



WOMEN IN TVET AND THE FOCUS ON FOOD SUFFICIENCY IN NIGERIA

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Abstract

This research examines the role of women's engagement in agriculture-related Technical and Vocational Education and Training (TVET) in promoting agricultural productivity and food sufficiency in Nigeria, with emphasis on the role of institutional innovations in agricultural equipment fabrication and the use of drones in controlling pests in the agricultural sector. An institutional-based cross-sectional study using survey-method research design was employed in this study. Data were collected using structured questionnaires administered to women in various TVET institutions in Southwest Nigeria, with a total of 987 respondents. Results showed women engagement in agriculture through TVET is high, especially where the level of practical exposure is high. Access to TVET-fabricated agricultural equipment was found to enhance women productivity in agriculture, thereby supporting the significance of local fabrication in promoting agricultural production and supporting bumper harvest. Although awareness of the use of drones in controlling pests in the agricultural sector was high, and the actual level of technology use was low. Logistic regression results revealed that the level of awareness of the use of drones in controlling agricultural pests did not significantly predict the actual use of the technology. The study concludes that TVET plays a critical role in the empowerment of women in agriculture for the purpose of promoting agricultural productivity in the country. It is recommended that the capacity of TVET in fabricating agricultural equipment and the actual level of engagement in the hands-on use of drones in controlling agricultural pests be enhanced for promoting inclusive, technology-driven agricultural development in Nigeria.

Keywords: TVET, Agricultural Productivity, Fabricated Equipment, Skills, Food Sufficiency

1. Introduction

Agriculture has been the bedrock of Nigerians from the days of old. Before amalgamation of the Northern and Southern Protectorate in 1914, there have been groundnut pyramid and cotton plantation in the North, Rubber in the Middle belt and

Cocoa in the West (Sadiq et al., 2020). These glory have vanished from our land due to myriad of challenges ranging from human to natural causes.

The challenges which included bandits and cattle-rearers' incursion to farmlands in Benue State and other parts of the nation



quickly come to mind. There were also problems associated to draught and flooding in some other times. While these challenges are surmountable and being addressed by the Government, women in TVET institutions are looking at ways by which their women folks can be made more productive through the use of modern fabricated agricultural equipment and tools that will make them produce more farm products and do well in other agribusinesses (poultry, piggery, snail farming, etc.) (Njiraini, Ngigi & Barake, 2018).

Women in TVET institutions have belief that they will be able to organize training for their gender better than their male counterpart (Doss et al, 2018; Anderson et al, 2021).

The nation, Nigeria is faced with food sufficiency challenges and this have been affecting the economy as a whole. The challenges caused by food shortage was anchored by previous studies on bandits and cattle rearers' involvement in killing, maiming and chasing farmers from their farms. Little studies have been carried out on how to empower women, bulk of who engaged in farming in the North-Western, North-Eastern, North-Central, Eastern and South-Western zones of Nigeria. Most of the tools these women-farmers use are crude implements (cutlasses, hoes, diggers, etc.). These farming implements can only produce crops for subsistence living. This study therefore, focuses on how to aid women-gender to overcome challenges of food production through training in the use of fabricated agricultural equipment and

tools and in collaborating in the hire of agricultural drones to combat farm pests in Nigeria. This is with a view to produce more crops in larger scale to combat food shortage in the nation.

Based on the identified problems, the following objectives are being looked at in the study:

- i. to examine the involvement of women in agriculture through TVET;
- ii. to explore the efforts of TVET-based institutions in the fabrication of agricultural equipment and tools that will aid women in agriculture towards bumper harvest; and
- iii. to amplify the efforts of TVET-based institutions in providing solutions towards pest control through the use of agricultural drones.

2. Literature Review

2.1 Conceptual Review

2.1.1 TVET and Agricultural Transformation

TVET refers to education programs that provide technical knowledge, and occupational skills relevant to various sectors of the economy (Mishra et al., 2025). TVET is vastly different from general education. Given its emphasis on practical application, relevance, practical skills and experience, TVET is quite appropriate for agro industry.



