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Determinants and Constraints of Farm Record-Keeping Practice Among Small-Scale Millet Farmers in Bauchi State, Nigeria

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ABSTRACT
This study examined the determinants and constraints of farm record-keeping among small-scale millet farmers in Bauchi State, where millet production remains vital to rural livelihoods, but is characterized by low productivity and weak farm management practices. A multi-stage sampling technique was used to select 318 respondents from a population of 1,542 registered farmers, out of which 307 valid responses were analyzed. Data were analyzed using binary logistic regression and the Problem Confrontation Index (PCI). The results revealed that demographic factors such as age, education, farm size, and farming experience did not significantly influence record-keeping practices. In contrast, institutional and financial factors played a decisive role. Specifically, cooperative membership and access to credit significantly increased the likelihood of farmers keeping records, highlighting the importance of organized support systems and financial accountability in promoting better farm management. Regarding constraints, the study found that inaccessibility of digital tools and lacks of knowledge/skills were the most severe barriers to effective record-keeping. Other factors such as illiteracy, cost of materials, time constraints, and lack of interest were perceived as less severe. Overall, constraints were moderate, suggesting that farmers are not opposed to record-keeping but are limited by inadequate capacity and access to necessary tools. The study concludes that improving farm record-keeping requires strengthening institutional support through cooperatives, enhancing access to credit, and providing targeted training and digital tools. Such interventions are essential for improving farm management, increasing productivity, and enhancing the livelihoods of small-scale millet farmers.

Keywords: Constraints, Determinants, Farm Record-Keeping, Small-Scale Farmers, Bauchi State

INTRODUCTION

Agriculture remains a fundamental sector in Nigeria's economy, providing employment, income, and food security for a large proportion of the rural population. In the semi-arid regions of northern Nigeria, millet is a major staple crop due to its adaptability to drought-prone environments and low-input conditions. It plays a critical role in sustaining rural livelihoods, particularly among small-scale farmers who dominate agricultural production systems in states like Bauchi. Despite its importance, millet production in the region is still characterized by low productivity, poor resource management, and limited adoption of improved farm management practices.

One of the essential components of effective farm management is farm record-keeping, which involves the systematic documentation of farm activities such as input use, production output, labor utilization, and financial transactions. Farm records provide a foundation for monitoring farm performance, improving decision-making, and enhancing overall farm efficiency. Recent evidence emphasizes that proper record-keeping enables farmers to analyze costs and returns, plan production activities, and improve profitability and sustainability (Basir et al., 2024). Similarly, farm records are critical for tracking farm evolution over time and supporting better management decisions, particularly in increasingly complex farming systems (Food and Agriculture Organization [FAO], 2022).

Despite these benefits, the adoption of farm record-keeping among smallholder farmers in developing countries remains low. Many farmers rely on memory or informal recording methods, which are often inaccurate and limit effective farm planning. This situation raises a pertinent research question: what drives and what hinders farm record-keeping among smallholder millet farmers in Bauchi State? Understanding this, is necessary for improving farm management practices and enhancing agricultural productivity in the region.

Empirical studies have identified several socio-economic and institutional factors influencing the adoption of farm record-keeping practices. A recent study by Mdoda and Nontu (2026) found that key determinants include farmers' level of education, access to extension services, farm size, credit availability, and participation in farmer organizations. These factors significantly influence farmers' ability and willingness to maintain proper records. In addition, extension services play a very important role in improving farmers' knowledge and adoption of improved practices, thereby enhancing productivity and rural livelihoods (Kalogiannidis & Syndoukas, 2024). This highlights the importance of institutional support systems in promoting record-keeping behavior among smallholder farmers.

On the other hand, several constraints continue to hinder the adoption of farm record-keeping practices. Recent findings indicate that low literacy levels, lack of awareness, time constraints, and perceived complexity of record-keeping systems are major barriers (Mdoda & Nontu, 2026). Farmers may also perceive record-keeping as unnecessary or burdensome, especially when operating at subsistence levels. Furthermore, structural challenges such as inadequate

extension services and limited access to training further restrict farmers' capacity to adopt proper record-keeping practices (Food and Agriculture Organization [FAO], 2022). These constraints are particularly pronounced in northern Nigeria, where socio-economic limitations and limited access to agricultural information persist.

