Promoting Climate-Smart Agricultural Technologies: Extension and Behavioral Intention

Chin-Ling Lee

Texas A&M Unversity
600 John Kimbrough Blvd
College Station, TX 77843-2116
cllee1261@tamu.edu

Dr. Robert Strong

Texas A&M Unversity
600 John Kimbrough Blvd
College Station, TX 77843-2116
r-strong@tamu.edu

Dr. Theresa P. Murphrey

Texas A&M Unversity
600 John Kimbrough Blvd
College Station, TX 77843-2116
t-murphrey@tamu.edu

Introduction/need for research

Priority 2 of the American Association for Agricultural Education's *National Research Agenda* called for inquiries to investigate new technology adoption decisions (Lindner et al., 2016). Adopting climate-smart agricultural (CSA) technologies provides one of the most important solutions to one of the global sustainable development goals (Lee et al., 2021). Challenges such as an aging agricultural workforce, extreme climates, and carbon storage threaten food security (Ganpat et al., 2016). Wolde et al. (2020) suggested the 2050 Food Challenge requires global scientific innovation focusing on sustainable agricultural practices that support the process of healthy dietary solutions for agriculture.

CSA technologies refer to the agricultural management adaptation solutions that can increase productivity, enhance resilience to climate stresses, and reduce greenhouse gas emissions (Senyolo et al., 2018). Adopting CSA technologies is necessary to adjust to (Balafoutis et al., 2017) extreme climates that can bring new pests and diseases (Sundström et al., 2014). Agricultural technologies need to be promoted by agricultural Extension and adopted by farmers to be effective (Rogers, 2003). The adoption of CSA technologies depends on farmers and the Extension dissemination of the innovation's advantages (Mikwamba et al., 2021; Wynn et al., 2013). Developing the capacity of Extension workers is a necessary part of improving services that meet the needs of farmers (Harder et al., 2013; Strong & Harder, 2011). Therefore, understanding the extent of Extension agents familiar with the given CSA definition and the factors determining Extension professionals' intention to promote CSA technologies can help reveal gaps in information dissemination and improve farmer adoption (Lee et al., 2021).

Theoretical Framework

This study explored agricultural Extension professionals' behavioral intention to promote CSA technologies in their extension programs by applying the unified theory of acceptance and use of technology (UTAUT) model by Venkatesh et al. (2003). The UTAUT helped to investigate the research objectives of this study, to examine whether performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating condition (FC) predict behavioral intention (BI) to promote CSA technologies. The following hypothesis was proposed to achieve the research objective: PE, EE, SI, and FC have an effect on the behavioral intention of Extension professionals to promote CSA technologies in their Extension program.

Methodology

A survey design was implemented with 308 agricultural Extension professionals in California. The online survey was developed in Qualtrics and administered via email to recruit participants. We followed Dillman et al.'s (2014) tailored design method for five steps for contacting participants and collecting data. The e-survey was distributed over a ten-day period and 33 responses were collected, resulting in a response rate of 10.7%. Construct validity was based upon prior literature and researchers' instrument assessment from Texas A&M University. We used the common statistical package SPSS 20 to analyze the survey data. The internal reliability was measured by Cronbach's (1951) alpha coefficients for all constructs, yielding coefficients of 1.00 for PE, .96 for EE, 1.00 for FC, and .96 for SI. Cronbach (1951) indicated that reliability coefficients of .80 or higher are acceptable. Multiple linear regression was used to analyze the data based on the research objectives.

Results/findings

The multiple linear regression analysis indicated the significance between behavioral intention and performance expectancy, effort expectancy, facilitating condition, and social influence were statistically significant $p < .05$ (see Table 1).

Table 1
Results of Multiple Linear Regression Analysis

Construct	Coefficient	Standardized Coefficient	95 % Confidence Interval	t-value	p-value
Constant	1.105		.491-1.720	3.684	.00*
PE	.378	.493	.198-.558	4.300	.00*
EE	-.232	-4.167	-.433- -.030	-2.357	.03*
FC	.417	.499	.215-.619	4.223	.00*
SI	.221	3.981	.020-.421	2.256	.03*

Note*. $p < .05$.

The regression model presented in this abstract provided a good fit ($p < .05$) for the data collected with an R^2 value of .74, and thus, explaining 74% of the variance on behavioral intention. The result also showed that 27 out of 32 participants ($n = 27$, 84.38%) agreed with the definition of CSA technologies that we provided in the survey. However, the percentage of participants who felt familiar with the definition was lower with a value of 65.63% ($n = 21$).

