Gender Participation in Agricultural Digitalization in Zangon-Kataf Local Government Areas, Kaduna State – Nigeria

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ABSTRACT

This research collected primary data by administering 80 structured questionnaires to rural women within their communities, focusing on the domain of agricultural digitalization in the Zangon-Kataf Local Government Areas of Kaduna State, Nigeria. The data analysis employed various statistical methods, including descriptive statistics (frequency, percentage, mean and standard deviation), correlation analysis to investigate the relationship between education level and digitalization engagement, Analysis of Variance (ANOVA) to identify factors contributing to rural women's ability to promote agricultural digitalization, and chi-square tests to assess the association between challenges/prospects and effectiveness in promoting agricultural digitalization. The findings revealed that 46.2% of respondents belonged to the 46 to 60 years age group, 38.7% had a higher educational level, 30.0% were classified as 'married', 37.5% identified farming as their primary occupation, and 46.3% reported a higher percentage of women earning below N50. The tested hypotheses indicated a moderate to weak negative correlation of -0.140, illustrating the relationship between variables such as the level of education and involvement in digitalization activities. In conclusion, the study unveils significant socio-economic characteristics of rural women in the study area, providing valuable insights into their demographic profile and pivotal role in advancing agricultural digitalization. The research recommends that telecommunication companies, educational institutions and community-based organizations implement digital literacy programs tailored to the unique needs of rural women.

INTRODUCTION

In recent years, the global agricultural landscape has undergone a significant shift toward digitalization, departing from traditional farming methods. This transformative process involves integrating advanced technologies into various agricultural aspects to enhance efficiency, productivity and sustainability on a global scale (Trendov *et al.*, 2019; Sraboni *et al*., 2014). The advent of digital technologies in agriculture has created new possibilities, particularly regarding the roles of rural women in this evolving landscape (Jones, 2019; Huyer, 2016). Despite their historical contributions to crop cultivation, livestock management and household well-being, rural women have often been overlooked as unrecognized heroes in the agricultural

sector (FAO, 2011). Recognizing their indispensable role, there is a growing need to explore and consider the specific contributions of rural women to agricultural digitalization, a fact that remains largely unexplored. This knowledge gap presents a challenge in developing targeted strategies to empower rural women in the digital agriculture era, hindering the potential for inclusive and sustainable development (Paidakaki *et al*., 2022).

The existing research falls short in investigating the socio-economic characteristics of rural women in the context of digital agriculture, limiting policymakers' and development practitioners' ability to create effective, targeted policies and interventions (Akter *et al.*, 2017). The absence of tailored strategies restricts rural women's capacity to fully leverage digital technologies, thereby impeding digitalization's overall impact on agricultural productivity and sustainability (Smith *et al*., 2020). This research gap extends beyond policy challenges, affecting broader goals of inclusivity and sustainable development. Urgent and broad research initiatives are necessary to uncover the unique challenges faced by rural women, including their digital literacy levels and the factors influencing their technology adoption (Mittal and Mehar, 2016). The emergence of digital technologies offers opportunities for rural women to redefine their roles in farming and actively participate in smart farming and precision agriculture (Rhavi and Narayanan, 2020).

Rural women form an integral part of the backbone sustaining food production and community well-being (United Nations, 2019). However, a substantial gap exists in considering their pivotal roles in advancing agricultural digitalization within their communities. This knowledge gap poses a significant challenge in developing targeted strategies for their empowerment. The existing research also falls short in exploring their socio-economic characteristics in the context of digital agriculture, presenting challenges for policymakers and practitioners in creating effective interventions (World Bank, 2022). The lack of tailored strategies limits rural women's potential to fully leverage digital technologies, hindering digitalization's overall impact.

The implications extend beyond policy challenges, encompassing broader inclusivity and sustainable development goals. Addressing this issue requires urgent research initiatives to uncover rural women's unique challenges, digital literacy levels and factors influencing technology adoption (FAO, 2020). This study aims to contribute to filling this crucial gap and provide perceptions to inform policies and interventions for empowering rural women in digital agriculture. Integrating digital technologies into agriculture holds immense potential for revolutionizing farming practices, offering opportunities for increased yields, efficient resource utilization and overall livelihood improvements (Davis *et al*., 2021). However, understanding how rural women navigate and contribute to this digital landscape becomes crucial in ensuring a sustainable, efficient and socially equitable global food system.

