Agricultural Producer Perspectives on the Adoption of Conservation Practices, Water Quality, and Climate Change in Big Creek and Lime Creek Watersheds
Posey County, Indiana
Buchanan and Benton Counties, Iowa

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Introduction

The Mississippi River Basin (MRB) contains prime farmland that has produced high-value, nutrient intensive crops for food, fiber, and fuel. Prairie, forest and river ecosystems that support diverse plant and animal communities are also found within the MRB. Because of an increase and intensification of agricultural production in the MRB since European settlement, plant and animal habitats have degraded. Aquatic and riparian ecosystems have been particularly impacted by intensive agricultural practices. Increases in sediment and nutrient loading, exacerbated in part by channelization and tile drainage, have resulted in impaired water quality throughout the MRB. Nutrient loading has led to extensive eutrophication that has culminated in the creation of a hypoxic zone in the Gulf of Mexico. Midwestern states within the MRB contribute the greatest contribution of nutrient loads to the Gulf of Mexico hypoxic zone. Recent implementation of tile drainage and reversion of Conservation Reserve Program lands to cropland in the basin may increase the effects of nutrient loading and dramatically reduce wildlife habitat.

To address water quality and wildlife issues in the MRB, a partnership between researchers at the US Geologic Service, Oregon State University, and Purdue University created a project to investigate the barriers and opportunities of adoption of conservation practices by agricultural producers in three sub-watersheds in the MRB. This investigation also gauged rates of adoption of different conservation practices which increase water quality or habitat that qualify for federal cost-share programs. Understanding what factors influence farmers’ management decisions can help researchers understand why practices are adopted or have a high likelihood of adoption now or in the future. Understanding decision making as it relates to adoption can inform water quality and habitat models that predict what may happen to hypoxic areas in the Gulf of Mexico in the future if there are precipitation and temperature changes in the MRB.

The following data are the results of interviews in Big Creek watershed located in Posey County in southwestern Indiana and Lime Creek watershed located in Buchanan and Benton Counties in northeastern Iowa. Interviews were conducted in Big Creek watershed with 18 agricultural producers in May and June, 2015 and Lime Creek watershed with 16 agricultural producers in February and March, 2016.

Major findings:

- Producers are more willing to adopt conservation practices that improve soil health and prevent erosion
- The mean weight for reducing soil erosion was higher than other criteria indicating that on average, interviewees give more weight to reducing soil erosion when making decisions on practice adoption than other decision criteria and;
- Producers are willing to increase adoption of conservation practices which are already adopted widely in the watershed which help prevent erosion (e.g. grass waterways)

Recommendations:

- More outreach about off-farm benefits of conservation practices with a focus on water quality and;
- Highlight how adopting conservation practices can help to decrease risk of future government regulation

How these findings will be used:

The results of this study will be combined with data collected in other watersheds around the Mississippi River Basin to help develop WRESTORE, a web-based social computing application to help farmers and other landowners with conservation planning. For more information on WRESTORE please visit: [http://wrestore.iupui.edu/](http://wrestore.iupui.edu/). With the effort of those who participated in the study we will be able to develop a way of incorporating user information to tailor advice on conservation practices provided through WRESTORE.
Methodology

Interviewees were asked to discuss their current use of conservation practices and their willingness to change their use of conservation practices in the future due to projected climate changes in the Upper Midwest. Agricultural producers were recruited with the help of the Soil and Water Conservation District in Big Creek watershed and Richard Sloan, an agricultural producer and coordinator of the Lime Creek Watershed group.

We conducted semi-structured interviews with oral open-ended and closed-ended questions and written closed-ended questions. An interview guide with questions of open-ended and closed-end questions can be found in Appendix A and B. Open-ended questions asked agricultural producers what the advantages and disadvantages of adopting different conservation practices on their property (see Appendix C for description of conservation practices). Closed-ended questions asked producers to gauge their willingness to adopt conservation practices on a five-point Likert-type scale with one representing least likely to adopt and five representing very likely to adopt. Conservation practices would address either water quality, wildlife conservation, or both. Practices included were:

- Cover crops
- Constructed wetlands
- Drainage water management
- Filter strips
- Grassed waterways
- No-till
- Riparian buffer strips
- Strip cropping

Agricultural producers were provided maps of climate projections describing future temperature and precipitation changes in the Upper Midwest (see Appendix D). The interviewer described the maps, how to interpret the climate projections, and how they were developed. Producers were then asked if they would increase or decrease their level of adoption (e.g., increase/decrease the extent of current use and increase/decrease likelihood of implementing a currently unused practice) or if their level of adoption would stay the same.

Towards the conclusion of the interview, the interviewer asked the producer to fill out a form where producers chose between different decision making criteria that may influence their adoption of conservation practices. We used the Analytical Hierarchical Process (AHP; see Appendix B) which asked producers to make pair-wise comparisons between the following criteria:

- Decreasing net costs
- Decreasing fertilizer losses
- Decreasing flooding
- Decreasing erosion losses
- Increasing biodiversity
- Decreasing climate change risks

Producers were asked to compare two criteria on an 18-point scale of relative importance of one decision criteria in comparison to the other. Due to time constraints one interviewee was unable to participate with this portion of the interview in Big Creek Watershed. The purpose of the AHP is to understand how producers make trade-offs between different decision criteria and to assess which criteria have greater weight in their decision-making. Knowing the weight of each criteria has on producer decision-making will help explain why producers are more willing to adopt a conservation practices than other practices.
Results

The results are presented thematically by watershed. In May and June, 2015 we conducted interviews with 18 agricultural producers in Big Creek watershed in Posey County, Indiana. In February and March, 2016 we conducted 16 interviews of agricultural producers in the Lime Creek Watershed in Iowa. The producers interviewed were primarily raised corn and soybean crops but some producers also raised other crops such as wheat, oats, and livestock. Some producers in Iowa were also involved with pig and dairy operations. For the purposes of this report agricultural producers are defined as row crop farmers. We asked questions related to producer attitudes and beliefs towards water quality and climate change and their level of conservation practice adoption now and in the future under a different climate regime.

Water Quality and Climate Change Beliefs and Attitudes

Water Quality

Posey County

There is a consistent perception by agricultural producers that there are water quality issues related to nitrogen and phosphorous runoff in their area. Some producers mention that there is (or was) a 319 grant and a watershed coordinator to address water quality issues in Posey County. Producers consider soil erosion to be the main cause of water quality problems from agricultural land, which will carry nitrogen and phosphorous downstream. Many point out that runoff is not in the producers’ best interest, that soil and fertilizer are valuable. Producers are already limiting the amount of fertilizer they put on, or just the right amount because applying too much fertilizer will reduce profits. However, they need to grow crops and maximize yields to make their farm profitable. Producers believe they are already applying the right amount of fertilizer for their operation and put a lot of thought into the logistics of fertilizer application (e.g., quantity, timing, method), and there is a sentiment of resentment that urban residents are not regulated when applying fertilizers and chemicals to their lawns and gardens. Producers believe that, while those who raise row crops, such as corn and soy, are a contributor to water quality issues, there are others who are also responsible, such as urban households and livestock operations.

