2023
TENNESSEE NUTRIENT MANAGEMENT REPORT

Submitted to:
Tennessee Department of Agriculture
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EXECUTIVE SUMMARY

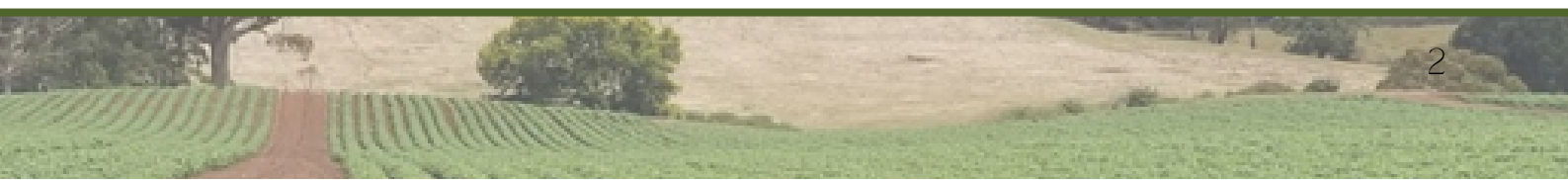
An online survey of producers in Tennessee was conducted in February and March of 2023 to better understand their use of, and objectives with, nutrient management practices such as nutrient management planning, soil testing, cover crops, no-till, and variable rate application, among other practices. Key findings of this report are:

- **90%** of all surveyed crop producers use no-till.
- **60%** of all surveyed crop producers use cover crops.
- **86%** of all surveyed crop producers soil test.
- **80%** of all pasture/hay producer respondents soil test.
- **73%** of all respondents said they determine how much fertilizer to apply based on soil tests.

While the survey data was insightful for understanding the use of these practices, we also utilized United States Department of Agricultural (USDA) Natural Resource Conservation Service (NRCS) data to see how Tennessee compares to other states. These data indicated:

- Tennessee ranked **second** in the US for enrollments into cover crops from 2014 to 2022.
- Tennessee ranked **first** in the US for total dollars spent on allocating acres into cover crops from 2014 to 2022.
- In the next five years, respondents expect to continue to **increase** the use of cover crops, no-till, soil testing, nitrogen stabilizers, and poultry litter.

These findings demonstrate Tennessee has made substantial progress in terms of public and private investment in nutrient management practices and can serve as a baseline for tracking the evolution of environmental stewardship among Tennessee crop producers.



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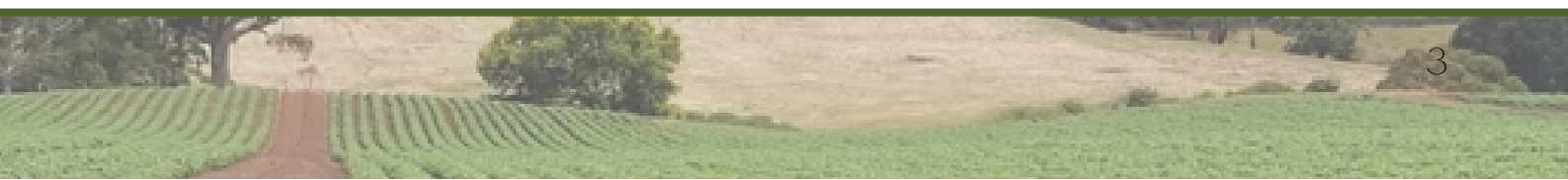

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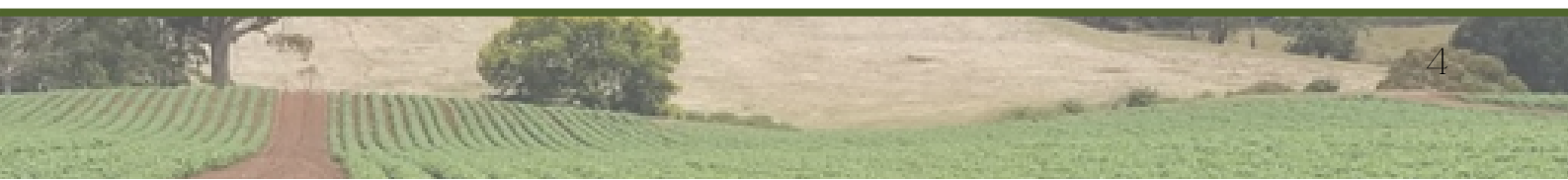


INTRODUCTION

The objective of this report is to examine and quantify the adoption of conservation practices focused on nutrient management in Tennessee. These practices include cover crops, no-tillage, soil testing, and poultry litter or manure applications for Tennessee crop producers. The purpose is to establish a baseline number of acres in Tennessee that are using various conservation practices in concert with a nutrient management plan. Nutrient management plans for crop production match nutrient applications to crop needs, reducing commercial fertilizer use while maintaining and, in some cases, enhancing soil productivity and crop yields. The baseline numbers contained in this report demonstrate the progress Tennessee farmers are making towards environmental stewardship while also identifying potential areas for improvement.

