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Backyard Agricultural Activities and Household Food Security and Financial Resilience among Civil Servants in Mubi North, Adamawa State

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Abstract

This study examines the relationship between backyard agricultural participation, household food security and financial resilience among civil servants in Mubi North, Adamawa State. A quantitative cross-sectional framework combines descriptive analysis, correlation analysis and multivariable regression to assess food insecurity, dietary diversity and short-term financial capacity. Robust estimation and alternative specifications examine whether the findings depend on model or outcome choices. Participation is associated with lower food insecurity, greater dietary diversity and stronger composite financial capacity after adjustment for household characteristics. However, the separate expense-adequacy model does not establish a statistically significant association, indicating that financial conclusions depend on the outcome definition. The study distinguishes food retained for consumption from cash sales and production costs, while recognising that current financial capacity does not demonstrate sustained income security. The findings illustrate the potential complementarity between residential production and wage-based livelihoods without establishing causal or population effects. The study recommends evaluating voluntary, locally suitable agricultural support alongside reliable water access, extension services and adequate wages.

Keywords: Backyard Agriculture; Household Food Security; Dietary Diversity; Financial Resilience; Civil Servants

1.0 Introduction

Regular employment does not remove household exposure to food-price changes, dependency burdens or unexpected expenditure. A fixed salary can provide predictable nominal income while leaving food purchasing power vulnerable. Civil servant households therefore offer a useful setting for studying whether supplementary food production is associated with welfare beyond the regularity of employment. The supplied proposal identifies this problem in Mubi North, Adamawa State. This article retains that local focus rather than claiming coverage of the entire state. The Food and Agriculture Organization of the United Nations et al. (2025) identify food-price inflation as a threat to purchasing power and healthy diets. This provides a broader rationale for examining household provisioning without assuming that public employment guarantees food access.

Backyard agriculture is defined here as crop or small-livestock production within or immediately adjacent to the residence, undertaken primarily for consumption with possible surplus sales. Distant commercial farms are excluded. This boundary matters because residential production has different land, labour and marketing requirements from full-time farming. The relevant question is whether

a feasible supplementary activity can improve food access and financial capacity while remaining compatible with formal work.

Food access, dietary variety and financial reserves are related but distinct outcomes. A household can consume its own vegetables without earning additional cash; it can earn sales revenue while incurring input costs; and it can diversify food sources without accumulating emergency savings. Treating these channels as interchangeable would overstate welfare gains. The analysis therefore distinguishes food insecurity, dietary diversity, cash sales, imputed food value and financial capacity.

Three objectives guide the article: to describe participation and its forms; to estimate conditional associations with food insecurity and dietary diversity; and to examine financial capacity and the accounting contribution of agricultural production. The corresponding null hypotheses state that agricultural participation has no conditional association with each of the three primary outcomes.

2.0 Literature Review

2.1 Backyard Agriculture and Household Food Provisioning

Backyard agriculture is a residential production strategy rather than a synonym for all urban farming. Xu et al. (2024) describe home food gardening across small residential spaces, including plots and containers. The present study extends its operational boundary to small livestock and poultry kept at or immediately around the dwelling. This definition excludes distant commercial farms and protects the comparison from combining enterprises with very different capital, land and labour requirements.

Production location matters because households can draw on existing residential resources. However, a small plot does not guarantee a low total cost: containers, water, feed and disease control still require expenditure. Mead et al. (2024) describe a generally modest contribution of urban agriculture to food security. The relevant hypothesis is therefore that residential production supplements household provisioning, rather than supplying the entire diet or replacing regular wages.

Enterprise type also matters. In a Bangladesh trial, Lambrecht et al. (2023) connect a homestead programme with poultry production and egg-consumption outcomes. This supports separating crop and animal-source pathways conceptually. It does not imply that poultry and gardening have identical effects. In the present article, activity frequencies are multiple-response descriptions, while the main exposure records any eligible participation; enterprise-specific treatment effects are not estimated.

The distinction between participation and dependence on own production is particularly important in Nigeria. Olabisi et al. (2021) find that producing a larger share of consumed food is not necessarily associated with greater dietary diversity, highlighting the role of markets and nonfarm income. Accordingly, the article examines supplementary participation rather than advocating household food self-sufficiency. Market purchases remain compatible with, and potentially essential to, a diversified household diet.

2.2 Household Food Access and Dietary Diversity

Food access concerns a household's ability to obtain food, whereas dietary diversity describes the variety consumed over a defined reference period. These dimensions can move together without being interchangeable. Ukonu et al. (2024) assess both HFIAS and HDDS in southeastern Nigeria, illustrating the usefulness of parallel measurement. The present framework similarly retains two outcomes instead of collapsing food insecurity and dietary variety into a single unvalidated welfare index.

Experience-based access measures capture difficulties that expenditure alone can miss. Coates et al. (2007) provide the HFIAS instrument, while Swindale and Bilinsky (2006) explain the household dietary-diversity measure. Their measurement guidance remains relevant despite its earlier publication date. Here the analysis uses scale-compatible totals and therefore does not claim validated item-response performance, clinical nutritional status or official HFIAS severity categories in the absence of the original item responses.

