From Inspiration to Action: Exploring Student Motivations and Learning Outcomes in Climate–Agriculture Science Education in California

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Introduction

The current and projected fragile climate in California raises concerns about its agricultural industry (Pathak et al., 2018). Extreme events such as heatwaves, drought (Moyers et al., 2024), wildfires (Pinzón et al., 2025), reduced water stocks (Liu et al., 2022), and increases in pests and diseases (Jha et al., 2024) are threatening growers. These aspects underscore a need to involve students in climate–agriculture science education to prepare the next generation of climate educators with relevant experiential knowledge for advising stakeholders on adaptation strategies (Dooley & Grady, 2020; Ikendi et al., 2026; Stein, 2024). This study sought to answer two questions relating to students' experiences and motivations to participate in climate–agriculture science education and their contributions to students' future engagements. These educational programs contribute toward promoting environmental health and preparing stakeholders to tackle salient issues affecting agricultural production, like climate extremes (AAAE, 2023, p. 9).

Conceptual Framework

The experiential learning framework, comprising four stages: experiencing, reflecting, thinking, and acting (Kolb, 2015), guided this climate–agriculture science education study. In experiential learning, learners and educators are cocreators of knowledge. Learners receive information through concrete experience and abstract conceptualization; transformations occur in reflective observation and active experimentation. Once learning occurs, learners' actions influence the next phase of their experience, and the cycle evolves with accumulating depth of understanding of the information and development of skills. Full-cycle learning is the ability to engage all the learning style types holistically and fluidly in any given situation, which also supports the notion that learners can start from any stage of the cycle (Coleman et al., 2024). These educators in the agricultural field have argued that mere participation in doing/experiencing an activity does not equate to the learning cycle; instead, all components of the cycle are experiences.

Methodology

This two-part qualitative content analysis examined undergraduate participants in climate–agriculture education programs (2024–2026) at University of California Merced and a Merced College. Programs were advertised through email invitations with anonymous links and QR codes. Interested students completed an eligibility survey assessing topic interest and career relevance. Out of 350 applicants, 61 were selected based on application strength and funding capacity. The study protocol was deemed exempt. The research focused on two questions: student motivations for participating (recruitment survey) and student learning across program themes (retrospective pre-then-post survey). Data were analyzed thematically through a five-step process: familiarization, coding, theme generation, theme review, and debriefing (Saldaña, 2024). Themes and codes were quantified into frequencies. Results are presented by theme using frequencies and selected student excerpts to illustrate experiences and interests.

Results

Students interests in climate–agriculture program were expressed in six themes: inspiration (f=133), learning (f=64), advocacy (f=32), networking (f=26), career (f=22), and research prospects (f=17). In inspiration, most students were driven by a passion for and curiosity in agriculture, looking to connect engineering with farming. For instance, a Junior in Computer Science and Engineering shared, "I have lived my whole life on a ranch. I witnessed my grandpa driving John

Deere tractors," noting that "During a memorable ride, he unveiled the tractor's features, including field mapping technology. This experience ignited my curiosity about how technology is used in agriculture." As a CSE major, this student wanted to explore "how technology can enhance efficiency and address challenges in the agricultural sector" (J25CSE13). Similarly, students viewed the program as a catalyst for their future research, career, and growth, as demonstrated by a Freshman in Electrical Engineering who stated, "My participation was motivated by my personal and career goals. I hope to utilize my education in Electrical Engineering on projects of data collection through sensors and the systems used in machines." This student sought to expand their knowledge in "one of the fields I'd like to enter: agriculture. Personally, I have always been fascinated by being aware of the methods by which my food comes to me" (F25EEE15).

In contributions of the program, five themes emerged: skills and knowledge development (f=146), motivation and inspiration (f=70), experiential learning (f=24), advocacy and education (f=23), and career prospects (f=17). In knowledge development, an Environmental Engineering major highlighted the irrigation theme, stating, "Learning more about deficit irrigation and plants that are resilient in these conditions helps to raise awareness of how we can transition and innovate farming practices" (P25ENE16). Also, a Microbiology and Immunology major stated, "I like the soil workshop because I was skeptical about composting, so I needed some extra knowledge on how to do it properly" (P25MIB31). Within the experiential learning theme, students engaged in farm field visits and hands-on lecture activities, such as computing agroclimate metrics, running hydrology models to track water movements, and trapping insects for integrated pest management. Reflecting on these experiences, a Public Health major shared, "I loved my workshop with hydrology and the professor who taught about and specializes in irrigation, groundwater in general," adding, "I loved his interaction with the water model of the different well systems." This student was "intrigued on how much overdraft has sunk into the farm grounds and how we need to address water problems after California only started to implement laws to regulate our waterway underground usage," concluding that "it was very informative; there was also calculations and simple physics to explain the way water moves in the ground" (P25PUH02).

Conclusions

This study assessed 61 students participating in a 2024–2026 climate–agriculture education program. Initially, student motivations spanned six themes: agricultural inspiration, learning climate-agriculture interactions, environmental advocacy, networking, career diversification, and academic research advancement. Post-participation feedback revealed program benefits across five interrelated areas: skills and knowledge development, climate-agriculture inspiration, experiential learning, environmental education advocacy, and future career prospects. The study highlights the profound impact that experiential learning has on students' academic and lifelong career trajectories. It demonstrates that multiple in-depth training opportunities enhance their scientific understanding of the complex climate–agriculture nexus as future agrifood leaders.

Implications

The findings demonstrate how institutions enrich student understanding of climate-agriculture interactions with future engagements in Cooperative Extension research. By investing in students, academics cultivate a climate-ready workforce, closing a critical coursework gap in California's Central Valley. This enhanced exposure delivers actionable agricultural solutions. Future initiatives will expand on these developments, engaging students in summer internships and year-long externships to sustain this educational pipeline and real-world impact.

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