



Local Decision-makers' Perspectives on Roadside Revegetation and Management in Iowa, USA

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Received: 7 August 2020 / Accepted: 11 February 2021 / Published online: 18 March 2021
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Abstract

Environmental practitioners must understand those they collaborate with to implement programs that are both socially and ecologically effective. Practitioners who understand decision-makers' perspectives are better able to collaborate to lower political, financial, and cultural obstacles. In this study, we surveyed decision-makers involved with a voluntary environmental program in Iowa, USA. Iowa counties can choose to manage their roadside vegetation using an ecological approach, called integrated roadside vegetation management. Key decision-makers who decide whether a county has a roadside program are the county board of supervisors and the county conservation board. We used a mixed-mode design to survey the conservation board directors and chairs of the board of supervisors in each county. Our main goals were to understand the decision-makers' perceived benefits and barriers to having a roadside program in their counties, as well as the key factors influencing their decisions about roadside vegetation management. Safety, maintenance cost savings, and erosion control were the main factors that influenced decision-making, while pollinators and other wildlife received the least consideration. However, decision-makers in counties with a roadside vegetation manager were more influenced by pollinators and other wildlife compared to their counterparts in counties without a roadside vegetation manager. The main barriers to having a program include a lack of resources or other concerns being a higher priority. Emphasizing safety, cost savings, and erosion control benefits of roadside programs, and identifying ways to lower startup costs may increase buy-in with county decision-makers.

Keywords Roadside · Roadside revegetation · Integrated roadside vegetation management · Native plants · Decision-makers · Pollinators

Introduction

One of the greatest challenges many environmental practitioners face is garnering institutional and political support

for their programs and projects. Practitioners may skillfully promote a program's environmental benefits. However, political, financial, and cultural barriers, and/or a lack of trust in resource managers may prevent environmental programs from getting started or being successful even if decision-makers appreciate the environmental benefits of the program (Baker et al. 2014; Metcalf et al. 2015). Decision-makers can be broadly defined as anyone who is involved in a problem or its solution, such as scientists, grassroots organizers, government officials, landowners, and members of the general public (DeCaro et al. 2017). However, for the purposes of this paper we are most interested in those decision-makers who have the power to approve funding or create policies, such as government policy makers, business leaders, and advisory boards. Through their decisions they determine if environmental programs receive the necessary financial and political infrastructure to proceed.

Understanding local decision-makers' environmental/conservation perceptions and the barriers to implementing

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00267-021-01448-z>.

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programs is important for gaining the support of communities and increasing project success (Mehta and Kellert 1998; Measham et al. 2011; Bennett 2016). This understanding can help practitioners such as environmental planners and natural resource managers focus communication efforts on program features that appeal to decision-makers and anticipate potential implementation barriers. Improving buy-in from local decision-makers is especially critical for programs that are largely voluntary and do not have an established regulatory nexus.

The goal of this study was to better understand how local decision-makers perceive roadside revegetation and management along county roadsides in Iowa, USA. The ecological and aesthetic value of roadside vegetation was increasingly recognized during the 1970s and 1980s in Australia (Huxtable 1994), northern Europe (Way 1977; Bretzel et al. 2009), Canada (Elmhirst and Cain 1990), and the United States (Saunders 1987; Dusablon 1988; Varland and Schaefer 1998). Iowa was the first area to incorporate the term “integrated roadside vegetation management” (IRVM) into statute (Berger 2005), and many US states have since developed IRVM plans (Armstrong et al. 2017). According to the National Roadside Vegetation Management Association, IRVM consists of “cultural, biological, mechanical, and chemical pest control methods to economically manage roadsides for safety plus environmental and visual quality” (Berger 2005). In Iowa, specific management techniques include seeding native plant species, judiciously spraying herbicides, strategic mowing, conducting prescribed burns, and removing brush (Brandt et al. 2015). Other areas of the world such as parts of Australia (Navie et al. 2010; New et al. 2020) and northern Europe (Lampinen and Anttila 2020; Phillips et al. 2020) use similar management techniques, whether or not they call their approach IRVM or the similar term Integrated Vegetation Management.

Prior to the development of IRVM, Iowa roads departments widely planted cool-season grasses, such as smooth brome (*Bromus inermis*) and tall fescue (*Festuca arundinacea*), when a roadside needed to be revegetated following construction or sediment removal (ditch cleanout) (Chittenden 1968; Smith 2004). However, these grasses require more frequent mowing and larger amounts of herbicides than native plants. Native plantings are more effective at outcompeting weeds once established (Smith 2004; Hillhouse et al. 2018). Moreover, cultural preferences shifted in the 1980s as citizens became increasingly concerned about the large amounts of herbicides sprayed on roadsides (Stone 1989; Weinzetl 1990; Drake 2020).

In 1988, the Iowa state legislature passed legislation stating that counties “may” adopt an IRVM plan (Iowa Code 314.22). During the same year, the Iowa legislature also created the Living Roadway Trust Fund (Iowa Code

314.21), which is administered by the Iowa Department of Transportation. The fund includes an annual competitive grant program that provides funding for eligible equipment and activities for cities, counties, and applicants with a statewide impact. To our knowledge, Iowa is the only state in the USA that provides a stable funding source to support an integrated approach to roadside management along county roadsides.

Seeding native plants in roadsides, strategically using herbicides, reduced mowing, prescribed burns, and brush removal to manage roadside plants provides many benefits. Reduced mowing saves operational costs (Barton et al. 2005; Guyton et al. 2014) without leading to a proliferation of invasive plant species (Guyton et al. 2014; Wigginton and Meyerson 2018) or complaints from the public (Norcini 2014). Native plants can help control snow drifts (Forman et al. 2003) and reduce erosion (Forman and Alexander 1998) along roadsides. Because drivers are drowsier when roadside scenery is monotonous (Thiffault and Bergeron 2003), diverse roadside vegetation could also increase driver alertness, thus reducing crash rates (Mok et al. 2006). Herbaceous grassland roadside vegetation provides a softer landing for vehicles that leave the road compared to a wide area of grass that is mowed short (Harper-Lore et al. 2008).

Roadsides can also have considerable conservation value and serve as wildlife corridors that connect larger patches of habitat (Spooner 2015; Gardiner et al. 2018). In recent years, conservationists have become increasingly interested in creating or enhancing pollinator habitat within roadsides (Hopwood et al. 2015a; Underwood et al. 2017). Roadsides are in sunny locations conducive to pollinator foraging. Roadsides can also be one of the few public areas available for restoring diverse, native nectar and host plants, especially in areas dominated by row-crop agriculture. In Iowa, for example, ~60% of public land, or 420,733 hectares, consists of roadsides and, of that, 308,370 hectares consists of county roadsides (personal communication, Mark Masteller, Iowa Department of Transportation).

