Emily Andrews, Kendall Daniels, Caitlyn Graves, Renee Hallstein

Cover Crop Adoption

Final Report

1) Introduction

The project partners for the Cover Crop Adoption Project are Sarah Vaughn and Kris Gertz from the Tippecanoe County Soil and Water Conservation District. The needs of this project are to educate the public on where improvements have been made over the years and where conservation efforts need more attention. In order to perform these tasks we had to analyze five years of cover crop and tillage practice data, and analyze two years of invasive species data. The deliverables for this project include six cover crop maps, six tillage practice maps, two invasive species maps, 50 yearly figures for cover crop and tillage, four summary figures, and an educational slide presentation.

2) Background/literature review

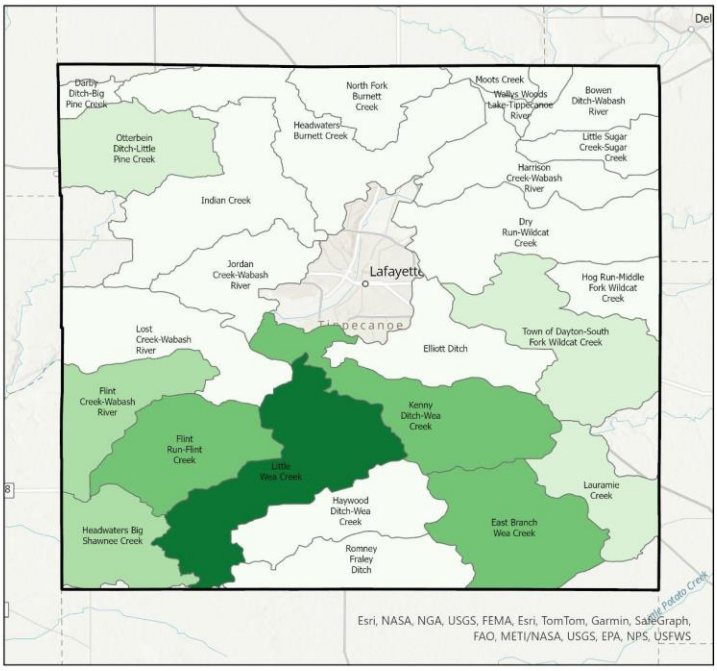
Background research was conducted into runoff from agricultural systems, tillage practices, cover crops, and invasive species. Agriculture is among the leading contributors to water pollution and the anthropogenic alteration of the nitrogen and phosphorus cycles. Runoff events transport sediment and excess fertilizer from agricultural fields. This nutrient pollution enters local water bodies, degrading freshwater quality in the region. Subsurface drains take on larger amounts of water during high precipitation events. These drains empty out into local waterways and carry large amounts of nutrient pollution into local water bodies. Long-term no-till systems and crop rotations result in a positive impact on soil carbon and nitrogen, soil water, runoff, and losses of nutrients. No-till systems prevent the degradation of soil aggregates and the loss of soil organic matter. Improved soil clods allow for better water and nutrient infiltration and help to reduce surface runoff. An increase in soil organic matter allows for more nutrients available in the soil for crops. Cover crops reduce sediment and nutrient transport into water bodies, reducing nonpoint source pollution, including subsurface drainage. Cover crops improve soil health as their roots penetrate compacted soil and introduce organic matter to the soil, alleviating compaction and poor soil structure. Invasive plant species regularly invade agricultural landscapes. Invasives can produce secondary metabolites that are allelopathic, affecting the growth, survival, and reproduction of the crop species. These metabolites can reduce the interactions of crops with the rhizosphere. Or release cytotoxic chemicals into the environment, increasing their ability to compete with surrounding organisms. One way to manage invasives is cover crops, they can suppress weeds and control pests by competing for light, water and nutrients.

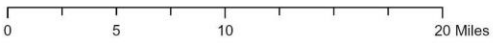
3) Goals and Objectives

The project goal had two parts, first to educate the public on areas of improvement in agricultural conservation practices in Tippecanoe County over the last five years and areas where improvement is still necessary. Second to educate the public on invasive species in Tippecanoe County, and the effect of invasives on ag production. The main objectives for this project were to analyze five years of transect data on cover crops and tillage practices. And analyze two years of invasive species data summarized by watershed and the entire county. Our goals stayed relatively the same throughout the project, however our objectives and deliverables changed. One change was how we were going to display the data. At first we thought we could do point data, since that was what we received, however we ended up doing watershed percentage. We found this style to be easier to interpret compared to point data. Another change was our number of maps, at the start we thought we would have around 7 maps. Five maps for the 5 years of cover crops and two maps for the 2 years of invasive species. In the end we had 13 GIS maps in total, which was much more than we originally expected. One reason this increase of maps occurred was because initially we thought we were doing single year maps. However, our partners wanted to see a change over the 5 year period. So we created maps for each of the 5 years, and then showed the percent difference from 2018 to 2023 (excluding 2020).

3) Deliverable Description - Include a listing and description of each product generated/analysis completed (can be a bulleted or numbered list, but with descriptions using complete sentences.

- 13 Total GIS Maps
    - 6 Cover crop and 6 Tillage Practice
        - All maps have shapefiles with Tippecanoe county and HUC 12 Watershed delineations. For each of the five years, there is a map that corresponds with the data for that year. There is one map displaying change in practice cover from year 1 to year 5 (2018-2023).





