

September 2019

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Recommended Citation

Becker, Ashley E.; Anderson, Robin A.; and Blair, Amy C. (2019) "Eastern Iowa Farmers' Attitudes Towards the Incorporation of Prairie Strips in Agricultural Fields and Economic Incentives," *RURALS: Review of Undergraduate Research in Agricultural and Life Sciences*: Vol. 12 : Iss. 1 , Article 2.

Available at: <https://digitalcommons.unl.edu/rurals/vol12/iss1/2>

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Eastern Iowa Farmers' Attitudes Towards the Incorporation of Prairie Strips in Agricultural Fields and Economic Incentives

Cover Page Footnote

Ashley E. Becker is a graduate student at the University of Wisconsin-Madison. She is pursuing a M.S. in Environment and Resources through the Nelson Institute for Environmental Studies. She previously received a B.S. in Biology and a B.S. in Behavioral Neuroscience from St. Ambrose University. Robin A. Anderson is a Professor of Psychology at St. Ambrose University. Amy C. Blair is an Associate Professor and Chair of Biology at St. Ambrose University. They served as the faculty sponsors of the research and can be reached at andersonrobina@sau.edu and blairamyc@sau.edu, respectively. The authors would like to thank the Hauber Chair of Biology and the Honors program at St. Ambrose University for funding this research. Additionally, they would like to extend a thank you to the following faculty at St. Ambrose University: Katy Strzepek, PhD, for guidance and feedback on the project proposal; Bill Parson, PhD, for advising political science aspects of the research; and Brett Billman, PhD, for feedback on data collection. The authors would also like to thank John Tyndall, PhD, at Iowa State University for assistance in generating the research question.

1. Introduction

The loss of prairie habitat in Iowa has been substantial. While the vast majority of land historically consisted of prairies, it has since been converted to more than 85% agricultural land, of which is mostly crop fields (Harris & Iyer, 2014). This decrease in prairie habitat has far reaching negative effects. Decreased soil coverage in crop fields leads to both increased erosion and runoff. The homogeneity of crop fields, likewise, has negative impacts on biodiversity.

Increased erosion is anticipated when prairie habitat is replaced with annual row crops, such as corn and soybeans. Because the surface area covered by row crops is less than that of prairie plants, more soil is left exposed. Changes in ground cover in conjunction with other factors, such as slope steepness and slope length, all contribute to the erodibility of the land (Kort et al., 1998). Soil erosion is a serious issue. In Iowa, a loss of five tons of soil per acre per year has been estimated by the United States Department of Agriculture with soil regeneration rates estimated at one tenth of that (Iowa Climate Change Impacts Committee, 2010). Erosion can also lower overall soil productivity because it affects soil characteristics such as water holding capacity and the percent of organic matter (Kort et al., 1998).

As with erosion, the structure of crop fields leaves agricultural fields more susceptible to runoff, which can result in non-point source pollution (Porter et al., 2015). This pollution is largely composed of nitrates and phosphorous, two compounds commonly applied to crop fields to help improve yield. Runoff from agricultural fields, particularly containing nitrates, is problematic in the purification process of drinking water (Eller, 2015). This is illustrated in the Des Moines Water Works lawsuit against farmers who were blamed by the company for increased costs associated with nitrate removal from drinking water (Eller, 2015). Both nitrogen and phosphorous are responsible for the hypoxic zone in the Gulf of Mexico, a large area unable to support most aquatic life because of severe declines in oxygen (Porter et al., 2015). Therefore, runoff has negative impacts beyond the state borders.

One final negative effect stemming from the shift of prairies to agricultural fields is decreased biodiversity. Biodiversity is best supported by habitat heterogeneity (Benton et al., 2003), or varying habitat, yet conventional row crop fields are homogeneous. Thus, row crop fields should support a less diverse array of organisms with fewer niches present to encourage this diversity. The positive relationship

between habitat heterogeneity and species diversity is supported by the meta-analyses of Tews et al. (2004) and Benton et al. (2003), the latter whose research focused specifically on agriculture. Such diversity trends are observed among both flora and fauna (Benton et al., 2003). Biodiversity threats are particularly prominent in Iowa as the state devotes a higher percent of the land to row crops than any other state (Santelmann et al., 2003). These threats are a concern because preserving biodiversity is essential both economically and environmentally. Pimentel et al. (1997) estimated that the values of services resulting from biodiversity totaled 11% of the global economy. Environmental benefits of biodiversity, specifically relating to crop farmers, include pest control and pollinator habitats.

