



ASSESSMENT OF ADOPTION OF GOOD AGRICULTURAL PRACTICES AND MOST CULTIVATED ARABLE CROPS AMONG ARABLE CROP FARMERS IN BORNO STATE, NIGERIA

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ABSTRACT

The study examined the adoption of Good Agricultural Practices (GAPs) and the most cultivated arable crops among farmers in Borno State, Nigeria. A multistage sampling technique was used to select 410 respondents from the study areas. Data were collected using structured questionnaires and analyzed using descriptive and inferential statistics. Male (73.85%) dominated arable crop production, (32.82%) had secondary education. The findings revealed that maize (82.56%), Bambara nut (76.15%) and groundnut (73.07%) were the most commonly cultivated crops. The most frequently adopted GAPs include fertilizer application (80.17%), seed treatment (65.91%), and proper spacing (64.79%). The results of Logistic regression analysis showed that farm size ($P < 0.05$), cooperative membership ($P < 0.01$), and access to credit ($P < 0.01$) were significant in influencing the adoption of GAP in the study area. The results also revealed that the major constraints to adoption of GAP were inadequate input supply (78.46%), lack of attending meeting and training (74.6%), insecurity (74.6%), and poor storage facilities (73.08%) to mention few. The study concluded that farm size, membership of association and access to credit were the factor influencing the adoption of GAP in the study area. This study recommends that; Development partners and NGOs should collaborate with research institutions to introduce and scale up climate-smart GAP technologies that are adaptable to the local environment. Risk management tools such as weather-indexed insurance schemes should also be introduced.

Keywords: GAP, Arable, Crops, Adoption, Constraints

INTRODUCTION

One key objective of Nigeria's agricultural development is to shift from low-yield subsistence farming to a high-output, agro-industrial system through improved technology (Nkwuagba and Nkamnebe, 2024). Since many rural poor depend on crop farming (Mathew, 2024), Good Agricultural Practices (GAPs) are promoted to enhance productivity, efficiency, and income (Abiodun, 2016). Introduced by FAO, GAPs ensure sustainable, environmentally sound production while improving food quality, safety, and market access (FAO, 2021). Adoption stabilizes yields, reduces post-harvest losses, and boosts market value, though increased supply may affect incomes (Adetarani *et al.*, 2021). Farmers also use GAPs to avoid disadvantages from poor practices and to meet food safety standards in competitive markets (Adetarani *et al.*, 2021).

FAO's framework highlights soil and water management, crop and animal health, processing, and worker safety, all vital for national food security (Omolehin *et al.*, 2019). Yet, Nigerian agriculture faces challenges including land degradation, pests, outdated techniques, and limited technologies (Bedru *et al.*, 2022; Onoja, 2023), alongside market constraints such as poor credit and weak farmer-market linkages (Adetarani *et al.*, 2021). Though programs like Fadama, FAO, N2Africa, and BOSAP promote GAPs in Borno State to raise productivity and livelihoods (Borno State Government, 2016), food insecurity persists. Empirical data on adoption in the state remain scarce. This study therefore seeks to assess adoption levels to guide policies for enhancing uptake among arable crop farmers in Borno State, Nigeria.



- i. Determine the socio-economic characteristics of the farmers;
- ii. Determine the most cultivated arable crop cultivated by the farmers;
- iii. Assess the most adopted Good Agricultural Practices among farmers (GAPs);
- iv. Determine the socio-economic factors influencing the level of adoption of Good Agricultural Practices; and
- v. Examine the constraints to the adoption of Good Agricultural Practices.

