Upland Cotton Producers' Willingness to participate in a BMP/STAX Pilot Program

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Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

Abstract:
Changes in the 2014 Farm Bill have reconnected federally-subsidized crop insurance to conservation compliance and eliminated direct payments that were tied to conservation compliance. The net effects of these changes on producers' incentives to comply with conservation standards and on the environment are uncertain, especially in regions such as the Mississippi Delta. We propose pilot crop insurance programs to improve the link between federally-subsidized crop insurance and conservation compliance in the southern United States and for crops such as cotton. The objective of this study was to determine Tennessee and North Central Mississippi cotton producers' willingness to participate in hypothetical pilot programs that would incentivize use of cover cropping and no-till practices coupled with crop insurance via an additional cost share payment above current Environmental Quality Incentive Program cost share payments. Data were collected using a mail survey of Tennessee and North Central Mississippi cotton producers conducted in early 2015. A bivariate probit model was estimated to ascertain the factors that impact cotton producers' willingness to participate in two pilot programs that link cover cropping or no-till with Stacked Income Protection Plan crop insurance. Results found that 35% of the cotton producers would be willing to participate in the cover cropping and Stacked Income Protection Plan pilot program, while 28% indicated they would participate in the no-till and Stacked Income Protection Plan pilot program. Results from the bivariate probit model showed that producers already planning to use Stacked Income Protection Plan in 2015 were more willing to participate in the pilot programs. A producers' age, income, and debt-to-asset ratio influenced their willingness to participate in the pilot programs. More producers stated they used no-till production than cover crops; therefore, we made pairwise comparisons between producers' ratings of potential outcomes from using cover cropping and no-till as well as between users and non-users of each of those practices. The results provide unique insight into producers' perceptions of these practices. Overall, the proposed hypothetical pilot programs could improve the linkage between federally-subsidized crop insurance and conservation compliance; however, future research should consider the potential for these pilot programs for other crops and regions of the United States.

Keywords: Cotton; Cover crops; Crop insurance; No-tillage

Introduction

Farms with wetland or highly erodible land (marginal land hereafter) are required to develop and implement an approved conservation plan to qualify for crop insurance premium assistance under the Agricultural Act of 2014 (2014 Farm Bill hereafter) (United States (US) Congress 2014). This requirement was established by the Food Security Act of 1985 but abandoned in 1996 to boost crop insurance enrollment (Kotin 2012). Reconnecting premium assistance to conservation compliance in the 2014 Farm Bill was a response to concerns that subsidized crop insurance could incentivize producers to intensify production on marginal land by shielding farmers from production risk, thereby increased soil erosion and wetland loss (Goodwin et al. 2004; Lubowski et al. 2006). However, the 2014 Farm Bill eliminated direct payments, which were a large share of federal assistance to producers and were withheld from farms with marginal land that did not have an approved conservation plan, removing an incentive for producers to comply with conservation requirements.

The environmental impacts from eliminating direct payments and reconnecting premium assistance to conservation compliance are difficult to forecast. Claassen (2012) concluded that making federally-subsidized crop insurance subject to conservation compliance could compensate for some of the lost conservation incentives from the elimination of direct payments in some regions of the US. However, in regions where direct payments were historically higher than crop insurance premium subsidies (e.g., the Mississippi Delta), the incentives through federally-subsidized crop insurance will likely fall short of those provided by direct payments (Claassen 2012). Furthermore, given the voluntary nature of crop insurance, its effectiveness as an instrument to encourage environmental policy depends on producers' willingness to enroll

(Howden et al. 2007). Consequently, the impact of federally-subsidized crop insurance on conservation compliance in regions, such as the Mississippi Delta, is uncertain.

In the Mississippi Delta and West Tennessee, upland cotton received the largest share of total direct payments among crops from 1995-2012 (Environmental Working Group, 2015) and has the potential to cause significant environmental damage in those states. Cotton leaves minimal crop residue on the soil surface, increasing the probability of soil erosion and nutrient runoff (Bradley and Tyler 1996). Moreover, much of the cotton production in the Mississippi Delta and West Tennessee occurs on marginal land subject to nutrient runoff (Bradley and Tyler 1996). These environmental concerns resulted in considerable research on using best management practices (BMPs) to reduce soil erosion and nutrient runoff in cotton production with cover crops and no-till being the primary BMPs of focus.

Cover crops and no-till can improve soils by reducing erosion, conserving nutrients, building organic content, and improving water retention (Karlen et al. 2013; Meisinger et al. 1991; Snapp et al. 2005; Toliver et al. 2012). Economic analyses found that the profitability of using cover crops was mixed and depended on the species of cover crop; however, no-till production was more profitable than conventional tillage for cotton produced in the southeastern US (Cochran et al. 2007; Giesler et al. 1993; Larson et al. 2001a; Toliver et al. 2012). Risk analyses showed that using cover crops or no-till can reduce cotton yield variability (or production risk) in the southeastern US (Jaenicke et al. 2003; Larson et al. 1998; Larson et al. 2001b; Toliver et al. 2012), making those BMPs potential risk management strategies for producers.

