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# Understanding stakeholder perspectives on agricultural best management practices and environmental change in the Chesapeake Bay: A Q methodology study

Daniel Schall[a], David Lansing[b,*], Paul Leisnham[c], Adel Shirmohammadi[c], Hubert Montas[c], Tom Hutson[d]

[a] Trees for the Future, USA
[b] University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore, MD, 21250, USA
[c] University of Maryland College Park, USA
[d] University of Maryland Extension, USA

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ABSTRACT

This paper examines differences in environmental attitudes and awareness among stakeholders involved in implementing and promoting agricultural best management practices (BMPs) in the Chesapeake Bay. BMP adoption studies have often considered variables such as environmental attitudes and BMP awareness in examining why farmers do or do not adopt BMPs. Such studies, however, rarely consider the range of viewpoints on these issues across diverse stakeholders such as environmental professionals, scientists, regulators, and agriculturalists. Thus, there is little understanding of how and why knowledge about the environment and BMPs might be deeply contested and a source of political friction between multiple types of actors. In this paper, we take up this issue by examining the relationship between one's subjective understanding of environmental changes and one's attitude towards agricultural best management practices. Doing so, the paper examines the ways in which these two domains align within actors, and maps the variance of these views across a diverse set of stakeholders associated with BMPs. We find a close alignment between one's view of environmental change and the value of BMPs as well as deep divisions between farmers and other non-farming stakeholders with regard to these views.

## 1. Introduction

We live in an age of increased contestation over environmental knowledge (Druckman et al., 2013). Researchers have documented partisan polarization around the basic facts concerning environmental issues such as climate change (McCright and Dunlap, 2011), genetically modified foods (Druckman and Bolsen, 2011), and endangered species reintroduction (Wilson, 1997). While few researchers would doubt the existence of polarized views around various environmental narratives, there is less understanding about the kinds of factors that drive these contestations, with scholars debating whether one's ideas about the causes of, and solutions to, environmental problems are grounded in one's structural position—whether one is a farmer, fisherperson, bureaucrat, businessperson, or activist—or if it is based on values that are idiosyncratically held (Hajer and Wagenaar, 2003; Robbins, 2006). Understanding this distinction is critical because if one's view of the environment is closely welded to identity, then polarization makes it difficult to find common ground among many different actors. If, however, people's values are more variable and less tied to one's structural position, then the opportunity for diverse political coalitions can emerge.

This paper takes up these broad issues of environmental polarization, values, and identity in order to understand how a diverse group of actors view the importance of agricultural best management practices. Best Management Practices (BMPs) are a suite of agricultural practices that are meant to reduce nutrient runoff from farms. These can include maintaining riparian buffers between a farmer's field and a nearby stream, developing nutrient management plans, installing field drainage, using winter cover crops, and practicing no-till agriculture. Because of the declines in ecological and human health that are associated with increased fertilizer and pesticide use, BMPs are promoted in many states, and have also been the focus of a number of voluntary,

* Corresponding author.
*E-mail addresses:* dschall@gmail.com (D. Schall), dlansing@umbc.edu (D. Lansing), leisnham@umd.edu (P. Leisnham), ashirmo@umd.edu (A. Shirmohammadi), montas@umd.edu (H. Montas), thutson@umd.edu (T. Hutson).

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pay-for-performance plans as well as regulations. The success of such efforts, however, has been mixed at best: BMP adoption rates by land users are uneven (Gillespie et al., 2007), and water quality across a number of critical estuaries and watersheds continue to decline (Donner et al., 2004; Leisnham, 2011).

Research on BMP adoption itself has tended to look for various relationships between farmers and BMP adoption. To date, no consistent predictor of BMP adoption has been found (Prokopy et al., 2008). In this paper we contend that this is due partly to the failure of such studies to interrogate the ways in which the identities and values of land users have come to shape their attitudes toward environmental regulation. This paper seeks to examine this relationship with regards to the wide range of actors involved in BMPs, and to understand the relationship between one's knowledge about environmental change and their attitude toward BMPs. In short, we examine the relationship between one's views on a widely promoted yet unevenly adopted environmental policy (BMPs), and one's view of the environment, and track the intersection of these views across many different types of actors. Doing so, this analysis contributes to broader debates over the causes of one's stance toward environmental problems and the extent to which one's view of an environmental problem lines up with their daily engagement with that issue.

Our analysis employs Q methodology, which is a statistically supported method for examining different subjective perspectives around an identified field of inquiry. It uses statistical factor analysis to identify a range of factors that underlie a set of statements that are ordered by participants according to their level of agreement. The researcher interprets the resulting factors as types of discourses (Brown, 1993). Rather than ask predefined questions across a population, Q methodology allows the research subject to define the key ideas for analysis and his or her relationship to them. For example, rather than engaging research subjects with predefined notions of what constitutes agricultural best management, participants are free to express, through interviews, what they believe “best management practice” of land is. The range of responses across actors around this topic is then incorporated into a set of statements that comprise the “Q sort”, where subjects are asked to rank their level of agreement with statements, in relation to all of the other statements. This approach allows for the emergence of different subjective perspectives between actors. It also is able to highlight points of multiple perspectives and allow contradiction within individual subjects to emerge.

We use this method (described in more detail below) to ask two sets of empirical questions. First, is contestation or agreement around BMPs due to the structural position of a person – whether they are farmer, regulator, extension agent, or environmental professional? Or, is one's view of BMPs more idiosyncratic, and not necessarily determined by one's profession? Second, what is the relationship between one's understanding of land use change and their attitude toward the adoption of best management practices?

To answer these questions, the paper examines the following two hypotheses. First, there is a clear divide between land users and non-land users concerning their attitudes toward BMPs and land use issues. In short, one's position as a farmer is congruent with an attitude toward land use issues that are distinct and separate from regulators, environmentalists, NGOs, and non-farming residents. Second, a respondent's understanding of land use change and attitudes toward BMPs are closely aligned. We propose that if one has an understanding of land use change from a synoptic and measurable point of view then it is likely paired with a positive opinion of BMPs. In contrast, more personal and experiential views of land use change are paired with skepticism toward conventional assessments of BMPs.

This paper proceeds as follows. The next section will describe the paper's study site and methods. This is followed by a summary of the significant factors to come out of the Q study. We conclude by assessing the two hypotheses, and discussing how they help explain each other.

## 2. Literature review

With an eye toward understanding how BMP adoption can be improved, a number of scholars have investigated the adoption of agricultural BMPs by examining social, behavioral, economic, and ecological variables that affect the adoption of these practices (Baumgart-Getz et al., 2012; Belknap and Saupe, 1988; Napier and Bridges, 2002; Greiner et al., 2009; Prokopy et al., 2008; Reimer et al., 2012). Collectively, these studies have been unable to find clear drivers of BMP adoption, with many different positive and negative determinants of adoption emerging, but with few consistent predictors. For example, Knowler and Bradshaw's (2007) metaanalysis of global conservation tillage adoption was unable to find consistent variables that explain adoption. Other studies found positive determinants of BMP adoption, but their effect on adoption was often statistically weak (Rubas, 2004; Prokopy et al., 2008). For example, none of the variables positively associated with BMP adoption in Prokopy et al.'s (2008) metastudy emerged as consistent significant predictors.