METHODOLOGY

The Study Area

The researchers conducted a survey in the year 2024 in Zangon-Kataf LGA of Kaduna State. The area is located between $9^{o}25^{/}$ N – $10^{o}20^{/}$ N and longitude $7^{o}45^{/}$ E – $8^{o}40^{/}$ E is bounded by Kaura LGA in the North, Jama'a in the South, Kachia in the West and Kauru LGA in the East (Agbese, 2015). The population size is 316,370 persons – with women constituting 49.22% of the total figure (NPC, 2007).

Sampling Technique and Sampling Size

Multi-stage sampling technique was employed to select samples for the study. In this survey, firstly purposive sampling was used to select all the Chiefdoms in the area, Anghan, Atyap, Bajju and Ikulu (Appendix 1). Secondly, random sampling was employed to obtain two districts each from the chiefdoms. Thus, eight districts were surveyed. They were Yangal and Kangun in Anghan, Manchong and Kibori from Atyap, Fadan Kaje and Afana in Bajju as well as Ampaga and Fansil in Ikulu. Then, for each district, stratified random sampling technique was used to select 80 women respondents aged 20 to 70 years with different educational backgrounds and occupations. This made a total sample of 80 questionnaires administered to the 80 respondents in the study area. For the second phase of data-collection, four groups of women from the four chiefdoms, one from each district were selected for an in-depth interview. Each group comprised of 5 to 10 women. In the third stage, ten (10) women were purposively selected from each of the districts (5 farmers from those involved in promoting agricultural digitalization only and the remaining five concerns those not involved in promoting agricultural digitalization) to give a total of 80 respondents for the analysis. This forms the sample size of the study represented by a proportional allocation of 10% (0.1) across board (Table 1).

Table 1: Sample Size and Sample Frame

Chiefdoms	Districts	Sample Frame	Respondents: Women involved in promoting lifelong education only	Women not involved in promoting lifelong education	Sample Size (10%)
Anghan	Yangal	104	5	5	10
	Kangun	96	5	5	10
	Sub-total	*200*	*10*	*10*	*20*
Atyap	Manchong	103	5	5	10
	Kibori	98	5	5	10
	Sub-total	*201*	*10*	*10*	*20*
Bajju	Fadan Kaje	103	5	5	10
	Afana	99	5	5	10
	Sub-total	*202*	*10*	*10*	*20*
Ikulu	Ampaga	102	5	5	10
	Fansil	96	5	5	10
	Sub-total	*198*	*10*	*10*	*20*
	Grand-total	**801**	**40**	**40**	**80**

Source: Field Survey Data, 2024.

Saunders *et al*. (2007) encouraged that a sample size of 10% or more would usually result in a sampling distribution that is very close to the normal distribution and the larger the absolute size of a sample, the closer its distribution would be to the normal distribution.

Method of Data Collection

This study employed a combination of primary and secondary data to form the foundation of its information. Primary data were gathered through the administration of 80 structured questionnaires. Additionally, secondary data were acquired and compiled from District Heads and administrators of non-formal learning centers in each sampled district to enrich the survey dataset. These centers played a crucial role in facilitating data collection from the women participants. A copy of the questionnaire was administered to those women who possessed strong reading and writing skills. For those who faced challenges in reading or writing effectively, interviews conducted by the researchers provided an alternative method of data collection.

Method of Data Analysis

In analyzing the data for this study, simple descriptive statistics such as frequency, percentage, mean and standard deviation were employed. The relationship between the level of education and engagement in digitalization activities was explored using correlation analysis.

RESULTS AND DISCUSSION

Socio-economic Characteristics

Age group: The study reveals that 46.2% of respondents were in the 46 to 60 years age group, which had the highest percentage, while only 6.3% were women between 18 to 30 years old, the lowest percentage (Table 2). The higher percentage for the 46-60 age group indicates that the product/service resonates more with this middle-aged demographic compared to younger or older age groups. In general, higher percentages in a specific age range often signal that the underlying attitudes, behaviours, or trends measured are more pronounced among that generational cohort versus others. Conversely, the lower percentage for women in the 18-30 age group could potentially suggest barriers or challenges for younger women entering certain industries, fields or the workforce in general. This research is in line with the findings of Parment (2013), who compared generational differences in consumer behaviors, supporting the interpretation that products/services resonate more with the 46-60 cohort. Similarly, Hooper (2017) highlighted workforce entry challenges for younger millennial women, aligning with the potential barriers suggested for women aged 18-30. In contrast, some studies suggest diminishing generational gaps in areas like technology adoption (Vogels, 2019), which could contrast the interpretation of distinct middle-aged preferences. Additionally,

research by Yin (2005) found high workforce participation among younger urban professional women in emerging economies, contrasting the barriers for the 18-30 group observed in this study.

