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Extension-linked nutrition education programs for addressing rural malnutrition through dietary diversification

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Abstract

How can targeted nutrition education, delivered through agricultural extension networks, reshape dietary habits in rural populations? This research examined extension-linked nutrition education programs in reducing malnutrition through dietary diversification among 186 intervention and 174 control households in Haut-Katanga Province, DR Congo, between March 2022 and February 2023. Household dietary diversity scores, nutrition knowledge, and anthropometric measurements of children under five were collected at baseline, midline, and endline. Intervention households achieved a mean dietary diversity score of 6.8 at endline compared to 4.3 in controls ($p < 0.001$). Knowledge scores rose by 34.9 points in the intervention group versus 6.1 among controls. Stunting prevalence dropped from 41.7% to 29.3% in intervention households, while controls declined from 40.2% to 37.8%. These findings point to the value of embedding nutrition education within extension frameworks as a cost-effective approach to addressing rural malnutrition.

Keywords: Nutrition education, agricultural extension, dietary diversification, rural malnutrition, household dietary diversity, food security, extension workers, community nutrition, child stunting, behavior change

Introduction

What role can agricultural extension systems play in tackling persistent malnutrition across sub-Saharan Africa? In many rural communities, families grow enough calories but lack the dietary variety needed for proper nutrition [1]. This disconnect between production and nutritional outcomes has drawn attention from researchers who see extension services as a bridge between farming and improved diets [2]. Malnutrition remains a leading contributor to child mortality in the Democratic Republic of Congo, where roughly 43% of children under five experience chronic malnutrition [3]. Rural areas bear a disproportionate burden, partly because families rely on narrow crop portfolios dominated by cassava and maize [4]. Traditional extension services have focused almost entirely on yield increases, with little attention to household consumption patterns [5]. Extension-linked nutrition education uses the trust and reach of extension agents to deliver nutrition messages alongside farming advice [6]. Evidence from East Africa suggests this approach can raise dietary diversity and reduce micronutrient deficiencies at lower cost than standalone nutrition interventions [7]. But few investigations have tracked outcomes beyond six months or measured child nutritional status alongside household dietary patterns [8]. There's also limited data from Central Africa, where food systems differ from settings where most evidence was gathered [9]. This research evaluated a 12-month extension-linked nutrition education program in Haut-Katanga Province. The objectives were to

measure changes in household dietary diversity, assess nutrition knowledge shifts, and track child anthropometric outcomes in intervention versus control communities.

Research Area Description

The research was carried out in six rural communes of Haut-Katanga Province, southeastern DR Congo, between latitudes 11.2°S–12.1°S and longitudes 27.3°E–28.4°E. The area has a tropical savanna climate receiving 1,050–1,300 mm of rainfall annually from October through April [10]. Soils are predominantly ferralitic, supporting mixed farming centered on cassava, maize, groundnuts, and sweet potato. The province has roughly 2.3 extension agents per 10,000 farming households [3].

Material and Methods

Material

The research was conducted from March 2022 through February 2023 at the Faculty of Agriculture, University of Lubumbashi. Ethical clearance was granted by the University of Lubumbashi Health Sciences Ethics Committee (Protocol UNILU-HSEC/2021-087, approved December 14, 2021). All households provided written informed consent. A quasi-experimental design assigned three communes to intervention and three matched communes as controls. Households were eligible if they had at least one child under five and relied on smallholder farming. The intervention group included 186 households and the control group 174 households matched on commune

size, market access, and baseline dietary diversity ^[11]. Instruments included the FAO Household Dietary Diversity Score questionnaire, a nutrition knowledge tool adapted from WHO guidelines, and standardized anthropometric protocols for children under five.

Methods

Fourteen trained extension workers delivered a structured nutrition education curriculum during regular visits over 12 months. Each worker received 40 hours of training on nutrition science, dietary diversity messaging, cooking demonstrations, and participatory education ^[12]. Monthly modules combined 90-minute group sessions with 30-minute household visits covering food group identification, balanced meal preparation, child feeding, food preservation, and kitchen garden management. Control households received standard agricultural extension without nutrition content. Dietary diversity was measured through 24-hour recall at baseline, midline (month 6), and endline (month

12). Child anthropometric measurements followed WHO Growth Reference protocols. Data were analyzed using SPSS version 26 with independent samples t-tests, chi-square tests, and repeated measures ANOVA ^[13]. Significance was set at $p < 0.05$.