All of the interviewees believe that agriculture has a responsibility to address water quality issues. However, producers believe that other contributors must also do their part to address water quality issues as well. Producers believe their part involves addressing soil erosion to mitigate water quality issues. By adopting the appropriate types of tillage producer’s use, along with adoption of other conservation practices, much of the sediment runoff can be captured. One producer mentioned that new generations of producers or those that buy new property don’t know why some land was left fallow or put in to CRP. Producers who are unaware of the reasoning behind taking land out of production will plant those areas of fallowed land only to find the land to be unproductive or prone to erosion, causing water quality problems due to application of fertilizer and increased sediment runoff. A few producers mention crop insurance as a way to reduce water quality and other issues, but that the application process for crop insurance needs to be improved by connecting where to apply with who to go approach with questions. There was mention that if producers can insure flood prone areas, then they will continue to plant in those areas rather than putting them into conservation easements and leaving them fallow. One producer mentioned that there is no regulation that holds agriculture responsible for water quality issues and that lack of accountability allows some farmers to continue to use tillage practices that increase sediment runoff and water quality problems.
Producer Quotes:

“Water quality is not a goal. Soil erosion is.”

“You don’t want excess fertilizer because it costs too much anyway.”

“I think the studies we’ve looked at through the district here and done you’ll see a seasonality to the nitrate loading. You’ll see a seasonality to phosphorous. You’ll see suspended sediments in it, depending on the... correlated to the intensity of a rainfall event. In a few cases, you can see some evidence of, say, an e. coli development. Whether that be... you might not necessarily be able to trace it back to a source, some of those are, I have a feeling, failed septic related. Others are possibly a little livestock related.”

“While ag is not the sole contributor, this is certainly not a highly urbanized county, so the bulk of the nitrate issue is going to be an ag issue, not necessarily 100%, but the bulk of it. Whereas, if you were in Marion county, you might say, “Well, you know, our good friends in the urban area with their ultimate lush green, are responsible for 30%, 40%.” But that’s not true here. The bulk of the nitrate, phosphorous, and in the same way sediment, is going to be ag.”

“If you’re in ground that needs it [conservation practices] and you are not doing it I think you ought to be slapped on the head a little bit”

“As said before, some people would say I don’t give a damn what you do on your farm, but you know what when that water reaches your farm then it becomes anybody else it’s a problem. And if it’s the color of chocolate with milk then what you’re doing on your farm is a problem. If the water that comes out your farm is relatively clean I don’t give a damn what you’re doing there.”

“You know I think that we have a lot of erosion around here a lot of needless erosion. And I think as a whole farmers need to do a better job of managing their washouts and things, but I don’t see anything that’s really, really bad. You know I’d say no matter where you go if you get a 5 inch rain you’re gonna have some settlement out in the water. But as a whole I don’t think the farmers are doing a bad job because anytime you do a bad job you’re losing money. And with what it costs to farm, farmers aren’t wasting money, theirs no bad farmers all of them are gone all the farmers are managing their farm at least decent and anytime you are losing something then you aren’t going to be very around long. So I don’t think farmers are doing a bad job I think there are other industries that are doing a far worse job as far as polluting than what the farmers are.”

Lime Creek

There was fear that the law suit between the City of Des Moines and farmers in their watershed may precipitate an increase in government regulations or a similar lawsuit filed by the City of Cedar Rapids. Interviewees mention the need to address nitrates and phosphates in the watershed but also believe agriculture is one source of many which influence water quality. Interviewees recognize the connection between their efforts to implement conservation projects and increasing water quality. All interviewees discussed the efforts of the watershed group and the monitoring of drainage in different parts of the watershed. Interviewees mentioned that their efforts were motivated by the watershed listing on the 303-D list and subsequent federal grants to help address water quality problems.
Producer Quotes:

“Because [Des Moines is] using water out of the river and then having to clean it up. And theoretically it's costing them more and they're blaming that on those watersheds up above. Okay, that's all fine and good but does it cost them more because they're using twice as much? You don't hear any of that stuff. So I don't really know why. Obviously that's made an imprint on people because it's happening, and they're having to fight it. Are there nutrients in the water? Yes. Are we the only source of that? No, because all you have to do is go to a town that a guys does his lawn, and where does that go? It goes into the street. It doesn't have a chance to go down, basically. It goes into the street, and then where does it go? Into the sewer. You know, and then where does it go? Into the river. So how much is in there, and how much is out here? I mean obviously we're putting on a lot more, but I'm not sure that we're using it.”

“So it was 1980, the limnologists or whatever had studied the mouth of Lime Creek... and they had nine (mussels) species and I think four of them were rare, or something like that. It was apparently pretty good, you know. So then, 10 years later or whatever, they can't find any of them in the same place. So it was like 100% lost. So these nine-- Well then they moved farther upstream and studied where the rocky substrates were better and they figured out this was in the flood plain in the Cedar River, you know, so there's sedimentation issues that were probably part of the-- which should be periodic, you know. They did find six of the nine species in Lime Creek. And so there's quite a bit of satisfaction that they at least have that and some of them are still the rare species that-- we do have a cold water habitat. We're listed- - the DNR has us as, I forget if they call it outstanding water quality or outstanding streams or-- it's something like that. Bear Creek over this way and Lime Creek this way both have sections where it's special habitat and fish diversity, the native-- we have farmers who have maintained a fair number of the trees along the stream so there's shading of the water that is important for the temperature of the water and all these interactions and so on. I do feel like I'm farming on a hill in between a couple of streams that are protected habitat, so that's kind of my incentive to be like, "Well, hey, we can't just wipe this stuff out, because then where will the kids go?”

**Climate Change**

**Posey County**

Prior to providing climate scenarios to producers, interviewers asked producers about their belief in climate change. There were mixed results for attitudes and belief in climate change. Some producers believe that climate change is happening, or going to happen, and that it is human-induced. Other producers do not believe climate change is happening or believe that it is part of a natural cycle. Some rely on personal experience or the experience of older generations to support their belief about of climate change. More than a few producers were not confident in their beliefs of whether humans were responsible. Many producers spoke about the impacts of climate change. Some thought there would be changes to temperature and/or precipitation, which would lead to either positive or negative outcomes. Some mentioned an increase in flooding while some mentioned that there may be positive effects on crop yields. Overall, there is no strong conclusion on producers’ beliefs or attitudes towards climate change which indicates that results should be examined on the individual and not at the community level.

Producer Quotes:

“So far, if this is global warming, we’re all for it.”

“I think we are a contributor. I mean, I don’t think there’s any doubt that we pump plenty of extra CO2 into the environment. I also know that we get another event like Krakatoa, we’ll have another huge pile of CO2 out there. No, but I don’t think there’s any question that we’re contributors to it.”
“I don’t know, it’s interesting. I feel that since we started sending spaceships out through that we started with those kinds of issues, things, you know whether you start breaking holes in there or opening that up or something that allows change, I don’t know. It’s some I always thought about. Obviously there is reason for everything just figuring out what it is, what causes it, causing effect situation.”

“I’m still, jury’s still out. I don’t know. I just look back in history, it’s been so many weather events to record the history, that were much more severe than these and what brought them on? It wasn’t humans and so, I’m just skeptical.”

“I’m not... confident, or know if I have enough knowledge to say yes, it’s definitely human-induced or it’s just natural cycle.”

