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The social factors influencing cover crop adoption in the Midwest: A controlled comparison

TNC Cover Crop Study in Indiana, Illinois, Iowa

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Recommended Citation:

Popovici, R., Bernard, M., Prokopy, L.S. (2020). *The social factors influencing cover crop adoption in the Midwest: A controlled comparison*. West Lafayette: Purdue University.

Acknowledgements

We are deeply grateful to the producers, crop advisors, and agency personnel that took the time to participate in our study.

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Acronyms

CC	Cover Cr
CSP	Conservation Stewardship Program
EQIP	Environmental Quality Incentives Program
NRCS	Natural Resources Conservation Service
OpTIS	Operational Tillage Information System
SWCD	Soil and Water Conservation District

1 Introduction

In recent years, cover crops (CCs) have become an increasingly popular tool for addressing soil health issues such as nutrient loss and erosion (Leslie *et al.*, 2017). Around the year 2016, the Midwest saw increased participation in cost-share programs for CCs, including the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). Such programs aim to encourage and mainstream CC adoption among crop and cattle producers by providing funds and technical expertise to help them conserve the environment while increasing productivity (NRCS, 2020).

In spite of increased funding and resources available for planting CCs, their adoption across different counties in the Midwest has been uneven. This study builds on a previous research project from TNC conducted by Majka (2020), which analyzed Operational Tillage Information System (OpTIS) data on CC adoption trends in the Midwest. As expected, the southern counties in each state were found to have more CCs than their northern counterparts, due higher temperature and precipitation. Indeed, a main reason for the variation in CC adoption is differences in climate. Specifically, CC adoption is more prevalent in regions that have higher temperatures and precipitation levels (Majka, 2020). In more arid areas, it is believed that CCs compete with cash crops for soil moisture and nutrients, which reduces their likelihood of adoption (Unger and Vigil, 1998; Alonso-Ayuso *et al.*, 2018; Majka, 2020).

Nevertheless, within the same climatic region, there are some counties with higher (and lower) levels of CC adoption than others. While climate conditions are important in determining CC adoption, social factors could help explain why we see different levels of adoption in counties with a similar climate. These include environmental stewardship values (Ahnström *et al.*, 2009; Reimer and Prokopy, 2014; Roesch-McNally, Arbuckle and Tyndall, 2018; Prokopy *et al.*, 2019), local leadership (Arbuckle and Roesch-McNally, 2015; Moore *et al.*, 2016; Bowman and Lynch, 2019; Ranjan *et al.*, 2019), institutions that provide appropriate information and guidance (Baumgart-Getz, Prokopy and Floress, 2012; Liu, Bruins and Heberling, 2018), and financial resources (Karali *et al.*, 2014; Carlisle, 2016).

Our study seeks to better understand these social factors that contribute to CC adoption in the states of Iowa, Illinois, and Indiana. To date, most studies analyzing these social factors have been conducted by assessing individual producers' perspectives through surveys and interviews. In contrast, our study seeks to explain the county-level social factors that motivate CC adoption. To achieve this, we compared pairs of neighboring counties where one county was a high adopter and the other was a low adopter of CCs. By comparing neighboring counties within the same climatic areas, we sought to minimize the variation in climate. This allowed us to get a clearer understanding of the social factors responsible for the difference in CC adoption levels between each county pair.

2 County selection and methods

2.1 Controlled Comparison

We used a controlled comparison strategy to select the county pairs in the three I-states (George and Bennet, 2005). Based on the TNC report by Majka (2020), average precipitation and average temperature from January to April (“ppt_mm_1234_avg” and “tmax_c_1234_avg,” respectively) were positively and statistically significantly correlated with CC adoption. Thus, we selected counties that were similar in population and that were in the same January-April precipitation and temperature zones but that had different levels of CC adoption. To determine the level of CC adoption, we looked at the total CC percentage (“Total_CC_Pct”) for each county. Population data for each county was obtained from the U.S. Census Bureau, County Population Estimates.

To determine how the counties in each pair differ in their adoption of CCs, we compared their average CC percentage adoption for 2016, 2017, and 2018. We only considered those three years (as opposed to calculating average CC percentage adoption from 2005- 2018) because in 2016 we observed a noteworthy increase in CC adoption for some counties. And it is in 2016 that strong differences in CC adoption started to appear between different counties in the same climate area. Before 2016, their CC adoption percentage levels were similar.