Ethical Considerations

This research followed Declaration of Helsinki guidelines. All household heads provided informed consent after receiving explanations of procedures and their right to withdraw. For households with limited literacy, verbal consent was obtained with a witness present. Child measurements were conducted by trained health workers. Personal data were coded and stored in password-protected databases. Control households were offered nutrition education materials after the research concluded.

Results

Table 1: Baseline Characteristics of Participating Households

Characteristic	Intervention (n=186)	Control (n=174)
Mean household size	6.3 ± 2.1	6.1 ± 1.9
Female-headed (%)	34.9%	32.8%
Mean farming area (ha)	1.7 ± 0.8	1.6 ± 0.9
Monthly income (USD)	47.3 ± 22.6	49.1 ± 24.3
Baseline HDDS (mean)	4.1 ± 1.3	4.2 ± 1.4

HDDS = Household Dietary Diversity Score. No significant baseline differences ($p > 0.05$).

Table 2: Changes in Dietary Diversity and Nutrition Knowledge

Indicator	Int. Base	Int. Mid	Int. End	Ctrl Base	Ctrl Mid	Ctrl End
HDDS (0-12)	4.1	5.6	6.8	4.2	4.4	4.3
IDDS (0-9)	3.2	4.7	5.9	3.3	3.5	3.6
Knowledge (%)	32.4	56.8	67.3	31.8	35.6	37.9
Stunting (%)	41.7	34.8	29.3	40.2	39.1	37.8

Int. = Intervention; Ctrl = Control. All endline between-group differences significant at $p < 0.001$.

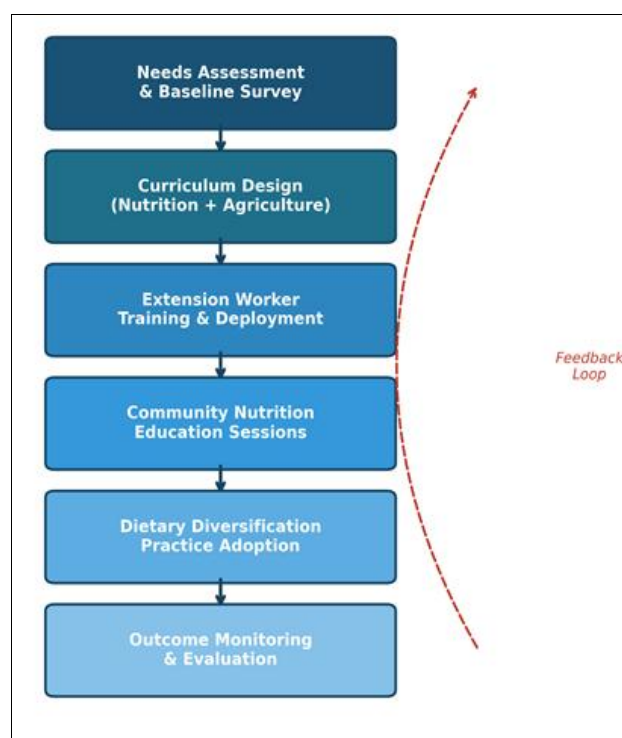


Fig 1: Extension-linked nutrition education program implementation framework with feedback loop

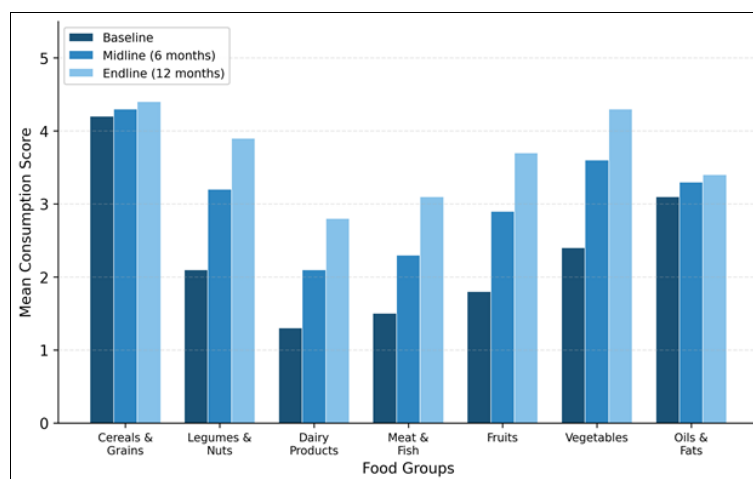


Fig 2: Mean food group consumption scores at baseline, midline, and endline for intervention households