METHODOLOGY

The Study Area

Borno State, located at latitude 12°08'60"N and longitude 12°53'59.99"E, spans an area of 61,435 km² and borders Niger, Chad, Cameroon, and the Nigerian states of Adamawa, Gombe, and Yobe. It comprises 27 Local Government Areas with a projected 2024 population of 7,171,104, based on a 3% annual growth rate from the 2006 census figure of 4,171,104 (National Population Commission, NPC, 2021). Agriculture is the backbone of the economy, predominantly practiced at the smallholder and subsistence level (Ayuba, 2017). Rainfall ranges from 600 mm in the north to 1,200 mm in the south, with a growing season of 100–180 days. Temperatures fluctuate between 13.6°C–31.9°C in January and 9.0°C–28.5°C in August (Quick Projects, 2018). The state cultivates a wide variety of arable crops, fruits, vegetables, tree crops, and livestock (NBS, 2019).

Sampling Technique and Sample Size

Borno State has (3) three Agricultural zones namely; (Zone 1, Zone 2 and Zone 3). Each of the Agricultural zone comprises of (9) nine local government areas. The first stage involved purposive selection of (3) three local government areas from each zone based on the intensity of agricultural production which were Zone 1; Biu, Kwaya Kusar and Bayo were selected in zone 1, in zone 2; Bama, Konduga and Jere, in zone 3; Magumeri, Nganzai and Monguno giving a total of 9 LGAs. The Second stage involved proportionate selection of 131 Agricultural blocks and 119 extension cells. In the third stage, the list of the 15450 registered farmers were obtained from BOSADP which was used as a sampling frame. From the list, farmers were randomly selected proportionate to the registered farmers from each of the selected extension cells. A total of 410 farmers were selected using Yamane (1969) formula.

Thus,

$$n = \frac{N}{1 + N(e)^2} \text{----- (3.1)}$$

n=390

n= Sample size

N= the finite population of crop farmers

l= constant

e = margin error

$$n = \frac{15450}{1 + 15450(0.05)^2}$$

n=390

Thus, the required sample size is 390, the sample size is adjusted by 5 percent to 410 because some of the entries were invalid. In the last stage, the sample size is distributed proportionally to all the selected Local Governments in the study area based on the registered farmers' population size.

Table 1: Sampling Procedure

| S/N | L.G. A | Extension Blocks | Extension Block Selected | Extension Cells | Extension Cells Selected | Registered Farmers | Farmers Selected |
|-------|------------|------------------|--------------------------|-----------------|--------------------------|--------------------|------------------|
| 1. | Biu | 16 | 11 | 30 | 15 | 2900 | 77 |
| 2. | Bayo | 10 | 7 | 12 | 9 | 1100 | 29 |
| 3. | KwayaKusar | 13 | 9 | 16 | 10 | 1400 | 37 |
| 4. | Bama | 80 | 54 | 28 | 14 | 1500 | 40 |
| 5. | Konduga | 11 | 8 | 16 | 9 | 1000 | 27 |
| 6. | Jere | 14 | 10 | 12 | 8 | 1600 | 42 |
| 7. | Magumeri | 15 | 11 | 20 | 13 | 2000 | 53 |
| 8. | Nganzai | 12 | 10 | 12 | 9 | 1000 | 27 |
| 9. | Monguno | 16 | 11 | 25 | 14 | 2950 | 78 |
| Total | 9 | 187 | 131 | 171 | 119 | 15450 | 410 |

Source: Field Survey, 2023

Methods of Data Collection and Analysis

Data were collected using structured questionnaires. Trained enumerators were used to collect data. Descriptive statistics and inferential statistics were used in the analysis of data collected for this study. Descriptive statistics in the form of frequencies, mean and percentage were used to achieve objectives (i, ii, iii, iv, v and vii). A five-point Likert scale (was used to further determine objective v) of the mean score in the determination of the mean score to determine the level of adoption of GAPs: $5+4+3+2+1 = 15/5 = 3$(3.2)