Recent intervention evidence shows why dietary outcomes require explicit attention. Waid et al. (2024) report dietary-diversity improvements during and after a homestead programme in Bangladesh using repeated measurements across seasons. The relevance is methodological as well as substantive: repeated observations can distinguish persistent change from a favourable single recall day. A cross-sectional HDDS coefficient cannot independently establish that a household maintains dietary quality throughout the agricultural year.

Food-price conditions further affect how production translates into access. The Food and Agriculture Organization of the United Nations et al. (2025) emphasise that elevated inflation undermines purchasing power and access to healthy diets. For salaried households, the analytical implication is that nominal wage regularity should be distinguished from real food access. Household salary enters the regressions as a resource control; the available records cannot estimate separate inflation or price-shock effects.

2.3 Income Sustainability and Short-Term Financial Resilience

Income sustainability is inherently temporal: it concerns the ability to maintain resources and withstand shocks over time. Financial capacity at one observation is narrower. Barrett et al. (2001) distinguish the motives and consequences of livelihood diversification, providing a basis for analysing additional activities without automatically equating them with resilience. The present financial-capacity index combines essential-expense adequacy and liquid reserves and is explicitly treated as a short-term proxy.

Backyard production can create two different resource flows. Sales generate cash, whereas retained produce contributes food valued at an imputed price. These flows should be accounted for separately because consumed output cannot directly service a cash payment. Zezza and Tasciotti (2010) motivate examining production and household welfare without assuming a dominant agricultural income contribution. The article deducts purchased costs from combined output value but does not label the result economic profit.

Programme continuity also affects financial interpretation. Blakstad et al. (2022) show that early dietary gains need not persist at later follow-up, despite continued differences in crop growing. This cautions against translating one favourable outcome into a claim of durable household security. In financial terms, continuing expenditure on water, inputs or animal care could weaken the value of an initially attractive enterprise. These potential time-varying costs require observed accounts rather than assumed constant returns.

The policy question is consequently whether agriculture complements, rather than substitutes for, a viable wage and food-market system. The food-price analysis of the Food and Agriculture Organization of the United Nations et al. (2025) reinforces the importance of purchasing power. This study therefore reports the composite and a separate binary adequacy model. Agreement across those outcomes would strengthen descriptive coherence; disagreement requires a qualified interpretation rather than selective emphasis on the significant specification.

2.4 Resource Constraints and Heterogeneous Household Opportunities

Access to productive resources can influence both participation and welfare. Khumalo et al. (2024) review climate-smart approaches to food and income security in urban sub-Saharan Africa, drawing attention to environmental and production conditions. The present model includes land and water access because these resources can shape the feasibility of backyard activities. Their coefficients are conditional associations and should not be interpreted as experimentally identified returns to resource provision.

Time is another binding resource for salaried households. Becker's (1965) household-production framework makes the opportunity cost of labour central to household decisions. A civil servant may value food provisioning but face limited time for feeding animals, watering or marketing. Blakstad et al. (2022) identify implementation barriers to sustained gardening outcomes; the implication for this study is to avoid assuming that continued participation itself demonstrates a positive net welfare return.

Gender indicators also require restrained interpretation. Waid et al. (2022) evaluate women's empowerment within a homestead-production programme using a dedicated empowerment measure. That approach differs from including respondent sex as a control variable. The current records contain a female indicator but no validated bargaining, ownership or unpaid-work scale. Consequently, the article cannot infer empowerment effects or identify which household member controls agricultural proceeds from the gender coefficient alone.

Institutional and crisis conditions may further limit transferability. Baliki et al. (2023) identify a divide between enthusiasm for home-garden interventions and the evidence available in crisis settings. Their discussion motivates attention to implementation conditions rather than presuming a uniform gardening technology. In Mubi North, actual evaluation would need to document resource access, security and support exposure directly; those contextual mechanisms are not estimated from the present household controls.

2.5 Empirical Evidence and the Unresolved Research Gap

Experimental and observational findings answer different questions. Blakstad et al. (2021) report improved dietary outcomes after a Tanzanian gardening intervention, while their later follow-up identifies weaker persistence (Blakstad et al., 2022). These findings are compatible when implementation and time are considered. They caution against framing the literature as uniformly favourable and show why the effect of a support package should not be confused with the cross-sectional association of self-selected participation.

The FAARM evidence supplies a complementary example. Waid et al. (2024) find sustained dietary-diversity gains, while Lambrecht et al. (2023) examine poultry production and egg consumption within the same broader programme. These are related analyses rather than independent replications of an identical intervention. Their contribution is to clarify multiple pathways and the value of repeated measurement; their numerical effects are not benchmark estimates for civil servants in northeastern Nigeria.

Nigerian evidence also limits simple extrapolation. Olabisi et al. (2021) stress market access and income opportunities in interpreting own-production dependence, whereas Ukonu et al. (2024) document food-access and diversity concerns in Nsukka households. Neither population is equivalent to the civil servant households proposed for Mubi North. The gap is therefore occupational, geographic and measurement-related, rather than a claim that agriculture–food-security relationships have never been studied in Nigeria.