There are some concerns about pollinator mortality from vehicle collisions (McKenna et al. 2001; Keilsohn et al. 2018). Several studies suggest that mortality rates from collisions are a small proportion (0.6–10%) of the population, depending on the species, and providing habitat in landscapes where little exists may provide a net benefit to pollinators (Munguira and Thomas 1992; Ries et al. 2001; Zielin et al. 2010; Skoroka et al. 2013; Hopwood et al. 2015b; Muñoz et al. 2015). Pollinator mortality may be further reduced by managing vegetation for pollinators along roads with less traffic, in wider road verges (at least 2 m) wide, and areas away from the road (Phillips et al. 2019). Strategically timing mowing can benefit pollinators by increasing adult butterfly and monarch egg abundance (Halbritter et al. 2015; Knight et al. 2019). Further research

should be conducted to better determine the net advantages and disadvantages of roadside habitat to declining pollinator populations.

There has never been a systematic effort to understand Iowa county officials' perceptions of roadside vegetation management. We do not know if the conservation community's interest in pollinator conservation or other values, such as water quality, align with county decision-makers' priorities. Key county decision-makers who decide if a county will have a roadside vegetation program include the county engineer, county conservation board director, and the county board of supervisors, which controls the county budget. Counties that choose to have a roadside vegetation program typically have a dedicated roadside vegetation manager on staff or create a management plan, called an IRVM plan, that is filed with Iowa Department of Transportation (2020). Other counties request native seed from the Iowa Roadside Management office at the University of Northern Iowa to plant on their roadsides, although some may not widely implement other types of IRVM practices in their counties. Currently, nearly half of Iowa's 99 counties have a roadside vegetation manager on their staff and slightly over half have an IRVM plan on file (Fig. 1). All but 11 counties have requested native seed mixes at some point over the last 22 years.

An improved understanding of county officials' perceptions can help support existing programs and encourage new counties to start programs (Bennett 2016). Several studies consider public perceptions of roadside vegetation in the United States (Wolf 2003; Lucey and Barton 2011; Hale and Morzillo 2020), England (Akbar et al. 2003), Iran (Fathi and Masnavi 2014), Finland (Lampinen and Anttila 2020), and Germany (Weber et al. 2014). However, to our knowledge, only one other study, conducted in the north-eastern United States, considers government decision-makers' perceptions of the benefits and barriers toward incorporating native plants into roadside vegetation management (Campanelli et al. 2019). In that case, the greatest barrier to transitioning from using non-native to native plants for roadside revegetation was a lack of funding for state departments of transportation (Campanelli et al. 2019). Further research should investigate funding for local counties.

The survey findings reported here will help roadside vegetation practitioners, administrators, and others interested in local decision-making, better understand how county decision-makers perceive roadside vegetation management. Our main questions include: What influences have the greatest impact on roadside vegetation management decision-making? What are the decision-makers' perceived

COUNTY INVOLVEMENT WITH NATIVE ROADSIDE VEGETATION

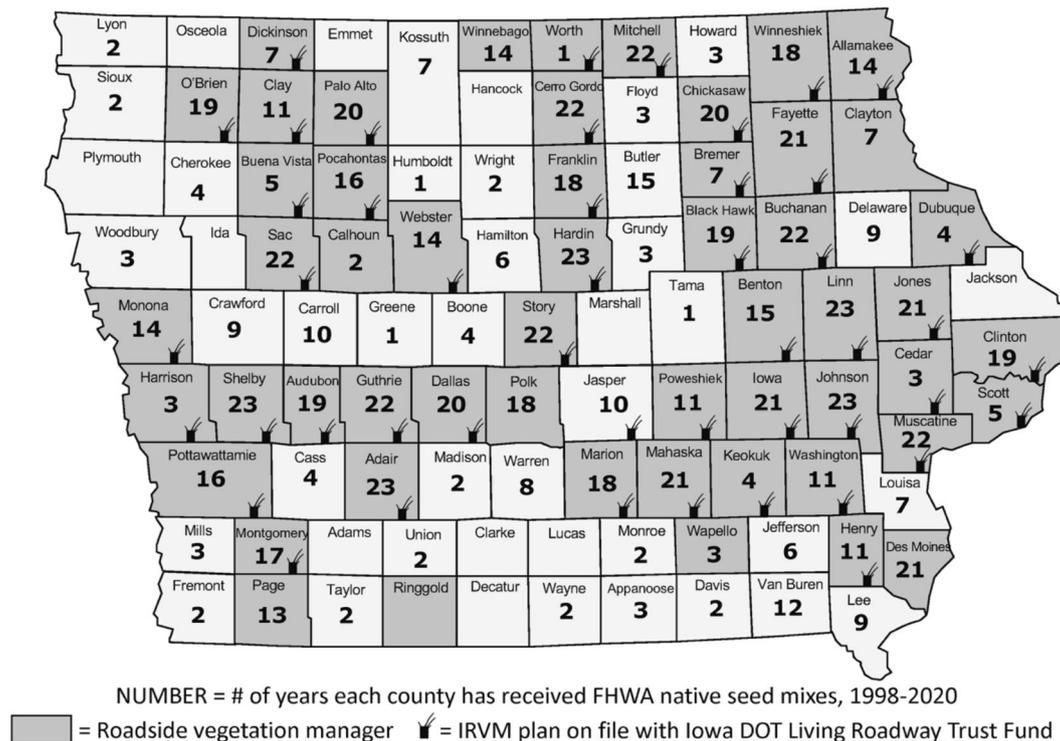


Fig. 1 Counties in Iowa that have a county roadside vegetation manager, an integrated roadside vegetation management (IRVM) plan on file with the Iowa Department of Transportation, and/or plant native

seed mixes in their roadsides with seed received through a Federal Highway Administration (FHWA) grant, as of 2020

benefits and barriers to implementing IRVM in their counties? How would they like to learn more about roadside vegetation management?

Materials, Methods, and Participants

Our survey was part of our community-based social marketing (CBSM) approach to working with counties. CBSM is derived from social science research and facilitates behavior change by delivering programs at the community level (McKenzie-Mohr 2011). It emphasizes lowering barriers and enhancing the benefits of a conservation behavior to encourage community members to implement the behavior. Studies indicate that public information campaigns may raise awareness of an environmental issue, but are not very effective in changing behavior (Kollmuss and Agyeman 2002; Mildemberger et al. 2013). Initiatives that incorporate principles of social sciences, such as social marketing or conservation psychology, can be effective in encouraging people to adopt conservation behaviors (Bennett et al. 2017; Cinner 2018; Green et al. 2019).