Cover Crop Adoption Percentage in 2018 by Watershed

This map displays the percentage of cover crop presence observed in 2018 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The watershed with the largest observed percentage was Little Wea Creek.

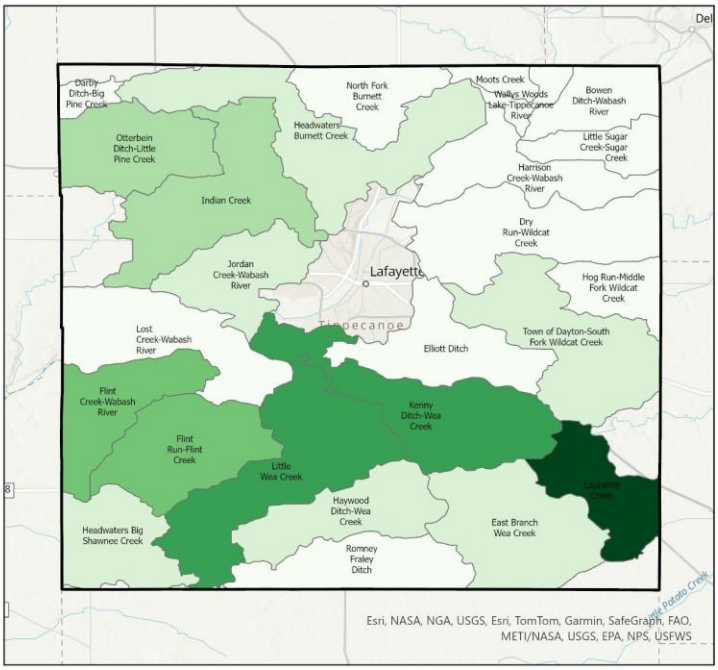
Legend

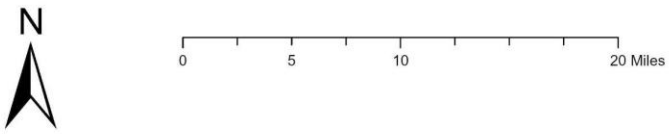
TippecanoeCo

CC Presence by Watershed (HUC 12)

Percentage2018

- 0.000000 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000
- 25.000001 - 30.000000





Cover Crop Adoption Percentage in 2019 by Watershed

This map displays the percentage of cover crop presence observed in 2019 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The watershed with the largest observed percentage was Lauramie Creek.

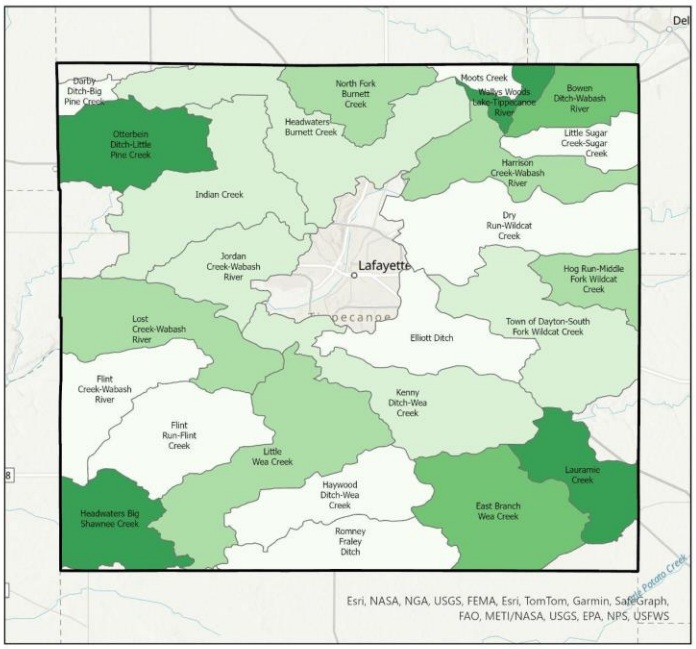
Legend

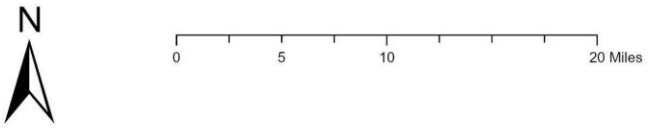
TippecanoeCo

CC Presence by Watershed (HUC 12)

Percentage2019

- 0.000000 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000
- 25.000001 - 30.000000
- 30.000001 - 40.000000





Cover Crop Adoption Percentage in 2021 by Watershed

This map displays the percentage of cover crop presence observed in 2021 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The watershed with the largest observed percentage was Wallys Woods Lake-Tippecanoe River.

