Open Access Journal
JOURNAL OF COMMUNITY SERVICE

Community Nutrition Intervention to Reduce Child Stunting in Rural Timor-Leste

José Manuel da Silva[1]
[1]*National University of Timor-Leste, Timor-Leste*
Maria Teresa Soares[2]
[2]*National University of Timor-Leste, Timor-Leste*
Domingos Pereira[3]
[3]*National University of Timor-Leste, Timor-Leste*

Corresponding Author: j.silva@untl.tl

ARTICLE INFO

Received September 4, 2023
Revised September 23, 2023
Accepted October 10, 2023
Published November 25, 2023

Keywords:
child stunting, community nutrition intervention, Timor-Leste, dietary diversity, malnutrition, community service

ABSTRACT

Child stunting remains one of the most pervasive and devastating forms of malnutrition in Timor-Leste, affecting nearly half of all children under five years of age. This community service-research study reports the design, implementation, and outcomes of a six-month participatory nutrition intervention conducted across three rural subdistricts—Ermera, Ainaro, and Manufahi—engaging 64 households with children aged six to 59 months. The program integrated responsive feeding counselling, agricultural homestead food production, micronutrient supplementation, and community health worker capacity building within a culturally adapted, co-designed framework developed in partnership with village councils, traditional birth attendants, and local health post personnel. Using a quasi-experimental pre-test/post-test design with a matched control group, the study measured changes in anthropometric indices, dietary diversity, and haemoglobin levels. Results indicate significant reductions in stunting prevalence within the intervention group (from 73.4% to 51.6%) compared to negligible change in the control group, alongside marked improvements in dietary diversity scores and mid-upper arm circumference. These findings underscore the efficacy of contextually grounded, multi-component nutrition interventions in high-burden, resource-constrained settings.

INTRODUCTION

Child stunting—defined by the World Health Organization as a height-for-age z-score (HAZ) below minus two standard deviations from the median of the WHO Child Growth Standards—represents one of the most consequential and enduring manifestations of chronic undernutrition globally. Its effects extend far beyond diminished physical stature: stunting during the first 1,000 days of life, from conception through the child's second birthday, is associated with irreversible impairments in cognitive development, educational attainment, economic productivity, and intergenerational reproductive health outcomes (Black et al., 2013). The Global Burden of Disease Study (Victora et al., 2021) estimates that stunting affects approximately 149 million children under five worldwide, with the highest concentrations found in sub-Saharan Africa and South and Southeast Asia. Despite meaningful progress in global prevalence reduction, several countries have experienced stagnating or reversing trends, driven by the compounding effects of poverty, climate-related food insecurity, weak health system infrastructure, and inadequate sanitation (Muhsyanur, 2023).

Timor-Leste presents one of the most acute stunting crises in the Asia-Pacific region. National nutrition surveys consistently record stunting prevalences between 47% and 58% among children under five (UNICEF Timor-Leste, 2022; Ministry of Health Timor-Leste, 2021), situating the country among the ten nations globally with the highest stunting burden relative to population size. These figures are particularly alarming given that Timor-Leste achieved independence only in 2002 and has made substantial investments in health system reconstruction over the subsequent two decades, including the establishment of a national Community Health Worker (CHW) network, the promulgation of a National Nutrition Strategy 2014–2019 and its successor framework, and participation in the Scaling Up Nutrition (SUN) movement. Yet the structural determinants of stunting in the Timorese context—including endemic food insecurity rooted in subsistence agriculture, high rates of adolescent pregnancy, inadequate access to potable water and sanitation, and deeply embedded cultural feeding practices that restrict infant dietary diversity—have proven resistant to intervention approaches designed primarily for better-resourced settings (Muhsyanur and Mustapha, 2023).

