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Abstract: Cotton farmers in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North and South Carolina, Tennessee, and Virginia were asked where they obtained information about precision farming. Farmers use Extension as a source of precision farming information, but in combination with other sources, including media, crop consultants, trade shows, and other farmers. Farmers using Extension as a source of information tend to be younger, with more education and higher incomes, compared to producers not seeking information from Extension. Understanding the profiles of producers using Extension resources for precision farming information may help Extension design programs to improve information delivery to clients.

Introduction

Farmers using precision agriculture technologies may decrease variable costs, increase profits, and moderate environmental risks by not applying more inputs than needed (Bullock, Lowenberg-DeBoer, & Swinton, 2002; Bongiovanni & Lowenberg-DeBoer, 2004; Roberts, English, & Larson, 2002; Watson, Segarra, Lascano, Bronson, & Schubert, 2005; Torbett, Roberts, Larson, & English, 2007). Given the potential economic and environmental benefits from some precision farming practices, effective dissemination of precision agriculture information by Extension appears justified. Extension plays an important role in the diffusion of information to help individuals make informed decisions that influence profitability (Hall, Dunkelberger, Ferreira, Prevatt, & Martin, 2003). Therefore, Extension is positioned to provide information to farmers about the costs, benefits, and use of precision agriculture technologies and about how these practices can be integrated into whole farm management plans.

Demand for information about technologies to manage agricultural production systems increased with the advent of yield monitors and global positioning systems and improvements in computing power and data management (Schnitkey, Batte, Jones, & Botomogno, 1992; Swinton & Lowenberg-DeBoer, 1998; Griffin, Lowenberg-DeBoer, Lambert, Peone, Payne, & Daberkow, 2004). However, with the decline in Extension resources over recent years (Aguilar & Thornsbury, 2005; Diem, 2002; Smith & Swisher, 1986), other information providers such as crop consultants, farm dealers, trade shows, media, and other farmers are important complements for Extension and its ability to meet farmer demand for precision farming information (Just, Wolf, Wu, & Zilberman, 2002; Schnitkey et al., 1992). Farmers may choose to use a single information source, but, more likely, producers will combine various sources of information to make farm business decisions.

The study reported here examined which sources of information farmers use to obtain precision farming information and evaluated how they make decisions about the use of each source of information. We focused on complementary use of Extension and other information sources, comparing the profiles of farmers using Extension as a single source of precision agriculture information, or in combination with other information sources, including private consultants or farm dealerships, electronic media, or other farmers. Understanding the farm business and operator characteristics of precision farming information consumers and the sources of information they use to learn about precision agriculture can provide Extension with better knowledge about clientele demand for precision agriculture information. Such knowledge may motivate innovative approaches to effectively coordinate, package and deliver precision agriculture information through a variety of channels.

Methods

A survey was mailed in January, 2005, to 12,243 cotton farmers in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North and South Carolina, Tennessee, and Virginia. Of the questionnaires mailed, 200 were returned undeliverable or by farmers no longer producing cotton. In total, 1,214 surveys were suitable for analysis (10% response rate).

The survey captured general demographic characteristics, including year born, highest level of education completed, number of years spent in farming, percentage of income derived from agriculture, number of acres farmed (owned versus rented), and percentage of taxable household income derived from farming. Additionally, the questionnaire asked farmers about the precision farming technologies used on their farms and the resources used to obtain precision farming information. Additional details of the survey are found in Roberts et al. (2002) and Walton, Lambert, Roberts, Larson, English, Larkin, Martin, Marra, Paxton, and Reeves (2008).

The information sources were divided into four groups: private (crop consultants, farm dealers, trade shows), Extension, other farmers, and media. Frequencies of information sources used by respondents were enumerated based on whether the respondent reported using Extension, other farmers, private consultants or farm dealerships, media, or combinations of these sources for information about precision agriculture. Of particular interest were (1) producers who used Extension alone or in combination with other information sources (Extension Users) and (2) respondents who did not use Extension, but used one or a combination of other information sources (Non-Users). For both groups, there were eight possible combinations of information sources (Table 1). The farm business and operator characteristics of Extension Users and Non-Users were compared using independent samples t-test.