We used the “Filter” function in Excel to select counties that were in the same temperature and precipitation range. In Iowa, Illinois, and Indiana, we cross-referenced the applicable precipitation and temperature ranges from January to April that were outlined in Majka (2020) (see Figures 1 and 2 below), to see which counties were in the same Jan-April climate range.

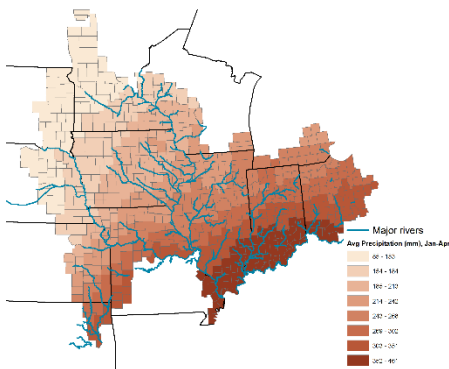


Figure 1: Average Jan-Apr Precipitation

Source: Reproduced from Majka (2020, p. 41)

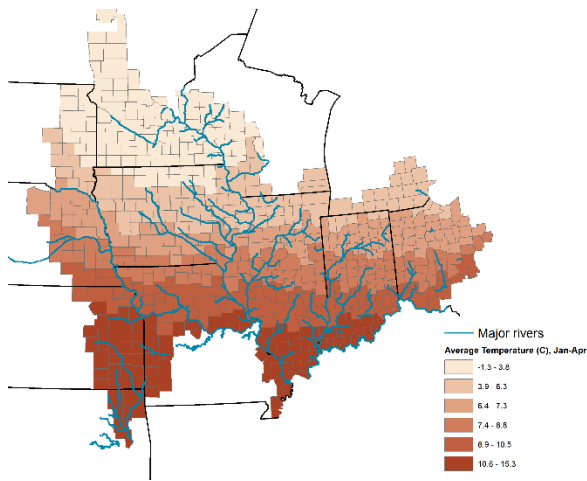


Figure 2: Average Jan-Apr Temperature

Source: Reproduced from Majka (2020, p. 41)

We selected the counties that were closest to each other in terms of proximity to large city and topography but that had the largest difference in CC percentage adoption from 2016-2018. We made sure to include counties in at least two different climate ranges. The neighboring counties with the largest difference in CC adoption but that were in closest proximity to each other (to reduce variation in soil type) were included in our study. We narrowed down the list to three county pairs per state. In two of the states, some high-adopter counties were counted twice because there were not sufficient high/low CC adopter pairs within the same climate range. Our final list of counties is summarized in Table 1 below.

Table 1: County Pairs for Controlled Comparison

State	January-April Precipitation (mm) and Temperature (°C)	County	Population (2018)	% agriculture	Avg CC % adoption 2016-2018	Difference in CC % adoption 2016-2018
Iowa	Prec: 185-213mm Temp: 6.4-7.3°C	Adair	7074	0.87	3	8.2
		Clarke	9502	0.34	11.2	
		Union	12298	0.65	4.3	6.9
		Clarke	9502	0.34	11.2	
	Prec: 154-184mm Temp: 3.9-6.3°C	O'Brien	13753	0.85	0.7	4.4
		Sioux	34855	0.82	5.1	
Illinois	Prec: 352-461mm Temp: 10.6-15.3°C	Wayne	16215	0.59	8.9	10.6
		White	13537	0.65	19.5	
		Hamilton	8116	0.6	11.3	8.2
		White	13537	0.65	19.5	
	Prec: 352-461mm Temp: 8.9-10.5°C	Wabash	11520	0.7	7.6	11.5
		Edwards	6395	0.6	19.1	
Indiana	Prec: 243-268mm Temp: T3.9-6.3°C	Steuben	34487	0.33	3.5	9.8
		LaGrange	39375	0.38	13.3	
	Prec: 352-461mm Temp: 8.9-10.5°C	Greene	32059	0.28	14.1	15.6
		Lawrence	45630	0.11	29.7	
		Jackson	44068	0.38	18.9	6.7
		Bartholomew	82722	0.41	12.2	

2.2 Qualitative data collection

In each county, we conducted focus groups and semi-structured interviews with personnel in county-level agencies such as the Natural Resources Conservation Service (NRCS), the Soil and Water Conservation District (SWCD), the Farm Bureau, the Farm Service Agency, and university extension. We also invited local producers, crop advisors, and members of other relevant organizations such as Practical Farmers of Iowa. Participants were invited to attend a focus group to discuss CC adoption in their respective counties. Each focus group had between two and five attendees. In addition, we conducted on-on-one interviews with participants that could not make it to the focus groups due to scheduling conflicts, as well as with crop advisors and agency personnel that operated in two or more counties. The questions we asked participants during the focus groups and interviews can be found in the Appendix.

