Why Don't Farmers Adopt Precision Farming Technologies in Cotton Production?

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Abstract

We used the 2009 Southern Cotton Precision Farming Survey data collected from farmers in twelve U.S. states (Alabama, Arkansas, Florida, Georgia, Louisiana, Missouri, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia) to understand why farmers do not adopt seemingly profitable precision farming technology. Farmers provided cost, time constraint, satisfaction with the current practice and other as reasons for not adopting precision farming technology. Results from a multinomial logit regression model indicated that manure application on field, more formal education, larger farm size, participation in conservation easement or agricultural easement generally decreases the probability of nonadoption of precision agriculture in cotton production.

Keywords: precision agriculture, technology adoption, multinomial logit
JEL classification: C25, Q16

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Precision farming is generally defined as a method capable of helping farmers to apply the right amounts of inputs, on right place, and at right time. Since its inception in mid 1980s, precision farming related technologies have been a common and growing occurrence in cereal production. In cotton production, as our recent survey of farmers in twelve cotton growing states revealed, the adoption rate is only around 34%. This finding is surprising because precision farming technologies are generally touted to have both increased profit and environmental quality benefits. Armed with this information, we attempt to identify why cotton farmers are reluctant to adopt this potentially beneficial farming technology.

Economic theory says that as long as an individual believes that benefits from adopting a technology exceed costs, the technology gets adopted. General understanding of perception of farmers reveal that farmers adopt a technology if it is in their best interest to adopt the technology. Farmers also have tendency to reject a technology at the beginning phase consistent with the typical technology adoption curve (only 2.5% farmers are innovative farmers). Answering to questions on why farmers do not adopt technology, Yapa and Mayfield (1978) state that lack of sufficient information, lack of favorable attitude, lack of economic means to acquire technology and lack of physical availability of technology are the major cause behind nonadoption. Nowak (1992) provides the reasons for being unable or unwilling to adopt a conservation technology. He indicates that farmers unable to adopt conservation technology because of lack of information, complexity of the system, high labor requirements, planning horizon for the technology to be profitable seem too far in the future, availability and inadequate managerial skill, lack of accessibility of supporting resources. For the reasons behind unwilling to adopt, Nowak provides information conflict, poor applicability and relevance of information, conflict between current production goals and the new technology, ignorance on the part of the farmers, practice is inappropriate for the physical setting, practice increases risk of negative outcomes, belief in traditional practices. Gillespie et al. (2007) indicated that unfamiliarity, non-applicability, high cost are some of the reasons why seemingly beneficial technologies do not get adopted by farmers. Saha et al. (1994) indicate that as long as information level on technology is above the threshold level, farmers would consider adopting a technology. Feder et al. (1985) highlight among other things the role information on producers' decision making process to adopt a new technology.

There lacks a study on nonadoption of cotton precision farming technologies although this topic deserves a close attention given the fact that cotton is number one value added crop in the U.S. Additionally, behavioral characteristics of nonadopters could be very different than the characteristics of adopters. Knowing the answer to the question on why farmers do not adopt precision farming technologies can be helpful to formulate effective policies so that adoption rate can be increased. Our objective is to identify variables important in determining the nonadoption of precision farming technologies by U.S. cotton farmers.

Method

We posit the same idea as Gillespie (2007) to describe why cotton farmers do not adopt a new technology. Suppose a cotton producer's utility function for a given technology is given as

$$U = U(\text{attitude, profit, willingness}, z). \qquad (1)$$

Here ‘attitude’ indicates cotton farmers’ attitude toward precision farming technology, profit indicates perceived profit from adopting precision farming technology, ‘willingness’ indicates cotton farmer’s willingness to adopt a technology and Z indicates vector of socio-demographic variables. Positive attitude about precision farming leads to its adoption which is a condition $U^{k+a} > U^{a}$. Here, U^{a} indicates initial attitude about the technology. As a technology is favored U^{k+a} becomes greater than initial level of attitude toward a technology, with k+a>a.