Conclusions

The relationship between behavioral intention and effort expectancy was negative, while the other three constructs had positive relationships with the behavioral intention. The finding suggests that the fewer barriers agricultural Extension professionals have to increasing their level of competence in CSA technologies, the more willing they are to promote these innovations. The percentage of participants who felt familiar with the definition of climate-smart agriculture technology was lower than the percentage who agreed with the definition, indicating a gap in the perception and practicality of CSA technologies among agricultural Extension workers.

Implications/recommendations/impact on profession

Extension professionals are more likely to promote CSA technologies when it is easy for them to gain competencies of the technology (Lee et al., 2021). Communicating CSA's effort expectancy (Venkatesh et al., 2003) and low complexity (Rogers, 2003) should be included in agricultural extension professionals' development to improve CSA adoption. Four variables moderate the outcome of behavioral intentions (Venkatesh et al., 2003). Research should continue to collect farmers' survey and experimental data to investigate further whether the moderating variables affect the adoption model produced in this California Extension study. California Extension workers need professional development from agricultural program leaders and the program development unit in performance expectancy, effort expectancy, facilitating conditions, and social influence as each variable forecasted behavioral intention to promote CSAs for farmer adoption. Extension educators should revisit the definition of CSA to close the gap in understanding of CSA promotion and adoption among agricultural Extension workers.

References

Balafoutis, A., Beck, B., Fountas, S., Vangeyte, J., Wal, T. V. d., Soto, I., Gómez-Barbero, M., Barnes, A., & Eory, V. (2017). Precision agriculture technologies positively contributing to GHG emissions mitigation, farm productivity and economics. *Sustainability, 9*(8), 1–28. https://doi.org/10.3390/su9081339

Cronbach, L. J. (1951). Coefficient Alpha and the internal structure of tests. *Psychometrika*, *16*, 297–334. https://doi.org/10.1007/BF02310555

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys : The tailored design method* (4th ed.). John Wiley & Sons, Incorporated.

Ganpat, W. G., Ramjattan, J., & Strong, R. (2016). Factors influencing self-efficacy and adoption of ICT dissemination tools by new extension officers *Journal of International Agricultural and Extension Education, 23*(1), 1–13. https://doi.org/10.5191/jiaee.2016.23106

Harder, A., Ganpat, W., Moore, A., Strong, R., & Lindner, J. R. (2013). An assessment of extension officers' self-perceived programming competencies in selected Caribbean countries. *Journal of International Agricultural and Extension Education*, *20*(1), 33–46. https://doi.org/10.5191/jiaee.2013.20103

Lee, C.-L., Strong, R., & Dooley, K. (2021). Analyzing precision agriculture adoption across the globe: A systematic review of scholarship from 1999–2020. *Sustainability, 13*, 1–15. https://doi.org/10.3390/su131810295

Lindner, J. R., Rodriguez, M. T., Strong, R., Jones, D., & Layfield, D. (2016). Research priority area 2: New technologies, practices, and products adoption decisions. In Roberts, T. G., Harder, A., & Brashears, M. T. (Eds). *American Association for Agricultural Education national research agenda: 2016-2020*. Gainesville, FL: Department of Agricultural Education and Communication.

Mikwamba, K., Dessein, J., Kambewa, D., Messely, L. & Strong, R. (2021). Collaborative governance dynamics in innovation platforms: Case of Malawi's District Stakeholder Panel. *The Journal of Agricultural Education and Extension, 27*(2), 255–275. https://doi.org/10.1080/1389224X.2020.1844767

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Senyolo, M. P., Long, T. B., Blok, V., & Omta, O. (2018). How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural innovations in South Africa. *Journal of Cleaner Production, 172,* 3825–3840. https://doi.org/10.1016/j.jclepro.2017.06.019

Strong, R., & Harder, A. (2011). Recommended competencies needed for teaching in international extension settings. *Journal of International Agricultural and Extension Education*, *18*(3), 71-82. https://doi.org/10.5191/jiaee.2011.18306

Sundström, J. F., Albihn, A., Boqvist, S., Ljungvall, K., Marstorp, H., Martiin, C., Nyberg, K., Vågsholm, I., Yuen, J., & Magnusson, U. (2014). Future threats to agricultural food production posed by environmental degradation, climate change, and animal and plant diseases – a risk analysis in three economic and climate settings. *Food Security, 6*(2), 201–2015. https://doi.org/10.1007/s12571-014-0331-y

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Wolde, Z., Wei, W., Kunpeng, W., & Ketema, H. (2020). Local community perceptions toward livelihood and water–energy–food nexus: A perspective on food security. *Food and Energy Security, 9*(3), 1–15. https://doi.org/10.1002/fes3.207

Wynn, J. T., Coppedge, R. H., & Strong, R. (2013). Future IPM trends in Trinidad and Tobago: A qualitative study of farmers' perspectives. *Journal of International Agricultural and Extension Education, 20*(2), 65–76. https://doi.org/10.5191/jiaee.2013.20205