One solution to the environmental problems associated with increased agricultural fields is the incorporation of vegetative buffers. Grassed waterways, a commonly used vegetative buffer, have been demonstrated to be beneficial in minimizing runoff and erosion, while offering potential increases in bird, insect and microbial biodiversity (Fiener & Auerswald, 2003). However, in research by Fiener and Auerswald (2003), the majority of plant diversity in grassed waterways was comprised of a handful of fast growing species and increases in faunal diversity may have been confounded by simultaneous changes to the fields surrounding the grassed waterways. As a result, grassed waterways alone may not be sufficient to address all three previously described concerns.

While grassed waterways appear to be an efficacious conservation practice in addressing erosion and runoff, other vegetative buffers have produced even more promising results, especially with improving biodiversity. Specifically, these highly effective vegetative buffers are classified as prairie strips. The Science-based Trials of Rowcrops Integrated with Prairie Strips (STRIPS) team at Iowa State University has been at the forefront of prairie strip research. Since 2007, the STRIPS team has been researching the benefits of a 10% conversion of row crops to prairie habitat (Harris & Iyer, 2014). Liebman et al. (2013) specifically address these benefits. From the results of their research, soil loss was, at minimum, ten times less in fields with prairie strips compared with fields containing no prairie strips. Amounts of nitrogen and phosphorous loss were additionally minimized in the fields containing prairie strips. Later estimates by Harris and Iyer (2014) state reductions of 85% and 90%, respectively. Over time, the introduction of prairie strips corresponded to significant increases in species richness (Liebman et al., 2013). Over 200% and 400% increases were observed for overall plant species and native plant

species richness, respectively, though these values are averages for 10-20% conversion to prairie (Liebman et al., 2013). These significant findings are also mirrored in an overview of prairie strip effectiveness at a 10% conversion by Grudens-Schuck et al. (2017). The impressive environmental benefits associated with the introduction of prairie strips supports their widespread use.

Following the research on the introduction of prairie strips, the STRIPS team at Iowa State has begun to analyze farmers' and non-farmers' attitudes towards general conservation strategies and policies (Schulte et al., 2017). This research was conducted through surveys randomly distributed to Iowans in which responses from farm residents were distinguished from non-farm residents. Results indicated drinking water quality and the increase of rural job opportunities were high priorities for both samples, while restoring prairie was only a moderate priority. Drinking water quality was ranked highest by both farmers and non-farmers, which is a concern addressed via the implementation of prairie strips in crop fields (Schulte et al., 2017).

While beneficial, the introduction of prairie strips into agricultural fields is not without costs. Thus, economic incentives through governmental programs provide a practical approach to encouraging farmers to adopt these practices. However, in order for incentives to be most effective, they should align with farmers' expectations of a reasonable incentive while addressing the underlying cause of why the incentivized practice is not used (Stone, 2012). Through the Natural Resources Conservation Service (NRCS), a few programs exist to support the financial burdens of environmentally friendly farming practices (United States Department of Agriculture¹, n.d.). These programs provide economic incentives to farmers to make their crop fields more environmentally friendly, though they continue to be voluntary (J. C. Tyndall, personal communication, October 18, 2017).

Of those programs, the Conservation Reserve Program (CRP) is likely the most relevant for compensating farmers for prairie strip adoption, as one related plan, CP-15A, is used for establishing contour grass strips (United States Department of Agriculture², n.d.). The CRP offers annual land payments for converting cropland to another alternative environmentally friendly use; this includes prairie strips. One benefit of this program is that its continued payments serve as "paying rent" on land taken out of production in addition to covering initial costs (United States Department of Agriculture², n.d.).