METHODOLOGY

Data was collected from a 2023 survey of Tennessee farmers administered through the Qualtrics online survey platform. The survey was designed in collaboration with TDA employees and researchers with the University of Tennessee Institute of Agriculture and contained sections related to nutrient management, use of cover crops and use of no-till agriculture. A link to the survey was posted on the UTCrops blog and emailed out through County Extension Agents, commodity boards, and conservation districts from early February to early March. During that period, a total of 484 respondents completed the survey.

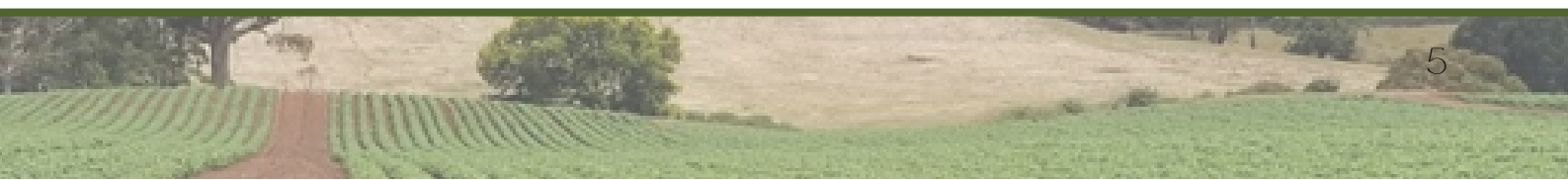
Hay accounted for the greatest number of acres produced by respondents, followed by pasture, soybeans, corn, cotton, and wheat (Table 1). Fifty-five of the 484 respondents that completed the survey reported producing row crops in 2022 representing 21,036 acres of soybeans, 16,874 acres of corn, 2,696 acres of cotton and 1,360 acres of wheat across 74 Tennessee counties. In addition, respondents reported farming 117,625 acres of hay and 25,193 acres of pasture.

Table 1: Crops and acres farmed by respondents and TN total acres in 2022

Crop	Acres farmed by respondents	*TN total acres (2022)
Hay	118,674	1,712,000
Pasture	25,194	---
Soybeans	21,036	1,650,000
Corn	16,874	840,000
Cotton	2,696	335,000
Wheat	1,360	410,000

*Data source: https://www.nass.usda.gov

In addition to the survey data, we also include USDA NRCS data on various uses of conservation practices focused on nutrient management in Tennessee. This data allows us to examine historical trends of nutrient management practice use in Tennessee and compare adoption rates to neighboring states. These data can be found here **(LINK)**.



RESULTS AND DISCUSSION

NUTRIENT MANAGEMENT

Producers were asked to provide information on how they determine fertilizer application rates and their primary goal with fertilizer application. Respondents most commonly (73%) used soil testing to determine fertilizer application rates, followed by the price of fertilizer (40%; Figure 1), indicating profit-maximization is a consideration in fertilizer application decisions. However, 44% of respondents also indicated they fertilize to maximize yield (Figure 2) which may not be the profit maximizing rate. This suggests producers may benefit from a better understanding of the economic factors that determine the optimal fertilizer application rate.

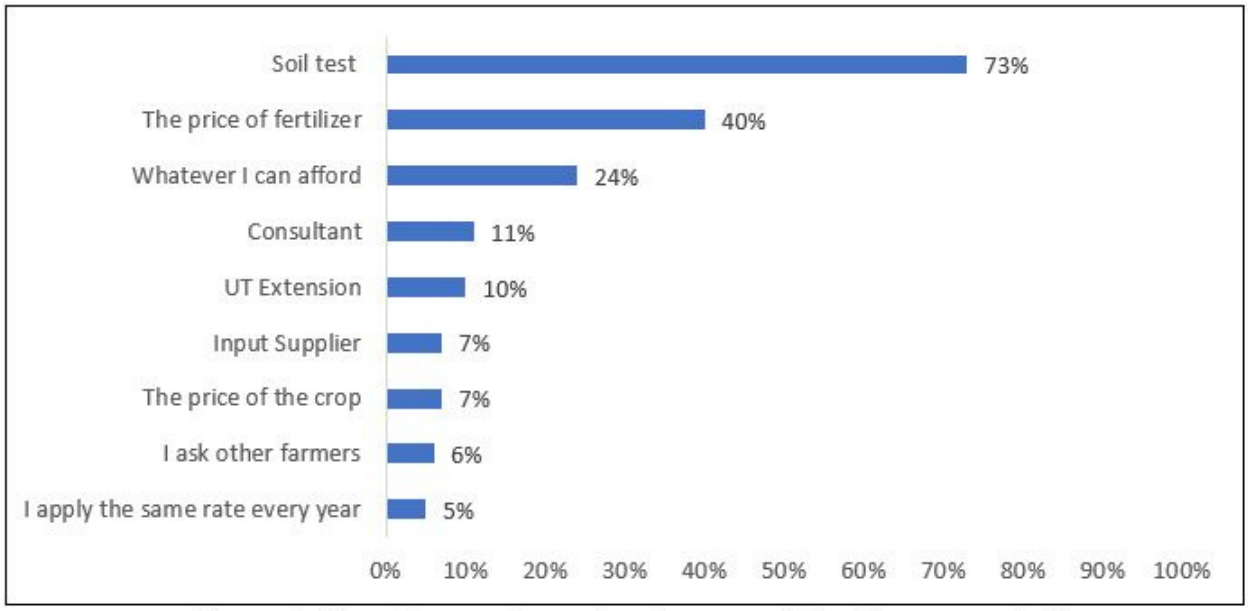


Figure 1: How do you determine how much fertilizer to apply?