Even though cover crops and no-till can provide many agronomic, environmental, and economic benefits to cotton producers in the southeastern US, their adoption is somewhat limited. The 2012 Agricultural Census reported that approximately 3% of all cropland in the US (4.1 million ha) was planted to cover crops in 2011 (USDA National Agricultural Statistics Service (NASS) 2012), but studies have found the number of users might vary from region to region (Dunn et al. 2016; Zhou et al. 2015). The 2012 Agricultural Census reported that over 39 million ha of cropland in the US was under no-till production (USDA NASS 2012). Although no-till production increased between 2007 and 2012 and is higher than cover crop use, no-till production covers less than half of US cropland (USDA NASS 2007, 2012).

Federal programs such as the Environmental Quality Incentive Program (EQIP) were established to encourage the voluntary adoption of BMPs on working farmland. The program provides producers with cost share payments for using BMPs such as cover crops (USDA Natural Resource Conservation Service (NRCS) EQIP 340) and no-till (USDA NRCS EQIP 329) (Cattaneo 2003). Producers work with USDA NRCS agents to document and implement BMPs in return for partial reimbursement of the BMP costs (Reimer and Prokopy 2014). In 2014, EQIP provided cost share payments for the use of cover crops and no-till on more than 526,000 ha, an increase from 2013 (USDA NRCS 2015). Funding for EQIP is projected to continue increasing through 2018, making EQIP a primary focus of US conservation policy (Lubben and Pease 2014).

Nevertheless, recent studies have indicated that producers were cautious to adopt BMPs because of the perceived risk and/or belief that these practices reduce yields (Arbuckle Jr. and Roesch-McNally 2015; Reimer et al. 2012). Cotton producers in regions where indemnity payments for crop insurance are historical low, such as the Mississippi Delta, might perceive lower risk of yield loss from events covered under crop insurance than the risk of yield loss from adopting a BMP. Thus, a producer in these regions may choose not to purchase crop insurance and face the risk of yield loss rather than face the higher perceived risk of being conservation compliant and adopting BMPs. An alternative policy approach might be needed to improve the linkage between federally-subsidized crop insurance and conservation compliance in some regions of the US, such as the Mississippi Delta, and for crops such as cotton.

Under the 2014 Farm Bill, cotton producers fall into a unique policy position relative to other crop producers. The shallow loss revenue protection and price protection programs under Title I were not available to cotton producers. However, cotton producers can enroll in the Supplemental Coverage Option (SCO) or the Stacked Income Protection Plan (STAX), with STAX being available only to upland cotton producers. The SCO and STAX are similar to Group Risk Income Protection in that they cover countywide losses and are designed to complement an individual's insurance policy. Thus, producers could purchase both an individual policy and an SCO or STAX policy. The individual policy would cover deeper losses and the SCO or STAX policy would cover shallow losses (Campiche 2013a). Since most US cotton producers have coverage levels of 70% or lower on individual policies, they could receive up to 20% STAX coverage (10% deductible) (Campiche 2013b).

Given the uncertainty relating to cotton producer adoption of crop insurance that is tied to BMPs under the 2014 Farm Bill, we evaluate two hypothetical pilot programs that link EQIP cost share payments for adopting cover crops or no-till with a STAX crop insurance policy to encourage adoption of these BMPs for risk averse producers. This policy mechanism would offer an additional EQIP cost share payment to producers who also purchase a STAX policy. Specifically, we determined Tennessee and North Central Mississippi cotton producers' willingness to participate in two hypothetical pilot programs that would incentivize adoption of cover cropping or no-till coupled with purchase of a STAX policy (CC/STAX and NT/STAX, respectively) via an increase in EQIP cost share payments. Furthermore, we investigated why the adoption of no-till is higher than the adoption of cover crops in the US by comparing producers' likelihood ratings of the potential profitability and environmental outcomes from adopting these BMPs.

Data

Data were collected from a 2015 survey of cotton producers in Tennessee and Mississippi. A total of 607 mail surveys were sent to all 367 cotton producers in Tennessee and 240 producers in the North Central Mississippi counties shown in Figure 1. The Cotton Board provided mailing addresses for producers who marketed cotton in 2014. A copy of the survey instrument is available from the authors upon request.

<<< Insert Figure 1 Here >>>

Survey implementation followed Dillman's total design method (Dillman 1978). Survey questionnaires were mailed in February of 2015 along with a postage-paid return envelope and a cover letter explaining the purpose of the survey. About a week after the initial mailing, a postcard was sent as a reminder. About two weeks after the postcard, a second copy of the survey was mailed to producers who had not yet responded. Of the 607 cotton producers on the mailing list, 86 surveys were returned (a response rate of 14.2%). The response rate was similar to previous cotton producer surveys (e.g., Zhou et al. 2015).

The survey was divided into four sections. The first section included questions about the producer's farm such as farm location, and irrigated and non-irrigated planted area in 2014. The second section focused on the producer's use and perceptions of cover crops and no-till. We asked producer's if they used cover cropping or no-till in the last year. We also asked them to rate the likelihood (1= extremely unlikely,…, 5=extremely likely) of the potential outcomes from using cover cropping or no-till. The third section included a set of questions on producer's use of risk management strategies such as futures, options, and crop insurance. In this section, two questions were asked about the producer's willingness to participate in the CC/STAX or NT/STAX pilot programs. The questions asked whether the producer would be willing to participate the CC/STAX or NT/STAX pilot programs if the EQIP cost share payment ha^{-1} for adopting cover cropping or no-till increased by \$22 ha^{-1} for the respective pilot program. The final section included questions regarding farm income, debt, and age.