One additional nuance of CRP is that there is a cap to the number of acres that can be set aside within the program (United States Department of Agriculture,

2017). The cap had been reached under the Agriculture Act of 2014, also referred to as the 2014 Farm Bill (United States Department of Agriculture, 2017). Now under the Agriculture Improvement Act of 2018, also referred to as the 2018 Farm Bill, the cap has been increased from 24 million acres to 27 million acres (Reid et al., 2018). Despite the increase in available acres, there has been a reduction in rental rates payable to farmers (Reid et al., 2018). Thus, this legislation may impact the attractiveness of this incentive program to farmers, and consequently, impact willingness to adopt the practices which benefit from these incentives.

The need for conservation practices in crop fields is evident, and governmental programs, which cover the cost of introducing such practices, at least partially, already exist. In addition, sufficient research suggests that the introduction of prairie strips into fields is a highly beneficial investment that would meet the priorities of farmers and non-farmers. Nonetheless, prairie strips are not a widespread practice. In order to better understand why farmers do not commonly use prairie strips, our study aimed to examine the following question: What barriers exist, as perceived by Eastern Iowa farmers, to implementing prairie strips statewide? More specifically, farmers' attitudes towards employing these practices are most relevant to increasing implementation, yet no qualitative studies have focused on these attitudinal components. By understanding the perceptions of farmers towards this conservation practice, and determining the perceived benefits and barriers, our study can be used to inform policy so that it best reflects the needs and desires of farmers. These perceptions of benefits and barriers can be assessed through incorporating the model outlined by the Theory of Planned Behavior (Ajzen, 1985) into this research. This model in psychology has been shown to better predict behavior in specific situations, more so than assessments of general attitudes towards that behavior. This is achieved by understanding attitudinal components towards a specific behavior, which predict behavioral intentions (Ajzen, 1985). With high levels of erosion and runoff and decreased biodiversity, an analysis of the barriers experienced by farmers in adopting this practice is a crucial step to ameliorate the negative consequences felt within Iowa and beyond.

2. Materials and Methods

Participants

Upon receiving approval from St. Ambrose University's Institutional Review Board (IRB), potential participants were identified via convenience sampling through contact with a local farmer. Ten farmers from those identified were invited to participate in this study. All farmers lived in Eastern Iowa, ranging in age from 22-80 years ($M = 48.7$, $SD = 16.8$). All were male. The acreage of their operations varied from 220-3500 acres ($M = 1682$, $SD = 1174$). Most had a combination of rented and owned land. All previously engaged in at least one conservation practice, such as no-tillage farming or cover crops, though none used prairie strips. Crops grown were exclusively corn, soybeans and hay.

Data Collection

After obtaining informed consent for participation and audio recordings, in-person, semi-structured interviews were conducted to assess farmers' attitudes towards prairie strips. A combination of 29 open- and closed-ended questions were asked, which appear in *Appendix A*. A portion of the questions was derived from the Theory of Planned Behavior. Questions fell within the three categories of the model: attitudes towards the behavior, subjective norms surrounding the behavior, and perceived behavioral control regarding the behavior. The questions corresponding to each category appear in *Appendix B*. This model was selected as the intent is to change the behavior of farmers. Supplemental questions were also used to clarify attitudes within the model, in addition to addressing knowledge and motivations related to farmers' current conservation practices. An audio recorder was used to document the interviews, which lasted between 20-50 minutes. Recordings were transcribed. Member checks were completed to ensure transcriptions were made correctly. Audio recordings were discarded following data analysis.

Data Analysis

Interview responses were analyzed using open coding, which assigned summarizing words or phrases to the transcribed lines within the relevant questions. From the codes, common themes were identified. Questions given specific focus were

those most relevant to the Theory of Planned Behavior and to addressing the overall research question. Themes discovered were used to suggest modifications to current economic incentives and identify where persuasive efforts would be most effective.

3. Results

Results include responses to both open- and closed-ended questions. The presented results are a subset of all the interview questions. Selection was determined by relevancy to the Theory of Planned Behavior and to the overall research question, which aimed to identify barriers to adopting prairie strips.

Research Questions and Summarized Responses

“Do you think prairie strips would be effective at decreasing runoff and/or erosion?”

