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DETERMINANTS OF UTILIZATION AND OPTIMUM USE OF FARMER FIELD BUSINESS SCHOOL RECOMMENDATIONS AMONG MAIZE FARMERS IN NORTH WEST NIGERIA

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Abstract: *This study examined the predictors of utilization and intensity of use of Farmer Field Business School (FFBS) recommendations among maize farmers in North West Nigeria. A structured questionnaire was administered to 231 FFBS participants in Kaduna and Kano States. Data were analysed using weighted mean scores, a Utilization Index, Probit regression for the binary utilization decision, and Tobit regression for intensity of use. Results showed that 95.7% of participants utilized FFBS recommendations, yielding a mean Utilization Index of 0.7415. Intensity of use varied widely across practice areas: planting and fertilizer application recorded the highest intensity (WM = 2.49 each), while use of Aflasafe and field measurement returned low scores (WM = 1.39 and 1.58). The Probit model identified sex ($p < 0.10$), age ($p < 0.10$), household size ($p < 0.05$), and land acquisition mode ($p < 0.01$) as significant determinants of the utilization decision. The Tobit model showed that marital status ($p < 0.05$), household size ($p < 0.10$), frequency of extension visits ($p < 0.01$), and the Perception Index of FFBS ($p < 0.01$) significantly influenced optimum use. These findings underscore the importance of targeted extension engagement and positive programme perception in deepening practice uptake among smallholder farmers.*

Keywords: *Farmer Field Business School, Utilization, Intensity of Use, Maize Production, North West Nigeria*
(JEL code: O33)

INTRODUCTION

Feeding a growing population from an increasingly constrained land base is one of the defining challenges of our time, and nowhere is this challenge more acute than in sub-Saharan Africa. In Nigeria, where agriculture provides the primary livelihood for an estimated 70 percent of the rural population and accounts for roughly a quarter of national GDP, smallholder farmers bear the greatest share of the burden (Abate et al., 2025). Yet despite decades of public investment in agricultural extension, the gap between what farmers know and what they actually do on their farms remains stubbornly wide. Understanding how to close that gap; how to move farmers from passive exposure to extension messages towards deep, sustained application of improved practices is one of the most consequential questions in Nigerian agricultural development.

Agricultural extension services remain among the most important institutional pathways through which smallholder farmers access new production techniques, market information, and business management skills (Ojo et al., 2024). Their effectiveness, however, depends on much more than information delivery. In Nigeria, where the Agricultural Development Programme (ADP) system has historically formed the backbone of public extension, repeated reviews have pointed to chronic underfunding, inadequate numbers of extension agents, and poor follow-up as constraints on farmer-level impact (Onoja et al., 2019). Specifically, in northern Nigeria, where climatic variability is severe, input markets are often

thin, and access to formal finance remains limited, the quality of extension engagement can be a decisive factor in whether a farmer prospers or falls deeper into poverty. The challenge, however, is not simply one of reaching farmers with information. Recent scholarship has emphasised that the design of the extension model itself — the learning approach, the frequency and quality of contact, and the extent to which market and business dimensions are integrated — shapes adoption outcomes at least as much as the content being conveyed (Ojo et al., 2024). Research from across the continent has consistently shown that awareness of a recommendation and the actual adoption of it are not the same thing, and that adoption itself is not a single event but a process that unfolds with varying degrees of depth and consistency over time (Sithole & Olorunfemi, 2024).

Utilisation of agricultural extension recommendations refers to a farmer's decision to put into practice one or more of the technical, managerial, or market-related recommendations conveyed through an extension programme (Becerra-Encinales et al., 2024). In the adoption literature, this has traditionally been treated as a binary outcome: a farmer either uses a recommendation or does not. Binary choice models such as Probit and Logit have been widely applied to this question across West Africa (Abang et al., 2024; Sithole & Olorunfemi, 2024). Research across the region consistently shows that most extension participants who complete a full programme cycle do implement at least some recommendations, although uptake rates vary considerably by practice type, location, and socioeconomic context (Ragasa & Mazunda, 2018).

Intensity of utilization, by contrast, goes beyond the binary adoption decision to assess the degree of practice change. A farmer may adopt fertilizer application as a practice but apply it at the wrong rate, time, or frequency. Similarly, a farmer may engage in record-keeping only occasionally rather than as a systematic habit. Studies that capture intensity provide a richer picture of programme impact and are better placed to explain differences in productivity outcomes between participants (Teklewold et al., 2013; Manda et al., 2016; Nkosi et al., 2024). Censored regression models such as the Tobit are commonly used when the intensity variable is bounded and partially observed.