The present article addresses that gap at the level of analytical design. It links one consistently coded participation variable to two dietary outcomes and an independently defined financial-capacity measure, with the same covariates across models. Mead et al. (2024) call for stronger evidence on urban agriculture and food security, a need consistent with this structured approach. The illustration remains separate from an empirical contribution based on newly collected observations.

2.6 Theoretical Framework

Household production theory provides the primary microeconomic foundation. Becker (1965) models households as combining time and purchased resources to produce valued household goods. Applied here, residential space, labour and inputs can generate food for consumption or sale. This implies that participation can affect welfare through noncash provisioning even when salary is unchanged. It also implies that benefits should be assessed net of resource costs and competing uses of household time.

The sustainable livelihoods framework supplies the complementary asset perspective. Chambers and Conway (1991) emphasise capabilities, assets and vulnerability rather than income alone. Land, water, knowledge and salary therefore appear as enabling resources rather than merely background descriptors. Baliki et al. (2023) reinforce the importance of context for whether home-garden pathways operate. This study uses resource controls to improve comparability, without claiming that a small covariate set fully represents household livelihood assets.

Livelihood diversification adds a risk-management explanation. Barrett et al. (2001) show why multiple activities can reflect either opportunity or distress. The expected participation sign is favourable for food access when own production supplements purchases, but financial gains are not guaranteed when expenses or correlated production risks offset output. Khumalo et al. (2024) motivate considering climate and adaptation alongside production. Actual income stability would require repeated observations of both agricultural and wage-resource flows.

Together, these perspectives imply three testable conditional associations: lower food-insecurity scores, higher dietary diversity and higher financial capacity among participants, after measured resource differences are considered. The expectations are not restrictions on estimation and are not universal causal propositions. The contrasting follow-up patterns in Blakstad et al. (2022) and Waid et al. (2024) support allowing outcomes and time horizons to differ. The separate adequacy model provides an explicit opportunity for financial findings to diverge.

2.7 Conceptual Framework and Correspondence with the Models

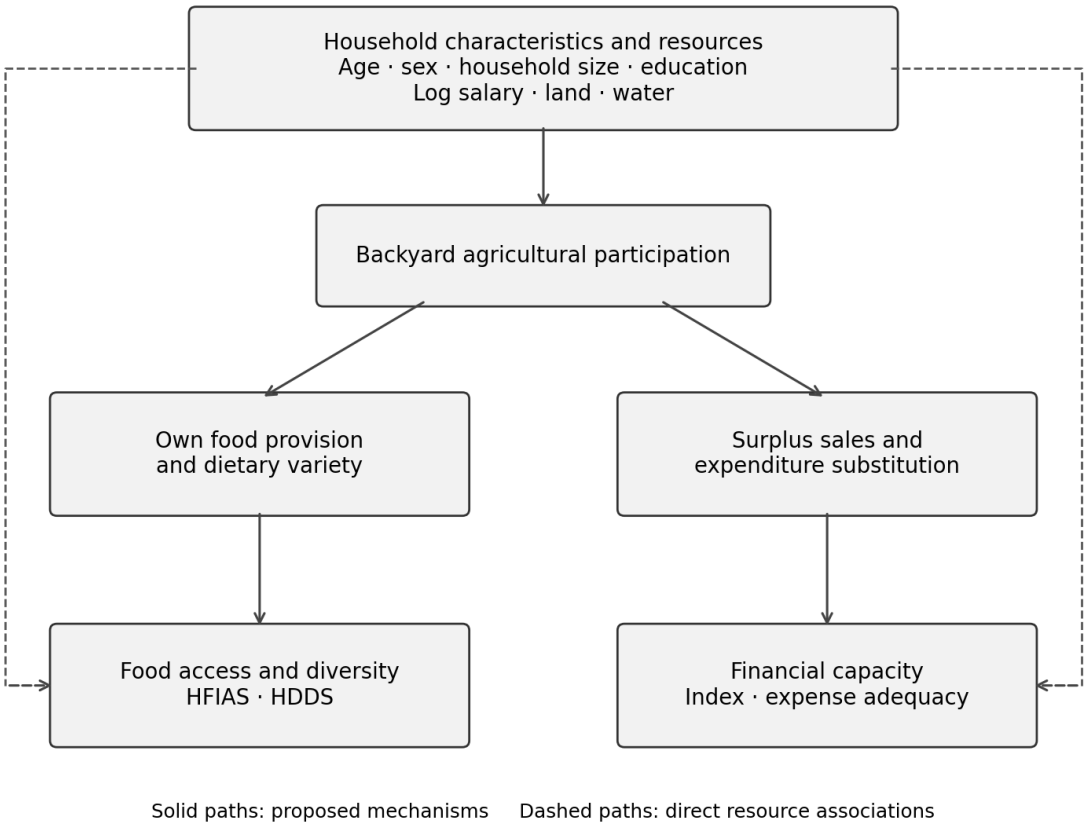
The conceptual framework connects household characteristics to participation and to welfare outcomes, while distinguishing provisioning from financial pathways. The resource block contains age, respondent sex, household size, education, log salary, land and water access. These are exactly the covariates in equations (1)–(3). The exposure is any eligible backyard participation. Following the mechanisms discussed by Mead et al. (2024), access and consumption outcomes remain separate from financial resources.