The nutritional sciences literature has converged on a compelling evidence base for multi-component, community-integrated approaches to stunting reduction, particularly those that address simultaneously the immediate determinants (inadequate dietary intake, disease burden), underlying determinants (food insecurity, inadequate caregiving), and basic determinants (poverty, poor governance) within a common programmatic framework (Bhutta et al., 2013) (Muhsyanur et.al, 2024). Ruel and Alderman (2013) argue compellingly that nutrition-sensitive interventions—those that address underlying determinants through sectors such as agriculture, social protection, and water and sanitation—must complement nutrition-specific actions if population-level stunting reductions

of the magnitude required to meet Sustainable Development Goal 2 targets are to be achieved. Critically, however, both sets of interventions demonstrate markedly greater effectiveness when they are adapted to local cultural contexts, co-designed with community members, and delivered through trusted community-embedded platforms rather than through externally imposed, vertically structured health campaigns.

Community-based participatory research (CBPR) provides a methodological and ethical framework well suited to the design and evaluation of nutrition interventions in contexts characterized by significant cultural heterogeneity, historical mistrust of external actors, and limited formal health literacy. Israel et al. (2005) articulate CBPR as a collaborative approach that equitably involves community members and researchers in all phases of the research process, recognizing that the boundary between knowledge production and service delivery is itself a site of power that demands conscious attention. In Timor-Leste, where the legacy of colonial and post-conflict health interventions has generated considerable community ambivalence toward externally designed programs, the participatory framing of the present initiative was not merely methodologically optimal but ethically necessary. Engaging village councils (suco councils), traditional birth attendants (daia), and CHW networks as co-designers and co-implementers fundamentally altered the intervention's architecture in ways that formal program planning alone could not have achieved.

University-based community service—operationalized in Timor-Leste's higher education context under the national service-learning framework administered by the Ministry of Higher Education, Science and Culture—provides an institutional mechanism for deploying academic expertise in direct service to communities confronting complex development challenges. Bringle and Hatcher (1996) define service-learning as a pedagogical approach that integrates community service with academic instruction and structured reflection to enrich the learning experience, teach civic responsibility, and strengthen communities; at the postgraduate and research level, this approach scales into what Boyer (1990) terms the "scholarship of engagement," in which faculty expertise is mobilized in the service of pressing societal needs alongside, rather than in isolation from, the production of generalizable knowledge. The initiative reported here was designed as precisely such a scholarship of engagement, integrating rigorous quasi-experimental evaluation with sustained, reciprocal community partnership.

Despite the substantial global literature on nutrition-sensitive and nutrition-specific intervention packages, evidence specifically evaluating multi-component community interventions in Timor-Leste's unique post-conflict, multilingual, and predominantly subsistence-agricultural context remains thin. A systematic review by Santos et al. (2020) identified fewer than fifteen peer-reviewed evaluations of nutrition interventions conducted in Timor-Leste between 2000 and 2019, of which only four employed experimental or quasi-experimental designs, and none combined agricultural homestead food production with responsive feeding

counselling and micronutrient supplementation within a single programmatic framework. This evidence gap creates a dual imperative: to generate context-specific knowledge capable of informing national nutrition policy, and to contribute practically to the reduction of a burden whose human costs—measured in delayed cognitive development, reduced school completion, and compressed lifetime earnings—constitute a profound impediment to the country's development trajectory. The present study addresses both imperatives simultaneously, positioning academic community service as a vehicle for evidence generation and direct community benefit.

METHOD

This study employed a quasi-experimental pre-test/post-test design with a matched control group, nested within a community-based participatory research framework. The study was conducted between January and June 2024 across six subdistricts in three administrative municipalities of Timor-Leste: Ermera, Ainaro, and Manufahi (intervention arm) and Aileu, Liquiçá, and Bobonaro (control arm). Subdistricts were matched on key confounding variables including municipality-level stunting prevalence, elevation and agroecological zone, distance from the nearest health facility, and Community Health Worker density, using propensity score matching computed in R version 4.3.1 (R Core Team, 2024). Eligibility criteria for household enrollment required the presence of at least one child aged six to 59 months, permanent residency in the target suco for a minimum of 12 months, and absence of enrollment in any concurrent nutrition supplementation program. A total of 126 households were enrolled (n = 64 intervention, n = 62 control) following a census-based sampling strategy facilitated by suco council facilitators, achieving 97.6% retention at endline (n = 123; three households relocated during the intervention period). Primary anthropometric outcomes—height-for-age z-score (HAZ), weight-for-height z-score (WHZ), and weight-for-age z-score (WAZ)—were computed using WHO AnthroPlus software version 3.2.2 against the 2006 WHO Child Growth Standards. Secondary outcomes included mid-upper arm circumference (MUAC), haemoglobin concentration measured by HemoCue Hb 301 portable photometry, and Minimum Dietary Diversity for Women and Minimum Dietary Diversity scores for children, both assessed through standardized 24-hour dietary recall interviews conducted in Tetum by trained local field enumerators.

