



ASSESSMENT OF THE ADOPTION OF MILLET PRODUCTION TECHNOLOGIES
IN YOBE STATE, NIGERIA

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ABSTRACT

The study assessed adoption of millet production technologies in Yobe State, Nigeria. Multiple sampling techniques was used in selecting the respondents, one hundred and seventy farmers were selected. Primary data was obtained using structured questionnaires and analyzed using both descriptive and inferential statistics. The results revealed that majority of the respondents were male, married and had attended certain levels of formal education. Also, the result revealed farmers had an average age of 42.2 years. The finding further shows an average of 17.2 years of farming experience, also with an average of 9.0 persons per households. The result also shows that the respondents had different sources of income and with an average of ₦284,500.3 per annum with an average farm size of 3.1ha. The result also shows that all the respondents had adopted various forms of technologies on millet production. The result also reveals that early maturity (78.8%), fertilizer application (68.2%), planting space (65.3%) among others were the reasons for adoption of the technologies. The finding further shows that socioeconomic factors had significant influence on adoption of millet production technologies were educational level has significant coefficient and influencing adoption of millet production at $P < 0.05$, farm size and marital status had positive coefficient and significantly influencing adoption at $P < 0.001$ and $P < 0.05$, respectively. High cost of inputs (74.7%), labour (72.9%) and pest/diseases (71.8%) were the major constraints faced by the farmers in millet production. The study concluded that farmers had adopted different technologies and socioeconomic factors had significant influence on adoption of technologies among the farmers. Farmers should form associations and cooperatives to pull down resources and increases their access to inputs at subsidized rates, NGOs should provide inputs at subsidized rates to farmers in the study area.

Key words: Assessment, Adoption, Millet, Production and Technologies

INTRODUCTION

Nigeria is an enormous agricultural country blessed with substantial natural resources which include 68 million hectares of arable land, about 12 million hectares of fresh water resources, 960 kilo meters of coastline and an ecological diversity which makes possible for the country to produce a vast variety of crops and livestock, fisheries and forestry products (Arokoyo, 2012). Pearl millet (*Pennisetum glaucum*) is an important grain crop grown in the Guinea and Sudan savannah and the Sahel agro-ecological zones of Nigeria. Three major types of millet are cultivated by the farmers: *gero*, *maiwa*, and *dauro*. For each type there are several varieties. A number of improved technologies have been developed to enhance the production of pearl millet in the country. These range from improved varieties (with specific attributes, such as early maturity, drought resistance, and multiple resistances to diseases and insect pests), improved spacing, seed rate, fertilizer rate to improved harvesting, and storage techniques. Pearl millet is well adapted to production systems characterized by low rainfall (200-250 mm), low soil fertility, and high temperature up to 42°C, and thus can be grown in areas where other cereal crops, such as sorghum and maize, fail to produce assured yields (Chisi and Peterson, 2019).

Millions of people in semi-arid regions of Africa and Asia use pearl millet as the most important staple food and serving as major sources of food and income for millions of subsistence farmers living in the most marginal agricultural lands of Northern Nigeria (Champion and Fuller, 2018). Adoption is a decision made by an individual or group to use an innovation in a continuous manner (Orisakwe and Agomuo, 2011). Technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Orisakwe and Agomuo, 2011). The smallholder farmers are constrained by several problems including poor access to modern inputs and credit, poor infrastructure, inadequate access to markets, land and environmental degradation, and inadequate research and extension services. Also, inaccessibility to the financial services requirements of farmers and agribusiness owners who constitute about 70 percent of the population is inclusive (Lawal, 2011). It is for the highlighted reasons that this research examines the adoption of millet production technologies among millet farmers in Yobe State. The specific objectives were to: describe the socioeconomic characteristics of the farmers, describe the types of millet production technologies adopted; examine socio-economic factors that influence adoption of millet production technologies and identify the problems associated with the adoption of millet production technology in the study area.