All farmers expressed the belief that prairie strips would be effective at decreasing runoff and/or erosion and increasing biodiversity. When assessing the perceptions of these outcomes, some farmers were asked about the effect of runoff and erosion simultaneously. Thus, these two outcomes cannot be separated within the data.

“Can you foresee any benefits or drawbacks of incorporating prairie strips throughout crops fields?”

Nine different types of outcomes were described by farmers (Figure 1). Outcomes listed as benefits included minimizing erosion and minimizing runoff. Minimizing erosion was the most frequently mentioned benefit. Outcomes described as drawbacks were concerns with efficiency, weed competition, unusable product for grazing or selling, yield, spray drift and cost. Yield concerns was the most frequently mentioned drawback. The outcome of increased wildlife was mentioned by four farmers, though there were discrepancies as to whether it constituted a benefit or a drawback. For example, one farmer explained, “Drawbacks, or benefits and drawbacks, would be the animals. I mean I like seeing animals, but also, you’re going to see probably two or three rows along the prairie that are somewhat destroyed or that could be a corridor for deer, raccoons, whatever.”

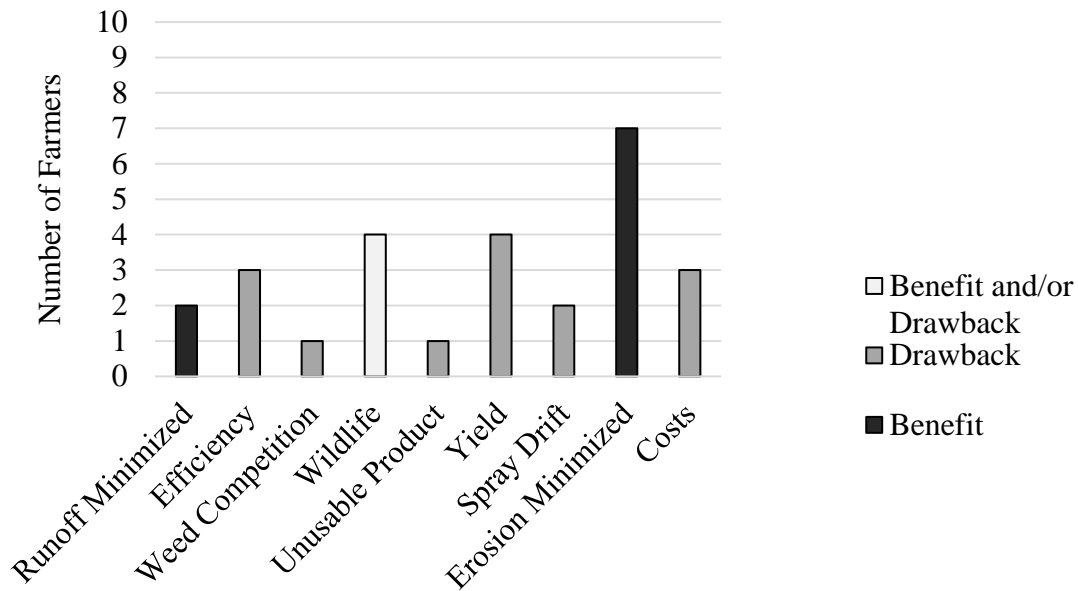


Figure 1. Frequency of perceived benefits and drawbacks of incorporating prairie strips among 10 row crop farmers.

“Do you have any concerns about the ease of introduction and/or maintenance of prairie strips?”

Nine out of 10 farmers expressed at least one concern related to the introduction and/or maintenance of this conservation strategy (Figure 2). The most common concern among farmers related to the initial establishment of this practice, as it was mentioned by four farmers. However, the concerns were not necessarily a complete deterrent to adopting this practice. As a farmer stated when expressing their concerns, “Introducing. I know some of those native grasses are hard to get established so, I mean it would be a challenge I guess, but I wouldn’t consider it a drawback. But it would be a challenge.”

