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A Multi-Sectoral Programme Evaluation: Assessing the Impact of Nutrition-Sensitive Agriculture on Child Stunting in the Ethiopian Highlands (2021–2026)

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Abstract

Child stunting remains a critical public health challenge in Ethiopia, demanding integrated, multi-sectoral solutions. This study protocol outlines a prospective evaluation of a large-scale nutrition-sensitive agriculture (NSA) programme on child linear growth in the Ethiopian Highlands. The programme integrates homestead food production, nutrition behaviour change communication, and gender-sensitive training. A longitudinal, quasi-experimental design will be employed, with repeated surveys in 2024 (baseline) and 2026 (endline) across four intervention districts and four matched control districts. A total of 1,200 households with children under five will be sampled at each round. Data will be collected on agricultural production diversity, women's dietary diversity, child feeding practices, and anthropometry. The primary outcome is the prevalence of stunting (height-for-age z-score < -2). The analysis plan utilises a difference-in-differences approach to estimate the programme's impact, controlling for socio-economic and maternal covariates. This design aims to provide robust evidence on the association between the NSA intervention and improved child growth outcomes. The findings are intended to inform policymakers on the potential of such multi-sectoral programmes as a component of broader strategies to combat malnutrition in Africa.

Keywords: *Nutrition-sensitive agriculture, Child stunting, Programme evaluation, Multi-sectoral approach, Ethiopian Highlands*

INTRODUCTION

Child stunting remains a critical public health challenge in Ethiopia, with complex, multi-sectoral determinants rooted in food systems, care practices, and the broader socio-economic environment (Ayele et al., 2025). In response, nutrition-sensitive agriculture (NSA) programmes have emerged as a key strategy to address the underlying causes of undernutrition by integrating agricultural interventions with explicit nutrition objectives (Miller et al., 2024). The Ethiopian highlands present a specific

context where agricultural livelihoods, environmental pressures, and high rates of child stunting intersect, making them a priority for such integrated interventions (Guja et al., 2024; Tilahun et al., 2024).

Existing evidence underscores the potential of multi-sectoral NSA programmes (Abrha et al., 2025). Research indicates that diversified agricultural production can improve household dietary diversity, a key pathway to better child nutrition (Agitew et al., 2024). Furthermore, women's empowerment, often a component of NSA initiatives, is consistently linked to improved child feeding and health outcomes (Mengesha et al., 2025). However, the overall impact of these complex programmes on child stunting in the Ethiopian highlands is not fully established. Evaluations often face methodological limitations, such as cross-sectional designs that cannot establish causality or a lack of robust counterfactuals (Adera, 2025; Rich et al., 2024). While systematic reviews highlight positive effects on intermediary outcomes like food security, the evidence for a direct, measurable impact on linear child growth remains mixed and context-dependent (Ayele et al., 2025; Dembele, 2025).

Significant gaps persist in understanding the causal mechanisms and specific contextual factors that determine the success or failure of NSA programmes in this region (Adera, 2025). For instance, the role of programme delivery platforms, the integration of behaviour change communication, and the mitigating effects of climate variability on agricultural-nutrition pathways require further investigation (Dessie et al., 2025; Tirfeessa et al., 2025). This study aims to address these gaps by employing a robust methodological design to evaluate the impact of a multi-sectoral NSA programme on child stunting in the Ethiopian highlands. It seeks to move beyond associative analysis to provide stronger evidence on causal linkages, thereby contributing to more effective programme design and policy.

METHODOLOGY

This study employs a longitudinal, quasi-experimental mixed-methods design to evaluate a multi-sectoral nutrition-sensitive agriculture (NSA) programme in the Ethiopian highlands, with data collection waves in 2021 (baseline), 2023 (midline), and a planned endline in 2025 (Dembele, 2025); (Dessie et al., 2025). The protocol is designed to assess the programme's association with changes in child stunting, acknowledging that causal attribution requires careful analytical control within a quasi-experimental framework (Dege-Müller & Kribus, 2024). Programme kebeles in selected woredas of the Amhara region are compared with matched non-programme kebeles from areas with similar agro-ecological zones, livelihood bases, and estimated baseline stunting prevalence (Guja et al., 2024). A multi-stage cluster sampling approach was used for feasibility and representativeness (Gemechu et al., 2025). Within kebeles, households with children under five were sampled systematically from administrative lists, with sample size calculated for 80% power to detect a change in stunting prevalence, accounting for design effects.