The five steps of CBSM are: (1) select on-the-ground behaviors a program wants to encourage community members to change, (2) identify barriers and benefits that a community faces in behavior change, (3) develop strategies to encourage change in behaviors, (4) implement a pilot strategy, and (5) broadly implement a successful pilot strategy. We report on how we applied phases 1 and 2 to our program.

First, we identified five roadside management behaviors that we were interested in: (1) planting native plants in roadsides, (2) managing plantings, (3) spot-spraying of herbicides to control weeds, (4) preserving roadside prairie remnants, and (5) evaluating success of plantings. Then, we assessed the knowledge and attitudes of Iowa county conservation board directors and county board of supervisors chairs to identify perceived barriers and benefits to implementing IRVM practices in their counties.

We sent questionnaires to the county conservation board director and chair of the county board of supervisors in each of Iowa's 99 counties. Each of these groups was surveyed separately because, in the context of our CBSM framework, each represents a different type of community with different roles, priorities, beliefs, and values. While county conservation board directors are focused on decision-making related to conservation management, members of the board of supervisors address many different needs and decisions within the counties, such as approving bonds and reports, economic development, and county budget and policy administration. County conservation board directors often have a natural resource background, while board of supervisors members typically come from a variety of other backgrounds, such as farming, business, health care, or education.

County conservation boards are appointed citizen volunteers who guide conservation program establishment (IACCB 2008). The county conservation boards are similar to other states' county parks and recreation departments (Meyer 2010). The conservation board hires a director to serve as its chief executive officer, responsible for overseeing all aspects of the county conservation department. Approximately 1/3 of Iowa county roadside vegetation managers are housed within the county conservation department. Nearly 2/3 are housed within the secondary roads department, reporting to the county engineer. The county engineers and roadside managers were the subjects of a different survey whose findings are not included here. Of the counties with a roadside program, five county roadside managers are independent, reporting directly to the county board of supervisors. Members of the county board of supervisors play a major role in determining county budgets and influencing the construction and maintenance of the county road system. The board may consist of three or five members, including the chair, and each member is elected every 3 or 4 years depending on county regulations (ISACS 2015).

Survey Administration

The Iowa State Association of Counties (ISAC) provided a list of all chairs of county boards of supervisors ($n = 99$) and county conservation board directors ($n = 98$) in early 2017. We collected data using a web–mail sequential mixed-mode design (de Leeuw and Berzelak 2016). Unlike single-mode approaches, mixed-mode surveys allow sampled members to answer the questionnaire using different modes, in this case mail and web surveys. Because online surveys were offered first, and paper questionnaires were only mailed to nonrespondents, our design was sequential. Mixed-mode surveys have become very popular in the last decades given their potential to reduce costs, improve response rates, and reduce coverage and nonresponse errors (de Leeuw 2018). We emailed the two groups on May 31, 2017 and sent e-mail reminders to nonrespondents on June 12 and June 20. We mailed a self-administered mail-back survey to those individuals who had not responded after the initial e-mail correspondence on July 19. We completed data collection on August 30. We received 113 completed questionnaires (63 from conservation board directors and 50 from board of supervisors chairs), resulting in response rates of 64% and 51%, respectively.

Variables and Analysis

The survey consisted of 30 questions. For the purposes of this study, four sets of questions were used, including

background information (gender, role, and time served), influences on decisions about roadside vegetation management, impact of IRVM practices, and barriers to implementation of these practices. The specific wording of the questions and response options (except for background information) is provided in the Supplementary material. The battery of questions assessing the impact of eleven aspects (e.g., public feedback, consideration of aesthetics) on decisions about roadside vegetation management was measured using four-point unipolar scales, ranging from “no impact” to “quite a bit of impact.” Visually separated from substantive responses, the option of “don’t know” and “prefer not to respond” were provided. Two batteries of questions explored barriers to using more native species and barriers to implementing IRVM practices (13 and 11 items, respectively). These were measured using four-point unipolar scales ranging from “not a barrier” to “significant barrier,” and offering “prefer not to respond” as an option, visually separated from the others. The second battery was contingent on a filter question (Are there, or were there, any barriers to your county’s implementation of IRVM practices?) and only asked to those respondents indicating the presence of barriers to their county’s implementation of IRVM practices. The last battery of questions queried respondents about the impact of IRVM practices on 21 dimensions of secondary roads (e.g., roadway safety, plant biodiversity). They were measured using five-point bipolar scales ranging from “worsen significantly” to “improve significantly.” “Prefer not to respond” was also offered.

For the analysis, descriptive statistics were computed. These included percentages, means, and standard deviations for each group (conservation board directors and board of supervisors chairs). Differences between the two groups were assessed using independent samples *t*-tests. We also used independent samples *t*-tests to analyze the data based on the presence or absence of a roadside manager and reported significant differences in the results. The counties with a roadside manager (Fig. 1) are considered to have the most active roadside programs since they have a dedicated person to implement the principles of IRVM along roadsides. We did not analyze the data based on the presence of an IRVM plan or history of seed requests. Some counties have an IRVM plan but no roadside manager. Sometimes a county develops an IRVM plan in preparation for hiring a roadside manager but may or not be implementing the principles of IRVM on a widespread basis in their county yet. Counties that have ordered seed mixes are implementing a key component of IRVM, the planting of native seed, but they may or may not be implementing the other aspects of IRVM—strategic, reduced mowing and herbicide use, for example.

