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AN ASSESSMENT OF ADOPTION OF IMPROVED PRODUCTION PRACTICES AMONG WATERMELON FARMERS IN JIGAWA STATE, NIGERIA

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ABSTRACT

This study examines the factors influencing the adoption of improved watermelon production practices among farmers in Jigawa State, Nigeria, with a focus on enhancing agricultural productivity and sustainability. Watermelon is an important cash crop in Jigawa State, contributing significantly to farmers' income and rural development. Despite the introduction of improved watermelon production practices to watermelon farmers, the adoption rates of such practices remain low. This study focuses on analysing the socio-economic characteristics of watermelon farmers, their level of awareness, adoption rate and factors influencing the adoption of improved watermelon production practices. Using a multi-stage sampling technique, data were collected from 236 watermelon farmers across three Local Government Areas (LGAs) in the state. Descriptive statistics and a Tobit regression model were employed to analyse the data. The findings revealed that most farmers are within their productive age range, with moderate household sizes and farm sizes averaging 1.75 hectares. Majority (94.1%) of respondents are aware of improved seed varieties, adoption rates for practices like storage techniques remain low at 35.0 percent. Farm size and Extension contacts were significant positive predictors of adoption, while larger household sizes and farming experience negatively influenced adoption. The study recommends strengthening institutional support and addressing socio-economic constraints to bridge the gap between awareness and full adoption of improved production practices. These findings provide valuable insights for policymakers, agricultural extension officers, and development organisations aiming to boost sustainable production of watermelon, contributing to food security and rural development in the state.

Keywords: Adoption, Watermelon, Improved Production Practices, Jigawa State

INTRODUCTION

In Nigeria, agriculture plays an important role in the country's economy, contributing significantly to employment, food security, and export earnings. Nigeria with its vast arable land, favourable climate, and diverse agro-ecological zones, has the potential to become a major global player in agricultural production (Pawlak and Kołodziejczak, 2020). In recognition of the immense potential of the sector, the Nigerian government has been proactive in developing and spreading agricultural technology adoption through Agricultural Development Programs (ADPs). Technology in agriculture is described as a combination of methods, tools, knowledge, and skills aimed at improving farm output, lowering costs of production, and conserving valuable resources like labour and energy. Such technologies are categorised into non-physical (such as knowledge and management practices), physical (tools and equipment), and biological technologies incorporated in the seed or planting materials (Ruzzante et al., 2021). As such, shifts towards utilising advanced agricultural technologies has proven to be a key solution for overcoming the inefficiencies of traditional farming systems, which are known for their low productivity (Kavhiza, 2022). The use of these advanced technologies in watermelon farming, for instance, has led to substantial gains in sustainable fruit production across the country, notably the introduction of improved watermelon seeds and farming methods. This is particularly true in semi-arid areas, where the implementation of irrigation systems, the conservation of soil moisture, and the reduction of labour, energy, and capital inputs have been instrumental (Abdullahi et al., 2021). In essence, technology adoption involves accepting and consistently utilising innovations, influenced by factors like education, access to resources and extension services where by a lack of access to technology and resources hinders adoption rates (Yokamo, 2020).

Watermelon is an essential agricultural crop in Jigawa State, contributing significantly to the local economy and livelihoods of farmers across the state (Oladokun et al., 2019). However, despite its economic importance, watermelon production faces various challenges, including low yields and limited sustainability due to traditional farming practices (Aliyu et al., 2020). In recognition of the need for enhanced productivity and sustainability, Jigawa State in northern Nigeria has been committed to improving watermelon production. The Jigawa State's Agricultural and Rural Development Authority (JARDA) have introduced improved watermelon production practices package (which include, improved seed varieties, recommended spacing, advanced planting method, efficient water management techniques, weed management, fertiliser application, integrated pest and disease management, harvesting and storage) aimed at increasing yields and reducing negative environmental impacts. Despite efforts to introduce improved production practices package, to watermelon farmers by JARDA through ADPs, there is a gap in its adoption among watermelon farmers in the state. This study provides insights into the practical benefits of the improved watermelon production practices with aim of understanding how each of these components of improved watermelon production practices either independently or together with other components of the package enhance yields of watermelon. Complementing the general aim, the specific objectives were to describe the socio-

economic characteristics, ascertain the level of awareness, determine the rate of adoption and identify the factors influencing adoption of improved watermelon production practices.