Similarly, from profit perspective, technology is adopted if $Profit|_{t=1} > Profit|_{t=0.}$ Here t=1 means cotton farmers adopts a technology and t=0 means farmers do not adopt a technology. Suppose cotton farmers provided four different reasons on why s/he is not adopting precision farming technology. Suppose we compare their behavior with the behavior of farmers who adopted the technology. Using a multinomial logit model, probability of choosing j (adopting/not adopting for various reasons) by farmer i can be presented as:

$$Prob(Y_i = j) = \frac{e^{\beta_j x_i}}{\sum_{k=1}^{5} e^{\beta_k X_i}} \quad \text{j=1, 2, 3,...., 5}$$

Here x is the vector of characteristics of farmers and β are the parameters associated with these characteristics. Choices examined were 1. Yes, I have adopted the technology, 2. No, I do not adopt the technology for cost reason, 3. No, I do not adopt the technology because I am satisfied with the existing technology, 4. No. I do not adopt the technology because I do not have time to adopt the technology, 5. No. I do not adopt the technology for other reasons. We estimated the model coefficients, marginal effects and elasticities of variables associated with each choice. We tested for the independence of irrelevant alternatives using the Hausman’s specification test.

Data and Variables

We used recently collected data to identify the variables behind nonadoption of precision farming technologies in cotton production. The data come from the 2009 Southern Cotton Precision Farming Survey conducted on farmers in twelve U.S. states (Alabama, Arkansas, Florida, Georgia, Louisiana, Missouri, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia). Survey method suggested by (Dillman, 1978) was used to collect information about precision farming technologies adoption. The mailing list of potential cotton farmers for the year 2007-08 marketing year was obtained from the Cotton Board in Memphis, Tennessee (Mooney et al., 2010). The survey was mailed in February 2009. Of the 14089 questionnaires mailed, 306 were returned undeliverable, 204 respondents were no longer cotton farmers, and 1,692 respondents provided usable information for a response rate of percent. The survey response rate of 12.5% for the twelve-state region was considered as the number of valid responses for this analysis. We tested for a nonresponse bias and found it to be nonsignificant in our data.

There were four choices provided to farmers on why they decided to not adopt the technologies. Those reasons provided were i. Cost, ii. No time to adopt, iii. Satisfied with the current practice, and iv. Other. We found that 34% farmers (478 farmers) have adopted and 66% farmers (924 farmers) have not adopted cotton precision farming technologies. Among the reasons provided for nonadoption, cost was given as a reason by 46% of nonadopters, no time to adopt as a reason by 3% of nonadopters, satisfied with the current practice as a reason by 41% nonadopters and other unspecified reasons by 10% nonadopters. Table 1 and Figure 1 provide details related to these choices.

The variables to explain the adoption/nonadoption pattern are based on human capital theory, farm and production characteristics, and other variables used in adoption literature. Education and farming experience are measures of human capital that reflect the ability to innovate ideas. We expect that human capital has positive influence in the decision to adopt a new technology. Previous studies (Paxton et al., 2010; Roberts et al., 2004; Velandia et al., 2010; Walton et al., 2010) have shown that age, income, farming experience are widely accepted human capital variable that affect adoption decisions. Most of these studies have shown that age has negative influence on technology adoption (Soule et al., 2000). Young farmers are educated and willing to innovate and adopt new technologies that reduce time spent on farming (Mishra et al., 2002). Therefore, education and farming experience positively influence technology adoption because farmers with those attribute are exposed to more ideas and have more experience making decisions and effectively using the information (Caswell et al., 2001).

Farm characteristics are important variable for understanding a farmer's decision to adopt (Prokopy et al., 2008). If a farmer perceives that the adoption of technology would be profitable prior to making decision, he will be likely to adopt precision agriculture (Napier et al., 2000; Roberts et al., 2004). We also use financial and location variables as reasons for precision agriculture technology adoption.

University publications are helpful to cotton producer to obtain precision farming information. Extension services convey information about university research and publication that help farmers to make informed decision which can influence profitability (Hall et al., 2003).

Producers tend to use multiple sources of information to increase their knowledge about precision agriculture (Velandia et al., 2010). Therefore, information is expected to be positively related to technology adoption because exposure to knowledge about precision agriculture leads some farmers to adopt new technology (Rogers, 2003).

