Science of the Total Environment 493 (2014) 898–909

Contents lists available at ScienceDirect

Science of the Total Environment

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

Human responses to Florida red tides: Policy awareness and adherence to local fertilizer ordinances

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HIGHLIGHTS

- Fertilizer ordinances currently feature in water pollution control programs (including for harmful algal blooms [HABs]) at federal, state, water basin, and local levels;
- The extent to which humans affected are aware of (and comply with) relevant rules is critical to policy effectiveness;
- A survey of an educated older population reported little knowledge about a local fertilizer ordinance, or possible effects on HABs;
- Targeted social-science research on human perceptions about risks of HABs, and education about the rationales for and applications of potential policy responses are warranted.

ARTICLE INFO

Article history:
Received 23 February 2014
Received in revised form 20 June 2014
Accepted 20 June 2014
Available online xxxx

Editor: Damia Barcelo

Keywords:
Florida red tide
Karenia brevis
Harmful algal bloom (HAB)
Total maximum daily load (TMDL)
Fertilizer ordinance

ABSTRACT

To mitigate the damages of natural hazards, policy responses can be beneficial only if they are effective. Using a self-administered survey approach, this paper focuses on the adherence to local fertilizer ordinances (i.e., county or municipal rules regulating the application of fertilizer to private lawns or facilities such as golf courses) implemented in jurisdictions along the Southwest Florida coast in response to hazardous blooms of Florida red tides (*Karenia brevis*). These ordinances play a role in the context of evolving programs of water pollution control at federal, state, water basin, and local levels. With respect to policy effectiveness, while the strength of physical linkages is of critical importance, the extent to which humans affected are aware of and adhere to the relevant rules, is equally critical. We sought to understand the public's depth of understanding about the rationales for local fertilizer ordinances. Respondents in Sarasota, Florida, were asked about their fertilizer practices in an area that has experienced several major blooms of Florida red tides over the past two decades. A highly educated, older population of 305 residents and "snowbirds" reported relatively little knowledge about a local fertilizer ordinance, its purpose, or whether it would change the frequency, size, or duration of red tides. This finding held true even among subpopulations that were expected to have more interest in or to be more knowledgeable about harmful algal blooms. In the face of uncertain science and environmental outcomes, and with individual motivations at odds with evolving public policies, the effectiveness of local community efforts to decrease the impacts of red tides may be compromised. Targeted social-science research on human perceptions about the risks of Florida red tides and education about the rationales for potential policy responses are warranted.

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http://dx.doi.org/10.1016/j.scitotenv.2014.06.083
0048-9697/

1. Introduction

Human responses (actions or policies) to mitigate the damages of natural hazards are beneficial only if they are effective. In stochastic environments, where cause and effect may be masked, concluding that a particular policy is effective can be problematic. Even if the link between the implementation of a policy and its consequences is clear, effectiveness also can be undermined when humans are unaware or otherwise non-compliant.

Local fertilizer ordinances (i.e., county or municipal rules regulating the application of fertilizer to private lawns or facilities such as golf courses) are increasingly being implemented in the jurisdictions along the southwest and other Florida coasts in response to prolonged and hazardous blooms of Florida red tides (due to the marine alga, *Karenia brevis*) (Voyles Pulver, 2014; Barchenger, 2014; http://www.fertlizesmart.com). Fertilizer ordinances are a type of water pollution control policy. Specifically, local fertilizer ordinances now are being adopted as one of an array of best management practices (BMPs) for use in achieving compliance with total maximum daily load (TMDL) limits for macro-nutrients (total nitrogen and phosphorous) in Florida water bodies (FDEP, 2010; EPA, 2013). Under Florida law and emerging regional (i.e., water basin) practices, local jurisdictions, including municipalities and counties, now may receive pollution load reduction credits for implementing local fertilizer ordinances (cf., CEBTS, 2012). Consequently, understanding the effectiveness of ordinances in reducing pollutant loads—and ultimately the frequency and potency of Florida red tides—is a critical issue.

Water pollution policies involve controls on the releases of pollutants to water bodies (EPA, 2013). Such controls are needed where the capacity of a water body to assimilate pollutants has been damaged or exceeded, leading to a degraded state. The degraded state can be characterized by periods of excessive algal growth, including the growth of harmful species in some cases, and possibly followed by periods of hypoxia. Degradation necessarily implies the loss of beneficial uses of water bodies, including those for drinking, swimming, fishing, habitat, and even some agricultural or industrial uses (Lotzel et al., 2006; Cowan, 2010).