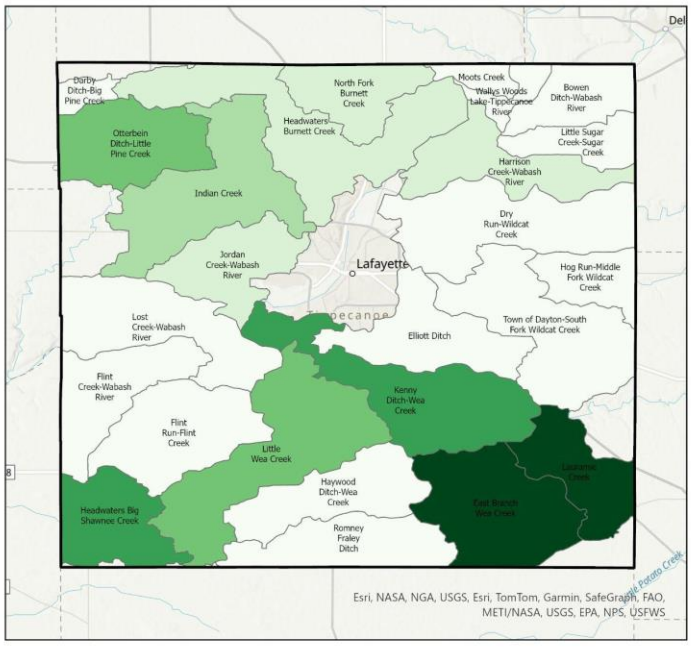
Legend

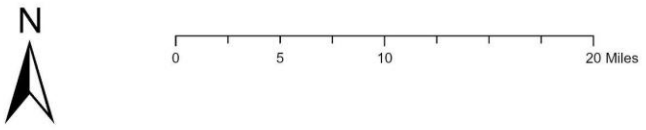
TippecanoeCo

CC Presence by Watershed (HUC 12)

Percentag2021

- 0.000000 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000





Cover Crop Adoption Percentage in 2022 by Watershed

This map displays the percentage of cover crop presence observed in 2022 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The watersheds with the largest observed percentages were East Branch Wea Creel and Lauramie Creek.

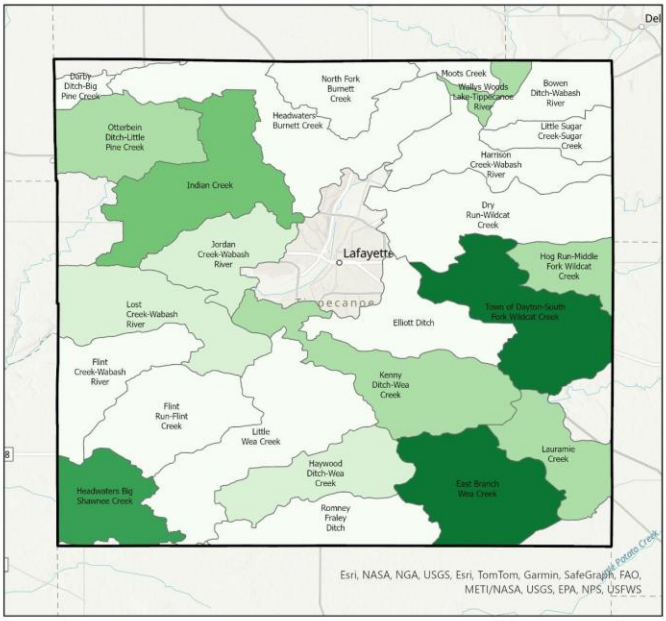
Legend

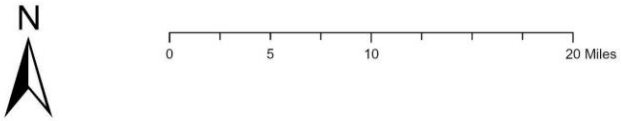
TippecanoeCo

CC Presence by Watershed (HUC 12)

Percentage2022

- 0.000000 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000
- 25.000001 - 30.000000
- 30.000001 - 35.000000





Cover Crop Adoption Percentage in 2023 by Watershed

This map displays the percentage of cover crop presence observed in 2023 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The watershed with the largest observed percentage was Town of Dayton-South Fork of Wildcat Creek.

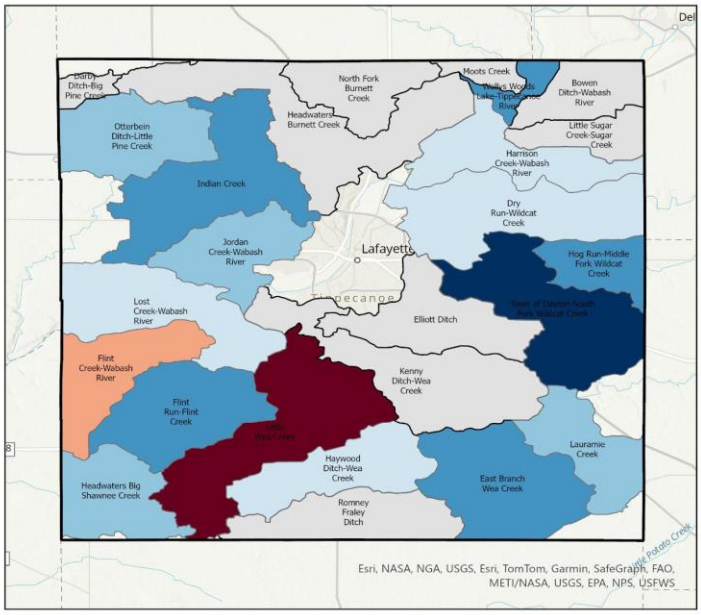
Legend

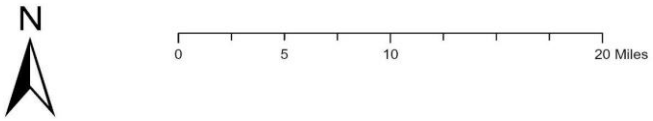
TippecanoeCo

CC Presence by Watershed (HUC 12)

Percentage2023

- 0.000000 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000
- 25.000001 - 30.000000





5 Year Difference In Cover Crop Adoption by Watershed

This map displays the percent change in cover crop presence observed in Tippecanoe County from 2018 to 2023.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey.