Across these studies, BMP adoption is often related to various forms of farmer attitudes toward, and knowledge of, the environment (Gillespie et al., 2007; Knowler and Bradshaw, 2007). A number of studies have more closely examined this relationship by developing various psychological frameworks—such as Ajzen's Theory of Planned Behavior (Ajzen, 1985) or the Reasoned Action Approach (Fishbein et al. 2007)—for understanding the relationship between farmer attitudes and their action (eg. Kaiser et al., 1999; Ahnström et al., 2009). While there are subtle differences between various theoretical approaches, most of them point to attitudes toward the environment as something that is conditioned by many other contextually mediating factors. Such mediating factors can include attitudes toward the behavior itself (Ajzen, 1985), perceived control (Lynne et al., 1995), as well as on-farm environmental, economic, and social constraints (Ahnström et al., 2009). The on-farm constraints mean that place-based contextual factors can shape the degree to which a person's environmental attitudes plays a role in their decision to adopt a particular conservation practice. For example, Reimer et al. (2012) found that farmers with attitudes toward the environment that extended beyond the farm's business itself and into off-farm stewardship benefits were more likely to adopt conservation practices, while farmers more focused on the farm's business were less likely to adopt.

Environmental psychology is not the only field that has informed scholars studying land user approaches toward conservation. A number of researchers across varied disciplines have honed in on the politicized nature of conservation itself, where both policy, and knowledge about the environment, can become a source of political contestation (Forsyth, 2004; Lave, 2012). Thus, seemingly neutral conservation tools, and ostensibly objective facts about the environment, can become highly contested, and even result in purposeful non-compliance with environmental laws and regulations by land users (McCarthy, 2002). Political friction concerning regulations, the science that informs such regulations, and attitudes toward what constitutes proper conservation have been shown in such varied contexts ranging from exurban land use planning (Walker and Fortmann, 2003), Elk hunting regulations in Yellowstone (Robbins, 2006), and the planting of Bt corn in Iowa (Kaup, 2008).

One theme to emerge from this research is that these politicized understandings of the environment are not grounded in ignorance. Instead, they reflect a sophisticated understanding of environmental change, but one that is mediated through a land users’ lived experience. The result is the emergence of conflicting attitudes that are grounded in fundamentally different approaches toward issues of uncertainty, complexity, and the resilience of nature (eg. Berkes, 2012). For example, Paolisso and Maloney (2000) study of farmer environmental knowledge in the Chesapeake Bay used interviews and ethnographic observation to conduct a triadic comparison method, where stakeholders are presented relevant terms in sets of three, and asked to pick

the term that least belongs, allowing for particular cultural attitudes to emerge. This study shows that farmers have a similar level of environmental knowledge compared to non-farmers, but this knowledge is ultimately interpreted through a lens of cultural values that result in a view of environmental protection that is significantly different from those of non-farmers (see also Lichtenberg and Lessley, 1992).

These kinds of discursive contestations have been grist for a number of scholars concerned with how discourse about environmental issues is contested, shaped, and mobilized, and with what effects (eg. Richardson and Sharp, 2001; Hajer and Versteeg, 2005; Lansing et al., 2015). In this context, discourse can be thought of as a shared way of understanding the world. Discourse rests on various judgments and contentions that allow those who subscribe to a discourse to process information into a coherent account of the world (Hajer and Versteeg, 2005). These shared understandings, however, are not shared by all, and the meanings around environmental issues is never fixed, but instead, moves within multiple realities and meanings for different types of actors. Thus, scholars have been able to show changes around contested environmental ideas as diverse as the hole in the ozone (Litfin, 1994), climate change (Oels, 2005), or the precautionary principle (Richardson and Sharp, 2001). In each case, discourse around key policy-making terms, and their underlying assumptions, involved contestations between different types of actors, each with their own agenda. One key insight from this work is that sharply contested beliefs about nature often persist between actors over time (Adger et al., 2001; Robbins, 2006). As Brannstrom (2011) points out, one relatively unresolved issue within this literature is the question of whether someone's discursive view is a function of their structural position–whether it is farmer, bureaucrat, scientist, or activist—or if it is unrelated to this, and is instead, a highly personal one.

This paper addresses this issue with regard to BMPs. We seek to understand the relationship between one's view of environmental change and one's view of land management policy (BMPs) among diverse actors. By comparing these views across a diverse range of stakeholders we aim to understand whether one's structural position determines their discursive view of the environment. Doing so, this study contributes to broader scholarly debates around the question of who holds particular environmental views and why. In addition, our inclusion of a diverse range of actors also contributes to BMP specific research, which, to date, has largely only focused on the attitudes and knowledge of farmers, and has done relatively less comparative work between farmers and other types of actors over the issue of BMPs and environmental change.

## 3. Study site

The study took place within the Choptank watershed on the Eastern Shore of Maryland (see Fig. 1). This predominantly agricultural watershed is approximately 675 square miles (1756 $km^2$) in area with 160 miles of environmentally impaired waters (Fig. 2) and drains directly into the Chesapeake Bay. It has a population of 71,000 with 11,000 in Cambridge, its largest city (MD-DNR, 2007). The topography is flat, ranging from 20 ft (6 m) AMSL in Cambridge to 70 ft (24 m) AMSL in Hartly, DE. Soils are predominantly of fine-silty textured Othello and Mattapex series, poorly to moderately well-drained, with moderately slow permeability, and a water table depth of 0–30 ft (0–10 m). Agricultural production (corn, soybean, small grain and poultry) is performed on 55% of the watershed surface (McCarty and McConnell, 2007) As the dominant land use, agriculture is estimated to be the major contributor of Nitrogen, Phosphorus and sediments to the Choptank river with 62%–85% of the loading attributed to it (McCarty and McConnell, 2007; see Table 1). This watershed was chosen as a study site because of the mix of grain and chicken farming activities, the widespread practices of agriculture, and the long-standing scrutiny farmers have been under to adopt BMPs and lessen nutrient loading into the watershed.

Agricultural production within the Choptank watershed is directly related to grain demand by poultry production in the wider Delmarva Peninsula. Currently the vast majority of soy, corn and wheat grown in the watershed are sold to poultry farmers located on the peninsula (Staver and Brinsfield, 2001). Practices of Delmarva land-users reflect the concurrent development of mechanized poultry farming and the intensification of agriculture on the Eastern Shore of Maryland.

In response to human-induced nutrient loading, there has been significant interest and research into developing methods to reduce agricultural nutrient loads (Baumgart-Getz et al., 2012; Staver and Brinsfield, 2001). Jurisdictions within the Chesapeake Bay watershed are governed by total maximum daily load (TMDL) requirements set by the Environmental Protection Agency. This requires the development of a Watershed Improvement Plan (WIP) for each watershed, which is developed among the relevant county commissioners. Such plans identify ways to reach nutrient reduction goals through the implementation of BMPs (that also include practices for urban areas as well). In Maryland, such plans are made by county governments that are encompassed by the watersheds. Thus, county commissioners are responsible for helping achieve the TMDL loads. They are, however, also highly constrained in what they can do by state laws and guidelines. Such plans typically use financial incentives to encourage voluntary use of BMPs.