TVET has been identified and accepted worldwide as an important tool in the diversification of the economy, creation of jobs, and promoting technological advancement (Young, 2025). TVET has been identified in developing countries, especially in sub-Saharan Africa, as an important tool in the modernization of agriculture and bridging the gap between traditional and modernized farming methods (African Development Bank [AfDB], 2018). In Nigeria, Polytechnics and other TVET tertiary institutions have been identified to operate at two levels: skills development and innovation centers, including agricultural tools fabrication.

However, the success of TVET in transforming agricultural sector depends on the link that combines skills training with appropriate technological solutions (Monteverde et al., 2025), particularly among women who face numerous obstacles in accessing mechanized farming and appropriate technical knowledge.

2.1.2 Women's Participation in Agriculture through TVET

Women make up a large percentage of the agriculture workforce in sub-Saharan Africa, significantly contributing to food production, processing, and marketing (FAO, 2011). Despite these positive contributions, women in the agricultural sector experience structural challenges, such as restricted access to land, credit, inputs, machinery, and extension services (Doss, 2018). These differences often result in gaps in agricultural productivity between male and female managed farms.

Engagement in agricultural-related TVET can be an opportunity to address the gaps in agricultural productivity between male- and female-managed farms. By engaging in structured training, the skills of the agricultural workforce will improve, enabling them to understand improved agricultural methods, machinery, and post-harvesting techniques (Keerthi et al., 2025). Empirical research have shown that access to technical education improves the efficiency of farm management, thereby increasing agricultural output (Montes de Oca Munguia et al., 2021).

In the case of Nigeria, the participation of women in TVET in crop production, agricultural engineering, and agribusiness can improve the skills and decision-making abilities of the agriculture workforce. However, the workforce must also have access to equipment and institutional support.

2.1.3 Institutional Fabrication of Agricultural Equipment

Institutional fabrication refers to the development of agricultural equipment by institutions. It is characterized by design, development, and modification of agricultural equipment by technical institutions. It is of particular significance in climes with high import costs and limited access to mechanization. In such climes with high import costs and low access to mechanization, fabricated agricultural equipment present alternatives that are affordable and flexible (Bakker & Pugeaux, 2025).



Food and Agriculture Organization (FAO) opined that small-scale mechanization is crucial in increasing labour productivity, reducing drudgery, and increasing the speed of farm operations. Women farmers, who heavily rely on manual operations, are likely to benefit from fabricated equipment such as planters, threshers, dryers, and weeders. Such equipment would help reduce drudgery and increase productivity.

More so, TVET institutions with effective engineering workshops would be instrumental in transforming agriculture by developing fabricated agricultural equipment that are usable in local environments. Such initiatives may be crucial in increasing productivity and knowledge with spill-over effects in local farming environments (Kabutieta et al., 2025).

However, it is imperative to note that the effectiveness of institutional initiatives is subject to consideration of issues of accessibility, affordability, and use of fabricated agricultural equipment by women. Where women lack access to fabricated equipment, productivity are likely to be limited despite skill acquisition.

2.1.4 Agricultural Productivity

Agricultural productivity is the efficiency level at which inputs are converted to output. Increases in agricultural productivity can be the result of technological innovations acquisition, and efficient allocation of resources (Woomer et al., 2025). For smallholder farmers,

improvements in agricultural productivity often involve access to machinery and technical knowledge.

In the study context, agricultural productivity is viewed in terms of increased yield, labour reduction, and increased efficiency in operations. The relationship between the skills of women and access to institutionally fabricated equipment is expected to improve agricultural productivity.

2.2 Theoretical Review

This paper is anchored on “Human Capital Theory” and “Diffusion of Innovation Theory”.

2.2.1 Human Capital Theory

Human Capital Theory, developed by Becker (1993), asserts that education and training can be viewed as investments that improve the productivity of individuals and generate more economic benefits. This theory is predicated on the assumption that improved skills and knowledge can improve the efficiency of individuals in performing productive activities and improve income-earning capacities.