Results

Respondent Characteristics

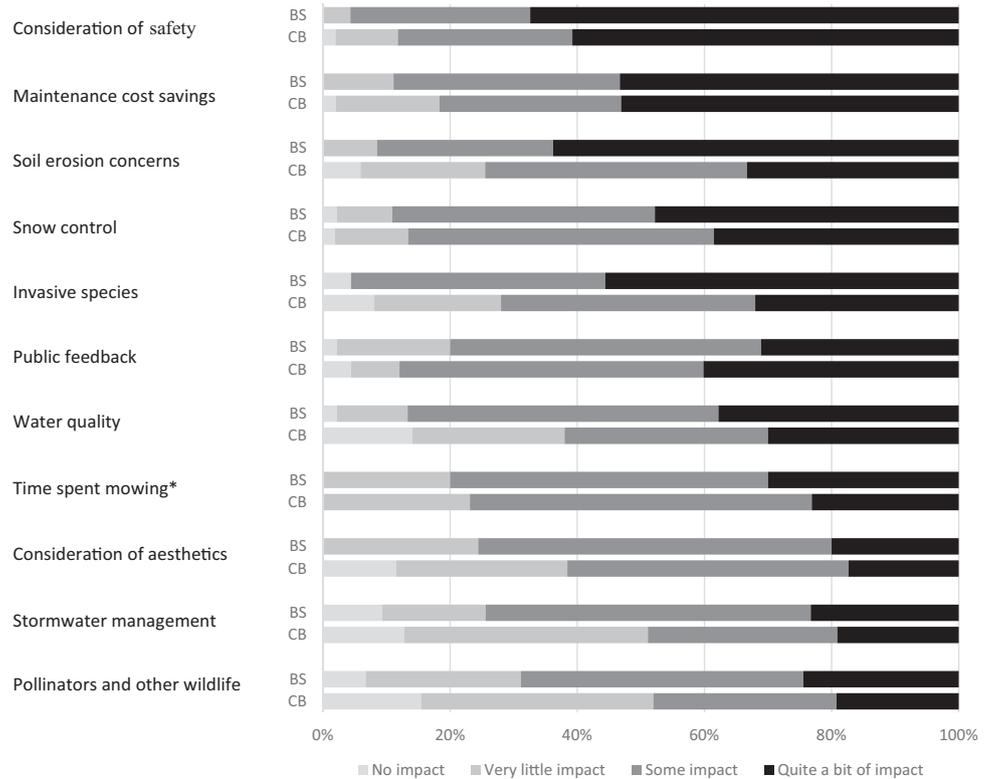
Of those who completed the questionnaire, nearly three-quarters (73%) of conservation board directors completed the online questionnaire, compared to 56% of board of supervisors chairs. A little over one-quarter (27%) of conservation board directors completed the mail questionnaire, while 44% of board of supervisors chairs completed the mail questionnaire. County conservation board directors reported having served in their roles for 15 years on average, while board of supervisors chairs reported having served in their roles for an average of 5 years. Nearly half of the conservation board directors (48%) and the board of supervisors chairs (49%) indicated that their county has a designated roadside vegetation manager. The vast majority of both conservation board directors (92%) and board of supervisors chairs (92%) were male.

Influences on Roadside Vegetation Management Decisions

Respondents identified the relative impact of different influences on roadside vegetation management decision-making in their counties. The two influences that were identified most often by both groups as having quite a bit of impact were “consideration of safety” and “maintenance cost savings” (Fig. 2). Two-thirds of board of supervisors chairs (67%) and 62% of conservation board directors identified “consideration of safety” as having quite a bit of impact on roadside vegetation management decision-making in their county. Slightly over half (53%) of respondents in each group indicated the same for “maintenance cost savings.” Board of supervisors chairs identified “soil erosion concerns” as having quite a bit of impact (64%) more often than did conservation board directors (33%). The board of supervisors chairs also identified “invasive species” (56%) and “water quality” (38%) as having more impact than the conservation board directors (32% and 30%, respectively). Finally, the practices identified most often as having no impact were “pollinators and other wildlife” for conservation board directors (15%) and “storm management regulations” for board of supervisors chairs (9%).

The presence of a roadside vegetation manager on the county staff increased the influence of some environmental values on decision-making. For example, conservation board directors in counties with a roadside manager had a significantly higher mean score ($n = 12$, $M = 3.42$ ($SD = 0.669$)) for the degree of impact that pollinators and other wildlife had on their decision-making compared to conservation board directors in counties without a roadside manager ($n = 18$, $M = 2.28$ ($SD = 0.895$), $t = 3.76$ ($df = 28$),

Fig. 2 Responses of chairs of the county board of supervisors (BS) and conservation board directors (CB) to the question “How much impact does each of the following items have on your county’s decisions about roadside vegetation management?”



$p = 0.001$). Similarly, chairs of the boards of supervisors in counties with a roadside manager had a higher mean score ($n = 27, M = 2.93 (SD = 0.874)$) for the degree of impact that pollinators and wildlife had on their decision-making compared to chairs of boards of supervisors without a roadside manager ($n = 7, M = 2.14 (SD = 0.900), t = 2.10 (df = 32), p = 0.044$).

Benefits of Integrated Roadside Vegetation Management

Respondents were asked to identify the impact that IRVM practices have on improving secondary roads. The dimensions that both groups saw as improving the most were roadside aesthetics, native plant use, water quality, soil health, and plant biodiversity, with the conservation board directors seeing these as significantly improving to a greater extent than the conservation board directors (Fig. 3). Both groups viewed short-term costs as improving the least. There were no significant differences in responses of either group when comparing counties that had a roadside manager to counties that did not have a roadside manager.

Barriers to Integrated Roadside Vegetation Management

Barriers to implementing IRVM practices were indicated more often by conservation board directors (42%) than

board of supervisors chairs (19%). However, a large percentage of both groups (conservation board directors = 46%, board of supervisors chairs = 48%) expressed uncertainty by indicating they were not sure whether there were or have been IRVM implementation barriers in their counties. Those who did indicate the presence of barriers were asked to identify the most important from a list of ten potential obstacles (Fig. 4). The top 3 barriers identified by both board of supervisors chairs and conservation board directors were “other concerns being given a higher priority” (56% and 33%, respectively), “lack of staff capacity/support” (33% and 44%, respectively), and “cost of starting a program” (44% and 28%, respectively). A separate item in the questionnaire asked respondents to rate the priority given to 11 different issues by their county’s board of supervisors. Both groups identified “repairing roads and bridges” as a moderate or high priority for their county’s board of supervisors. Other issues identified most often by both board of supervisors chairs and conservation board directors as high priorities were economic development, expanding recreational opportunities, farmland preservation, and environmental protection/conservation.

Barriers to Native Species Use

Respondents were asked to assess the degree to which a number of possible obstacles are or have been barriers to using more native plant species in their counties’ land

Fig. 3 Responses of chairs of the county board of supervisors (BS) and conservation board directors (CB) to the question “Please indicate, how you believe IRVM practices affect each of the following dimensions of secondary roads.”