Methods

Econometric Model

The likelihoods that a producer would participate in either the CC/STAX or the NT/STAX pilot program were determined using a bivariate probit model (Greene 2011). This model allows the joint determination of the likelihoods that a producer will participate in either pilot program. That is, the observed and unobserved factors that impact a producer's decision to participate in either pilot program might be correlated. Given that I_1^* represents the producer's decision to participate in the CC/STAX program and I_2^* represents the decision to participate in the NT/STAX program, the bivariate probit model is

(1) $$I_1^* = \boldsymbol{\beta}' \mathbf{x} + u_1, \quad I_1 = \begin{cases} 1 & if \;\; I_1^* > 0 \\ 0 & if \;\; I_1^* \le 0 \end{cases} ,$$

(2) $$I_2^* = \boldsymbol{\beta}' \mathbf{x} + u_2, \quad I_2 = \begin{cases} 1 & if \;\; I_2^* > 0 \\ 0 & if \;\; I_2^* \le 0 \end{cases} ,$$

with

(3) $$\begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \sim BVN\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_{12} \\ \rho_{12} & 1 \end{bmatrix}\right),$$

where **x** represents a matrix of independent variables; **β** represents a vector of coefficients that describe the relationship between participation and the independent variables; and *BVN* is the bivariate standard normal cumulative distribution function. The dependent variables for CC/STAX participation (I_1) and NT/STAX participation (I_2) equal one when a cotton producer is willing to adopt the respective pilot program (zero otherwise). The likelihood ratio test was used to test the null hypothesis of zero correlation between willingness to participate in the two pilot programs (ρ_{12} = 0). If the null hypothesis is rejected, the bivariate probit model is appropriate, but if we fail to reject the null, estimating two independent probit models would be the appropriate method (Greene 2011).

Because the coefficients of a bivariate probit model do not directly represent the change in the dependent variable for a one unit change in an independent variable, the marginal effects must be calculated (Greene 2011). Marginal effects indicate the impact of a one unit change in an independent variable on the dependent variable. For binary independent variables, the marginal effect is interpreted as a *ceteris paribus* change in the probability of adopting a pilot program, given the binary independent variable equals one (Greene 2011). The marginal effect of a continuous independent variable is interpreted as a *ceteris paribus* change in the probability of adopting a pilot program, given a unit change in the continuous variable. The bivariate probit model and marginal effects were estimated using STATA 12 (STATA 2012). The accuracy and significance of the overall model were evaluated with the percentage of observations correctly predicted and the likelihood ratio test (LLR).

Table 1 presents the names, descriptions, and mean values of the data included in the bivariate probit model. The likelihood that a producer would select either the CC/STAX or NT/STAX pilot program was hypothesized to be higher for a producer who was already using cover crops (CC) or no-till (NT). By enrolling in either pilot program, a producer already using cover crops or no-till could increase the EQIP cost share payment and receive subsidized crop insurance. We also hypothesized that, if a producer planned to participate in the STAX program in 2015 (STAX), the likelihood of participating in the CC/STAX and NT/STAX pilot programs would increase. If a producer was already planning on participating in the 2015 STAX program, adopting a BMP with its accompanying agronomic and economics benefits (Larson et al. 2001a; 2001b) and higher EQIP cost share payments would encourage participation in each of the pilot programs.

<<< Insert Table 1 Here >>>

We hypothesized that a producer's age (AGE) would impact willingness to participate in a pilot program. Several studies have shown that as age increased, producers were less likely to adopt BMPs (Arbuckle Jr. and Roesch-McNally 2015; Reimer et al. 2012). However, we estimated the probability of participation as a quadratic function of age with the expectation that the probability of participation increases at a decreasing rate with age. The use of futures and/or options contracts (FUTOP) to manage risk was anticipated to increase the likelihood of participation in the pilot programs. Since these producers are already managing risk, they also might be interested in the additional risk management potential provided by the pilot programs. If the producer's farm income (INCOME) was greater than $100,000 and their farm debt-asset ratio (DEBT) was greater than 40%, we expected they would be more likely to participate in the pilot programs. Higher incomes have been found to increase the use of BMPs (Arbuckle Jr. and

Roesch-McNally 2015) and higher farm debt might increase a producer's desire to protect against losses.

We were uncertain about whether a producer located in Tennessee (STATE) would be more willing to participate in the pilot programs than one located in Mississippi since the conditions in Tennessee and Mississippi are quite similar (Figure 1). If a producer practiced irrigation (IRR), we hypothesized the producer would be less likely to participate in either of the pilot programs since studies have shown irrigation can be a substitute for crop insurance in humid regions (Dalton et al. 2004). We were uncertain about how purchasing crop insurance for cotton in 2014 (INS) would affect the likelihood of participating in either of the pilot programs since the 2014 crop insurance program was different from the STAX policy offered in 2015.