In this study, the participation of women in TVET can be viewed as an investment in agriculture human capital, where training improves the skills of individuals, and the institutional support improves the application of the skills acquired by the individuals. The positive relationship between training exposure and productivity is in consonance with the core assumption



of the theory that education improves performance outcomes.

However, it has also been argued that the human capital theory, by itself, is not sufficient to improve the productivity of individuals in the face of structural constraints (Bowles & Gintis, 1976).

2.2.2 Diffusion of Innovation Theory

The Diffusion of Innovation Theory, developed by Howaldt, Kopp & Schwarz (2025), explains the process of the diffusion of new technologies in the society, where the decision to adopt new technologies is influenced by the “perceived relative advantage, compatibility, complexity, trialability, and observability of the new technologies”.

Institutionally fabricated agricultural tools are considered a form of technological innovation through TVET structures. The adoption of such tools is more likely for women when the tools are deemed useful, affordable, and consistent with traditional farming practices.

The theory also focused on the importance of institutional support in the adoption of technology. It is suggested that without the support of such diffusion and adoption structures, the adoption of an innovative technology may not be significant.

2.3 Theoretical Integration

The combination of the “Human Capital Theory and the Diffusion of Innovation Theory” provides a comprehensive framework for understanding the subject.

Human capital formation improves the technical skills of women in the region, and institutional fabrication initiatives improve the diffusion and adoption of technologies. Productivity improvements are a result of the synergistic interaction of the two processes. Therefore, the productivity of women in the agricultural sector of the Southwest region is a function of human capital and the diffusion of innovative technologies.

2.3 Empirical Review

Women are insufficiently recognized contributors to Africa's agriculture and food sector, providing a substantial portion of the labour while encountering considerable challenges, such as inequitable access to land, traditional labour divisions, mobility restrictions, disparities in educational attainment, financial exclusion, and gender norms. Consequently, women are relegated to lower productivity positions and get inferior compensation compared to men (Njiraini et al., 2018; Doss et al, 2018; Anderson et al, 2021).

TVET is an essential catalyst for the sustainability of Nigeria's agro-allied industry. The training equips the labor force with enhanced agricultural competencies through the fusion of formal, non-formal, and informal training. The improvement in skill levels is directly proportional to increased productivity and enhanced market competitiveness (Tsige, Synnevåg & Aune, 2020).

TVET is also instrumental in the sustainability of the environment. It enables



agro-allied firms to develop sustainable operational competencies. The training equips the firms with the technical ability to implement organic farming, enhance waste management, and boost their energy efficiency levels. These competencies enable agro-allied firms to mitigate their negative impacts on the environment, thus becoming environmentally sustainable (Doss et al., 2018; Anderson et al., 2021; Akinroluyo et al., 2024; Khail & Ahmadzai, 2022; Chanana-Nag & Aggarwal, 2020). The incorporation of TVET in the agricultural sector ensures that the economy grows in an inclusive and environmentally sustainable way.

An empirical analysis of “TVET and the sustainability of agro-allied firms in Nigeria” utilized a quantitative methodology, employing structured questionnaires to collect data from employees and management of agro-allied enterprises in Nigeria. The study underscores the crucial importance of training in improving the sustainability of agro-allied enterprises in Nigeria, stressing the necessity for ongoing investment in this sector (Ige & Fowokan, 2020; Adepoju & Fakayode, 2021).

A World Bank report, derived from comprehensive field research in Kabul, Parwan, Balkh, and Herat Provinces, indicated that women are predominantly situated at the lower tiers of high-value agricultural chains, including grape/raisin, almond, and saffron. Irrigation, weeding, harvesting, and minor processing, including drying and packaging of raisins and

almonds, are conducted at the home level (Munyi & Cheruiyot, 2019; Zhu et al., 2024; Adenekan, Augustus & Ala, 2020).