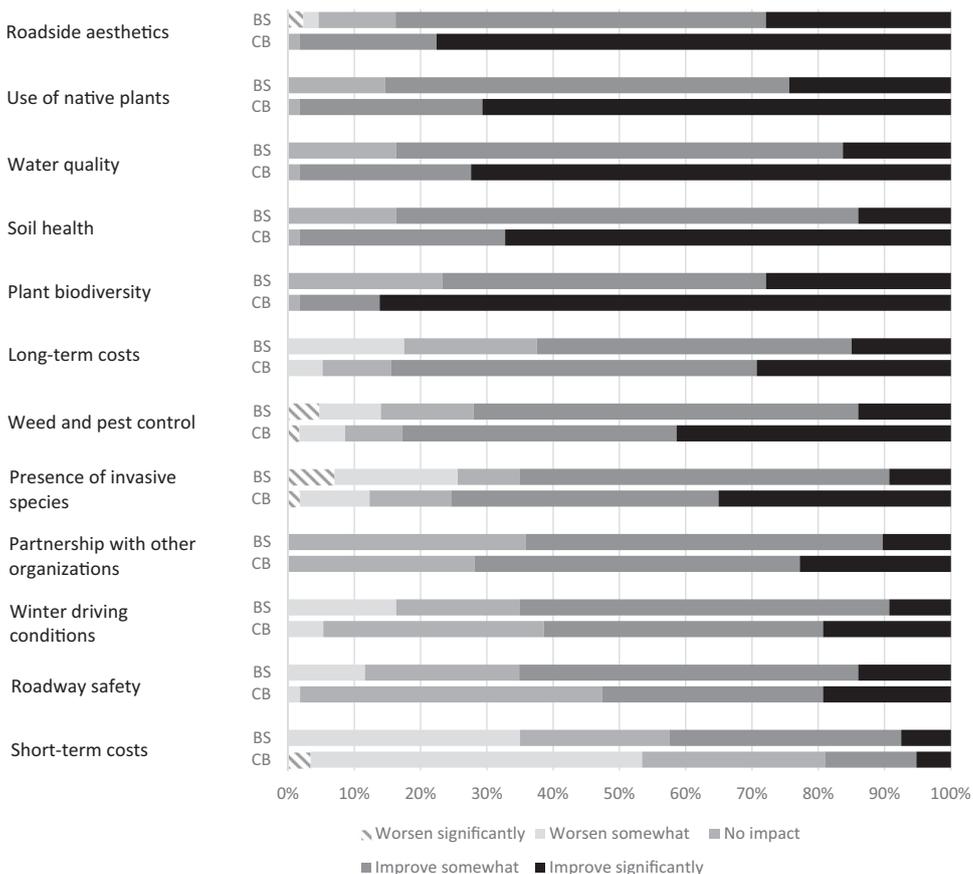


Fig. 4 Responses of chairs of the county board of supervisors (BS) and conservation board directors (CB) to the question “Which of the following have been or currently are barriers to your county’s implementation of IRVM practices?”

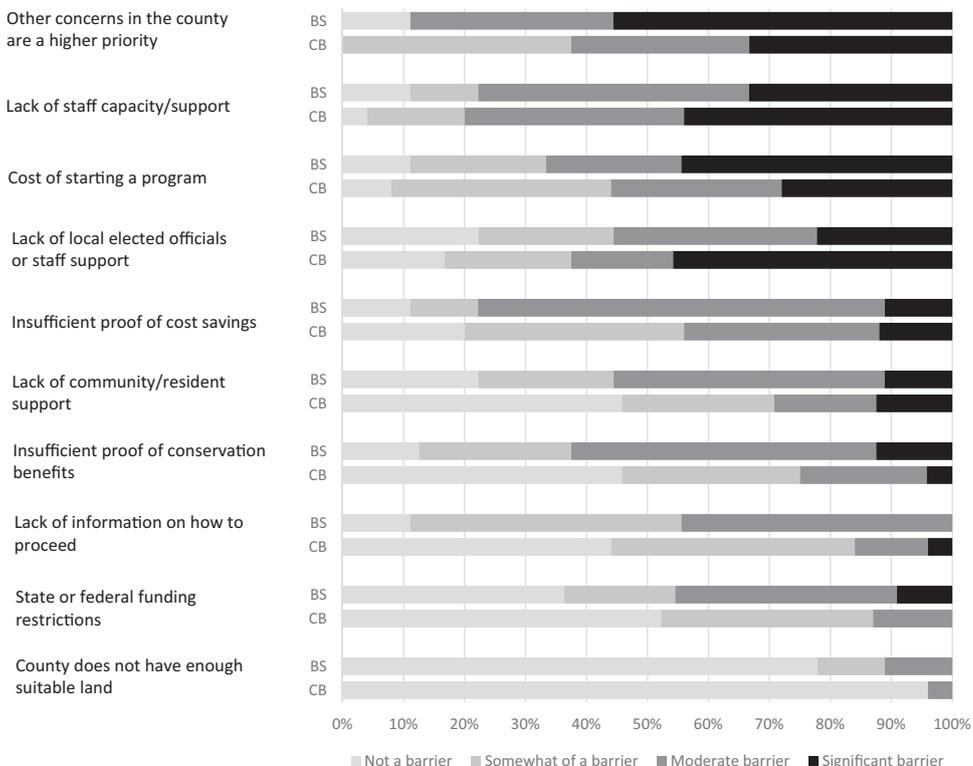
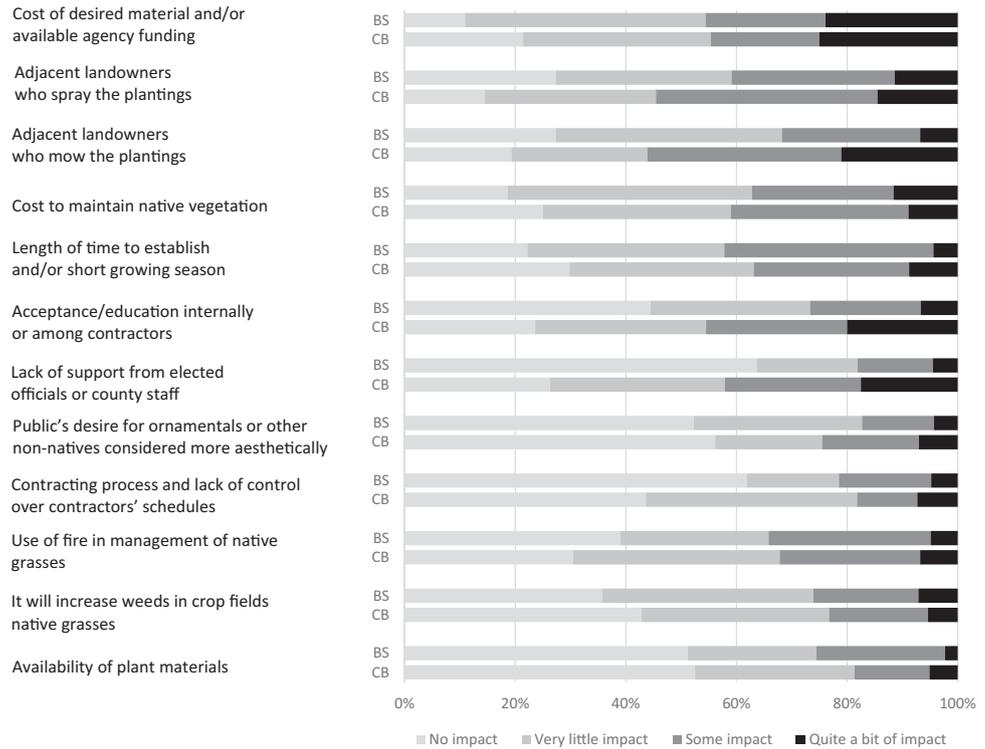