There are also a range of non-governmental organizations involved in affecting the broader practices of land use. There are a number of state-wide, and local, environmental NGOs that has been vocally critical of the practices of farmers. In one high-profile case, they unsuccessfully took farmers to court for improper storage of chicken waste (Wheeler, 2012). There are also more moderate environmental NGOs, most notably the Clean Chesapeake Coalition, which is primarily composed of county commissions from Maryland's Eastern shore (Clean Chesapeake Coalition, 2017). Chicken farmers themselves are further constrained by both environmental laws, but also by the specifications of their chicken contracts. Most chicken famers work under contract with Perdue, and have to comply with a welter of production specifications, as well as deal with weekly price fluctuations. A typical chicken farmer in this area is also a grain farmer, with 2–3 chicken houses on their land that serves as a supplement to their income, rather than their primary income.

Finally, collaborative and individual work of the Maryland Department of Agriculture (MDA), Department of Natural Resources (MD-DNR), Department of the Environment (MDE), USDA ARS, State NRCS, University of Maryland researchers, extension agents, tributary teams and stakeholders has promoted the implementation of BMPs, including nutrient management plans, conservation tillage, animal waste management systems, stream fencing, tree planting, cover cropping, riparian buffers and controlled drainage, in the Choptank watershed (McCarty et al., 2008; MDE, 2010).

Nevertheless, BMP policy is as diverse as the actual BMPs themselves. Some are required by law, such as nutrient management plans and riparian buffers. Others are encouraged through the use of cost-sharing subsidies from the state of Maryland. These include activities such as conservation tillage, tree planting, cover cropping, and controlled drainage (Perez, 2010). The broader idea of BMP can extend beyond these activities. Interviews with land users, show that, at times, a broader range of land use regulations are often conceptually lumped together with certain BMPs, especially if they are required by the state. The Q methodology employed in this study does not pre-define what is or is not a BMP. Instead, they are defined through the interviews by the research participants themselves.

The Maryland Department of Natural Resources estimates that standard BMP practices have successfully contributed to reducing loadings of nitrogen and phosphorus from agricultural sources in the Choptank by 40% and 49%, respectively, from 1985 to 2005 (MD-DNR, 2007). Monitoring data however still indicates fair to poor conditions for N, P and sediments, and the most recent (up to 2003) Index of Biotic

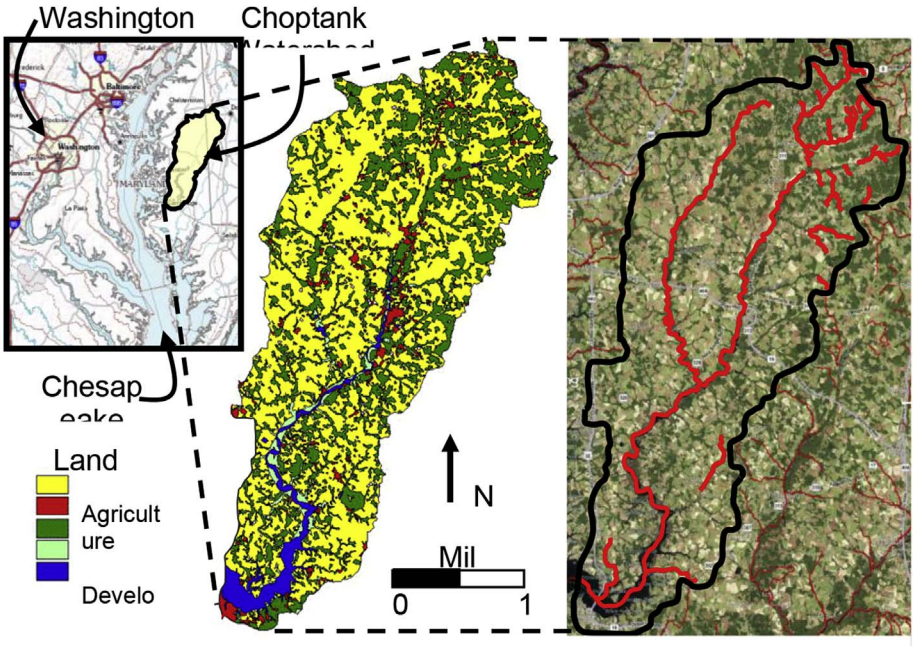


**Fig. 1.** Choptank Watershed location map (top left), land use (center) and environmentally impaired streams (bold red, right) from Cambridge, MD, to watershed divide (Sources: USGS National Map Viewer; McCarty and McConnell, 2007; US EPA MyWATERS Mapper). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Integrity indicates poor to very poor conditions, stressing the need to fully reach the target reduction goals.

## 4. Methods

Q method is a way to determine an actor's subjective understanding of a particular topic (Brown, 1980). The method has been increasingly used by social scientists interested in gauging people's understanding of environmental issues (eg. Barry and Proops, 1999; Pelletier et al., 2000; Robbins, 2006; Brannstrom, 2011). Rather than measure responses to variables between people (ie. how many people agree with a statement or set of statements), a Q analysis is meant to examine the interrelation of many different statements across individual people. This approach allows for a coherent "discourse" or set of beliefs about a particular topic, to emerge. Researchers can then gauge which actors tend to align with particular discourses (Zagata, 2010; Brannstrom, 2011).

The Q methodology generally takes place in four phases. First, a concourse of statements around a specific subject is created. This is usually done through interviews with research subjects, and by analyzing relevant printed sources. After a concourse of statements is identified (usually 30 to 45), participants are identified through purposive sampling, and are asked to sort these statements according to their level of agreement or disagreement. Participants are usually asked to sort statements following a quasi-normal distribution (see Fig. 2). After sorting, the researcher performs a correlation and factor analysis of the sorts so that the researcher may extract and rotate significant factors. Once the factors are identified, researchers interpret the extracted factors. Factors are often interpreted as types of "discourses" around which particular actors tend to coalesce (Brannstrom, 2011).

**Table 1**
Land use and contribution to loading in the Choptank watershed.
Sources: MD-DNR, 2007; McCarty and McConnell, 2007.

| Land Use | Spatial Extent in Watershed | Estimated Contribution to River Loading | | |
|---|---|---|---|---|
| | | Nitrogen | Phosphorus | Sediment |
| Agriculture | 55% | 70% | 62% | 85% |
| Forest | 27% | 6% | 1% | 5% |
| Developed | 8% | 13% | 19% | 4% |
| Wetlands | 2% | – | – | – |
| Water | 15% | – | – | – |

One advantage of Q method is that the range of possible claims about the subject is relatively open. Statements come from the actors themselves, and are not predetermined by the researcher (Brown, 1993). In this case, the definition of what "best management" means in an agricultural context is often based on a set of practices found in the scientific and policy literature, but this specific interpretation is not "forced" on the respondent. Instead, interviews allow participants to express what they believe "best management" of agriculture means. Similarly, the notion of what constitutes a "driver" of land use change is not pre-defined by the researcher but is left open for respondents to decide what this is supposed to mean. Such an approach allows for a wide range of possible ideas about the nature and extent of land use changes and the forms of best management that are possible, but that are not necessarily confined to what has been articulated by scientists or state agencies.

