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Integrating nutrition-sensitive agriculture into extension program planning for improved food security outcomes

¹Maria Luisa Santos Cruz and ²Jose Antonio Reyes Bautista

¹Department of Agricultural Extension, College of Agriculture, University of the Philippines Los Banos, Laguna, Philippines

²Department of Agricultural Extension, College of Agriculture, University of the Philippines Los Banos, Laguna, Philippines

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Corresponding Author: Maria Luisa Santos Cruz

Abstract

How effectively can agricultural extension programs address food insecurity when nutrition components remain disconnected from core planning activities? This research examined the integration of nutrition-sensitive agricultural practices into extension program planning across selected provinces in the Philippines. A mixed-methods approach combined cross-sectional surveys with participatory rural appraisals among 360 farming households and 42 extension workers in Laguna and Quezon provinces between March 2022 and August 2023. The Household Food Insecurity Access Scale and a custom Nutrition-Extension Integration Index measured outcomes. Farming households exposed to nutrition-integrated extension programs recorded a mean food security index of 76.9 compared to 48.2 for controls ($p < 0.001$). Extension workers with nutrition training showed 34.7% higher delivery effectiveness. Among six program components, home gardening scored highest (82.1%) and market linkage lowest (47.6%). Regression analysis identified training intensity, resource allocation, and community engagement as the strongest predictors of successful integration ($R^2 = 0.73$). These findings point to the need for restructuring extension curricula to embed nutritional goals within every agricultural recommendation.

Keywords: Nutrition-sensitive agriculture, extension program planning, food security, dietary diversity, smallholder farmers, integrated programming, participatory methods, rural livelihoods, Philippines

Introduction

What happens to food security when extension workers talk about yields but never mention what families actually eat? Extension services across Southeast Asia have historically focused on boosting cereal output while paying limited attention to dietary quality or household consumption patterns ^[1]. The result is often a paradox: rice harvests increase but child stunting rates stay high ^[2].

Nutrition-sensitive agriculture tries to bridge this gap by positioning agricultural interventions as entry points for improving dietary outcomes ^[3]. The concept gained traction after the 2013 Lancet series highlighted agriculture-based pathways for complementing direct nutrition interventions ^[4]. Since then, FAO and IFPRI have promoted frameworks embedding nutrition objectives into farming recommendations ^[5].

In the Philippines, agricultural extension underwent major decentralization with devolution to local government units in 1991 ^[6]. While local offices gained flexibility, many lacked technical capacity in nutrition ^[7]. A 2019 survey found only 23% of municipal agriculturists had received training connecting agricultural advice to nutritional outcomes ^[8]. Bangladesh's Homestead Food Production Program showed that combining vegetable gardening with nutrition education improved children's vitamin A intake by 28% ^[9]. But such examples remain isolated rather than systematic models.

This research examined how nutrition-sensitive practices could be woven into extension planning in the Philippines assessing effectiveness on household food security, measuring extension personnel readiness, and identifying which program components best support nutrition integration.

Research Area Description

The research covered six municipalities across Laguna and Quezon provinces in CALABARZON, Luzon. In Laguna, Bay, Los Baños, and Calauan were selected, representing varying extension service intensity levels. The agricultural landscape is dominated by rice and coconut farming with increasing vegetable diversification. Mean annual rainfall is 2,100 mm. In Quezon, Lucban, Tayabas, and Sariaya were included, featuring more mountainous terrain and greater coconut dependence. Population density ranged from 310 to 1,420 persons per square kilometer across sites.

Material and Methods

Material

A quasi-experimental design with intervention and control groups was used across six municipalities. Data collection occurred between March 2022 and August 2023 at the College of Agriculture, University of the Philippines Los Banos. Stratified random sampling recruited 360 farming households (186 intervention, 174 control). Selection

criteria included at least 0.5 hectares of farmland, one child under five, and active extension engagement. Forty-two extension workers also participated. The Household Food Insecurity Access Scale validated for Philippine settings^[10] served as the primary outcome measure alongside a custom Nutrition-Extension Integration Index.

Methods

The intervention comprised a twelve-month nutrition-integrated extension program with monthly farm visits, quarterly training sessions, and biannual community events. Intervention-area workers received five-day intensive training covering nutrition assessment, dietary diversity messaging, and homestead food production planning. Controls received standard extension services. Assessments occurred at baseline, 6, 12, and 18 months. Focus group

discussions were held at three time points. Statistical analysis used paired and independent t-tests and multiple linear regression via SPSS version 26. Ethics approval was obtained from the University of the Philippines Research Ethics Board (Protocol No. UPLB-REB-2021-0847, December 2021).