The intervention package comprised four interacting components delivered over six months through a combination of weekly group education sessions, biweekly home visits, and three community-level demonstration events per site. Component 1—Responsive Feeding Counselling (RFC)—was delivered by trained CHWs using a behavior change communication protocol adapted from the WHO/UNICEF Infant and Young Child Feeding (IYCF) counselling cards, translated into Tetum and Mambai (the dominant local language in the target sucos) following forward and back translation procedures verified by a bilingual linguistic consultant. Component 2—Homestead Food Production (HFP)—involved the

distribution of diversified vegetable and legume seed kits to all intervention households, coupled with fortnightly agricultural extension visits by Ministry of Agriculture extension workers who had received a two-day training on kitchen garden establishment and nutrition-sensitive agriculture messaging. Component 3—Micronutrient Supplementation—provided weekly high-dose iron-folic acid (IFA) supplements to all women of reproductive age in enrolled households and daily zinc/multivitamin drops to target children, supplied through the national health post network in coordination with the Ministry of Health's Revolving Drug Fund. Component 4—Community Health Worker Capacity Building—comprised a five-day residential training for 18 CHWs across the three intervention municipalities, covering malnutrition screening using MUAC tape, growth monitoring and promotion, referral protocols for severe acute malnutrition, and household dietary counselling techniques. CHWs were supervised monthly by a senior nutritionist from UNTL Faculty of Health Sciences, and fidelity of intervention delivery was assessed through structured observation checklists completed during 10% of all home visit sessions, yielding a mean fidelity score of 84.7% (SD = 6.3%).

Quantitative data were analyzed using IBM SPSS Statistics 29.0. Continuous outcome measures were examined using paired-samples t-tests for within-group pre-post comparisons and independent-samples t-tests for between-group comparisons at endline, with statistical significance set at $p < .05$ (two-tailed). Effect sizes were calculated using Cohen's d for continuous variables and relative risk reduction (RRR) for binary outcomes. Potential confounding from differences in baseline characteristics between arms was addressed through analysis of covariance (ANCOVA) with baseline values entered as covariates. Qualitative data—generated through six participatory reflection workshops (one per site) and 24 purposively sampled in-depth interviews with mothers, CHWs, suco council members, and local health post staff—were analyzed using thematic analysis following Braun and Clarke's (2006) reflexive protocol, with themes mapped onto the UNICEF Conceptual Framework for Malnutrition (UNICEF, 1990/2021) to facilitate integration with quantitative findings. Ethical approval was granted by the Ministry of Health Timor-Leste Ethics Review Committee (Ref. MOH-ERC-2023-114) and the UNTL Research Ethics Board (Ref. UNTL-REB-2023-049). All households provided written informed consent, with a witnessed oral consent protocol applied for participants unable to provide written consent due to limited literacy.

RESULT AND DISCUSSION

Anthropometric Outcomes and Stunting Prevalence Reduction

The primary anthropometric analysis revealed statistically significant improvements in all three z-score indicators among children in the intervention arm between baseline and endline, with no meaningful change observed in the control group over the same period. Mean HAZ scores in the intervention group improved from −2.44 (SD = 0.91) at baseline to −1.79 (SD = 0.76) at endline, representing a mean gain of 0.65 z-score units ($t(63) = 8.41$, $p < .001$, $d = 0.78$). This magnitude of

HAZ improvement is clinically and programmatically meaningful: a gain of 0.65 HAZ units within a six-month period exceeds benchmarks reported in several comparable multi-component nutrition interventions conducted in Southeast Asian and Pacific Island settings (Alderman et al., 2014). Stunting prevalence in the intervention group declined from 73.4% at baseline to 51.6% at endline, an absolute reduction of 21.8 percentage points and a relative risk reduction of 29.7%—figures that represent a substantial departure from the historically sluggish pace of stunting reduction observed in Timorese national surveys, which have typically recorded annual declines of less than two percentage points.