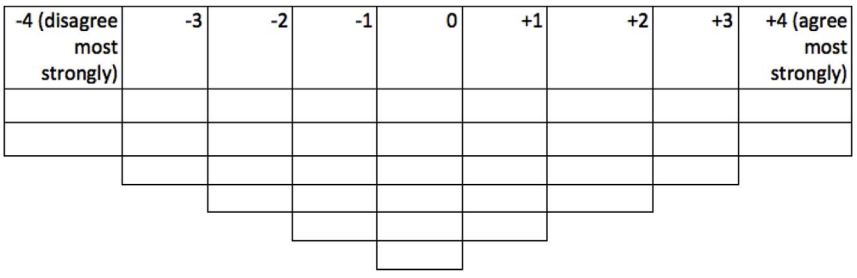


**Fig. 2.** Shape of Q sort grid used by authors.

Research took place in three steps. First, the primary author undertook archival work on previous BMP policy documents from the previous twenty-five years. Second, the primary author conducted twenty-six field interviews with farmers, waterman, government regulatory agents, environmental and social scientists, extension agents, environmental activists, and non-farming Eastern Shore residents. The interviews were wide ranging and, following a modified grounded theory approach, the questions changed from subject to subject (Charmaz, 2014). For the purposes of developing a comparable concourse of statements, every interview subject was asked questions pertaining to two broad topics: 1) what is an agricultural best management practice? And 2) what drives land-use decision making on the Eastern Shore? The semi-structured interviews also covered a variety of topics such as, land-use change over time, regulations related to land-use, Chesapeake Bay water quality, media perceptions of farmers/farming and the cultural division between land-user and non-farmer.

The primary author coded transcriptions to developing emerging themes. From these codes, the primary author developed an initial concourse of 300 statements that reflect persistent themes and explanations that emerged in interviews. The broad themes for BMPs were centered on issues of equity/inequity, coercion, accountability, sustainability, and empty rhetoric. The main ideas concerning the drivers of land use change included: agricultural companies, government intervention, applied science, misinformed public, farmer decision making, market forces, and inevitable growth. The primary and secondary authors worked to narrow down the statements to 34 representative quotes from interviews to be used for Q sorting. Quotes were selected according to persistent themes that emerged from the grounded theory approach (see Charmaz, 2014; PQMethod) undertaken by the researcher. Q sorts were conducted with 23 actors, 14 of whom were previously interviewed by the first author. Actors were purposively sampled to include a wide range of experiences and perspectives, including environmental activists, extension agents, non-farming residents, scientists, and farmers. All respondents either live or work in the study site. Respondents were given a pre-defined "grid", and were asked to sort statements into the grid so that it follows a quasi-normal distribution (see Fig. 2). For this study, a total of 23 respondents performed sorts from October to November 2013. Finally, the primary author performed a correlation and factor analysis using PQMethod in order to extract significant discourses concerning the intersection of land use change and carbon offset goals (PQMethod). After examining the different factors, we decided on a two factor solution. A three factor solution was considered, but ultimately rejected. The third factor only explained an additional 8% of the variation in sorts, and also had a 51% correlation with Factor 2. A qualitative assessment of the third factor showed a very similar discursive pattern to the second factor. After an exploratory rotation of a three factor solution, we found all of the high loading respondents for a potential F3 factor to be agriculturalists or extension agents. Given these qualities, we ultimately considered a potential third factor to be a small variation on the F2 discourse. For parsimony, we therefore decided on a two-factor solution. Two significant factors were ultimately extracted and rotated (Table 2). After experimenting with a combination of varimax and hand rotation, the authors decided on varimax rotation as the providing the best explanation. In the following section we outline a descriptive interpretation of the two significant factors, based on the significant loading statements (see also, Table 3) and interview data.

**Table 2**
Factor characteristics.

| | F1 | F2 |
|---|---|---|
| Eigenvalue | 6.0966 | 4.839 |
| % Variance Explained | 27 | 21 |
| No. of Defining Variables (sorts) | 10 | 13 |
| Average Relative Coefficient | 0.8 | 0.8 |
| Composite Reliability | 0.976 | 0.981 |
| Standard Error of Factor Z-Scores | 0.156 | 0.137 |
| Correlation with other Factor | 11.5% | 11.5% |

## 5. Results

### 5.1. Factor 1 – science-based agricultural regulation

This factor—Science-based Agricultural Regulation—is a discourse that accepts the scientific consensus that agricultural practices degrade the aquatic environment of the Chesapeake Bay. This discourse stresses that the economic structure of the chicken industry drives such practices, and that large poultry companies such as Perdue should be held responsible for the damage done to the Chesapeake Bay. This discourse also has a tempered view of agriculture's environmental impact by recognizing that there are land uses that could have worse environmental outcomes, such as widespread urbanization, and that agriculture provides certain environmental goods through the maintenance of open space. F1 stresses, however, that such open spaces need to be regulated, and that BMPs are needed to make agricultural spaces environmentally friendly. The discourse's high loading respondents were scientists, environmentalists, and state regulators. No farmers loaded high on F1 (see Fig. 3).

This discourse also aligns with the broader scientific consensus concerning the role of agriculture in water quality degradation. Statement 31, for example, was taken from a scientific review article on the Chesapeake Bay, and scored the highest on this discourse (+4, 1.64). It reads: "There is very strong evidence that agriculture is the single largest source of nitrogen, phosphorous, and sediment going into the Chesapeake Bay". One high loading respondent, a research scientist, elaborated on this view:

> … if you take a sample of nitrate in the stream water you can predict within about five or ten percent how much row crop agriculture's upstream. It's just a good tracer; very strong evidence for that. That's true not just in the Choptank, it's true throughout any coastal plain setting without lots of forests and mountains. That's a good relationship; so it's very clear that agriculture is a big driver (Interview with Environmental Professional, 2013).

Under this discourse, the scientific data concerning the linkages between agriculture and the Chesapeake Bay are not open to serious question, and should serve as a starting point for discussions around regulating agricultural practices.

While F1 is closely aligned with scientific assessments concerning agriculture's contribution to water quality degradation, it also attributes the drivers of this degradation to the economic structure of the poultry industry, and calls for increased regulation of how large poultry companies such as Perdue operate in the area. For example, F1 asserts that large poultry companies need to be held responsible for a farm's Best Management Practices. This view is expressed by strong agreement with statement 14 (+3, 1.70): "If you are under a contract with Perdue to grow their chickens, and they control every aspect of growing those chickens, they should be paying to put these Agricultural Best Management Practices in." During interviews, many environmental activists repeatedly criticized Perdue, a large-scale poultry industry with many contract farmers in the Delmarva Peninsula. The belief that the big chicken industry on the Eastern Shore should be held to the standards of environmental regulations is affirmed in F1. One environmental professional put it this way:

> People think they're getting cheap chicken and they're not getting cheap chicken because if the price of chicken reflected all the taxpayer subsidies that go in to the industry to grow chickens—both in crop and animal production—the price of chicken would be much closer to what organic chicken costs in the grocery store, but people don't see that and most people don't make that connection or they