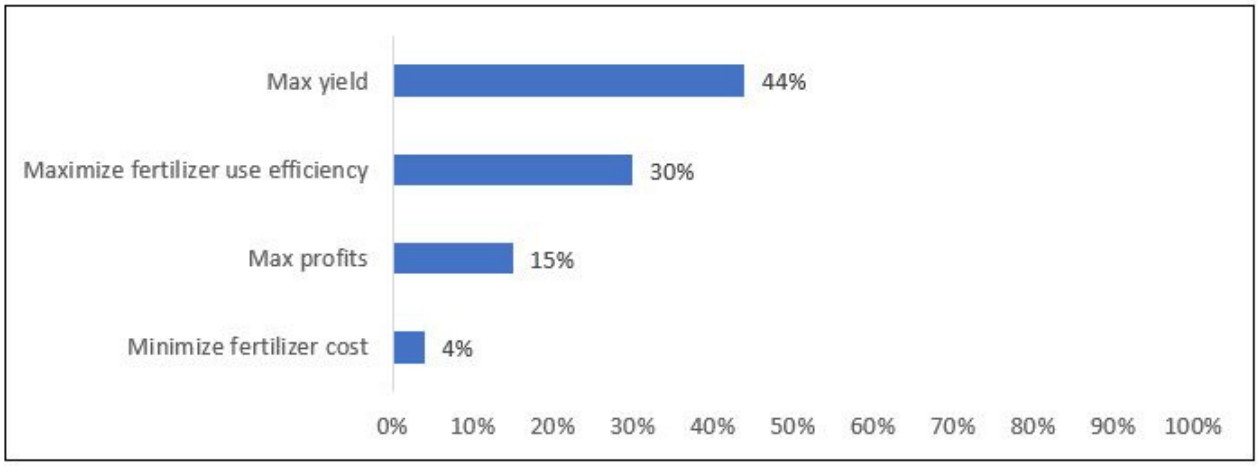


Figure 2: What is your primary goal with fertilizer application?

RESULTS AND DISCUSSION CONT...

Respondents were asked how frequently they soil test. Eighty percent of the pasture/hay producers and 86% of the row crop producers reported soil testing at least every 5 years (Figure 3). Row crop producers most commonly soil tested every year while pasture/hay producers most commonly soil tested every three years.

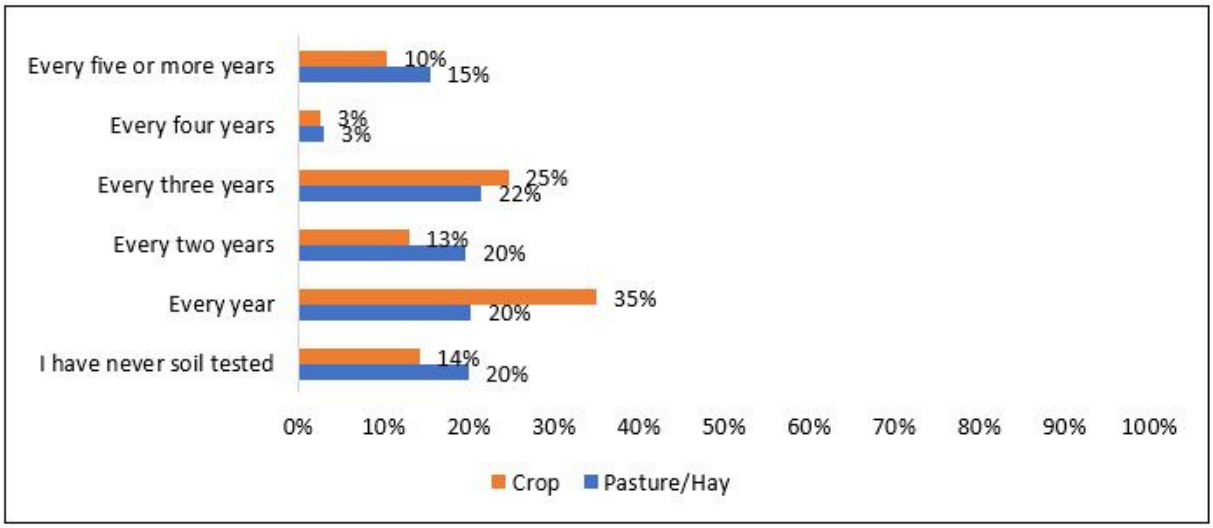


Figure 3: How often do you soil test for nutrient needs for pasture/hay and row crops?

The survey also collected data on whether the producers had a nutrient management plan. Among all respondents, only 36% indicated they had a nutrient management plan while 64% did not (Figure 4). Among row crop producers, 81% reported having a nutrient management plan while 19% did not, suggesting nutrient management plan development may be another potential area for education among producers.