Highlights:
The largest percent decrease was observed in the Little Wea Creek watershed.
The largest percent increase was observed in the Town of Dayton- South Fork of Wildcat Creek watershed.

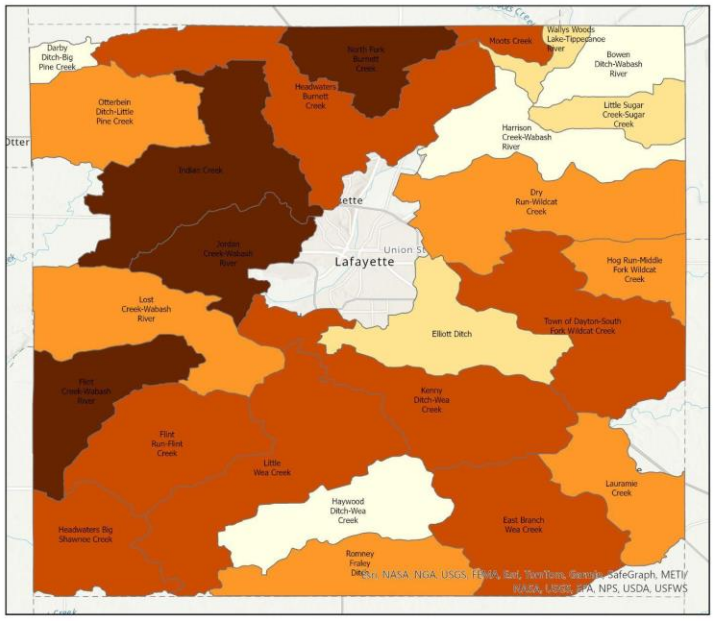
Legend

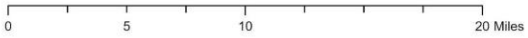
TippecanoeCo

CC Presence by Watershed (HUC 12)

PercentChange

- -22.480000 - -20.000000
- -19.999999 - -15.000000
- -14.999999 - -10.000000
- -9.999999 - -3.000000
- -2.999999 - 0.000000
- 0.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 25.000000





2018 Tillage

This map displays the percentage of no-till presence observed in 2018 for Tippecanoe County.

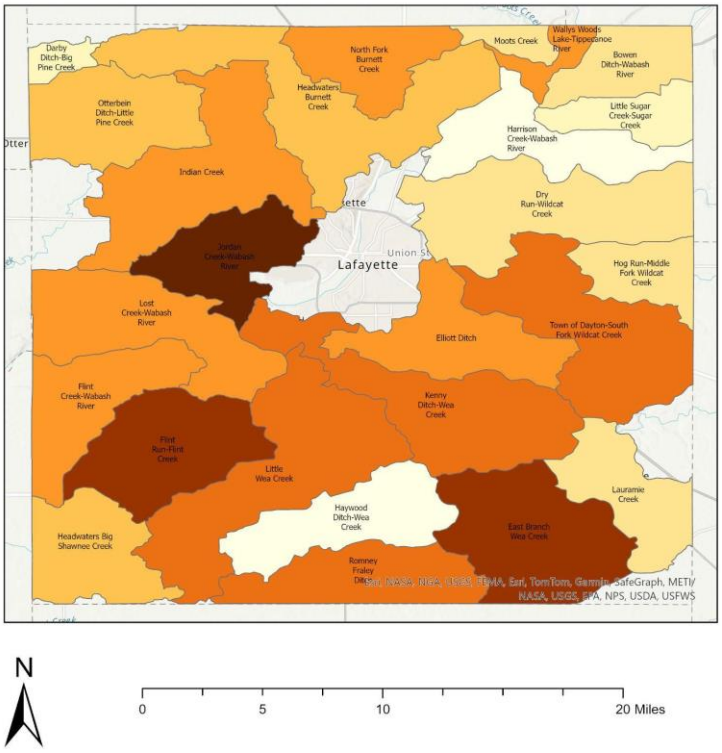
Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey

Highlights:
Four watersheds have 90-100% no-till presence; North Fork, Indian Creek, Jordan Creek and Flint Creek

Legend

No-Till Presence
2018

- 50.000000 - 60.000000
- 60.000001 - 70.000000
- 70.000001 - 80.000000
- 80.000001 - 90.000000
- 90.000001 - 100.00000



2019 Tillage

This map displays the percentage of no-till presence observed in 2019 for Tippecanoe County.