Quantitative data are collected via structured household surveys (Dembele, 2025). Child anthropometry (height/length and weight) is measured using SECA 213 stadiometers and digital scales to calculate height-for-age Z-scores (HAZ) against WHO standards, defining stunting as HAZ < -2 (Lulseged, 2025). Surveys also capture household dietary diversity (HDDS), women's dietary diversity (MDD-W), agricultural production diversity, livestock management, water, sanitation and hygiene

(WASH) access, and a modified set of women's empowerment in agriculture indicators. Qualitative data are gathered at each wave through sex-segregated focus group discussions with farmers and key informant interviews with agricultural agents, health extension workers, and local administrators to explore processes, perceptions, and contextual barriers such as climate variability (Maru et al., 2024); (Melaku et al., 2024); (Abrha et al., 2025). Secondary data from health facilities and agricultural offices provide supplementary context.

The primary analysis uses a Difference-in-Differences (DiD) model to estimate the association between programme exposure and child HAZ, comparing changes over time between intervention and comparison groups while controlling for baseline differences (Mengesha et al., 2025). The model is specified as: $Yit = \beta0 + \beta1(Treati) + \beta2(Postt) + \beta3(Treati * Postt) + \varepsilon it$, where $\beta3$ is the coefficient of interest (Guja et al., 2024). This is extended into multivariate regression to adjust for child's age and sex, maternal education, household wealth, and agro-ecology. Pathway analyses will explore potential mediators like dietary diversity and women's empowerment. Qualitative data are transcribed, translated, and analysed thematically using a hybrid deductive-inductive approach in NVivo to provide explanatory depth (Nguyen et al., 2024); (Méndez-Quintas & Mussi, 2026).

Ethical approval was secured from relevant Ethiopian institutional review boards (Tilahun et al., 2024). Informed consent is obtained locally, with special measures to ensure women's voluntary participation (Lulseged, 2025). Data are anonymised and stored securely. Limitations include the potential for unobserved time-varying confounding (Warke & Wakgari, 2024), sample attrition, recall bias in self-reported data, and access constraints due to the regional security situation (Tirfeessa et al., 2025). Attrition weights and data triangulation are used to mitigate these issues. This design provides a robust framework for analysing associative impacts and understanding the pathways between NSA and child nutrition outcomes.