The first proposed pathway runs from participation through own-produced food to food access and dietary variety. The second runs through surplus sales and expenditure substitution to household financial capacity. Lambrecht et al. (2023) demonstrate why production and consumption pathways deserve separate scrutiny, while Waid et al. (2024) show the relevance of repeated dietary measurement. Here these arrows represent theoretical mechanisms; the regression models do not estimate mediation or separately identify the contribution of each channel.

Direct paths from household resources to outcomes represent potential confounding. For example, salary can influence food purchases and the ability to finance production, while water can affect residential production opportunities. Unmeasured preferences, health and prior farming experience may influence both. Olabisi et al. (2021) use panel methods to address some persistent unobserved household differences; the present cross-section has no such within-household identification and retains an associational interpretation.

The outcome block maps directly to HFIAS, HDDS and financial capacity, with expense adequacy as an alternative financial outcome. No arrow is treated as evidence that all four dimensions of food security or long-term income sustainability have been measured. The distinction is consistent with the parallel food-access and diversity assessment in Ukonu et al. (2024). Figure 1 summarises this author-developed framework; it is a model of proposed relationships rather than an estimated causal network.

Figure 1 Conceptual pathways linking backyard agriculture and household welfare



Note. Author-developed framework. Proposed pathways are not estimated mediation effects. Unobserved confounding remains possible; the outcome regressions estimate conditional associations.

3.0 Methodology

3.1 Research design

The study follows a quantitative household-survey to examine backyard agricultural activities, household food security and income sustainability among civil servants. A structured cross-sectional questionnaire provides the intended measurement framework for comparing participants and non-participants. Descriptive statistics, correlation analysis and regression analysis address the three study objectives. In accordance with the quantitative-only scope of this study, key informant interviews, focus group discussions and thematic analysis are excluded. The numerical results in this study are calculated from 384 administered questionnaires.

3.2 Description of the study area

The study setting is Mubi North Local Government Area of Adamawa State in northeastern Nigeria. The study identifies its urban and peri-urban residential areas as relevant to the combination of

formal employment and supplementary household agriculture. Backyard gardening, poultry keeping, small livestock production and residential crop cultivation form the agricultural activities considered in this study.

The study identifies Kolere, Sabon Layi, Shuware, Muchalla, Vimtim and Mayo Bani as suitable locations because of their residential and agricultural characteristics and the presence of civil servant households. The geographic scope remains Mubi North rather than the whole of Adamawa State.

3.3 Population and sampling procedure

The target population consists of male and female civil servants employed in public-sector institutions within Mubi North, covering different employment cadres, grades, ministries, departments and agencies. Both civil servants engaged in backyard agricultural activities and those not participating are included. The respondent supplies household-level food-security and income information; the household is the welfare observation, so duplicate reporting by two civil servants in the same household were prevented.

The study adopts a multistage sampling procedure. In the first stage, wards are purposively selected on the basis of urban and peri-urban characteristics, concentration of civil servants and observable backyard agricultural activities. In the second stage, simple random selection of eligible civil servants is undertaken within the selected locations using staff lists from ministries, departments and agencies, supplemented by relevant union and residential-association records after deduplication. Random selection at the second stage applies to eligible people on the selected-location lists. It gives every civil servant across all wards of Mubi North an equal inclusion probability.

3.4 Sample size determination

The study uses Cochran's sample-size formula, $n_0 = Z^2p(1 - p)/e^2$, where n_0 is the initial sample requirement, $Z = 1.96$ for 95% confidence, $p = 0.50$ for maximum variability and $e = 0.05$ for the desired precision. Substitution gives $n_0 = (1.96^2 \times 0.50 \times 0.50)/0.05^2 = 384$.

3.5 Data collection instrument and sources

The principal quantitative instrument is a structured questionnaire containing closed-ended questions and Likert-type items. Its sections cover socio-demographic characteristics, employment profile, agricultural participation, enterprise types and production scale, household food security, income sources, income sustainability indicators and constraints. Food access, dietary diversity, agricultural receipts, production costs and liquid reserves provide the operational variables used in the analysis.

The study conducted pilot testing in a neighbouring local government area to assess clarity, consistency and suitability before full questionnaire administration. Appropriate revisions and enumerator training followed that exercise.

The study used the Adamawa State Agricultural Development Programme, National Bureau of Statistics, Ministry of Agriculture and Food and Agriculture Organization as secondary information sources. They provide the intended contextual and administrative background rather than the household records analysed here. No numerical administrative series from those agencies is represented as part of the generated household sample.

Field implementation followed the requirements for informed consent, voluntary participation, confidentiality, privacy and enumerator training.

