Research

Tailoring Professional Development: A Needs Assessment of Georgia Extension Agents' Precision Agriculture Competencies

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Introduction and Need for Study

Precision agriculture (PA) technologies play a vital role in bracing agricultural production against climate impacts, and more widespread adoption of PA can improve global food security through more efficient resource use and increased agricultural productivity (Finger et al., 2019). PA technologies can be conceptualized into technologies that guide data collection (e.g., yield and soil monitors; sensors; drones), decision support (e.g., mapping), and input adjustment (e.g., variable rate applications) (McFadden et al., 2023). To meet global sustainable development goals, PA adoption levels worldwide, and particularly in agricultural economies, must increase (Pandey & Pandey, 2023). Georgia, despite its large agricultural economy, has fallen short of desired adoption levels (USDA-NASS, 2024). Therefore, diverse stakeholders in the region, including the federal government (McFadden et al., 2023), Cooperative Extension System (CES) (e.g., Clemson Cooperative Extension, 2024), and commodity associations (U.S. Cotton Trust Protocol, 2024), have worked to promote PA adoption. Farmers choose whether to adopt PA technologies based on several considerations, including socio-economic, technological, and environmental factors (John et al., 2023), and Extension agents are central to fostering adoption of PA technologies through knowledge transfer. However, for Extension agents to effectively promote PA to farmers, they require a specific set of competencies (Khan & Ray, 2023). Effective PA knowledge transfer hinges upon Extension agents' PA-related knowledge, skills, and abilities (KSAs) (Ayre et al., 2019), which determines their aptitude to assist farmers with PA needs. To date, these competencies have not been investigated in Georgia agents.

Theoretical Framework

This study utilized the Borich needs assessment approach, established to inform tailored interventions by illuminating the gap between the current state of a situation (i.e., what is) and the desired state (i.e., what should be) (Borich, 1980).

Purpose and Objectives

The purpose of this study was to understand how Cooperative Extension can ensure agents are equipped and prepared with the necessary competencies to facilitate PA knowledge transfer to farmers. We performed a needs assessment using 13 items identified in a previous Delphi study (Lee et al., 2024) to achieve the following objectives: 1) Describe the perceived importance of 13 PA competencies for Extension agents when engaging with farmers; 2) Describe the current state of organizational support for PA competency acquisition; 3) Explore tailored professional development (PD) strategies to address revealed gaps in competencies.

Methods

Using Borich's (1980) constructs, "what is" was operationalized as the current level of *organizational support* by CES for each competency, identified in a previous study (Lee et al., 2024). The "what should be" component was measured as how *important* each competency item was to assisting farmers with PA needs. Then, a mean-weight discrepancy score (MWDS) was calculated to quantify the gap between the two measures. A survey containing these competencies measured via a Likert scale was given to Georgia agriculture and natural resources Extension agents at their regional meetings (*n* = 84, *N* = 127). Data were analyzed in SPSS.

Findings

Table 1 represents the 13 previously identified competencies, their average level of *importance to farmers* and *organizational support*, and the MWDS between the two constructs. Larger MWDS indicated bigger gaps between comparison constructs.

Table 1

Averages and MWDS of 13 PA-related Competencies (n = 84)

Competency	Importance		Organizational Support		MWDS	
	M	*SD*	*M*	*SD*	*M*	*SD*
Equipment operation skill	3.92	1.032	3.63	1.021	1.181	4.77
Strategy execution	3.84	0.969	3.65	0.956	0.74	3.67
Problem-solving	4.01	1.012	3.83	0.992	0.716	4.04
Regional commodity knowledge	3.87	1.003	3.71	0.939	0.599	3.73
Data interpretation	3.49	1.167	3.5	1.059	-0.042	4.42
Collaboration	3.88	1.102	3.95	0.93	-0.277	3.8
Communication	3.75	1.171	3.85	0.963	-0.357	4.6
Facilitation	3.32	1.099	3.49	1.029	-0.526	3.81
Sustainability awareness	3.43	0.997	3.66	1.039	-0.785	3.44
Digital literacy	3.19	1.103	3.44	1.057	-0.798	3.53
Data collection and analysis	3.21	1.193	3.36	1.083	-0.803	3.55
Innovativeness	3.50	1.135	3.74	1.054	-0.833	3.87
Precision agriculture awareness	3.42	1.143	3.76	0.937	-1.168	3.85