Farmers with larger farms or higher yields are more likely to believe they will observe positive externalities associated with precision farming (Larkin, 2005). In addition, Larkin (2005) found that farmers who found precision farming profitable or who believed input reduction was important had higher probabilities of adopting precision farming technologies. Farmers with larger farms and higher than average county yield were more likely to adopt precision technology (Banerjee et al., 2008). Computer is essential to keep financial record and to find information about use of precision agriculture. It has been found that farmers who kept computerized financial records were more likely to be successful (Mishra et al., 1999).

Use of excessive chemical fertilizer could leach or runoff causing water pollution. Thus, use of manure could be an important factor in choice of precision technology that reduces water pollution. If a farmer perceives that fertilizer efficiency can be increased by adopting precision farming technologies, he would do so (Torbett et al., 2007).

An agricultural easement is a legal agreement limiting the use of land to predominantly agricultural use, so landowners who sign for agricultural easement agree to use the land only for agricultural purposes and permanently relinquishes the right to develop the land for non-agricultural activities (Brinkman, 2011). Hence, the main propose of agricultural easement is to maintain agricultural areas by preserving good agricultural soils under intermediate development pressure. We expect that agricultural easement has negative effect on technology adoption because landowner receives payment for the development value of the land, and they care more about environment than profit.

Farmers owning irrigated land may benefit having precision farming technology. Knowledge of soil moisture variability in the field is helpful in reducing irrigation cost. McBratney et al. (2005) suggest beneficial role of precision farming in managing irrigation water. Paxton et al. (2010) studied the role of spatial yield variability on the number of precision farming technology adopted. They found that more within-field yield variability causes farmers to adopt precision farming technology.

Although these studies provide some reasons for the adoption of precision farming technologies, there could be other possible variables affecting farmers' decision making process. Many farmers are uncertain to use available technology due to environmental regulations, public concern, and economic gains from reduced inputs and improved managements, and hence these factors determine success of precision farming (Zhang et al., 2002).

Table 2 provides definitions and summary statistics for the variables used in empirical model. Summary statistics show that the average age of cotton farmers in the twelve states is 53.8 years. Cotton farmers have an average of 14 year of schooling and 31.5 years of farming experience. Seventy two percentages of household income come from cotton farming. Additionally, 77% percent of cotton farmers thought precision agriculture would be profitable in the future. Almost 75% farmers use computer for their farm management.

Results and Conclusions

We used a multinomial logit model to analyze the impact of exogenous variables on nonadoption. We assumed that the response depends upon characteristics of individual cotton producer. Before running the model, we tested for the IIA assumption using the Hausman test (See Table 3). It was found that the IIA assumption holds for our data. Additionally, our analysis also indicated that multicollinearity is not a problem among the explanatory variables included in the model. We also did not find any explanatory variables included in the model as an endogenous variable as indicated by Durbin-Wu-Hausman test statistics. We used "Yes, I have adopted" as the base category in the regression model.

Multinomial logit regression coefficients are presented in Table 4. These coefficients are interpreted based on their comparison to the base category. A positive coefficient means that as the explanatory variable increases, a farmer is more likely to choose alternative j than the base category "Yes, I have adopted precision farming technology."

Marginal effects are generally chosen to interpret compared to the regression coefficients of the model. These marginal effects do not give the same sign as the regression coefficients. We obtain the marginal effect on a choice of a change in explanatory variable evaluated at the sample mean of explanatory variables. Marginal effects are presented in Table 5. Only significant coefficients are interpreted here.

A unit increase in variables irrigation, education, university publication, agricultural easement, number of precision farming meeting attended, and states being Alabama, Arkansas, Georgia, Louisiana, North Carolina, South Carolina, Tennessee and Virginia decreases the probability of choosing cost as the reason for nonadoption than other choice categories. A A unit change from the perception of precision farming being not important to important increases the probability of choosing no time to adopt as the reason for nonadoption than other choice categories.

A unit increase in variables important, manure, farm size, agricultural easement conservation easement and states being Alabama, Arkansas, Florida Georgia, Louisiana, Mississippi, South Carolina and Virginia decreases the probability of choosing no time to adopt as the reason for nonadoption than other categories.