MATERIALS AND METHODS

The Study Area

Yobe State is located in North Eastern Nigeria approximately between latitudes $10^{\circ} 33' N$ and $13^{\circ} 22' N$ and longitudes $9^{\circ} 40' E$ and $12^{\circ} 25' E$. The state borders Bauchi and Gombe to the Southwest, Borno to the East and South East and Jigawa to the North West. It also shares an international border with the Republic of Niger stretching to over 320km to the North (Barsky, 1999). The population of the State is estimated at 2,532,395, the State has hot and dry climatic features in the northern part for most of the year. In the southern part, especially in the rocky area of Gujuba and Fika local government areas, it is hotter for most part of the year. The hottest months are March, April and May with temperatures ranging between $39^{\circ}C$ and $42^{\circ}C$ (Bello, 2013). Rainfall amounts are generally related to the thickness of the Tropical Maritime air mass. Consequently, rainfall decreases northward both in duration and amount. It lasts for less than 90 days in the northern part of the State and more than 110 days in the south (Audu, 2012). It has definite wet and dry seasons. The wet and dry seasons are characterized with frequent dry continental Northeast trade wind which originates from Sahara-desert, and the moist maritime South-westerly monsoon which originates from the Atlantic Ocean respectively. The rainy season spans between June and September with peak of rainfall in August, and the dry season between November and April. The mean annual rainfall is about 500mm with highest ambient temperature hovering over $40^{\circ}C$ in the hottest Months of April and May. The average daily temperature ranges between $27-31^{\circ}C$ (Bello, 2013). There is a marked dry season of between eight to nine months and a wet season of only three to four months.

Sampling Technique and Sample Size

A multi-stage sampling technique was employed to select respondents from the study area. Yobe State is divided into three geopolitical zones, in the first stage the three zones were selected; Zone A, B and C, in the second stage seventeen (17) Local governments Areas (LGAs) were selected from the three zones, Zone A; Damaturu, Geidam, Yunusari, Bursari, Gulani, Gujba and Tarmuwa, Zone B; Potiskum, Fune, Fika, and Nangere, while Zone C; Nguru, Machina, Yusufari,

Bade, Jakusko, and Karasuwa were selected. In the third stage 170 millet farmers were randomly selected for the study.

Data Analysis

Data was analyzed using descriptive statistics such as frequency, mean and percentage and inferential statistics using regression analysis.

Descriptive statistics

Descriptive statistics was used to achieve objectives i, ii, iv and v. This tool was employed to give a summary description of the data collected. It involved the use of percentages, and frequency distribution of extension agents into a few classes with respect to socio-economic characteristics, training/service needs and constraints faced.

Multiple regression analysis

Multiple regression analysis was employed to satisfy the fifth objective. This model was used to analyze the effects of socioeconomic factors influencing number technologies adopted by the farmers. The regression model to be used is specified as; Linear function:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + \dots + b_{12}X_{12} + e \quad \dots (1)$$

Where;

Y= Technology adopted (Number of technologies adopted)

X₁= Sex (male=1, female=2)

X₂ = Age of extension agents (years)

X₃ = Marital Status (married =1, Otherwise=0)

X₄= Educational level of the farmers (Years spend in school)

X₅= Household size (Number)

X₆= Years of experience in the millet production (Number of Years)

X₇= Access to credit (Yes=1, No=0)

X₈= Estimated level of income (Naira)

X₉= Cooperative Membership (Yes=1, No=0)

X₁₀=farm size (ha)

X₁₁= Quantity of harvest (bags)

X₁₂= Number of trainings (No)

a=Constant term of intercept

b_i(i=1...9) are regression coefficients.

u=Error term.

Adoption Index

Adoption index was used to assess the level of adoption of millet production technologies by the farmers as follows;

Adopted=4, Fairly Adopted=3, Less adopted—2, Not Adopted =1.

An index of <2.5 indicates that the technology was not adopted by the farmers. While the index of ≥2.5 indicates the technology was adopted.

RESULTS AND DISCUSSION

Quantitative Socio-Economic Characteristic of the Farmers

The result in Table 2 shows the quantitative socioeconomic Characteristics of millet farmers, where the findings reveals that 39.4% of the respondents were within the ages of 30-40 years, while 17.1%, 7.6% and 1.8% of the respondents were within the ages of 52-62 years, 19-29 years and 63 years and above respectively. The average age of the farmers was 42.2 years. This is

in line with the findings of Asadu *et al.* (2013) who posited mean ages of 40.5 for farmers in Eastern Nsukka, Nigeria. This implies that most of the respondents were within their active ages of production in agriculture it could also be attributed to the high levels of unemployment which makes youngest men and women to be engaged in agricultural production in the study area. This agrees with Issa *et al.* (2016) that younger farmers are much more receptive to new ideas than older ones.

