



IMPACT OF THE AGRO-PROCESSING, PRODUCTIVITY ENHANCEMENT AND LIVELIHOOD IMPROVEMENT SUPPORT (APPEALS) PROJECT ON THE LIVELIHOODS OF VULNERABLE GROUPS IN KADUNA STATE, NIGERIA

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ABSTRACT

This study evaluates the **impact of the Agro-Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) Project** on the livelihoods of women, youth, and persons with disabilities across seven agricultural value chains in Kaduna State, Nigeria, using a mixed-methods approach. Quantitative data were collected from 300 **APPEALS beneficiaries**, complemented by qualitative evidence from 20 key informant interviews. Impact assessment employed paired t-tests and transition matrix analysis to examine changes in income, food security, and market access before and after **participation in the APPEALS Project**. The paired t-test results indicate that the three livelihood indicators improved significantly following participation in the project. Mean annual income rose from ₦512,415 before the project to ₦692,339 after participation, which represents a 35% increase ($t = 51.39$, $p < 0.01$). Similarly, the mean food security score increased from 45.00 to 64.45, an improvement of 42% ($t = 63.63$, $p < 0.01$). Mean market access also increased from 40.00 to 58.46, representing a 46% increase ($t = 47.07$, $p < 0.01$). The results show that these improvements were also observed among the three vulnerable groups considered in the study. Annual income increased by ₦176,142 for women, ₦181,227 for youth, and ₦186,043 for persons with disabilities. Food security scores increased by 18.98, 19.24, and 18.70 points for women, youth, and persons with disabilities, respectively. Market access scores also recorded increases of 18.88, 18.42, and 19.57 points, respectively. The transition analysis further shows a general improvement in beneficiaries' food security and market access status after participation in the APPEALS Project. In particular, many beneficiaries moved from the low category to the medium category, while others moved from medium to high. Taken together, these results suggest that participation in the APPEALS Project was associated with improved livelihood outcomes among vulnerable groups in Kaduna State. The study therefore concludes that APPEALS participation had a positive and statistically significant association with beneficiaries' income, food security, and market access. Based on these findings, the study recommends that APPEALS-type interventions should be sustained and strengthened, particularly through continued support and more equitable access for women, youth, and persons with disabilities.

Keywords: APPEALS, Project, Livelihood, Improvement, Vulnerable, Groups

INTRODUCTION

Agriculture remains an important part of Nigeria's economy, providing employment, supporting rural livelihoods, and contributing to food security. However, the sector continues to face challenges such as low productivity, weak value chains, and limited opportunities for value addition (Adesoye *et al.*, 2018). These challenges tend to affect vulnerable groups, particularly women, young people, and persons with disabilities, more severely because they often have limited access to markets, finance, relevant skills, and productive resources (Nwanguma *et al.*, 2025). Against this background, strengthening inclusive agricultural value chains has become increasingly important for improving livelihoods and creating opportunities for economic diversification in developing countries such as Nigeria (Awoyemi *et al.*, 2023). In response to these challenges, the Federal Government of Nigeria, in partnership with the World Bank, developed the Agro-Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) Project, which was approved in 2017 and subsequently commenced implementation in 2018. **The project** was designed to strengthen agricultural productivity, promote agro-processing, create market opportunities, and improve livelihoods along selected



agricultural value chains, with particular attention to women and youth and other vulnerable beneficiaries. Implementation activities included support for production and productivity enhancement, agro-processing, market linkages, technical and business skills development, and livelihood support. Evidence from Kano State shows that the extent to which beneficiaries utilise different project components differs depending on their socio-economic and institutional circumstances (Okopi, 2021). Similarly, recent studies conducted in other states suggest that APPEALS interventions have contributed to better post-harvest handling, increased processing capacity, and improved access to markets among beneficiaries (Dahiru *et al.*, 2025). However, there is still limited empirical evidence on whether these interventions have resulted in measurable improvements in the livelihoods and empowerment of vulnerable groups, particularly women, youth, and persons with disabilities. Existing studies have largely examined project implementation or individual value chains, with less emphasis on broader livelihood outcomes such as income, food security, market access, and inclusion. This study therefore evaluated the APPEALS Project in Kaduna State by examining changes in beneficiaries' income, food security, and market access. It also assessed how agricultural and agro-processing interventions contributed to the empowerment and inclusion of women, youth, and persons with disabilities.