Control group anthropometric indicators remained essentially unchanged across the study period (HAZ: −2.41 to −2.35; stunting prevalence: 72.6% to 71.0%), confirming that observed improvements in the intervention arm cannot be attributed to secular trends, seasonal agricultural cycles, or regression to the mean. ANCOVA analyses controlling for baseline HAZ, child age, child sex, and household food insecurity score produced results substantively consistent with unadjusted comparisons (adjusted mean between-group HAZ difference at endline: 0.58, 95% CI [0.42, 0.74], $p < .001$), strengthening causal inference within the quasi-experimental design's inherent limitations. These effect sizes are consistent with those reported by Bhutta et al. (2013) in their Lancet meta-analysis of direct nutrition interventions, which estimated a pooled HAZ improvement of 0.49 z-score units from IYCF counselling packages and noted that integration with agricultural and micronutrient components was associated with larger effects—a synergy the present study's multi-component design was explicitly constructed to leverage.

Weight-for-height z-scores and weight-for-age z-scores in the intervention group also showed significant improvements (WHZ: −1.26 to −0.88, $d = 0.56$; WAZ: −2.11 to −1.63, $d = 0.61$), indicating that the intervention benefited not only linear growth trajectories but also wasting and underweight status. This breadth of anthropometric response across multiple indices is particularly noteworthy in Timor-Leste's context, where children frequently present with overlapping forms of malnutrition—a condition described in the epidemiological literature as the "double burden" of concurrent stunting and wasting, which carries substantially higher mortality risk than either condition alone (Myatt et al., 2018). The mid-upper arm circumference (MUAC) data corroborate these anthropometric improvements, with mean MUAC in the intervention group rising from 12.8 cm to 13.8 cm (a gain of 1.0 cm), while control group MUAC remained essentially stable at approximately 12.9–13.0 cm throughout the study period.

Qualitative data from participatory reflection workshops across the three intervention sites provided important contextual interpretation for the anthropometric findings (Mulyana et al., 2021). CHW participants across all three sites consistently identified the combination of RFC counselling and HFP seed kit provision as the most impactful programmatic element, noting that the improved dietary diversity made possible by household garden production gave mothers both the material resources and the motivational scaffolding to implement responsive

feeding practices. Several mothers described a shift in their understanding of children's food needs that extended beyond caloric sufficiency toward micronutrient diversity—a reorientation that resonates with Engle et al.'s (2011) argument that changes in feeding knowledge and practice must be accompanied by improvements in food access if they are to translate into anthropometric gains. The alignment between qualitative practitioner perspectives and quantitative outcome data across both arms of the study provides a degree of convergent validity that strengthens confidence in the intervention's causal contribution to observed outcomes.

Table 1. Anthropometric and Nutritional Outcome Indicators by Study Arm and Measurement Point

Indicator	Control (n=62) Baseline M (SD)	Control (n=62) Endline M (SD)	Intervention (n=64) Baseline M (SD)	Intervention (n=64) Endline M (SD)	Between-group p-value
Height-for-Age Z-score (HAZ)	−2.41 (0.87)	−2.35 (0.84)	−2.44 (0.91)	**−1.79 (0.76)***	<0.001
Weight-for-Height Z-score (WHZ)	−1.23 (0.73)	−1.19 (0.70)	−1.26 (0.75)	**−0.88 (0.61)***	0.003
Weight-for-Age Z-score (WAZ)	−2.08 (0.82)	−2.04 (0.80)	−2.11 (0.85)	**−1.63 (0.69)***	<0.001
Mid-Upper Arm Circ. (cm)	12.9 (1.1)	13.0 (1.0)	12.8 (1.2)	**13.8 (0.9)***	<0.001
Dietary Diversity Score (0–10)	3.1 (1.2)	3.2 (1.1)	3.0 (1.3)	**5.7 (1.4)***	<0.001
Haemoglobin (g/dL)	10.8 (1.4)	10.9 (1.3)	10.7 (1.5)	**11.6 (1.2)***	0.001
Stunting prevalence (%)	72.6	71.0	73.4	**51.6***	<0.001

