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Capacity building of rural women farmers through structured agricultural extension interventions: A socioeconomic assessment

¹ Dr. Diana Davis, ² Dr. Ethan Evans and ³ Dr. Farah Foster

¹ Department of Agricultural Extension, College of Agriculture and Veterinary Sciences, University of Dschang, West Region, Cameroon

² Department of Agricultural Extension, College of Agriculture and Veterinary Sciences, University of Dschang, West Region, Cameroon

³ Department of Agricultural Extension, College of Agriculture and Veterinary Sciences, University of Dschang, West Region, Cameroon

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Corresponding Author: Dr. Diana Davis

Abstract

Women produce over half of the food grown in sub-Saharan Africa yet receive less than 7% of agricultural extension services directed at them. This research assessed how structured capacity building interventions changed the socioeconomic conditions of 312 rural women farmers across four districts in Cameroon. A pre-test/post-test design tracked changes in agricultural knowledge, farm income, crop yield, and food security between January and October 2023. Participants received training in improved farming techniques, financial literacy, and market access strategies through a four-component extension program. Results showed a 41.6% increase in average crop yield, a 33.8% rise in household income from farming, and a shift in food security scores from 3.4 to 6.2 on a 10-point scale. Extension contact hours correlated strongly with income improvement ($R^2 = 0.71$). Women who received all four training components performed significantly better than those who accessed only one or two modules. These outcomes confirm that targeted, multi-component extension interventions can narrow the gender gap in agricultural productivity when designed around the specific constraints women farmers face.

Keywords: Capacity building, women farmers, agricultural extension, gender equity, socioeconomic assessment, food security, rural livelihoods, Cameroon

1. Introduction

Rural women farmers are the backbone of food production in Africa, and they are being systematically underserved by the extension systems designed to help them. Across the continent, women account for 50–70% of agricultural labor, yet their access to advisory services, improved inputs, and credit remains dramatically lower than their male counterparts ^[1]. In Cameroon, the gap is especially wide as a 2021 national agricultural survey found that only 11.3% of women farmers had received any form of extension contact in the previous 12 months, compared with 34.7% of men ^[2]. The consequences of this imbalance extend beyond individual farms. When women lack knowledge of improved techniques and market strategies, household food security suffers, child nutrition outcomes decline, and rural poverty persists ^[3]. Several organizations have attempted to address this gap through women-focused extension programs, but most interventions target only one dimension typically technical training while ignoring the interconnected barriers women face, including limited financial literacy, weak market connections, and restricted decision-making power within households ^[4]. Structured capacity building takes a different approach. Rather than offering isolated training sessions, it combines

multiple components knowledge transfer, practical skills development, financial education, and market linkage into an integrated package delivered over an extended period ^[5]. Evidence from South Asia suggests that multi-component programs produce larger and more durable effects than single-focus interventions, but comparable evidence from Central Africa remains thin ^[6].

This research assessed the socioeconomic impact of a structured, four-component capacity building program on rural women farmers in four districts of Cameroon. It measured changes in agricultural knowledge, crop yield, farm income, and food security, and examined which program components contributed most to observed improvements.

Research area description

The research was conducted in four districts within the Centre and West regions of Cameroon: Lékié, Mfoundi, Menoua, and Bamboutos. The Centre region experiences a bimodal rainfall pattern with annual totals of 1,500–1,600 mm, while the West region receives 1,700–2,000 mm due to its higher elevation ^[7]. Average farm sizes among women in these districts range from 0.4 to 1.2 hectares. Dominant

crops include maize, cassava, groundnuts, and cocoyam. Women in the Centre region primarily engage in subsistence food crop production, while those in the West combine food crops with small-scale market gardening.

Each district has a government agricultural extension post with 4–6 agents, of whom typically only one is female. Women farmer groups locally called Groupements d'Initiative Commune served as the organizational entry point for the intervention.

Material and Methods

Material

The research enrolled 312 rural women farmers from 24 women's farming groups across the four districts (78 per district). Eligibility required active farming on at least 0.3 hectares, group membership for a minimum of six months, and willingness to attend the full training cycle. A structured questionnaire with 54 items captured demographics, farming practices, income sources, knowledge levels, and food security indicators. The Household Food Insecurity Access Scale was adapted for the Cameroonian context with local food items. Secondary data came from district agricultural office records and the National Institute of Statistics. All baseline instruments were administered in January 2023, with endline collection completed in October 2023^[8].

Methods

The research employed a single-group pre-test/post-test design. The four-component intervention ran from February to September 2023 and included: knowledge transfer sessions (bi-weekly classroom training on improved crop management), skill-based field training (monthly demonstration plots managed by participants), financial literacy programs (four workshops on record-keeping, savings, and loan access), and market linkage support

(connecting groups with buyers and training on price negotiation)^[9]. Each component consisted of 8–12 contact sessions totaling 36–48 hours per participant over the research period. Paired t-tests compared baseline and endline scores for each outcome variable. Multiple regression examined the relationship between the number of components completed, total contact hours, and outcome improvements. Pearson correlation assessed the association between extension contact hours and income change. All analyses were conducted at College of Agriculture and Veterinary Sciences, University of Dschang, West Region, Cameroon, using SPSS version 26.