**Table 3**
Z and rank score for Q-Sort statements.

| | F1 Science-based Agricultural Regulation | | F2 Contested Knowledge and Blame Shifting | |
|---|---|---|---|---|
| | Rank | Z-Score | Rank | Z-Score |
| 1.Because of regulations like nutrient management farmers and supporting businesses are starting to become less competitive. | −1 | −0.73** | 1 | 0.41** |
| 2.University researchers in extension feel that you can take a half-acre research plot and apply it to thousands of acres and it'll work. Farmers try and it doesn't work because you can micromanage a half acre but you can't micromanage thousands of acres. | 0 | 0.29* | −1 | −0.23* |
| 3.The root environmental problem is that farmers are over applying nitrogen fertilizer because recommendations are based on 1950s science. | 0 | −0.38** | −3 | −1.43** |
| 4.You can't tell if Agricultural Best Management Practices are effective because there is still groundwater entering waterways that's 10 or 15 years old. | −1 | −0.78** | 1 | 0.61** |
| 5.Regulations are preventing farmers from being good stewards of the land. | −3 | −1.48** | 0 | 0** |
| 6.It is unfair to farmers that state road vehicles found alongside highways can apply growth regulators on the grass, but farmers are not allowed to put chemicals within 55 feet of a well head or intermittent stream. | 0 | 0.32** | 2 | 0.98** |
| 7.It is unfair to farmers that in the Chesapeake Bay Region there are millions of suburban turf farmers that apply tremendous amounts of nutrients, and do not need a nutrient management plan. | 1 | 0.79 | 3 | 1.11 |
| 8.Because of all the rain this year, the Cover Crop program is going to be a lot of wasted money. | −2 | −0.98** | −1 | −0.08** |
| 9.Farmers need to understand that excess fertilizer application is not profiting them. | 1 | 0.53 | 1 | 0.53 |
| 10.The bay is as clean right now as it was thirty years ago. | −4 | −1.57* | −2 | −1.11* |
| 11.Farmers have made progress in cleaning up the bay, but their successes are due to economic pressures not because of regulations. | −2 | −0.96* | −1 | −0.49* |
| 12. Agricultural Best Management Practices in the Chesapeake Bay Basin has resulted in very little benefit to water quality. | −1 | −0.82 | −2 | −0.55 |
| 13.Farmers should either quit farming or quit complaining about regulations. | −2 | −0.87** | −4 | −2.11** |
| 14.If you are under a contract with Perdue to grow their chickens and they control every aspect of growing those chickens they should be paying to put these Agricultural Best Management Practices in. | 4 | 1.64** | 0 | 0.14** |
| 15.Farmers have massive chicken coops on their farm with huge rooftops. There's more impervious surface on chicken coops than a Wal-Mart. Yet, they're not regulated the same way as a Wal-Mart just because they are a farmer. | 1 | 0.38** | −3 | −1.27** |
| 16.An Agricultural Best Management Practice is a set of practices that are the most effective, economically practical means of controlling point and non-point pollutant levels compatible with environmental quality goals. | 1 | 0.90 | 1 | 0.78 |
| 17.Widespread use of Agricultural Best Management Practices on Bay region farms could reduce the amount of nitrogen pollution going into the Bay from nonpoint sources by as much as 60 percent. | 2 | 0.99** | −1 | −0.13** |
| 18.The poultry industry is the only industry in the state of Maryland where the company that produces the waste isn't responsible for paying for its cleanup. | 3 | 1.46** | −2 | −0.84** |
| 19. With population growth the number of rules made to keep that population viable also increases. | −1 | −0.21** | 1 | 0.42** |
| 20.It is not productive for a county commissioner to say, “you know, they're just farmers and farmers just want to farm. We should stop putting roadblocks in front of them.” A house builder just wants to build houses. Why does he have to worry about how he wires up the house? He just wants to build houses. | 2 | 0.94** | 0 | −0.03** |
| 21.There are regulators from Washington DC who cannot tell the difference between corn and soybeans. | 0 | −0.35** | 3 | 1.21** |
| 22.The most effective regulators are people who came up from the industry of whatever it is they're regulating because they understand what actually happens. | −2 | −1.05** | 2 | 1.1** |
| 23.Even if farmland is polluting it is best to keep it because open space gives you a lot of options. Once you develop it, once you take it out of open space into anything else, then you lose those options. | 3 | 1.16** | 1 | 0.54** |
| 24.The 100-acre family farm is a thing of history. | −3 | −1.13** | −3 | −1.86** |
| 25.Pfiesteria should not be blamed on chicken manure because of all of the sewage being pumped into the bay right in the port of Baltimore. | −4 | −1.61** | 4 | 1.26** |
| 26.Farmers are paranoid because they know they're part of the problem, so farmers are circling the wagons trying to protect what they see as a threat to their livelihood. | 1 | 0.54** | −2 | −1.17** |
| 27.Because of regulations, if commodity prices dropped, and there was some development pressure, farmers would probably lose farmland pretty quick. | −1 | −0.47** | 2 | 0.82** |
| 28.A cleaner bay is going to make it more expensive to live in the Chesapeake Bay basin. | 0 | −0.11 | 0 | 0.14 |
| 29.People focus on the scientific models so much that they tend to ignore reality based evidence. | 2 | 0.91 | 2 | 0.96 |
| 30.The number of people in a watershed is strongly correlated with how much nitrogen and phosphorous is in a stream or in a river. | 3 | 1.41 | 3 | 1.25 |
| 31.There is very strong evidence that agriculture is the single largest source of nitrogen, phosphorous and sediment going into the Chesapeake Bay. | 4 | 1.64** | −4 | −2.01** |
| 32.Many farmers put in poultry farms because they had kids who wanted to come back to the farm, and could not provide that option on just corn and soybeans. | 0 | −0.21 | −1 | −0.3 |
| 33.If farmers used only commercial fertilizer instead of chicken litter in Maryland, there would be no public outcry at all. The Bay may not be any healthier, but the public would be happier. | −3 | −1.09** | 0 | 0.01** |
| 34.Farmers are not the only ones to blame. Just look at the number of homes around the bay and how much they fertilize. | 2 | 1.04 | 4 | 1.35 |

** Indicates distinguishing statement (where $p < 0.01$).
* Indicates distinguishing statement (where $p < 0.05$).
In a two-factor solution, distinguishing statements are common to the two factors.
Statement position on Q-Sort grid is expressed in rank.

> don't even understand how much subsidy money goes into propping up these industries (Interview with Environmental Professional, 2013).

Finally, while the F1 discourse attributes the degradation of water quality to agricultural practices, and holds large corporations responsible for such practices, the discourse nevertheless recognizes the environmental value of farmland. For example, statement 23, which loads high in F1 (Rank +3, Z-Score 1.16), states: "Even if farmland is polluting it is best to keep it because open space gives you a lot of options." F1 discourse stresses that there is a limit to what regulation can accomplish and that developed land is more difficult to improve in terms of run-off than intensive agriculture. Another high loading respondent, a research scientist, explained it this way:

> … science indicates that your (farming) production areas, if they're well managed, is the next best thing for Muddy Creek and the Shenandoah Valley or the Chesapeake Bay compared to a well-managed piece of forest land (Interview with Environmental Professional, 2013).

This discourse also agrees that, for agriculture to meet its environmental potential, a suite of agricultural BMPs are an effective way to achieve such goals. This is reflected in positive agreement with statement 17: "Widespread use of Agricultural Best Management Practices on Bay region farms could reduce the amount of nitrogen pollution going into the Bay from nonpoint sources by as much as 60 percent." (+2, Z-score .99). In addition, there is support for more regulation, and frustration that this has not happened, as reflected in agreement with statement 18: "The poultry industry is the only industry in the state of Maryland where the company that produces the waste isn't responsible for paying for its cleanup." (+3, Z-score 1.46). There is also disagreement with some of the more skeptical ideas about BMPs. F1 disagrees with statement 1: "Because of regulations like nutreient management farmers and supporting businesses are starting to become less competitive" (+1, Z-score −.073). F1 also disagrees with statement 4 "You can't tell if Agricultural Best Maagement Practices are effective because there is still ground water entering waterways that's 10 or 15 years old (−1, Z score −.78). Both of these claims reflect common sentiments against BMPs along economic and ecological lines, and are rejected by the F1 discourse.