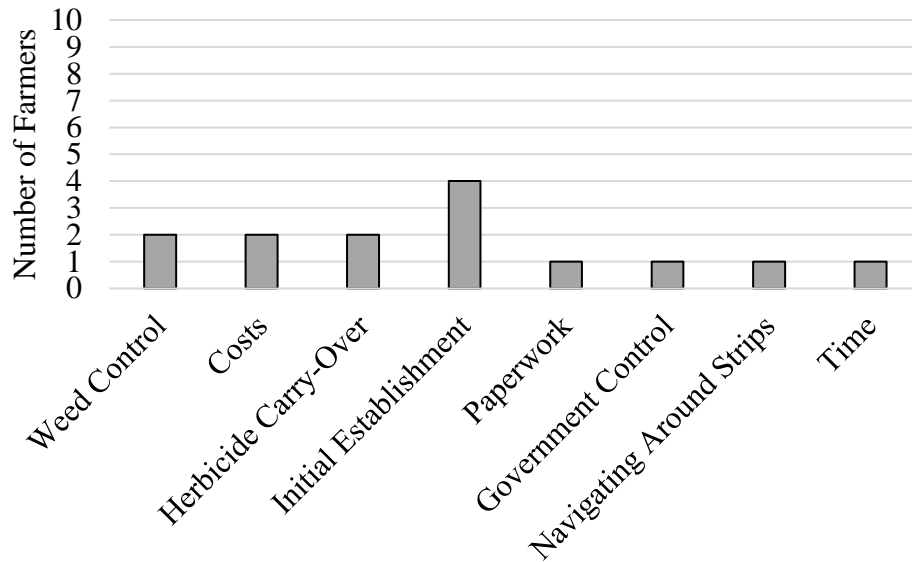


Figure 2. Frequency of anticipated concerns about maintenance and introduction of prairie strips among 10 row crop farmers.

“Can you share what motivated you to use your current conservation practices?”

Seven out of 10 farmers expressed environmental reasons as motivation for their conservation practices, and seven out of 10 farmers mentioned economic reasons. Those expressing environmental reasons were not the same seven farmers who expressed economic reasons. As an example of an environmental concern, one farmer shared, “For erosion. For ourselves, taking care of our own land, the stewardship of the land.” Another farmer, sharing an economic motivation, explained, “And the waterways, the cost sharing with the NRCS is so good that it’s really easy to justify a new waterway where it needs it.” All responses classified as economic motivations did not explicitly refer to costs. Farmers stating the use of conservation practices because of no decreased yield or greater efficiency were likewise deemed economic motivations.

“Do you think you would get grief from other farmers or the community for incorporating prairie strips?”

Nine of the 10 farmers did not anticipate receiving grief from other farmers in the community. The sole farmer that did anticipate such a response immediately followed up with that not being a concern for him when asked. Several farmers seemed to take the perspective that what you do on your land is your own concern. This was shown with statements such as, “what you do on your farm is your business,” and, “whatever the neighbors do and how much they get done today, it does not affect what we do.”

“Do you think it is necessary to incorporate prairie strips into the majority of fields statewide?”

Only two of the farmers agreed with the necessity of incorporating prairie strips statewide. Of the remaining farmers, five did not feel they were necessary statewide, while three did not provide a direct response to the question. Even when disagreeing with the necessity of statewide prairie strips, farmers remained open to incorporating prairie strips. For instance, “I wouldn’t say the majority, but it would be nice to see it in the crop fields, some of the highly erodible ground and even along streambanks,” was one response given. A similar response by a different farmer stated, “I don’t think it’s necessary in all the acres. I think it would be beneficial and I think it is possible. It’s like waterways are almost in every field so I don’t see the problem with putting prairie strips in every field ‘cause I think that everyone needs a waterway somewhere.” The disagreement was not associated with an overall negative perspective.

“Is there any economic incentive that would provide you reasonable security to incorporate prairie strips in the majority of your fields?”

Six farmers listed compensation comparable to current income for the land, as rent or crop revenue, as a potential sufficient economic incentive. This price was reached by renters and landowners as most farmers held both roles, but differences may exist depending on the perspective taken. From the perspective of a landowner, it was expressed, “if the producer of a rented farm was going to do it, it would have to have the economic value of the return that person is used to renting the land for.” Taking the perspective of a renter, a higher incentive was also considered by one farmer, stating “if I was a renter, it would probably have to be more than what, if you know what that payment would be to get you to entice you to do that.”