METHODOLOGY

The Study Area

The study was conducted in Kaduna State, located in the northwestern part of Nigeria (Kaduna State, 2025). The state covers an area of approximately 46,053 km² and has an estimated population of about 8.76 million. It falls within the derived savannah zone and has distinct wet and dry seasons, with annual rainfall estimated at between 1,837 and 3,236 mm (NPC & NBS, 2016). Agriculture is the main economic activity in the state, with maize, rice, legumes, and vegetables among the major crops produced, alongside livestock farming (Africa Exchange (AFEX), 2025; Britannica, 2025). Kaduna State is also one of the areas where the APPEALS Project was implemented. The project supports vulnerable groups, including women, youth, and persons with disabilities, through technical, business, and life-skills training, start-up grants provided through Business Investment Plans (BIPs), mentorship, and access to inclusive services. Support is provided across seven major value chains: rice, maize, poultry, tomato, ginger, aquaculture, and dairy (BusinessDay NG, 2019; Blueprint Newspapers, 2018). The state's agricultural importance and its involvement in the APPEALS Project provide a suitable setting for examining changes in beneficiaries' income, food security, market access, and empowerment.

Research Design and Data Sources

The study used a mixed-methods impact evaluation design to examine the influence of the APPEALS Project on the livelihoods, empowerment, and inclusion of vulnerable groups in Kaduna State. For the quantitative component, a cross-sectional survey was conducted among 300 beneficiaries. Respondents provided retrospective information on their income, food security, and market access before and after participating in the project, which was used to assess changes associated with project participation.

The quantitative survey was complemented by 20 key informant interviews involving project implementers, extension agents, and value-chain actors. These interviews provided additional information on the effectiveness of the project interventions and helped explain how the project contributed to empowerment and inclusion among the targeted groups. Combining the two approaches allowed the study to examine the project outcomes using both statistical evidence and the experiences and perspectives of key stakeholders.

Sampling Procedure and Sample Size

Beneficiaries of the APPEALS Project in Kaduna State were selected using a four-stage sampling procedure. At the first stage, the state was divided into four agricultural zones: Birnin-Gwari, Maigana, Lere, and Samaru-Kataf. The second stage involved selecting eight LGAs where the APPEALS Project was active. These included Birnin-Gwari and Giwa from the Birnin-Gwari zone; Soba and Kubau from the Maigana zone; Lere and Kudan from the Lere zone; and Kachia and Jama'a



from the Samaru-Kataf zone. At the third stage, communities and villages with APPEALS beneficiaries were identified and selected within the sampled LGAs. In the fourth stage, registered beneficiaries in the selected communities and villages were identified, from which respondents were randomly selected for the survey. The selected beneficiaries were classified according to their value chains, namely rice, maize, poultry, tomato, ginger, aquaculture, and dairy, as well as their vulnerable group status, covering women, youth, and persons with disabilities. For the quantitative survey, 300 beneficiaries were selected. In addition, 20 key informants were purposively selected for the qualitative component. These included APPEALS project officials, extension personnel, and value-chain facilitators who were selected because of their involvement in project implementation and their knowledge of the supported value chains. This sampling approach provided coverage across the four agricultural zones, selected LGAs, communities and villages, value chains, and the different vulnerable groups. The distribution of the 300 beneficiaries across the selected zones, LGAs, value chains, and vulnerable groups is presented in Table 1.

Table 1: Population and Sample Size Distribution across Communities in the Study Area

Zone	LGAs	Value Chains	Women	Youth	Persons with Disabilities	Total
Birnin-Gwari	Birnin-Gwari, Giwa	Maize, Ginger, Poultry	34	28	13	75
Maigana	Soba, Kubau	Rice, Tomato, Poultry	36	31	13	80
Lere	Lere, Kudan	Maize, Ginger, Dairy	33	29	13	75
Samaru-Kataf	Kachia, Jama'a	Rice, Aquaculture, Poultry	36	29	5	70
Total			139	117	44	300

Note: Distribution reflects probability proportional to size (PPS) allocation of registered APPEALS beneficiaries across zones and value chains. This composition ensures adequate representation of women, youth, and persons with disabilities in line with the project's inclusion objectives.

Analytical Techniques

The study utilized both descriptive statistical tools and econometric methods to address the research objectives.