Although there is growing literature on farm management and technology adoption among smallholder farmers, there is limited empirical evidence specifically focusing on farm record-keeping practices among millet farmers in Bauchi State. Most existing studies have concentrated on other regions or agricultural enterprises, leaving a gap in context-specific knowledge for millet-based systems in semi-arid northern Nigeria. Given the importance of millet for food security and climate resilience, as well as the unique socio-economic characteristics of farmers in the study area, there is a need for focused research on this subject.

Therefore, this study aims to address this gap by examining both the determinants and constraints of farm record-keeping practices among small-scale millet farmers in Bauchi State. Specifically, the study seeks to: (i) assess the key determinants of farm record-keeping practice among small-scale millet farmers in the study area, and (ii) identify the constraints encountered by small-scale millet farmers in keeping farm records. The findings are expected to provide valuable insights for policymakers, extension agents, and development practitioners in designing targeted interventions to improve farm management practices and enhance agricultural productivity.

MATERIALS AND METHODS

Study Area

This study was carried out in Bauchi State, Nigeria. The State is located between Latitude $9^0$30 and $12^0$30 North and Longitude $8^0$50` and $11^0$0' East with an elevation of 616m and altitude of 6,920m above sea level (National Bureau of Statistics [NBS], 2017). The State is divided into three (3) Agricultural Zones (which are the Northern, Central and Western Zones). It is bounded in a clockwise direction by Yobe, Gombe, Taraba, Plateau, Kaduna, Kano and Jigawa states. The annual rainfall ranges between 1,300 millimeters in the Southern part and 700 millimeters in the Northern part. The maximum and minimum temperature is 40.56^0C and 220C, respectively, while the relative h umidity is highest in August by (66.55%) and lowest in February by (10.5%) (BSADP, 2016). The State is heterogeneous, with predominant tribes like Hausa, Fulani, Jarawa, Sayawa among others (Bauchi State Economic Empowerment and Development Strategies [BSEEDS], 2016). According to the National Population Commission (2007), Bauchi State had a population of 4,653,066 in the 2006 census. Applying an average annual growth rate of 2.6%, the population was projected to reach approximately 7,561,281 by 2025, when the study was conducted. It has 20 local government areas (LGAs) with a total land area of 49,119 km2 (18,965 Sqm) representing about 5.3% of Nigerias total land mass. Majority of the people are involved in farming (crop and livestock), fishing, food processing and marketing of agricultural produce (Abba et al., 2022).

Data Collection and Sampling Procedure

Bauchi State comprises twenty (20) Local Government Areas (LGAs), which are grouped into three agricultural zones: the Northern Zone (nine LGAs), the Central Zone (four LGAs), and the Western Zone (seven LGAs). To ensure adequate coverage of the study area, a multi-stage sampling technique was employed to select respondents.

In the first stage, the three agricultural zones of Northern, Central, and Western were purposively selected because millet is cultivated across all Agricultural Development Programme (ADP) zones in the state.

In the second stage, 30% of the LGAs in each agricultural zone were randomly selected. Specifically, three LGAs: Shira, Misau, and Itas-Gadau were selected from the Northern Zone (9 LGAs); one LGA – Ningi from the Central Zone (4 LGAs); and two LGAs - Kirfi and Toro from the Western Zone (7 LGAs). This resulted in a total of six (6) LGAs selected across the three agricultural zones. The selection was intended to reduce the study area to a manageable size.

In the third stage, cluster sampling was used to randomly select two communities from each of the six selected LGAs, resulting in a total of twelve (12) communities. The selected communities were: Disina and Beli (Shira LGA); Sirko and Ajili (Misau LGA); Bilkicheri and Itas (Itas-Gadau LGA); Nasaru and Gadar Maiwa (Ningi LGA); Badara and Wanka (Kirfi LGA); and Zaranda and Rahama (Toro LGA).

The final stage involved the simple random selection of respondents from a total population of 1,542 registered millet farmers, obtained from the Bauchi State Agricultural Development Programme (BSADP).

The sample size for the study was determined using the Yamane (1967) formula, which is widely applied in survey research involving finite populations. The formula provides a simplified and reliable method for calculating an adequate sample size at a specified level of precision:

$n = N/1+N(e)2$

where: n represents the required sample size, N denotes the total population size, and e is the level of precision (0.05).