Pairwise Comparisons

To evaluate why more producers use no-till production than cover cropping, we asked them to rate the likelihood of 10 potential outcomes that might occur from using these BMPs. The scale of the responses was from one (outcome is extremely unlikely) to five (outcome is extremely likely). The outcomes included increase farm profits, increase average yield, reduce soil erosion, increase risk associated with cotton production, improve organic matter in the soil, reduce carbon dioxide (CO_2) from the soil, interfere with obtaining crop insurance, interfere with off-farm activities, increase complexity of farming operation, and improve water holding capacity of the soil. We used pairwise t-tests to compare the average ratings between cover cropping and no-till for each potential outcome. We also performed pairwise comparisons of the average ratings for each outcome between users and non-users of cover crops as well as between users and non-users of no-till. A variance ratio test was used to determine whether a t-test assuming equal variances or unequal variances should be used.

Results and Disccussion

The means of the variables used in the bivariate probit model are presented in Table 1. About 35% of the cotton producers indicated they would be willing to participate in the CC/STAX pilot program and 28% indicated they would participate in the NT/STAX pilot program. However, the survey data sugget that 25% of cotton producers in the survey region currently use cover crops while 77% use no-till. The perecntage of cover crop use was similar to Zhou et al. (2015) for cotton producers in 14 southern states. However, the percentage using no-till was higher than reprted by Horowitz et al. (2010) and in the 2012 Agricultural Census (2012). Interestingly, more cotton producers were willing to particiate in the CC/STAX pilot program than the NT/STAX program even though more producers use no-till than cover crops. This result suggests that the proposed CC/STAX program may encourage additional cotton producers in the study area to use cover crops on more land, while the NT/STAX program may do so to a lesser extent. Further research is need to determine the impact of the pilot programs on the amounts of land in cover crops or no-till production.

Approximetely 32% of cotton producers indicated they would use STAX in 2015. According to USDA Risk Management Agency (RMA) data, 28% of Tennessee planted area was insured through STAX in 2015, and in Mississippi the percent of planted area was 43% (USDA RMA 2015). A state land-weighted average of those percentages suggests that 38% of the planted cotton area in those states was enrolled in STAX.

The average age of the producers in the survey was about 58 years old, which is similar to Zhou et al. (2015). Around 19% of cotton producers indicated they used futures or options to manage risk. Taxable income in 2013 was greater than $100,000 for 23% of the cotton producers, and about 25% of the cotton producers had a debt-to-asset ratio greater than 40%. Most of the producers were located in Tennessee (71%) and 87% of the cotton producers had purchased crop insurance for cotton in the past year. One-quarter of the producers indicated they used irrigation for cotton production.

The correlation coefficient of the residuals for the pilot programs ($\rho_{12} = 0.631$) was positive and significant ($p \leq 0.01$), suggesting gains in efficiency by simultaneously modeling willingness to participate in the pilot programs (Greene 2011). Estimated coefficients and marginal effects from the bivariate probit model are shown in Table 2. The model was statistically significant overall based on the likelihood ratio test. The bivariate probit model correctly classified 65% and 71% of the observations for willingness to participate in the CC/STAX or NTSTAX programs, respectively.

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The estimated coefficients and marginal effects for the variables representing prior use of cover cropping and no-till practices were not significant, suggesting that prior use of those BMPs did not significantly influence willingness to participate in either pilot program. However, producers planning to purchase a STAX policy in 2015 were 33% more likely to participate in the CC/STAX pilot program ($p \leq 0.05$) and 23% more likely to participate in NT/STAX pilot program ($p \leq 0.05$). These results suggest that the proposed programs may be more effective at encouraging STAX participates to use cover crops and no-till than encouraging cover crop and no-till users to participate in STAX. Thus, the programs may be most effective at encouraging cover crop and no-till use by targeting producers already participating in STAX.

A producer's age significantly affected the decision to participate in the CC/STAX and NT/STAX pilot program ($p \leq 0.05$). The positive coefficient for age and the negative coefficient for age squared indicate the probability of participating in these pilot programs increases at a decreasing rate as a producer's age increases. The estimates suggest that the probability of being willing to participate in the CC/STAX program increases with age to 54 years (= $-0.215/(2*-0.002)$), but decreases thereafter. Similarly, the probability of participating in the NT/STAX program increases with age to 55 years, but decreases thereafter.

If a producer had a farm income greater than $100,000 in 2013, the probability of participating in the CC/STAX pilot program decreased by 28% ($p \leq 0.05$). Conversely, producers making less than $100,000 per year were more likely to adopt the pilot program. This result is counter to other research on BMP adoption (Arbuckle Jr. and Roesch-McNally 2015). Farmers with lower incomes may feel that they are less able to withstand production and price risks and thus are more likely to carry crop insurance. Having a debt-to-asset ratio greater than 40% increased producers' willingness to participate in the NT/STAX pilot program by 19% ($p \leq 0.10$). Producers with more debt relative to assets might find an additional incentive to help manage risk beneficial. The results indicate that producers with higher levels of debt relative to assets and with lower farm income were more likely to participate in the pilot programs.

Pairwise comparisons of the average ratings for potential outcomes from using each practice are shown in Table 3. Cover crop adopters were more likely than no-till adopters to indicate reduced soil erosion, reduced CO_2 losses from the soil, and improved water holding capacity as outcomes ($p \leq 0.05$). In contrast, producers did not view no-till as more likely to provide any of the potential outcomes than cover crops. This result was unexpected since more producers have adopted no-till production than cover crops, suggesting further research is needed on this topic. Contrary to Arbuckle Jr. and Roesch-McNally (2015) and Reimer et al. (2012), our results indicated that producers believed that cover crops and no-till are unlikely to increase risk associated with cotton production. Furthermore, the mean ratings indicate that producers did not perceive that these practices increased the complexity of farming, a reason given as being a barrier to adoption of BMPs by farmers (e.g., Dunn et al. 2016).