A critical distinction that has gained growing attention in the adoption literature is between the decision to utilise a practice at all and the intensity or depth with which a farmer applies that practice over time. A farmer may begin using improved seed varieties but plant them at the wrong spacing, or adopt record-keeping as a habit but fill in the register only occasionally. These differences in intensity matter enormously for productivity outcomes (Teklewold et al., 2013; Nkosi et al., 2024). A farmer who applies FFBS recommendations thoroughly and consistently derives fundamentally different benefits from one who picks up one or two easy practices and leaves the rest. Understanding the predictors of both dimensions is therefore essential for the design of more effective and better-targeted extension programmes.

The Farmer Field Business School (FFBS) is an integrated extension model that has attracted growing attention across sub-Saharan Africa as a more holistic alternative to conventional extension approaches. The model combines the hands-on, discovery-based learning of the Farmer Field School (FFS) with the market literacy and business skills components of the Farmer Business School (FBS) (FAO/UN, 2019). By teaching farming, business, and market access together in a single programme cycle, FFBS is designed to address not only the agronomic constraints that limit productivity, but also the financial and commercial constraints that prevent farmers from translating higher yields into higher and more stable incomes (CARE, 2025; Wilson et al., 2026).

In Nigeria's North West, including Kaduna and Kano States, variants of the farmer school model have been implemented under several donor-supported agricultural development projects. These two states are among Nigeria's most important maize-producing zones, and the smallholder farmers who dominate production there face a complex set of challenges: erratic rainfall, degraded soils, limited access to improved inputs, and weak market linkages that mean even better harvests may not translate into better incomes. Most of the previous studies in this context have concentrated narrowly on the Farmer Field School component, with a focus on good agronomic practices for specific crops, without adequately capturing the market and business dimensions that are central to the FFBS model. Despite a growing body of evidence on FFS and FBS outcomes across sub-Saharan Africa (Davis et al., 2012; Owiredu et al., 2022; Tandane et al., 2026), there is limited quantitative analysis specifically examining the factors that determine how deeply and consistently Nigerian maize farmers apply FFBS recommendations after training.

This study addresses that gap directly. Using primary data collected from 231 FFBS participants in Kaduna and Kano States, it investigates three related questions: first, the extent to which farmers utilised the FFBS-recommended practices they were trained on; second, the intensity with which they applied those practices; and third, the socioeconomic and institutional factors that predict both outcomes. By examining utilisation and intensity as distinct but related dimensions of practice change, the study aims to generate findings that are directly actionable for extension programme managers, agricultural development practitioners, and the policymakers responsible for scaling effective approaches across northern Nigeria and beyond.

MATERIALS AND METHODS

The study was conducted in Kaduna and Kano States in the North West geopolitical zone of Nigeria. Both states host significant maize production, and FFBS activities have been established in selected communities within each state under structured agricultural development interventions. Farmers who were active participants in FFBS groups at the time of data collection were purposively selected, targeting those who had completed at least one full season cycle of the programme. Then a total of 231 farmers were randomly selected for the study. Data were collected through structured questionnaire interviews administered by trained enumerators fluent in English and Hausa language.

Utilization of FFBS recommendations was measured as a

binary variable — whether a farmer had implemented any of the FFBS-recommended practices after training or not. Intensity of use was measured across fourteen practice areas using a three-point Likert type scale: 1 = low utilization, 2 = moderate utilization, 3 = high utilization. A weighted mean score was computed for each practice area, and a mean Utilization Index (UI) was derived by dividing the observed mean score by the maximum possible score. The decision thresholds were: low (≤ 1.66), moderate (1.67–2.33), and high (≥ 2.34).

Predictors of utilization were examined using two regression models. A Probit model was estimated for the binary utilization outcome (whether or not a farmer utilized FFBS recommendations), and a Tobit model was estimated for the continuous intensity of use index, which is censored on both ends. Independent variables included sex, age, marital status, household size, education level, primary income source, years in farming, land acquisition mode, farm size, frequency of extension visits, credit access, and the FFBS Perception Index. Marginal effects (dy/dx) were computed for the Probit model to facilitate interpretation. Tobit is not just a "good choice" but it is the consistent and unbiased estimator for continuous intensity doubly-censored intensity index. It respects the bounded nature of agricultural data, it corrects for truncation bias, and provides a coherent bridge between the discrete adoption decision and the continuous usage level. To ensure that there is no reverse causality, it is possible that a more favorable perception of the program increases adoption intensity, but it is equally plausible that a higher level of adoption leads to a more positive perception of the program. empirically we test the direction of the correlation, we estimated a reverse regression. While we find that intensity correlates with perception, the magnitude of the coefficient is substantially smaller than the primary model's effect, and the R-squared is dominated by exogenous farmer characteristics.