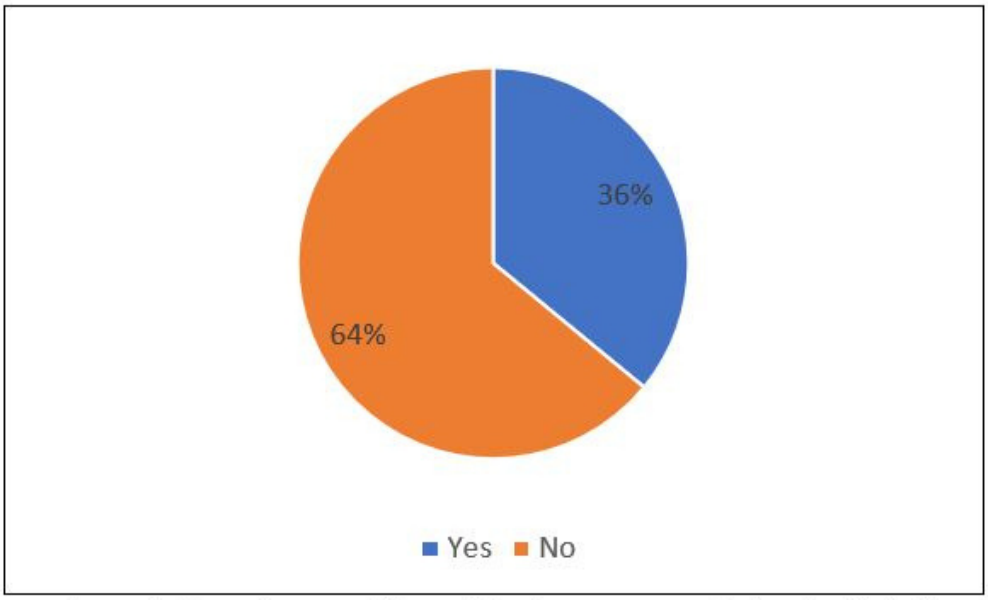


Figure 4: Percentage of all producers with a nutrient management plan for their farm (*n*=54)

RESULTS AND DISCUSSION CONT...

Respondents were asked to indicate the number of acres they fertilize using various technologies. Variable rate application was used most frequently, followed by grid soil sampling, nitrogen stabilizers, and poultry litter or manure (Table 2). While the adoption of these precision technologies, alternative fertilizer sources, and nitrogen stabilizers is limited, changes from these baselines will be interesting to watch for in the future.

Table 2: Number of acres fertilized by respondents using various technologies in a typical year

Technology	Corn acres	Cotton acres	Soybean acres	Wheat acres	Pasture acres	Hay acres
Variable rate application	3,545 (7)	10,896 (5)	8,493 (7)	700 (2)	434 (11)	405 (7)
Grid soil sampling	4,650 (8)	1,375 (4)	8,833 (8)	525 (1)	500 (3)	386 (6)
Poultry litter or manure	2,490 (5)	365 (1)	630 (2)	745 (3)	807 (11)	712 (15)
Nitrogen stabilizer	8,753 (13)	3,245 (4)	- (-)	200 (1)	530 (7)	751 (12)

Number of observations in parentheses. The use of biosolids was included in the survey but omitted from analysis due to limited responses.

USE OF NO-TILLAGE FARMING

Compared to conventional till, no-till has been shown to improve soil health and reduce fuel and labor costs, while no-till with cover crops can improve soil physical properties compared to no-till or conventional till without cover crops. Ninety percent of respondents reported using no-tillage in 2022 (Figure 5). Soybeans accounted for the most no-till acres in 2022, followed by corn, cotton, and wheat (Table 3). Nearly all (99.7%) no-till acres planted by respondents were privately funded.

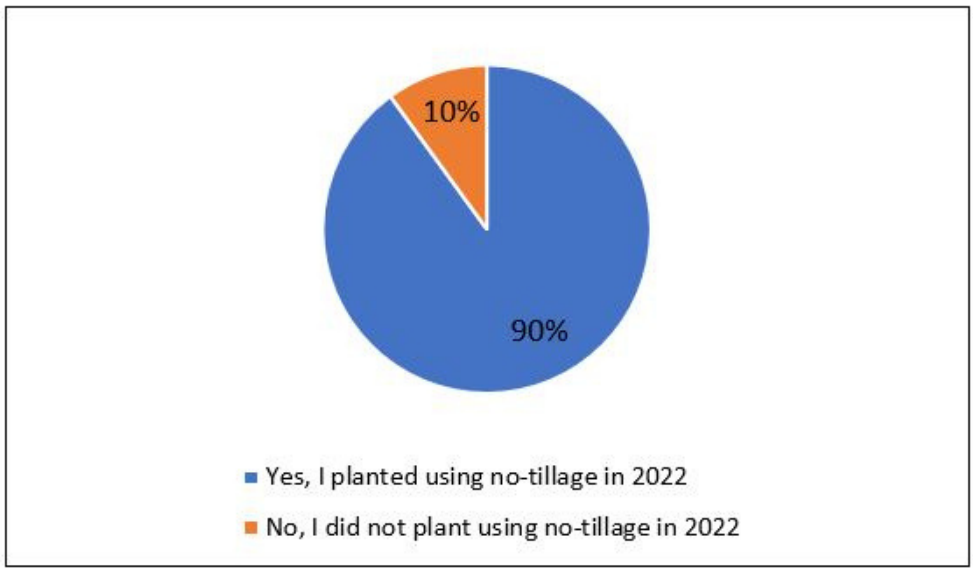


Figure 5: Percentage of respondents using no-tillage farming in 2022 (*n*=50)