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The pairwise comparisons of the outcome ratings between cotton producers who have used and not used cover crops or no-till are shown in Table 4. Cotton producers who have not used cover crops rated improvement in soil organic matter and the likelihood of cover crops interfering with off-farm activities higher than users of cover crops ($p \leq 0.05$). The likelihood of cover cropping interfering with off-farm activities might suggest a barrier to adopting cover crops. No-till users rated the likelihood of no-till increasing cotton yields higher than non-users ($p \leq 0.05$), suggesting that cotton producers who switched to no-till production may have increased their cotton yields. Similarly, the likelihood of no-till interfering with off-farm activities was higher for non-users than users ($p \leq 0.05$), suggesting a reason for not adopting no-till.

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Conclusions

Changes in the 2014 Farm Bill link federally-subsidized crop insurance to conservation compliance and eliminated direct payments that were tied to conservation compliance. The former increased the incentive to be conservation compliant while the latter decreased the incentive, relative to the former farm bill. The net effect of these policy changes on producers' incentive to remain conservation compliant is uncertain, especially in regions such as the Tennessee and Mississippi Delta. We examined Tennessee and North Central Mississippi cotton producer willingness to participate in hypothetical pilot programs that would incentivize use of cover cropping or no-till practices coupled with crop insurance (CC/STAX or NT/STAX, respectively) via an additional cost share payment above current EQIP payment levels. Additionally, we investigated why more producers adopt no-till than cover crops.

Data were collected from a mail survey of Tennessee and North Central Mississippi cotton producers conducted in early 2015. A bivariate probit model was used to estimate the impacts of several factors on a cotton producer's willingness to participate in the pilot programs. We also asked producers to rate the likelihood of outcomes from using cover crops and no-till. Pairwise comparisons were made between the outcome ratings as well as between users and non-users of cover crops and no-till to explain why adoption of no-till was higher than adoption of cover crops.

We found that 35% of the cotton producers indicated they would be willing to participate in the CC/STAX pilot program, while 28% indicated they would participate in the NT/STAX pilot program. Results from the bivariate probit model indicated that producers planning to use STAX in 2015 were 33% more likely to participate in the CC/STAX pilot program and 23% more likely to participate in NT/STAX pilot program, whereas the use of cover crops or no-till did not significantly impact their willingness to participate in either pilot program. A producer's age, income, and debt-to-asset ratio also influenced willingness to participate in the pilot programs.

Pairwise comparisons showed that producers believed cover crop adoption was more likely to reduce soil erosion, reduce CO_2 losses from the soil, and improve water holding capacity than no-till adoption. Additionally, producers believed that no-till or cover crops were unlikely to increase risk associated with cotton production, which differs from previous research (Arbuckle Jr. and Roesch-McNally 2015; Reimer et al. 2012). A further investigation of the likelihood of outcomes from using these practices found that the likelihood of increasing cotton yields was higher for producers using no-till than for non-users, suggesting that cotton producers who switched to no-till production believe their cotton yields are higher.

The hypothetical CC/STAX and NT/STAX programs evaluated in this study appear to have potential to encourage cover crop or no-till adoption by improving the linkage between federally-subsidized crop insurance and conservation compliance. Future research should consider expanding this research to other regions of the US and other crops, and anticipate the additional land in cover crops and no-till production from having these pilot programs available.

Acknowledgements

This study was funded in part by a grant from Cotton Incorporated and by University of Tennessee AgResearch. We thank the Tennessee and Mississippi cotton producers who participated in the survey.

References

Arbuckle Jr., J.G. and G. Roesch-McNally. 2015. Cover crop adoption in Iowa: The role of perceived practice characteristics. Journal of Soil and Water Conservation 76(6):418-426.

Bradley, J.F., and D.D. Tyler. 1996. No-till: Sparing the plow to save the soil. Tennessee Agri Science 179:7-11.

Campiche, J. 2013a. Analysis of the STAX and SCO programs for cotton producers. Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2013 Crop Insurance and the Farm Bill Symposium, Louisville, KY, October 8-9, 2013.

Campiche, J. 2013b. Details of the proposed Stacked Income Protection Plan (STAX) Program for cotton producers and potential strategies for extension education. Journal Agricultural and Applied Economics 41(1):569-575.

Cattaneo, A. 2003. The pursuit of efficiency and its unintended consequences: Contract withdrawals in the environmental quality incentives programs. Review of Agricultural Economics 25(2):449-469.

Claasen, R. 2012. The future of environmental compliance incentives in U.S. agriculture. USDA Economic Research Service. Economic Information Bulletin Number 94.

Cochran, R.L., R.K. Roberts, J.A. Larson, and D.D. Tyler. 2007. Cotton profitability with alternative lime application rates, cover crops, nitrogen rates and tillage methods. Agronomy Journal 99:1085-1092.