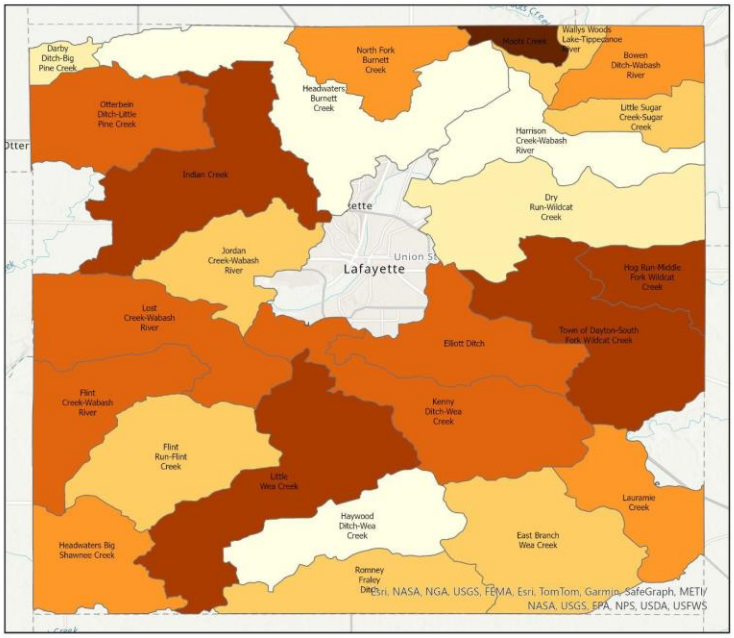
Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey

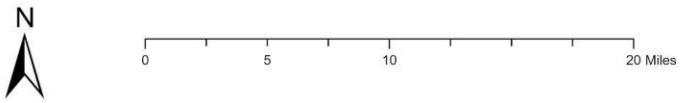
Highlights:
There was a drop-off, as many counties dipped below 50% which was the lowest percent in the previous year

Legend

No-Till Presence
2019

- 11.100000 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 40.000000
- 40.000001 - 50.000000
- 50.000001 - 60.000000
- 60.000001 - 70.000000
- 70.000001 - 80.000000
- 80.000001 - 90.000000
- 90.000001 - 100.00000





2021 Tillage

This map displays the percentage of no-till presence observed in 2020 for Tippecanoe County.

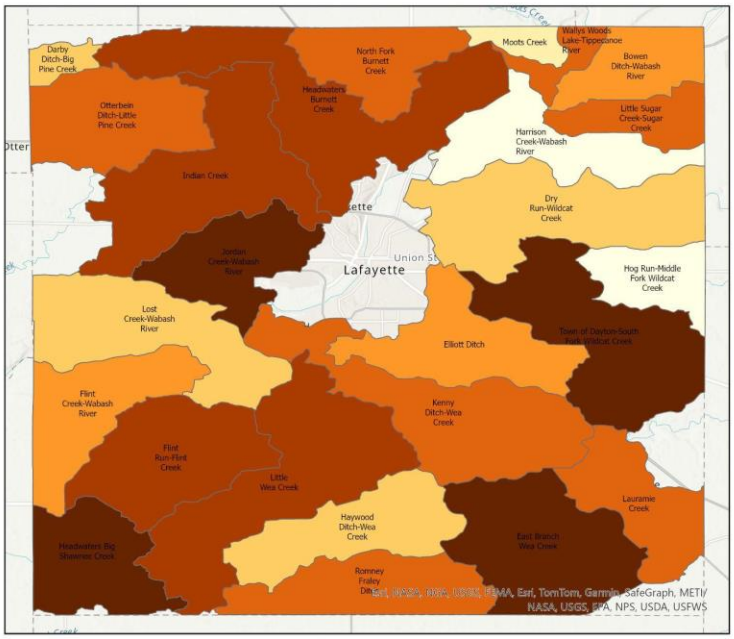
Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey

Highlights:
Moots Creek notably increased from the previous year while both Harrison Creek and Haywood Ditch stayed in low percentages

Legend

No-Till Presence
2021

- 25.900000 - 30.000000
- 30.000001 - 40.000000
- 40.000001 - 50.000000
- 50.000001 - 60.000000
- 60.000001 - 70.000000
- 70.000001 - 80.000000
- 80.000001 - 90.000000



2022 Tillage

This map displays the percentage of no-till presence observed in 2022 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey

Highlights:
Four watersheds have 80-90% presence; Jordan Creek, Town of Dayton, East Branch, and Big Shawnee

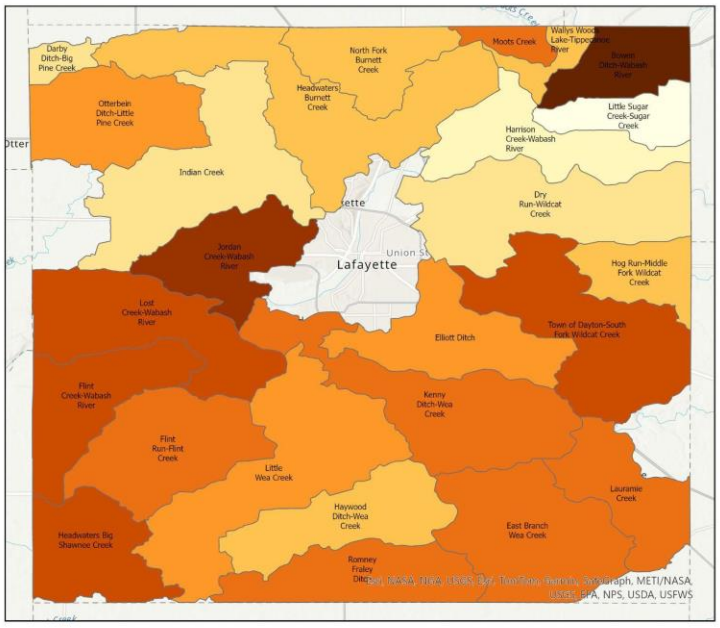
Legend

No-Till Presence
2022

- 26.900000 - 30.000000
- 30.000001 - 40.000000
- 40.000001 - 50.000000
- 50.000001 - 60.000000
- 60.000001 - 70.000000
- 70.000001 - 80.000000
- 80.000001 - 90.000000

N

0 5 10 20 Miles



2023 Tillage

This map displays the percentage of no-till presence observed in 2023 for Tippecanoe County.