RESULT AND DISCUSSION

Utilization of FFBS Recommended Practices

Table 1 presents the distribution of participants by whether they utilized FFBS-recommended practices. Out of 231 respondents, 221 (95.7%) reported utilizing the recommendations, while only 10 (4.3%) did not. This high rate of utilization is broadly consistent with findings from comparable FFBS evaluations in West Africa (Owiredu et al., 2022; Adi & Tubasen, 2024) and reflects the participatory, action-oriented design of the programme, which places farmers directly in the learning environment. When farmers practise skills and observe outcomes within the same season, the barrier between knowing and doing is considerably reduced (van den Berg & Jiggins, 2007). The small proportion of non-utilizers (4.3%) suggests that structural barriers to any level of adoption are relatively low among those who have been enrolled in FFBS, which is consistent with the programme's emphasis on low-cost, farmer-friendly practices. However, the binary utilization rate alone cannot reveal whether farmers are applying recommendations thoroughly or superficially, which makes the analysis of intensity particularly important.

Table 1. Distribution of Participants by Utilization of FFBS Recommended Practices (n = 231)

Utilization of FFBS Recommended Practices	Frequency	%
No	10	4.3
Yes	221	95.7
Total	231	100

Source: Field Survey Data, 2024

Intensity of Use of FFBS Recommended Practices

Table 2 presents the intensity of use of each FFBS recommendation. The mean Utilization Index of 0.7415 indicates a moderately high overall intensity of practice uptake across the programme's recommendation areas. However, significant variation exists across individual practices.

Planting and fertilizer application each recorded the highest weighted mean of 2.49, placing them firmly in the 'High' intensity category. This finding is encouraging because both practices sit at the heart of FFBS agronomic training and are directly linked to maize yield improvement. The fact that farmers apply them consistently suggests that the core production recommendations of FFBS have been successfully internalised. Harvesting (WM = 2.44) and good storage (WM = 2.40) also fell in the high intensity category, reflecting growing awareness of post-harvest losses as a significant threat to farm income — a concern that FFBS training explicitly addresses (Nakoma-Ngoma et al., 2025).

Seed selection returned a weighted mean of 2.36, also rated as high intensity. This is noteworthy because seed quality decisions are made before the season begins, and consistent high-intensity application suggests that farmers have genuinely shifted their input procurement behaviour — a more durable form of practice change than one that occurs only during the season (Mawia et al., 2025).

A cluster of practices fell in the moderate intensity range: input sourcing (WM = 2.31), use of herbicides (WM = 2.32), weeding (WM = 2.29), use of insecticide (WM = 2.26), marketing (WM = 2.26), savings (WM = 2.30), and land preparation (WM = 2.27). These results suggest that while farmers have adopted these practices, they are not yet applying them at maximum consistency or depth. The relatively moderate scores for marketing and savings are particularly worth noting, as these represent the business skill components of FFBS — areas where application requires not just knowledge but consistent habit formation and access to functioning markets and financial services (Sseguya et al., 2018).

The two practices with low intensity scores were use of Aflasafe (WM = 1.39) and field measurement (WM = 1.58). Aflasafe is a biological control product for aflatoxin contamination. Its low use intensity is likely explained by a combination of limited availability of the product in rural markets, unfamiliarity with the concept of mycotoxin management, and the perception that benefits accrue only in the medium term. Field measurement scored low despite being a foundational record-

keeping skill, possibly reflecting low confidence in numeracy and data use among a population where formal education levels are modest (Bello et al., 2024; Nyberg et al., 2025).

Table 2. Distribution of Participants by Intensity of Use of FFBS Recommended Practices (n = 231)

FFBS Recommendation	Low	Moderate	High	WMS	WM	Decision
Field measurement	121	174	69	364	1.5758	Low
Seed selection	8	266	270	544	2.3550	High
Input sourcing	16	254	264	534	2.3117	Moderate
Land preparation	16	272	237	525	2.2727	Moderate
Planting	15	176	384	575	2.4892	High
Use of herbicides	20	236	279	535	2.3160	Moderate
Fertilizer application	16	172	387	575	2.4892	High
Weeding	26	226	276	528	2.2857	Moderate
Use of Aflasafe	161	100	60	321	1.3896	Low
Use of insecticide	32	216	273	521	2.2554	Moderate
Harvesting	14	202	348	564	2.4416	High
Good storage	23	184	348	555	2.4026	High
Marketing	16	278	228	522	2.2597	Moderate
Savings	33	192	306	531	2.2987	Moderate
Mean Utilization Index (UI) = 0.7415						

Note: Decision rule: ≤ 1.66 = Low; 1.67–2.33 = Moderate; ≥ 2.34 = High.
Source: Field Survey Data, 2024.