Table 3: Number of acres planted no-till in 2022 that were privately funded and partially funded by a government agency

	n	Number of Acres
Acres privately funded		
Soybeans	30	18,204
Corn	32	11,049
Cotton	5	2,596
Wheat	7	1,642
Acres partially funded by government agency		
Corn	1	100
Soybeans	-	-
Cotton	-	-
Wheat	-	-

USE OF COVER CROPS

Cover crops have been shown to slow erosion, improve soil health, enhance water availability, control weeds, pests, and diseases, and increase biodiversity on cultivated land. Cover crops have also been shown to increase crop yields, contribute to soil organic matter, mitigate nutrient leaching, and attract pollinators and evidence suggests cover crops also offer protection in the face of erratic and increasingly intensive rainfall, as well as during drought conditions. Sixty percent of row crop producers reported planting cover crops in 2022, while 40% did not (Figure 6). Similarly, 60% of the acreage reported to be planted in cover crops in 2022 was privately funded and 40% partially funded by a government agency (Table 4). Twenty-six respondents reported planting a total of 9,013 acres due to cost-share payments.

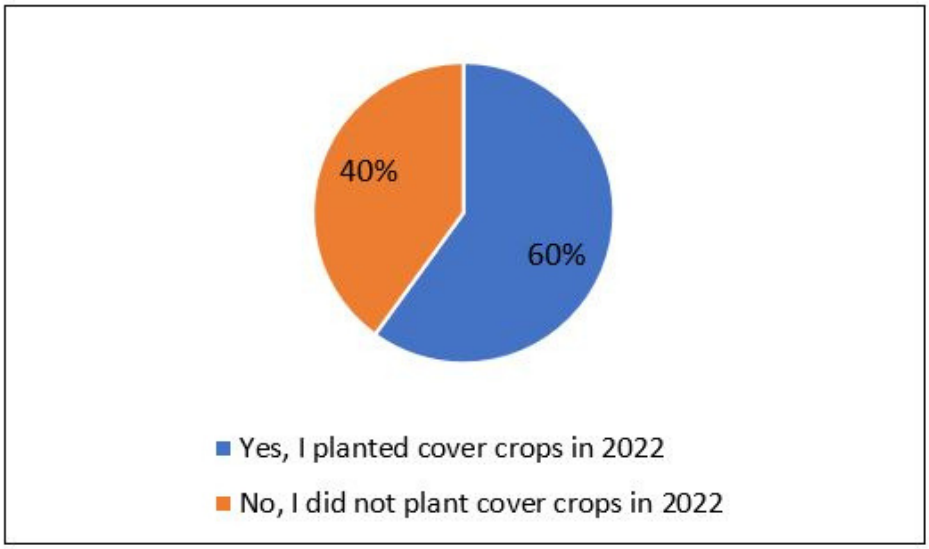


Figure 6: Percentage of respondents that planted cover crops in 2022 (*n*=50)

Table 4: Acres of cover crops planted in 2022 that were privately funded and partially funded by a government agency

	n	Acres
Privately funded		
Corn Acres	16	3,218
Cotton Acres	1	240
Soybean Acres	11	2,043
Wheat Acres	1	62
Pasture Acres	1	112
Hay Acres	2	76
Other Acres	2	37
Partially funded by government agency		
Corn Acres	8	1,800
Cotton Acres	3	1,126
Soybean Acres	7	809
Wheat Acres	-	-
Pasture Acres	-	-
Hay Acres	-	-
Other Acres	-	-

TRENDS AND OUTLOOK FOR NUTRIENT MANAGEMENT IN TENNESSEE

Recognizing our data indicates a point in time, we also include historical USDA NRCS data on various uses of conservation practices focused on nutrient management in Tennessee. Although there are limitations to this data (e.g., it does not account for producers who adopted a nutrient management plan without cost-share assistance), it reveals broad trends to supplement the survey data. Figure 7 shows the number of cost-share applications administered for a nutrient management (practice code 590) plan in Tennessee and Figure 8 shows similar statistics for cover crop adoption in Tennessee. The number of applications and dollars allocated for both programs vary across years. After seeing an increase in NRCS cover crop funding in Tennessee from 2014-2017, funding gradually declined through 2022 (Figure 8).

