

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 6; June 2025; Page No. 151-154

Received: 22-04-2025
Accepted: 25-05-2025

Indexed Journal
Peer Reviewed Journal

Indicator development for measuring knowledge, attitude, and practice changes among extension beneficiaries

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DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i6b.3372>

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Abstract

Extension services have been measured and evaluated for decades, yet the tools used to capture changes in farmer knowledge, attitudes, and practices remain surprisingly inconsistent. This research developed and validated a set of indicators for measuring Knowledge, Attitude, and Practice (KAP) changes among agricultural extension beneficiaries in Namibia. A three-phase instrument development process was followed: item generation through literature review and expert consultation, content validation by a panel of nine extension specialists, and field testing with 246 extension beneficiaries across Omusati, Oshana, and Kavango East regions between March and December 2022. The initial pool of 78 items was refined to a final framework of 53 indicators (18 knowledge, 14 attitude, 21 practice) with overall reliability of 0.87 (Cronbach's alpha). Confirmatory factor analysis supported the three-factor KAP structure (CFI = 0.91, RMSEA = 0.054). Longitudinal application over 12 months revealed that knowledge scores improved most rapidly (32.4% to 67.9%), attitude change was gradual but steady (38.7% to 62.4%), and practice adoption lagged behind both (24.1% to 51.8%). The validated indicator set provides extension agencies with a standardized tool for tracking beneficiary-level outcomes across diverse agricultural extension programs.

Keywords: Knowledge Attitude Practice, KAP indicators, extension evaluation, instrument development, beneficiary assessment, extension impact, farmer knowledge, agricultural practices, Namibia extension, indicator validation

Introduction

Since the 1960s, agricultural extension programs have sought to change what farmers know, how they feel about new technologies, and what they actually do on their fields^[1]. These three dimensions knowledge, attitude, and practice form the backbone of extension evaluation, yet the measurement tools applied across programs and countries lack standardization^[2]. A review of 47 extension evaluation reports from sub-Saharan Africa found that 83% used custom-built questionnaires with no reported validity or reliability testing^[3]. This inconsistency makes it difficult to compare outcomes across programs, track progress over time, or identify which extension approaches produce the most meaningful beneficiary-level changes.

In Namibia, the Directorate of Agricultural Extension and Engineering Services oversees extension delivery through 14 regional offices serving approximately 120,000 farming households^[4]. Evaluation of these services has relied on output indicators such as number of farmers visited and demonstrations conducted rather than outcome indicators that capture actual changes in farmer capacity and behavior^[5]. The KAP framework, widely used in health education research, offers a structured approach to measuring these changes but requires adaptation for agricultural contexts where knowledge domains, attitudinal constructs, and practice categories differ substantially from health settings^[6, 7]. This research aimed to develop, validate, and field-test a set of KAP indicators suited for measuring changes among agricultural extension beneficiaries in Namibia.

Theoretical framework

The indicator development process was grounded in the Theory of Planned Behavior, which posits that behavioral change (practice) is preceded by intention, shaped by attitudes toward the behavior and subjective norms, and mediated by perceived behavioral control^[8]. In extension contexts, this translates to a sequential pathway: knowledge acquisition enables attitude formation, which in turn influences practice adoption. The KAP framework aligns with this theoretical sequence while recognizing that the relationship is not always linear farmers may adopt practices without full understanding or hold positive attitudes without translating them into action^[9]. The indicator development followed DeVellis's scale development guidelines, incorporating content domain specification, item generation, expert validation, and psychometric testing as sequential phases^[10].

Materials and Methods

Materials

A three-phase instrument development design was adopted. Phase 1 involved item generation through systematic literature review (43 sources) and semi-structured interviews with 12 extension professionals. Phase 2 comprised content validation by a panel of nine extension specialists from the University of Namibia and the Ministry of Agriculture. Phase 3 involved field testing with 246 extension beneficiaries across Omusati (n = 87), Oshana (n = 82), and Kavango East (n = 77) regions. These regions

were selected to represent different agro-ecological zones and extension service models ^[11]. Field testing was conducted between March and December 2022 through the Department of Agricultural Sciences, University of Namibia, Windhoek.