Results

About 65% of producers used Extension either solely or in combination with other information sources. Only 2.6% of the total farmers surveyed used Extension as the only source of precision farming information. About 75% of the Extension users combined information from Extension with media sources, crop consultants, farm dealers, and other farmers.

Table 1.
Survey Question: Where Did You Get Your Precision Farming Information?

Information Source Combinations[a]	**Number of Farmers**	**Percentage**
(1) Used only Extension sources	31	2.55
(2) Used private and Extension sources	37	3.05
(3) Used Extension and other farmer sources	17	1.40
(4) Used Extension and media sources	17	1.40
(5) Used private, Extension, and other farmer sources	57	4.70
(6) Used private, Extension, and media sources	25	2.06

(7) Used Extension, other farmer, and media sources	18	1.48
(8) Used Extension, other farmer, media and private sources	596	49.09
Total Extension users	798	65.73
(9) Used none of the sources considered in the survey	203	16.72
(10) Used only private sources	43	3.54
(11) Used only other farmer sources	29	2.39
(12) Used only media sources	48	3.95
(13) Used private and other farmer sources	21	1.73
(14) Used private and media sources	33	2.72
(15) Used other farmer and media sources	15	1.24
(16) Used private, other farmer, and media sources	24	1.98
Total non-Extension users	416	34.27

Table 2 compares the farm business and operator characteristics of Extension and non-Extension users. Respondents using Extension, individually or in combination with other sources, are typically younger than farmers not using Extension. Producers who use Extension tend to have more years of education than those not using Extension. A larger percentage of farmers using Extension earn more than $150,000 than those who do not use Extension (35.82% and 30.45%, respectively).

The average farm size varies between the two groups, with Extension users operating larger farms than non-users. Additionally, Extension users rent more land to farm than non-users, as evidenced by the own-to-total operated acres ratio (31.80% and 35.43%, respectively).

Table 2.
Variable means for Extension Users and Non-Extension Users

Variable	**Extension Users**	**Non-Extension Users**
Average age of producers as of 2004 (in years)***	48.57	53.28
Proportion of farmers with a high school degree (%)	80	79
Proportion of farmers with an associate degree (%) ***	19	11
	37	29

Proportion of farmers with a bachelor's degree (%) ***		
Proportion of farmers with a graduate degree (%) **	9	5
Proportion of farmers with income higher than $150,000 (%)*	36	30
Average percent of income from farming (%)	73	71
Average farm size (in acres)***	1469.10	1151.67
Land tenure (owned acres divided by owned acres plus rented acres %) *	32	35
*, **, and *** represent statistical significance at 10%, 5%, and 1% levels, respectively.		

Summary and Discussion

Producers learning about precision farming tend to use multiple sources of information to increase their knowledge about precision agriculture. Extension is one of the main sources of information, but it appears that farmers combine Extension with other information sources. About 66% of producers used Extension, and about 75% of these users combined Extension with all the other information sources, including private consultants and farm dealerships, media, and other farmers.

Users of Extension tend to be younger, have larger farms, and rent a larger percentage of land than non-users of Extension. A higher percentage of Extension users have earned an Associate, Bachelor, or graduate degree and earn higher incomes than non-users. This is consistent with the demographic profile of producers who typically adopt precision agriculture technologies (Roberts et al., 2002; Walton et al., 2008)

Information suppliers (crop consultants, farm dealers, Extension educators and media information providers) may be able to tailor their services to clientele, based on the information provided in the study reported here. For example, because farmers tend to use Extension and private information sources simultaneously, Extension educators can tailor a more comprehensive training/outreach program for this target population in conjunction with crop consultants and/or farm dealers. This information might help to develop precision farming Extension programs that combine efforts with other sources of information to provide more effective precision farming information to consumers.

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