“What has been your experience with economic incentives and the NRCS?”

Nine out of 10 farmers used unfavorable language in their description of the NRCS. Unfavorable language included phrases such as questioning their approaches, disagreement and concerns with their control. Five out of 10 farmers used favorable language within their description. Favorable language was considered getting along with or good experiences with the NRCS. Some farmers used both types of language in describing their experience. As an example, a farmer stated, “They were rigid, and they told every farmer what they had to do,” and later continued, “I don’t think that was a great relationship and as they softened it up, he became more of a partner and everything through the years has been a lot better.” This seems to illustrate an attitudinal shift towards this agency.

Summary of Results

First, all farmers anticipated prairie strips would achieve the outcomes predicted in the literature, i.e. decreased erosion and/or runoff and increased biodiversity. Foreseen benefits of this conservation practices related to environmental benefits, and concerns expressed were economic-driven. Most farmers had at least one concern with the introduction and maintenance of prairie strips. As for the motivation to use current conservation practices, farmers mentioned environmental motivations as frequently as economic motivations. Most farmers did not expect to receive grief from others in adopting this practice. Half of the farmers explicitly stated prairie strips may not be necessary statewide. Over half also expressed wanting economic incentives comparable to the income potential. Finally, most farmers used some unfavorable language in using economic incentives and working with the NRCS.

4. Discussion

In order to begin understanding why prairie strips are not a widely adopted conservation strategy, farmers were interviewed to determine which perceived barriers exist to implementing this practice statewide. Interview questions were guided by the Theory of Planned Behavior to suggest policy modifications and courses of further action to best lead to a change in farmer behavior.

First, it appears that only minimal changes to the economic incentive itself would be necessary to increase its attractiveness. Rather, current economic incentives, such as CP-15A, meet farmers' expectations for available funding and seem to address some of farmers' root concerns in adopting prairie strips. Meeting expectations and addressing concerns were both criterion for effective incentives previously described by Stone (2012). Examples of this alignment include yearly payments and cost-sharing for establishment fees within CP-15A (United States Department of Agriculture², n.d.) to meet expectations of incentive amount and address economic concerns.

Small potential changes begin with program descriptions. Despite the many incentive options, relevant programs described through the NRCS seem to provide more general descriptions while farmers' concerns are very specific. Thus, the incentive may benefit from focusing on the nuances of the program. For example, for those farmers expressing concern with introduction and maintenance, a detailed breakdown of the support during each year of adoption, financially or through working with an individual at the NRCS, may make the program more enticing to farmers. Also, the incentive could highlight the *necessity* of prairie strips as half of farmers do not believe they are necessary in the majority of crop fields. Additionally, a variable incentive for renters and landowners could be used to account for the extra burden already experienced by renters as they pay to rent the land, while also asking them to take land out of production.

One major concern that arose in the interviews was farmers' experience with the NRCS. Because this agency provides the economic incentives to farmers and works closely with them throughout the years of adoption of the practice, it is concerning that nine of 10 did not use favorable language in their descriptions. While one farmer did seem to note a change in the behavior of the NRCS, negative impressions can be lasting. Thus, efforts should be focused on fostering this relationship to increase farmers' willingness to work with this agency.

Many of the other financial concerns shared by farmers seems to suggest that there may be a lack of awareness of the current incentive benefits. As previously described within CP-15A, farmers have been historically offered a 90% cost share of establishment costs and an annual rental payment, which may be nearly equivalent to the market rent value of the land. This eases much of the financial burden of introducing the prairie strips and taking some cropland out of production. Hence, future efforts may be directed towards educating farmers on incentive opportunities.

On a national scale, it is important to recognize legislation, specifically the 2018 Farm Bill, which may also influence farmers' willingness to incorporate prairie strips. The acreage cap through the 2014 Farm Bill may have once been a limiting factor for enrolling in CRP, but that consideration may now be replaced by concerns with reduced rent payments. Given the environmental benefits of prairie strips, and environmental consequences of their absence, supporting farmers who are choosing to adopt this practice should be a primary concern, which is best achieved through acknowledging these larger driving forces.

