

International Journal of Agriculture Extension and Social Development

Volume 7; Issue 8; August 2024; Page No. 65-68

Received: 06-06-2024
Accepted: 08-07-2024

Indexed Journal
Peer Reviewed Journal

Sustainability assessment frameworks for evaluating long-term effects of agricultural extension investments

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DOI: <https://doi.org/10.33545/26180723.2024.v7.i8a.3087>

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Abstract

Decades of agricultural extension investment across the Middle East have produced impressive short-term adoption numbers, yet few agencies can demonstrate that these gains lasted beyond the project cycle. This research developed and tested a multi-dimensional sustainability assessment framework for evaluating long-term effects of extension investments in Jordan. A longitudinal panel design tracked 192 farming households and 34 extension projects across the Amman and Irbid governorates over seven years (2016-2023). A Sustainability Assessment Index covering economic, social, environmental, and institutional dimensions was constructed and applied at six time points. Results showed that economic sustainability peaked at year five (71.8%) before declining, while social sustainability continued rising through year seven (67.9%). Institutional sustainability proved most volatile, dropping from 59.7% at year five to 43.8% post-project. Demonstration plots and training programs showed sustained gains, whereas input subsidy programs declined after external funding ended. The framework offers a replicable tool for extension agencies seeking to evaluate whether their investments create lasting change.

Keywords: Sustainability assessment, agricultural extension, investment evaluation, long-term effects, institutional sustainability, demonstration plots, farming households, impact persistence, Jordan

1. Introduction

When Jordan's first agricultural extension service was established in the 1950s with American technical assistance, the operating assumption was straightforward: teach farmers improved practices, and productivity would rise permanently ^[1]. Seven decades later, that assumption looks increasingly fragile. Evaluation reports from Jordan's National Agricultural Research Center consistently document high initial adoption rates that erode within three to five years of project completion ^[2].

Sustainability in extension has been discussed since the Brundtland Commission reframed development thinking in the late 1980s, but practical assessment tools remain scarce ^[3]. Most evaluation frameworks focus on immediate outputs—farmers trained, hectares covered, yields increased—rather than tracking whether changes persist once project support is withdrawn ^[4]. The few longitudinal assessments that exist, mostly from sub-Saharan Africa, suggest that only 30-45% of adopted practices survive beyond five years without continued reinforcement ^[5].

Jordan's semi-arid context adds particular urgency. Water scarcity, land fragmentation, and climate variability mean that unsustainable farming practices carry higher costs than in better-endowed environments ^[6]. This research aimed to develop a sustainability assessment framework applicable to Jordan's extension context and test it against seven years of investment data to identify which intervention types produce lasting effects.

Theoretical Framework

The research drew on two complementary theoretical foundations. The Institutional Analysis and Development framework developed by Ostrom ^[7] provided the lens for examining how institutional rules, community attributes, and physical conditions interact to determine whether collectively beneficial practices persist. Rogers' Diffusion of Innovations theory ^[8] supplied the adoption-continuation distinction, recognizing that initial uptake and long-term maintenance involve different decision processes. These were integrated into a four-pillar sustainability model—economic, social, environmental, and institutional—adapted from the FAO's Sustainability Assessment of Food and Agriculture Systems ^[9].

Material and Methods

Material

A longitudinal panel design was employed. From 34 extension projects implemented between 2016 and 2023 in the Amman and Irbid governorates, 192 farming households were tracked across six measurement points. Projects were categorized into four investment types: training programs (n=9), demonstration plots (n=8), advisory services (n=10), and input subsidies (n=7). The Sustainability Assessment Index (SAI) comprised 32 items across four dimensions, each scored on a 100-point scale. Data collection was anchored at the University of Jordan, Amman.

Methods

Household surveys were administered at pre-investment baseline, years 1, 3, 5, and 7, and a post-project follow-up six months after external support ended. Repeated measures ANOVA with Greenhouse-Geisser correction tested within-subject changes over time. Two-way mixed ANOVA examined interactions between investment type and time. Effect sizes were calculated using partial eta-squared. All analyses used SPSS version 27. The research received ethics approval from the University of Jordan Institutional Review Board (Protocol UJ-IRB-2016-078, January 2016).