3.6 Measurement of study variables

Table 1 Operational definitions

Variable	Definition and scale
Participation	Any eligible residential agricultural activity in the hypothetical previous 12 months; 1 yes, 0 no
Food insecurity	HFIAS total proxy, integer 0–27; higher values indicate worse access
Dietary diversity	HDDS total proxy, integer 0–12; higher values indicate greater variety
Expense adequacy	Binary indicator of ability to cover essential monthly spending
Reserve months	Liquid resources divided by essential monthly expenditure; bounded 0–6
Financial capacity	100 × [0.5 × adequacy + 0.5 × min(reserve months / 3, 1)]
Salary	Monthly household civil-service salary in illustrative naira
Accounting contribution	Cash sales + imputed consumed output − purchased production costs

Note. HFIAS and HDDS totals are scale-compatible proxies.

The financial-capacity index is a study-defined descriptive composite, not a validated income-sustainability scale. Its equal weights combine expense adequacy and reserves capped at three months. It excludes current agricultural receipts and imputed output from its formula to avoid a mechanically favourable participation coefficient. Nevertheless, it reflects short-term capacity rather than demonstrated long-term sustainability.

Cash sales, consumed-output value and purchase costs are calculated separately for participants. Consumed output represents food not purchased and is not added to cash income. Accounting contribution is not profit after unpaid labour, depreciation or land opportunity cost. Some households can have negative contributions. Actual field measurement uses crop-cycle accounts and consistent price dates, with 12-month income and output histories to address seasonality.

3.7 Model specification and estimation

Three outcome equations relate backyard agricultural participation to household food access, dietary diversity and the financial-capacity proxy for income sustainability. A common set of controls is used to keep the estimates comparable across outcomes. The specifications are

$$HFIAS_i = \alpha_0 + \alpha_1 BA_i + \alpha_2 AGE_i + \alpha_3 FEMALE_i + \alpha_4 HHSIZE_i +$$

$$\alpha_5 EDU_i + \alpha_6 lnSAL_i + \alpha_7 LAND_i + \alpha_8 WATER_i + \varepsilon_i \quad \text{----------} \quad (1)$$

$$HDDS_i = \beta_0 + \beta_1 BA_i + \beta_2 AGE_i + \beta_3 FEMALE_i + \beta_4 HHSIZE_i +$$

$$\beta_5 EDU_i + \beta_6 lnSAL_i + \beta_7 LAND_i + \beta_8 WATER_i + u_i \quad \text{----------} (2)$$

$$FINCAP_i = \gamma_0 + \gamma_1 BA_i + \gamma_2 AGE_i + \gamma_3 FEMALE_i + \gamma_4 HHSIZE_i +$$

$$\gamma_5 EDU_i + \gamma_6 lnSAL_i + \gamma_7 LAND_i + \gamma_8 WATER_i + v_i \quad \text{----------} \quad (3)$$

HFIAS is the 0–27 food-insecurity access score; HDDS is the 0–12 dietary-diversity score; FINCAP is the 0–100 financial-capacity index; BA equals one for backyard agricultural participation; AGE is age in years; FEMALE equals one for a female respondent; HHSIZE is household membership; EDU is completed years of schooling; lnSAL is the natural logarithm of monthly household civil-service salary; LAND and WATER equal one for access to the respective resource. The subscript i identifies a household. Intercepts and disturbance terms are equation-specific. Male respondents, non-participants and households without the corresponding resource access form the binary reference groups.

The expected participation coefficients are $\alpha_1 < 0$, $\beta_1 > 0$ and $\gamma_1 > 0$. These are theoretical expectations rather than restrictions imposed on estimation. The null hypotheses are $\alpha_1 = 0$, $\beta_1 = 0$ and $\gamma_1 = 0$. Age and female status have no unambiguous prior sign; household size is expected to increase food pressure, while salary and productive resources are expected to improve welfare. Financial capacity remains a short-term proxy and does not establish intertemporal income sustainability.

For the alternative expense-adequacy outcome, the logit model is

$$\ln\left[\frac{P(ADEQ_i = 1)}{1 - P(ADEQ_i = 1)}\right] = \delta_0 + \delta_1 BA_i + \delta' X_i \quad \text{----------} \quad (4)$$

Here X contains the seven controls in equations (1)–(3), excluding the intercept and BA. The reported odds ratio for participation is $\exp(\delta_1)$. In the sensitivity analysis, propensity scores are estimated as $P(BA_i = 1 \mid X_i) = \Lambda(\theta_0 + \theta' X_i)$, where Λ is the logistic distribution function; the inverse-probability weights are $BA_i/p_i + (1 - BA_i)/(1 - p_i)$. Weighted outcome regressions retain the same covariates as the main specifications.

Descriptive frequencies and percentages address participation and agricultural types; means and dispersion describe household welfare. Pearson correlations examine bivariate relationships. For each continuous outcome, the estimated equation is $Y_i = \alpha + \beta D_i + \gamma' X_i + \varepsilon_i$. The covariate vector includes age, female status, household size, education, log salary, land access and water access. The participation coefficient β is interpreted as an adjusted difference in outcome units. Ordinary least squares uses HC3 heteroskedasticity-robust covariance. Welch tests compare unadjusted means without assuming equal group variances; they do not address selection bias.

A binomial logit for expense adequacy uses the same covariates. Its participation estimate is reported as an odds ratio with a heteroskedasticity-robust sandwich 95% confidence interval, not as a percentage-point probability change. An inverse-probability-weighted regression uses estimated participation probabilities from the observed covariates and weights $D_i/p_i + (1-D_i)/(1-p_i)$. This is an associational sensitivity specification; estimated-weight uncertainty is not fully propagated by its HC3 intervals. It is not described as a doubly robust causal estimator.