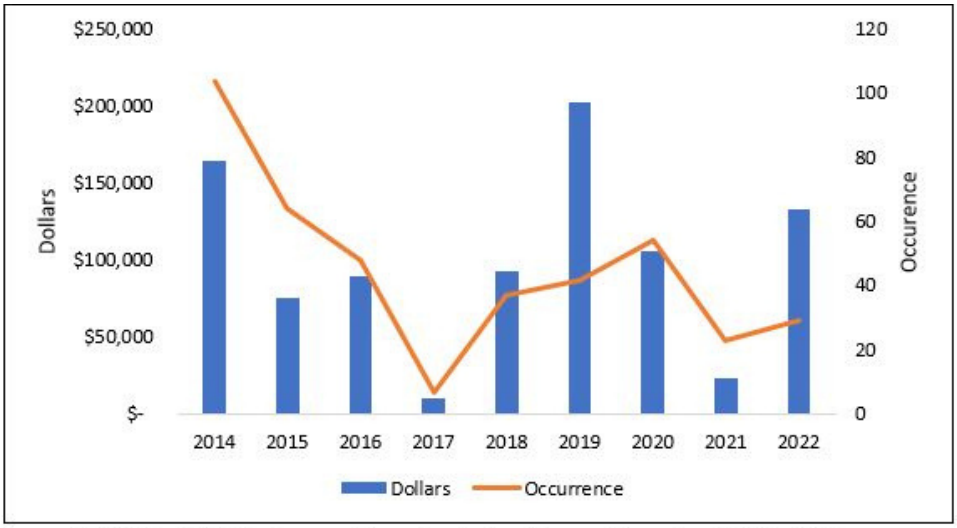


Figure 7: USDA NRCS dollars and contracts for Comprehensive Nutrient Management Plan (590) in Tennessee from 2014-2022

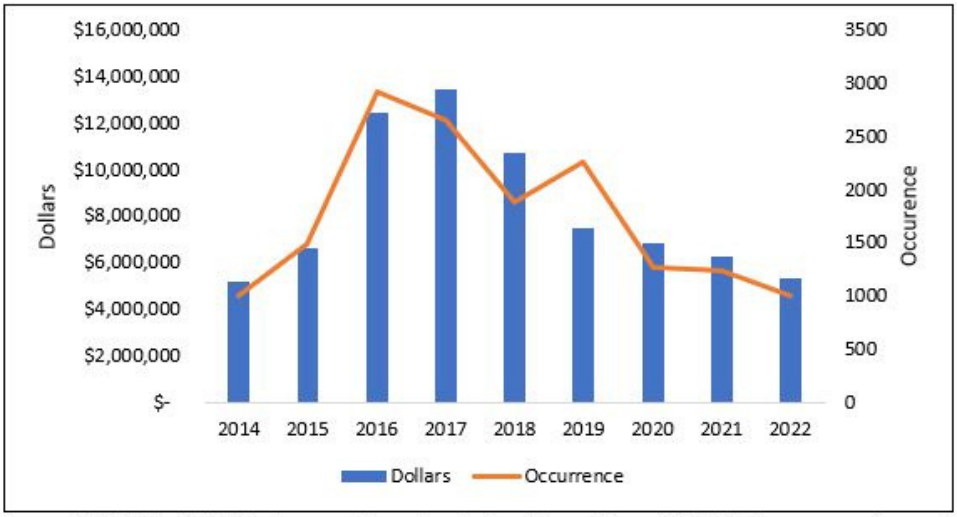


Figure 8: USDA NRCS dollars and contracts for Cover Crop (340) in Tennessee from 2014 to 2022

In addition to quantity of acres and dollars spent, the acreage location is important as these investments generate the highest value in places where the impacts of the practice are the greatest. Compared to counties located in the eastern portion of the state, counties in central and western Tennessee saw relatively more acres and dollars invested in nutrient management practices between 2014 and 2022 (Figures 9 & 10). This might be explained by the higher numbers of crop acres in west Tennessee but highlights a need for continued efforts to expand adoption to East Tennessee. The data does not allow us to isolate acres by practice within a county, but we can assume all these practices address environmental stewardships needs.