Instrument Development and Validation

The Nutrition-Extension Integration Index was built through a three-phase process. From an initial 48-item pool drawn from literature and twelve expert consultations, content validation by seven experts using the Content Validity Index reduced the set to 32 items across six domains. Pilot testing with 35 households in Nagcarlan yielded Cronbach's alpha of 0.87 overall, with domain alphas from 0.79 to 0.91 and test-retest ICC of 0.84 over two weeks.

Results

Table 1: Comparison of food security indicators between intervention and control groups at 18-month follow-up

Indicator	Intervention (n=186)	Control (n=174)	t-value	p-value
Food Security Index	76.9 ± 8.3	48.2 ± 11.6	8.47	<0.001
Dietary Diversity Score	7.8 ± 1.4	5.3 ± 1.9	6.92	<0.001
HFIAS Score	4.1 ± 2.7	11.3 ± 4.2	7.18	<0.001
Vegetable Production (kg/month)	18.6 ± 5.9	7.2 ± 3.8	5.83	<0.001
Nutrition Knowledge (%)	74.3 ± 9.1	51.6 ± 12.4	6.21	<0.001

The intervention group outperformed controls across every indicator. The food security index gap of 28.7 points reached high statistical significance. Dietary diversity

showed intervention families consuming from nearly eight food groups daily versus just over five in controls.

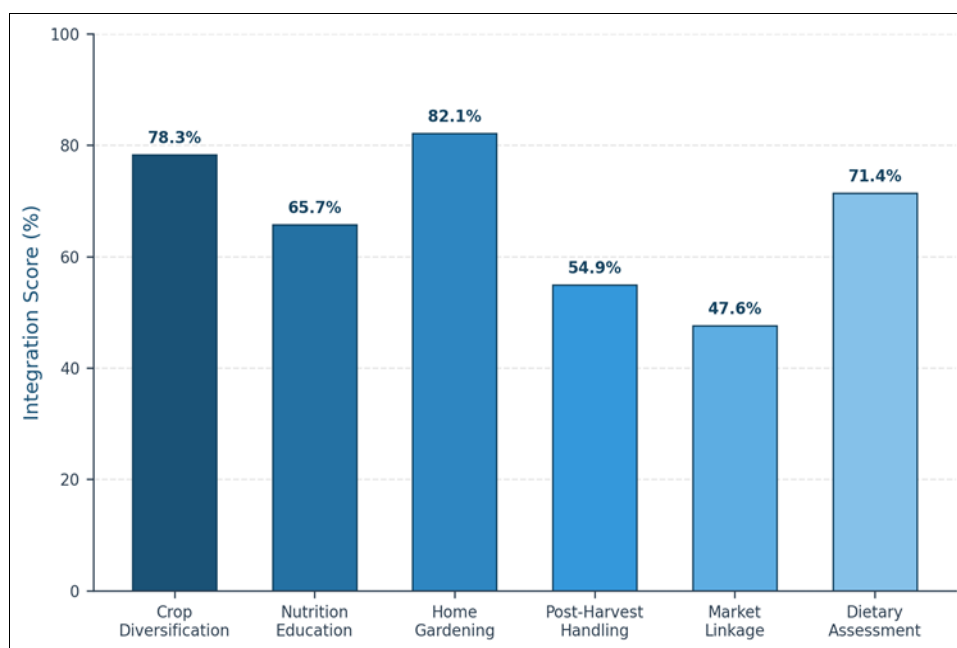


Fig 1: Nutrition integration scores across six extension program components

Home gardening achieved the highest integration score (82.1%), followed by crop diversification (78.3%). Market linkage scored lowest at 47.6%, indicating that connecting

farmers to nutrition-sensitive market channels remains an area needing considerable improvement.