A unit increase in variables important, future adoption, computer, university publication, and state being Missouri decrease the probability of choosing satisfied with current practice as the reason for nonadoption than other categories. A unit change in variable manure and states being Florida, Missouri, South Carolina, Virginia decreases the probability of choosing "other reasons" as the reason for nonadoption than other categories.

Variable important has positive effect on the choice of "no time to adopt" as a reason for nonadoption but negative effect on the choice of "satisfied with current practice" as a reason for no adoption. As a proportion of irrigated area increases by one percent, the probability of choosing cost as a reason for no adoption decreases by 0.1392 than other categories.

Marginal effects of variables affecting the adoption of precision farming technologies are also presented in the Table 5. Those who stated precision farming is important for farmers, those who apply manure on the field, those who use university publication, those who are participating in a conservation easement program and those who attend more number of precision farming related meetings have higher probability of adopting precision farming in cotton production. Similarly, farmers from Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia are more likely to adopt precision farming in cotton production.

Disaggregated direct elasticities of continuous variables based on the multinomial logit regression are presented in Table 6. One percent increase in irrigation area decreases the choice of cost being the reasons for nonadoption of precision agriculture by 0.18%. One percent increase in the number of years in education attainment reduces the choice of cost being the reasons for nonadoption by 1.41%. Interestingly, one percent increase in the number of years in educational attainment has positive impact on the choice of no-time to adopt for precision agriculture by 9.51%. Similarly, spatial yield variability has positive impact on the choice of no-time to adopt as a reason for nonadoption of precision farming. The magnitude of this elasticity is 0.79%

If a policy is needed to be formulated so that cotton farmers adopt precision farming technologies, then perhaps we should target those farmers who say precision farming is important, those who apply manure on cotton field, those who are participating in conservation easement program and those who use university publication in farm-decision-making process. Of course, these are preliminary results which need to be carefully looked at before developing a definitive policy to increase adoption rate of precision farming technologies in cotton production.

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Table 1: Frequency of adoption and reasons for non-adoption

Reasons	Adopted	Not Adopted
	478	
Cost		429
No time to adopt		27
Satisfied with current practice		375
Other		93
Total	478	924

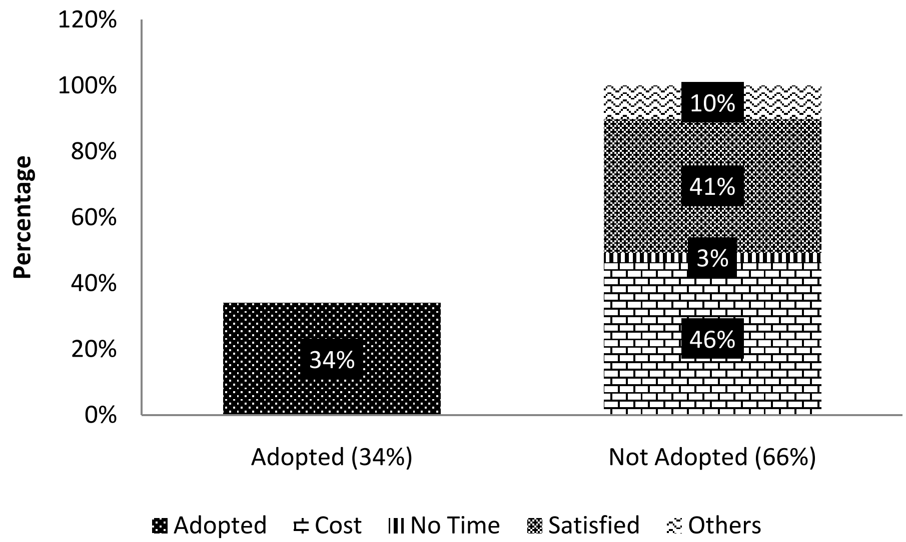

Table 2: Hausman tests of IIA assumption (N=517)

Omitted Dependent variable category	Chi-square	df	P-value	Evidence
2	7.011	11	0.79	for Ho
3	0	6	1	for Ho
4	0	18	1	for Ho
5	0	15	1	for Ho
1	0	19	1	for Ho

Chi-square = Chi-square with 2 degree of freedom
df = degree of freedom
Ho= Null hypothesis