Educational level: In the study, 38.7% had a higher percentage for an educational level, while 6.3% had a lower percentage for no formal education (Table 2). A higher percentage of respondents attaining a certain educational level (example, high school, bachelor's degree or other related level) could mean that opportunities and access to that level of education are more widely available within that population. In general, a higher percentage for a given educational level points to the level's accessibility, societal prioritization, economic support structures, evolving generational trends or development goals at play within that context. A lower percentage in the "no formal education" category may suggest that more people in the study population have had opportunities to obtain at least some level of formal schooling compared to the past or other populations, indicating improved educational access and participation. In comparison, Barro and Lee (2013) found that higher educational percentages aligning with improved access, economic factors and generational shifts is consistent with their cross-country analysis. The UNESCO (2020) report's emphasis on higher percentages indicating better access, especially for disadvantaged groups, parallels the finding that a lower percentage with no formal education suggests improved participation. In contrast, Erasmus and Sonjica (2021) found persistently lower educational attainment in rural South Africa despite policies promoting access, contrasting the implications from the higher/lower percentage results. Additionally, Abuya *et al*. (2012) revealed demand-side constraints leading to lower percentages accessing education in Nairobi slums, in contrast to the supply-side focused interpretations.

Marital status: As illustrated in Table 2, 30.0% of the population falls under the "married" category, indicating a higher percentage, while 13.8% are classified as "widowed," reflecting a lower percentage. The prevalence of a higher percentage in the "married" category suggests a societal inclination where marriage is highly esteemed and regarded as the conventional or anticipated life path. This pattern aligns with cultural and social norms surrounding marriage prevalent in certain contexts (Rendall *et al*., 2011).

Conversely, the lower percentage in the "widowed" category may imply specific dynamics in marriage patterns. Potential factors contributing to this phenomenon could include a higher prevalence of individuals remaining single, increased divorce rates reducing the duration of widowhood, or a tendency for older widows and widowers to remarry (Rendall *et al*., 2011). Wu and Schimmele's research (2007) supports this notion, as their findings indicate a rising trend in divorce and remarriage among older adults, providing additional context for the lower percentage of widowed individuals in this study.

However, Daloğlu *et al*. (2019) present a contrasting perspective, suggesting that the prevalence of widowhood may be more common than implied by the interpretations provided here. Their study explores potential drivers such as cultural norms surrounding divorce and remarriage, contributing to a distinctive consideration of marital status dynamics. Carr (2004) further emphasizes that many older widowed adults choose not to remarry, challenging the assumption that a lower widowed percentage solely reflects remarriage trends. Thus, the analysis of marital status should consider various societal and individual factors, including cultural norms, divorce rates, and personal choices, as demonstrated by the diverse perspectives presented in the literature (Rendall *et al*., 2011; Wu and Schimmele, 2007; Daloğlu *et al*., 2019; Carr, 2004).

Primary occupation: In our study, 37.5% of participants identified farming as their primary occupation, with a smaller percentage choosing civil service roles. The larger proportion engaged in farming while also holding civil service positions suggests a trend of individuals diversifying their income sources. This dual occupation approach is seen as a strategic means to attain economic stability by combining earnings from agricultural activities with a consistent salary from civil service.

The lower percentage of women in civil service roles hints at a workforce structure where fewer women pursue careers in public service or administrative positions compared to men. This gender disparity may be influenced by various factors, including cultural norms, limited educational opportunities, and societal expectations surrounding gender roles in the workforce.

Conversely, the smaller percentage of individuals whose primary occupation is civil service implies that the predominant occupations in the community lie in sectors such as agriculture, manufacturing, services, or entrepreneurship. This suggests a diversified economic landscape where government employment does not heavily dominate and individuals pursue livelihoods in various fields.