Descriptive Statistical Analysis

Descriptive statistics were used to summarize the socio-economic and project-related characteristics of the beneficiaries. Frequencies and percentages were used to present the distribution of respondents by gender, vulnerable group (women, youth, and persons with disabilities), and agricultural value chain. Female beneficiaries accounted for 54.7% of the total sample. Gender distribution was also presented within the youth and persons with disabilities categories to reflect the actual composition of beneficiaries in each group. Thus, male respondents were retained within the relevant vulnerable groups, particularly youth and persons with disabilities, rather than being excluded from the analysis. Means and other measures of dispersion were used to describe the beneficiaries' income, food security, and market access before and after their participation in the APPEALS Project. This provided a basis for comparing the changes in these indicators following participation in the project.

Paired Sample Mean Difference Test (Paired t-test)

To evaluate changes in livelihood outcomes attributable to participation in the APPEALS Project, Paired sample t-tests were used to compare beneficiaries' pre- and post-project livelihood outcomes. This approach is appropriate when the same individuals are observed at two points in time.

Let: Y_i^{Before} = outcome variable for beneficiary i before APPEALS participation; Y_i^{After} = outcome variable for beneficiary i after APPEALS participation; $D_i = Y_i^{After} - Y_i^{Before}$ = difference in outcomes for beneficiary i

The mean difference is given by:



$$D = \frac{1}{n} \sum_{i=1}^n D_i \dots (1)$$

The paired t -statistic is computed as:

$$t = \frac{D}{S_D/\sqrt{n}} \dots (2)$$

where: S_D = standard deviation of the differences; n = number of paired observations

This test was applied separately to income, food security, and market access. Statistical significance of the t -statistics indicates whether the observed mean differences between pre- and post-intervention outcomes are statistically different from zero.

Percentage change in outcomes was calculated as:

$$\% \text{ Change} = \left(\frac{Y^{\text{after}} - Y^{\text{before}}}{Y^{\text{before}}} \right) \times 100$$

Transition Matrix Analysis

To assess distributional changes beyond mean effects, transition matrix analysis was used to examine movements of beneficiaries across categorical levels of food security and market access (low, medium, and high) before and after APPEALS participation.

Let: $S_i^{\text{before}} \in \{L, M, H\}$ denote the initial status of beneficiary i ; and $S_i^{\text{after}} \in \{L, M, H\}$ denote the post-intervention status

The transition probability from category j to category k is defined as:

$$P_{jk} = \frac{n_{jk}}{\sum_k n_{jk}} \dots (3)$$

where: n_{jk} = number of beneficiaries transitioning from category j before APPEALS to category k after APPEALS

This matrix captures upward mobility, stagnation, or regression in food security and market access status following project participation.

Multivariate Regression Analysis

To examine the effectiveness of APPEALS interventions in improving agricultural and agro-processing enterprises, multivariate regression models were estimated using enterprise-related livelihood outcomes namely income from agricultural and agro-processing activities, food security score, and market access index as dependent variables.

The general regression model is specified as:

$$Y_i = \beta_0 + \beta_1 APEALS_i + \beta_2 V_i + \beta_3 VC_i + \beta_4 L_i + \varepsilon_i \dots (5)$$

where: Y_i = livelihood outcome (income, food security score, or market access index);

$APEALS_i$ = participation intensity in APPEALS interventions;

V_i = vulnerable group indicators (women, youth, PwDs);

VC_i = value chain affiliation;

L_i = location-specific characteristics; and ε_i = error term.

This approach controlled for confounding factors and strengthened inference on enterprise-level improvements attributable to the project.

Multivariate Binary Logit Regression Model

To analyze determinants of participation in APPEALS empowerment and inclusion interventions skills training, start-up grants, and mentorship multivariate binary logit models were estimated.

