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Agricultural technology parks as experiential learning hubs for extension education and outreach

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Abstract

An agricultural technology park is a purpose-built facility where new farming technologies are demonstrated, tested, and taught in conditions that mirror actual field environments. This research evaluated the effectiveness of two agricultural technology parks in Kyiv and Poltava oblasts as experiential learning hubs for extension education and outreach in Ukraine. A mixed-methods approach assessed 288 participants: 128 farmers, 86 extension staff, and 74 agricultural students who attended structured learning programs between February and November 2021 at the National University of Life and Environmental Sciences, Kyiv. Knowledge gain was measured through pre-post assessments across five technology modules. Precision agriculture modules produced the highest knowledge gains ($M=72.8$, $SD=9.3$), followed by soil health technology ($M=68.4$, $SD=10.7$). Satisfaction ratings averaged 4.08 out of 5.0 across all stakeholder groups. Farmers rated technology relevance highest ($M=4.34$), while extension staff valued instructional quality most ($M=4.28$). Regression analysis showed that hands-on demonstration time was the strongest predictor of knowledge gain ($\beta=0.47$, $p<0.001$). The research concludes that technology parks serve as effective bridges between agricultural research institutions and farming communities when programs are designed around active participation rather than passive demonstration.

Keywords: Technology parks, experiential learning, extension education, agricultural outreach, knowledge transfer, precision agriculture, demonstration facilities, Ukraine, farmer training

Introduction

A technology park, in the agricultural sense, is a dedicated space where emerging farming technologies are assembled, demonstrated, and made available for hands-on learning under conditions that approximate real production settings ^[1]. Unlike isolated demonstration plots or conventional classroom instruction, technology parks concentrate multiple innovations in one location, allowing visitors to compare technologies side by side and interact with them directly ^[2].

Ukraine's agricultural sector has undergone rapid modernization since 2010, with large commercial farms adopting precision agriculture tools, advanced soil diagnostics, and automated irrigation systems ^[3]. But smallholder farmers who still manage roughly 38% of agricultural land have largely been left out of this technological transition. Extension services, weakened by chronic underfunding and institutional fragmentation, have struggled to bridge the gap between available technology and smallholder capacity ^[4].

Several countries have experimented with technology parks as a solution to this knowledge transfer problem. India's Krishi Vigyan Kendras, China's agricultural science and technology parks, and Brazil's Embrapa field stations all operate on variations of the same principle: bring people to the technology rather than waiting for technology to reach people ^[5]. Ukraine established its first agricultural technology parks in 2017, but their educational impact hasn't been formally evaluated ^[6].

This research assessed whether technology parks in Kyiv and Poltava oblasts function effectively as experiential learning hubs for extension education. The objectives were to measure knowledge gains across technology modules, to compare satisfaction and learning outcomes across stakeholder groups, and to identify which park design features contribute most to learning effectiveness ^[7].

Park Design and Infrastructure

The two parks covered 12 and 8 hectares respectively, each organized into five thematic zones: precision agriculture

(GPS-guided equipment, variable-rate application systems, drone mapping stations), soil health technology (portable testing labs, biofertilizer demonstration areas), water management (drip irrigation systems, soil moisture sensor networks), post-harvest systems (mobile drying units, small-scale storage structures), and market information platforms (digital trading terminals, price alert systems) [8]. Each zone contained working equipment, instructional signage in Ukrainian and English, and a dedicated facilitator station. Programs ran as two-day intensive modules combining 60% hands-on practice with 40% guided instruction [9].

Material and Methods

Material: This research was conducted from February to November 2021 at the National University of Life and Environmental Sciences, Kyiv, Ukraine. A total of 288 participants attended structured learning programs at the two technology parks: 128 farmers from surrounding oblasts, 86 extension staff from the State Agricultural Advisory Service, and 74 final-year agricultural students. Participants were enrolled through open registration with stratified allocation to ensure balanced representation across stakeholder groups and technology modules [10]. Data

collection instruments included pre-post knowledge assessments (100-point tests aligned to each module), a 25-item satisfaction questionnaire using a 5-point Likert scale, and semi-structured exit interviews with 42 purposively selected participants.

