii) social factors such as values, or social norms – the accepted ‘rules’ of behaviour within a social group; (iii) emotional factors such as status; and, (iv) contextual factors such as availability of garbage bins or recycling facilities (41, 42). Effective behaviour change programs therefore should not solely rely on information, but also address the psychological factors that influence behaviour (41). Nonetheless, our findings reinforce the importance of knowledge as a component of building support for water management initiatives. In practice, when working with communities it is important to recognise that knowledge is not binary, but varies in depth and breadth across issues — individuals may be well informed on some water issues, but poorly informed on others. When planning engagement or education initiatives, it is important not to assume pre-existing knowledge, and to make information relevant for the target group.

Conclusions

Our findings indicate that community knowledge about water management is poor, especially in content areas related to management of stormwater and wastewater. Higher knowledge was strongly associated with greater uptake of pollution-reduction behaviours, support for raingardens and willingness to pay for waterway protection, even after adjusting for participant characteristics. These findings highlight both the importance of water-related knowledge in the community and fostering that knowledge when planning community engagement that aims to change behaviour or build support for integrated water management initiatives.