Dalton, T.J., G.A. Porter, and N.G. Winslow. 2004. Risk management strategies in humid production regions: A comparison of supplemental irrigation and crop insurance. Agricultural and Resource Economic Review 33:220-32.

Dillman, D. 1978. Mail and Telephone Surveys, the Total Design Method. New York: John Wiley & Sons.

Environmental Working Group. 2015. Available at: http://farm.ewg.org/progdetail.php?fips=47000&progcode=total_dp&yr=mtotal (accessed December 30, 2015).

Giesler, G.G., K.W. Paxton, and E.P. Millhollon. 1993. A GSD estimation of the relative worth of cover crops in cotton production systems. Journal of Agricultural and Resource Economics 18(1):47-56.

Goodwin, B.K., M.L. Vandeveer, and J.L. Deal. 2004. An empirical analysis of acreage effects of participation in the federal crop insurance program. American Journal of Agricultural Economics 86(4):1058-1077.

Greene, W. 2011. Econometric Analysis. 7th Edition. Upper Saddle River, NJ: Prentice Hall.

Horowitz, J. R. Ebel, and K. Ueda. 2010. "No-Tillage" farming is a growing practice. United States Department of Agriculture Economic Research Service Bulletin Number 70.

Howden, S., J. Soussana, F. Tubiello, N. Chhetri, M. Dunlop, and H. Meinke. 2007. Adapting agriculture to climate change. Proceedings of the National Academy of Sciences 104:50 (Dec. 11): pp. 19691-19696.

Jaenicke, E.C., D.L. Frechette, and J.A. Larson. 2003. Estimating production risk and inefficiency simultaneously: An application to cotton cropping systems. Journal of Agricultural and Applied Economics 28:540-557.

Karlen, D.L., J.L. Kovar, C.A. Cambardella, and T.S. Colvin. 2013. Thirty-year tillage effects on crop yield and soil fertility indicators. Soil and Tillage Research 130:24-41

Kotin, A., 2012. Farm Disaster Policy, Crop Insurance, and Climate Change: Investigating Support Mechanisms for Agricultural Adaptation. MA thesis, Brown University.

Larson, J.A., E.C. Jaenicke, R.K. Roberts, and D.D. Tyler. 2001a. Risk effects of alternative winter cover crop, tillage, and nitrogen fertilization systems in cotton production. Journal of Agricultural and Applied Economics 33:445-457.

Larson, J.A., R.K. Roberts, E.C. Jaenicke, and D.D. Tyler. 2001b. Profit maximizing nitrogen fertilization rates for alternative tillage and winter cover systems. Journal of Cotton Science 5:156-168.

Lubben B., and J. Pease. 2014. Conservation and the agricultural act of 2014. Choices 29:1-8.

Lubowski, R.N., S. Bucholtz, R. Claassen, M. J. Roberts, J.C. Cooper, A. Gueorguieva, and R. Johansson. 2006. Environmental effects of agricultural land-use change—the role of economics and policy. USDA Economic Research Service, Economic Research Report 25.

Meisinger, J.J., W.L. Hargrove, R.L. Mikkelsen, J.R. Williams, and V.W. Benson. 1991. Effects of cover crops on groundwater quality. *In* Cover crops for clean water, ed. W.L. Hargrove. Ankeny, IA: Soil and Water Conservation Society.

Mitchell, P.D., and D.A. Hennessy. 2003. Factors determining best management practice adoption incentives and the impact of green insurance. *In* Risk Management and the Environment: Agriculture in Perspective, ed. B.A. Babcock, R.W. Fraser, and J.N. Lekakis. Boston, MA: Kluwer Academic Publishers.

Reimer, A., and L. Prokopy. 2014 .One federal policy, four different policy contexts: An examination of agri-environmental policy implementation in the Midwestern United States. Land Use Policy 38:605-614.

Reimer, A.P., D.K. Weinkauf, and L.S. Prokopy. 2012. The influence of perceptions of practice characteristics: An examination of agricultural best management practice adoption in two Indiana watersheds. Journal of Rural Studies 28:118-128.

Snapp, S.S., S.M. Swinton, R. Labarta, D. Mutch, J.R. Black, R. Leep, J. Nyiraneza, and K. O'Neil. 2005. Evaluating cover crops for benefits, cost, and performance within cropping systems. Agronomy Journal 97:322-332.

STATA Corp. StataCorp LP Statistics/Data Analysis StataCorp, College Station, Texas, 2012.

Toliver, D.K., J.A. Larson, R.K. Roberts, B.C. English, T.O. West, and D.G. De La Torre Ugarte. 2012. Effects of no-tillage on yields as influenced by crop and environmental factors. Agronomy Journal 104(2):530-541.

U.S. Congress. 2014. The Agricultural Act of 2014. Washington DC: H.R. 2642, 113th Cong., 2nd sess.

U.S. Department of Agriculture. National Agricultural Statistical Service. 2012. 2012 Census of Agriculture Highlights. (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Conservation/Highlights_Conservation.pdf)

United States Department of Agriculture. Natural Resources Conservation Service. 2011. Conservation Practice Standard Cover Crop. Code 340. Available at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046845.pdf. (Accessed December 30, 2016).