The mean value of the scale of 3 and was used as the cutoff point to rank the responses. Any mean response of ≥ 3 is considered high adopter, while a mean score of ≤ 2 is considered a low adopter. Inferential statistics in the form of binary logit regression was used to achieve objective (vi) which is the socio-economic factors influencing the level of adoption of Good Agricultural Practices (GAPs). Logistics regression was used to measure the influence of socio-economic institutional factors on level of adoption of GAPs among farmers. Ochieng *et al.* (2017) used binary logit regression to analyze the level of adoption of GAPs in Kenya. The model is stated thus:

$$\text{Log}(Y_i) = \text{Ln} \left[\frac{p_i}{1-p_i} \right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e \dots (3.4)$$

$$Y_i = \begin{cases} 1 & \text{if the } i^{\text{th}} \text{ farmer is High Adopter*} \\ 0 & \text{if the } i^{\text{th}} \text{ farmer is Low Adopter} \end{cases}$$

*If an i^{th} farmer's mean score in the level of adoption of GAP is 3 and above, s/he is considered a high adopter and but if the mean score is less than 3, the farmer is considered a low adopter.

Where:

X_1 = Sex (1=Male, 0=Female)

X_2 = Education (Number of years spent in formal education)

X_3 = Farm size (hectares)

X_4 = Membership of Farmer Cooperative (1=Yes, No =0)

X_5 = Access to credit (1=Yes, 0=No)

X_6 = Access to Extension contact (1=Yes, 0=No)

RESULT AND DISCUSSIONS

Socio- economic Characteristics of the Respondents

The findings revealed that arable crop farming in Borno State is predominantly male-dominated (73.85%), likely due to traditional responsibilities such as providing for the family, aligning with Okon and Enete (2022). Low female participation is attributed to socio-cultural and religious factors, though contrasting findings by Nwaiju (2015) and Chisenga (2015) highlight women's significant role in farming in southeastern Nigeria and rural areas, respectively. Majority



(76.15%) of the respondents were married, supporting the view that marital status promotes farming involvement (Adebayo *et al.*, 2021; Ibidapo *et al.*, 2018). The results also showed that there was relatively high literacy, with 36.15% having tertiary and 32.82% secondary education, suggesting improved access in Borno compared to findings by Alabi and Adams (2020). Education, though beneficial, is one of many factors influencing adoption of Good Agricultural Practices (GAPs), including age, culture, peer interaction, finances, and extension services.

Table 2: Distribution of Respondents based on Socio-economic Factors (n=390)

| Gender | Frequency | Percentage |
|-------------------------------------|-----------|------------|
| Male | 102 | 73.85 |
| Female | 288 | 26.15 |
| Marital status | | |
| Divorced | 25 | 6.41 |
| Married | 297 | 76.15 |
| Single | 68 | 17.44 |
| Level of Education | | |
| Non-formal | 80 | 20.51 |
| Primary | 41 | 10.51 |
| Secondary | 128 | 32.82 |
| Tertiary | 141 | 36.15 |
| Membership of Cooperatives | | |
| No | 184 | 47.18 |
| Yes | 206 | 52.82 |
| Access to credit | | |
| No | 284 | 72.82 |
| Yes | 106 | 27.18 |
| Total | 390 | 100 |
| Access to extension services | | |
| No | 365 | 93.59 |
| Yes | 25 | 6.41 |
| System of land ownership | | |
| Family | 137 | 35.13 |
| Hired | 150 | 38.46 |
| None | 1 | 0.26 |
| Others | 20 | 5.13 |
| Personal | 82 | 21.03 |

Source: field Survey (2023)

Education significantly influences adoption of climate-resilient technologies (Onya *et al.*, 2019; Umeh & Igwe, 2019; Adam *et al.*, 2022). In Borno State, 52.82% of farmers belong to cooperatives that improve access to inputs and credit (Yusuf *et al.*, 2021; Ekweanya *et al.*, 2018). However, 72.82% lack credit and only 27.18% access extension services, much lower than elsewhere (Olagunju & Ayanwale, 2019). Credit is vital for inputs and adoption (Nwaru *et al.*, 2011; Afolabi, 2010; Ololade & Olagunju, 2013; Oboh & Kushwaha, 2009; Philip, 2013), while extension drives technology use like GAPs (Oluwatayo & Oluwaseyo, 2024), yet only 6.41% benefit in Borno versus 77% in Ghana (Akomdo *et al.*, 2023). Land remains constrained, mostly rented or inherited, often fragmented (Fasona *et al.*, 2020; Idowu, 2021; Ibrahim & Nabage, 2023)