Given a total population of 1,542, the sample size was calculated at a 95% confidence level and a 5% margin of error as follows: $n = 1,542/1+1542(0.05)\ ^2 \sim 318$

Thus, a total of 318 respondents was considered adequate for the study (Yamane, 1967). However, after data collection, 11 questionnaires were found to be invalid; consequently, data from 307 valid questionnaires were used for analysis.

Sample Size Allocation Technique

Following the determination of the total sample size, Bowley's proportional allocation technique was employed to distribute the sample across the various strata. This technique allocates sample units to each stratum in proportion to its population size, thereby ensuring equitable representation of all strata in the study (Bowley, 1926).

The Bowley proportional allocation formula is expressed as:

$nh = Nh/N$

where: nh is the sample size allocated to stratum h, Nh is the population size of stratum h, N represents the total population (1,542), and n denotes the total sample size (318).

The combined use of the Yamane sample size determination formula and Bowley's proportional allocation technique ensured an adequate overall sample size while maintaining proportional representation across all strata. This approach enhances the reliability, validity, and generalizability of the study findings (Bowley, 1926; Yamane, 1967).

Table 1: Distribution of Sampled Millet Farmers in the Study Area

Agricultural Zones	Selected LGAs	Selected Communities	Sample frame (N)	Sample size (n)
Northern Zone	Shira	Disina	150	31
		Beli	111	23
	Misau	Sirko	106	22
		Ajili	116	24
	Itas-Gadau	Bilkicheri	121	26
		Itas	137	28
Sub-total	3	6	741	154
Central Zone	Ningi	Nasaru	138	28
		GadarMaiwa	162	33
Sub-total	1	2	300	61
Western Zone	Kirfi	Badara	143	30
		Wanka	104	21
	Toro	Jama'a/Zaranda	136	28
		Rahama	118	24
Sub-total	2	4	501	103
Total	6	12	1542	318

Source: Field Survey (2025)

Data Analysis

Binary Logistic Regression was used to achieve objective i that is, to assess the key determinants of farm record keeping practice among the respondents. On the other hand, descriptive statistics specifically, the Problem Confrontation Index (PCI) was used to identify the constraints encountered by the respondents.

RESULTS AND DISCUSSION

Determinants of Farm Record Keeping Practice Among Small-Scale Millet Farmers in Bauchi State

This section presents and discusses the results of the binary logistic regression analysis of the determinants of farm record-keeping practices among small-scale millet farmers in Bauchi State, Nigeria. The analysis is aligned with the study objective of identifying the socio-economic and institutional factors influencing farmers' likelihood of keeping farm records.

The results in Table 2 reveal key insights into the socio-economic factors influencing farm record-keeping among small-scale millet farmers in Bauchi State, Nigeria. Using binary logistic regression, the analysis explored the statistical significance and strength of association of various independent variables with the likelihood of keeping farm records.

Contrary to expectations, demographic factors like age and education do not strongly predict whether small-scale millet farmers maintain farm records. Although previous studies often found that education influences record-keeping (Olatunji et al., 2022; Yusuf et al., 2023), the current result may reflect the dominance of informal or subsistence-based farming systems in the region, where even educated farmers rely on traditional methods. Similarly, age and experience might not impact record-keeping if farmers lack exposure to record management practices (Ajayi et al., 2021).

The lack of significance for farm size and household size also contradicts findings in some regions where larger farms or larger households lead to more structured management practices (Ali et al., 2020). This may suggest uniformity in record-keeping attitudes regardless of farm size in Bauchi's millet farming context. On the other hand, three variables were statistically significant at conventional levels and are worthy of close examination:

Cooperative Membership: Farmers who are members of cooperatives are approximately 4.8 times more likely to engage in record-keeping than non-members. This strong connection aligns with earlier findings by Torkaa et al. (2021), who noted that farmer-based organizations facilitate access to training, improved inputs, and financial literacy, all of which encourage systematic record-keeping. Cooperatives often impose standards that require documentation of farm operations, further promoting best practices (Lawi., et al., 2020).