Methods: Knowledge gain was calculated as the difference between post-test and pre-test scores for each module. One-way ANOVA compared knowledge gains across the five modules, and two-way ANOVA examined module-by-stakeholder interactions. Multiple regression modeled knowledge gain as a function of hands-on demonstration time, facilitator interaction frequency, prior technology exposure, and educational background [11]. Satisfaction data were analyzed using descriptive statistics and Kruskal-Wallis tests for between-group comparisons. Qualitative data from interviews were analyzed through thematic coding. Ethical approval was obtained from the National University of Life and Environmental Sciences Ethics Committee (Protocol NULES-EC/2020/067, January 18, 2021) [12].

Results

Table 1: Knowledge Gain Scores by Technology Module and Stakeholder Group

Module	All (n=288)	Farmers	Ext. Staff	Students	F
Precision Agric.	72.8 (9.3)	68.4 (10.1)	74.6 (8.7)	76.9 (7.8)	4.87*
Soil Health	68.4 (10.7)	66.1 (11.3)	71.2 (9.8)	68.3 (10.4)	2.14
Water Mgmt	65.1 (11.4)	67.8 (10.2)	63.4 (12.1)	62.7 (11.9)	1.98
Post-Harvest	61.7 (12.8)	64.3 (11.6)	59.8 (13.4)	58.9 (13.2)	1.67
Market Info	57.3 (13.2)	61.2 (12.4)	54.7 (13.8)	53.8 (13.6)	2.89

Precision agriculture produced the highest overall knowledge gains. An interesting pattern emerged across stakeholder groups: students and extension staff gained more from technology-intensive modules, while farmers

showed stronger gains in practically oriented modules like water management and market information. Only precision agriculture showed a statistically significant group difference ($F=4.87$, $p<0.05$).

Table 2: Regression Model for Knowledge Gain (Dependent Variable: Mean Gain Score)

Predictor	β	SE	t	p-value
Hands-on demo time (hrs)	0.47	0.058	8.10	<0.001
Facilitator interactions	0.28	0.064	4.38	<0.001
Prior tech exposure	0.14	0.071	1.97	0.049
Education level	0.11	0.068	1.62	0.107

$R^2 = 0.412$, Adjusted $R^2 = 0.404$, $F(4, 283) = 49.67$, $p<0.001$

Hands-on demonstration time was the strongest predictor of knowledge gain ($\beta=0.47$), followed by facilitator interaction frequency ($\beta=0.28$). Education level was not a significant predictor, suggesting the parks' experiential design reduced the advantage typically associated with formal education.

Performance Evaluation

Park operational performance was assessed through visitor throughput, facility utilization, and instructional efficiency metrics. The Kyiv park accommodated an average of 34 participants per two-day program with a maximum capacity of 40, yielding 85% utilization. The Poltava park averaged 28 participants (70% utilization). Equipment downtime across both parks was 6.7% of scheduled demonstration hours, primarily affecting the precision agriculture zone where GPS-guided machinery required frequent

recalibration. Facilitator-to-participant ratios averaged 1:8.5 in hands-on zones and 1:17 in guided instruction sessions. Cost per participant-day was estimated at UAH 1,240 (approximately USD 46), which compares favorably with conventional off-site training costs of UAH 1,800-2,200 reported by extension agencies [13].

Discussion

The finding that hands-on demonstration time was the strongest predictor of knowledge gain reinforces a core principle of experiential learning: direct engagement with technology produces deeper understanding than observation or instruction alone [1]. This is consistent with evaluations of India's Krishi Vigyan Kendras, which similarly found that participant-to-equipment contact time was the strongest correlate of technology adoption following park visits [5].