United States Department of Agriculture. Natural Resources Conservation Service. 2011. Conservation Practice Standard Residue and Tillage Management No Till/Strip Till/Direct Seed. Code 329. Available at: https://efotg.sc.egov.usda.gov/references/public/WI/329.pdf (Accessed December 30, 2016).

U.S. Department of Agriculture. Natural Resource Conservation Service. 2014. NRCS Conservation Programs. Environmental Quality Incentives Program (EQIP) (http://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/fb08_cp_eqip.html).

U.S. Department of Agriculture Risk Management Agency. 2015. Available at: http://www.rma.usda.gov/data/sob.html (Accessed December 30, 2016).

Zhou, X., B.C. English., C.N. Boyer, R.K. Roberts, J.A. Larson, D.M. Lambert, M. Velandia, LL. Falconer, S.W. Martin, S.L. Larkin, K.P. Paudel, A.K. Mishra, R.M. Rejesus, C. Wang, E.Segarra, and J.M. Reeves. 2015. Precision farming by cotton producers in fourteen southern states: results from the 2013 southern cotton farm survey. Research series 15-001, Sept. 2015.

Table 1. Descriptions and summary statistics of dependent and independent variables.

Variable Name	Description	Hypothesized Sign	Mean
Dependent variables			
CC/STAX	= 1 if would participate in the cover crop with Stacked Income Protection Plan pilot program, 0 otherwise		0.35
NT/STAX	= 1 if would participate in the no-till with Stacked Income Protection Plan pilot program, 0 otherwise		0.28
Independent Variables			
CC	= 1 if used cover crop on cotton in 2014, 0 otherwise	+	0.25
NT	= 1 if used no-till on cotton in 2014, 0 otherwise	+	0.77
STAX	= 1 if planned to use with Stacked Income Protection Plan in 2015, 0 otherwise	+	0.32
AGE	= Age of the primary decision maker	+	57.58
AGE^2	= Age squared of the primary decision maker	-	3454.04
FUTOP	= 1 if producer used cotton futures or options contracts to manage risk, 0 otherwise	+	0.19
INCOME	= 1 if the producer's 2013 household income was greater than $100,000, 0 otherwise	-	0.23
DEBT	= 1 if financed debt was $40 or more for every $100 of assets, 0 otherwise	+	0.25
STATE	=1 if the producer's farm was located in Tennessee, 0 otherwise	-	0.71
IRR	=1 if the producer used irrigation , 0 otherwise	-	0.25
INS	=1 if the producer purchased crop insurance last year for cotton production, 0 otherwise	+	0.87

Table 2. Estimated bivariate probit model for willingness to participate in the pilot programs for cover crop with Stacked Income Protection Plan (CC/STAX) and no-till with Stacked Income Protection Plan (NT/STAX) for cotton producers in Tennessee and Mississippi.

	CC/STAX		NT/STAX	
Variable Name*	Estimated coefficients	Marginal effect	Estimated coefficients	Marginal effect
Intercept	-2.479	-	-12. 845[b]	-
CC	-0.366	-	-	-
NT	-	-	-0.004	-
STAX	1.182[a]	0.333[a]	0.937[b]	0.232[b]
AGE	0.215[b]	0.061[b]	0.441[b]	0.110[b]
AGE^2	-0.002[b]	-0.0006[b]	-0.004[b]	-0.001[b]
FUTOP	0.601	-	1.046[b]	0.258[b]
INCOME	-0.994[b]	-0.279[b]	-0.974	-
DEBT	0.309	-	0.779[c]	0.193[c]
STATE	-0.124	-	-0.148	-
IRR	-0.222	-	-0.244	-
INS	-0.862	-	-0.316	-
Rho			0.631[a]	
LLR	<0.001		<0.001	
Percent correctly classified	65.0%		71.3%	

Note: CC/STAX = cover crop with Stacked Income Protection Plan pilot program and NT/STAX = no-till with Stacked Income Protection Plan pilot program.
* The letters a, b, and c represent significance at the 1%, 5%, and 10%.

Table 3. Comparison of ratings about the likelihood of potential outcomes between cover cropping and no-till practices for cotton producers in Tennessee and Mississippi

	Mean likelihood rating* (1=extremely unlikely,…, 5= extremely likely)	
Potential Outcome from Cover Cropping or No-till	Cover Crops	No-Till
Increase farm profits	3.52[a]	3.40[a]
Increase average cotton yields	3.68[a]	3.60[a]
Reduce soil erosion	4.58[b]	4.21[a]
Increase risk associated with cotton production	2.46[a]	2.42[a]
Improve organic matter in the soil	4.36[a]	4.16[a]
Reduce CO_2 losses from the soil	3.82[b]	3.28[a]
Interfere with obtaining crop insurance	1.80[a]	1.78[a]
Interfere with off-farm activities	1.97[a]	1.85[a]
Increase complexity of farming operation	3.09[a]	2.85[a]
Improve water holding capacity of the soil	4.01[b]	2.04[a]

* A letter difference between practices for the same potential outcome indicates a difference at the 0.05 level.