3 Results

Our results indicate that there were several social factors that contributed to the difference in CC adoption between counties. Specifically, the higher levels of CC adoption in some counties could not be attributed to one single factor. Rather, counties with higher CC adoption presented a “cluster” of social factors that together increased adoption over time. These factors are summarized in Table 2 and are described in more detail below.

Table 2: Factors Contributing to Increased Cover Crop Adoption

Factors	IOWA					ILLINOIS					INDIANA					
	Clarke*	Adair	Union	Sioux	O'Brien	White	Wayne	Hamilton	Edwards	Wabash	Lawrence	Greene	Jackson	Bartholomew	LaGrange	Steuben
Early adoption of CCs due to more erodible soil (rolling hills)						x			x		x				x	
CC "culture" (i.e., network of growers who use CCs)	x			x		x	x	x	x		x				x	
Programs beyond EQIP and CSP	x				x	x	x	x	x	x	x	x	x	x		x
NRCS and SWCD employees are promoting CCs beyond their regular duties (entrepreneurial staff)	x			X		x			x	x	x	x				
Collaboration between organizations (NRCS, SWCD, Extension, Farm Bureau) and individual entrepreneurs (crop advisors, producers)	x			x		x			x		x		x		x	
Organic produce, pastured livestock and/or smaller-scale farms				x							x				x	
More cattle	X			x											x	

*Note: The counties that are highlighted in blue are the high CC adopters in their respective pairs.

3.1 Early adoption of cover crops

In four of the county pairs, participants mentioned that early adoption of CCs by some producers in the community was a key factor that contributed to the different levels of adoption. Early adopters are producers that started planting CCs in the 90s and 2000s and continue doing so presently, regardless of whether they participate in incentive programs.

In three of the counties – White (IL), Edwards (IL), and Lawrence (IN) – early adoption of CCs was due to the presence of more rolling hills in those counties. Because the soil on rolling hills is highly erodible, producers whose land was on hills derived clear benefits from planting CCs to retain soil. In one of the counties (LaGrange, IN), early adoption was not due to rolling hills but was attributed to rotational grazing, which has been practiced for decades among the large Amish community living in the county. We were told that producers who own livestock (especially pasture-raised) are more likely to adopt CCs such as wheat and cereal rye because it can serve as a source of feed. As such, for producers in these four counties, the early adoption of CCs seemed to have been due to hillier topography and to specific livestock raising practices.

It is important to note that at least one early CC adopter was present in all the counties in our sample. However, they were not reported to have significant influence on overall CC levels in low-adopting county because they were too few in numbers. Early adopters were only seen as being influential when consisting of a large enough group of people.

3.2 Cover crop “culture”

Another inter-related factor mentioned by participants that contributed to the high levels of CC adoption in some counties was the presence of a network of producers that used CCs, referred to as a CC “culture.” In Clarke (IA) and Sioux (IA), CCs were part of an “entrepreneurial culture” where we were told that producers were more willing to experiment with CCs and that, in general, people are open to experimenting with new practices. These producers communicate with each other and exchange ideas and expertise. In Sioux (IA), there was a local producer and crop advisor who had a side business selling CC seeds and helping other producers plant them. In contrast, counties such as Union (IA) and Adair (IA) had some individual producers that adopted CCs, but they tended to operate alone, as this practice was not widespread or accepted in the community. In some counties, we were told that the attitude held by most producers is that CCs would not work in their area.

In White (IL), Edwards (IL), and Lawrence (IN), the CC culture was attributed to the fact that these counties are hillier. To prevent soil erosion, more producers adopted CCs out of necessity, and the practice became part of the mainstream culture. Some interviewees said that many producers are embarrassed to have “naked” fields and that CCs are increasingly becoming mainstreamed. In Lawrence (IN), focus group participants also mentioned that CC adoption, along with other conservation practices, is seen as a way for producers to maintain autonomy over their own farming practices. Specifically, some producers attempt to implement their own conservation activities in order to avoid future environmental regulations that might be imposed by the federal government.

