Journal of Hydrology 558 (2018) 205–213

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Research papers

Efficacy of a national hydrological risk communication strategy: Domestic wastewater treatment systems in the Republic of Ireland

Paul Hynds [a,*], Owen Naughton [b], Eoin O'Neill [c,d], Simon Mooney [c]

[a] Environmental Sustainability and Health Institute, Dublin Institute of Technology, Dublin 7, Ireland
[b] Dept. of Civil, Structural and Environmental Engineering, Trinity College, Dublin 2, Ireland
[c] UCD Planning and Environmental Policy, School of APEP, University College Dublin, Dublin 4, Ireland
[d] UCD Earth Institute, University College Dublin, Dublin 4, Ireland

ARTICLE INFO

Article history:
Received 27 May 2017
Received in revised form 6 December 2017
Accepted 17 January 2018
Available online 3 February 2018
This manuscript was handled by G. Syme, Editor-in-Chief, with the assistance of Heather M. Smith, Associate Editor

Keywords:
Wastewater treatment
Regulation
Policy
Engagement
Socio-hydrology
Risk communication

ABSTRACT

A significant body of research has focused on the role of domestic wastewater treatment systems (DWWTSs) as sources of human-specific aquatic contaminants in both developed and developing regions. However, to date few studies have sought to investigate the awareness, attitudes and behaviours of DWWTS owners and the efficacy of associated communication initiatives. The current study provides an examination of a public national engagement campaign undertaken in the Republic of Ireland which seeks to minimise the impact of DWWTSs on human and ecological health via concurrent inspection and information dissemination. Overall, 1634 respondents were surveyed using a "before and after" study design to capture if and how awareness, attitudes and behaviours evolved over time. Findings suggest that whilst the campaign provided a modest baseline to raise general awareness associated with the basic operational and maintenance requirements of DWWTS, there has been little or no behavioural engagement as a result, suggesting a significant awareness-behaviour gap. Accordingly, efforts to minimise potential human and ecological impacts have been unsuccessful. Moreover, results suggest that public attitudes towards water-related regulation and policy became increasingly negative over the study period due to parallel political and economic issues, further complicating future engagement. Future strategies, both in Ireland and further afield, should focus on health-based demographically-focused message framing to achieve significant knowledge and attitudinal shifts amongst specific population cohorts, and thus bring about significant behavioural change. Study findings and recommendations may be used by myriad stakeholders including local, provincial and national authorities to effectively engage with individuals and communities prior to and during implementation of legislative and policy-based instruments within numerous spheres including climate change adaptation, environmental quality, hydrological risk, and hydro-ecology.

1. Introduction

Rural Ireland is currently home to approximately 37% (1.78 million) of the national population (4.64 million), and is characterised by a heavily dispersed yet locally dense settlement pattern (Scott and Murray, 2009), with most settlements comprised of individual private or "one-off" dwellings situated outside urban administrative zones (CSO, 2012hy). An estimated one third of Irish households (>75% of rural households) are not connected to a municipal sewerage scheme, with approximately 440,000 (27.5%) individual dwellings associated with a DWWTS (CSO, 2012). When correctly located, designed, installed and maintained, DWWTSs represent an appropriate method for domestic wastewater treatment and disposal. However, if improperly situated, constructed, and/or managed, they constitute a significant threat to human health and the aquatic environment via contamination of surface and groundwater resources (Hynds et al., 2012, 2014).

A significant percentage of existing DWWTSs in the Republic of Ireland are believed to be operationally deficient and situated near private wells and group water schemes, both of which are ubiquitous throughout rural Ireland (CSO, 2012; Hynds et al., 2013). When considered in concurrence with the high numbers (and density) of DWWTSs in Ireland, large areas characterised by high and extreme groundwater vulnerability, and shifting climatic patterns (i.e. increased incidence of high intensity rainfall events and flooding), the risk of groundwater contamination attributable to DWWTSs is believed to be high (Hynds et al., 2012, 2014).

* Corresponding author.
E-mail address: hyndsp@tcd.ie (P. Hynds).

https://doi.org/10.1016/j.jhydrol.2018.01.041
0022-1694/

Cussen (2010) previously estimated that approximately 25,000 DWWTSs are actively polluting groundwater while approximately 120,000 are polluting surface water, with these figures likely to rise due to a marked increase in the number of "one-off" rural dwellings constructed during Ireland's property boom from the mid-1990s to the mid-2000s, allied with a longstanding absence of regulatory controls pertaining to both private groundwater sources and DWWTSs (Scott and Murray, 2009; CSO, 2012). Moreover, recent studies suggest consistently increasing national rates of waterborne infection over the past decade, and note a marked association between confirmed cases and previous exposure to private wells (Garvey et al., 2016; ÓhAiseadha and Hynds, 2017).