Let P_i denote the probability that beneficiary i participates in a given intervention. The logit model is specified as:

$$\ln \left(\frac{P_i}{1 - P_i} \right) = \alpha + \beta_1 PI_i + \beta_2 INC_i + \beta_3 FS_i + \beta_4 MA_i + \beta_5 G_i + \beta_6 V_i + \beta_7 VC_i + \mu_i \dots (4)$$

where: INC_i = pre-intervention income;

FS_i = pre-intervention food security score;



MA_i = pre-intervention market access index; and

μ_i = stochastic error term

Marginal effects were computed to estimate the change in the probability of participation associated with a unit change in each explanatory variable:

$$ME_j = \frac{\partial P_i}{\partial X_{ij}} = P_i(1 - P_i)\beta_j$$

Model adequacy was evaluated using the likelihood ratio chi-square statistic and pseudo R^2

RESULTS AND DISCUSSION

Impact of The APPEALS Project on Beneficiaries' Income, Food Security, and Market Access

Table 2a shows the gender distribution of APPEALS beneficiaries. Females accounted for 52.9% of the total respondents, compared with 55.1% among youth and 48.1% among persons with disabilities. The figures indicate that both male and female beneficiaries were represented across the groups, with women accounting for slightly more than half of the overall sample. This is in line with evidence showing that women remain important contributors to agriculture in Nigeria, although they continue to face difficulties in accessing productive resources (FAO, 2025; Thisday, 2024). The representation of youth and persons with disabilities also suggests that the project was able to reach the vulnerable groups targeted under its inclusive approach (NWAPDI, 2025).

Table 2a: Gender Distribution of APPEALS Beneficiaries by Vulnerable Group

Vulnerable Group	Female	%	Male	%
Persons with Disabilities	26	48.1	28	51.9
Youth	65	55.1	53	44.9
Total	91	52.9	81	47.1

Source: Field survey, 2025.

Note: Female beneficiaries made up 54.7% of the total sample. Gender is reported within each vulnerable group (youth and persons with disabilities).

Table 2b shows how APPEALS beneficiaries were distributed across the different value chains and vulnerable groups. Within the core value chains in Kaduna State, participation was fairly consistent across maize, ginger, and dairy. Women had the highest participation in dairy (17.3%), while youth were more represented in ginger (13.7%). Persons with disabilities had a relatively even level of participation across the three core value chains, with about 14% in each. The project also reached beneficiaries through other value chains. Persons with disabilities recorded a relatively high level of participation in aquaculture (34%), while youth participation was higher in rice and aquaculture, at approximately 18%. Beneficiaries were also involved in supplementary value chains such as tomato, poultry, rice, and aquaculture. Overall, the distribution indicates that APPEALS beneficiaries were engaged across both the priority and supplementary value chains supported by the project. This pattern is consistent with evidence that agricultural interventions targeting staple and high-value commodities can create livelihood opportunities for women, youth, and other marginalized groups in Nigeria (Adesoye *et al.*, 2018; Okopi, 2021).



Table 2b: Value Chain Participation of APPEALS Beneficiaries by Vulnerable Group

Value Chain	Persons with Disabilities		Women		Youth	
	Freq.	%	Freq.	%	Freq.	%
Core Focus Chains						
Maize	6	13.6	20	14.4	13	11.1
Ginger	6	14	18	12.9	16	13.7
Dairy	6	14	24	17.3	15	12.8
Supplementary Chains						
Aquaculture	15	34	17	12.2	22	18.8
Poultry	8	18.2	15	10.8	17	14.5
Rice	7	15.9	17	12.2	22	18.8
Tomato	6	13.6	17	12.2	13	11.1
Total	44	100	139	100	117	100

Source: Field survey, 2025.

Impact of APPEALS on Income, Food Security, and Market Access

Table 3 presents the pre- and post-intervention outcomes for income, food security, and market access among APPEALS beneficiaries, disaggregated by vulnerable group and supported by overall paired *t*-test results. Across all categories, notable improvements were recorded following participation in the project. Mean income increased by ₦176,142 for women, ₦181,227 for youth, and ₦186,043 for persons with disabilities. These improvements suggest that APPEALS support in the form of productive inputs, skills development, enterprise support, and market-oriented interventions may have strengthened beneficiaries' capacity to generate income from agricultural and agro-processing activities. This finding is consistent with Awoyemi *et al.* (2023), who reported that participation in agricultural value-chain interventions improved farmers' access to productive resources and income-generating opportunities, particularly among women. In a similar pattern, food security scores improved by 18.98, 19.24, and 18.70 points for women, youth, and persons with disabilities, respectively, while market access indices rose by 18.88 points for women, 18.42 points for youth, and 19.57 points for persons with disabilities. The improvement in food security is consistent with evidence that interventions which increase agricultural productivity, strengthen livelihood opportunities, and improve access to productive resources can contribute to improved household food security. Similarly, the observed increase in market access is consistent with findings from agricultural value-chain interventions showing that improved production capacity, business skills, market linkages, and agro-processing support can enhance beneficiaries' participation in markets (Okopi, 2021; Dahiru *et al.*, 2025).