Table 3: Definition of variables and summary statistics

Variable	Definition	Obs.	Mean	Std. dev
Reasons*	Important reasons for not- practicing precision farming	1402	2.4123	1.3633
Important	=1 If precision farming is important for farmers	1584	0.8687	0.3378
Irrigation	Irrigated cotton acres	1688	0.2190	0.5012
Manure	=1 if manure apply on fields	1675	0.1827	0.3865
Age	Age of farm operator (years)	1609	53.8210	12.6509
Education	Formal education of farm operators (years)	1541	14.1908	2.5229
Experience	Farming experience (years)	1594	31.5270	13.5086
Farm size	Farm size (,000 acres)	1681	1.0620	1.3754
Computer	=1 if farmers use computer for farm management	1614	0.5440	0.4982
Future Adoption	Plan to adopt precision farming in future (years)	1632	3.7518	1.5516
University Publication	1= if reads university publications	1584	0.3542	0.4784
Farm income	Percentage of farm income in total household income	1567	72.7294	29.0846
Agricultural Easement	=1 if the farm currently have agricultural easement	996	0.1386	0.3457
Spatial yield variability	Spatial yield variability	1167	37.2461	23.3562
Conservation Easement	=1 if the farm currently have conservation easement	1145	0.1904	0.3928
Number of PF meeting	Number of attendance in precision farming related meeting	1519	0.9631	14.7895
Alabama	Dummy variable, = 1 if state is Alabama	1692	0.0626	0.2424
Arkansas	Dummy variable, = 1 if state is Arkansas	1692	0.0372	0.1894
Florida	Dummy variable, = 1 if state is Florida	1692	0.0160	0.1253
Georgia	Dummy variable, = 1 if state is Georgia	1692	0.0999	0.2999
Louisiana	Dummy variable, = 1 if state is Louisiana	1692	0.0420	0.2006
Missouri	Dummy variable, = 1 if state is Missouri	1692	0.0201	0.1404
Mississippi	Dummy variable, = 1 if state is Mississippi	1692	0.0757	0.2645
Texas	Dummy variable, = 1 if state is Texas	1692	0.0626	0.2424
North Carolina	Dummy variable, = 1 if state is North Carolina	1692	0.0999	0.2999
South Carolina	Dummy variable, = 1 if state is South Carolina	1692	0.0284	0.1661
Tennessee	Dummy variable, = 1 if state is Tennessee	1692	0.0621	0.2413
Virginia	Dummy variable, = 1 if state is Virginia	1692	0.0136	0.1158

* 1 = Adopted, 2 = Cost, 3= No Time to Adopt, 4 = Satisfied with current practice, 5= Other

Table 4: Parameter estimates of factors associated with non-adoption of precision farming by cotton farmers.

Variable	Cost	No Time to Adopt	Satisfied with current practice	Other
Important	-1.3687**	13.2358***	-2.1079***	-1.4372*
	(0.014)	(0.000)	(0.000)	(0.057)
Irrigation	-1.0266**	-1.3721	-0.3197	-0.2478
	(0.010)	(0.514)	(0.404)	(0.838)
Manure	-0.6097*	-15.5015***	-0.6577*	-1.8803*
	(0.089)	(0.000)	(0.057)	(0.082)
Age	0.0139	0.0102	0.0171	0.0419
	(0.553)	(0.861)	(0.510)	(0.237)
Education	-0.1566**	0.5820**	-0.1197	-0.0408
	(0.033)	(0.028)	(0.140)	(0.697)
Experience	-0.0107	-0.0660	0.0074	-0.0231
	(0.633)	(0.348)	(0.755)	(0.476)
Farm size	-0.3488**	-1.8009**	-0.1863	-0.2752
	(0.034)	(0.041)	(0.327)	(0.229)
Computer	-0.2831	-1.0246	-0.6765**	-0.5768
	(0.333)	(0.369)	(0.026)	(0.218)
Future Adoption	-0.1255	-0.1250	-0.2111**	0.1273
	(0.172)	(0.572)	(0.029)	(0.453)
University Publication	-0.7532***	1.4742	-0.9822***	-0.1280
	(0.007)	(0.315)	(0.001)	(0.808)
Farm income (%)	-0.0054	0.0005	0.0009	-0.0116
	(0.277)	(0.974)	(0.870)	(0.193)
Agricultural Easement	0.0738	-15.8652***	1.1724**	0.9801
	(0.899)	(0.000)	(0.011)	(0.224)
Spatial yield variability	0.0045	0.0229***	-0.0028	-0.0017
	(0.401)	(0.009)	(0.644)	(0.886)
Conservation Easement	-0.7014	-13.1287***	-0.9261**	-2.2412*
	(0.146)	(0.000)	(0.015)	(0.041)
Number of PF meeting	-0.0232*	0.0122	-0.0140	-0.0261
	(0.096)	(0.877)	(0.360)	(0.127)
Alabama	-1.3687**	-18.9703***	-0.0765	0.6089
	(0.033)	(0.000)	(0.900)	(0.469)
Arkansas	-2.7675***	-15.0333***	-2.1962**	-0.2287
	(0.007)	(0.000)	(0.017)	(0.714)
Florida	-0.5119	-18.4815***	-1.2361	-16.8351***
	(0.554)	(0.000)	(0.197)	(0.000)