Table 3: Descriptive Statistics of some Socio-economic Continuous Variables

| Variables | Mean | Std | Minimum | Maximum |
|-----------------------|---------|---------|---------|-----------|
| Age | 43.015 | 12.778 | 19 | 80 |
| Household Size | 8.104 | 5.92 | 1 | 34 |
| Farm size | 3.314 | 2.02 | 0.45 | 10 |
| Average Annual income | 1176219 | 1438386 | 10,000 | 9,000,000 |

Source: field Survey (2023)



The results from Table 3 showed that the average age of farmers in Borno State was 43 years, indicating a productive and economically active population, consistent with findings by Adebo and Sekumade (2019), Kundiri *et al.* (2022), Onya *et al.* (2019), Achukwu *et al.* (2023), and Omolehin (2019). The results further revealed that the average household size was 8 members, supporting rural labor needs but potentially increasing resource strain, as noted by Oladeji *et al.* (2020) and Ibrahim *et al.* (2023). The average farm size was 3.31 hectares, aligning with Onyekuru and Marchant (2021) and suggesting smallholder, subsistence-based farming. Larger farm holdings are associated with increased adoption of conservation practices (Kolapoa *et al.*, 2023). The mean cultivated area is 8.59 hectares, slightly below the 4.66-hectare average with improved yield potential found in Kebbi State (Idowu, 2021). The results further revealed that the respondents earned an average annual income of ₦1.18 million, though disparities are wide. This surpasses the ₦850,000 average reported by Oseni and Winters (2021), potentially due to better market conditions or crop types. However, many farmers still face structural constraints like inadequate credit and extension services

The Most Cultivated Arable Crops by the Respondents

Table 4 identifies 15 arable crops cultivated by respondents, with maize being the most widely grown (82.56%), followed by Bambara nut (76.15%), groundnut (73.07%), and sesame (70.76%). Tomato, sorghum, and millet each accounted for 70.05% of cultivation. These findings indicate that maize is the dominant cereal, while Bambara nut and groundnut are the leading leguminous crops. Sesame also plays a significant role. The widespread cultivation of these crops suggests they are culturally accepted and well-suited to the soil and climate conditions of Borno State.

Table 4: Distribution of Respondents based on Most Cultivated Arable Crops (n=390)

| Arable Crops | *Frequency | Percentage | Rank |
|----------------|------------|------------|------------------|
| Maize | 322 | 82.56 | 1 st |
| Bambara nut | 297 | 76.15 | 2 nd |
| Ground nut | 285 | 73.07 | 3 rd |
| Sesame | 276 | 70.76 | 4 th |
| Tomatoes | 273 | 70.00 | 5 th |
| Sorghum | 273 | 70.00 | 5 th |
| Millet | 273 | 70.00 | 5 th |
| Rice | 265 | 67.94 | 8 th |
| Soybean | 263 | 67.43 | 9 th |
| Cowpea | 256 | 65.64 | 10 th |
| Onion | 245 | 62.82 | 11 th |
| Sweet Melon | 244 | 62.56 | 12 th |
| Okra | 156 | 40.00 | 13 th |
| Sweet potatoes | 123 | 31.53 | 14 th |
| Cocoyam | 17 | 4.35 | 15 th |

Source: field Survey. 2023 *Multiple responses.

The findings identified additional arable crops based on cultivation proportion: rice (67.94%, ranked 8th), soybean (67.43%, 9th), cowpea (65.64%, 10th), and onion (62.82%, 11th). Rice was noted as the 6th most cultivated crop, though maize remains the most preferred and widely produced. Other crops cultivated include sweet melon (62.56%, 12th), okra (40.0%, 13th), sweet potato (31.53%, 14th), other crops (9.48%, 14th), and cocoyam (4.35%, 15th). Similar findings by Mudi *et al.* (2019) revealed cultivation of maize, millet, sorghum, groundnut, and cowpea, while Tahir *et al.* (2020) identified maize, sorghum, groundnut, cowpea, pepper, and onion in Borno State.