At the aggregate level, the paired *t*-test results confirm statistically significant improvements across all livelihood indicators, with income rising from ₦512,415 to ₦692,339 ($t = 51.39$, $p < 0.01$), food security increasing from 45.00 to 64.45 ($t = 63.63$, $p < 0.01$), and market access improving from 40.00 to 58.46 ($t = 47.07$, $p < 0.01$), representing relative increases of 35%, 42%, and 46%, respectively. The statistically significant differences between the pre- and post-intervention results suggest that beneficiaries recorded noticeable improvements in the livelihood indicators examined after participating in the APPEALS Project. The improvements observed in income, food security, and market access point to a positive association between participation in the project and the livelihood outcomes of the vulnerable groups covered by the study in Kaduna State. The findings are also consistent with Dahiru *et al.* (2025), who reported improvements in post-harvest handling, processing capacity, and market integration among APPEALS beneficiaries. Similarly, Awoyemi *et al.* (2023) found that participation in agricultural value-chain support programmes was associated with improved livelihood outcomes.



Table 3: Pre and Post-Intervention Mean Income, Food Security, and Market Access Outcomes by Beneficiary Group

Group	Income Before (₦)	Income After (₦)	Diff (₦)	Food Sec Before	Food Sec After	Diff	Market Access Before	Market Access After	Diff
Women	511,886	688,028	176,142	44.83	63.81	18.98	39.51	58.39	18.88
Youth	514,627	695,854	181,227	46.21	65.45	19.24	38.79	57.2	18.42
PWD	508,834	694,877	186,043	45.09	63.8	18.7	41.81	61.39	19.57
Mean	512,415	692,339	179,924	45	64.45	19.45	40	58.46	18.46
t-test			51.39***			63.63***			47.07***
% Increase			35%			42%			46%

Note: % Increase = (Mean After – Mean Before) / Mean Before × 100. The abstract rounds Market Access to 48% for simplicity.



Transition in Food Security and Market Access Status of APPEALS Beneficiaries

Table 4 shows the changes in beneficiaries' food security and market access categories before and after participation in the APPEALS Project. For food security, the results show a clear shift towards better categories. Of the 81 beneficiaries who were initially in the low category, 70 moved to the medium category after participating in the project. Also, 104 out of the 216 beneficiaries who were initially in the medium category moved to the high category, while only 3 beneficiaries remained in the high category in both periods. A similar pattern was observed for market access. Among the 104 beneficiaries who initially had low market access, 78 moved to the medium category after participation. In addition, 103 of the 188 beneficiaries who were initially in the medium category progressed to the high category, while 8 maintained high market access in both periods. These movements indicate an overall improvement in both food security and market access following participation in the project. The findings suggest that the APPEALS Project contributed to improving the livelihood conditions of its beneficiaries and are consistent with previous evidence that inclusive agricultural interventions can improve nutritional outcomes and market access among women, youth, and persons with disabilities in Nigeria (Adesoye *et al.*, 2018; Okopi, 2021).

Table 4: Transition Matrix of Beneficiaries' Food Security and Market Access Status Before and After APPEALS

Before → After	Low	Medium	High	Total
Food Security Status				
Low level	11	70	0	81
Medium level	0	112	104	216
High level	0	0	3	3
Total	11	182	107	300
Market Access Status				
Low level	26	78	0	104
Medium level	0	85	103	188
High level	0	0	8	8
Total	26	163	111	300

Source: Field survey, 2025.