Table 4: Contd.

Variable	Cost	No Time to Adopt	Satisfied with current practice	Other
Georgia	-1.3223***	-17.0353***	-1.3183**	-1.0884
	(0.005)	(0.000)	(0.011)	(0.157)
Louisiana	-2.3045***	-16.9624***	-0.8873	-1.0394
	(0.006)	(0.000)	(0.215)	(0.369)
Missouri	0.2865	-16.0079***	-15.6499***	-15.6196***
	(0.775)	(0.000)	(0.000)	(0.000)
Mississippi	-1.1282**	-16.4915***	-1.1865**	-1.6735
	(0.019)	(0.000)	(0.013)	(0.108)
North Carolina	-1.4112**	-2.0136*	-1.0341**	-1.4211
	(0.001)	(0.082)	(0.019)	(0.125)
South Carolina	-1.9194**	-16.3585***	-0.6718	-15.9149***
	(0.015)	(0.000)	(0.319)	(0.000)
Tennessee	-2.2522***	-16.4106***	-2.0455**	-1.4364
	(0.001)	(0.000)	(0.020)	(0.206)
Virginia	-17.7819**	-15.9708***	-0.7295	-16.3617***
	(0.000)	(0.000)	(0.272)	(0.000)
Constant	5.7616***	-21.6917***	4.6675**	0.5598
	(0.001)	(0.000)	(0.008)	(0.794)

Table 5: Marginal effects associated with non-adoption of precision farming by cotton farmers.

Variable	Cost	No Time to Adopt	Satisfied with current practice	Other	Adopt
Important	-0.0326	0.0132**	-0.2271***	-0.0141	0.2605***
	(0.592)	(0.012)	(0.001)	-(0.680)	(0.000)
Irrigation	-0.1392**	-0.0081	0.0286	0.0084	0.1102*
	(0.014)	(0.694)	(0.544)	(0.863)	(0.064)
Manure	0.0329	-0.0143***	-0.0327	-0.0436**	0.1236**
	(0.592)	(0.006)	(0.432)	(0.022)	(0.013)
Age	0.0005	0.0000	0.0009	0.0014	-0.0029
	(0.865)	(0.976)	(0.743)	(0.294)	(0.402)
Education	-0.0198**	0.0064	-0.0069	0.0015	0.0186*
	(0.027)	(0.030)	(0.435)	(0.696)	(0.076)
Experience	-0.0017	-0.0006	0.0021	0.0009	0.0010
	(0.571)	(0.363)	(0.409)	(0.470)	(0.752)
Farm size	-0.0339	-0.0152*	0.0034	-0.0038	0.0495**
	(0.182)	(0.090)	(0.889)	(0.694)	(0.021)
Computer	0.0113	-0.0077	-0.0701*	-0.0130	0.0795*
	(0.780)	(0.540)	(0.064)	(0.542)	(0.065)
Future Adoption	-0.0080	-0.0004	-0.0227**	0.0102	0.0209*
	(0.518)	(0.838)	(0.044)	(0.178)	(0.099)
University Publication	-0.0719*	0.0234	-0.0914**	0.0170	0.1228***
	(0.078)	(0.179)	(0.013)	(0.524)	(0.002)
Farm income (%)	-0.0008	0.0000	0.0006	-0.0005	0.0006
	(0.238)	(0.815)	(0.337)	(0.223)	(0.427)
Agricultural Easement	-0.083***	-0.0133***	0.1682**	0.0298	-0.1016
	-(0.273)	(0.003)	(0.023)	(0.525)	(0.108)
Spatial yield variability	0.0009	0.0002	-0.0007	-0.0001	-0.0002
	(0.247)	(0.040)	(0.332)	(0.812)	(0.760)
Conservation Easement	-0.0310	-0.0122***	-0.0592	-0.0483	0.1506*
	(0.657)	(0.007)	(0.183)	(0.006)	(0.011)
Number of PF meeting	-0.0026*	0.0003	-0.0001	-0.0007	0.0031
	(0.080)	(0.737)	(0.929)	(0.214)	(0.161)
Alabama	-0.1779***	-0.0180***	0.0529	0.0618	0.0812
	(0.000)	(0.001)	(0.481)	(0.288)	(0.339)
Arkansas	-0.2195***	-0.0120***	-0.1347	0.0594	0.3067***
	(0.000)	(0.007)	(0.028)	(0.200)	(0.000)
Florida	0.0169	-0.0132***	-0.0960	-0.0532***	0.1456
	(0.883)	(0.003)	(0.183)	(0.000)	(0.236)