In short, this discourse views BMPs are effective tools for cleaning the Bay, and regulations, along with political pressure from outside actors (ie. from the "Western Shore") are necessary for the long-term sustainability of the area. As one environmental professional on the Eastern shore put it:

> … without the Western Shore votes we [people on the Eastern shore] woulda blown the environment away here to a much larger extent. I know people on the [Eastern shore] shore don't like [hearing] that, but screw 'em. (Interview with Environmental Professional, 2013).

### 5.2. Discourse factor 2 – contested knowledge and blame shifting

The second significant discourse, F2—Contested Knowledge and Blame Shifting—is a discourse that holds views that deeply contest scientific expertise concerning the impact of agriculture on the environment, while also emphasizing the importance of embodied, practical knowledge concerning farming. This discourse is also characterized by a strong suspicion against the intentions of "outsiders"—academics, politicians, and environmentalists—concerning the Eastern Shore. This discourse recognizes the water quality issues in the Chesapeake Bay, but ascribes this primarily to runoff from urban areas such as Baltimore. High loaders on the F2 discourse were all farmers and local agricultural extension agent farmers (see Fig. 3).

F2 discourse agrees with a range of statements that paint the intentions and abilities of "outsiders" in a negative light. For example, the discourse strongly agrees with the statement "there are regulators from Washington, DC who cannot tell the difference between corn and soybeans" (rank +3, Z-Score 1.21). Many respondents agreed with the sentiment that a lack of such common knowledge often leads to counterproductive regulations from the state. One farmer points out that:

> If they [regulators] don't have that life skill because they only ever worked in an office doing whatever paperwork they did, they don't have any practical application of that knowledge, and that's a big difference (Interview with Eastern Shore Farmer, 2013).

Some farmers elaborated in interviews that regulations around the application of chicken litter may have unforeseen consequences on wet years. As one farmer puts it:

> When you get a real wet year, if [government] force us to go to commercial fertilizer, you could very well have to go out in the field and re-fertilize, put more nitrogen out, because everything is washed away you started with (Interview with Eastern Shore Farmer, 2013).

Paired with the distrust of "outsider" knowledge, F2 discourse strongly agrees with the idea that people brought up around agriculture are more capable to adequately regulate agriculture. For, example the discourse strongly agrees with the statement, "The most effective regulators are people who came up from the industry of whatever it is they're regulating because they understand what actually happens" (+2, 1.1).

F2 also disagrees with the forms of scientific knowledge that received strong agreement in the F1 discourse. The F2 discourse strongly disagrees with statement 31: "There is very strong evidence that agriculture is the single largest source of nitrogen, phosphorous and sediment going into the Chesapeake Bay" (rank −4, Z-Score −2.01). This statement is something that F1 discourse and scientific research are generally in strong agreement with, and garnered a +4 in the F1 discourse. The F2 discourse instead points to other processes as the primary sources of pollution. The discourse, for example, strongly agrees with the statement 25: "*Pfiesteria* should not be blamed on chicken manure because of all of the sewage being pumped into the Bay right in the port of Baltimore." (+4, 1.26). Attention to non-agricultural sources of pollution was a common theme during interviews as well. In a typical comment, one farmer asserted:

> Most homes on the water aren't poor people's homes where they don't care if the grass grows or not. Most people's homes like that got real good looking yards. Real good looking yards require a lot of fertilizer. There's a lot of runoff. Just all the factories and stuff up and down the bay. I mean everything's contributing to it. Not just us. I think we were just the easiest one to point the finger at (Interview with Eastern Shore Farmer, 2013).

Interviewees who are from the Eastern Shore felt that agriculture was unfairly targeted and that agriculturalists should not and cannot clean up the Bay by themselves. In interviews, farmers would continually bring up "wealthy homeowners" as culprits to the pollution problem of the Bay. They live on the waters edge and, as one respondant put it: "… use fertilizer year round and destroy their riparian buffers (vegetative buffers) along with the industrial port (Baltimore)". Another farmer elaborated:

> It goes right back to we're not criminals here. We don't need to be treated like we are. We're not out tryin' to destroy the bay. We're tryin' to make a livin'. We certainly are not the only ones that are to blame here. I mean when you take the number of houses around the bay and how much fertilizer they're puttin' on (Interview with Eastern Shore Farmer, 2013).

The F2 discourse expresses support for the same skeptical sentiments about BMPs, that F1 opposes (statements 1 and 4). It was neutral

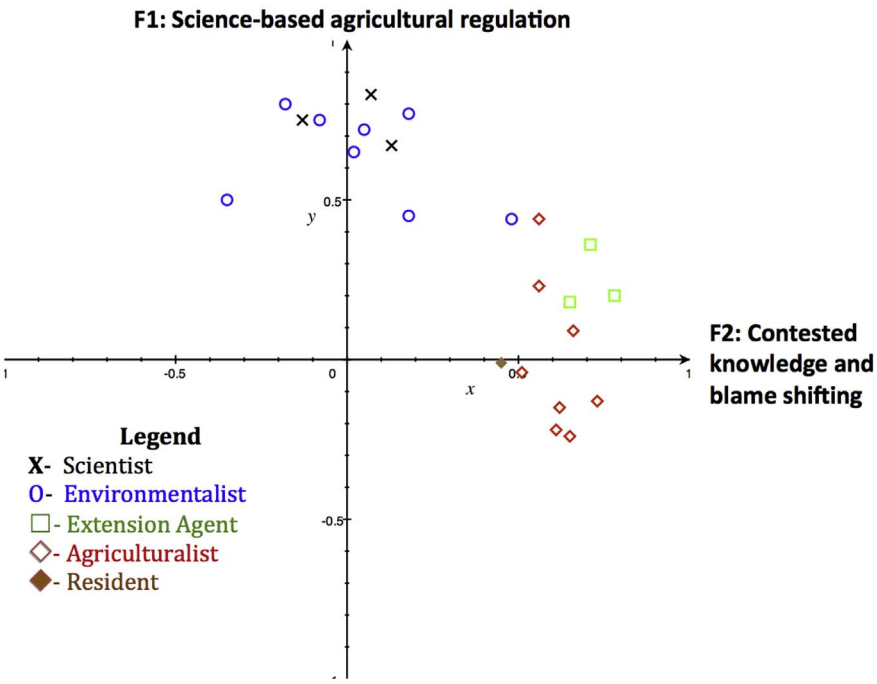


**Fig. 3.** Participant loadings on Q sort discourses. This figure is a graphic representation of how all of the subjects that performed a Q sort lined up in relation to the two significant factors. A loading above .5 is considered a significant loading. The higher loading a person is, the more their individual sort conformed to extracted factors. One way to think about it is the higher that one loads on an axis the more that actor "agrees" with the discourse. All significant loading actors for the F1 discourse were scientists and environmentalists. All significant loading actors for the F2 discourse were agriculturalists and extension agents.

on statement 15 (0; Z-score .14), which states that Purdue should pay for BMPs (this statement garnered a +4 in the F1 discourse). It also agreed with statements 6 and 7, which expresses the basic unfairness of applying BMP regulations to farmers but not state agencies and suburban homeowners.

Many of the statements in the F2 discourse are, in many ways, the polar opposite of F1's. This is not surprising as environmentalists, scientists, and regulators loaded high on Factor 1 and agriculturalists loaded high on Factor 2. There is a clear and distinct polarization regarding attitudes surrounding which types of land-use affects water quality in a particular watershed. The high-loading statements in both F1 and F2 do shed light into the ways in which attitudes are polarized. Contestations around expertise and land-use policy are two main themes that appear to shape the polarization expressed between F1 and F2.