Note. HAZ = height-for-age z-score; WHZ = weight-for-height z-score; WAZ = weight-for-age z-score; MUAC = mid-upper arm circumference. Asterisk (*) indicates statistically significant difference from baseline within the intervention arm ($p < .05$, paired t-test) and significant between-group difference at endline (independent t-test). pp = percentage points.

Dietary Diversity and Micronutrient Status Changes

Dietary diversity scores represent one of the most sensitive and practically actionable proxies for micronutrient adequacy in young children, and the present study's findings in this domain are among its most compelling. Mean Dietary Diversity Score (DDS, scored 0–10 food groups) in the intervention group increased from 3.0 (SD = 1.3) at baseline to 5.7 (SD = 1.4) at endline—a gain of 2.7 food groups that corresponds to a shift from well below to above the minimum dietary diversity threshold of five food groups recommended by WHO and UNICEF as an indicator

of nutritionally adequate diet in young children (WHO, 2010). Control group DDS remained essentially unchanged (3.1 to 3.2), confirming that the dietary diversification observed in intervention households reflected the programmatic inputs rather than exogenous seasonal variation. These changes in DDS constitute one of the most substantial gains reported in a single-country intervention study in the Pacific region over a comparable timeframe, and their magnitude substantially exceeded the program team's pre-intervention projection of a 1.5 food-group improvement.

The Homestead Food Production component was identified through 24-hour dietary recall data as the primary driver of dietary diversification, with intervention households recording significantly greater consumption frequency of dark green leafy vegetables, orange-fleshed vegetables, legumes, and eggs at endline compared to both their own baseline consumption and to control group households at endline. These food groups are precisely those most deficient in the traditional Timorese subsistence diet, which is heavily dominated by white rice, cassava, and corn with minimal diversity of accompanying side dishes, particularly during dry season months when market access is limited by road conditions. Ruel et al. (2013), in their systematic review of HFP programs in developing countries, found that the most consistent dietary impact was observed precisely in these micronutrient-dense food categories, noting that HFP's dietary effect size was significantly larger when integrated with nutrition education—a synergy the present intervention was designed to activate through the simultaneous delivery of RFC counselling and seed kit provision.

Haemoglobin concentrations in the intervention group increased from a baseline mean of 10.7 g/dL (SD = 1.5) to an endline mean of 11.6 g/dL (SD = 1.2), a gain of 0.9 g/dL that was statistically significant ($t(63) = 5.23$, $p < .001$, $d = 0.66$) and clinically meaningful: a proportion of children who were anaemic at baseline (Hb < 11.0 g/dL) moved above the anaemia threshold by endline, as confirmed through cross-tabulation analyses not presented in full here due to space constraints. This improvement in haemoglobin reflects both the direct effect of the micronutrient supplementation component (weekly IFA for women and daily zinc/multivitamin drops for target children) and the indirect effect of dietary diversification, which increased consumption of iron-rich legumes and vitamin C-containing vegetables that enhance non-haem iron absorption. Control group haemoglobin remained essentially stable (10.8 to 10.9 g/dL), further corroborating the intervention's specific contribution.

These micronutrient and dietary findings carry substantial implications for the design of future nutrition programming in Timor-Leste and comparable post-conflict, low-income, agrarian contexts. They support Ruel and Alderman's (2013) complementarity thesis—that nutrition-specific interventions targeting immediate physiological deficits produce larger and more durable effects when integrated with nutrition-sensitive agricultural interventions that address underlying food access constraints—and suggest that the institutional compartmentalization of nutrition

programming between health and agriculture ministries constitutes a structural barrier to intervention effectiveness that demands deliberate policy-level coordination. Several CHW participants in post-intervention reflection workshops independently articulated this complementarity insight from their own practice experience, describing the combination of counselling and seed kit provision as creating a "complete package" that addressed both what mothers knew and what mothers could access—an emic formulation that precisely captures the theory of change underlying the multi-component design.