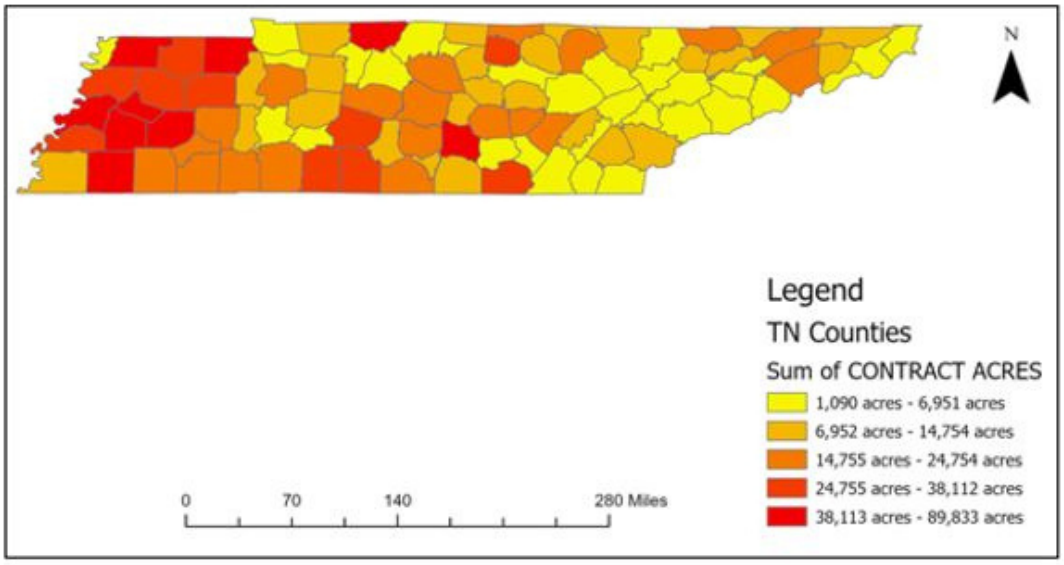


Figure 9: USDA NRCS contract acres from 2014 to 2022

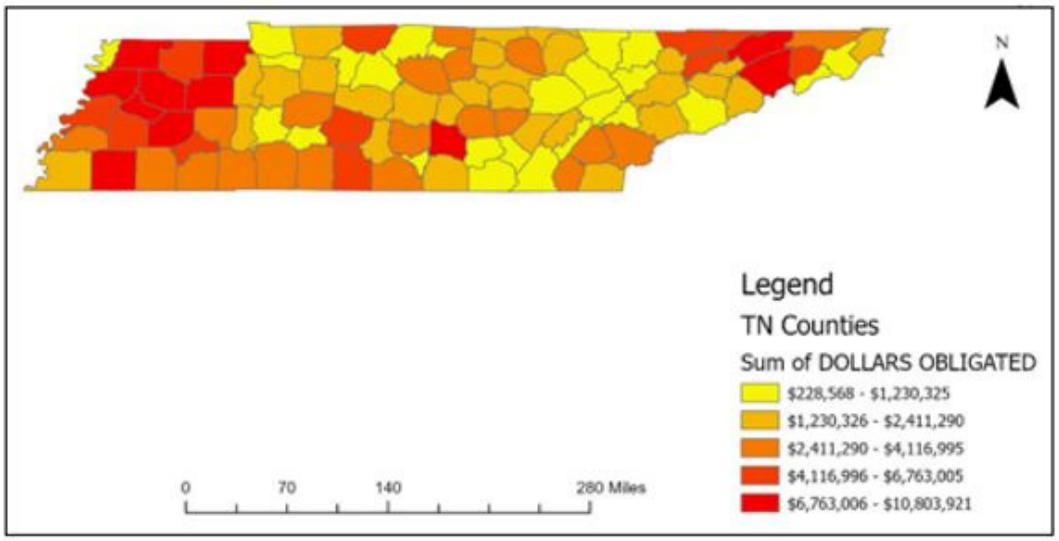
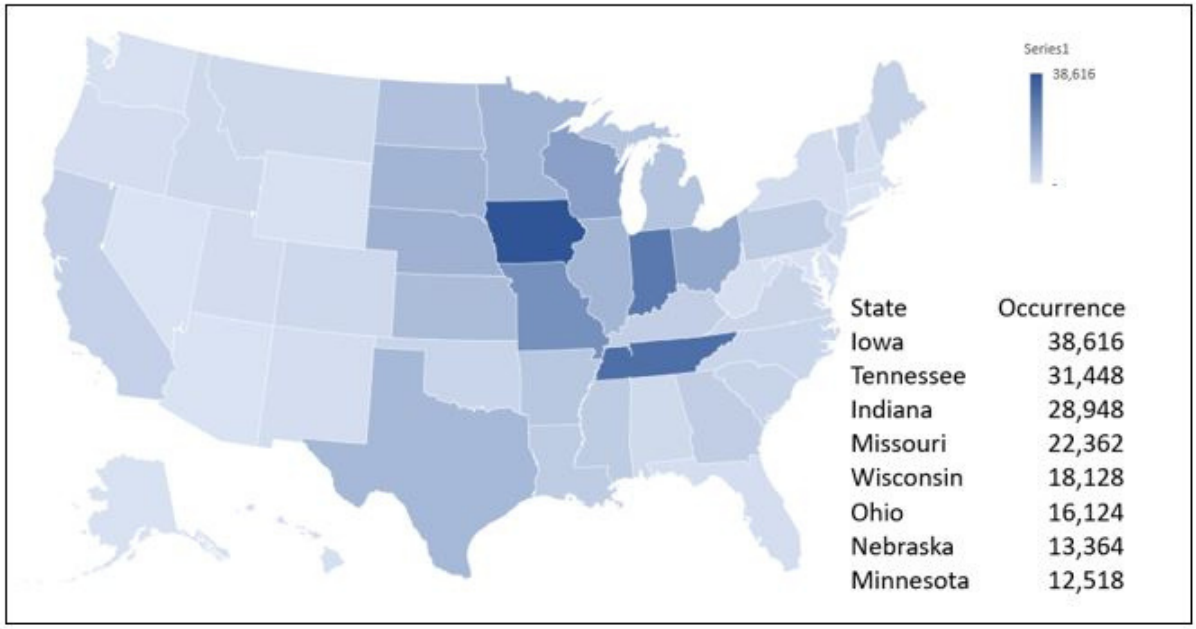