Effectiveness of APPEALS Interventions in Improving Agricultural and Agro-processing Enterprises

Table 5 reports the factors associated with beneficiaries' income, food security, and market access after participation in the APPEALS Project. The results indicate that the baseline outcomes were strong predictors of the corresponding post-intervention outcomes. Baseline income, for example, had a positive and statistically significant effect on post-intervention income ($\beta = 1.360$, $p < 0.01$). The models for food security and market access also recorded high R^2 values of approximately 0.94–0.95, suggesting that beneficiaries' conditions before the intervention were closely related to their outcomes after participation. Participation intensity was also statistically significant in the food security model ($\beta = -2.383$, $p < 0.05$). This suggests that differences in the level of beneficiaries' engagement with the APPEALS Project were associated with differences in their food security outcomes. The constant terms for food security ($\beta = 73.683$, $p < 0.01$) and market access ($\beta = 67.833$, $p < 0.01$) were also statistically significant, indicating the presence of underlying levels of these outcomes within the sample. However, gender, vulnerable group status, and value chain affiliation did not have statistically significant effects on the outcomes. Overall, the results suggest that beneficiaries' pre-intervention livelihood conditions played an important role in shaping their post-intervention outcomes. This finding agrees with Awoyemi *et al.* (2023), who noted that baseline conditions can strongly influence the outcomes of agricultural interventions. At the same time, the significant effect of participation intensity on food security suggests that the level of engagement with the project may matter for some livelihood outcomes.



Table 5: Determinants of Post-Intervention Income, Food Security, and Market Access among APPEALS Beneficiaries (MMR Estimates)

Variable	Income			Food Security			Market Access		
	Coef. (β)	Std.Err	t	Coef. (β)	Std.Err	t	Coef. (β)	Std.Err	t
APPEALS intensity	2,902	3,029	0.96	-2.383**	1.021	-2.33	0.209	1.307	0.16
Baseline outcome	1.360***	0.02	69.49	-6E-06	0.000007	-0.89	-0.000020**	0.000008	-2.32
Gender (Male = 1)	-9,167*	4,809	-1.91	-0.387	1.621	-0.24	-3.32	2.075	-1.6
Vulnerable group	5,539*	3,253	1.7	0.554	1.097	0.51	1.131	1.403	0.81
Value chain	-1,768	1,228	-1.44	0.088	0.414	0.21	-0.106	0.53	-0.2
constant	-11,803	16,062	-0.73	73.683***	5.416	13.6	67.833***	6.93	9.79
obs	300			300			300		
R ²	0.944			0.947			0.955		
F-stat	996.96***			1051.90			1186.83		
Prob > F	0.000			0.000			0.000		

Note: ***, ** and * implies statistically significance at 1%, 5% and 10% level. The high R-squared values largely reflect the inclusion of baseline outcome variables, indicating strong persistence in income, food security, and market access over time, which is consistent with expectations in livelihood impact studies.



Project's Contribution to the Empowerment and Inclusion of Women, Youth and Persons with Disabilities.

Table 6 shows the extent to which beneficiaries from the different vulnerable groups participated in the empowerment and inclusion interventions provided by the APPEALS Project. Women had the highest participation across all four interventions. About 43.46% of women received skills training, 40.55% benefited from start-up grants, 40% had access to mentorship, and 40.42% received inclusive services. Youth also recorded considerable participation, with their involvement ranging from 38.46% in skills training to 41.47% in start-up grant provision. Participation among persons with disabilities was comparatively lower, ranging from 18% to 19% across the interventions. The findings therefore suggest that the APPEALS Project was able to reach women and youth to a greater extent, but additional efforts may be needed to ensure that persons with disabilities benefit more fully from the available interventions. This finding agrees with previous studies showing that marginalized groups often face difficulties in accessing training, financial assistance, and market opportunities. It also highlights the importance of adopting more targeted inclusion strategies in agricultural development programmes (Nwanguma *et al.*, 2025; Awoyemi *et al.*, 2023).

Table 6: Participation in APPEALS Empowerment and Inclusion Interventions by Beneficiary Group

Intervention	Persons with Disabilities		Women		Youth	
	Freq.	%	Freq.	%	Freq.	%
Skills Training	47	18.08	113	43.46	100	38.46
Start-up Grant	39	17.97	88	40.55	90	41.47
Mentorship	41	19.52	84	40	85	40.48
Inclusive Services	45	18.75	97	40.42	98	40.83

Source: Field survey, 2025.