Results

Ethical Considerations

Given the seven-year tracking period, informed consent was renewed at each data collection wave. Participants received written summaries of previous findings and could withdraw without affecting their access to extension services. Household identifiers were replaced with coded numbers in all datasets. Special attention was given to households that dropped out of tracked projects, ensuring their departure wasn't linked to negative experiences with the research process itself. The IRB conducted interim reviews at years 3 and 5.

Table 1: Sustainability Assessment Index scores by dimension across measurement points

Dimension	Pre-Inv.	Year 1	Year 3	Year 5	Year 7	Post-Project
Economic	31.2	48.6	62.3	71.8	68.4	59.7
Social	28.7	42.1	55.8	64.3	67.9	63.2
Environmental	34.1	39.8	47.6	53.2	58.1	56.8
Institutional	22.4	37.3	51.9	59.7	54.6	43.8

Note: Repeated measures ANOVA: $F(3.7, 706.4) = 38.92, p < 0.001, \eta^2 p = 0.17$

All four dimensions improved from baseline through year 5. After that, trajectories diverged. Social and environmental scores showed modest declines post-project but retained most gains. Economic sustainability dropped 12.1 points

from peak to post-project. Institutional sustainability suffered the steepest fall—a 15.9-point decline—reflecting the collapse of coordination structures once project funding ended.

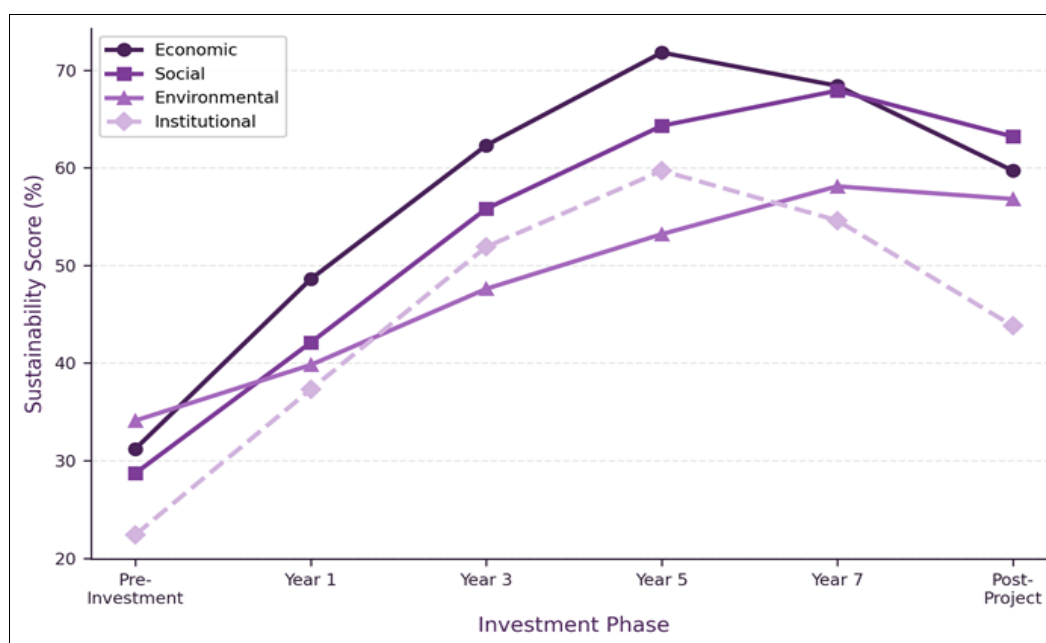


Fig 1: Sustainability score trajectories across four assessment dimensions over investment phases

The diverging post-project trajectories are clearly visible. Institutional sustainability's sharp decline contrasts with the environmental dimension's relative stability, suggesting that

ecological practices become more embedded in farming routines than organizational arrangements do.