MATERIALS AND METHODS

The Study Area

Jigawa State is located in the north-western part of Nigeria, and it shares borders with Kano and Katsina States to the west, Bauchi State to the east, and Yobe State to the northeast, to the north it shares an international border with Republic of Niger (Mukhtar, 2023). The State has a projected population of 6,714,777 million, in 2023 using a 3 percent annual growth rate. The total land area is 22,210 Km^2 with topography characteristics of high elevated areas reaching up to 750 meters. The soil is fertile, consisting of sandy-loamy terrain with occasional pockets of *fadama* (seasonally flooded areas) and alluvial plains. These soil conditions make it suitable for cultivating crops such as rice, wheat, sugar-cane, millet, vegetables, sorghum, etc. (Mukhtar, 2023). There are two distinct seasons; the rainy season, which occurs from May to October with an average annual rainfall of 700 mm, and the dry season, which spans from November to April. Jigawa State primarily relies on agriculture, with more than 80 percent of the population engaged in farming activities. The economic activities common in the area are fishing, and livestock rearing. Crops grown are rice, maize, millet, sorghum, cowpea, groundnut, cocoyam, soya beans, sesame, sugarcane, hot pepper, okra, tomatoes, onions, and watermelon (MTEF, 2022)

Sampling Procedure and Sample Size

A multi-stage sampling technique was used to select the respondents. In the first stage, a purposive sampling procedure was used in selecting zone one (Birnin kudu zone) being known for high level of watermelon production. In the second stage, three (3) Local Government Areas (LGAs), namely Dutse LGA, Kiyawa LGA and Jahun LGA were selected. The third stage involved the selection of four communities from each LGA to give a total of 12 communities.

The final stage involved a random selection of 236 farmers from a sample frame of 1,819 watermelon farmers for enumeration. The Roasoft online calculator, with a 5 percent margin of error and 90 percent confidence level, was employed to determine the sample size. Yamane Taro's formula was also applied to establish the sample proportion from each community.

The formula was expressed as:

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

Where, *n* is the sample size, *N* is the population size, and *e* is the level of precision or margin of error, expressed as a decimal

Method of Data Collection

The study used cross-sectional data from primary source using questionnaires and interview schedules in the study area with the help of trained enumerators. After reviewing the completed interview schedules, 236 copies were approved for analysis.

Method of Data Analysis

Descriptive statistics such as means, standard deviations, percentages, frequency distribution, adoption index and Tobit regression were used for this study.

Models Specifications

Adoption Index

Adoption index shows the rate of use of a number of recommended practices by farmers which is measured by an adoption quotient (number of improved production practices used over total number of improved production practices). Adoption index was calculated to obtain each farmer's level of use of multiple practices from the 9 components of improved watermelon production practices and finally categorise them into low, medium and high level of adoption. In order to determine the level of adoption of the improved watermelon production practices, adoption index of individual farmer was calculated using the following formula of adoption quotient employed by Abdulsalam et al. (2025); Mailumo and Onuwa (2022).

$$B_i = \sum(\frac{R_i}{R_T}) \quad (2)$$

Where, B_i = the adoption index of improved watermelon production practices by i^{th} farmer;

R_i = number of improved watermelon production practices adopted by i^{th} farmer; and R_T = Total number of improved watermelon production practices available to the i^{th} farmer i = (1 .n)

Tobit Regression Model

The Tobit regression model was specified as:-

$$y_i^* = X_i\beta + \varepsilon_i \quad (3)$$

Where, y_i^* = is the latent variable of adoption index (number of improved production practices used over total number of improved production practices), X_i = is the vector of independent variables, β = is the vector of coefficients, ε_i = error term, X_1 = Age (in years), X_2 = Household size (number of people in the household), X_3 = Farming experience (number of years in farming), X_4 = Farm size (hectare), X_5 = Membership of association (Dummy variable: 1= member, 0= otherwise), X_6 = Extension visit (number of extension visits farmer received in the research season), X_7 = Affordability (Very Expensive = 1 Expensive = 2 Cheap = 3 Very Cheap = 4), X_8 = Compatibility (Strongly disagree = 1 Disagree =2 Neutral = 3 Agree = 4 Strongly Agree = 5), X_9 = Complexity (Agree= 1 Undecided = 2 Disagree = 3).