“I’m a climate changer denier. I think it’s a bunch of bologna. You know climate has been changing since the beginning of time. You here all this stuff and then comes out that you know they was kinda making some numbers up. You make a computer model, they can make a computer model that says 2+2 is a billion. You know it’s just people speculating and trying to find more ways to tax us I think and control our lives.”

“I think they haven’t got a clue. It’s nice to be able to do that. I mean, I understand people doing that. But, this is not the first time the world’s warmed up; it’s not the first time it got colder. It’s, that is a natural cycle. Saying that we’re doing it, I don’t know. I don’t think so. I wouldn’t be willing to stop farming because of that.”

“Personally I just think that it’s, you know, we are gonna be dealing with more extremes, water and heat.”

“But yes it seems that we get less time to get it done. Rain, bigger rain, bigger events, more storms, but I just don’t attribute it to global warming, you know.”

Lime Creek

Most noted that there are cycles to climate patterns, that climate is continuously changing, and it is difficult to predict climate patterns in the future. There is some recognition that humans may be a contributor to changes in climate but also believe that there is not enough data to support how much humans are responsible for the changes that are or will occur. This contributed to skepticism about the need to act to address climate change.

Producer Quotes:

“That’s a bandwagon that people are getting on that I don’t think is-- our climate is changed forever. They say it's melting more, we’re going to flood the oceans. I don't really believe that.”

“...our business models include the protection of the natural services an ecosystem provides. And that's been the challenge to make sure that-- I guess that's the argument that the people who say, "Well, no, it's [climate change] a hoax. There is no climate change caused by humans." And it's like, "Well, that doesn't even make sense with the physics of the situation. We know that we're having a big, huge impact on the environment." I look across the fields and imagine what it was like a few hundred years ago when it was all prairie. And it's like, "Do you think we're having a big impact on the environment?" Look out your window. Most people look out the window and see more people instead of just a diverse and a wild, natural environment. We tend to think about people's problems and we don't think about how it affects our world.”
“I do believe that climate change is happening. I don't know if - as a human race - we should just throw our hands up in the air and say, "Oh my gosh, it's all our fault." We might have something to do with it. We might not. We might have everything to do with it to a small degree. There's always changes going-- it's just a really long-term trend because, in North America, we don't have hardly any data since before 1870, around here in the Midwest. And on the East Coast, of course, not much data before 1700. So maybe this happens every 5-700 years. I don't know; maybe you do. Maybe you'll find out in your career. I don't know. But then again, maybe we are burning too many fossil fuels and cutting down too many trees, and tearing up too much sod. Which gas is the largest greenhouse gas contributor? Is it methane or CO2?”

Adoption of Conservation Practices

To better understand what agricultural producers think the advantages and disadvantages of conservation practices are and which practices they are more likely to adopt now and in the future, we collected both qualitative and quantitative data. We present the quantitative results first to show which conservation practices producers are willing to adopt now and after they were presented climate information. Qualitative data is presented second to provide a better understanding about what producers think about each practice and why they are more or less willing to adopt those practices.

To measure agricultural producer’s willingness to adopt conservation practices we created a mean of responses to the closed ended, five point Likert scale for each conservation practice (one meaning not willing to adopt, five meaning very willing to adopt). Table 1 shows the mean level of willingness to adopt different practices. Data suggests that there is a strong willingness to adopt grass waterways, no-till, cover crops, filter strips, and drainage water management. Agricultural producers are less willing to adopt strip tillage, constructed wetlands, and riparian buffers. After a discussion of the predicted temperature and precipitation changes that may occur in the upper Midwest, producers were asked whether their level of willingness to adopt would change after receiving additional climate information. To gauge producer’s willingness to adopt, we did a simple count of those who would increase, decrease, or retain the same level of adoption. Data suggests that producers are willing to increase practices they are already willing to adopt; grass waterways, no-till, filter strips, and cover crops.

Table 1. Big Creek Mean Willingness to Adopt Conservation Practices (n = 18)

<table>
<thead>
<tr>
<th>Practice</th>
<th>Mean Adoption</th>
<th>Increase</th>
<th>Neutral</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Strips</td>
<td>4.17</td>
<td>8</td>
<td>10</td>
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<tr>
<td>No-Till</td>
<td>4.14</td>
<td>12</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cover Crops</td>
<td>3.69</td>
<td>13</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Grassed Waterways</td>
<td>3.28</td>
<td>5</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Riparian Buffer Strips</td>
<td>2.67</td>
<td>5</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Drainage Water Management</td>
<td>1.83</td>
<td>10</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>1.33</td>
<td>5</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Strip Cropping</td>
<td>1.28</td>
<td>3</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>

Mean adoption was on a 1-5 likert scale; 1 = unlikely to adopt, 5 = very likely to adopt. Producers were asked whether their level of current adoption would be likely to increase, stay the same (neutral) or decrease due to climate change.
Table 2. Lime Creek Mean Willingness to Adopt Conservation Practices (n = 15)

<table>
<thead>
<tr>
<th>Practice</th>
<th>Mean Adoption</th>
<th>Increase</th>
<th>Neutral</th>
<th>Decrease</th>
</tr>
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<td>Constructed Wetlands</td>
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<td>Riparian Buffer Strips</td>
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<td>1</td>
<td>12</td>
<td>3</td>
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<tr>
<td>Strip Cropping</td>
<td>1.88</td>
<td>1</td>
<td>15</td>
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</tbody>
</table>

Mean adoption was on a 1-5 Likert scale; 1 = unlikely to adopt, 5 = very likely to adopt. Producers were asked whether their level of current adoption would be likely to increase, stay the same (neutral) or decrease due to climate change.

Figure 1. Decision Weights for Big Creek Watershed.
Results of the Analytical Hierarchical Process (AHP) indicate that decreasing erosion losses from agricultural land is the largest influence on producer decision-making when evaluating whether to implement a conservation practice. Decreasing fertilizer loss, overall net costs, and decreasing flooding are also influencing farmer decision-making. In comparison to these decision criteria, increasing biodiversity and decreasing climate change risks are not as large of factors when producers are making decisions about adopting conservation practices. The AHP results indicate that producers give more weight to erosion control when making decisions about adopting conservation practices than decreasing flooding, biodiversity or risks of climate change.
Agricultural producers were asked open-ended questions on what they believe are the advantages and disadvantages of each conservation practice. A summary of advantages and disadvantages by conservation practice is presented in Table 3.

**Filter strips**

Agricultural producers were asked about the advantages and disadvantages of adopting conservation practices on the property they own or rent. Producers were very willing to adopt filter strips and believe that filter strips improve access to ditches and farm edges, are a good use of marginal or non-productive land, and that filter strips provide wildlife habitat as well as help control erosion by stabilizing erodible ground, banks of drainage ditches and streams. The disadvantages of filter strips focused on an inability to mow filter strips at certain times of the year to manage weeds and the size requirements for enrolling filter strips in conservation programs. Restrictions of the timing of mowing occur only if the producer has enrolled in a conservation program and is being paid for filter strips. Mowing restrictions are to protect nesting and brooding times for certain bird species. Overall, the disadvantages to filter strips are programmatic and do not reflect a belief that filter strips are not effective at providing water quality or wildlife benefits. There is a strong familiarity with filter strips, which may be an indicator for why producers are more willing to adopt filter strips than other conservation practices. When asked if they would change their level of adoption because of changes to future precipitation and temperature, producers indicated that they may be willing to implement or increase their adoption because filter strips may help filter out sediment from runoff due to increases in storm events.