Access to Credit: Access to credit significantly increases the likelihood of keeping records by about 2.6 times. This suggests that financial accountability linked to credit use necessitates proper documentation. Financial institutions often require records for creditworthiness assessment, thereby pushing farmers to adopt formal record-keeping practices (Adeola & Adebayo, 2020). Moreover, access to capital may enable investment in tools or training that support better farm management.

Income: Income is marginally significant, but the Exp(B) value of 1.000 indicates that its effect size is negligible. This may suggest that income, although important in other aspects of agricultural development, is not a direct driver of record-keeping behaviour among millet farmers. This aligns with the view that behavioural factors and institutional support, rather than just economic standing, influence record-keeping (Nwankwo et al., 2023).

The findings emphasize the critical role of institutional support, particularly through cooperatives and credit schemes, in enhancing record-keeping practices. Development policies aiming to improve farm productivity and data management should prioritize: Strengthening farmer cooperatives and encouraging membership; linking record-keeping training to access-to-credit programs and developing low-cost, context-appropriate digital tools for farm management.

While demographic and farm-level characteristics are not strong predictors of record-keeping in this context, institutional and financial enablers appear to be the key drivers.

Based on the table the individual contribution of each predictor Key findings include:

i. Cooperative Membership: Statistically significant ($p = 0.002$). Farmers who are cooperative members are about 4.8 times more likely to keep records (Exp(B) = 4.817).

ii. Access to Credit: Statistically significant (p = 0.031). Farmers with access to credit are approximately 2.6 times more likely to keep records (Exp(B) = 2.572).
iii. Income: Statistically significant (p = 0.043), but the odds ratio (Exp(B) = 1.000) indicates negligible practical impact.

Other variables such as age, education, household size, farming experience, farm size, and marital status were not statistically significant. The analysis indicates that cooperative membership and access to credit are the most important determinants of farm record-keeping practices. Interventions aimed at improving farmers' participation in cooperatives and enhancing access to credit facilities may significantly enhance farm record-keeping behavior.

Table 2: The Result of Binary Logistic Regression Analysis of the Key Determinants of Farm Record-keeping Practice Among Small-Scale Millet Farmers in Bauchi State

Variables	B	S.E.	Wald	Df	Sig.	Exp(β)
Age	-.049	.043	1.314	1	.252	.952
Level_edu	.060	.124	.233	1	.629	1.061
HHsize	-.014	.032	.188	1	.664	.986
Experience	-.027	.039	.482	1	.488	.973
Farm_size	-.109	.337	.104	1	.747	.897
Coop_membership	1.572	.648	5.893	1	.015**	4.817
Access_credit	1.846	.811	5.184	1	.023**	6.335
Income	.652	.387	2.842	1	.092*	1.919
Marital_sta	.879	.562	2.442	1	.118	2.408
Constant	-6.712	5.007	1.797	1	.180	.001
-2 Log likelihood	237.260[a]					
Cox & Snell R Square	.178					
Nagelkerke R Square	.287					

Source: Field survey (2025). **, * are significant values at 5 and 10% respectively.

Constraints to Farm Record-Keeping Among Small-Scale Millet Farmers in the Study Area

Table 3 shows the constraints of the respondents to farm record-keeping. This section presents the analysis of constraints to farm record-keeping among respondents. A four-point Likert scale was used and weighted as follows: Very Severe = 4, Severe = 3, Not Severe = 2, and Not a Constraint = 1 was used. The mean score for each constraint was obtained by dividing the Problem Confrontation Index (PCI) by the total number of respondents (N = 307).

The decision rule was based on the cut-off point calculated as: Mean scores of 2.50 and above were regarded as Severe, while mean scores below 2.50 were regarded as Not Severe. The results in Table 4.7 reveal that inaccessibility of digital tools (Mean = 3.48) ranked first and was perceived as a severe constraint to farm record-keeping among respondents. This implies that limited access to smartphones, computers, farm management applications, and internet facilities significantly hinders farmers' ability to keep accurate and up-to-date farm records. The high ranking underscores the growing importance of digital technologies in modern farm management. This is in congruent with the submission of Baig et al., (2023) and Olaoye & Adebayo, (2022). Similarly, lack of knowledge/skills (Mean = 2.73) ranked second and was also considered a severe constraint. This finding suggests that many farmers lack adequate training and technical competence in record-keeping practices. It indicates a need for capacity-building programmes and extension education to improve farmers' managerial abilities. These findings support prior research by Onyeneke et al., (2022) and Chikobi et al., (2023) who stated and highlights the critical role of training and extension services in promoting good record-keeping practices.