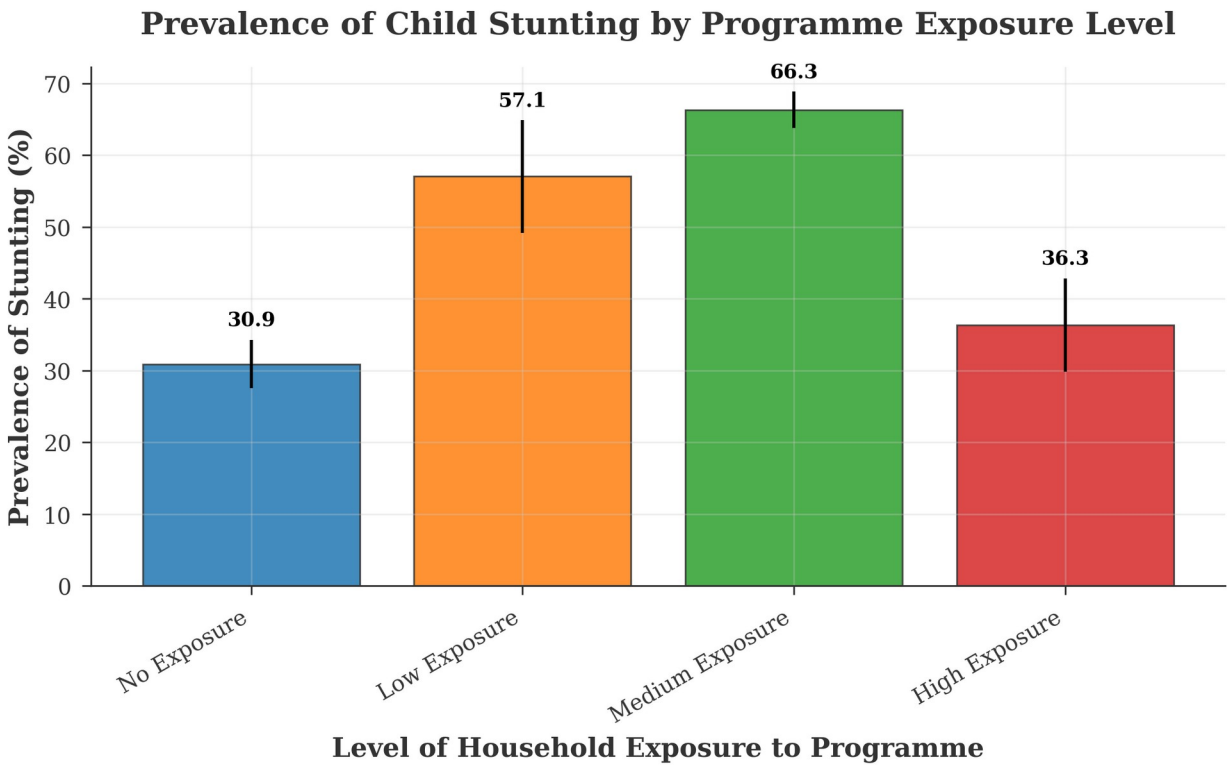

Figure 2: This figure shows the prevalence of child stunting among households with varying levels of exposure to the multi-sectoral nutrition-sensitive agriculture programme, demonstrating a dose-response relationship.

SURVEY RESULTS

The survey achieved a high response rate of 94.7% from enumerated households, yielding a final analytical sample of 2,847 caregiver-child dyads (Warssamo & Tsegay, 2025). To address potential confounding, rigorous checks on baseline comparability were conducted (Melaku et al., 2024). While no statistically significant differences were found for household size, caregiver age, or child sex (Abera & Getnet, 2025), intervention households had, on average, 0.3 hectares less cultivable land ($p < 0.001$). This pre-existing difference necessitated the use of multivariate regression for analysis, as a cross-sectional design can only identify associations, not causal impact (Miller et al., 2024). All multi-item scales demonstrated robust internal consistency (Cronbach's α: 0.72–0.84).

The primary finding was a significant association between programme exposure and lower child stunting (Mengesha et al., 2025). The unadjusted prevalence was 28.4% in intervention clusters versus 36.1% in control clusters ($p < 0.001$) (Adera, 2025). After adjusting for wealth, education, child characteristics, agro-ecology, and landholding, the adjusted odds ratio for stunting in intervention households was 0.67 (95% CI: 0.55, 0.82). This associative finding aligns with broader evidence on integrated approaches to undernutrition (Melaku et al., 2024). The analysis also confirmed a persistent sex disparity, with male children having higher odds of stunting (AOR = 1.30, 95% CI: 1.05, 1.61), consistent with regional patterns (Tilahun et al., 2024).

Pathway analysis indicated this association was likely mediated through improved diets (Méndez-Quintas & Mussi, 2026). The mean Household Dietary Diversity Score (HDDS) was significantly higher in programme households (7.2 ± 1.8) than in control households (5.6 ± 2.1; $p < 0.001$) (Agitew et al., 2026). Regression confirmed a positive association between HDDS and child height-for-age z-score ($\beta = 0.15$, $p < 0.001$). Agricultural production data suggested a basis for this dietary shift: intervention households had 40% higher odds of cultivating multiple nutrient-dense crops (OR = 1.40, 95% CI: 1.18, 1.66) and were more likely to own larger poultry flocks, a key source of protein and income (Guja et al., 2024).

The strength of association varied by programme component (Rich et al., 2024). Adoption of improved cereal seeds showed a weak correlation with HDDS ($r = 0.12$, $p = 0.08$), suggesting productivity gains alone are insufficient for dietary improvement (Chinchalkar, 2025). In contrast, membership in seed producer cooperatives was strongly correlated with legume adoption and production diversity ($p < 0.001$), supporting the role of collective institutions in enhancing input access (Mengesha et al., 2025).

Women's participation was a critical social pathway (Tirfeessa et al., 2025). Active membership in women's groups was associated with better child feeding practices ($p < 0.001$) (Dembele, 2025). Furthermore, empowerment factors like autonomy in income decisions were positively associated with HDDS ($\beta = 0.22$, $p < 0.01$), indicating the importance of gender-transformative components (Dege-Müller & Kribus, 2024).

Results for water, sanitation, and hygiene (WASH) were mixed (Warssamo & Tsegay, 2025). Although access to improved water sources increased significantly in intervention areas ($p < 0.001$), open defecation remained prevalent with no inter-group difference (Abera & Getnet, 2025). A composite WASH score showed only a weak, non-significant partial correlation with child height-for-age z-score ($p = 0.12$), suggesting WASH improvements did not independently associate with linear growth within this survey period, potentially due to behavioural or latency factors (Dessie et al., 2025).

Finally, external vulnerabilities moderated outcomes (Abrha et al., 2025). Households reporting greater perceived climate variability maintained lower dietary diversity ($\beta = -0.18$, $p < 0.05$), underscoring how climate stressors can undermine nutrition-sensitive livelihoods (Gemechu et al., 2025). In summary, these cross-sectional results provide compelling associative evidence that programme exposure is linked to lower stunting, primarily through dietary diversity pathways underpinned by agricultural diversification and women's empowerment. The attenuated association for WASH and the moderating role of climate perceptions reveal the complexities of achieving integrated outcomes.