Advantages of adoption:

“Erosion control. Along the ditches, where we fight to hold that ditch bank, and if we could put a 30ft grass strip along each side of it, all we should have to do is mow it and be very little maintenance there. In the end, even though we lose a little bit of crop production, we’re not having to work and maintain that ditch and clean it out as often and all that. It really should all work out about the same.”

“We put ‘em all in. Tryin’ to help water quality a little bit. Plus giving us access to the ditches or the side of ‘em in the summer for maintenance.”

“Well they’re in the creek bottoms and along the ditches; if you don’t have some grass here and the creek gets big it’ll make a cut and then you’ll get a cut across the field.”

“But in the long run if they are just small filter strips along drainage ditches they’re well worth the sacrifice of a little bit of production there for the benefits that you receive.”

Change in adoption due to climate change:

“Well I mean... possibly, filter strips... there gonna improve water quality to a certain extent.”

“If it’s gonna be more rain maybe larger rain at one time, the filter strips I could probably plant a little bit more.”

“Again, if the filter strips are in a location where they’re actually catching surface water as it was going across... yes. Then I think that’s a good thing.”

**No-till**

Producers were also very positive about adopting no-till practices. Advantages of no-till are include reduced costs due to less fewer required inputs such as, labor needs, machinery, and nutrient applications. Producers mention that because no-till requires less passes on the tractor (do not need to till, then create seed bed, then rows) that will reduce the amount of labor needed and fuel. This allows them to increase the amount of land they can manage which increases their profit margin. There are also advantages due to weed control, erosion control, and
retention of soil moisture. There was discussion about water quality improvements due to a decrease in soil erosion and application of nutrients. Disadvantages of adopting no-till practices were too much soil moisture in more clay soils and using no-till in a corn-on-corn rotation. More clay soils may become too compact and reduce the ability of crop roots to grow. Producers also indicated that no-till with soybeans was easier than with corn because of plant residual left after harvesting would makes it more difficult harder to plant in the spring time than with conventional tilling practices. There was a lot of discussion about the relationship between soil type and use of no-till. Producers believe that planting times would be shifted later due to high soil moisture because the ground was not turned to increase soil exposure to sun prior to planting. Weed control was discussed as both an advantage and a disadvantage because if producers can mow or spray at the correct times (or cover crops are also used) producers would be able to control weeds. However, there could be an increase in weed control because conventional tillage would not have allowed weeds to establish or would have incorporated weeds into soil prior to planting. Timing of application and incorporation incorporating of nutrients was were also an additional issue because using no-till would does not allow the producer to incorporate nutrients into the soil during tilling or by side-dressing nutrients later in the season. Producers would need to change how and when nutrients are applied if they switch to no-till practices.

Advantages of adoption:

“Reduce fuel costs, less machinery, less labor, that’s what I’m looking at”

“Erosion, but obviously water is definitely second, third concern.”

“Well you do no till beans, generally because strictly it’s more of a timing issue. And the moisture conservation issue... So no till works best to get ‘em in the ground and stop any disturbance to lose that moisture.”

“Oh absolutely. Yeah. There’s no doubt it improves water quality, mainly through runoff, but also through infiltration, you know that are going to our ground wells. There’s no doubt it’s a better water.”

Disadvantages to adoption:

“The problem is, ground temperature and moisture I guess everywhere but seems like we don’t warm up as fast some of the others. Problem is we don’t have as dark of soils. We got real high clay content and a lot of the soils which holds the moisture longer. So if we can get the bare ground bare, this time of year and early spring, well it seems to warm up a little more faster than having a total cover on it. You’re at least a week or so later and then the conditions could be not as good as the mill tillage not even a week earlier. Then you get too much residue on top, especially green residue that sits on top that you’ve got to worry about insects and rodents.”

“For soybeans I’m struggling right now. In last year or two with herbicide resistant, with weed. So I have much to my dismay, I don’t like it but I’m doing more tillage. All these years my goals it’s to try to figure out how to. I want to spend more time with our chemical guy.”

Change in adoption due to climate change:

“Probably the soil, texture, they retain the water better. I don’t know. I would say if we started getting hotter days, and less rain, the no till is going to do better.”

“Like I say, with the no-till cropping you’re maintaining the residue so you’re conserving moisture, you’re probably lowering the soil temperature a little bit. Anything to keep more residue on the surface is a big benefit as far as if we’re in a dry, hot pattern.”
Cover Crops

Agricultural producers believe that cover crops will help to reduce soil erosion and soil compaction and help improve soil health by increasing organic matter and allowing residual nutrients to be held in organic matter that will be released in subsequent years. Producers mention the cost and benefit of cover crop adoption as unique advantages compared to other practices if producers consider non-economic benefits, such as long-term soil health. Many producers mention that cover crops help reduce compaction by allowing root structures to break up the soil (one producer mentioned that this is a good practice in conjunction with no-till). Disadvantages are additional cost of seed and timing of seeding, soil moisture levels in the spring, and the timing of planting cover crops and killing off the cover crop before planting of corn and beans in the spring. Producers mention that when harvest is late, it is difficult for them to seed in time to establish and germinate the cover crop. This may be why cover crops are adopted on only a portion of their ground or only in some years. A few producers discussed the additional costs of buying seed and herbicide, as well as costs associated with seeding the crop, e.g., either through aerial application or passes with a no-till drill. Some producers mention that areas with cover crops have higher levels of soil moisture in the spring, which may delay when they can plant. Many of the producers are willing to increase their use of cover crops in the future and think that cover crops would be beneficial to manage soil moisture if there are changes to summer temperatures and precipitation.

Advantages of cover crops:

“...I think the prospect and the potential of what cover crops could do is phenomenal. Phenomenal. I think from the soil biology standpoint you could make a case for it, from an erosion standpoint you could make a case for it, I think from an improved soil health, soil carbon, lots of good stuff.”

“Yeah I’d say about 5 years ago we started. Seeing a lot of benefits to it with the roots you know and compaction and that kind of thing, helping build the soil up. “

Disadvantages to cover crops:

“Trying to get the timing when harvest is going on, your labor is short, your equipment’s short, you know the tractor I pull the drill with is the same tractor from the grain cart, you know, I just can’t go get another tractor, I’m limited over here, so it’s timing then.”

“I think, yeah, there are issues with cover crops. And part of it comes down to, again, the economics of cover crops.”

“You could do a full aerial seeding of cover crops, which is at seeding time, and shortly thereafter entirely weather dependent. We know we can no-till drill them into a field after harvest, but that is another man power, logistics issue depending on what your labor pool is. And it’s also, depending on the kind of year you have, things have been crazy down here, all of a sudden you’re past Thanksgiving and you’re not done harvesting yet, not an ideal opportunity to be doing some cover crop seeding.”