Methods

Item analysis included corrected item-total correlations, with items below 0.30 removed. Exploratory Factor Analysis (EFA) with principal axis factoring and varimax

rotation identified the underlying factor structure. Confirmatory Factor Analysis (CFA) tested the three-factor KAP model using AMOS version 26. Model fit was assessed through chi-square/df ratio, Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). Longitudinal data from five assessment points (baseline, months 3, 6, 9, and 12) were analyzed using repeated measures ANOVA to track KAP score changes over time ^[12].

Results

Table 1: Psychometric properties of the validated KAP indicator framework

Dimension	Initial Items	Final Items	Cronbach α	Item-Total r (range)	Variance Explained (%)	Test-Retest r
Knowledge	26	18	0.84	0.38-0.71	28.4	0.81
Attitude	22	14	0.89	0.42-0.76	22.7	0.84
Practice	30	21	0.86	0.34-0.69	18.3	0.79
Overall KAP	78	53	0.87	0.34-0.76	69.4	0.82

The initial 78-item pool was reduced to 53 items after removing those with corrected item-total correlations below 0.30. The three subscales showed acceptable to good reliability: attitude indicators had the highest internal consistency ($\alpha = 0.89$) while knowledge indicators were

slightly lower ($\alpha = 0.84$). The three-factor structure explained 69.4% of total variance. Test-retest reliability over a two-week interval ranged from 0.79 (practice) to 0.84 (attitude).

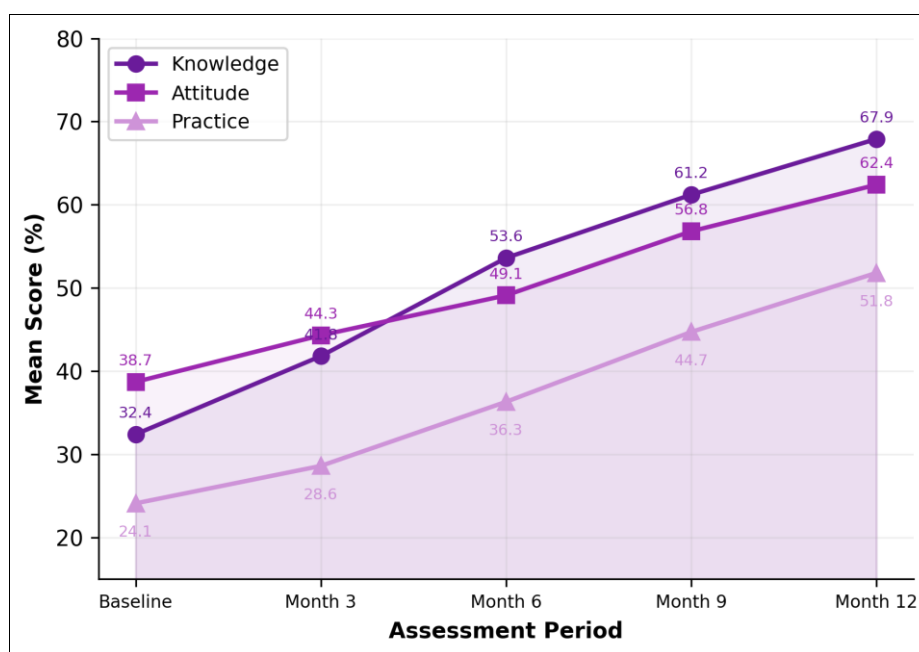


Fig 1: Longitudinal KAP score changes among extension beneficiaries over 12 months (n = 246)

Knowledge scores showed the steepest trajectory, rising from 32.4% at baseline to 67.9% at month 12. Attitude scores followed a steadier pattern (38.7% to 62.4%). Practice scores started lowest (24.1%) and showed the most

delayed improvement, reaching 51.8% by month 12. Repeated measures ANOVA confirmed significant time effects for all three dimensions ($p < 0.001$).