From this preliminary research on farmers' attitudes towards prairie strips, future research should focus on conducting large-scale survey research to assess if these attitudes are representative of all Iowa farmers. Furthermore, research efforts should specifically aim to understand if deficits are present in farmers' awareness of benefits offered through economic incentives. If a lack of awareness is determined to be present, action should be taken to raise awareness so that incentives can continue to be used rather than resorting to involuntary laws and regulations.

Prairie strips are shown to be effective at offsetting the negative consequences associated with the conversion of prairie habitat to crop fields in Iowa. In order to be most effective, this practice must be widely adopted, a feat accomplished by addressing farmers' hesitations in incorporating prairie strips and explored by this research. As this practice becomes more attractive and prairie strips become a more common occurrence, restoration of the prairie habitat once dominating Iowa can become a collective, statewide effort.

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Appendix A: Interview Questions

1. How did you get into farming?
2. How long have you been farming?
3. What types of crops do you grow?
4. Do you do conventional farming or organic? How long for each?
5. Do you mind sharing an estimate of the acreage of your farming operation?
6. Do you rent or own the land?
7. If you rent, what is the process with the owner for modifying the land?
8. May I ask how old you are?
9. Do you currently use any conservation strategies, or have you tried any in the past? (Examples include grassed waterways, stream-side vegetation, and cover crops)
10. Can you share what motivated you to employ those practices?
11. Any reasons you have chosen not to use a conservation practice?
12. Do you currently rely on economic incentives, or have received funding, through the Natural Resources Conservation Service for those other conservation practices? (Examples include reimbursement for no-till agriculture or start-up payments for introducing filter strips)
13. What has been your experience with those and the NRCS?
14. Are you familiar with the practice of incorporating prairie strips into crop fields as a conservation strategy?
 - a. If so: How did you hear about prairie strips? Can you share what you know about prairie strips? If farmers are using prairie strips in their crop fields, they convert 10% of their land to perennial prairie plants. These strips are spaced throughout the field and follow the contours of the land (show image and reference flyer).
 - b. If not: If farmers are using prairie strips in their crop fields, they convert 10% of their land to perennial prairie plants. These strips are spaced throughout the field and follow the contours of the land (show image and reference flyer).
15. Can you foresee any benefits or drawbacks of incorporating prairie strips throughout crop fields? What are they?
16. Do you think they would be effective at decreasing runoff and erosion?
17. Do you think they would be effective at increasing biodiversity?
18. Do you have any economic concerns?
19. Do you have any concerns about looks?

20. Do you have any concerns about taking the enjoyment out of the process?
21. Do you have any concerns about the ease of introduction or maintenance?
22. Do you have any concerns about insects or weeds?
23. Do you think you would get grief from other farmers or the community?
24. Do you think the benefits would outweigh the drawbacks?
25. Do you think it is possible to incorporate prairie strips into the majority of fields statewide? Why or why not?
26. Is that necessary?
27. Is there any economic incentive that would provide you reasonable security to incorporate prairie strips in the majority of your fields? (Examples include a specific dollar amount or something more general such as “it would need to be equivalent to the cost of renting the land”.)
28. If you did incorporate prairie strips, what criteria would the strips have to follow? For example, would there be a maximum amount you would incorporate or a maximum width that you would not want to exceed?
29. Are you familiar with the Iowa Nutrient Reduction Strategy? If so, what do you know about it?

Appendix B: Theory of Planned Behavior Question Categories

Attitudes Towards the Behavior:

1. Can you foresee any benefits or drawbacks of incorporating prairies strips throughout crop fields? What are they?
2. Do you think they would be effective at decreasing runoff and erosion?
3. Do you think they would be effective at increasing biodiversity?
4. Do you think the benefits would outweigh the drawbacks?

Perception of Subjective Norms:

1. Do you think you would get grief from other farmers or the community?

Perceived Behavioral Control:

1. Do you have any concerns about the ease of introduction or maintenance?
2. Do you currently rely on economic incentives, or have received funding, through the Natural Resources Conservation Service for those other conservation practices?
3. Is there any economic incentive that would provide you reasonable security to incorporate prairie strips in the majority of your fields?