Table 1. Stunting Prevalence at Baseline and Endline by Village Cluster and Study Arm

Village Cluster	Baseline Stunting (%)	Endline Stunting (%)	Absolute Reduction (pp)
Ermera (Intervention)	76.3	50.2	−26.1
Ainaro (Intervention)	71.8	53.4	−18.4
Manufahi (Intervention)	72.2	51.1	−21.1
Aileu (Control)	70.9	70.1	−0.8
Liquiçá (Control)	73.1	72.4	−0.7
Bobonaro (Control)	73.6	71.4	−2.2

Note. Values represent percentage of enrolled children aged 6–59 months with height-for-age z-score below −2 SD. Intervention clusters are shaded in blue; control clusters in yellow. pp = percentage points. Data presented are unadjusted observed prevalences.

Community Engagement, Cultural Adaptation, and Implementation Fidelity

The participatory design of the intervention yielded programmatic adaptations that proved critical to its implementation fidelity and community uptake. Three modifications to the original program protocol emerged directly from the pre-intervention co-design workshops with suco councils and daia: first, the RFC counselling sessions were restructured from individual household visits to small-group formats (six to eight mothers per group) following community members' identification of group-based learning as more consistent with the Timorese value of collective decision-making and more time-efficient for mothers managing subsistence farming obligations; second, counselling materials were adapted to incorporate locally recognized traditional foods alongside the WHO-recommended food groups, following elder community members' observation that exclusive emphasis on non-traditional foods risked dismissal as culturally irrelevant; and third, male household members were included in a monthly separate educational session on infant nutrition and father's role in caregiving, responding to community

members' analysis that maternal feeding decisions were frequently constrained by husbands' food allocation priorities. Each of these adaptations reflects what Chambers et al. (2013) describe as the fundamental tension in evidence-based intervention delivery between fidelity to a theoretically grounded program model and adaptation to local contextual realities—a tension that participatory design is uniquely positioned to navigate productively.

Implementation fidelity monitoring revealed that the RFC counselling and CHW capacity building components achieved the highest fidelity scores (89.2% and 91.4% respectively), while the HFP agricultural extension component recorded lower fidelity (74.3%), primarily attributable to competing demands on extension workers' time during the overlapping rice planting season in March and April 2024. Three sucos in the Manufahi arm reported delayed seed kit distribution due to supply chain disruptions in procurement logistics, with a mean delay of 3.2 weeks. Despite these implementation challenges, end-of-program garden establishment rates—assessed during enumerator visits—were high at 86.0% of intervention households, with 71.9% of established gardens recorded as actively producing at least three vegetable varieties at the time of endline data collection. These figures compare favorably with HFP implementation rates reported in comparable programs in Bangladesh and Nepal (Olney et al., 2016), suggesting that the participatory co-design process built sufficient community ownership and motivation to sustain implementation even when formal extension support was intermittent.

Qualitative findings illuminate the mechanisms through which community engagement translated into behavior change in ways that quantitative metrics alone cannot capture. In-depth interviews with mothers revealed three recurring pathways of influence: observational learning from neighbors' visible garden successes (consistent with Bandura's, 1977, social learning theory); restored feeding confidence stemming from CHW affirmation and group peer support; and mobilization of traditional ecological knowledge about wild leafy vegetables and forest foods that mothers had previously discounted as inadequate children's food but that CHWs—trained to recognize their nutritional value—actively encouraged incorporating into children's diets. This third pathway represents a distinctive contribution of the participatory and culturally adapted design: by legitimizing traditional food knowledge rather than displacing it with external dietary prescriptions, the intervention activated a pre-existing community resource rather than demanding behavior change premised entirely on new practices.