In LaGrange (IN), the high CC adoption was attributed to the presence of Amish community members, who make up about half of the county’s population. Not only are CCs integrated into farm practices such as rotational grazing, but they are also part of the environmental stewardship values that are part of their culture.

3.3 Programs beyond EQIP and CSP

Most counties had programs beyond EQIP and CSP that were available to producers interested in adopting CCs. These included local cost-share funds, watershed grants, or grants from specific environmental organizations. We were told that these additional programs were attractive to producers that had not adopted CCs previously because their contracts were usually shorter (one year) and their requirements were less onerous. While these additional programs were mentioned as being helpful in promoting CC adoption, we did not find them to be a key differentiating factor between the county pairs.

3.4 NRCS and SWCD employees promoting CCs beyond their regular duties

Another factor that was mentioned by participants as being important in promoting CC adoption were the efforts made by NRCS and SWCD staff to promote this practice beyond their regular duties. These additional efforts included the early promotion of cost-share programs, applying for grants that provide CC funding beyond EQIP and CSP, getting funds to hire an additional SWCD employee, and building relationships with producers.

3.5 Collaboration between agencies and entrepreneurs

This factor was only present in almost all high adopter counties and not in their lower adopter neighbors. These counties included Clarke (IA), Sioux (IA), White (IL), Edwards (IL), Lawrence (IN) and Jackson (IN). What distinguished these high adopting counties was a much higher level of collaboration between agencies (NRCS, SWCD, Extension, Farm Bureau) and individual entrepreneurs (crop advisors, producers). Higher collaboration was apparent in the focus groups, where agency participants knew and talked among each other. When answering questions, they also asked each other to fill in some of the gaps by saying things like “s/he can tell you more about this.” Participants with high levels of collaboration also mentioned regular and frequent interactions between agencies, crop advisors, and/or an entrepreneurial producer who promotes CCs.

Agency staff and entrepreneurs consulted with each other when giving advice to other producers about specific CC issues, to make sure they were aware of the most up-to-date practices. For example, if producers visited the NRCS or SWCD for advice on planting CCs, their staff often called other crop advisors and/or farmers for additional input. That way, they provided targeted advice and technical assistance that corresponded to each producer’s specific need.

Agency and staff entrepreneurs also coordinated when organizing field days. In some cases, crop advisors, who were discouraged from providing advice on CCs by their company, collaborated with the SWDC to push for cost-share programs for CC adoption. In addition, agency personnel and entrepreneurs in high adopter counties continually brainstormed and discussed ways of integrating CCs into farm management systems. Both agency personnel and entrepreneurs were particularly concerned about demonstrating the economic value to producers through field days and empirical studies.

3.6 Organic produce, pastured livestock, and/or smaller-scale farms

Participants reported that producers who operated smaller plots, raised pastured livestock, and grew organic produce were more likely to adopt CCs. According to participants, producers in Sioux (IA), Lawrence (IN), and LaGrange (IA) owned and operated smaller fields. We were told that smaller fields are more manageable because owners are familiar with every inch of their land, thus making it easier to coordinate the timing of CC planting and termination. We were also told that smaller-scale producers were more likely to grow organic crops and raise pastured livestock. These types of producers are also more likely to care about soil health, and therefore are more likely to adopt CCs. This factor was

particularly salient in LaGrange, where the large Amish population farmed on smaller plots, practiced organic agriculture, and raised pastured livestock.

3.7 More cattle

Participants mentioned that producers who owned more cattle, especially dairy cows, were more likely to adopt CCs because they served as an additional source of feed. Counties that had a larger proportion of cattle compared to their neighbors were Clarke (IA), Sioux (IA), and LaGrange (IN).