### 5.3. Consensus statements

There were a number of statements that were not distinguishing for either sort, and, in fact, had a degree of shared agreement or disagreement between the two discourses (see Table 4). Both factors agree that the Chesapeake Bay is more degraded today than in the past, as they both disagreed with the statement that "the Chesapeake Bay is as clean today as it was thirty years ago" (statement 10), although F1 more strongly disagreed with this statement. There is also relatively strong agreement (+3 for both factors) for statement 30: "The number of people in a watershed is strongly correlated with how much nitrogen and phosphorous is in a stream or in a river." It is interesting to note that all types of actors—environmentalists, regulators, scientists, and farmers—point to population growth as a driver of excess nutrient loads. There is also agreement between factors that farmers are but one of many land users that pollute the Bay (statement 34: "Farmers are not the only ones to blame. Just look at the number of homes around the bay and how much they fertilize") with the farmers in F2 agreeing more strongly (+4) than those that loaded high on the F1 discourse (+2). This agreement is consistent with both discourses, as F1 does acknowledge the open land benefits of farmers while F2 had a number of instances of shifting pollution blame to farmers.

Both factors are in agreement with the statement that "people focus on the scientific models so much that they tend to ignore reality based evidence" (statement 29). TMDL loads for the Chesapeake Bay are determined by models, but there has long been a contingent of scientists that questioned the accuracy of models, and have advocated for more, and better, use of actual empirical data in setting policy (Layzer, 2015). This debate in the scientific and policy world has extended to farmers as well, especially since many of the early Bay models have been proven to be inaccurate. Scientific critics of the models, however, have charged that the models often underestimate the extent to which land users contribute to nutrient loadings in the bay (Blankenship, 2000; Layzer, 2015). Given the contours of the F2 discourse, it seems unlikely that farmers distrust models for the same reasons as scientists. While both of the discourses considered in this study are in agreement that over-reliance on models is bad (both F1 and F2 rated this a +3), the polarizing views over other scientific statements suggest that it is likely that their agreement belies more fundamental differences over the health of the Bay.

Finally, shared disagreement between the factors suggests that there is common ground over rejecting some of the more polemical statements about BMPs and the health of the Bay. Both factors disagreed with statement 10—"the Bay is as clean right now as it was thirty years ago"—as well as statements 11 and 12, both of which suggest that regulations and BMPs have little effect on water quality. Within Q methodology consensus statement are those that fail to distinguish between factors, so their importance in interpretation is less than distinguishing statements (Brown, 1993). Nevertheless, it is instructive to view the areas where these two seemingly opposite discourses overlap, and to note that there is some point of common ground between these discourses.

## 6. Discussion

This paper's objective is to analyze the different discourses around best management practices that exist within and between various Chesapeake Bay stakeholders. It seeks to determine the different discourses around BMPs and land use change, and to map out where various actors line up in terms of their agreement/disagreement with these views, and understand why this is so. Another key objective of this paper is to understand the internal character of these discourses by

**Table 4**
Consensus statements by shared agreement and disagreement between discourses. Consensus statements are statements that do not distinguish between any of the two discourses (Sandbrook et al., 2013).

| | F1: Science-based regulation | F2: Contested Knowledge and blame shifting |
|---|---|---|
| **Shared Agreement** | | |
| 7. It is unfair to farmers that in the Chesapeake Bay Region there are millions of suburban turf farmers that apply tremendous amounts of nutrients, and do not need a nutrient management plan. | 1 | 3 |
| 9. Farmers need to understand that excess fertilizer application is not profiting them. | 1 | 1 |
| 16. An Agricultural Best Management Practice is a set of practices that are the most effective, economically practical means of controlling point and non-point pollutant levels compatible with environmental quality goals. | 1 | 1 |
| 28. A cleaner bay is going to make it more expensive to live in the Chesapeake Bay basin | 0 | 0 |
| 29. People focus on the scientific models so much that they tend to ignore reality based evidence. | 2 | 2 |
| 30. The number of people in a watershed is strongly correlated with how much nitrogen and phosphorous is in a stream or in a river. | 3 | 3 |
| 34. Farmers are not the only ones to blame. Just look at the number of homes around the bay and how much they fertilize | 2 | 4 |
| **Shared Disagreement** | | |
| 10. The bay is as clean right now as it was thirty years ago | −4 | −2 |
| 11. Farmers have made progress in cleaning up the bay, but their successes are due to economic pressures not because of regulations. | −2 | −1 |
| 12. Agricultural Best Management Practices in the Chesapeake Bay Basin has resulted in very little benefit to water quality. | −1 | −2 |

gauging how views of BMPs and views of land use change do or do not align with each other. In this discussion we will revisit our hypotheses and offer explanations for the results that we have seen.

The results from the Q sort confirm our first hypothesis, which is that the structural position of people in terms of their occupation, and where they live, was closely aligned with their attitudes toward BMPs, regulations, and the future of land use in the region. There was a striking polarization along lines based on occupation and geography. Fig. 3 provides a graphic representation of the overall level of polarization. Most of respondents were significant loaders on either the F1 or F2 discourse, and these loadings break along the extent to which the respondent was involved in agriculture. The clearest point of polarization was the strong loadings concerning the state of nutrient pollution in the Chesapeake Bay. Statement 31 would be an uncontroversial statement in a scientific grant application, peer reviewed paper, or in a policy briefing among state regulators, and yet it received the highest level of disagreement among high-loading respondents in F2 – farmers and extension agents.

Other distinguishing statements were similarly polarizing. Statement 25, blaming a Pfiesteria outbreak from the 1990s (a major environmental event in the state) on urban sewage was a distinguishing statement for both discourses, but with polar opposite responses to it, F1 disagreed with it while F2 agreed. Statement 22 was another distinguishing statement for both discourses. It posits that regulators from within the agricultural industry have the best knowledge and therefore are the most effective. F1 disagreed with this statement while F2 supported it.

There was also general disagreement over BMPs between these two discourses. The F1 discourse—which had non-agricultural loaders—-agreed with statements that favored further BMP regulation (statement 14), claimed positive results from BMPs (statement 17). These statements were negative or neutral on the F2 discourse. Statements that expressed skepticism about the efficacy of BMPs (statement 1 and 4) were positively rated by F2, and negative by F1, and statements that expressed the basic unfairness of agricultural BMPs were positively rated by F2. There was some clear common ground between these discourses over BMPs. Consensus statements show a common rejection of the most polemical statements against BMPs (statement 12) and agreement with a stock, positive definition of BMPs (statement 16).

Despite some points of common ground, there is more polarization than agreement over ideas about BMPs and the future of land use. We suggest that the more polarized positions can be explained by looking within the results of the Q study itself. Specifically, we argue that the 2nd hypothesis is also confirmed, and that the respondent's views of BMPs are aligned with their views of land use change. The coupling of these two views can help explain the polarization suggested by hypothesis one. For those that loaded high on the F1 discourse, land use was understood primarily in terms of overall environmental tradeoffs, and farming was seen as one of many competing forms of land use, each with specific kinds of impacts on the overall watershed. This understanding of land use change was paired with a managerial and technical approach toward controlling nutrient outflows, of which BMPs are a key tool for doing this. For those who aligned high on F1 environmental problems were issues of correctly managing inflows and outflows, and with the right data and techniques, these flows can theoretically be controlled with the right tools.