Factors Influencing Utilization and Intensity of Use

Table 3 presents the results of the Probit regression (for the binary utilization decision) and the Tobit regression (for intensity of use). The Probit model had a Wald chi² (10) of 35.4 and a Pseudo R^2 of 0.2091, indicating reasonable model fit. The Tobit model had an F (11, 200) of 17.37 (Prob > F = 0.000), with a log pseudolikelihood of 160.466.

Sex was positively and significantly associated with the utilization decision (dy/dx = 0.023; z = 1.82, $p < 0.10$), suggesting that male farmers were more likely to utilize FFBS recommendations than their female counterparts. This finding is consistent with Shehu et al. (2024), Kadafur & Shehu (2023) and Kinkingninhoun et al. (2023), who found that gender-based differences in resource access, decision-making authority, and social mobility often translate into differential adoption rates in West Africa. Female farmers may face additional barriers such as limited control over land use decisions, reduced mobility to access input markets, or competing household responsibilities that constrain the time available for implementing new practices.

Age was also a positive and marginally significant predictor of utilization (dy/dx = 0.001; z = 1.66, $p < 0.10$). This is somewhat contrary to studies that portray older farmers as more risk-averse adopters (Abate et al., 2017), but it is consistent with evidence from participatory programmes specifically where older, more experienced farmers may be more confident in evaluating the merits of a recommendation and applying it selectively where they see fit. Older farmers in the study area may also hold more authority within their households and communities, giving them greater latitude to implement changes in farming practice.

Household size was negatively and significantly associated with both utilization (dy/dx = -0.001; z = -2.46, $p < 0.05$) and intensity of use (dy/dx = -0.004; T = -1.94, $p < 0.10$). Larger households imply greater consumption needs and a more complex internal allocation of resources. Rather than channelling additional household labour into implementing FFBS recommendations, larger families may face tighter budget constraints that limit investment in inputs, or the diffusion of decision-making across more household members may slow the adoption of new techniques (Katya et al., 2025).

Land acquisition mode was a significant negative but associated with utilization in the Probit model (dy/dx = -0.002; z = -2.78, $p < 0.01$). Farmers who acquired land through non-ownership channels such as borrowing or renting were significantly less likely to utilise FFBS recommendations. This is consistent with Lawry et al. (2017) and Olumba et al. (2024), who identify land tenure insecurity as a major barrier to investment in productivity-enhancing practices. A tenant or borrower has limited incentive to invest labour and inputs in improving a plot from which they may be displaced, particularly for practices whose returns span multiple seasons.

Marital status was positively and significantly associated with intensity of use in the Tobit model (dy/dx = 0.019; T = 2.00, $p < 0.05$). Married farmers may benefit from spousal labour support and shared household decision-making that facilitates deeper engagement with recommended practices (Bekele & Temesgena, 2024). This finding aligns with the broader

household economics literature, which identifies the pooling of marital resources as a positive factor in smallholder technology intensity.

The frequency of extension visits was strongly and negatively associated with intensity of use (dy/dx = -0.088; T = -3.44, $p < 0.01$). The negative direction of this relationship is counterintuitive at first glance, but several explanations are plausible. Farmers who require more frequent extension visits may be those experiencing greater difficulty implementing recommendations. In other words, more visits may be a response to lower intensity rather than its cause. Alternatively, high-frequency visits from multiple extension systems may deliver contradictory or overlapping messages that create confusion rather than clarity. This pattern has been noted elsewhere in Nigeria (Onoja et al., 2019) and underscores the importance of coordinating extension messaging across agencies.

The FFBS Perception Index was the strongest and most significant correlate of intensity of use in the Tobit model (dy/dx = 0.461; T = 5.54, $p < 0.01$). This is among the most important findings of the study. Farmers who had a more positive assessment of the programme's effectiveness practised its recommendations more consistently and at a deeper level. This finding reinforces the theoretical proposition advanced by Meijer et al. (2015), Red et al. (2021), and Babu et al. (2025) that knowledge and attitude toward a programme are not merely antecedents of a single adoption decision but continue to correlate with ongoing practice behaviour. It also supports the conclusion that efforts to improve farmers' perception of the FFBS programme through clearer communication of results, stronger peer demonstration, and responsive facilitation are likely to yield measurable improvements in practice uptake.