Fig. 5 Responses of chairs of the county board of supervisors (BS) and conservation board directors (CB) to the question “Which of the following have been or currently are barriers to your county using more native species in any land management projects?”



management projects. Approximately one out of four respondents in both groups (24% of board of supervisors chairs and 25% of conservation board directors) identified the “cost of desired material and/or available agency funding” as a significant barrier (Fig. 5). One in five conservation board directors (20%) indicated “acceptance/education internally or among contractors” as a significant barrier for the use of native species. A majority of conservation board directors identified issues with adjacent landowners “mowing” (56%) or “spraying the plantings with herbicides” (55%) as moderate to significant barriers for the use of native species. Approximately one-third of both groups identified the “use of fire in management of native grasses” (32% of conservation board directors and 34% of board of supervisors chairs) and “length of time to establish and/or short growing season” (37% of conservation board directors and 42% of board of supervisors chairs) as a moderate to significant barrier.

The questionnaire also asked respondents about concerns regarding local prescribed burns. The main concerns regarding local prescribed burns for board of supervisors chairs and conservation board directors were “damage to private property,” “liability,” and the “levels of smoke.” A majority of boards of supervisors chairs (55%) and four in ten conservation board directors (41%) expressed moderate or great concern about the damaging effects of prescribed burns to private property. Similarly, 54% of board of supervisors chairs and 47% of conservation board directors showed moderate or great concern about the levels of smoke produced by prescribed fires.

Methods for Receiving Information about IRVM Practices

Half of the board of supervisors chairs (50%) and conservation board directors (51%) indicated that they were interested in receiving more information about IRVM practices. Respondents were asked in an open-ended question how they thought information about IRVM practices would best be communicated to their county’s officials. Suggestions included creating information resources, including pamphlets, brochures, newsletters, emails, or websites that could be shared with county supervisors as well as conservation and secondary roads departments. Additional suggestions included in-person presentations at county meetings or annual workshops, including the ISAC annual conference.

Discussion

This study indicates some differences between local decision-makers’ and environmental practitioners’ priorities when managing roadsides. For example, many practitioners value roadside vegetation as potential pollinator habitat (Wojcik and Buchmann 2012; Thogmartin et al. 2017; Cariveau et al. 2019; Rights-of-Way as Habitat Working Group 2020). However, both the conservation board directors and board of supervisors chairs indicated pollinators as an insignificant consideration when determining

how to manage roadsides. Plant communities seemed to be more important. Both groups acknowledged that IRVM practices were likely to improve “use of native plants,” “plant biodiversity,” and “presence of invasive species.” Most believed invasive species had “some impact” to “quite a bit of impact” on their county’s decisions about roadside vegetation management, although we did not ask about how much the other two aspects of plant conservation factored into decision-making.

With safety listed as the highest consideration by both groups, it is imperative that practitioners are prepared to communicate how management activities, such as planting native plants or reduced mowing, impact safety. In one author (KN’s) experience, county officials’ greatest safety concerns are the effect of reduced mowing, resulting in taller vegetation, on deer–vehicle collisions and the perception that driver visibility will be affected. Counties that use IRVM principles continue to maintain a clear zone of short vegetation ~3 m wide adjacent to the road so drivers can see around the vegetation. To keep taller vegetation further from the road for driver visibility, roadside vegetation managers only seed native plants in areas away from intersections. Roadside managers also seed along the ditch backslope and the portion of the fore slope closer to the ditch bottom in areas without intersections.

Some residents are also concerned that white-tailed deer (*Odocoileus virginianus*) may forage and bed in roadsides planted with natives. Iowa roadsides consist predominantly of introduced or native grasses. In the Midwest, white-tailed deer consume more forbs, tree seedlings, and tree saplings than grasses (Anderson et al. 2001; Pruszenski and Hernández 2020). Although forbs are included within roadside seed mixes, grasses are seeded at higher rates for better erosion control on the steep roadside slopes. A study in Virginia, USA, observed white-tailed deer behavior along roadsides and found that white-tailed deer spent 0.5% of their time bedding on roadsides (Donaldson et al. 2015). Future research should investigate deer behavior along planted Midwestern roadsides.

Deer movement and the probability of deer–vehicle collisions are complex and differ among landscapes and regions. For example, Snow et al. (2018) found that in Midwest eco-zones dominated by agriculture, variations in traffic volume and abundance of deer were better predictors of deer–vehicle collisions than landscape composition. An Illinois, USA study found that the most important predictor of high deer/vehicle accident collisions was proximity to forest cover. This is likely since deer prefer to remain close to wooded cover when moving through an area or foraging (Finder et al. 1999).

Erosion control was another important factor in decision-making listed by both groups. In focus groups, New England state Department of Transportation workers also

indicated erosion control as a major benefit to their departments and that it was larger than the value of native plants to pollinators (Campanelli et al. 2019). Many native plants seeded along roadsides are effective in reducing erosion, although they may take a few years to develop their deep roots (Hopwood et al. 2016).

Roadside aesthetics were also a perceived improvement when managing roadsides using IRVM principles. A survey of Iowa residents found that 49% prefer the appearance of managed roadside prairie plantings, while 26% preferred a mowed, park-like appearance. Moreover, 25% preferred the appearance of roadsides that are periodically mowed for safety, but otherwise left alone, resulting in taller, but non-native vegetation (Mindfire Communications 2016). In England (Akbar et al. 2003) and Iran (Fathi and Masnavi 2014), residents prefer variety in vegetation types compared to monotonous, uniform vegetation.