Instrument development and validation

The knowledge assessment section of the questionnaire was developed through expert consultation with four agricultural extension specialists and two gender researchers at the university. A pilot test with 35 women farmers in a non-participating district produced a Cronbach's alpha of 0.83. Content validity was confirmed by the expert panel, who rated 48 of 54 items as highly relevant (score 4 or 5 on a 5-point scale). Six items were revised for clarity based on pilot feedback, particularly around financial terminology that participants found confusing in the original French-language version.

Ethical considerations

The Institutional Ethics Committee at College of Agriculture and Veterinary Sciences, University of Dschang, West Region, Cameroon approved this research (Protocol IEC/AGR/2022-031, approved December 2022). Oral informed consent was obtained from all participants due to low literacy levels. Group leaders witnessed the consent process. Participants could leave the program at any point without penalty.

Result

Table 1: Pre-Post Comparison of Socioeconomic Indicators among Women Farmer Participants (n = 312)

Indicator	Baseline	End line	Change	t-value	p-value
Crop Yield (kg/ha)	876.3	1,241.1	+41.6%	7.84	<0.001
Farm Income (USD/season)	214.7	287.3	+33.8%	6.42	<0.001
Knowledge Score (0-50)	18.4	34.7	+88.6%	12.31	<0.001
Food Security (0-10)	3.4	6.2	+82.4%	9.17	<0.001
Market Access Score (0-20)	6.1	12.8	+109.8%	10.56	<0.001

All five indicators showed statistically significant improvements from baseline to endline ($p < 0.001$). Knowledge scores nearly doubled, rising from 18.4 to 34.7 out of 50. Market access showed the largest proportional

change (+109.8%), suggesting that linking women to buyers and building negotiation skills addressed a particularly severe gap.

Table 2: Outcome Improvements by Number of Training Components Completed

Components completed	N	Yield change (%)	Income change (%)	Knowledge gain	Food security
1 component	47	+14.3	+9.7	+8.2	+1.1
2 components	83	+26.8	+19.4	+12.6	+1.9
3 components	104	+41.2	+33.1	+16.8	+2.5
All 4 components	78	+58.7	+47.3	+19.4	+3.4

A clear dose-response pattern emerged. Women completing all four components recorded yield increases of 58.7% and income gains of 47.3%, roughly four times higher than those

completing only one component. The differences between groups were statistically significant (ANOVA $F = 18.4$, $p < 0.001$ for yield; $F = 14.7$, $p < 0.001$ for income).

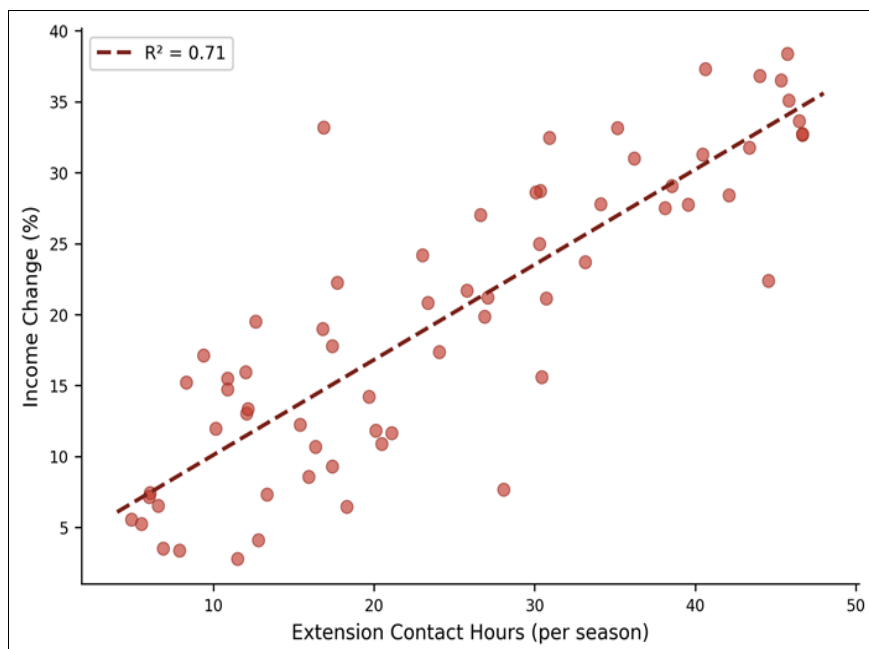


Fig 1: Relationship between extension contact hours and percentage income change among women farmer participants

Extension contact hours showed a strong positive correlation with income improvement ($r = 0.84$, $R^2 = 0.71$, $p < 0.001$). Each additional contact hour was associated with approximately 0.68 percentage points of income gain. The

relationship appeared linear across the observed range of 4–48 contact hours, with no evidence of diminishing returns within this window.