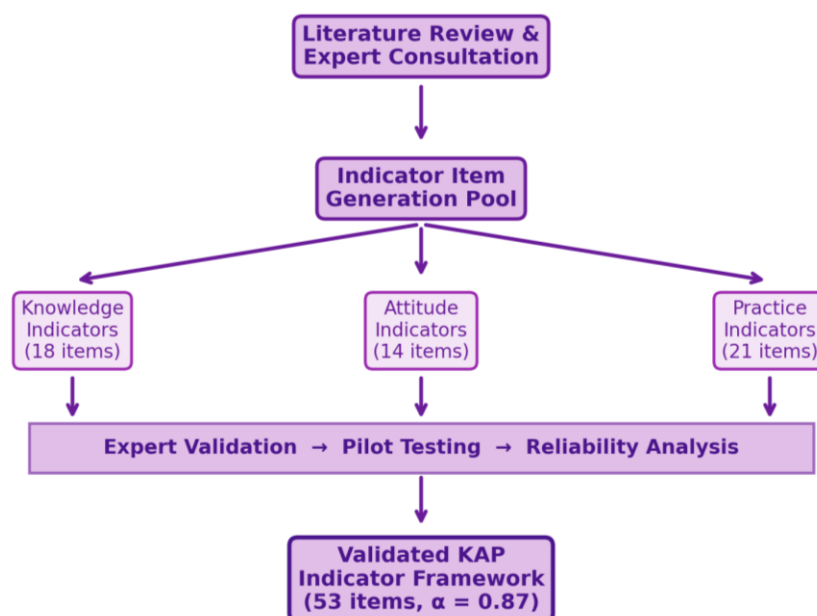


Fig 2: Framework for KAP indicator development and validation process

The framework traces the development process from literature review and expert consultation through item generation, branching into three KAP dimensions, and converging through validation, pilot testing, and reliability analysis to produce the final 53-item validated indicator set.

Discussion

The validated 53-item KAP framework addresses a gap in extension evaluation methodology. The three-factor structure confirmed by CFA supports treating knowledge, attitude, and practice as related but distinct dimensions a finding consistent with health education KAP research but not previously tested in agricultural extension contexts ^[6, 13]. The attitude subscale's higher reliability ($\alpha = 0.89$) likely reflects the more internally consistent nature of attitudinal items compared to knowledge questions, which span diverse technical domains from soil management to pest control.

The longitudinal results revealed an expected pattern: knowledge changed fastest, attitudes shifted gradually, and practice adoption lagged behind both. This sequence aligns with the Theory of Planned Behavior and mirrors adoption diffusion patterns described by Rogers ^[14]. The 16.1 percentage-point gap between knowledge and practice scores at month 12 (67.9% vs 51.8%) represents the well-documented knowledge-practice divide in extension. Factors including resource constraints, labor availability, and risk aversion may explain why farmers who understand new techniques don't always implement them ^[15, 16]. The indicator framework's ability to capture this gap makes it a more diagnostic tool than single-dimension evaluations.

One limitation worth noting is that the indicators were developed and tested within Namibian extension contexts. While the underlying KAP constructs are transferable, specific items may need adaptation for different agricultural systems and cultural settings. The relatively short longitudinal period of 12 months may also understate practice changes, which often take multiple cropping seasons to stabilize ^[17].

Conclusion

This research produced a validated 53-item indicator framework for measuring KAP changes among extension beneficiaries in Namibia. The instrument demonstrated acceptable psychometric properties across all three dimensions and captured differential change patterns over a 12-month period. Knowledge indicators were most responsive to extension exposure, while practice indicators showed the greatest lag. Extension agencies seeking outcome-level evaluation tools may find this framework a practical starting point, though adaptation for specific agricultural contexts and extension modalities is recommended. The consistent gap between knowledge acquisition and practice adoption underscores that extension programs should be evaluated on behavioral change rather than knowledge transfer alone ^[18, 19, 20, 21].

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