Table 5: Contd.

Variable	Cost	No Time to Adopt	Satisfied with current practice	Other	Adopt
Georgia	-0.1039**	-0.0167**	-0.0779	-0.013	0.2114***
	(0.037)	(0.039)	(0.103)	(0.614)	(0.001)
Louisiana	-0.2113***	-0.0135***	-0.0004	-0.0101	0.2352***
	(0.000)	(0.005)	(0.996)	(0.814)	(0.006)
Missouri	0.2039	-0.0123***	-0.2192***	-0.0530***	0.0806
	(0.185)	(0.006)	(0.000)	(0.000)	(0.606)
Mississippi	-0.0808	-0.0139***	-0.0691	-0.0324	0.1961***
	(0.155)	(0.004)	(0.142)	(0.170)	(0.001)
North Carolina	-0.1299**	-0.0097	-0.0383	-0.0256	0.2034***
	(0.005)	(0.178)	(0.415)	(0.316)	(0.000)
South Carolina	-0.1822***	-0.0124***	0.0306	-0.0533***	0.2172**
	(0.004)	(0.006)	(0.722)	(0.000)	(0.011)
Tennessee	-0.1828***	-0.0127	-0.1185*	-0.0135	0.3273***
	(0.001)	(0.007)	(0.075)	(0.724)	(0.000)
Virginia	-0.2779***	-0.0118***	0.0653	-0.0527***	0.2771***
	(0.000)	(0.007)	(0.428)	(0.000)	(0.001)

Table 6: Elasticity of factors (only continuous variables) associated with non-adoption of precision farming by cotton farmers.

Variable	Cost	No Time to Adopt	Satisfied with current practice	Other
Irrigation	-0.1823*	-0.2594	-0.0246	-0.0085
	(0.010)	(0.578)	(0.712)	(0.973)
Age	0.1942	-0.0003	0.3641	1.6707
	(0.787)	(1.000)	(0.670)	(0.282)
Education	-1.4187*	9.5152*	-0.8725	0.2952
	(0.027)	(0.012)	(0.265)	(0.820)
Experience	-0.2401	-1.9388	0.3174	-0.6195
	(0.555)	(0.358)	(0.477)	(0.466)
Farm size	-0.2751	-2.0056	-0.0815	-0.1874
	(0.076)	(0.054)	(0.650)	(0.462)
Farm income (%)	-0.2650	0.1571	0.1869	-0.7133
	(0.236)	(0.883)	(0.487)	(0.213)
Spatial yield variability	0.1278	0.7982*	-0.1395	-0.0994
	(0.275)	(0.006)	(0.366)	(0.802)

Note: Probability value for the significance of the parameters is shown in parentheses.