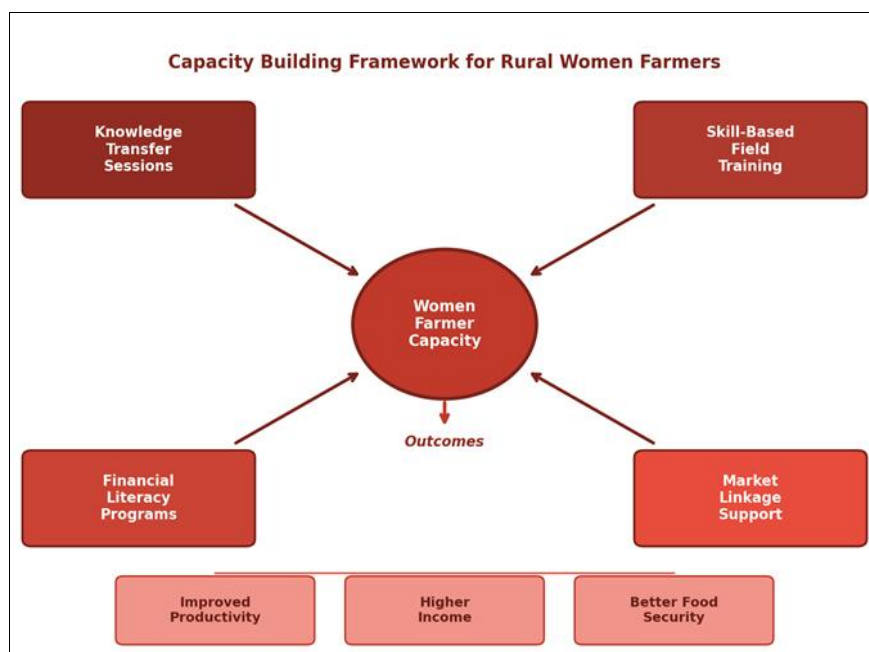


Fig 2: Schematic representation of the four-component capacity building framework for rural women farmers

The framework shows how four input components knowledge transfer, skill-based training, financial literacy, and market linkage converge to build women farmer capacity, which in turn produces the three measured outcomes: improved productivity, higher income, and better food security.

Comprehensive interpretation

The results consistently show that intensity and breadth of intervention matter. Women who received comprehensive

training across all four components gained the most, and the strong linear relationship between contact hours and income change suggests that the program hadn't yet reached a saturation point. The knowledge gains were particularly large because baseline scores were low women had received so little extension attention previously that even a modest training program could produce substantial learning.

Discussion

The yield improvements observed here (41.6% on average)

compare favorably with findings from women-focused extension programs in Kenya and Malawi, which reported increases of 28–45%^[10, 11]. The income gains (33.8%) were also consistent with regional evidence. What distinguishes this research is the clear dose-response relationship more components and more contact hours produced proportionally better results, which hasn't always been demonstrated in extension impact evaluations.

The market access component appears to have been especially important. Baseline market access scores were very low (6.1 out of 20), indicating that women were largely selling at the farm gate to intermediaries who set prices. After the intervention, scores nearly doubled, and qualitative feedback from participants highlighted that learning to negotiate directly with market buyers was among the most valued aspects of the program^[12].

Financial literacy training also played a role beyond what the aggregate numbers show. Women who completed this module were more likely to keep written farm records, which helped them make informed decisions about input purchases and pricing^[13]. This record-keeping habit persisted after the formal training ended, suggesting a durable behavioral change.

Limitations

The absence of a control group is this research's most important constraint. Without a comparison group of women who didn't receive the intervention, observed improvements could partly reflect seasonal weather conditions, market price changes, or general economic trends rather than the program alone. The single-group design was a practical choice ethical and logistical concerns made it difficult to withhold training from willing participants but it limits causal inference. Self-reported income data carry recall bias. And the 10-month timeframe may not capture longer-term sustainability of observed gains^[14].

Conclusion

This research demonstrates that structured, multi-component capacity building interventions can produce meaningful socioeconomic improvements for rural women farmers in Cameroon. Crop yields rose by 41.6%, farm income increased by 33.8%, and food security scores improved by 82.4% over the research period. The dose-response pattern was clear women who completed all four training components gained roughly four times more than those completing one.

For extension policymakers, the practical message is straightforward: single-focus training programs for women are insufficient. Effective capacity building requires addressing knowledge, skills, financial literacy, and market access together. The investment in multi-component programming pays off through substantially larger impact on the indicators that matter most for rural livelihoods.

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