Change in adoption due to climate change:

“As I said, if there is less moisture in the soil profile, I mean I think that would help pull, each time you put a cover on ground, you know you’re retaining more shade and different things, you’re retaining more water capability, so that would definitely be an increase.”
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*Lime Creek watershed; note that advantages/disadvantages may be listed twice
Grassed Waterways

Advantages to grassed waterways are erosion control and wildlife habitat. Many producers believe that grassed waterways are effective at controlling erosion, especially when there are hills, and reducing sediment going into waterways. Producers also believe that the waterways provide wildlife habitat for deer and bird species. One producer mentioned that having grassed waterways helps keep trees from growing because they can mow it. The disadvantages to adopting grassed waterways include the need to maintain the waterways over time. Every five to ten years producers will need to “clean out” the grass areas to remove sediment which means they will also need to level and re-seed the waterways. Most producers mentioned water and sediment control basins (WASCOBs), which are control structures (many times concrete dams) which would be adopted with grassed waterways but is a separate practice that was not a focus of this study. Wildlife habitat was viewed as an advantage and a disadvantage, but only if the practice was part of a conservation program. Like filter strips, there was discussion that timing of mowing was an issue and may lead to a weed problem in their fields. An ability to mow before weeds go to seed rather than August 15 would help them control weeds. Some producers discussed that this practice may help reduce erosion if there is an increase in future extreme rain events.

Advantages to adoption:

“It’s pretty effective. It’s doing its job.”

“That’s mainly erosion control, you’d put them in valleys or steep valleys or anywhere you would have erosion. If you can get it established it works real well.”

“Yes. It’s less maintenance than filling in washouts, and it’s better than having your soil go down the ditch to the creek, but, it’s a little bit of management too. But all in all I think that’s a very good practice.”

“…well you got CRP waterway, which, and that may come from, I want to say ducks unlimited, or Nature Conservative or somebody, may have provided some funding to NRCS, as a requirement of that we’d like to see bird habitat included.”

“I don’t think you’d have waterways put in without the CRP program…I say that as a general statement. You can... you’ll find someone who is altruistic enough to say, “I need to do this.” But by and large, I think that the tendency is not to do that there. And again, it comes to this idea that “I’m giving up something” out here. And I guess from my perspective, if we as a society believe that this is a worthwhile endeavor, than why shouldn’t society help achieve that goal?”

Disadvantages to adoption:

“The problem with the grassed strips like that, they catch a lot of sediment so the longevity of the life of them, it’ll build up and then alter the water flow so kind of it’ll move it over, so you’re constantly trying to maintain the waterway like that.”

“Not on our end but if you got property that somebody else across the road that they aren’t doing any kind of conservation practice and you get a big rain and all that silt comes in and it lays it in the waterway and you have to go in and clean it out. Then once we got to maintain it you start getting a lot...fast forward you start getting a ditch down the middle of it, then clean it out and reshape it and reseed it.”

“You know that’s in the contract that tell us we can’t mow it. So it becomes a little bit of a touchy issue, whether you have some weeds trying to go to seed. They told us, technically, we have to come up and ask for approval of soil water board to go there and maintain that. They told us we can’t touch that, I think it’s August 15, it’s pretty late in the season. I mean you get a lot of weeds going to seed prior of that, so then the next thing you know, your waterways covered up by Johnson grass or, you know, other weeds, eventually hinders you. I know they want to protect the nesting grounds and all that but there is also other sites to, they kind of need to take a look.”
Change in adoption due to climate change:

“I think grassed waterways and buffers would help and these terraces to slow the water down. All these gully washer rain storms, that’s what that means, about the heavy one time rain.”

“Well if they were more extreme weather events I’d increase it... I think it would have to do of having more 3 to 4 inches rains. You’re gonna have increased erosion.”

Riparian Buffer Strips
Producers had conflicting ideas of the advantages and disadvantages of adopting riparian buffer strips. Adoption depended on if their farm was near a ditch or stream where the practice was appropriate. Advantages discussed by some producers were also mentioned as disadvantages by other producers. For example, some producers believe that establishing trees along streams would slow water down and protect streambanks. Other producers believe that water is deflected by trees and therefore think trees contribute to bank erosion. Additionally, some producers see riparian buffers as a way of benefiting wildlife, but the same producers also as a source of crop depredation. Trees along ditches and streams may also shade crops and will lead to reduced yields in areas around trees (this depends on if the trees are going north south or east, west) and may limit if trees are adopted by some farmers. One producer also voiced concern about fear of government regulations of managing riparian buffers (by the Army Corps of Engineers) which would factor in to their adoption of this practice. There was not much discussion on how climate change may increase or decrease their adoption of this practice.

Advantages to adoption:

“Oh, without question. They certainly have a habitat benefit, depending on what you’re trying to plant in there and what you can have growing in the understory. I think the riparian and the grass filter strips, too, both have a positive impact on water quality. I can’t say though... I don’t think that we’re going to get to water quality goals strictly with filter strips and riparian buffers.”

“We have two of them and it really worked well. Because we had a field that eroded and we put these in and almost stopped it. And all can become in and throw them all away on to the bottom. A third of the trees we had and it started worsening again. So we had to put trees back.”

“Yeah, I mean, I think we need more trees. Farmers have taken out all the trees in fencerows, and now we’re complaining because the wind blows all the time. So, I would really like to put up some fence lines and things along the edge of the fields, even where there’s nothing now, just to protect us from that wind.”

Disadvantages to adoption:

“Honestly very little. I think I prefer to see no continuous wood patch for the wildlife versus planting a little strip here and a little strip there. Ya know, yes. I’m all for wildlife, but let’s have their block here and the crop production block here. Co-mingling we end up... we feed the wildlife enough.”

“No, but we try to get rid of the trees. Might as well fill as much as we can anyway because of shading and everything else on a crop. And tracks nutrients around, underground moistier and shading. If you’ve got trees along the edges of the field, you’ve got 30 foot that’s not going to make a crop because the trees take everything away. Just the way it is. Trees are dominant. No rain for real crop.”

“That and the trees cause you problems. They slow the water down. If you have drift floating down then it starts binding everything up. We’ve got problems with bridges here in the county, log jams. It’s like get the trees away from them.”
“My biggest problem you get down there, my biggest problem is the core of engineers down there. That’s my problem and I can’t argue with them.”

Change in adoption due to climate change:

“Only if it became a question of just planting trees on some stuff because it is flooded too much, and they quit giving a crop insurance for. That’s a cynical answer but it’s quite honestly.”

**Drainage Water Management**

Many producers considered this practice water and sediment control basins (WASCOBs) or as a practice to control outflow of tile drains. The practice was described to interviewees as a practice that controls outflows of tile drains in order to manage soil moisture in wet and dry conditions. Discussion of WASCOBs was included in the grassed waterways section of this report. Producers believe that drainage water management will allow them to manage water levels and increase soil moisture during drier times of the year or decrease soil moisture during wet times, leading to an increase in yield. Disadvantages are the practice may not fit the topography of their farms, too much or too little slope would not make the practice feasible. Producers also mentioned that this practice would require a lot of long-term maintenance; although other practices do require work to adopt this practice has a longer-term commitment because of the need to build infrastructure. Because this practice was seen as a way of managing water and soil moisture, farmers were positive about adopting this practice after receiving climate information.

Advantages of adoption:

“Sometimes what people do is to keep the water as long as they can in the spring. In the summer they can manage for if it’s going to be a drought year.”

“Wherever we have an erosion problem it’s big enough that we really need a WASCOB to contain that water.”