Education level, primary income source, years in farming, farm size, and credit access were not statistically significant predictors of either utilization or intensity in this sample. The non-significance of education is somewhat surprising but may reflect the practical, hands-on delivery of FFBS which reduces the literacy premium on learning outcomes. The non-significance of credit access may be partly explained by the high overall utilization rate, which leaves little statistical variation in the dependent variable for the Probit model to exploit.

Table 3. Factors Influencing Utilization and Intensity of Use of FFBS Recommended Practices (n = 231)

Variable	dy/dx	Probit Robust Coef. (Std. Err.)	Z	dy/dx	Tobit Coef. (Robust Std. Err.)	T
Sex	0.0230	0.8336 (0.4586)	1.82*	0.0288	0.0288 (0.0256)	1.13
Age	0.0008	0.0703 (0.0424)	1.66*	-0.0002	-0.0002 (0.0012)	-0.20
Marital status	0.0000	0.0000 (0.0000)	0.00	0.0194	0.0194 (0.0098)	2.00**
Household size	-0.0010	-0.0858 (0.0349)	-2.46**	-0.0036	-0.0036 (0.0019)	-1.94*
Education level	-0.0029	-0.2567 (0.1973)	-1.30	-0.0047	-0.0047 (0.0063)	-0.74
Primary income source	0.0000	-1.0000 (8.0000)	-0.19	0.0000	0.0000 (0.0000)	0.00
Years in farming	-0.0003	-0.0226 (0.0454)	-0.50	0.0018	0.0018 (0.0012)	1.48
Land acquisition mode	-0.0024	-0.2123 (0.0764)	-2.78***	-0.0038	-0.0038 (0.0038)	-1.00
Farm size	0.0006	0.0551 (0.1648)	0.33	-0.0055	-0.0055 (0.0076)	-0.72
Frequency of ext. Visits	-0.0009	-0.0754 (0.1669)	-0.45	-0.0881	-0.0881 (0.0256)	-3.44***
Credit access	0.0000	0.0000 (0.0000)	0.00	-0.0038	-0.0038 (0.0085)	-0.45
Perception Index (PI_FFBS)	-0.0017	-0.1532 (1.5464)	-0.10	0.4605	0.4605 (0.0831)	5.54***
Constant (_cons)		1.5166 (1.7910)	0.85		0.3832 (0.0814)	4.71
/sigma					0.1107 (0.0060)	
No. of observations	211			211		
Wald chi²(10)	35.4			—		
F (11, 200)	—			17.37		
Prob > chi²	0.001			—		
Prob > F	—			0.000		
Pseudo R²	0.2091			-0.5841		
Log pseudolikelihood	15.6798			160.466		

*Note: * significant at 10%; ** significant at 5%; *** significant at 1% level.*
Source: Field Survey Data, 2024.

CONCLUSION

This study set out to examine the predictors of utilization and intensity of use of FFBS recommendations among maize farmers in North West Nigeria. The findings reveal a high overall utilization rate of 95.7%, a mean Utilization Index of 0.7415, and considerable variation in intensity across practice areas. Practices with direct, visible impact on yield (planting, fertilizer application, seed selection, and harvesting) were consistently applied at high intensity, while newer or more complex recommendations such as use of Aflasafe and field measurement lagged behind.

The regression results identify several actionable leverage points for programme improvement. First, the negative effect of large household size on both utilization and intensity suggests that extension messaging needs to engage all relevant household decision-makers, not just the primary farmer who attends FFBS sessions. Including spouses and other household members in at least selected learning events could help build broader household alignment behind the recommended changes.

Second, the negative effect of non-ownership land tenure on utilization points to a structural constraint that extension alone cannot resolve. Programmes operating in areas with high proportions of tenant or borrowed-land farmers should consider advocating for secure land access arrangements or designing practice packages that deliver visible returns within a single season, making them relevant even for farmers without long-term tenure security.

Third, the counterintuitive negative relationship between extension visit frequency and intensity of use calls for a critical review of how extension contacts are organised and coordinated. More contacts do not automatically translate into better practice uptake; the quality, consistency, and specificity of the messages delivered during visits matter more than their frequency. Reducing overlapping or conflicting messages through better inter-agency coordination would be a practical step.

Finally, and most significantly, the strong positive effect of the FFBS Perception Index on intensity of use reinforces the case for investing in activities that build and maintain positive programme perception. Farmer-to-farmer exchange visits, regular sharing of practice results within groups, and transparent feedback on agro-economic outcomes can all contribute to strengthening the attitudinal foundations of sustained practice change. Future research should explore how perceived effectiveness evolves over successive seasons, and whether formal graduation or follow-on mechanisms can sustain the engagement that drives high-intensity utilization beyond the programme period.

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