Table 4. Comparison of ratings about the likelihood of potential outcomes from cover cropping or no-till between users and non-users

Potential Outcome from Cover Cropping or No-till	Mean likelihood rating* (1=extremely unlikely,…, 5= extremely likely)	
	User	Non-User
Cover Cropping		
Increase farm profits	3.45[a]	3.42[a]
Increase average cotton yields	3.81[a]	3.56[a]
Reduce soil erosion	4.54[a]	4.52[a]
Increase risk associated with cotton production	2.18[a]	2.52[a]
Improve organic matter in the soil	4.27[a]	4.36[b]
Reduce CO_2 losses from the soil	3.82[a]	3.69[a]
Interfere with obtaining crop insurance	1.60[a]	1.88[a]
Interfere with off-farm activities	1.64[a]	2.12[b]
Increase complexity of farming operation	3.45[a]	3.00[a]
Improve water holding capacity of the soil	4.18[a]	3.84[a]
No-Till		
Increase farm profits	3.42[a]	3.45[a]
Increase average cotton yields	3.64[b]	3.54[a]
Reduce soil erosion	4.50[a]	4.07[a]
Increase risk associated with cotton production	2.57[a]	2.30[a]
Improve organic matter in the soil	4.28[a]	4.11[a]
Reduce CO_2 losses from the soil	3.25[a]	3.28[a]
Interfere with obtaining crop insurance	1.64[a]	1.84[a]
Interfere with off-farm activities	1.50[a]	2.03[b]
Increase complexity of farming operation	3.23[a]	2.53[a]
Improve water holding capacity of the soil	1.85[a]	2.15[a]

* A letter difference between practices for the same potential outcome indicates a difference at the 0.05 level.

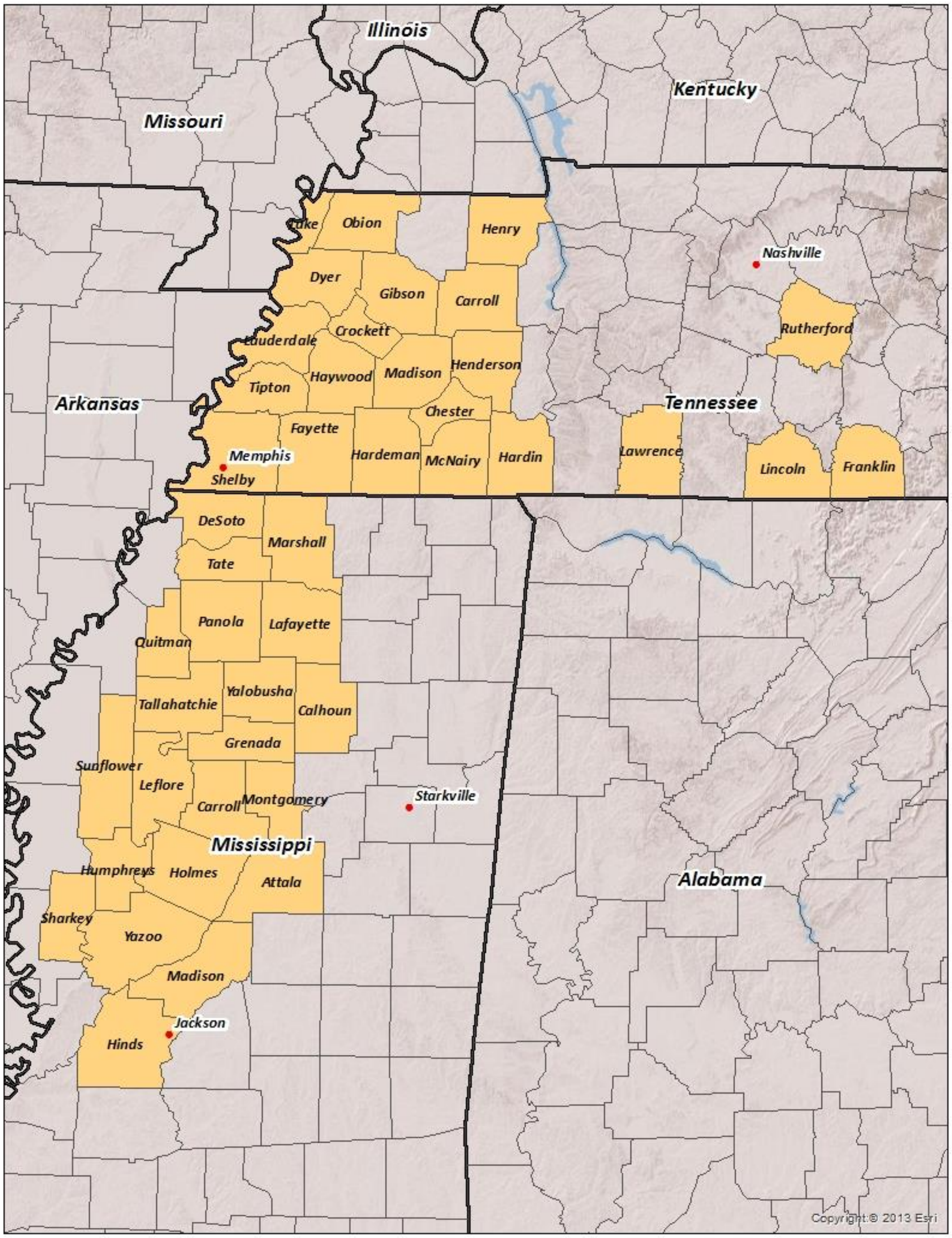

Figure 1. Tennessee and Mississippi counties included in the survey