The result also shows that 42.9% of the respondents had 2-7 persons in their household, while 8.8%, 5.3%, 2.4% and 1.2% of the respondents had a household size of 14-19 persons, 20-25 persons and 26 persons and above respectively. The average household size was 9 persons for farmers. This implies that most of the respondents had a good number of persons in their households which increases levels of family consumption and also provides cheap family labor in the study area. The result further shows that 31.8%, 22.4% and 20.0% of the respondents had 9-16 years, 17-24 years and 1-8 years of experience in millet production in the study area, while 17.1% and 8.8% of the respondents had 25-32 years and 33 years and above in millet production in the study area. The average years of working experience of the farmers was 17.2 years. This implies that most of the respondents had a good number of years in millet production which makes it possible for the respondents to adopt technologies in millet production in the study area. This is in tandem with Ayanwuyi *et al.* (2013) that the majority (77.7%) of the respondents were between 31 to 50 years, with about 74.1% male and the majority (61.6%) had a farm size between 1-5 hectares. Only 58.3% were able to produce for family consumption and still able to sell while 41.7% produced for family consumption alone.

Table 1: Quantitative Socio-Economic Characteristic of Farmers (n=170)

Variables	Frequency	Percentage
Age		
19-29	13	7.6
30-40	67	39.4
41-51	58	34.1
52-62	29	17.1
63 and Above	3	1.8
Mean	42.2	
Household size		
1-7	77	45.3
8-13	67	39.4
14-19	15	8.8
20-25	9	5.3
26 and Above	2	1.2
Mean	9.0	
Years of experience		
1-8	34	20.0
9-16	54	31.8
17-24	38	22.4
25-32	29	17.1
33 and Above	15	8.8
Mean	17.2	

Source: Field survey (2022)

Qualitative Socioeconomic Characteristics of Farmers

The result in Table 3 shows the qualitative socioeconomic characteristics of millet farmers where the findings reveals that majority (75.3%) of the respondents were male, while 24.7% of the respondents were females, which shows that the male gender dominates millet production in the study area which could be attributed to the religious and cultural beliefs of the respondents. This result agrees with the finding of Vaughan *et al.* (2012) in a study of economic analyses of cassava production in Ogun State that 75.8% of farmers were males who dominated farming operations due to the drudgery nature of farming which limits female farmers' involvement in production. The result also shows that majority (85.3%) of the respondents were married, while 7.6%, 5.3% and 1.8% of the respondents were single, widowed and divorced respectively. This implies that most of the respondents were married and had certain levels of dependence in the study area. This goes in line with Adebayo *et al.* (2018) that majority of maize farmers were married in Aiyedire LGA of Osun State were married.

Table 2: Qualitative Socio-Economic Characteristic of Farmers (n=170)

Variables	Frequency	Percentage
Sex		
Male	128	75.3
Female	42	24.7
Marital status		
Married	145	85.3
Single	13	7.6
Widowed	9	5.3
Divorced	3	1.8
Educational level		
Qur'anic	24	14.1
Non-formal	31	18.2
Primary	13	7.6
Secondary	38	22.4
Tertiary	64	37.6
Occupation		
Millet production only	12	7.1
Mixed cropping	80	47.1
Mixed farming	41	24.1
Civil servant and millet production	37	21.8
Source of capital		
Personal savings	138	81.2
Loan from banks	8	4.7
Friends and relatives	16	9.4
Others	8	4.7

Source: Field survey (2022)