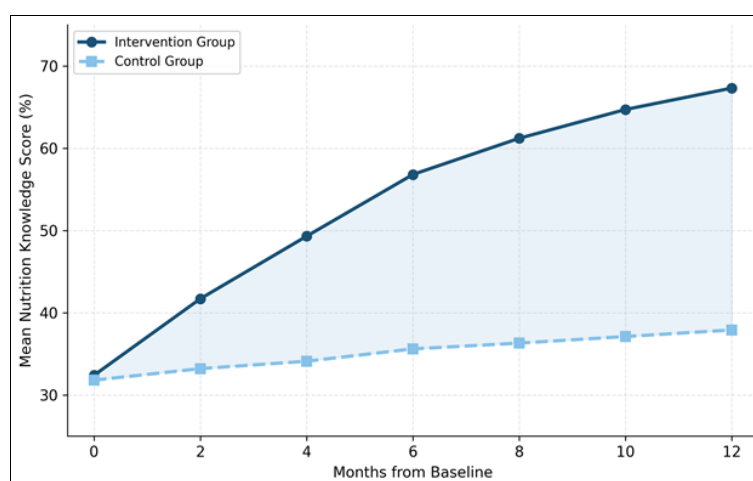


Fig 3: Nutrition knowledge score trajectories over 12 months for intervention and control groups

Comprehensive Interpretation

Baseline comparisons confirmed well-matched groups with no significant demographic differences (Table 1). Dietary diversity scores rose from 4.1 to 6.8 in the intervention arm while controls showed no meaningful change (Table 2). The between-group endline difference was significant ($t = 8.94$, $p < 0.001$). Figure 2 shows gains were largest in vegetables, fruits, and legumes—food groups amenable to kitchen garden production. Nutrition knowledge climbed steeply in the intervention group (Figure 3), and repeated measures ANOVA confirmed a significant time-by-group interaction ($F = 47.3$, $p < 0.001$). The stunting reduction from 41.7% to 29.3% in intervention households suggested knowledge gains were translating into feeding behavior changes.

Discussion

These findings add to evidence that extension services can effectively deliver nutrition education in resource-limited settings. The 2.7-point dietary diversity improvement was comparable to results from Burkina Faso, where a similar approach yielded a 2.4-point gain over 24 months [6]. The faster improvement here may reflect the intensive monthly contact schedule combining group and household visits. Vegetables, fruits, and legumes showed the greatest gains, likely because these crops grow well in kitchen gardens with minimal investment. That said, dairy and meat consumption

improved more modestly, pointing to limits of education alone without addressing supply-side barriers [7]. The 12.4 percentage point stunting decline was encouraging but should be interpreted carefully, as child growth responds to many factors beyond diet [8].

Extension worker capacity appeared as both a strength and bottleneck. Satisfaction was high (78.4%), but each agent served roughly 13 households alongside regular duties. Scaling this model will require careful attention to staffing ratios.

Limitations

The quasi-experimental design doesn't fully eliminate selection bias. The 12-month follow-up was insufficient to assess sustainability of dietary changes. Self-reported dietary data carry recall and social desirability biases. Results from Haut-Katanga may not generalize to other regions with different agroecological conditions or extension infrastructure.

Conclusion

Embedding nutrition education within agricultural extension services produced meaningful improvements in dietary diversity, nutrition knowledge, and child nutritional status in rural DR Congo. Intervention households increased dietary diversity by 2.7 food groups, knowledge scores rose by

nearly 35 points, and child stunting declined by 12.4 percentage points over 12 months.

The model worked because it built on existing extension infrastructure. Extension workers with established community relationships proved effective nutrition educators. For policymakers, these results suggest nutrition-agriculture integration through extension represents a practical pathway to addressing rural malnutrition within existing resource constraints.

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