RESULTS AND DISCUSSION

Socioeconomics Characteristics

Socio-economic profiles of households presented in Table 1 shows the distribution of the respondents according to age. Majority (51.7 percent) of the respondents were within the age range of 41 - 50 years, while 3.0 percent were within the age above 71 years with mean age of 46.30 years. This indicates that the majority of farmers were within their active years and more capable of carrying out operations involved in watermelon production. Also, farmers could be open to adopting new agricultural practices. This finding disagreed with Afolabi (2019) in his study in Kwara State Nigeria, which found that the age range of the farmers in the study was from 20 to 59 years. The findings also aligned with Muhammad et al. (2018) in their study which revealed that farming was largely dominated by active group of farmers, particularly those within age range of 46 - 55 years. The findings in Table 1 also revealed that 100 percent of the farmers were male. This indicated that the dominance of farming by male may be due to culture of the respondents in the study area and also attributed to the fact that watermelon is a labour intensive enterprise which in most cases is suitable for men. This agreed with the findings of Obalola et al. (2021) who reported similar findings. The results of the findings also supported the findings of Umar (2020) who reported a male

dominance in onion production in Goronyo LGA of Sokoto State, Nigeria. Results in Table 1 on marital status showed that majority (93.2 percent) of the respondents were married, while 4.7 percent were unmarried. This indicated that the dominance of married men could be due to the struggle to meet the needs of the families. This result was similar with the findings of Umar (2020) in the study of adoption of recommended onion production practices in Sokoto State, which reveals that 99.17 percent of the respondents were married. The result in Table 1 shows the distribution of household size about 41.0 percent of the respondents had household size ranging from 1- 5 person. This implies that the respondents had medium household sizes which could be used as source of labour for watermelon production. The findings agreed with the position of Atube et al. (2021) in the study of determinants of smallholder farmers' adaptation strategies to the effects of climate change who posited that household size is an important source of labour to reduce cost of production. The results in Table 1 shows that majority (64.0 percent) of the respondents had non-formal education. This could be due to the fact that Islamic education is highly emphasised in the study area or may indicate limited access to formal educational opportunities. This agreed with the findings of Umar (2020) who found that the majority of the respondents in his study had Islamic education. The findings disagreed with Olusegun et al. (2024) in their study on adoption of climate smart agricultural practices among smallholder rice farmers in Dutse, Jigawa State, which shows that majority (66.4%) of the respondents had formal education. Table 1 shows that 36.0 percent of the respondents had been in farming for between 11 – 20 years, with mean age of 19.46 years. This level of farming experience indicate a strong foundation of agricultural knowledge and practices, contributing to their productivity and adaptability in farming activities. Their willingness and ability to try new innovation is expected to increase with increase in farming experience. The findings is in line with Muhammad et al. (2018) in a study on evaluation of recommended improved rice production technologies by small scale farmers in Kebbi State Nigeria, who revealed that 38.43 percent of the respondents had 11 – 20 years of farming experience with mean age of 19.46 years. On the variable relating to watermelon farming experience, results in Table 1 shows that majority (45.8 percent) of the respondents had been in watermelon production for 6 – 11 years with mean of 6.4 years. This suggests a growing interest in watermelon farming by the respondents, with a significant number of relatively new farmers willing to engage in watermelon production. This results disagreed with findings of Alofabi (2019) in similar study in, Kwara State, Nigeria who revealed that the majority (52.0 percent) of the farmers had farming experience ranging between 1 - 5 years.

Table 1: Distribution of the respondents based on socio-economic characteristics (n = 236)

Variable	Frequency	Percentage	Mean
Age			
<30	17	7.2	46.30
31 – 40	39	16.5	
41 – 50	122	51.7	
51 – 60	35	14.8	
61 – 70	16	6.8	
> 71	7	3.0	
Sex			
Male	236	100	
Female	0	0	
Marital status			
Single	11	4.7	
Married	220	93.2	
Widower	5	2.1	
Household size			
1 – 5	97	41.0	7.50
6 – 10	71	32.0	
11 – 15	38	16.0	
16 – 20	22	9.0	
Above 21	8	2.0	
Level of education			
Non formal	151	64.0	
Primary	45	19.0	
Secondary	24	10.2	
Tertiary	16	6.8	
Farming experience			
1 – 10	50	21.2	19.46
11 – 20	85	36.0	
21 – 30	69	29.3	
31 – 40	25	10.6	
41 – 50	6	2.5	
51 – above	1	0.4	