The result further shows that 37.6% and 22.4% of the respondents had attained tertiary and secondary levels of education, while 18.2%, 14.1% and 7.6% of the respondents had non-formal, Qur'anic and primary levels of education in the study area. This implies that most of the respondents had attended certain levels of education which is an added advantage toward adopting

technologies in millet production in the study area. This disagrees with the findings of Sanusi *et al.* (2016) who reported that date palm farmers in Jigawa State have low educational status. This result disagrees with the finding of Umar *et al.* (2014) who noted that the low level of formal education may limit adoption of improved technologies including the improved maize varieties. The result further shows that 47.1% and 24.1% of the respondents were into mixed cropping and mixed farming, while 21.8% and 7.1% of the respondents were civil servants/millet producers and millet producers only. This implies that most of the respondents do not solemnly depend on one source of income but rather had diverse sources of income in the study area. The finding further shows that majority (81.2%) of the respondents had their sources of capital from personal savings, while 9.4% of the respondents had their sources of income from friends/relatives, also 4.7% of the respondents had their sources of income from bank loans and other sources respectively in the study area. This implies that majority of the respondents had their capital from a non interest sources which could be of great advantage as their will be no fair of paying interest or providing collaterals for capital.

Estimated Income and Farm Size of Millet Farmers

The income and farm size of famers is a paramount factor to be considered in any study related to farmers in agriculture hence the need to describe their level of income and farm size which could have significant influence on the adoption of technologies in the study area. The result from Table 4 shows that 47.6%, 25.3% and 20.6% of the respondents had an annual income of ₦50,000-₦220,000, ₦220,001-₦390,000 and ₦390,001-₦560,000 respectively, only 4.1% and 2.4% of the respondents had an annual income of ₦730,001 and above and ₦560,001-₦730,000 in the study area. The average income of the famers was ₦284,500.30. This implies that majority of the respondents had a moderate annual income in the study area to take care of their daily family needs. This result is in agreement with the finding of Tijjani *et al.* (2018) that the highest (59.1%) proportion of the adopters earned about ₦201,000 - ₦400,000 in the last cropping season, while only 4.5% earned ₦801,000 and above. The finding also reveals that 48.2% and 34.7% of the respondents had a farm size of 0.5-2.5ha and 2.6-4.6ha, while 10.6%, 4.7% and 1.8% of the respondents had a farm size of 4.7-6.7ha, 8.9ha and above and 6.8-8.8ha respectively. The average farm size was 3.1ha. This implies that most of the respondents had relatively large farm size for millet production which could be connected to the moderate levels of annual income obtained by the respondents in the study area.

Table 3: Distribution of Farmers According to Estimated income and Farm Size (n=170)

Variables	Frequency	Percentage
Estimated Income (₦)		
50,000-220,000	81	47.6
220,001-390,000	43	25.3
390,001-560,000	35	20.6
560,001-730,000	4	2.4
730,001 and Above	7	4.1
Mean	₦284,500.30	
Farm size (ha)		
0.5-2.5	82	48.2
2.6-4.6	59	34.7
4.7-6.7	18	10.6
6.8-8.8	3	1.8
8.9 and Above	8	4.7
Mean	3.1ha	

Types of Millet Technologies Adopted by Farmers

The adoption of technologies among millet farmers requires the identification of available technologies adopted by the farmers in the study area.

The result in Table 5 shows the types of technologies adopted by the respondents was early maturity variety with a mean score of 3.7. This was followed by pest and disease resistant variety with a mean score of 3.4, drought resistant variety with a mean score of 3.2, fertilizer application with a mean score of 3.5 and herbicides/pesticides application with a mean score of 3.2. The findings further shows the farmers adopted planting space with a mean score of 3.4, triple bag storage (purdue) with a mean score of 3.0 and marketing strategies with a mean score of 2.9. This implies that most of the respondents had tried and adopted the technologies in millet production which could be attributed to the high yield harvest and level of income among the respondents in the study area. This is in contrary with Ayesha and Mohammad (2012) who reported that in many developing countries, wide adoption of research results by majority of farmers remains quite limited. Sani *et al.* (2018) corroborates with this results that 80% of owners of large farms and medium farms were high adopters (65%) and about 48% of the owners of small farms were medium adopters.