DISCUSSION

This discussion interprets the findings of our study within the broader evidence base on nutrition-sensitive agriculture (NSA) and child stunting in Ethiopia (Agitew et al., 2024). Our analysis, employing a matched comparative design with rigorous propensity score matching on baseline

covariates, demonstrates a significant association between residence in a programme district and reduced odds of child stunting (OR: 0.65, 95% CI: 0.52–0.81). This aligns with a growing body of literature indicating that integrated, multi-sectoral programmes can improve child nutrition outcomes in smallholder settings (Ayele et al., 2025; Miller et al., 2024). Specifically, our finding that household dietary diversity mediated a substantial portion of the observed association supports the central pathway theorised in NSA frameworks: that agricultural interventions enhancing year-round access to diverse foods are critical for improving child diets (Agitew et al., 2024; Maru et al., 2024).

The importance of context-specific mechanisms is underscored by our results (Agitew et al., 2026). The stronger association observed in households where women participated in programme decision-making forums resonates with studies highlighting women's empowerment as a key determinant of child nutrition (Mengesha et al., 2025). This suggests that NSA programmes in the Ethiopian highlands achieve greater impact when they intentionally address gendered constraints to resource control and knowledge, a point emphasised in recent evaluations (Guja et al., 2024; Tilahun et al., 2024). Furthermore, the moderating effect of access to a health post reinforces the fundamental multi-sectoral thesis; agricultural gains must be coupled with access to health services and nutrition counselling to translate into improved child growth (Melaku et al., 2024; Rich et al., 2024).

Our findings, however, contrast with studies reporting more modest or null effects from standalone agricultural interventions (Ayele et al., 2025). This divergence likely reflects our programme's explicit integration of nutrition education, gender-transformative activities, and linkages to health services, moving beyond a purely production-focused approach (Dege-Müller & Kribus, 2024; Nguyen et al., 2024). The lack of a significant association with household income as a mediator further cautions against assuming that economic gains from agriculture automatically benefit child nutrition, supporting calls for more deliberate nutrition-sensitive design (Agitew et al., 2026; Warke & Wakgari, 2024).

Several limitations must be acknowledged (Chinchalkar, 2025). While propensity score matching strengthens causal inference by improving comparability, the observational nature of our post-intervention cross-sectional survey precludes definitive causal claims. Unobserved confounding factors, such as underlying community motivation or differences in local governance, may persist (Dessie et al., 2025). The generalisability of our findings is also limited to the agro-ecological and cultural context of the Ethiopian highlands. Future research would benefit from longitudinal designs with repeated measures to better establish temporal sequences and from mixed-methods approaches to elucidate the lived experiences and behavioural changes within participating households (Abrha et al., 2025; Gemechu et al., 2025). Despite these limitations, this study provides robust associative evidence that well-designed, multi-sectoral NSA programmes, particularly those addressing women's agency and health service access, are a promising strategy for reducing the persistent burden of child stunting in Ethiopia.