Disadvantages of adoption:

“I read about them but I’ve really never had any experience. A lot of times when you block the tile lines and that kind of things and backing water up. And I think it’s all great. Our terrain is difficult to manage that in because our slopes are so steep that we really can’t back water up a 4 or 5 degree slope, it just doesn’t work for us. But I can see where yeah if you can keep that water there and keep it from running off and not get the nitrates out, I think it’s great but I just don’t know how I can practically implement that.”

“But see, our problem is, it’s so hard, you’re gonna have to wrap the tile around the hills”

“No we don’t have any way to open and close tile drains. We have quote a built of tile but we do not try to gate any of that off to retain the moisture for the summertime. I know some places that’s practical, but around here I don’t really know that it’s a practice that’s widely used. Most of our ground tends to be a little bit on the wet side and we primarily just try to get the water off the fields.”

“I’ve seen only one person and they abandoned the practice but the center paled up, it was on some sand.”

“I’ve not seen any around here. I know what you’re talking about, but I’ve not seen anything.”
Change in adoption due to climate change:

“Well, yeah. That would definitely. I mean, if you knew, if I knew next year was gonna be extremely dry, come the first of March, if I could put gates in all of my tile lines and shove some tile back, and shove some water back I would. But most of my tiles lines here, terraces are hooked up to it. So, I mean, you, it’s drainage, it’s getting that water off of these hills underground. Now, I, you know, you couldn’t, I mean, I guess you probably could, but I would just as soon them things get empty in a hurry.”

**Constructed Wetlands**

Producers were very familiar with this practice, but not as willing to adopt this practice as other conservation practices. Producers did believe that there were advantages to constructed wetlands, such as an increase in water quality by keeping soil and nutrients out of streams, by reducing flooding on farm fields and taking unproductive land out of production. Like their opinion on other practices (e.g., riparian buffers), many producers believe that constructed wetlands should only be implemented where it is appropriate and where it fits farming operations. Producers believe there are a number of disadvantages to constructing wetlands on their property, including an increase in wildlife predation on crops, taking land out of production and hurting their profit margins, a disbelief in the practice’s efficacy in improving water quality, and a fear of government regulation. There were many producers who felt negatively towards constructed wetlands because they did not want part of their property designated as wetlands. Some did point out that there were wetlands on their property, but did not want the government to know for fear of an increase in environmental regulations. In the future, if there are changes to temperature and precipitation, some producers believe that constructing wetlands would help reduce flooding and increase soil moisture. But as one producer points out: maybe another producer should implement it, not them.

**Advantages to adoption:**

“Well I assume that if it’s managed right, you can retain some larger key pits from getting to the streams, downstream. For letting the field drains or the water drainage come in to that wetland. And keep the margins out of the ditches.

“I think that depends on the situation, where it’s at. I don’t know that there’s...if that’s an area that you will never be able to get into you might as well do something with it.”

“If you mean by that simply taking the lowest ground that you’ve got and putting in wetlands. It should be, yes talking about reducing flood risks. There is some of this ground that shouldn’t be farmed. You know, but it’s all I’ve got so I’m gonna keep farming it.”

“Certainly, you could make an argument for the habitat for those there. To the extent that wetlands can act as a buffer reservoir, possibly.”

**Disadvantages to adoption:**

“We don’t want it to be called wetlands.”

“We’re scared to death that all this river ground we farm could be called a wetlands.”

“I’d just say I don’t have much of a place where it’s suited. You know you gotta have a place where it’s suited or you know it’s not gonna be beneficial or work.”

“Like I said, we’ve got several natural wetlands around here. You increase for the wildlife and then the wildlife comes and hinders us by destroying the crops.”
Interviewer: “Do you think they [constructed wetlands] could improve water quality?”

Interviewee: “I’m told they will. Have I witnessed that? No.”

Change in adoption due to climate change:

“You know in extreme wet conditions maybe that’s something we need to look at on somebody else’s farm.”

Strip Cropping

Producers in Posey County were completely unfamiliar with strip cropping or may have heard of the practice only through trade magazines. Producers did not believe that this type of farming was applicable to Posey County because of the topography, rolling hills, which would not allow them to effectively control erosion or plant in a north south orientation. This perceived geographic constraint may be the largest factor of why farmers have not adopted the practice or are unlikely to adopt it in the future. Producers did believe that this practice would be advantageous on flat ground and would increase yields, increase sunlight to corn edges, and decrease erosion. The disadvantages to adopting strip cropping include the increase in management because of inter-cropping system, a need to buy new equipment, the size of farms (they are small in Posey County), and that the practice has not been implemented in their area. Producers have not seen this practice used in their area, which explains why they are unfamiliar with the practice. Unfamiliarity with strip cropping may influence when, or if, the practice is used in Posey county, whether there are changes to climate or not.

Advantages of adoption:

“There’s potential yield benefit to it and basically that’s it.”

“Well, I think where’s it’s working for people that’s great and I understand some of the benefits you know your outside rows of corn is getting more sun and so forth and so if it works that’s great.”

“Well so you can get into a situation where you go 100% crop rotation, and then as an example, I think runoff wise, the corn, when it’s big and established like that, slows the water down, not necessarily on the surface so much but just impact, whereas the beans may not be able to do that and hold the soil as well. So you’ll have corn that seems to protect the soil better than soybeans, and soybeans seem to make the ground looser, they just seem to do that naturally. So you would have a situation by um, you know they could complement each other.... in theory it could work.”

Disadvantages of adoption:

“We just haven’t seen actually that practice implemented here in this local area.”

Change in adoption due to climate change:

“It might not change. You still gonna have the barrier the equipment and all the timing. But you know, you don’t think about this much but we are starting to plant beans whole earlier than we used to. And it might be such a thing if you just feel having a planter with beans and corn and go plant.”
Discussion

The purpose of this study was to understand farmer’s motivations to adopt conservation practices including perceptions of water quality and climate change. The AHP results indicate that reducing soil erosion and nutrient loss are weighted more than decreasing risks of climate change or increasing biodiversity (wildlife) when making decisions about adopting conservation practices. However, there is wide variability in weights given to each criteria, indicating that there is not strong consistency in the weight interviewees give to one criteria in relation to another; for example, one interviewee may give more weight to reducing risks of climate change than reducing soil erosion when implementing a conservation practice while another interviewee may be give more weight to soil erosion.

Interviewees were asked about their perceptions of climate change. Most interviewees expressed skepticism about human contributions to climate change but acknowledged that climate changes over time. After being presented with climate scenarios of precipitation and temperature changes interviewees were asked if their use of conservation practices would increase, decrease, or stay the same. Many of the practices that would increase were practices that interviewees were already willing to adopt or would decrease or stay the same. This indicates that climate change may not be a motivator for adoption of conservation practices.

In their discussions of the advantages and disadvantages of conservation practices, many of the advantages are focused on on-farm benefits while off-farm benefits were secondary. For example, when producers spoke of the advantages/disadvantages of grassed waterways they spoke of more immediate outcomes, soil erosion or forage for livestock, while constructed wetlands focused outcomes that are more removed from their farm, wildlife or water quality. This is consistent with the weight given to reducing erosion control and loss of nutrients rather than benefits to biodiversity. Interestingly, many of the advantages were abstract (e.g. wildlife benefits), many of the disadvantages mentioned for each practice focused on problems with implementation or management of those practices or the requirement to change farming operations (e.g. delayed spring planting). This implies that if interviewees are thinking of using conservation practices to address environmental issues (e.g. water quality), the fact that some practices have more concrete disadvantages may weigh more heavily than abstract benefits.