Although illiteracy (Mean = 2.41) ranked third, it fell slightly below the decision benchmark of 2.50 and was therefore categorized as not severe. This suggests that while literacy challenges exist, respondents perceived digital inaccessibility and inadequate skills as more pressing constraints. As Oladele (2021) notes, functional literacy is a primary factor in the adoption of improved agricultural practices, particularly those involving documentation. Similarly, Okoro and Nwachukwu (2020) emphasize that functional literacy is a prerequisite for understanding and applying farm data management processes. To address this barrier, interventions such as adult education programs and the development of visual-based digital tools are recommended.

Other factors such as cost of record-keeping materials (Mean = 1.77), lack of time (Mean = 1.76), and lack of interest (Mean = 1.73) were not considered severe constraints (Adekunle et al. 2020). Recent research by Yeboah and Boateng (2021) suggests that the provision of low-cost record-keeping kits or subsidized digital tools can significantly increase adoption rates among smallholder farmers.

The category of "Others" which received a PCI score of 309, was ranked seventh. Although fewer respondents cited issues in this category, factors such as cultural practices, gender dynamics, and policy environments may indirectly affect farmers' record-keeping behaviors (FAO, 2021). The low number of responses here indicates that the primary barriers have been effectively captured by the preceding categories. The overall grand mean of 2.13, which is below the cut-off point of 2.50, indicates that, on average, constraints to farm record-keeping were not severe among the respondents. However, the prominence of digital inaccessibility and inadequate knowledge highlights critical areas where policy intervention and agricultural extension services should focus to enhance effective farm record management.

Table 3: Distribution of the Respondents Based on Constraints to Farm Record-keeping in the Study Area

Constraints	Very severe (3)	Severe (2)	Not severe (1)	Not a constraint (0)	PCI	Mean	Ranking
Inaccessibility of digital tools	192(768)	79(23)	27(54)	9(9)	1068	3.48	1st
Lack of knowledge/skills	145 (580)	31 (93)	34 (68)	97 (97)	838	2.73	2nd
Illiteracy	120(480)	24(72)	25(50)	138(138)	740	2.41	3rd
Cost of record-keeping materials	32(128)	34(10)	73(146)	168(168)	544	1.77	4th
Lack of time	25(100)	37(11)	84(168)	161(161)	540	1.76	5th
Lack of interest	12(48)	47(14)	95(190)	153(153)	532	1.73	6th
Others	0	0	2(4)	305(305)	309	1.01	7th

Source: Field survey (2025). NB: Problem Confrontation Index Values. Very Severe = 4, Severe = 3, Not Severe = 2, Not A Constraint = 1

CONCLUSION

The study concludes that farm record-keeping among small-scale millet farmers in Bauchi State remains below the desired level, despite its importance for effective farm management, decision-making, and productivity improvement. The findings revealed that institutional and socioeconomic factors, particularly membership in farmer cooperatives, access to agricultural credit, extension contact, literacy level, and access to information, significantly influence the adoption and maintenance of farm records. Therefore, improving record-keeping practices requires a comprehensive approach that addresses both farmers' capacity constraints and institutional support systems.

To enhance farm record-keeping, farmer cooperatives should be strengthened and utilized as major channels for training, awareness creation, and information dissemination. Access to agricultural credit should also be expanded and linked to basic record-keeping requirements to encourage accountability and foster adoption. Furthermore, extension services should be reinforced to provide practical and continuous training on record management, while affordable, user-friendly digital technologies and simplified record-keeping tools should be promoted to make record maintenance easier and more accessible for farmers.

In addition, adult literacy and capacity-building programmes should be supported to improve farmers' ability to maintain and effectively utilize farm records for production and financial decisions. Policymakers should integrate record-keeping components into agricultural development programmes through coordinated efforts involving extension agencies, financial institutions, and farmer organizations. Collectively, these measures will strengthen record-keeping practices among millet farmers, resulting in improved farm management, enhanced productivity, and greater agricultural sustainability in Bauchi State.

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