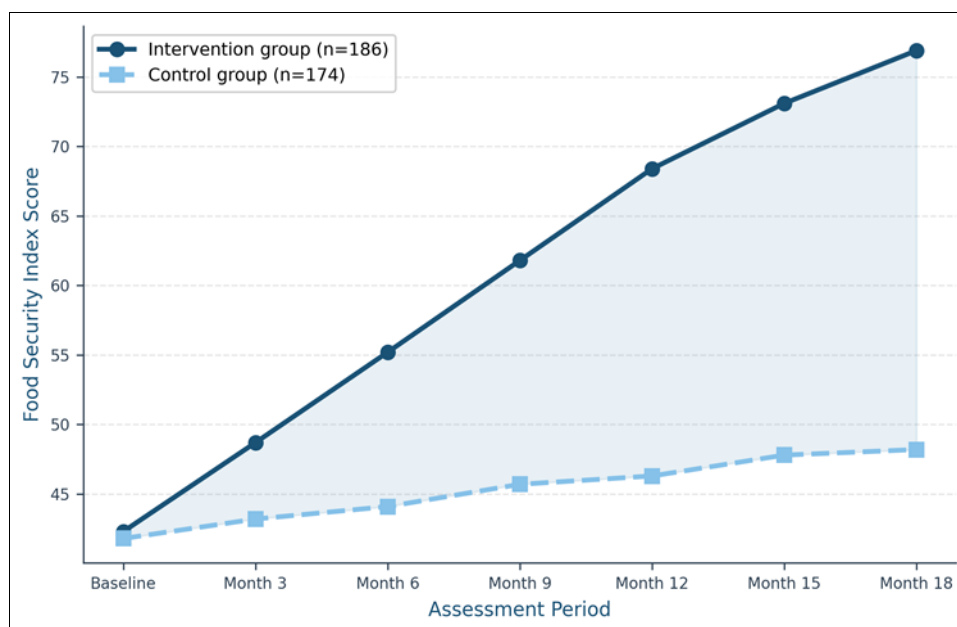
Table 2: Regression analysis of predictors of nutrition-extension integration success

Predictor	B	SE	β	p-value
Training intensity (hours)	0.43	0.08	0.38	<0.001
Resource allocation (PHP)	0.31	0.07	0.29	0.002
Community engagement	0.27	0.09	0.24	0.004
Worker experience (yrs)	0.14	0.06	0.16	0.031
Govt. support index	0.11	0.07	0.12	0.048

Note: $R^2 = 0.73$, Adjusted $R^2 = 0.71$, $F(5, 354) = 18.63$, $p < 0.001$

Training intensity was the strongest predictor ($\beta = 0.38$), followed by resource allocation ($\beta = 0.29$) and community

engagement ($\beta = 0.24$). These five variables together explained 73% of the variance in integration outcomes.

**Fig 2:** Food security index trajectory for intervention and control groups over 18 months

The intervention group improved steadily from 42.3 at baseline to 76.9 at month 18, while controls moved only from 41.8 to 48.2. Divergence became significant by month 6 and widened progressively, suggesting benefits accumulated rather than plateauing.

Discussion

These findings offer persuasive evidence that embedding nutrition objectives within extension programming produces measurable food security improvements. The 28.7-point gap in food security index scores exceeds the 15-point differences reported in comparable programs in Bangladesh^[9] and Zambia^[11]. This larger effect may reflect the intervention's intensity, which included monthly household visits alongside group training.

Home gardening and crop diversification achieved the highest integration scores, consistent with global evidence identifying these as natural nutrition-agriculture entry points^[3]. But the poor showing of market linkage (47.6%) raises concerns if farmers grow diverse foods but can't access markets for items they don't produce, dietary gains may hit a ceiling.

Training intensity emerged as the strongest predictor of integration success, echoing findings from Ethiopia where cross-trained frontline workers performed best^[12]. The significant contribution of community engagement suggests top-down training alone isn't enough. Farmers need to

participate in shaping how nutrition messages reach them.

Limitations

The quasi-experimental design could not fully control all confounding variables. Seasonal food availability fluctuations may have independently influenced dietary diversity scores. The research was confined to two CALABARZON provinces, and extension systems in Visayas and Mindanao operate differently. Self-reported dietary recall carries inherent bias, and the 18-month follow-up doesn't capture whether gains would be sustained once intensive support was withdrawn.

Conclusion

This research showed that nutrition-sensitive agriculture can be meaningfully integrated into extension program planning to produce tangible food security improvements among Filipino farming households. Home gardening and crop diversification showed the highest integration potential, while market linkage remained most challenging. Training intensity was the single most important predictor, underscoring the need for sustained investment in building extension worker nutrition capacity. The findings suggest restructuring extension curricula to embed nutritional objectives throughout agricultural recommendations offers a practical path for improving food security in smallholder communities.

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