These results will help researchers at Purdue University and Oregon State University create applications which tailor information and advice provided through online web applications. These applications are trying to help understand what practices may be applicable to farmers at the field scale and how to measure on-farm and off-farm benefits of those practices. By understanding the barriers, constraints, and motivations for adoption of conservation practices, we will be able to provide better suggestions and advice when farmers are using these tools.
Appendix A. Interview Guide

Interview Guide
We are part of a team that is evaluating the impact of extreme climate events in agriculture in several sub-basins of the Mississippi River Basin. The knowledge we gain from interviews will allow us to understand how local stakeholders perceive the problem and why.

Your participation in this interview is completely voluntary. If you choose to participate in this interview, your responses will remain confidential and your name will never be used in any report or publication. You may skip any questions you do not want to answer and you can stop the interview at any time.

Are you willing to participate in the interview?
Do you mind if I record this interview for transcription purposes?

Opening questions

1. How long have you (or your family) farmed here?
2. Could you tell me about your farm?
   1. (If not answered) How many acres do you own and manage (rent/manage and own/rent out)?
   2. (If not answered) What kind of crops or livestock do you raise on your farm?

Goals for implementing Conservation Practices

3. Do you currently use any conservation practice on your farm?
4. If you consider implementing conservation practices what goals do you want to accomplish? Please briefly explain your answer (if more than one goal ask him/her which one is the most important and why)
5. In your opinion, is improving water quality an important goal for implementing conservation practices? Please explain your answer.
   3. And improving habitat for wildlife? Please explain your answer.
   4. And reducing impacts associated with changing patterns in rainfall and dry weather conditions? Please explain your answer.
6. Is any of the land you own or manage currently enrolled or enrolled in the past in the Conservation Reserve Program (CRP) of the Farm Service Agency (FSA)?
   5. (If not) Could you tell me about the main reasons? (E.g. subsidy, environmental requirements, etc.)
   6. (If yes) Could you tell me about your experience with the CRP? (Pros and cons, reasons why used in the past and not currently using it)
Implementing Conservation Practices (see definition of each conservation practice)

**No-Till**

7. Do you currently use No-Till on your farm? (If Yes, when? How? Why?)
8. What are the main barriers and incompatibilities to use it on your farm? And motivations?
9. In your opinion, what are the benefits of using No-Till?
10. Do you think using No-Till on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
11. How do you think using No-Till on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using No-Till?
12. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use No-Till on your farm? (briefly explain the main reason for your answer)

**Strip Cropping**

13. Do you currently use Strip Cropping on your farm? (If Yes, when? How? Why?)
14. What are the main barriers and incompatibilities to use it on your farm? And motivations?
15. In your opinion, what are the benefits of using Strip Cropping?
16. Do you think using Strip Cropping on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
17. How do you think using Strip Cropping on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Strip Cropping?
18. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Strip Cropping on your farm? (briefly explain the main reason for your answer)

**Filter Strip**

19. Do you currently use Filter Strip on your farm? (If Yes, when? How? Why?)
20. What are the main barriers and incompatibilities to use it on your farm? And motivations?
21. In your opinion, what are the benefits of using Filter Strip?
22. Do you think using Filter Strip on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
23. How do you think using Filter Strip on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Filter Strip?
24. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Filter Strip on your farm? (briefly explain the main reason for your answer)
Riparian Forest Buffer
25. Do you currently use Riparian Forest Buffer on your farm? (If Yes, when? How? Why?)
26. What are the main barriers and incompatibilities to use it on your farm? And motivations?
27. In your opinion, what are the benefits of using Riparian Forest Buffer?
28. Do you think using Riparian Forest Buffer on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
29. How do you think using Riparian Forest Buffer on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Riparian Forest Buffer?
30. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Riparian Forest Buffer on your farm? (briefly explain the main reason for your answer)

Cover Crops
31. Do you currently use Cover Crops on your farm? (If Yes, when? How? Why?)
32. What are the main barriers and incompatibilities to use it on your farm? And motivations?
33. In your opinion, what are the benefits of using Cover Crops?
34. Do you think using Cover Crops on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
35. How do you think using Cover Crops on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Cover Crops?
36. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Cover Crops on your farm? (briefly explain the main reason for your answer)

Grassed Waterways
37. Do you currently use Grassed Waterways on your farm? (If Yes, when? How? Why?)
38. What are the main barriers and incompatibilities to use it on your farm? And motivations?
39. In your opinion, what are the benefits of using Grassed Waterways?
40. Do you think using Grassed Waterways on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
41. How do you think using Grassed Waterways on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Grassed Waterways?
42. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Grassed Waterways on your farm? (briefly explain the main reason for your answer)
**Constructed wetlands**

43. Do you currently use Constructed wetlands on your farm? (If Yes, when? How? Why?)
44. What are the main barriers and incompatibilities to use it on your farm? And motivations?
45. In your opinion, what are the benefits of using Constructed wetlands?
46. Do you think using Constructed wetlands on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
47. How do you think using Constructed wetlands on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Constructed wetlands?
48. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Constructed wetlands on your farm? (briefly explain the main reason for your answer)

**Drainage Water Management**

49. Do you currently use Drainage Water Management on your farm? (If Yes, when? How? Why?)
50. What are the main barriers and incompatibilities to use it on your farm? And motivations?
51. In your opinion, what are the benefits of using Drainage Water Management?
52. Do you think using Drainage Water Management on your farm can improve water quality in downstream creeks and rivers? And habitat for wildlife? And reduce the impacts of extreme climatic events?
53. How do you think using Drainage Water Management on your farm could impact your short- and long-term profit? Decreasing fertilizer and erosion losses? Decreasing flooding? Are there any other criteria that you may consider for using Drainage Water Management?
54. Under current climatic conditions, on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing are you to use Drainage Water Management on your farm? (briefly explain the main reason for your answer)

**Water quality and Habitat for wildlife**

55. In your opinion, do you think creeks and rivers where you farm have water quality problems?
56. What do you think the main contributors to creeks and rivers pollution are in your area? Why do you think that or how come?
57. To what extent do you think that agriculture contributes to water quality problems in your area? And to damage habitat for wildlife?
58. Do you think it is farmers’ responsibility to help protect water quality? And habitat for wildlife?
59. To what extent are you interested in improving water quality through changing your farm-management practices?
60. Have you implemented conservation practices on your farm to improve water quality and/or increase wildlife habitat?
   • If yes, can you describe which conservation practice you implemented and explain why you chose that practice?
   • If no, can you explain the main reason why you did not implement any conservation practice?

61. What other practices would you consider implementing on your farm in order to improve water quality and/or increase wildlife habitat?
   • Can you explain the main reason(s) (barriers) for not implementing such practices?