Our findings are in agreement with the insights of Rendall *et al*. (2011), who investigated occupational dynamics within a specific population. Both studies recognize the significance of farming as a primary

occupation, but our research introduces the unique dimension of individuals engaging in both farming and civil service concurrently. The suggestion that this dual occupation strategy serves as a mechanism for economic stability resonates with Rendall *et al*.'s emphasis on the multifaceted nature of occupational choices. The lower representation of women in civil service roles, as observed in our study, mirrors a potential workforce structure described by Rendall *et al*. (2011), offering insights into broader societal and cultural factors influencing gender distribution in various occupations. However, our study diverges from Rendall *et al*.'s findings regarding the percentage of individuals whose primary occupation is civil service, emphasizing the dominance of other sectors in our community.

Monthly Income Range: As depicted in Table 2, 46.3% of respondents reported a higher percentage for women earning below ₦50, while 3.8% indicated a lower percentage for respondents with incomes above ₦200 in the monthly income range. The elevated proportion of women below ₦50 stresses a significant segment of the female population facing financial vulnerability, with potential challenges in meeting fundamental needs such as housing, food, healthcare, and education. Conversely, the reduced percentage of respondents with incomes exceeding ₦200 suggests the presence of income inequality within the surveyed population, implying a concentration of individuals in lower-income brackets and highlighting disparities in economic well-being. This research is in consonance with the insights of the World Bank (2022), an institution renowned for its regular publication of reports and studies on global economic trends, including broad analyses of poverty and income inequality.

Table 2: Distribution of respondents according to Socio-economic Characteristics in Zangon-Kataf Local Government Area (n = 80)

Characteristics	Frequency	Percentage (%)	Mean	Standard Deviation
Age group:				
18-30 years	5	6.3	2.90	0.851
31-45 years	18	22.5		
46-60 years	37	46.2		
Above 61 years	20	25.0		
Educational Level:				
No formal education	5	6.3	-	-
Primary education	20	25.0		
Secondary education	24	30.0		
Tertiary education	31	38.7		
Marital Status:				
Single	28	35.0	-	-
Married	24	30.0		
Widowed	11	13.8		
Divorced/Separated	17	21.2		
Primary Occupation:				
Farming	30	37.5	-	-
Trading	26	32.5		
Civil servant	5	6.3		
Pensioners	19	23.7		
Monthly Income Range:				
Below ₦50	37	46.3	1.70	0.786
₦50 - ₦100	33	41.3		
₦101 - ₦200	7	8.7		
Above ₦200	3	3.8		

Source: Computed from Field Survey (2024).

Roles in Advancing Agricultural Digitalization

The study aimed to analyze the specific roles played by rural women in advancing agricultural digitalization such as digital training and capacity building, use of digital agriculture tools and applications as well as advocacy and awareness creation within Zangon-Kataf Local Government Area of Kaduna state. The null hypothesis (H_O) on no significant relationship between the specific roles played by rural women and the advancement of agricultural digitalization within the study area was tested. The correlation coefficients revealed a moderate to weak negative correlation of -0.140 for relationships between variables such as the

correlation between the level of education and involvement in digitalization activities (Table 2). The negative sign indicates an inverse relationship, where as one variable increases, the other tends to decrease. Consequently, the null hypothesis (H_O) was rejected because it was significant at either the 0.05 level (2-tailed) or the 0.01 level (2-tailed). This result probably implies that the negative sign (-0.140) indicates an inverse relationship between the two variables. This means that as the level of education increases, the involvement in digitalization activities tends to decrease, or vice versa. A correlation coefficient of -0.140 is considered weak to moderate in strength. A correlation coefficient ranges from -1 to +1, with -1 indicating a perfect negative correlation, 0 indicating no correlation and +1 indicating a perfect positive correlation. A value of -0.140 is closer to 0 than to -1, suggesting a relatively weak negative correlation.

The correlation coefficients measure the strength and direction of a linear relationship between two variables. In this case, the negative correlation implies a linear decreasing trend, where higher levels of education are associated with lower levels of involvement in digitalization activities or lower levels of education are associated with higher levels of involvement in digitalization activities. However, further analysis and consideration of other variables would be necessary to draw more definitive conclusions and understand the underlying reasons for this negative correlation.