Additional checks exclude the top and bottom 5% of salary observations and replace the composite outcome with reserve months. Model diagnostics include variance inflation factors and Breusch–Pagan tests. Because only three primary participation comparisons are designated, a Bonferroni threshold of 0.05/3 = 0.0167 is used alongside conventional 95% intervals.

4 Results and Discussion

4.1 Participation and Household Characteristics

Table 2 household characteristics by participation

Characteristic	Participants	Nonparticipants
Households	251	133
Age years	42.95 (9.32)	40.07 (8.70)
Female n percent	102 (40.64)	54 (40.60)
Household size	5.50 (2.38)	5.70 (2.22)
Education years	14.85 (3.35)	15.49 (3.57)
Monthly salary naira	152,285 (50,944)	151,375 (56,753)
Land access n percent	152 (60.56)	59 (44.36)
Water access n percent	167 (66.53)	59 (44.36)

Note. Continuous characteristics are mean (standard deviation); binary characteristics are n (%). Participants n = 251; nonparticipants n = 133. All records are complete.

The sample contains 251 participants and 133 non-participants, equivalent to 65.4% and 34.6%. The group structure provides sufficient observations for the multivariable models.

Differences in land and water access are substantively relevant because the participation process explicitly depends on these resources. A raw welfare difference therefore combines production status with resource selection. The controls improve comparability within the constructed sample; they do not turn the comparison into a randomized experiment. Gender differences also reflect assumed probabilities and should not be interpreted as observed barriers among women in Mubi North.

Table 3 Types of agricultural activity among participants

Activity	Number	Percent
Vegetable or home gardening	204	81.27
Poultry keeping	124	49.40
Small livestock	76	30.28
Residential staple crops	76	30.28

Note. Multiple responses; denominator is participating households. Percentages can exceed 100% in total.

The activity profile demonstrates how overlapping enterprises are presented: a poultry keeper can also cultivate vegetables. Adding activity percentages to estimate participation would double count households. The result gives gardening the broadest coverage.

4.2 Unadjusted food and financial outcomes

Table 4 Unadjusted outcome differences

Outcome	Participants mean (SD)	Nonparticipants mean (SD)	Difference	Welch p
Food insecurity points	9.06 (4.25)	11.25 (4.18)	-2.18	< 0.0001
Dietary diversity groups	7.18 (1.65)	6.24 (1.75)	0.94	< 0.0001
Financial capacity points	57.88 (27.88)	42.97 (28.90)	14.92	< 0.0001

Note. Group values are mean (standard deviation). Differences equal participant minus nonparticipant means. P values are from two-sided Welch tests; these unadjusted comparisons do not establish causation.

Participants display more favourable average outcomes under the imposed structure. Lower food-insecurity totals represent fewer or less frequent access-related difficulties, whereas higher dietary diversity represents additional food groups. These measures remain separate because a more varied day of consumption does not demonstrate stable access across the year.

The financial index comparison concerns a bounded composite of expense coverage and liquid reserves. It does not mean that agricultural participation raises permanent income by the reported number of points. A household can improve food provisioning while retaining weak cash buffers, and an otherwise well-paid nonparticipant can remain financially secure. The adjusted models examine whether the direction survives measured compositional differences.

Table 5 Pearson correlations among study variables

Pair	Pearson r	p value
Participation and food insecurity	-0.2393	< 0.0001
Participation and dietary diversity	0.2574	< 0.0001
Participation and financial capacity	0.2443	< 0.0001
Food insecurity and dietary diversity	-0.1918	0.0002

Note. Participation correlations are point-biserial correlations expressed as Pearson coefficients; they are unadjusted and do not establish causation.

Correlation analysis complements the descriptive comparisons. The participation correlations describe the direction and strength of linear bivariate associations. The correlation between food insecurity and dietary diversity illustrates whether two welfare measures move together within the sample. These correlations do not control for salary, household resources or selection into agriculture; the multivariable regressions provide the adjusted comparisons.

4.3 Adjusted outcome associations

Table 6 Multivariable OLS estimates with HC3 standard errors

Regressor	Model 1 HFIAS	Model 2 HDDS	Model 3 Financial capacity
Constant	30.9299*** (7.5749)	-1.8452 (3.3722)	-116.5652** (51.1544)
Backyard participation	-2.0890*** (0.4518)	0.9492*** (0.1843)	14.7079*** (3.0364)
Age	0.0367 (0.0248)	-0.0042 (0.0099)	-0.0611 (0.1664)
Female	-0.6321 (0.4246)	-0.1214 (0.1766)	5.2429* (2.8265)
Household size	0.5815*** (0.0880)	-0.1143*** (0.0378)	-3.2477*** (0.5767)
Education years	-0.1145* (0.0650)	0.0232 (0.0296)	0.7390* (0.4327)
Log monthly salary	-1.8692*** (0.6871)	0.7300** (0.3145)	14.1080*** (4.6252)