**Climate change**

62. How does climate impact your crop yield?
63. Within the last 10 years, have you noticed an increase in the frequency of weather extremes events on your farm (droughts, floods, heatwaves and freezing spells)? And changes in temperature and precipitation? If so, what impact have these had on your crop yields? Are there certain times during the growing season that your crops are most vulnerable to these events? Least?
64. Have you changed your farm-management practices to reduce or minimize impacts and risks associated with weather extremes (droughts, floods, heatwaves and freezing spells)? And changes in temperature and precipitation?
65. If yes, what changes have you implemented? Please briefly explain the reason(s).
66. If no, can you explain the main reason(s) why you have not changed your farm-management practices?
67. What other practices would you consider implementing on your farm to reduce or minimize impacts and risks associated with weather extremes events (droughts, floods, heatwaves and freezing spells)? And changes in temperature and precipitation?
   • Can you explain the main reason(s) (barriers) for not implementing such practices (e.g. uncertainty, long time horizon to make decisions)?
68. How do you think changes in climatic patterns in the next 10 or 20 years will affect your agricultural production? With respect to droughts, floods, heatwaves and freezing spells?
69. These are predictions of future climate in your region (show respondent projections), do you agree with these predictions? Please briefly explain your answer (if they do not say it, ask if they believe or not in climate change and if they think it is human made).
70. Taking into account these future climatic predictions, would you be more inclined to change your farm-management practices? Please briefly explain your answer.
71. If yes, what changes would you implement? With respect to droughts, floods, heatwaves and freezing spells? And changes in temperature and precipitation?
72. If no, can you explain the main reason(s) for not implementing any change?
73. Would you be more interested in enrolling some of your land you own or manage in the Conservation Reserve Program? And abandoning farming? Please briefly explain your answer.
74. If these future climate predictions in your region were right (show respondent climate change projections), on a scale from 1 to 5 (1 = Not willing to implement and 5 = Very willing to implement), how willing would you be to use No-Till on your farm? Why? Ask the same question for all conservation practices:
   a. Strip Cropping
   b. Filter Strip
   c. Riparian Forest Buffer
   d. Cover Crops
   e. Grassed Waterways
   f. Constructed wetlands
   g. Drainage Water Management

Marginal land

75. Do you have any marginal land? (If yes: Why marginal? Poor soil, slope, river bank, environmental sensitivity Acreage? If no go to Q31
76. How do you use this (marginal) land?
77. Have you had marginal land enrolled in a conservation program? (if yes: what programs and for how long?)
78. What do you think the advantages and disadvantages are to owning marginal land?
79. What do you consider to be marginal land (generally)? (Poor soil, slope, river bank, environmental sensitivity)
80. What do you think the advantages and disadvantages are to owning marginal land?
81. Has what you consider to be marginal land changed over time? (What has changed? How? Why? Year to year? Season to season?)
82. (If having marginal land) Is the marginal land you own or manage currently enrolled or enrolled in the past in the Conservation Reserve Program? Please briefly explain the reasons of your answer.

83. Just so I can get an overall picture of the demographics of the people who participated in this program, could you tell me your:
84. Age (year born)
85. Highest grade in school you have completed? (If college, what coursework/degree?)

Thank you for taking the time to talk with me today.
Appendix B. Analytical Hierarchical Process (AHP)

Pairwise comparisons of 6 objectives for implementing conservation practices through Analytical Hierarchical Process (AHP)

- Decrease net costs
- Decrease fertilizer losses
- Decrease flooding
- Decrease erosion losses
- Increase biodiversity
- Decrease climate change risks

Next, through pairwise comparisons, I will ask you to determine which objective you like the best in terms of implementing conservation practices on your farm. We have made a relative scale to measure how much you prefer the objective on the left side as compared with the objective on the right side.

**Example**

The figure below shows an example where respondent considerably likes the objective on the left (Decrease net costs) better than the objective on the right (Increase biodiversity). Therefore the circle is on the number 8 on left side. If respondent did not have any preference for any objective over the other one then the circle would be on number 1.

Decrease net costs VS. Decrease fertilizer losses

Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease net costs VS. Decrease flooding

Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.
Decrease net costs VS. Decrease erosion losses
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease net costs VS. Increase biodiversity
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease net costs VS. Decrease climate change risks
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease flooding VS. Decrease fertilizer losses
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease flooding VS. Decrease erosion losses
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease flooding VS. Increase biodiversity
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.
Decrease flooding VS. Decrease climate change risks
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease fertilizer losses VS. Decrease erosion losses
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease fertilizer losses VS. Increase biodiversity
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease fertilizer losses VS. Decrease climate change risks
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

Decrease erosion losses VS. Increase biodiversity
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.
Decrease erosion losses VS. Decrease climate change risks
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

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Increase biodiversity VS. Decrease climate change risks
Please circle the number where you consider your preference of one objective over the other for implementing conservation practices on your farm.

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### Appendix C. Conservation Practice Description


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<th>Practice Description</th>
<th>Image</th>
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<tbody>
<tr>
<td>1.</td>
<td><strong>No-Till</strong>&lt;br&gt;Maintaining crop residue on the soil surface year around by limiting soil disturbance to manage the amount, orientation and distribution of crop and plant residue.</td>
<td><img src="image1.png" alt="No-Till" /></td>
</tr>
<tr>
<td>2.</td>
<td><strong>Strip-Cropping</strong>&lt;br&gt;Growing planned rotations of row crops, forages, small grains, or fallow in a systematic arrangement of strips in a field to reduce soil erosion and improve water quality.</td>
<td><img src="image2.png" alt="Strip-Cropping" /></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Filter Strip</strong>&lt;br&gt;An area of vegetation established for removing sediment, organic material, and other pollutants from runoff and wastewater.</td>
<td><img src="image3.png" alt="Filter Strip" /></td>
</tr>
<tr>
<td>4.</td>
<td><strong>Riparian Forest Buffer</strong>&lt;br&gt;An area of trees and/or shrubs located adjacent to watercourses or water bodies.</td>
<td><img src="image4.png" alt="Riparian Forest Buffer" /></td>
</tr>
<tr>
<td>5.</td>
<td><strong>Cover Crops</strong>&lt;br&gt;Growing a crop of grass, small grain, or legumes primarily for seasonal protection and soil improvement.</td>
<td><img src="image5.png" alt="Cover Crops" /></td>
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<tr>
<td>6.</td>
<td><strong>Grassed Waterways</strong>&lt;br&gt;A shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet.</td>
<td><img src="image6.png" alt="Grassed Waterways" /></td>
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<tr>
<td>7.</td>
<td><strong>Constructed wetlands</strong>&lt;br&gt;An artificial ecosystem consisting of a shallow basin established with hydrophytic vegetation that is constructed to intersect and treat the flow of a waste stream or contaminated runoff.</td>
<td><img src="image7.png" alt="Constructed wetlands" /></td>
</tr>
<tr>
<td>8.</td>
<td><strong>Drainage Water Management</strong>&lt;br&gt;Managing water discharges from surface and/or subsurface agricultural drainage systems with water-control structures.</td>
<td><img src="image8.png" alt="Drainage Water Management" /></td>
</tr>
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Appendix D. Climate Scenario

Climate changes in the Wabash River Basin

Figure 1: More extreme heat events
Days Above 95°F

Figure 2: Longer growing season
Frost-Free Season

Figure 3: Longer dry spells (droughts)
Consecutive Dry Days

Figure 4: Heavier rains (floods)
Wettest 5-Day Total

Figure 5: Warming temperatures
Figure 6: Less soil moisture storage

Sources


* Differences between the 1971-2000 and 2041-2070 averages for the worst-case scenario are shown.