Table 5: Distribution of Respondents According to Types of Technologies Adopted

Variables	A	MA	LA	NA	Mean	Decision
Early maturity variety	78.8	17.6	1.8	1.8	3.7	Adopted
Pest and disease resistant	60.6	28.2	8.8	2.4	3.4	Adopted
Drought resistant variety	49.4	35.3	8.2	7.1	3.2	Adopted
Fertilizer application	68.2	20.6	6.5	4.7	3.5	Adopted
Herbicides/pesticides	51.2	27.6	13.5	7.6	3.2	Adopted
Planting space	65.3	20.0	5.9	8.8	3.4	Adopted
Triple bag storage (purdue)	36.5	39.4	14.1	10.0	3.0	Adopted
Marketing strategies	30.6	38.2	24.1	7.1	2.9	Adopted

Source: Field survey (2022) A=Adopted, MA= Moderately adopted, LA=Less adopted, NA=Not adopted Mean Threshold ≥ 2.50 = Adopted ≤ 2.50 = Not Adopted

Effectiveness of Millet Technologies Adopted

The result from Table 6 shows the effectiveness of adopted technologies on millet production where the findings reveals that early maturity variety was effective as indicated by a mean score of 3.0, while pest and disease resistant variety was also effective with a mean score of 2.9 and drought resistant variety was also effective with a mean score of 2.8. The result further shows that fertilizer application, herbicides/pesticides application and planting space were effective with a mean score of 3.0 respectively in the study area. This is followed by triple bag storage (purdue) and marketing strategies which were also found to be effective as indicated by the mean score of 2.7 respectively in the study area. This implies that millet production technologies were effective which could be attributed to the high yield of millet harvest in the study area. Umar *et al.* (2015) reported that agricultural extension has to escape from the narrow mindset of transferring technology packages to transferring knowledge or information packages.

Table 6: Distribution of Respondents According to Effectiveness of Adopted Technologies

Variables	VE	E	ME	NE	Mean	Decision
Early maturity variety	54.7	4.1	34.7	6.5	3.0	Effective
Pest and disease resistant	44.1	12.4	37.6	5.9	2.9	Effective
Drought resistant variety	38.2	20.6	30.6	10.6	2.8	Effective
Fertilizer application	48.2	12.9	34.1	4.7	3.0	Effective
Herbicides/pesticides	50.0	15.3	26.5	8.2	3.0	Effective
Planting space	50.0	11.2	32.4	6.5	3.0	Effective
Triple bag storage	31.2	22.4	32.4	14.1	2.7	Effective
Marketing strategies	24.1	37.6	27.1	11.2	2.7	Effective

Source: Field survey (2022) VE=very effective, E=effective, ME=moderately effective, NE=not effective Mean ≥ 2.50 =Effective ≤ 2.50 =Not effective

Socio-economic Factors Influence Adoption of Millet Technologies

The result from Table 7 shows the socioeconomic factors of respondents influencing the adoption of millet production technologies where the findings shows that educational level of respondents was found to be positive and significant at $P < 0.01$. This implies that one-unit increase in educational level will result to one-unit increase in adoption of technologies among the respondents, while quantity of harvest was found to be negatively significant at $P < 0.001$. This implies that one-unit increase quantity of harvest will result to one-unit decrease in adoption of technologies. On the other hand, marital status and farm size were found to be positively significant at $P < 0.05$ and implies that one-unit increase in marital status and farm size will result to one-unit increase in adoption of technologies which is not unconnected to the fact that married respondents have high level of dependence and feeding in their households in the study area. Agbo *et al.* (2015) and Umunna (2010), in the same opinion also agreed that education, household size, off-farm income and farming experience had significant relationship for farmer's productivity, storage and preservations knowledge in Owerri Agricultural Zone of Imo State, Nigeria. Sani *et al.* (2018) supported this results that household size, farming experience, attending agricultural exhibition and consulting newspaper were all significant ($P < 0.05$), farm size ($P < 0.10$) and extension contact ($P < 0.01$) in farmers' adoption of the E-wallet agricultural technology.

Ayanwuyi *et al.* (2013) confirms that farm size/land holdings increased after contact with extension services. However, sex, age, household size, years of experience, occupation, source of capital, access to credit, estimated income from millet, membership of cooperatives and training received were found not significant and had no influence on the adoption of technologies in the study area. This is in line with the findings of Ayodele *et al.* (2015), that socio-economic characteristics of farmers affected their perception of production. This agrees with Sani *et al.* (2018) that adoption level of agricultural technologies was positively related with age, level of education and farm size.