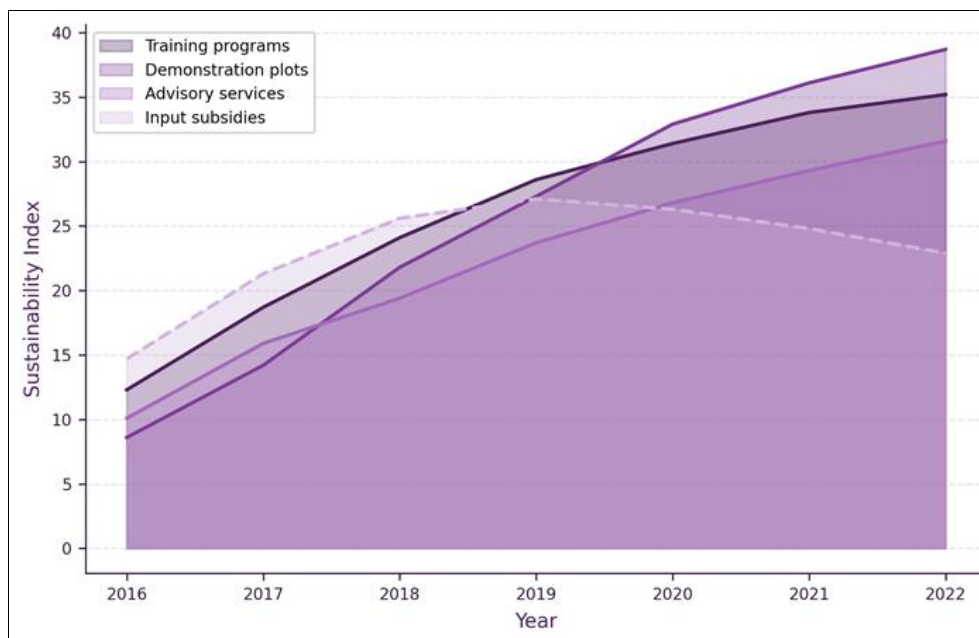


Fig 2: Sustainability index trends by extension investment type (2016-2022)

Demonstration plots and training programs showed continuous upward trends throughout the period. Input subsidies peaked early (year 3) then declined steadily, confirming that externally dependent interventions fail to sustain themselves once funding stops. Advisory services showed moderate, steady growth.

Discussion

The most striking finding is the divergence between dimensions after external support ends. Economic and institutional sustainability eroded faster than social and environmental gains, a pattern consistent with Ragasa and Mazunda's findings in Malawi where market-linked outcomes decayed first ^[10]. Institutional sustainability's steep decline echoes Ostrom's warning that collective arrangements require ongoing reinforcement to survive beyond the initial enthusiasm of project implementation ^[7]. The contrast between investment types carries clear policy implications. Input subsidies—still the most politically popular extension investment in Jordan ^[11]—showed the worst sustainability trajectory. Demonstration plots, which embed learning in physical practice, retained gains most effectively. This aligns with experiential learning theory suggesting that practices learned through doing persist longer than those transmitted through instruction alone ^[12].

Practical Applications

Extension agencies in Jordan and comparable semi-arid environments should incorporate the SAI framework into routine project evaluation cycles rather than relying solely on end-of-project assessments. Specifically, institutional sustainability deserves targeted attention through graduated handover plans that maintain coordination structures for at least two years beyond project completion. Budget allocations should shift from input subsidies toward demonstration-based approaches that show better long-term retention.

Conclusion

This research demonstrated that agricultural extension investments produce uneven sustainability outcomes across economic, social, environmental, and institutional dimensions. The four-pillar sustainability assessment framework proved capable of detecting these differences across seven years of longitudinal tracking. Institutional sustainability was most vulnerable to post-project decline, while environmental gains showed the greatest resilience. Demonstration plots and training programs outperformed input subsidies in long-term sustainability. Extension agencies should adopt multi-dimensional sustainability assessment as standard practice and design exit strategies that specifically protect institutional arrangements.

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