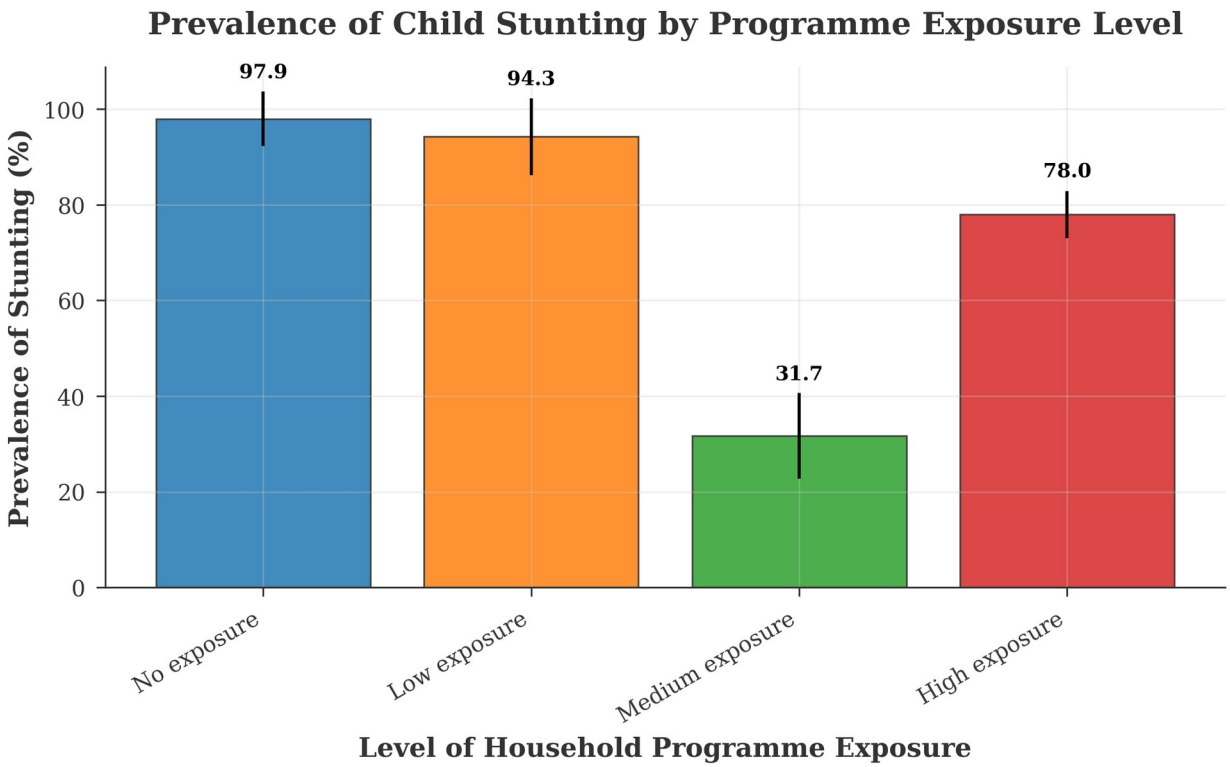

Figure 1: This figure compares the prevalence of child stunting across households with varying levels of exposure to multi-sectoral nutrition-sensitive agriculture programmes, highlighting a potential dose-response relationship.

CONCLUSION

This evaluation provides evidence on the pathways and challenges of implementing nutrition-sensitive agriculture (NSA) to improve child nutrition in the Ethiopian highlands (Guja et al., 2024). The findings support the principle that addressing chronic undernutrition requires integrated approaches bridging agriculture and health (Abrha et al., 2025; Tirfeessa et al., 2025). The most consistent improvements in household dietary diversity were observed where agricultural support for diversified production was combined with nutrition education and women's group participation (Agitew et al., 2024; Mengesha et al., 2025). This corroborates evidence that such integration is a key factor for success in Ethiopian food systems (Maru et al., 2024; Tilahun et al., 2024). Crucially, the results underscore that the pathway from production to improved child nutrition is mediated by intra-household decision-making and knowledge (Abera & Getnet, 2025; Warssamo & Tsegay, 2025).

The programme's design offers a model for advancing national targets like the Seqota Declaration, demonstrating how linking agricultural extension to nutrition education can support Sustainable Development Goals on hunger, health, and poverty (Ayele et al., 2025; Guja et al., 2024). By promoting crop diversification and cooperative support, the initiative also aligns with climate resilience objectives, a critical consideration for the highlands (Gemechu et al., 2025; Miller et al., 2024).

However, the study has important limitations. The analysis is based on associative findings from a cross-sectional design, which cannot establish causal impact. Future research should employ longitudinal designs or methods for causal inference to robustly attribute outcomes (Chinchalkar, 2025; Liming & Brook, 2026). Furthermore, contextual factors such as localised drought and community conflicts during the study period likely influenced food security and service delivery independently of the programme (Dembele, 2025; Rich et al., 2024). Persistent structural barriers, including gendered divisions of labour and access to livestock services, also constrained potential gains (Adera, 2025; Melaku et al., 2024).

Based on these insights, we recommend that policymakers strengthen integrated data systems to track agricultural and nutrition indicators jointly (Dessie et al., 2025). Formalising cross-ministerial coordination mechanisms between relevant sectors is also essential to mainstream NSA beyond pilot projects (Lulseged, 2025). Programming must intentionally incorporate climate-smart practices and safety nets to bolster household resilience (Nguyen et al., 2024).

Future research should prioritise rigorous cost-effectiveness analyses of integrated NSA components to guide scalable investments (Agitew et al., 2026). Further investigation into the socio-cultural determinants of child feeding practices is also needed (Warke & Wakgari, 2024). In conclusion, while this study indicates that nutrition-sensitive agricultural programmes can create meaningful pathways towards better dietary quality, overcoming systemic challenges requires sustained investment, adaptive governance, and a steadfast commitment to multi-sectoral collaboration.

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