Discussion, Conclusions, Implications, and Recommendations

Findings highlight a strong need for equipment operation skill development, notably ranked as the second most important competency. Knowing how to operate PA equipment, such as variable rate applications-related equipment, one of the most widely adopted PA in the U.S. (McFadden et al., 2023), is crucial for Extension agents, as it enhances their ability to demonstrate the technology's usefulness and ease of use. Strategy execution and problem-solving also emerged as top priorities, with problem-solving being the most important competency. Both skills enable Extension agents to navigate the complexities of modern agricultural practices and address clients' evolving needs. As regional commodity knowledge was also identified as an area requiring greater organizational support, PD should be tailored to unique regional applications (Khan & Ray, 2023). Further research should survey farmers to ascertain their desired competencies. Overall, CES should examine current PD programs considering these findings to guide resource allocation to address critical competency gaps, thus empowering Extension agents and increasing their efficacy in catalyzing the adoption of PA.

References

Ayre, M., McCollum, V., Waters, W., Samson, P., Curro, A., Nettle, R., Paschen, J-A., King, B., & Reichelt, N. (2019). Supporting and practicing digital innovation with advisers in smart farming. *NJAS – Wageningen Journal of Life Sciences*, 90–91, 100302. http://doi.org/10.1016/j.njas.2019.05.001

Borich, G. D. (1980). *A state-of-the-art assessment of educational evaluation*. ERIC Clearinghouse. https://eric.ed.gov/?id=ED187717

Clemson Cooperative Extension. (2024). *Clemson precision agriculture.* Clemson University. https://www.clemson.edu/extension/precision-agriculture/

Finger, R., Swinton, S. M., Benni, N. E., & Walter, A. (2019). Precision farming at the nexus of agricultural production and the environment. *Annual Reviews of Resource Economics*, *11*, 313–335. https://doi.org/10.1146/annurev-resource-100518-093929

John, D., Hussin, N., Shahibi, M. S., Ahmad, M., Hashim, H., & Ametefe, D. S. (2023). A systematic review on the factors governing precision agriculture adoption among small-scale farmers. *Outlook on Agriculture*, *52*(4), 469–485. https://doi.org/10.1177/00307270231205640

Khan, N, Ray R. L. (2023). Key role of Extension agents in the transfer and adoption of agricultural technologies: A review. *Data Plus, 1*(1). https://doi.org/10.62887/dataplus.001.01.0007

Lee, C.L., Orton, G., & Croom, B. (2024). Enhancing the capacity of southeastern Extension change agents to facilitate the dissemination of precision farming: A Delphi approach [Manuscript submitted for publication].

McFadden, J., Njuki, E., & Griffin, T. (2023). *Precision agriculture in the digital era: Recent adoption on U.S. farms*, EIB-248. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/105894/eib-248.pdf

Pandey, P. C., & Pandey, M. (2023). Highlighting the role of agriculture and geospatial technology in food security and sustainable development goals. *Sustainable Development*, *31*(5), 3175–3195. https://doi.org/10.1002/sd.2600

Schimmelpfennig, D., & Lowenberg-DeBoer, J. (2020). Farm types and precision agriculture adoption: Crops, regions, soil variability, and farm size. Global Institute Agri-Tech Economics Working Paper, 1–20. https://doi.org/10.2139/ssrn.3689311

U.S. Cotton Trust Protocol. (2024). Sustainability and precision agriculture in cotton production. https://trustuscotton.org/sustainability-and-precision-agriculture-in-cotton-production/

USDA National Agricultural Statistics Service (NASS). (2024). *Quick stats.* https://quickstats.nass.usda.gov/