Regressor	Model 1 HFIAS	Model 2 HDDS	Model 3 Financial capacity
Land access	0.0209 (0.4300)	-0.2772 (0.1741)	-4.0575 (2.7784)
Water access	-0.6034 (0.4154)	0.1261 (0.1757)	2.9632 (2.8982)
Observations	384	384	384
R squared	0.1920	0.1193	0.1765
Adjusted R squared	0.1748	0.1005	0.1589
Robust joint F statistic	11.8197	5.8949	11.1445
Model p value	< 0.0001	< 0.0001	< 0.0001
Residual standard error	3.9508	1.6476	26.6725

Note. Unstandardised OLS coefficients with HC3 robust standard errors in parentheses. N = 384 per model. *** p < .01, ** p < .05, * p < .10; two-sided tests. Joint F tests all eight slopes. Salary enters in natural logarithms. The three primary participation tests also use a Bonferroni threshold of .0167.

Table 7 Primary participation estimates and uncertainty

Outcome	Coefficient	95 percent CI	p value
Food insecurity points	-2.0890	-2.9745 to -1.2036	< 0.0001
Dietary diversity groups	0.9492	0.5880 to 1.3104	< 0.0001
Financial capacity points	14.7079	8.7567 to 20.6591	< 0.0001

Note. Bonferroni threshold for the three primary participation tests is 0.0167.

For food insecurity points, the adjusted participation coefficient is -2.0890 (HC3 robust SE = 0.4518; 95% CI -2.9745 to -1.2036; p < 0.0001). The coefficient is conditional on the included household characteristics and is interpreted as an adjusted association. The estimate is expressed in the original outcome units, rather than as a percentage change or a causal treatment effect.

For dietary diversity groups, the adjusted participation coefficient is 0.9492 (HC3 robust SE = 0.1843; 95% CI 0.5880 to 1.3104; p < 0.0001). The coefficient is conditional on the included household characteristics and is interpreted as an adjusted association. The estimate is expressed in the original outcome units, rather than as a percentage change or a causal treatment effect.

For financial capacity points, the adjusted participation coefficient is 14.7079 (HC3 robust SE = 3.0364; 95% CI 8.7567 to 20.6591; p < 0.0001). The coefficient is conditional on the included household characteristics and is interpreted as an adjusted association. The estimate is expressed in the original outcome units, rather than as a percentage change or a causal treatment effect.

The food-access coefficient is consistent with the modelled own-production channel: a household can obtain some food without purchasing it. The dietary-diversity coefficient illustrates a

complementary channel, particularly when production includes foods outside a narrow staple basket. Neither relationship establishes a change in calorie intake, child growth or micronutrient deficiency because those outcomes were not measured.

The financial-capacity coefficient is conditional on salary and household composition and therefore differs conceptually from a raw income comparison. The index does not include agricultural proceeds in its arithmetic, although participation is deliberately related to its components in the study. This distinction prevents an accounting identity from being presented as an independently discovered effect while making the assumed financial pathway explicit. The primary estimates that pass the adjusted threshold indicate that the result signal is distinguishable from the result noise under the fitted models.

4.4 Financial contribution and alternative outcome

Table 8 Monthly agricultural accounting among participants

Component	Mean naira	Median naira
Cash sales	13,975	11,955
Consumed output value	16,235	14,782
Purchased production costs	8,230	7,217
Net accounting contribution	21,980	20,603

The accounting table separates revenue from the value of household consumption. Purchased costs have been deducted from their combined value, but the resulting balance is a resource contribution rather than a wage-equivalent return. Summing consumed output into cash salary would overstate disposable cash and could double count food if consumption expenditure were also adjusted. The absence of a labour charge is especially consequential for civil servants with limited discretionary time.

The expense-adequacy logit gives a participation odds ratio of 1.3531 (95% CI 0.8591–2.1312; p = 0.1920). The confidence interval includes one; therefore, the adjusted association with this binary outcome is not statistically significant at 5%. This differs from the composite financial-capacity result and indicates sensitivity to the outcome definition. Odds ratios describe proportional differences in odds rather than percentage-point changes in probability. Because financial capacity is defined from adequacy and reserve months, and the reserve-month association is positive, the composite result cannot be generalised to every financial indicator. The nonsignificant adequacy result is retained as a substantive qualification.

Table 9 Binary logit estimates for essential expense adequacy

Regressor	Coefficient	Robust SE	z	p value	Odds ratio
Constant	-8.0694	3.9773	-2.0289	0.0425	0.0003
Backyard participation	0.3024	0.2318	1.3046	0.1920	1.3531

Regressor	Coefficient	Robust SE	z	p value	Odds ratio
Age	-0.0060	0.0128	-0.4700	0.6383	0.9940
Female	0.3717	0.2202	1.6880	0.0914	1.4502
Household size	-0.1401	0.0465	-3.0128	0.0026	0.8693
Education years	0.0362	0.0337	1.0762	0.2818	1.0369
Log monthly salary	0.7173	0.3604	1.9903	0.0466	2.0489
Land access	-0.3495	0.2181	-1.6027	0.1090	0.7050
Water access	0.2727	0.2230	1.2229	0.2214	1.3135

Note. Binomial logit with heteroskedasticity-robust sandwich standard errors; N = 384. The dependent variable equals one when essential expenditure can be covered. Log likelihood = -250.2984. Estimates are unstandardised log-odds coefficients; odds ratios equal their exponentials. Two-sided Wald z tests are reported.