Source: Field survey data, 2024

The results in Table 2 on farm sizes show that majority (50.4 percent) of the respondents had farm sizes range of 1.5– 2.0 hectares with mean of 1.75 hectares. This results implies that majority of the watermelon farmers had farm sizes of less than 3.0 hectares implying that most of the farmers operate on a small-scale basis. The results were in line with the findings of Orifah et al. (2021) in his study on perceived effectiveness of adaptation strategies to climate change among rice farmers in Jigawa State. The results in Table 2 on source of land shows that majority (46.6 percent) of the respondents acquired their land through purchase, 30.9 percent of the respondents acquired their lands through inheritance. This indicate that majority of the respondents reliance on more flexible or short-term access to land, possibly due to financial constraints or a preference for lower-risk investment strategies. The findings disagreed with study of Adeoye (2020) in his study on economic analysis of watermelon production in Ibarapa central Local Government Areas of Oyo State, Nigeria who reveal that majority (78 percent) of the farmers obtained their lands through inheritance. The results of the study on access to credit reveals that about 84.7 percent of the respondents do not have access to any form of credit. This limited access to credit may hinder the majority of respondents from investing in improved agricultural practices, purchasing quality inputs, or expanding their operations. The findings suggest that financial barriers remain a critical. The results agreed with the findings of Abdulhamid et al. (2020) in their study on perception and awareness of rice farmers to climate change, who reported that despite the presence of numerous credit sources in Jigawa State, farmers lack access to credit facilities. Majority (91.5 percent) of the respondents were members of cooperative. This high level of cooperative membership could suggested a strong sense of community and collective action among the respondents, which can enhance access to shared resources, information, and markets. The results of the study is in line with findings of Adeoye (2020) in his study who found majority of the farmers were part of a cooperative society and had the opportunity to access credit, extension services, agricultural resources, and information on improving farming practices. The results reveals that the majority (89.4 percent) of the respondents had contact with extension agents, the results also shows that 59.7 percent of the respondents met with extension agents ranging from 1- 3 times in a year. This high level of contact with extension services could suggested that most of the respondents have access to vital agricultural information on improved production practices. Such contact is likely to enhance their productivity and decision-making. Limited contact with extension agents could lead to the inefficient use of recommended practices. This finding agreed with Yusuf (2019) who reported that low extension contact negatively impacted the use of recommended technologies among farmers in Kaduna State.

Table 2: Distribution of the respondents based on socio-economic characteristics (n = 236)

Variable	Frequency	Percentage	Mean
Farm size			
0.5 – 1.0	84	35.6	1.75
1.5 – 2.0	119	50.4	
2.5 – 3.0	30	12.7	
3.5 – 4.0	3	1.3	
Source of farmland			
Inheritance	73	30.9	
Purchase	110	46.6	
Lease	53	22.5	
Credit access			
No	200	84.7	
Yes	36	15.3	
Membership of association			
Non-member	20	8.5	
Member	216	91.5	
Extension contact			
Contact	211	89.4	
No contact	25	10.6	
Number of Extension visit			
1 – 3	141	59.7	
4 – 6	95	40.3	

Source: Field survey data, 2024

Level of Awareness of Improved Watermelon Production Practices

The results in Table 3 revealed that majority (94.1 percent) of the respondents were aware of the improved seed varieties, recommended spacing 66.9 percent, planting methods 78 percent, water management 61.0 percent. The least known practices was storage techniques 45.3 percent. The findings indicates that the respondents show a high level of awareness of various agricultural production practices, which may likely reflects the success of extension services, agricultural programs, or farmer networks in disseminating information about improved agricultural production practices and their benefits. The results of the study are in line with the findings of Abdulmumini et al. (2021) in their study on awareness and adoption of rice production technologies in Jigawa State, who reported the use of recommended improve rice variety rice production technology in Jigawa State has high awareness level. This results are also similar with the findings of Umar (2020) in his study on adoption of recommended production practices by farmers who found that majority of farmers had high knowledge about recommended varieties.

Table 3: Distribution of Respondents According to their levels of Awareness of Improved Watermelon Production Practices

Variables	Frequency	Percent
Improved seed varieties	222	94.1
Recommended spacing	158	66.9
Planting method	184	78.0
Water management	144	61.0
Weed management	132	55.9
Fertilizer application	163	69.1
Pest and disease control	208	88.6
Harvesting techniques	121	51.3
Storage techniques	107	45.3

Source: Field survey, 2024

Rate of Adoption of Improved Watermelon Production Practices

Table 4 shows the rate of adoption of improved watermelon production practices adopted by the farmers. These include improved seed varieties 75.8 percent, recommended spacing 59.7 percent, planting method 61.0 percent, water management 59.7 percent, storage techniques 35.0 percent was the least adopted practices. These findings indicate a need to promote the adoption of less-practiced techniques, particularly harvesting, and storage methods. Support access to resources, training programs, and financial support can help bridge the gap between awareness and adoption, enabling farmers to fully benefit from improved watermelon production practices and achieve sustainable growth. The findings is align with the study of Chukwuka (2021) on the determinants of technology adoption among watermelon farmers in Delta State, the study found that a majority (42.0 percent) of the farmers were using seeds and recommended varieties provided by private agencies. The results is also similar with findings of Ogisi and Begho (2023) in their study on adoption of climate-smart agricultural practices in sub–Saharan Africa, stated that various factors influence farmers' decisions to adopt improved production practices, including environmental, physical, and ecological factors, personal and social psychological factors, farm-related and economic factors, as well as institutional, policy, and structural factors.