To our knowledge, no other studies have evaluated the effects of IRVM techniques on water quality, which were also ranked highly as being improved by IRVM practices. However, narrow prairie strips (4 m minimum in width) planted at regular intervals within Iowa cropland are effective at reducing water runoff and soil erosion (Schulte et al. 2017). County roadside vegetation, which is also narrow in width (8–12 m), may reduce water runoff and soil erosion when it includes prairie plants. It is uncertain what effect roadsides’ greater slope may have on water quality improvements.

Board of supervisors chair and conservation board director perceptions of barriers are especially important, since an understanding of the barriers can help environmental practitioners better understand how to meet the communities’ needs and connect with decision-makers (Steinfeld 2007; Kotler and Lee 2008). The main barrier to implementing IRVM was other concerns in the county being a higher priority. Both groups indicated that repairing roads and bridges was the highest priority out of a list of 11 concerns. Like neighboring states, Iowa’s agricultural economy relies heavily on roads and bridges to transport products (Kulkarni and Shafei 2018). However, extreme weather events in recent years have resulted in an increasing number of deteriorating, aging bridges and roads that need repaired (Kulkarni and Shafei 2018; IASCE 2019). Roadside vegetation management was one of the two lowest priorities for the chairs and a moderate priority for directors. When there is a disconnect between environmental practitioners’ and decision-makers’ values, environmental practitioners may find it helpful to reframe the issue in terms of how it benefits the decision-makers’ priorities, whether it is human health or economics (Crowe 2020; Dearing and Lapinski 2020). In this case, because road and bridge repairs often disturb the adjacent roadside soil, roadside managers and officials who value roadside vegetation could

discuss the benefits of reseeding the disturbed soil with native vegetation.

The next two top barriers to implementing IRVM in general were related to a lack of resources—lack of staff capacity/support and cost of starting a program. Similarly, Campanelli et al. (2019) found that concerns about funding repeatedly came up when state DOTs in New England considered using more native warm-season grasses. Since maintenance cost savings is an important consideration for both conservation board directors and board of supervisors chairs, data showing long-term cost savings can be valuable. Some information is available for the economic benefits provided by ecological roadside management (Harrison 2014) and cost savings from reduced mowing and herbicide use along state highway roadsides (Barton et al. 2005; Guyton et al. 2014; Hopwood et al. 2015a; Wigginton and Meyerson 2018). Little data are available for cost savings at the county level, although some counties have quantified the cost savings from activities, such as reduced herbicide use (personal communication, Wes Gibbs, Jones County, Iowa). Since local jurisdictions, such as counties, can vary greatly in the types of roadside brush and noxious weeds they have to manage, it is more effective to provide cost savings data for counties with similar roadside vegetation. Planting native plants reduced maintenance costs along state roadsides in Indiana, USA (Herold et al. 2013) and urban roadsides in Germany because of reduced mowing and herbicide use (Mody et al. 2020). Startup costs such as educating contractors and employees about new management techniques and hiring personnel to focus on managing using IRVM principles can be a deterrent to decision-makers. Finding ways to reduce startup costs and showing the amount of time in which the startup costs would pay for themselves may help get a program approved (Warner and Schall 2015). For Iowa counties, grants from the Living Roadway Trust Fund and prairie seed provided by the University of Northern Iowa's Iowa Roadside Management office through a Federal Highway Administration grant can help offset startup costs.

Although respondents indicated concern over programmatic costs, decision-making can be influenced by social norms, or how people think certain behaviors are viewed by the individuals and groups around them (Ajzen 1991; Farrow et al. 2017). For this reason, when interacting with a county without a roadside program, practitioners may want to involve county officials from neighboring counties and indicate how many counties have roadside programs. Because 1/4 of conservation board directors and 2/3 of board of supervisors chairs surveyed in our study were unsure if their neighboring counties had roadside vegetation managers, increasing their awareness of what their neighbors are doing may generate more interest in roadside programs. Some studies have found homeowners are more

likely to adopt sustainable landscaping practices if their neighbors are implementing these practices (Nassauer et al. 2009; Blaine et al. 2012; Uren et al. 2015), and the same may be true of counties. A map of Iowa counties that currently have roadside programs (Fig. 1) illustrates how a given county is more likely to have a program if neighboring counties have one.

According to our survey, a majority of both conservation board directors and board of supervisor chairs identified “leadership of local staff” and “improving the community” as significant factors in their decision to hire a roadside vegetation manager. As our findings indicate, roadside vegetation managers may influence decision-makers to give a higher priority to environmental values. It is also possible that county decision-makers who already hold environmental values are more likely to hire a roadside manager.

In our experience, counties are able to secure funding for a roadside manager by shifting funding priorities for personnel. For example, some counties have funded a roadside manager position by waiting until a spray truck driver retires. Instead of replacing the spray truck driver, a roadside manager will spray weeds strategically and use less herbicide. Some have suggested cost-share agreements between two counties in which a roadside manager serves two counties, as a means to save costs. So far, this approach has not been used often because it can be difficult for a roadside manager to effectively manage the total acres of roadsides in multiple counties.

The barriers to planting native species, as opposed to the entire suite of IRVM principles, were also assessed. Similar to another survey conducted of Iowa county engineers and roadside managers (unpublished data collected by the authors), one major barrier identified by conservation board directors was landowners mowing or spraying plantings. Roadsides are public land and Iowa code prohibits landowners from burning, mowing, or spraying roadsides unless they have a permit and the activity is consistent with the county IRVM plan (Iowa code 317.13). However, some landowners prefer a mowed appearance or view native plants as weeds that may encroach on their cropland.

While there were some general similarities in how the two groups perceived the barriers and benefits to IRVM practices and the use of native species, there were some notable differences. For example, 63% of board of supervisors chairs thought insufficient proof of conservation benefits was a moderate or significant barrier to the county implementing IRVM practices compared to 25% of conservation board directors. Over half of conservation board directors responded that landowners who spray (55%) or mow (56%) the plantings have “some” to “quite a bit” of impact as a barrier to the county using native species in any land management projects. In contrast, over half of the board of supervisors chairs thought that landowners who

spray (59%) or mow (68%) the plantings have no or very little impact as a barrier to the county using native species. While nearly half (46%) of conservation board directors thought acceptance and education internally or among contractors had “some” to “quite a bit” of an impact as a barrier to the use of native species, 73% of board of supervisors chairs thought acceptance/education internally or among contractors had no or very little impact.