Due to the rural infrastructural profile of the Republic of Ireland, the magnitude of these issues is almost unique, however contamination problems deriving from DWWTSs have been noted elsewhere (Borchardt et al., 2011), as have other impediments to state interventions such as geographical isolation (Castleden et al., 2015). The responsibility to safeguard ecological and human health from domestic wastewater thus frequently lies with "non-expert" custodians (i.e. private well owners, DWWTS owners, etc.). These individuals often lack financial and/or material support, necessitating establishment of focused communication strategies to promote DWWTS risk awareness and maintenance (Castleden et al., 2015). Precedents for best practice in this field are scarce. However, existing research relating to behavioural change campaigns and public acceptance in various other domains has repeatedly emphasized the significance of contextual factors and target audience characteristics in determining campaign structure and outcomes (Howlett and Cashore, 2009; Atkin and Rice, 2012).

In late 2009, Ireland was formally admonished by the European Court of Justice (ECJ) for continued negation of its obligations to appropriately regulate domestic wastewater generated in unsewered (rural) areas, as required under articles 4 and 8 of the 1975 EU Waste Framework Directive (75/442/EEC) (European Commission, 2011). Subsequently, the European Commission announced its intention to impose a lump-sum fine (€2.7 million) and daily penalties (€26,173), resulting in amendments to existing national legislation and enactment of new legislation in 2012 (i.e. Water Services (Amendment) Act (WSA)). The WSA comprised a suite of obligations for DWWTS owners including system registration and appropriate maintenance/remediation, in addition to requiring local authorities to undertake DWWTS inspections within their jurisdiction. Accordingly, Ireland's Environmental Protection Agency (EPA) developed an overarching National Inspection Plan (NIP), which aimed to safeguard public health and the environment using a two-strand approach of education and awareness strategies along with a risk-based inspection process (EPA, 2013, 2015). Due to financial limitations (and perhaps, to a greater or lesser extent, a degree of political expediency), a relatively low number of inspections ($n \approx 1000$) will be undertaken annually, thus the primary NIP component is a public information strategy to promote good practice relating to the operation and maintenance of DWWTSs (EPA, 2013).

Communication strategy structure and content were developed following consultation with various environmental, agricultural and rural interest groups, in addition to expert opinions and recommendations. Notably, there was no targeted dialogue with or platform for DWWTS householder opinions or concerns during the public consultation phase. Consequently, it was decided that the communication strategy would comprise a public awareness campaign focused on communicating key messages pertaining to clean water and appropriate DWWTS maintenance. Nationally, numerous mechanisms including national press (newspaper, radio, television) and a dedicated website were employed, with outreach activities initiated in early/mid-2013. Approximately 1.5 million information leaflets were issued to local authorities and relevant bodies (e.g. group water schemes) for distribution (EPA, 2015). Locally, employed mechanisms included: emails/letters to registered owners, information packs, leaflets, local authority website notices, local radio and newspaper articles/interviews, pre-inspection visits, school visits, social media notices and stakeholder meetings. (EPA, 2015).

The objective of the current study was to examine the overall efficacy of the aforementioned public risk communication campaign through comparative analyses of temporal shifts ("before and after") in awareness, perception and behaviour among DWWTS users based on a previous ("before") study undertaken prior to NIP implementation (i.e. the intervention) (Naughton and Hynds, 2014). This paper thus represents a longitudinal evaluation of a national environmental communication campaign and a timely examination of householder risk awareness and prevention pertaining to DWWTSs. More broadly, the paper examines societal responses to policy instruments and public information campaigns with respect to hydrological risks, water contamination, and human health, thus permitting assessment of strategy efficacy and development of recommendations pertaining to similar future campaigns. To guide and inform overall survey development and data collation, the following research questions were formulated:

1. What are current ("post-intervention") levels of environmental awareness and risk perception among Irish DWWTS owners and users?
2. Have levels of environmental awareness and risk perception changed over the study period?
3. Has the process of public outreach succeeded and, if not, why?
4. What amendments might be employed to improve/optimise future public hydrological communication?

2. Materials and methods

2.1. Survey design and completion

In order that direct comparisons could be made and a primary study objective realised (i.e. quantification of strategy success), several previous ("pre-intervention") survey questions associated with respondent awareness and perception (Naughton and Hynds, 2014) were retained, including all questions from Sections 1 (n = 10), 2 (n = 6), and 5 (n = 5), as outlined below. New questions were devised to i) investigate respondents' primary sources of information on hydrological issues in general and DWWTSs and ii) examine perceived strategy strengths and weaknesses.

Previously elucidated behavioural and/or perception-based relationships, in addition to previously highlighted knowledge gaps (Naughton and Hynds, 2014) were used to inform overall questionnaire structure, individual questions and available responses. The developed questionnaire comprised 31 questions, with dichotomous (n = 9), categorical (n = 12), and Likert-scale (ordinal) (n = 8) response options favoured over open-ended (format) questions to ensure survey brevity, comprehension, and comparative analyses. A small scale (≈5% of sample size) pilot study was undertaken for survey validation; pilot study data have been omitted from analyses. All survey questions included a "Don't Know" response option, to permit quantification of a lack of awareness or risk perception. The final questionnaire comprised five sections, as follows:

- *Section 1 (10 Questions): Respondent socio demographics* (age, gender, residential ownership; household size and composition; geographical location) *and domestic (waste)water reliance* (DWWTS type, on-site location, age, discharges and design; drinking water source and treatment)