Table 4: Distribution of Respondents According to their Rate of Adoption of Improved Watermelon Production Practices

Practices	Frequency	Percent
Improved seed varieties	179	75.8
Recommended spacing	141	59.7
Planting method	144	61.0
Water management	141	59.7
Weed management	122	51.7
Fertilizer application	101	42.8
Pest and disease control	179	75.8
Harvesting techniques	115	48.7
Storage techniques	83	35.0

Source: Field survey, 2024

Adoption Index of Improved Watermelon Production Practices

The results in Table 5 shows that majority (48.3 percent) of the respondents had an adoption index between 0.40 - 0.60 while 11.0 percent had adoption index between 0.10 - 0.30. An adoption index of ≤0.30 indicates low adoption, adoption index of ≤0.60 indicates medium adoption while an adoption index of ≥0.70 indicates high adoption. This suggests that the majority of farmers have adopted improved watermelon production practices to a moderate level, but not fully adopted all the components of package indicating that still there is needs for collaborating effort from extension agent and other stakeholder for creating an awareness on the benefit of adoption of such practices. The findings disagreed with Olusegun et al. (2024) in their study on adoption of climate smart agricultural practices among smallholder rice farmers in Dutse, Jigawa State, who shows that majority (78.3%) of the respondents had an adoption index between 0.01- 0.40. The findings is also agreed with the study of Uchemba et al. (2021) in their study on adoption of improved cassava production technologies among small-scale farmers who found that improved cassava production technologies has not been fully adopted by all the farmers.

Table 5: Distribution of respondents by adoption index

Adoption index	Frequency	Percentage	Adoption decision
0.10 - 0.30	26	11.0	Low adoption
0.40 - 0.60	114	48.3	Medium adoption
0.70 - 1.0	96	40.7	High adoption

Source: Field survey, 2024

Factors Influencing Adoption of Improved Watermelon Production Practices

The results of Tobit regression analysis in Table 6 shows that the LR chi2 (9) = 23.86 is significant at five percent suggesting that the model represent a significant improvement in fit as against intercept model. The results also shows that household size had a negative coefficient (-0.004) and was significant at ten percent, Farming experience had a negative coefficient (-0.002) and was significant at five percent., Farm size had a positive coefficient (0.0168) and was significant at five percent, extension contact was found to have a positive coefficient (0.020) and was significant at 5 percent. This result was similar with the finding of Christopher (2024) who found that farmers with greater experience had more awareness of innovations but remained selective in adopting them. They may adopt new practices only when they perceive a strong return on investment or when it aligns with economic incentives such as cost savings or premium market opportunities.

Table 6: Tobit Regression Result of the Factors Influencing Adoption of Recommended Watermelon Production Practices

Variable	Coefficient	SE	T	P>t
Age	0.0007	0.0013	0.56	0.578
Household size	-0.0041	0.0024	-1.71	0.090*
Farming experience	-0.0023	0.0013	-1.74	0.083*
Farm size	0.0168	0.0086	1.95	0.053**
Membership in ass.	0.0494	0.0385	1.28	0.201
Extension visit	0.0673	0.0215	3.12	0.002**
Affordability	-0.0056	0.0147	-0.39	0.700
Compatibility	-0.0269	0.0267	-1.01	0.314
Complexity	-0.0802	0.0828	-0.97	0.334
Constant	0.8574	0.3006	2.85	0.005
/sigma/	0.1615	.0076		
Log likelihood	81.0767			
LR chi2(9)	23.86			
Pseudo R^2	-0.1726			

Note: * = Significant at 10%, ** = Significant at 5%, *** = Significant at 1%
Source: Field survey data, 2024

CONCLUSION

The findings of this study reveal that socio-economic and institutional challenges influence the adoption of improved production practices. While farmers generally show awareness of practices such as using improved seed varieties and pest and diseases control, their adoption and implementation is not uniform. Practices like storage techniques and fertilizer application remain underutilised, reflecting gaps in awareness and resource availability. Frequent contact with extension services and farm size were drivers of adoption. Based on the findings of the study, the following recommendations were made; Governments and private organisations should design and implement policies that provide farmers with practical experience, farmers should join and also stay active in association; being part of association helps with sharing knowledge, farmers should also maintain contact with extension agents.

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