Transition in Food Security and Market Access Status of APPEALS Beneficiaries

Table 7 presents multivariate logit estimates of the determinants of participation in APPEALS empowerment interventions. The results indicate that participation intensity is the strongest and most consistently significant predictor across all intervention types, increasing the likelihood of beneficiaries receiving skills training ($\beta = 1.305$, $p < 0.01$), start-up grants ($\beta = 1.884$, $p < 0.01$), and mentorship ($\beta = 1.978$, $p < 0.01$). The marginal effects further confirm this influence, ranging from 0.128 to 0.274. Market access prior to the APPEALS intervention had a small but statistically significant negative effect on participation in mentorship ($\beta = -0.024$, $p < 0.1$), indicating that beneficiaries with stronger initial market connections were slightly less inclined to engage in mentorship activities. The constant term for mentorship is also statistically significant ($\beta = -3.768$, $p < 0.05$), indicating the baseline probability of participation in the absence of explanatory factors. Other variables, including gender, income, food security, vulnerable group status, and value chain affiliation, are not statistically significant. The results suggest that participation intensity in the APPEALS Project is the primary driver of empowerment and inclusion outcomes, rather than pre-existing socioeconomic characteristics. This finding is consistent with Awoyemi *et al.* (2023), who reported that targeted participation in value chain interventions improved income and resource access among women farmers in Nigeria, and Nwanguma *et al.* (2025), who found that active involvement in technical training and enterprise support programmes enhanced youth participation in markets and improved livelihood outcomes.



Table 7: Determinants of Participation in APPEALS Empowerment Interventions

Variable	Skills Training				Start-up Grant				Mentorship			
	Coef. (β)	Std. Err	z	AME	Coef. (β)	Std. Err	z	AME	Coef. (β)	Std. Err	z	AME
participation intensity	1.3049***	0.2469	5.29	0.128	1.884***	0.250	7.54	0.262	1.9778***	0.2539	7.79	0.274
Income before				-1.14				-1.84				2.01
APPEALS	-1.2E-06	1.6E-06	-0.74		-1.32e-06	1.30e-06	-1.01		1.50E-06	1.30E-06	1.13	
Food security (before)	0.023	0.0196	1.18	0.002	0.0128	0.0162	0.79	0.001	-0.0252	0.0167	-1.51	-0.003
Market access				-0.000				0.001				-0.003
(before)	-0.0006	0.0161	-0.04		0.0075	0.013	0.57		-0.0244*	0.0137	-1.78	
Gender	0.0133	0.3743	0.04	0.001	0.235	0.316	0.74	0.032	0.4382	0.3195	1.37	0.060
Group	0.1953	0.2695	0.72	0.019	-0.717	0.210	-0.34	-0.009	0.1039	0.2174	0.48	0.014
Value chain	0.0632	0.0969	0.65	0.006	0.532	0.080	0.66	0.007	-0.04	0.0804	-0.5	-0.005
Constant	-2.7948	1.7551	-1.59		-4.877	1.494	-3.26		-3.7680**	1.5042	-2.51	
LR chi2 (7)	37.64				98.01				107.44			
Prob > chi2	0.000				0.000				0.000			
Pseudo R-squared	0.1598				0.277				0.2931			

Note: ***, ** and * implies statistically significance at 1%, 5% and 10% level.



CONCLUSION AND RECOMMENDATION

The study concludes that inclusive agricultural value-chain interventions such as the APPEALS Project can contribute meaningfully to improving the livelihoods of vulnerable groups in Kaduna State. The findings show improvements in beneficiaries' income, food security, and market access after participation in the project. The empowerment interventions also supported greater involvement in agricultural activities and improved inclusion, particularly among women and youth. The results suggest that programmes designed to address the needs of vulnerable groups can support both economic and social empowerment. Expanding and strengthening such interventions could therefore help extend their benefits to a wider population. Based on the findings of the study, the following recommendations are proposed:

- i. The improvements recorded in income, food security, and market access suggest that the APPEALS Project provided useful support to beneficiaries. Similar agricultural value-chain interventions should therefore be expanded to other regions and value chains. This would increase the number of women, youth, and persons with disabilities who can benefit from support in production, processing, and market access.
- ii. Skills training, mentorship, and start-up grants should be strengthened and sustained because of their role in improving beneficiaries' participation and empowerment. Future programmes should place greater emphasis on practical business development, financial literacy, and technical skills, while also adapting the training and support to the specific needs of beneficiaries in different locations.
- iii. Greater attention should be given to persons with disabilities, whose participation in the project interventions was lower than that of women and youth. Project implementers should adopt targeted outreach approaches, improve accessibility, and provide appropriate technologies and support services to reduce the barriers faced by persons with disabilities. These measures would help promote more equitable participation across the agricultural value chains.

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