Some HUC 12 Watersheds are not displayed as they either do not contain data or are not in the path of the transect survey

Highlights:
Compared to the previous year there are many watersheds that decreased in no-till presence

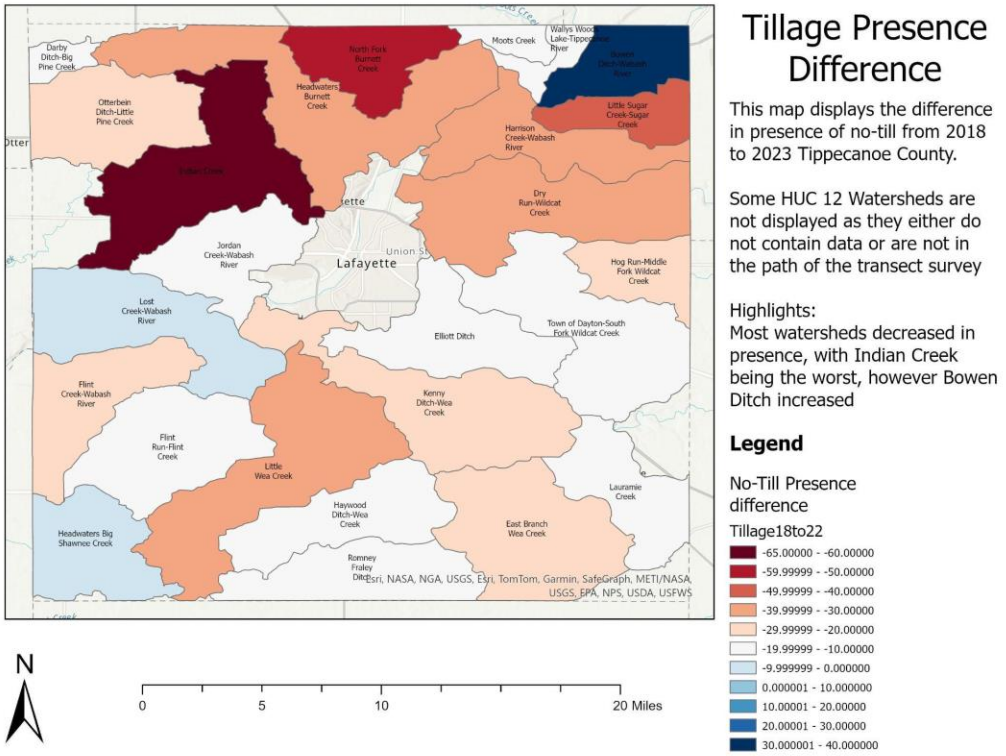
Legend

No-Till Presence
2023

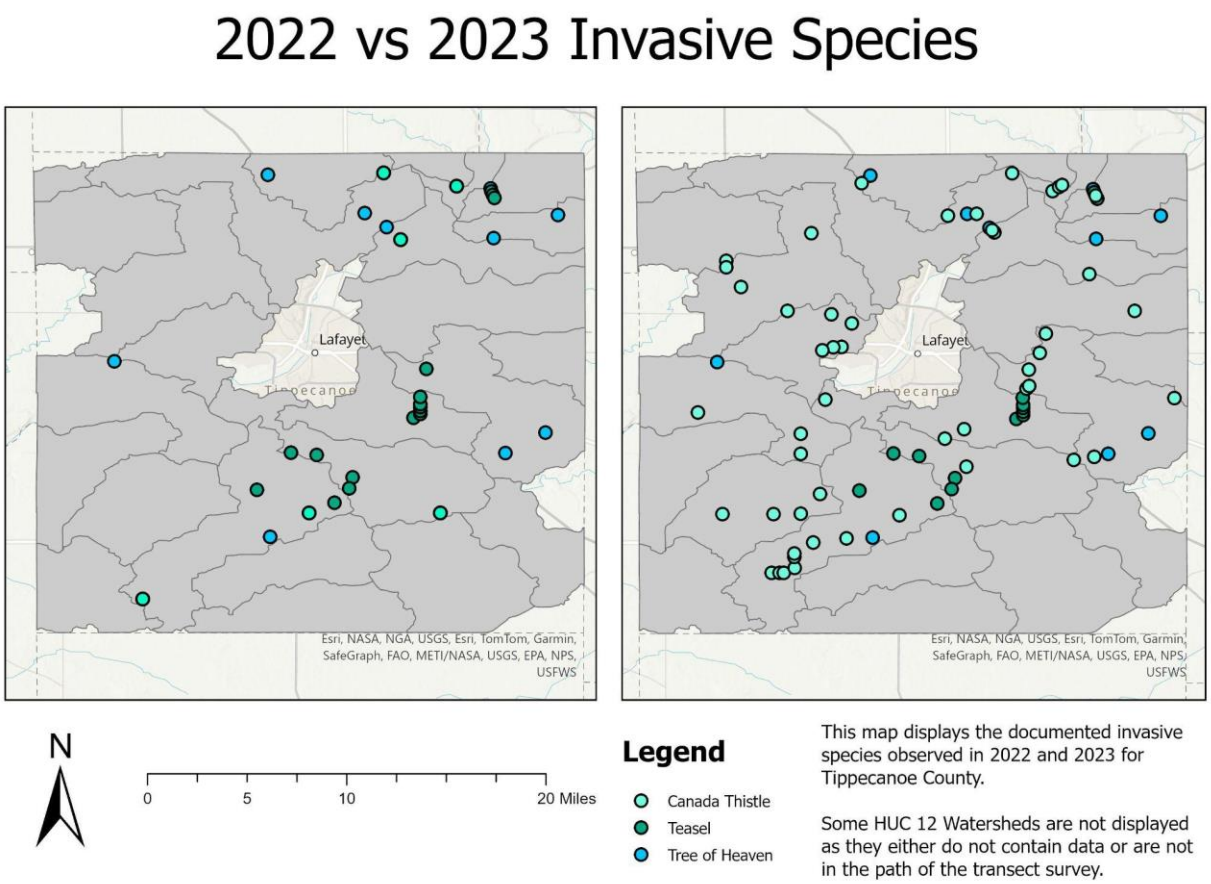
- 18.200000 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 40.000000
- 40.000001 - 50.000000
- 50.000001 - 60.000000
- 60.000001 - 70.000000
- 70.000001 - 80.000000
- 80.000001 - 90.000000
- 90.000001 - 100.00000