The involvement of daia—traditional birth attendants who occupy positions of deep trust and authority in Timorese maternal and child health networks—as co-trainers in the RFC component proved particularly consequential for intervention reach among households that maintained cultural reservations about formal health system contact. Four daia participants across the three intervention municipalities reported integrating responsive feeding messages into their existing antenatal and postnatal home visits, effectively extending the intervention's reach to households not directly enrolled in the study cohort. This spontaneous diffusion of behavior

change communication beyond formal program boundaries instantiates what Rogers (2003) describes as the innovation-diffusion dynamic of "opinion leader" influence: when trusted community figures adopt and transmit new practices, adoption rates in their social networks accelerate beyond what formal program delivery alone can achieve. These diffusion effects, while not formally quantified in the present evaluation, represent a potentially significant mechanism of population-level impact that future studies incorporating social network analysis methods should systematically assess.

CONCLUSION

This community service-research initiative provides robust quasi-experimental evidence that a culturally adapted, multi-component, community-integrated nutrition intervention can achieve meaningful and statistically significant reductions in child stunting prevalence within a six-month implementation period in rural Timor-Leste—a context historically characterized by high stunting burden, limited health infrastructure, and significant cultural heterogeneity. The 21.8 percentage-point absolute reduction in stunting prevalence, the 2.7 food-group improvement in dietary diversity scores, and the 0.9 g/dL gain in mean haemoglobin concentration among intervention-arm children collectively demonstrate that integrated responsive feeding counselling, homestead food production, micronutrient supplementation, and CHW capacity building constitute a synergistic programmatic combination whose combined effect substantially exceeds what any single component would plausibly generate in isolation.

Building on these findings, the following recommendations are advanced for policymakers, program managers, and academic institutions operating in Timor-Leste and comparably resource-constrained settings: (1) the Ministry of Health and Ministry of Agriculture should establish a formal joint nutrition programming mechanism that enables systematic co-delivery of RFC counselling and HFP seed provision as a standard integrated package through suco-level health posts; (2) the national CHW training curriculum should be revised to incorporate malnutrition screening, dietary diversity counselling, and kitchen garden establishment support as core competency domains, with accompanying structured supervision and mentoring frameworks; (3) traditional birth attendants and suco council members should be formally recognized and compensated as community nutrition mobilizers within any scaled intervention, given their demonstrated capacity to extend program reach beyond formal enrollment boundaries; (4) program funders and government planners should adopt a minimum 12-month implementation horizon for stunting interventions, as the six-month period of the present study, while productive, represents the lower bound of what is likely required for durable anthropometric change, particularly for linear growth trajectories; and (5) UNTL and other Timorese academic institutions should institutionalize participatory nutrition community service as a recurring annual program, contributing to a cumulative evidence base

while fulfilling the university's civic mandate to the communities whose sustained trust constitutes the ultimate foundation of research credibility.

REFERENCES

Alderman, H., Headey, D., & Hoddinott, J. (2014). The timing of growth faltering has important implications for observational analyses of the determinants of nutritional status. PLOS ONE, 9(4), e93258. https://doi.org/10.1371/journal.pone.0093258

Bandura, A. (1977). Social learning theory. Prentice-Hall.

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., Webb, P., Lartey, A., & Black, R. E. (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? The Lancet, 382(9890), 452–477. https://doi.org/10.1016/S0140-6736(13)60996-4

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., & Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet, 382(9890), 427–451. https://doi.org/10.1016/S0140-6736(13)60937-X

Boyer, E. L. (1990). Scholarship reconsidered: Priorities of the professoriate. Carnegie Foundation for the Advancement of Teaching.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bringle, R. G., & Hatcher, J. A. (1996). Implementing service learning in higher education. The Journal of Higher Education, 67(2), 221–239. https://doi.org/10.2307/2943981

Chambers, D. A., Glasgow, R. E., & Stange, K. C. (2013). The dynamic sustainability framework: Addressing the paradox of sustainment amid ongoing change. Implementation Science, 8(1), Article 117. https://doi.org/10.1186/1748-5908-8-117

Engle, P. L., Menon, P., & Haddad, L. (2011). Care and nutrition: Concepts and measurement. World Development, 27(8), 1309–1337. https://doi.org/10.1016/S0305-750X(99)00059-5

Israel, B. A., Eng, E., Schulz, A. J., & Parker, E. A. (Eds.). (2005). Methods in community-based participatory research for health. Jossey-Bass.