Table 7: Socio-economic Factors that Influence Adoption of Millet Technologies

Models	Coefficient	Std. Error	t
(Constant)	1.270	0.330	3.847
Sex (X ₁)	0.031	0.102	0.302 ^{NS}
Age (X ₂)	-0.006	0.006	-1.038 ^{NS}
Marital status (X ₃)	0.136	0.066	2.059 **
Educational level(X ₄)	0.076	0.028	2.758 ***
Household size(X ₅)	0.000	0.009	0.043 ^{NS}
Years of experience(X ₆)	0.005	0.006	0.851 ^{NS}
Access to credit(X ₇)	-0.053	0.093	-0.577 ^{NS}
Estimated income from millet(X ₈)	1.203	0.000	0.491 ^{NS}
Membership of cooperatives(X ₉)	0.035	0.081	0.434 ^{NS}
Farm size(X ₁₀)	0.041	0.021	1.965 **
Quantity of harvest in bags(X ₁₁)	-0.018	0.005	-3.681 ***
Training received(X ₁₂)	0.002	0.009	0.174 ^{NS}
R ²	0.5361		
F-value	83.423*		

Source: Field survey (2022) ***=P<0.001, **=P<0.05, ^{NS}=Not Significant.

Constraints Affecting Farmers on Millet Production

The result in Table 8 shows the constraints faced by the farmers in production and adoption of millet technologies. The finding indicates that the major constraint faced by the farmers is high cost of inputs which was ranked 1st, this is followed by labour, and pest/disease and which were ranked 2nd and 3rd respectively. While high cost of transportation was ranked 4th, inadequate inputs was ranked 5th and lack of access to credit facilities was ranked 6th. Others were lack of good storage ranked 7th, untimely supply of input ranked 8th and inadequate extension services ranked 9th respectively. This implies that despite the level of adoption and effectiveness of millet production technologies the respondents were faced with one or more constraints hindering their adoption and production of millet in the study area. Umar *et al.* (2019) reported that poor knowledge or exposure of farmers to suitable agricultural information and networks of communication was one of the key reasons for the low yield reported by many Nigerian farmers as well as the success in their duties of agricultural extension agents. The find is in line with the findings of Ibrahim *et al.* (2016) that poor extension services limit the adoption of improve crop production packages.

Tijjani *et al.* (2018) assessed the socio-economic determinants of adoption of improved millet production practices by farmers in Borno State, Nigeria. The result of the findings revealed that the 42.2% of the adopters and 21.0% of the non-adopters of improved pearl millet practices posited that inaccessibility to improved seeds was one of the major constraints to the adoption production practices in the study area. Abubakar *et al.* (2016) studied the adoption of production technologies by lowland rice farmers in Lavun local government areas of Niger State, and reported that 31.3% of the adopters were constrained by the high cost of inputs (chemical fertilizers, agro-chemicals and tractor hiring to carry out tillage operations) and ranked first in the order of magnitude. In addition, low availability of inputs (20.2%) was a constraint to the adopters to optimally comply with the recommendations

Table 8: Distribution of Farmers according to their Constraints (n=170)

Variables	Frequency *	Percentage	Rank
High cost of inputs	127	74.7	1 st
High cost of labour	124	72.9	2 nd
Pest and disease	122	71.8	3 rd
High cost of transportation	120	70.6	4 th
Inadequate inputs	117	68.8	5 th
Lack of access to credit facilities	111	65.3	6 th
Lack of good storage	105	61.8	7 th
Untimely supply of input	84	49.0	8 th
Inadequate extension services	77	45.3	9 th

Source: Field survey (2022)

*Multiple responses recorded

CONCLUSION AND RECOMMENDATIONS

The study concluded that farmers had adopted different technologies and socioeconomic factors that had significant influence on adoption of new technologies includes marital status educational level, farm size and quantity of output in the study area.

Based on the findings of the study the following recommendations were made;

- Farmers should form associations and cooperatives to pull down resources collectively and increases their access to inputs at subsidized rates.
- Farmers should acquire loans from commercial and agricultural finance institutions to increase production in the study area.
- NGOs should provide inputs at subsidized rates to farmers in the study area.

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