These different perceptions may be due to differences in the professional backgrounds and associated values and experiences of the two groups. In our experience interacting with both groups, while conservation board directors have typically held natural resource positions prior to becoming a director, board of supervisors chairs usually do not have a natural resource background. In rural counties, which make up the majority of Iowa, many chairs have farming or other backgrounds. They may have more empathy toward landowners who spray or mow the plantings and see those behaviors as part of proper land management, especially if taller prairie vegetation is viewed as being weedy. Conservation board directors likely have greater direct experience with interacting with contractors who have been tasked with managing natural resources compared to board of supervisors chairs, and are more familiar with the benefits and challenges of communicating with contractors about natural resource projects.

Changing landowners' perceptions of native plants can be challenging. One approach to changing social norms may be identifying landowners who appreciate native plants and have a lot of social influence in their community, and making their opinion visible, with their approval. The landowner could be featured in a local publication that the community reads or a sign could be placed within a planting adjacent to the landowner's property showcasing how the landowner is benefiting the environment with a catchy phrase (McKenzie-Mohr et al. 2011; Busse et al 2015). For example, the organizers of one initiative in an Indiana watershed gave certain residents yard signs saying “Healthy Shoreline and Healthy Soils” (Busse et al. 2015). Signage can invoke a descriptive norm, signaling that others are implementing sustainable behavior, and enhance injunctive norms, indicating that others approve of the behavior (Cialdini 2003). Rural landowners who value native plants and also understand shared agricultural communication conventions and jargon could be invited to talk to roadside managers at conferences like the annual roadside conference. They could help roadside managers learn techniques for effectively communicating about native plants with landowners.

Some respondents were not familiar with IRVM practices. They may also not be aware of the resources available to them, such as the high-quality, regional-ecotype seed that is available to them for free, or grants from the Living

Roadway Trust Fund. Since respondents said they preferred to learn more by e-mail, a regular e-mail newsletter would help (Tully 2020). They also mentioned in-person presentations, as a majority of respondents attend the ISAC conference. Presenting at the ISAC conference, district county conservation meetings, or district board of supervisors meetings may be an effective way to reach these groups.

We applied the first two steps of the CBSM framework to county implementation of IRVM in Iowa: (1) selecting on-the-ground behaviors to change and (2) identifying barriers and benefits that a community faces in behavior change (McKenzie-Mohr 2011). The next steps are to: (3) develop strategies to encourage change in behaviors, (4) implement a pilot strategy, and (5) broadly implement a successful pilot (McKenzie-Mohr 2011). There are several pilot strategies that we can implement. For example, the Iowa Roadside Management office can reach the respondents through their preferred method of communication, e-mail, and emphasize positive social norms by starting an e-newsletter that profiles counties with roadside vegetation programs. The office can create handouts that acknowledge benefits and identify ways to overcome barriers. These could be used as talking points by the roadside vegetation managers when they interact with county officials and landowners. Interpersonal communication can be an especially effective driver of behavior change (Green et al. 2019). Some topics for the handouts could include the benefits of reseeding areas of bare soil exposed by road and bridge repairs with native plants, information about the relationship between white-tailed deer and vehicle collisions, testimonials from conservation board director and chairs of the board of supervisors about their programs, startup costs for a roadside vegetation program and how to mitigate them, and information on cost savings from IRVM practices at the county level.

To encourage landowners who may view the plantings as weedy to better appreciate them, the Iowa Roadside Management office and roadside vegetation managers could apply for funding for signage to place near plantings that highlights the benefits of the plantings. We could also increase the visibility of landowners who value native plantings by profiling landowners in publications or outlets that will reach other landowners in the county. After implementing pilot strategies, we can evaluate which strategies are most effective in encouraging more counties to hire a roadside vegetation manager, develop an IRVM plan, request native seed mixes, or implement on-the-ground conservation behaviors such as reduced mowing or spraying without formally developing a plan or hiring a roadside manager. We could also do a follow-up survey and include more questions that identify the role of pilot strategies, including the importance of social norms, in changing

behavior. There are very few studies comparing message types on different audience segments and this knowledge could be useful (Verissimo et al. 2018; Kidd et al. 2019). We could then focus on strategies that resulted in change more broadly and consistently.

This study provides insights into how local decision-makers prioritize roadside management, as well as how they perceive the benefits and barriers to an integrated approach to roadside vegetation management. The perspectives of Iowa county roadside decision-makers about the IRVM approach to roadside management have not been studied before. Some limitations of our study include: (1) multiple testing and the increased risk of achieving significant results by chance (Type I error); (2) the small group sample sizes, especially for some subgroup analyses, which reduce the statistical power of our analysis, and (3) the use of bivariate analyses to compare the groups, not controlling for potential confounders. Our study results present a general overview of respondent's perspectives that can provide a useful context when working with county officials in Iowa. We recognize that each county, and county official, is unique. Practitioners and decision-makers must still seek to understand each other's perspectives and build relationships if they are going to be effective collaborators.

Conclusion

Social marketing techniques can help practitioners who are interested in fostering voluntary behavior change within specific communities. Although most social marketing studies and initiatives have applied to citizens, groups such as county conservation board directors and board of supervisors chairs are also communities with characteristic values, cultures, and beliefs. Other local planning initiatives that might benefit from the general approach used in our study include community efforts to develop local climate action plans or resilience plans. This study provides insights into how county government officials perceive roadside vegetation management. Barriers to counties having roadside vegetation programs are often related to a lack of resources, including funding and staff capacity. Practitioners and county decision-makers need to collaborate to identify ways of meeting their roadside management needs and goals within their constraints. If political conditions are favorable, proposing legislation that increases funding may also lower financial barriers to starting and maintaining roadside programs.

Data Availability

All of our data and materials support our published claims and comply with field standards.

Acknowledgements We thank the Iowa Department of Transportation's Living Roadway Trust Fund (Project 90-00-LR17-208) for funding this study. We also thank the county conservation board directors and county board of supervisors chairs who contributed their time and opinions. We thank colleagues who reviewed earlier drafts of the paper.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethics Approval The study was approved by the University Institutional Review Board (IRB) and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed Consent Each participant was provided a letter stating that "Participation is voluntary and your responses will be kept confidential to the degree permitted by the technology used. Each questionnaire has a unique number that is used to indicate when it has been returned, so that we do not burden those who have responded with additional mailings. Though special precautions have been established to protect the confidentiality of your responses, no guarantees can be made regarding the interception of data transmitted electronically. In reporting, no identifying information will be stored with your responses. There are no direct benefits for participating; however, your participation in the study is very important to us, as your answers will be combined with others to better understand roadside vegetation management in Iowa. Risks are minimal and similar to those typically encountered in day-to-day life."

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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