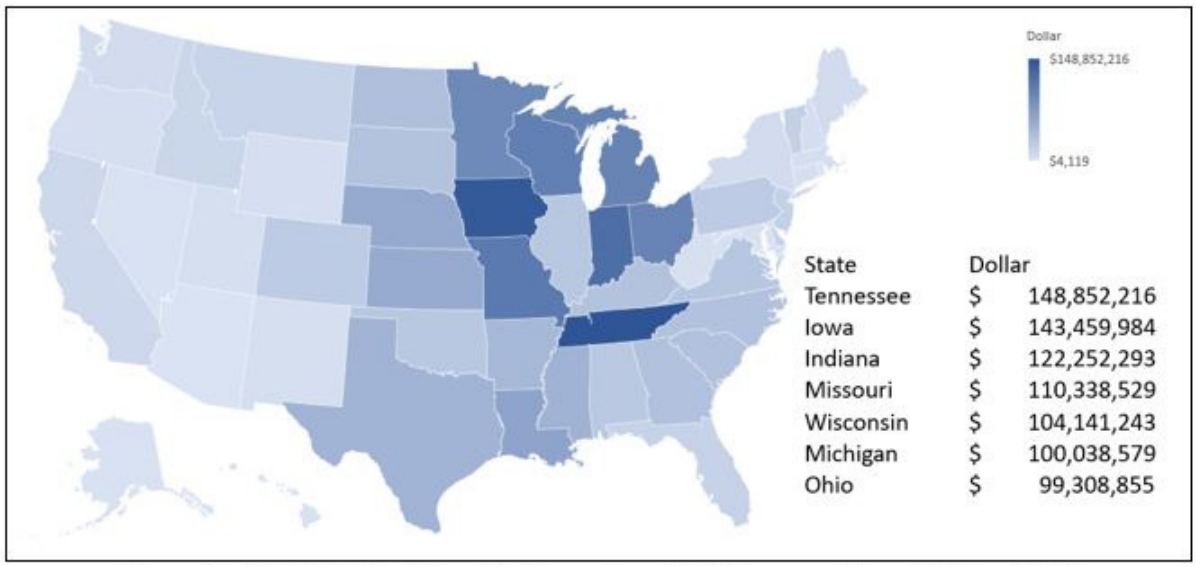
Figure 10: USDA NRCS dollars obligated from 2014 to 2022

Tennessee producers' participation in USDA NRCS cover crop programs is relatively high compared to other states. For the period 2014-2022, Tennessee ranked second among all states in cover crop occurrences (Figure 11) and first among all states in dollars spent on cover crops (Figure 12). While there are areas for improvement, Tennessee producers' adoption of nutrient management practices such as cover crops, demonstrates Tennessee farmers have made progress in environmental stewardship.



State	Occurrence
Iowa	38,616
Tennessee	31,448
Indiana	28,948
Missouri	22,362
Wisconsin	18,128
Ohio	16,124
Nebraska	13,364
Minnesota	12,518

Figure 11: USDA NRCS contracts for Cover Crop (340) by state from 2014 to 2022



State	Dollar
Tennessee	$ 148,852,216
Iowa	$ 143,459,984
Indiana	$ 122,252,293
Missouri	$ 110,338,529
Wisconsin	$ 104,141,243
Michigan	$ 100,038,579
Ohio	$ 99,308,855

Figure 12: USDA NRCS dollars for Cover Crop (340) by state from 2014 to 2022

RESULTS AND DISCUSSION CONT...

Looking ahead, we asked respondents to report how their use of various practices had changed over the last five years and how their use of those practices will change in the next five years. Overall, respondents reported a net increase in cover crop acres planted, no-till acres, soil testing, and the use of nitrogen stabilizers, poultry litter and biosolids over the previous 5 years, accompanied by a net decrease in total fertilizer applied (Table 5). Respondents' expectations for the next 5 years suggest these trends may continue (Table 6). These findings are encouraging and imply further adoption of nutrient management practices in Tennessee, which is already a leading state in terms of NRCS program use. However, because of the method used to promote and administer the survey, results may be subject to self-selection bias and may not accurately represent the entire population of producers in the state.

Table 5: Use of various nutrient management techniques compared to 5 years ago (% of respondents)

	Decrease	Increase	About the Same	Will not Use
Cover Crops Acres	18%	27%	41%	14%
No-Till Acres	7%	22%	71%	0%
Soil Testing	2%	24%	73%	0%
Total Fertilizer Applied	24%	20%	53%	2%
Nitrogen Stabilizer	5%	27%	38%	30%
Poultry Litter	3%	16%	16%	65%
Biosolids	0%	3%	10%	87%

Table 6: Expected use of various nutrient management techniques over the next 5 years (% of respondents)

	Decrease	Increase	About the Same	Will not Use
Cover Crops Acres	9%	47%	40%	4%
No-Till Acres	2%	22%	76%	0%
Soil Testing	0%	18%	82%	0%
Total Fertilizer Applied	23%	12%	63%	2%
Nitrogen Stabilizer	6%	12%	56%	26%
Poultry Litter	3%	13%	30%	53%
Biosolids	0%	14%	11%	75%