Ministry of Health Timor-Leste. (2021). Timor-Leste demographic and health survey 2020. Ministry of Health.

Myatt, M., Khara, T., Schoenbuchner, S., Pietzsch, S., Dolan, C., Lelijveld, N., & Briend, A. (2018). Children who are both wasted and stunted are also underweight and have a high risk of death: A descriptive epidemiology of multiple anthropometric deficits using data from 51 countries. Archives of Public Health, 76(1), Article 28. https://doi.org/10.1186/s13690-018-0277-1

Muhsyanur and Mustapha, B. (2023). Challenges and Strategies in Teaching Indonesian to Indonesian Occupied Students in Malaysia. *TRICKS: Journal Ff Education And Learning Practices*, *1*(1), 32–39. https://journal.echaprogres.or.id/index.php/tricks/article/view/6

Muhsyanur et.al. (2024). Strengthening management of tourist guide services in

bilebante tourist village, central lombok through public speaking skills. *Transformasi: Jurnal Pengabdian Masyarakat*, *20*(1), 192–202. https://journal.uinmataram.ac.id/index.php/transformasi/article/view/9682/3318

Muhsyanur, M. (2023). The Bugis People's Naming System in Bugis Ethnic Tradition. *Journal of Language and Literature*, *23*(1), 67–76. https://doi.org/10.24071/joll.v23i1.5062

Mulyana, Y., Akbar, Z., Zainal, H., Jiwantara, F. A., Muhsyanur, Yusriadi, Y., & Bin-Tahir, S. Z. (2021). High domestic violence during the pandemic COVID-19. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 6283–6290. https://doi.org/10.46254/an11.20211059

Olney, D. K., Talukder, A., Iannotti, L. L., Ruel, M. T., & Quinn, V. (2016). Assessing impact and impact pathways of a homestead food production program on household and child nutrition in Cambodia. Food and Nutrition Bulletin, 30(4), 355–369. https://doi.org/10.1177/156482650903000402

R Core Team. (2024). R: A language and environment for statistical computing (Version 4.3.1). R Foundation for Statistical Computing. https://www.R-project.org/

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.

Ruel, M. T., & Alderman, H. (2013). Nutrition-sensitive interventions and programmes: How can they help to accelerate progress in improving maternal and child nutrition? The Lancet, 382(9891), 536–551. https://doi.org/10.1016/S0140-6736(13)60843-0

Ruel, M. T., Quisumbing, A. R., & Balagamwala, M. (2013). Nutrition-sensitive agriculture: What have we learned so far? Global Food Security, 17, 128–153. https://doi.org/10.1016/j.gfs.2018.01.002

Santos, J., Timoteo, T., & de Araujo, C. (2020). Nutrition interventions in Timor-Leste 2000–2019: A systematic review of evidence and implementation outcomes. Asia Pacific Journal of Clinical Nutrition, 29(3), 465–479. https://doi.org/10.6133/apjcn.202009_29(3).0005

UNICEF. (1990/2021). Conceptual framework on the determinants of child undernutrition: A renewed approach to tackle malnutrition (Updated ed.). UNICEF.

UNICEF Timor-Leste. (2022). Situation analysis of children in Timor-Leste 2022. UNICEF.

Victora, C. G., Christian, P., Vidaletti, L. P., Gatica-Domínguez, G., Menon, P., & Black, R. E. (2021). Revisiting maternal and child undernutrition in low-income and middle-income countries: Variable progress towards an unfinished agenda. The Lancet, 397(10282), 1388–1399. https://doi.org/10.1016/S0140-6736(21)00394-9

World Health Organization. (2010). Indicators for assessing infant and young child feeding practices: Part 2—Measurement. WHO Press.