4 Discussion

As we can see, the counties with higher levels of CC adoption had a diverse set of contributing factors. This supports previous studies indicating that some conservation practices become adopted as a result of multiple social factors rather than one specific policy (Muhumuza and Balkwill, 2013). Furthermore, our findings support the notion that local community leaders play an important role in encouraging the adoption and diffusion of environmental conservation practices (Reimer, Thompson and Prokopy, 2012; Moore *et al.*, 2016). However, local leadership is more likely to be effective when it is embedded within a larger network of stakeholders that can provide complementary assistance (Floress, Prokopy and Ayres, 2011; Baumgart-Getz, Prokopy and Floress, 2012; Arbuckle and Roesch-McNally, 2015). It appears that such collaborations provide the necessary financial and technical assistance that help reduce the risk of adopting CCs, which has been deemed a key obstacle (Liu, Bruins and Heberling, 2018). Among the different factors, two of them – CC culture and collaboration between agencies and entrepreneurs – were present in almost all of the high adopter counties. In particular, collaboration between agencies and entrepreneurs only existed in the high adopter counties, suggesting that this factor might be among the most important, followed closely by CC culture. These two factors can be created and nurtured at the county level. For example, creating a CC culture could be encouraged through education and by encouraging producers to participate in cost-share programs that encourage more producers to participate, thereby mainstreaming the practice. In addition, agencies such as the NRCS and SWCD could focus on strengthening their relationships with specific crop advisors or local producers that use CCs and build a network where information and expertise can be exchanged. A simple mechanism for fostering this type of network would be for NRCS, SWCD, and Extension staff to have regular phone calls with producers and crop advisors that have experience with CCs. In successful counties, agency staff called these local entrepreneurs on the phone when a producer walked into their office to ask for assistance regarding CCs. Agencies helped connect producers with local entrepreneurs, which ensure that the producer got complementary and personalized advice from different sources. Agency personnel could also ask local entrepreneurs how the agencies can best assist them with their experimentation with and diffusion of CC practices. In high adopter counties, local entrepreneurs paved the way by experimenting with cover crops and incurring most of the risk associated with the practice. For example, they experimented with different types cover crops and different planting timeframes. In turn they turned to agencies to diffuse the information they acquired through their experimentation, and also contacted Extension for help in quantifying the benefits obtained from CCs. Thus, agencies could position themselves as intermediaries between the local entrepreneurs and the wider community. They can play an important role in facilitating communication channels and providing specialized information that is otherwise difficult for local entrepreneurs to access.

5 Potential next steps

There are several possibilities for next steps to this study. First, it would be interesting to conduct in-depth interviews to better understand how relationships and networks between the agencies and local entrepreneurs emerged. This could provide some additional insights into the formation of pro-environmental networks and the mechanisms through which relationships are formed and maintained. Second, it would be interesting to conduct follow-up surveys with farmers and agency staff to see whether (1) farmers in high-adopting perceive CC adoption as being less risky and (2) there is more communication between agency staff, entrepreneurs, and other producers. This could provide additional evidence for our findings and tell us whether they are statistically significant.

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Appendix: Questions asked during focus groups and interviews

1. Please tell us the organizations(s) you work for and your specific role in that organization.
2. What type of assistance is available to farmers in your county regarding cover crops?
 - a. Educational (field days, etc.)
 - b. Financial (EQUIP; CFP; \$5 incentive, incentives beyond EQUIP)
 - i. Who funds what grant?
 - c. Technical (crop advisors, seed stores, etc.)
3. Which specific organizations is in charge of providing this assistance?
4. Does your organization have a board? (i.e., Farm Bureau, Soil and Water)
 - a. Who makes up your board?
 - b. How do priorities get assigned?
 - c. Do members vote?
 - d. Were cover crops considered a priority by the board? Why/why not?
 - e. Can board members decide whether additional funds are allocated for cover crops (i.e., 319 grants).
5. For organizations without boards (i.e., NRCS), how do priorities get assigned?
 - a. Do priorities differ by county or are they similar across the state?
6. How often do you or your organization communicate with other agencies?
 - a. Soil and water/NRCS
7. How often do you interact with farmers?
8. Who do farmers contact when making decisions about cover crops?
9. What do you think of cover crops as a practice?
10. In general, in this county, has there been an effort to promote cover crops?
11. Why do you think some farmers adopt cover crops and not others?
12. Why do you think there is more/less cover crop adoption in this county than in others?
13. Do farmers in your county participate in programs such as Priority Watershed Initiatives?
 - a. What other programs?
14. Could you please describe the type of activities that take place in these programs?

15. In your county, are there any farmers that play a leadership role regarding cover crop adoption?
 - a. If yes, what roles do they play?

16. What does the learning process associated with cover crops look like?
 - a. Do farmers learn from each other regarding cover crop management?
 - b. Who else do farmers learn from?
 - c. Do farmers learn about CCs from different sources?

17. Does environmental stewardship matter for cover crop adoption?