Most Adopted Good Agricultural Practices (GAPs)

Table 5: Distribution of Respondents based on Most Adopted Good Agricultural Practices

| Most Adopted GAPs | Frequency* | Percentage |
|---|------------|------------|
| Fertilizer for Planting | 285 | 80.97 |
| Seed Treatment | 232 | 65.91 |
| Intra and Inter Row Recommended Spacing | 228 | 64.77 |
| Improved Storage Method | 223 | 63.35 |
| Timely Land Preparation | 215 | 61.08 |
| Timely and Clean weeding | 212 | 60.23 |

Source: field Survey (2023) * Multiple response exists

Table 5 shows that the most widely adopted Good Agricultural Practice (GAP) among arable crop farmers in Borno State. The findings revealed that fertilizer use (80.97%) was one of the widely used GAPs, highlighting its role in improving soil fertility and yields (Abdoulaye & Sanders, 2005; Morris *et al.*, 2007). The results also revealed that seed treatment (65.91%) and recommended plant spacing (64.77%) were also widely used, aiding pest protection, better germination, and efficient resource use (Ojiako *et al.*, 2007; FAO, 2010). Improved storage methods (63.35%) help reduce post-harvest losses (World Bank, 2011; Kader, 2005), while timely land preparation (61.08%) and clean weeding (60.23%) support better soil structure and reduce competition from weeds (Erenstein *et al.*, 2006; Zimdahl, 2013; These adoption patterns reflect broader sustainable farming trends that aim to enhance productivity and resilience (Tilman *et al.*, 2002; Bennett *et al.*, 2012)

Socio-economic Factors Influencing Level of Adoption of GAPs

A logistic regression analysis of 352 farmers showed that socio-economic factors significantly influence GAPs adoption (LR Chi² = 21.61, p = 0.0014). The model has low multicollinearity (mean VIF = 1.24) and no major outliers (hatsq p = 0.493). The constant term (1.873584, p < 0.001) indicates baseline adoption odds. Access to credit increases adoption, while agricultural association membership unexpectedly has a negative effect. Farm size also negatively affects adoption (-0.1250464, p = 0.039), suggesting smaller farms are more likely adopters—possibly due to local conditions.

Table 6: Factors Influencing Level of Adoption of GAPs

| Variables | Coefficient | Standard error | z-value | Prob > z |
|-----------------------------|---------------|----------------|---------|----------|
| Sex | -0.0238925 | 0.2944263 | -0.08 | 0.935 |
| Education | -0.0704216 | 0.3695659 | -0.19 | 0.849 |
| Farm Size | -0.1250464** | 0.0606829 | -2.06 | 0.039 |
| Membership of Cooperatives | -0.9392567*** | 0.3042572 | -3.09 | 0.002 |
| Access to credit | 1.240503*** | 0.3491348 | 3.55 | 0.000 |
| Access to extension service | -0.1028168 | 0.292443 | -0.35 | 0.725 |
| Constant | 1.873584 | 0.5216463 | 3.59 | 0.000 |
| LR Chi2 | 21.61*** | | | |
| Prob > Chi2 | 0.0014 | | | |
| Mean VIF | 1.24 | | | |
| Hatsq | -0.1900711 | 0.2773972 | -0.69 | 0.493 |
| Pearson Chi2 | 108.90 | | | |
| Prob > Chi2 | 0.3776 | | | |

Field Survey, 2023 *** Significant at 1% level ** Significant at 5% level, LR is Log likelihood

The study reveals a strong positive relationship between credit access and GAP adoption (coef. = 1.240503, p < 0.001), confirming that credit is essential for technology uptake (Akudugu *et al.*, 2010; Oyewole & Olaguj, 2024). Credit eases liquidity constraints, enabling smallholders to afford inputs like seeds, fertilizer, and labor, thereby enhancing productivity (Bolarinwa & Fakoya, 2011). It also provides a buffer against risks, encouraging adoption in uncertain conditions (Nuryartono *et al.*, 2005). In Nigeria, formal credit has been shown to boost improved seed and fertilizer use, raising output (Awotide *et al.*, 2015; Oyewole & Olaguj, 2024).