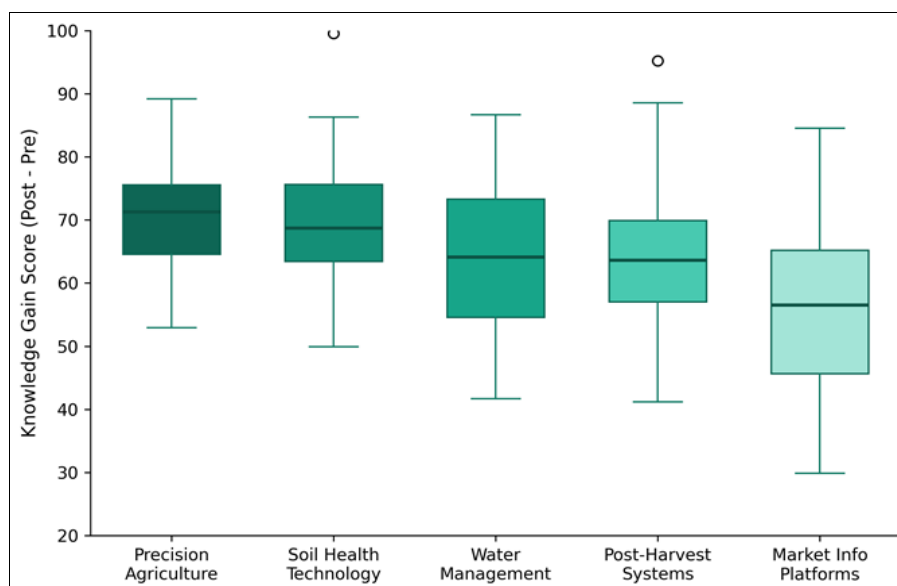


Fig 1: Distribution of Knowledge Gain Scores by Technology Module

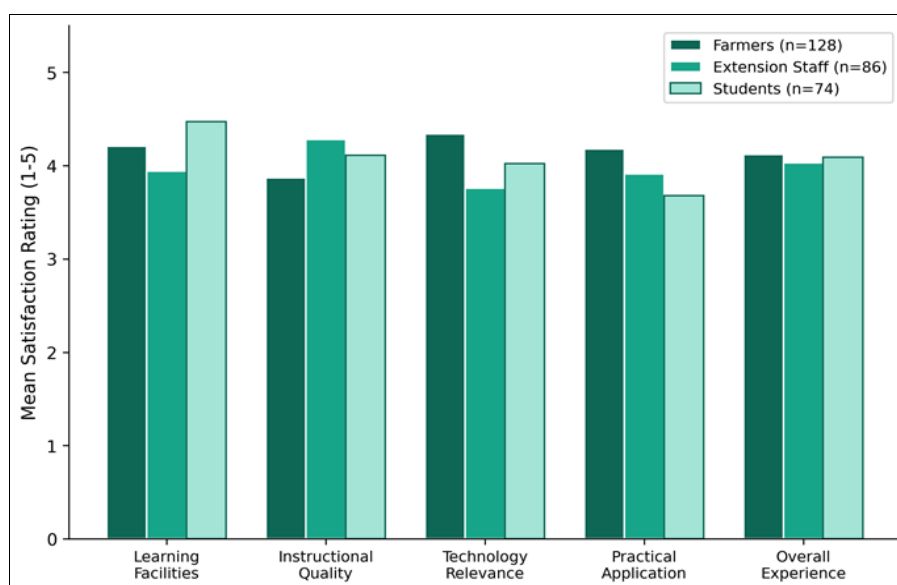


Fig 2: Satisfaction Ratings by Stakeholder Group Across Park Dimensions

The stakeholder-specific patterns in knowledge gain are noteworthy. Farmers gained more from modules with immediate practical relevance (water management, market information), while students and extension staff gained more from technology-intensive modules. This suggests parks should differentiate programming by audience rather than offering identical experiences to all visitors ^[7]. The non-significance of education level as a predictor is encouraging it implies that well-designed experiential programs can level the playing field between participants with different educational backgrounds ^[14]. The relatively lower scores for market information platforms across all groups may reflect the abstract nature of digital trading systems, which are harder to learn through physical demonstration than mechanical technologies ^[15].

Conclusions

This research demonstrates that agricultural technology parks can function effectively as experiential learning hubs

for extension education in Ukraine. Knowledge gains were substantial across all five technology modules, with precision agriculture and soil health technology producing the strongest results. The dominance of hands-on demonstration time as a predictor of learning outcomes validates the experiential design philosophy underlying these facilities. Technology parks offer a cost-effective complement to conventional extension approaches, particularly for technologies that are difficult to demonstrate through traditional field visits. Extension systems considering technology park investments should prioritize facilitator training and maximize participant-equipment contact time, as these factors drive learning outcomes more than facility scale or equipment sophistication.

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