The farmers that loaded high on F2, however, understood land use and environmental change in terms of the more practical knowledge, and as something that occurs within the seasonal rhythms of agriculture, and more long-term temporalities of environmental change. Under this view of land use, nature is often unpredictable, and more resilient, than people often understand, and the best way to know how land use and environmental change unfolds is to “be there” among it. Hence, statements such as statement 25 (denying that a Pfiesteria outbreak was caused by agriculture) received positive scores, while scientific assessments like statement 31 (strongly linking agriculture to nitrogen and phosphorus in the Bay) received negative scores. Awareness of competing land uses exist, but the centrality of embodied forms of practice and knowledge is paired with attitudes toward BMPs that are more subjective. BMPs are not just tools for managing flows, but are techniques that only “work” if they do not interrupt forms of practical, everyday, living on the land. During pre and post-sort interviews, it was common to hear farmers talk about the environment in terms of stewardship, and how they are stewards of the land. To those that load high on F1, this may appear contradictory—how can one claim to be a good steward of the land yet ignore evidence that their practices are hurting the environment? However, this is less of a contradiction when it is clear that the ways of knowing the impacts of land use change are deeply contested.

### 6.1. Blame shifting and place making

We suggest here that these patterns can be seen as the consequence of two processes. First, there is an active and ongoing practice of "place making", a broad term geographers have used to express the combination of feelings and experiences that produce an attachment to a particular locale (Tuan, 1991; Cresswell, 2013). The polarization over statement 25 is illustrative of this sense of place in action. The so-called "Pfisteria hysteria" was a Pfisteria outbreak detected in the Chesapeake Bay in 1997. The outbreak was largely blamed on agricultural outflows, and was a key contributing factor to subsequent agricultural regulations (Paolisso and Maloney, 2000). This event was continually brought up in interviews as a prime example of the ways in which those living outside of the Eastern shore lack the ability to understand the complexities and nuances of that place.

A number of defining statements for F2 reinforces a pattern of blame shifting among the farmers and regulators that loaded high on this discourse. Statements 6, 7, 25, and 30 all place the blame for the Bay's pollution on non-agricultural actors: state highway agencies, suburban lawns, sewage from Baltimore, and population growth in general. All of these statements received positive scores from the F2 group. Statement 18, which places the blame for the Chesapeake Bay's pollution more squarely on chicken farmers, garnered a negative score from the F2 group. In short, this "us vs. them" attitude is consistent with significant discourses found in this Q study. The F2 discourse is blames outsiders for pollution, and denies the primary role of agriculture in this process.

It is also notable that many of the Q statements in F2 talked as much about regulations as much as BMPs. These statements were included in the sort because they reflected what was found consistently across interviews – many farmers actively conflated voluntary BMPs and other kinds of regulations. Both were commonly seen as impositions from outsiders, even if farmers readily implemented BMPs if it made "economic sense".

The results presented here are both similar to, and divergent from, the findings of Paolisso and Maloney (2000), who have assessed the different attitudes toward the environment among diverse actors in the Chesapeake Bay, albeit with different methods. These authors have argued that farmers and environmental professionals have similar understandings of environmental issues, but come to interpret them through different cultural lenses concerning nature, land, and the economy. This view sees the quality of the environment and the economic success of a farm as intricately linked. For example, many farmers bristled at the nutrient management plan requirement as an unnecessary burden. It was a common sentiment to hear that no rational farmer would apply more nutrients than needed. This was seen as good economic sense that also translated into good environmental stewardship as well. Under this view, nutrient management plans simply become an unnecessary burden imposed by the state.

Paolisso and Maloney also found a feeling among farmers that nature cannot be understood completely and is unpredictable. This is in contrast to the aspirations of physical scientists that seek to transcend such limitations with science. A similar process is at play with actor understandings of BMPs and land use change, where one's assessment of the efficacy of BMPs and pollution control generally tracked how one understands changes in land use. But where Paolisso and Maloney found points of shared agreement between farmers and environmentalists, the results of the Q methodology found comparatively less common ground. Land users and non-land users do have some common ground that can be seen from the consensus statements. There is agreement that there is something amiss environmentally with the Chesapeake Bay, and there is some agreement that this is related to changes on the Eastern Shore. This can be seen in the agreement over statements that ascribe population growth and new housing to Bay pollution. There is even agreement that the models that inform policy toward the Bay are far from perfect. But when it comes to assessing the role of agriculture in polluting the Bay, and the weight given to Best Management Practices in fixing the Bay's problems, there was little common ground.

## 7. Conclusion

In this paper, we have used a Q methodology to examine different stakeholder perspectives concerning agricultural best management practices and nature of land use change within part of the Chesapeake Bay watershed. We found that within discourses there is a level on internal consistency between understandings of land use change and attitudes toward BMPs. We also found high levels of polarization across discourses, and a sorting of actors between land users and non-land users. Assessments of agriculture's role in environmental degradation and the role of BMPs in the landscape were deeply divided between farmers and non-farmers.

Our findings contribute to current research on BMP adoption by adding more intensive empirical details around what constitutes a stakeholder's environmental knowledge and their knowledge about BMPs. In various permutations, "knowledge" and "environmental attitudes" are two variables have long been mainstays in research on BMP adoption. There has often been little attention paid to how environmental knowledge and attitudes intersect with politically charged opinions that could potentially be the source of friction over BMP adoption. While this paper does not purport to measure how one's attitude about BMPs translates into adoption, it has shown the ways in which there is striking polarization over both environmental knowledge and attitudes toward BMPs.

This approach adds nuance to past studies that have rated farmer awareness in either binary terms, or that have deployed large scale N surveys (eg. Baumgart-Getz et al., 2012; Greiner et al., 2009). What such approaches do not measure, and what we have sought to show here, is how and why different actors comes to hold different views of agriculture and BMPs. The result is that the amount of information a respondent has about BMPs is less relevant than how this information comes to be interpreted and understood. This is in line with findings across the social sciences (eg. Paolisso and Maloney, 2000; Nyhan et al., 2014) that show that a subject's cultural and political frame for making sense of the world shapes the conclusion they draw from the information they have. As Nyhan et al. (2014) have shown with subjects concerning anti-vaccination beliefs, this effect can be so strong that a subject will often come to hold their belief more strongly *after* being presented with scientific evidence that contradicts this view. This state of affairs means that frequent calls for environmental education are potentially ineffective at best unless the cultural and political frames that subjects use to make sense of information is carefully considered. Many farmers would rate themselves as having a high level environmental awareness and positive environmental attitudes. That very same farmer, however, would also deeply distrust mainstream science concerning the health of Chesapeake Bay water quality and the need for BMPs. How one might reconcile different frames for making sense of the environment and land use across diverse stakeholders—farmers, extension agents, environmentalists, and scientists—is beyond the scope of this article, but recognizing that such a gulf exists, and what its contours are, is a first step toward doing so.

Such findings therefore do have a practical result in that it is not clear if further farmer education or engagement will have the intended effect. The results presented here suggest limited efficacy of such approaches if they fail to consider the ways that particular knowledge claims about the environment are contested, and how understandings of BMPs are interpreted through one frame for making sense of these claims.

## Informed consent statement

Informed consent was obtained from all individual participants included in the study.

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