Research

Is Cooperative Extension Prepared to Promote Precision Agriculture Technologies?

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Introduction/need for research

Investigating stakeholders' adoption decisions of innovative technologies is the second priority of the American Association for Agricultural Education's *National Research Agenda* (Lindner et al., 2016). Digital transformation has created opportunities for the provision of smart farming tools. While much work remains to be done in smart agriculture, the need for farmers to adopt smart agricultural technologies has been increasing (Monteiro et al., 2021). The promotion of precision farming technologies and increasing their adoption rates will be indispensable for the sustainable development of global agriculture (Bhakta, 2019).

The capacity of precision agriculture Extension professionals is an important part of improving the quality of Extension services to meet farmers' needs (Mikwamba et al., 2021). Farmers may not adopt technology due to Extension professionals' lack of communication of precision agriculture technologies (Lee et al., 2021). Understanding the predictors that can increase the likelihood of Extension professionals promoting precision farming will simultaneously enhance food security and contribute to global Sustainable Development Goals (Seitz et al., 2022).

Theoretical framework

We used the unified theory on the acceptance and use of technology (UTAUT) model (Venkatesh et al., 2003) and Bandura's (1993) theory of self-efficacy in our study. Performance expectancy is the degree to which using technologies improves an individual's performance. Effort expectancy is the perception of ease of use (Venkatesh et al., 2003). Social influence is the extent to which influential people believe that individuals should use technology. Facilitating conditions are the extent to which individuals believe that infrastructure exists to support technology usage. Self-efficacy is an individual's belief in one's ability to produce achievements (Bandura, 1993). The purpose was to assess the effect of self-efficacy, performance expectancy, effort expectancy, social influence, facilitating conditions, age, gender, and years of service on Extension professionals' behavioral intentions to promote precision agriculture technologies.

Methodology

We followed Dillman et al.'s (2014) survey design method of five steps for contacting participants and collecting data. Two hundred fifty-five (n = 255) of 507 Extension professionals responded to a survey with thirty-eight statements measuring six multi-item scales, resulting in a response rate of 50.3%. Criterion validity was assessed by agricultural education and crop sciences scholars. Internal consistency was measured by Cronbach's (1951) alpha coefficient for each construct, yielding coefficients of .93 for self-efficacy, .91 for performance expectancy, .89 for effort expectancy, .75 for facilitating conditions, .86 for social influence, and .95 for behavioral intention. Cronbach (1951) indicated that reliability coefficients of .70 or more are good. A Pearson correlation analysis examined the relationship between each of eight independent variables and behavioral intention. We also conducted multiple regression to investigate the effects of independent variables on behavioral intention.

Results/findings

Zero order correlations were calculated to examine relationships between the primary outcome variable (behavioral intention) and each of the possible predictor variables. A significant positive relationship existed between behavioral intention and performance expectancy (r = .72, p < .01) indicating a very strong correlation. Social influence (r = .64, p < .01), self-efficacy (r = .54, p < .01), and effort expectancy (r = .50, p < .01) had substantial correlations with behavioral intention. Facilitating conditions (r = .44, p < .01) was moderately correlated with behavioral intention.

All independent variables were entered into a regression equation to predict behavioral intention. The regression model explained 64% of the variance in behavioral intention (R^2 = .64, F(8, 177) = 37.62, p <.01). The results indicated performance expectancy, social influence, and facilitating conditions significantly (p <.01) predicted behavioral intention to promote precision agriculture technologies. On the other hand, self-efficacy (p = .52), effort expectancy (p = .74), age (p = .08), gender (p = .85), and years of service (p = .05) were not significant predictors of behavioral intention. A reduced regression equation was created using the three statistically significant predictors. Behavioral intention to promote precision agriculture technologies was equal to .45 intercept + .40 × performance expectancy + .32 × social influence + .15 × facilitating conditions, as predicted by Extension professionals.

Conclusions

The extent Extension professionals believed the technologies improve their performance, are adopted, and promoted by credible members in their social system, and if the physical and human infrastructure is provided by the system predicted professionals' precision agriculture promotions to stakeholders. The symbiosis of the technologies' positive attributes to the professional benefit of change agents' development predicted their promotion of climate-smart technologies to stakeholders. When Extension professionals perceive promoting precision agriculture as beneficial either to themselves or to others, faster behavioral change process may occur. The organizational and technical infrastructure supporting the use of technologies predicted Extension professionals' behavior to promote precision agriculture technologies.

Implications/recommendations/impact on profession

Strategic professional development initiatives would assist Extension professionals to learn the extent to which technologies improve job performance. Further, mentorship programs and professional associations should be utilized to foster the diffusion of precision agriculture technologies to mentees, and Extension organizations should invest in physical and human capital of the technologies to improve professionals' intention to promote precision agriculture (Venkatesh et al., 2003). It is necessary to strengthen Extension professionals' training in the promotion of precision agriculture technologies to achieve food security for all (Strong et al., 2022). Food insecurity cannot be reduced and agricultural land sustainability cannot be improved without competent professionals serving as change agents, translating agricultural technology research to stakeholders (Lee et al., 2021). The study produced a UTAUT illustration juxtaposed to Venkatesh et al. (2003), informing our profession (Lindner et al., 2016) that technology acceptance and adoption are more multidimensional than previously reported.

References

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117–148. https://doi.org/10.1207/s15326985ep2802_3

Bhakta, I., Phadikar, S., & Majumder, K. (2019). State-of-the-art technologies in precision agriculture: A systematic review. *Journal of the Science of Food and Agriculture*, *99*(11), 4878–4888. https://doi.org/10.1002/jsfa.9693

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.

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*(18), 10295. 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

Monteiro, A., Santos, S., & Goncalves P. (2021). Precision agriculture for crop and livestock farming–Brief review. *Animals, 11*(8), 1–18. https://doi.org/10.3390/ani11082345

Seitz, P., Strong, R., Hague, S., & Murphrey T. P. (2022). Evaluating agricultural extension agent's sustainable cotton land production competencies: Subject matter discrepancies restricting farmers' information adoption. *Land*, *11*(11), 2075. https://doi.org/10.3390/land11112075

Strong, R., Wynn II, J. T., Lindner, J. R., & Palmer, K. (2022). Evaluating Brazilian agriculturalists' IoT smart agriculture adoption barriers: Understanding stakeholder salience prior to launching an innovation. *Sensors, 22*(18), 6833. https://doi.org/10.3390/s22186833

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