A positive average accounting contribution can coexist with individual losses. This cautions against assuming that every household benefits from adoption or that low-cost production is risk-free.

4.5 Sensitivity analysis and model diagnostics

Table 10 Sensitivity of the participation coefficient

Specification	Food insecurity	Dietary diversity	Financial capacity
Main OLS	-2.0890	0.9492	14.7079
Weighted regression	-2.0397	0.9521	14.8972
Exclude salary tails	-2.1600	0.9413	13.9230

Note. Salary-tail exclusion removes observations below the fifth and above the ninety-fifth percentile. Weighted estimates adjust only for specified observed covariates.

The estimated propensity scores range from 0.279 to 0.906; the largest inverse-probability weight is 6.69. These summaries help reveal whether the weighting exercise relies heavily on rare observations. Weighted results are treated as a specification comparison rather than a validated causal effect.

Replacing the composite with reserve months produces a participation coefficient of 0.68 months (95% CI 0.54–0.82; $p < .001$). This check demonstrates whether the financial association depends entirely on the expense-adequacy component. Neither the reserves measure nor the composite can demonstrate persistent income security from one observation per household.

Table 11 Model diagnostic summaries

Diagnostic	Food insecurity	Dietary diversity	Financial capacity
Breusch Pagan p	0.169	0.295	0.852
Maximum nonconstant VIF	1.34	1.34	1.34
Residual RMSE	3.90	1.63	26.36

Note. HC3 inference is used regardless of the heteroskedasticity-test outcome. Low VIF values do not exclude omitted-variable bias.

Agreement across these specifications indicates internal stability for this particular design. It cannot test assumptions deliberately excluded from design, such as severe unobserved selection, correlated local weather shocks or salary arrears related to participation. Robust standard errors address covariance estimation under unequal variances; they do not correct endogeneity, measurement error or an inadequate sampling frame.

4.6 Integrated Discussion

The dietary associations are being interpreted against mixed external evidence. The favourable direction is compatible with the intervention pathways examined by Blakstad et al. (2021) and Waid et al. (2024), but the quantities are not directly comparable: those studies assess programme assignments and individual dietary outcomes, while this study models self-selected participation and a household 12-group score. The later Tanzanian follow-up also cautions against assuming persistence (Blakstad et al., 2022).

The Nigerian panel findings of Olabisi et al. (2021) provide a useful counterpoint: dependence on a narrow set of own-produced foods can coexist with limited dietary diversity. The present participation variable identifies any residential production, not the share of the diet supplied by production. Thus a positive participation coefficient and an adverse relationship with excessive self-provisioning need not be logically inconsistent. The distinction supports recommendations that preserve food-market access rather than promote complete self-sufficiency.

The analytical contribution lies in separating provisioning benefits from monetary earnings and separating current financial capacity from long-term sustainability. This follows the household-production logic of Becker (1965) without presuming that all nonmarket production is efficient. It also recognises the asset constraints highlighted in the livelihoods framework. A future empirical study could test these channels with production quantities, time diaries and repeated welfare measurements.

The diversification interpretation must account for correlated risk. Crops and livestock can be affected by the same rainfall, water or disease conditions that increase market food prices. Additional activities therefore need not reduce volatility. Barrett et al. (2001) provides a conceptual reason to examine the quality and risk structure of diversification rather than merely count income sources.

The cross-country urban-agriculture literature motivates modest expectations about contributions to overall household income (Zezza & Tasciotti, 2010). Its useful comparison is methodological: food consumption and production accounting need separate measurement.

5 Conclusion and Recommendations

5.1 Conclusion

The study demonstrates a coherent quantitative presentation in which backyard agricultural participation is associated with lower food insecurity, more diverse consumption and stronger short-term financial capacity after adjustment for selected household characteristics. Its principal substantive lesson is that residential agriculture could complement salary-based livelihoods in Mubi North. It contributes to the empirical question of the size or sustainability of residential agricultural benefits.

5.2 Recommendations

First, agricultural extension services and civil-service welfare units could jointly offer support for to ensure increased residential production. Second, assess financial viability before providing credit. Enterprise budgets should include purchased inputs, expected losses, depreciation, water and the value of unpaid labour. Households should receive information that distinguishes surplus-sales cash from food retained for consumption. Any financing decision should use verified local costs and repayment capacity. Third, design access arrangements for households without secure residential land or reliable water. Shared plots or container gardening may be evaluated where locally appropriate, but their administrative and household costs should be measured. Participation must remain compatible with formal work obligations and should avoid transferring excessive unpaid labour to women or dependants. Fourth, retain adequate wages and broader food-access measures as separate policy priorities. Supplementary household production cannot be assumed to compensate for inadequate salaries, health shocks or persistent food inflation. Programme evaluation should record both beneficial outcomes and potential burdens, including reduced leisure, workplace conflict, water expenditure and agricultural losses.

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