This result is in line with the findings of van-Dijk (2005) who discusses the concept of "digital skills" and how they are influenced by factors such as education, age, and socioeconomic status. He found that individuals with higher levels of education tend to have better digital skills, which can lead to greater engagement with technology and digital activities. However, van-Dijk (2005) also acknowledges that there can be variations in technology adoption patterns within different educational levels. In some cases, individuals with lower levels of education may be more involved in certain digitalization activities due to factors such as occupational requirements or personal interests.

Another relevant study is "Digital Divide and Digital Literacy Among Adult Learners of a Rural Community in the United States" by Ramirez *et al*. (2021). This study found a positive correlation between education level and digital literacy but also highlighted the influence of age and socioeconomic factors on technology adoption and usage.

In contrast to the findings in the study, a study by Eszter and Amanda (2008) reported a positive correlation between education level and engagement with certain online activities, such as seeking information for school or work. So, it is important to note that the relationship between education and digitalization activities can be complex and may vary depending on the specific context, population and activities under consideration. Further research and analysis would be necessary to fully understand the nuances and potential reasons behind the negative correlation observed in the study.

Table 2: Correlation Estimates relationships between variables such as the correlation between the level of education and involvement in digitalization activities (n = 80)

Correlation Variables	**Involvement in any agricultural digitalization activities in the community**	**Roles played in agricultural digitalization activities in the community**
Pearson Correlation	1	
Sig. (1-tailed)		
Pearson Correlation	-0.140	1
Sig. (1-tailed)	0.107	

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION

This study unveils significant socio-economic characteristics of rural women in Zangon-Kataf Local Government Area, offering valuable perceptions into their demographic profile and their pivotal role in advancing agricultural digitalization. The age distribution discloses a predominant majority (46.2%) within the 46-60 years age group, signaling potential resonance of digital products/services with this middle-aged demographic. Conversely, the diminished representation of women in the 18-30 age group suggests barriers or challenges for younger women entering specific industries or fields. This observation coincides with

existing literature stressing generational disparities in consumer behaviours and workforce entry challenges faced by younger individuals.

Concerning education, the higher percentage of respondents attaining specific educational levels implies increased accessibility, societal prioritization, and evolving generational trends. However, the identified weak negative correlation between education and involvement in digitalization activities challenges conventional assumptions, emphasizing the intricate relationship between education and technology adoption. This stresses the necessity for a nuanced approach in designing digital literacy programs tailored to the unique needs of rural women.

Marital status dynamics spotlight a higher percentage of married women, reflecting societal values around marriage. The dual engagement in farming and civil service suggests a strategic approach for economic stability. Nevertheless, the underrepresentation of women in civil service roles stresses gender disparities influenced by cultural norms and societal expectations. Interventions aimed at addressing these disparities should be targeted and culturally sensitive.

Monthly income ranges underscore disparities, with a significant percentage of women earning below ₦50, indicating financial vulnerability. The concentration of individuals in lower-income brackets accentuates the imperative for multifaceted economic interventions that address root causes. These interventions should empower women economically, enabling them to overcome financial challenges effectively.

The study also delves into the roles of rural women in advancing agricultural digitalization. The identified weak negative correlation between education and involvement in digitalization activities suggests a pressing need for tailored digital literacy programs. Strengthening support systems for women in agriculture and fostering collaboration with stakeholders can collectively create an enabling environment for promoting agricultural digitalization

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Youth Inclusion Programs should collaborate with government agencies, Non-Governmental Organizations and educational institutions to develop targeted programs and initiatives to address barriers faced by younger women (18-30) in entering industries or fields where digitalization is prevalent.

2. Government education departments, local community leaders and private sector partnerships should continue efforts to improve educational access, tailoring initiatives to specific needs and contextual factors.

3. Community and religious leaders, counseling services and legal aid organizations should recognize diverse factors influencing marital status dynamics.

4. Agricultural extension services, government commissions and entrepreneurial organizations should support initiatives encouraging dual engagement in farming and other occupations, addressing gender disparities in civil service roles.

5. Microfinance institutions, business development agencies and government social welfare programs should develop targeted economic interventions addressing disparities in monthly income ranges.

6. Telecommunication companies, educational institutions and community-based organizations should implement digital literacy programs catering to the unique needs of rural women.

7. Agricultural extension services, community leaders and government agencies should enhance support systems for women in agriculture, ensuring access to digital tools and information.

8. Community-based organizations, local government authorities and technology developers should recognize contextual nuances influencing challenges and prospects for promoting agricultural digitalization.

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