N

0 5 10 20 Miles

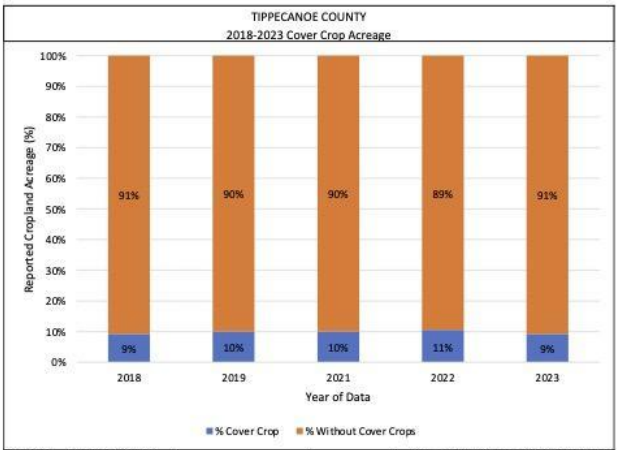


- Invasive species
    - One map displaying change in invasive species cover from 2022 to 2023. In 2022 they documented 18 different invasive species and in 2023 they only documented three invasive species. With the three invasive species the data shared, we created a map to display the difference between the years. The three invasive species were Canada Thistle, Teasel, and Tree of Haven.



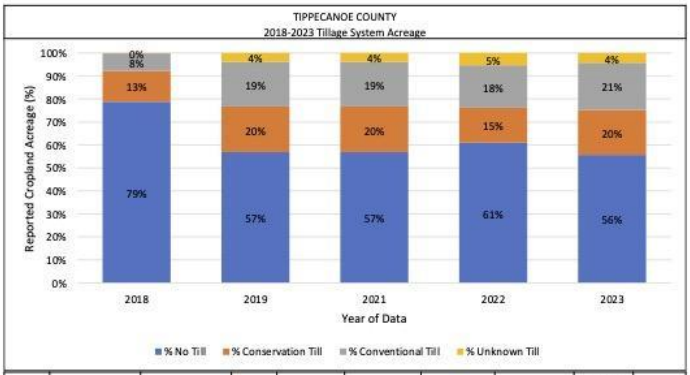
- Charts and Tables

Over 50 figures were created. Included here are the summary figures, but all can be viewed in the zipped file submitted with the final report in BrightSpace.



Year of Data	Reported Cropland Acreage	Cover Crop Acreage	% Cover Crop	Acreage without Cover Crops	% Without Cover Crops
2018	195,896	18,186	9%	177,711	91%
2019	197,743	19,968	10%	177,775	90%
2021	207,835	20,987	10%	186,848	90%
2022	203,557	21,549	11%	182,008	89%
2023	202,460	18,795	9%	183,665	91%

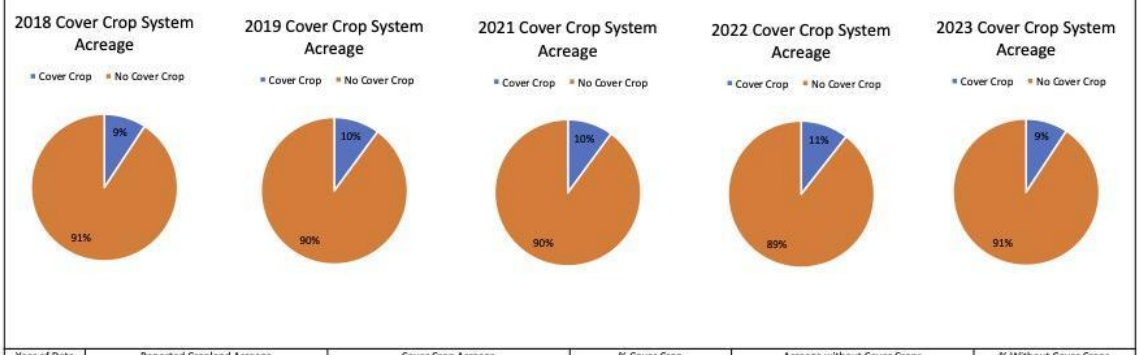
*Data is limited to what is reported by the individuals conducting windshield surveys and recording data
*No data from 2020 was recorded due to COVID-19 lockdown