In order to prevent or reverse degraded water quality, pollution control policies must be effective (where policy effectiveness is defined as the degree to which a particular policy, once implemented, achieves its intended purpose). Policy effectiveness depends upon how well pollutant controls affect pollutant fluxes directly, and therefore water quality indirectly. While the strength of these physical linkages is of critical importance, the extent to which humans adhere to a control policy is equally critical. Often, proposals for implementing pollution controls focus on the science of the physical linkages, assuming that humans will fully comply with any adopted controls (Spillane et al., 2002).

1.1. Similar studies

Other researchers have surveyed homeowners regarding the use of fertilizer on their properties. Reasons for fertilizing included a rise in social status or neighborhood acceptance (Blaine et al., 2012), the use of a lawn by children or pets (Carrico et al., 2013), and emotional decision-making over knowledge-based decision-making (Harris et al., 2013). Of note, in these studies, other factors such as: the presence of a homeowners association, the practices of neighbors, and location in an urban or suburban area meant that both fertilizers and lawn care companies were more likely to be used. The reasons for not using any fertilizer were associated with homeowners' poor understanding of best management practices (BMPs); however, the perception of a negative environmental impact from fertilizer application is not consistently associated with fertilizer use (Blaine et al., 2012; Brehm et al., 2013; Carrico et al., 2013; Dietz et al., 2004). Lehman et al. (2009) were able to find a reduction in phosphorus (P) following the implementation of a fertilizer ban, noting, however, that the fertilizer ban was only one of several concurrent strategies used to improve water quality; Dietz et al. (2004) also found increased water quality after intensive BMP education. A survey conducted in Southwest Florida revealed that homeowners did not think that their fertilizing practices influenced the quality of local freshwater springs, and, the further away they lived from a body of water, the stronger they believed in this lack of a physical linkage (Kerr and Downs, 2012).

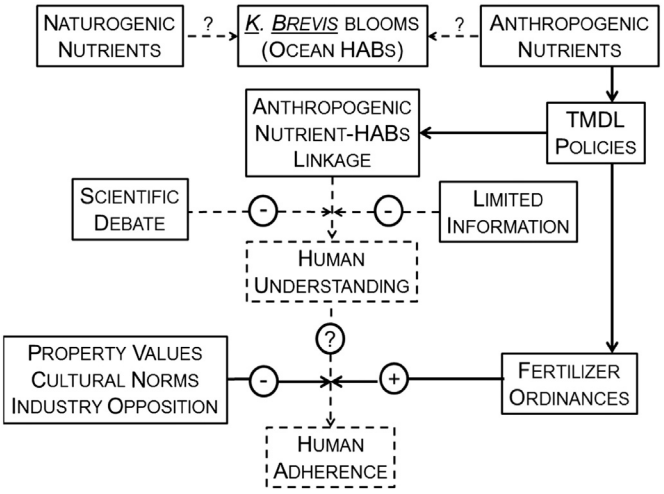

Fig. 1. Elements influencing the overall effectiveness of a policy such as a municipal or county fertilizer ordinance.

In this paper, we focus on characterizing human awareness and understanding of local fertilizer ordinances. We review Florida red tides and outlined the relevant policy context, including the ongoing evolution of water pollution controls and the adoption of local ordinances to manage the timing and scale of the use of residential lawn fertilizers. We stress that the policy context is complex; and we posit that the public may be incompletely informed about the Florida red tide hazard, ongoing scientific controversies, and the rationales for human responses. Homeowners face disincentives, in the form of potential property value losses and social norms, which also may work against the effectiveness of fertilizer ordinances.

Fig. 1 depicts the several factors influencing policy effectiveness for the case of fertilizer ordinances and Florida red tides. The effectiveness of a policy such as a municipal or county fertilizer ordinance depends upon: (i) the physical linkage between anthropogenic nutrients and algal blooms (specifically, blooms of the harmful marine alga, *K. brevis*); and (ii) human adherence to the policies. Both are uncertain (as depicted in the figure by dotted lines or boxes). Importantly, the relative contributions of nature- and human-sourced nutrients to *K. brevis* blooms are uncertain, and they may be idiosyncratic. As discussed in the next section, government agencies and stakeholders have argued for clear linkages, leading to the implementation of TMDL policies, including fertilizer ordinances among others. An ongoing scientific debate and inadequate public education adversely affect human understanding of the linkage between nutrients and blooms. If human understanding of this linkage, and therefore the rationale for the policy, were more certain, it would positively affect human adherence. The potential impacts of reductions in lawn fertilizer applications on home values, the likely contravention of cultural norms (such as those relating to property appearance), and the opposition of the fertilizer industry to local ordinances, also may reduce adherence.

We also report on the methods used and the results of a survey of full-time and seasonal residents ("snowbirds," defined as individuals who live in Florida for longer than three months but less than six months per year) in Sarasota, Florida, to explore public perceptions and knowledge about both the purposes of fertilizer ordinances and