Constraints to the Adoption of Good Agricultural Practices (GAPs)

The adoption of Good Agricultural Practices (GAPs) in Borno State is significantly limited by inadequate access to essential inputs like seeds, fertilizers, and pesticides, as reported by 78.46% of farmers. This constraint negatively affects productivity and adoption willingness, consistent with findings by Meijer *et al.* (2015) and Adesina and Oluwatayo (2024), who also identified input shortages as a major barrier for smallholder farmers.

Table 7: Distribution based on Constraints to the Adoption of Good Agricultural Practices

| Constraints | Frequency* | Percentage | Rank |
|---|------------|------------|------------------|
| Inadequate supply of inputs (seeds, fertilizer, pesticides) | 306 | 78.46 | 1 st |
| Lack of time to attend training and meetings | 291 | 74.62 | 2 nd |
| Insecurity problems | 291 | 74.62 | 2 nd |
| Poor storage facilities | 285 | 73.08 | 4 th |
| Insurgency | 285 | 73.08 | 4 th |
| Lack of interest to adoption in GAPs | 279 | 71.54 | 6 th |
| Local politics | 277 | 71.03 | 7 th |
| Fear of risk or uncertainty | 277 | 71.03 | 7 th |
| Poor/ inadequate information | 271 | 69.49 | 9 th |
| Climate change | 270 | 69.23 | 10 th |
| Lack of incentives | 269 | 68.97 | 11 th |
| Incompatibility of GAPs technologies | 268 | 68.72 | 12 th |
| Late distribution of inputs | 263 | 67.44 | 13 th |
| Difficulty of accessing technical information | 255 | 65.38 | 14 th |
| Language barrier | 248 | 63.59 | 15 th |
| Illiteracy and poor education | 246 | 63.08 | 16 th |
| Lack of farming equipment for land preparation | 242 | 62.05 | 17 th |
| Lackadaisical attitudes of farmers and trainers | 216 | 55.38 | 18 th |
| Late dissemination of technical information | 169 | 43.33 | 19 th |
| Inadequate financial institutions / Capital | 157 | 40.26 | 20 th |

Source: Field survey: 2023 * Multiple Response

Other significant constraints include lack of time to attend training (74.62%), insecurity (74.62%), poor storage facilities (73.08%), and the ongoing insurgency (73.08%), all of which disrupt the farming environment and limit farmer engagement with GAPs. Issues such as local politics, fear of risk, poor information access, and climate change were also notable, each affecting over 65% of respondents. These challenges highlight the need for targeted interventions to improve input delivery, information dissemination, and farmer security in the region.

CONCLUSION AND RECOMMENDATION

The study that farm size, cooperative membership, and access to credit were the significantly influenced adoption of GAPs in the study area. Also, the most cultivated crops were maize, Bambara nut and Groundnut. To enhance the adoption of Good Agricultural Practices (GAPs) in Borno State the study recommended that,

- The government should provide subsidized inputs and invest in rural infrastructure. Strengthening extension services through recruitment and training is vital for continuous farmer education.
- Security must be improved to support safe farming activities. Supporting farmer cooperatives will boost credit access and market efficiency.
- Climate-smart and risk-resilient practices should be promoted through collaboration with NGOs and research institutions.
- Lastly, effective policy implementation requires robust monitoring and evaluation systems to track progress and ensure impact.



- v. The findings highlight the need for improved input delivery systems, enhanced security, and stronger farmer support services to boost GAP adoption and arable crop productivity in the region.

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