Year of Data	Reported Cropland Acreage	Not Tilled Acreage	% No Tilled	Conservation Tilled Acreage	% Conservation Tilled	Conventional Tilled Acreage	% Conventional Tilled	Acreage with Unknown Tillage	% Unknown Tillage
2018	195,896	154,420	79%	26,162	13%	14,995	8%	319	0%
2019	197,743	112,398	57%	39,291	20%	38,325	19%	7,729	4%
2021	207,835	118,134	57%	41,296	20%	40,281	19%	8,124	4%
2022	203,557	123,991	61%	31,163	15%	37,462	18%	10,940	5%
2023	202,460	112,771	56%	39,569	20%	41,547	21%	8,573	4%

*Not Tilled – Any direct seeding system, including site preparation, with minimal soil disturbance (includes strip & ridge till).
*Conservation Till – Any tillage system leaving 16% - 75% residue cover after planting, excluding no-till (includes mulch and reduced tillage).
*Conventional Till – Any tillage system leaving less than 15% residue cover after planting.
*Unknown Till – Describes transect points with established hay, Conservation Reserve Program, and other non-annual crop land uses or for fall-seeded small grain if the tillage practice is not known.
*Data is limited to what is reported by the individuals conducting windshield surveys and recording data
*No data from 2020 was recorded due to COVID-19 lockdown

TIPPECANOE COUNTY
2018-2023 Cover Crop Acreage



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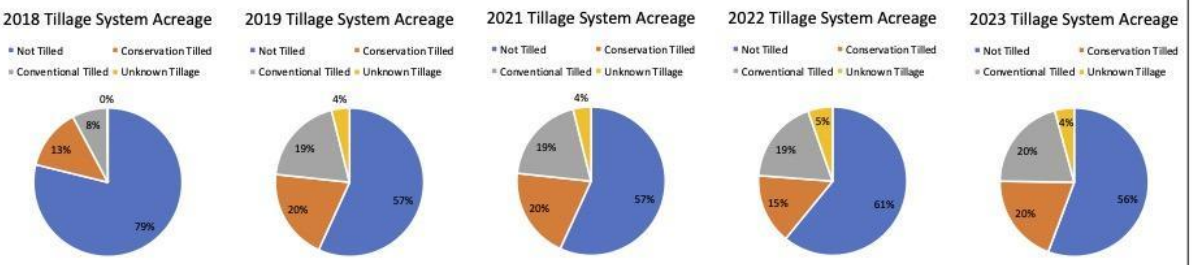
TIPPECANOE COUNTY
2018-2023 Tillage System Acreage



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4) Metadata/Technical details

ArcGIS Pro and Excel were the main software used to create the deliverables for this project. ArcGIS Pro was used to organize data and create the maps. Excel was used to analyze the data.

Deliverable Type	Software	Link
Combined Tillage and Cover Crop Data	Excel	https://purdue0-my.sharepoint.com/:x:/r/personal/rhallste_purdue_edu/Documents/combined%20cover%20crop.xlsx?d=wa66cbab215b04206ad58598bc33916a6&csf=1&web=1&e=HrAhzc
Combined Invasive Species	Excel	https://purdue0-my.sharepoint.com/:x:/r/personal/rhallste_purdue_edu/Documents/combined%20invasive%20species.xlsx?d=w08b108273d1a42e581b12f2eac7ae149&csf=1&web=1&e=ei0rib
Cover Crop Adoption Maps	ArcGIS Pro	Images Above
Tillage Practice Maps	ArcGIS Pro	Images Above
Invasive Species Maps	ArcGIS Pro	Images Above
Summary Tables	Excel	Submitted zip file
Education Presentation	PowerPoint	https://purdue0-my.sharepoint.com/:p:/r/personal/graves68_purdue_edu/_layouts/15/Doc.aspx?sourcedoc=%7B4942F8D8-4B94-4B5D-A3D4-2FFF497B9E24%7D&file=Cover%20Crop%20Presentation.pptx&action=edit&mobileredirect=true&DefaultItemOpen=1&web=1

5) Conclusions/future work

As discussed in our presentation, five years of data is not necessarily enough information to suggest a trend. Between the years, as the maps show, there is high amounts of variation for both cover crop and no-till presence. Cover crop acreage can vary due to corn and soybean rotation, individual farmer economics and weather. As for no-till we know that 2018 was particularly high, on average the number is expected to be within 50-60% for corn and soybean. Excluding 2018, the rest of the years are within a typical range. Tillage can differ due to farmer preference and their tillage rotational practices. We suggest that data is continued to be taken, and uploaded regularly into an organized excel that can be uploaded into GIS. More years of data, perhaps 15-20 would be better for suggesting overall trends. As for invasive species, 2 years of data is too limited to reach any conclusions on correlation to cover crops. Future analysis of cover crops and invasive species should be possible with more years of data.

6) Appendices

Our data is within zip files that have been emailed to our partners and Dr.Bowling as well as submitted on BrightSpace.