3. Materials and Methods

3.1 Research Design

This study adopted an institution-based mixed-methods research design. Mixed-methods research design is considered effective for exploring the complex interplay between education, gender, institutional innovations, and agricultural productivity because it allows for the incorporation of quantitative research findings, along with the results of statistical tests, to be supplemented by the insights that can be obtained from the institutional context (Taheri & Okumus, 2024). A cross-sectional research design was adopted. Data were collected at a specific point in time from the selected TVET institutions. Cross-sectional research design is the most frequently used research design for TVET studies, particularly for research on agricultural productivity (Subrahmanyam, 2020).

3.2 Study Area

This study was carried out in Southwest Nigeria. Southwest Nigeria is purposely selected because this region is known for having the highest concentration of polytechnics, relatively more advanced TVET infrastructure, and active engagement in agriculture-related TVET innovations. Several TVET institutions are found in this region, where fabrication workshops are already functional, making this region the best place to study the contribution of TVET institutions to



agricultural productivity and food sufficiency (Pierotti et al., 2022).

3.3 Population of the Study

The target population comprises of female students enrolled in agriculture-related TVET programmes, female TVET graduates (within the last three years), female farmers who have benefited from TVET-fabricated agricultural tools or drone-based pest control services, and TVET instructors and administrators involved in agricultural training, fabrication, or drone initiatives. This population structure aligns with institutional-based TVET research that links skills development to practical agricultural outcomes (Zulu, Djenontin & Grabowsk, 2021).

3.4 Sample Size and Sampling Technique

A purposive sampling method was used to sample ten TVET institutions spread across Lagos, Ogun, Oyo, Osun, Ekiti, and Ondo states based on their relevance and importance to agricultural-oriented training, fabrication, and innovation. Purposive institutional sampling is applicable when information-rich samples are needed for addressing specific research objectives (Nagpal, Kornerup & Gibson, 2021).

A total of 987 respondents were selected from the sampled institutions. Stratified random sampling was used at each institution to ensure proportional representation of female students,

graduates, and farmer beneficiaries. Stratification increases the level of representativeness and reduces sampling bias in multi-institutional research designs (Turner, 2020).

Table 1: Selected Institution and Samples Selected

State	Institution	Sample
Lagos	Yaba College of Technology	150
Ogun	Federal polytechnic, Ilaro	130
	Moshood Abiola Polytechnic, Abeokuta	125
	Ogun State Institute of Technology, Igbesa	53
Oyo	The Polytechnic, Ibadan	102
	Adeseun Ogundoyin Polytechnic, Eruwa	41
Osun	Federal Polytechnic, Ede	94
	Osun State Polytechnic, Iree	85



Ekiti	Federal Polytechnic, Ado-Ekiti	112
Ondo	Rufus Giwa Polytechnic, Owo.	95
Total		987

Table 1 depicts the ten (10) TVET institutions and their respective sample selected.

3.5 Data Collection Instruments

Structured Questionnaire was employed as the means of collecting the relevant data. The questionnaire collected information on the following variables: (i) women's participation in agriculture through TVET, (ii) exposure to TVET-developed equipment in agriculture, (iii) awareness and utilization of drone pest control, (iv) performance outcomes in agriculture, and (v) sufficiency indicators in households. Attitudinal and frequency questions were measured on a five-point scale, ranging from 1 = Never to 5 = Always, which is an accepted standard in collecting such types of data in social and agricultural studies, respectively (Jebb et al., 2021).

3.6 Validity and Reliability

The content validity of the questionnaire was ensured by consulting experts in TVET, Gender, and Agricultural Development studies. The pilot study was also conducted among a sample of participants other than the target sample. The internal consistency of the research

instrument was also tested through the application of Cronbach's Alpha, where all variables scored higher than 0.70, thus ensuring the reliability of the study, as recommended by Govindasamy et al. (2024).

3.7 Measurement of Variables

The study measured women's participation in TVET through variables such as enrolment status, period of time, number of practical working hours, and skill competency, respectively. Institutional performance was measured through variables such as exposure to locally made equipment, exposure to drone pest control, etc. Agricultural performance outcomes were measured through variables such as improvement in productivity, improvement in labour efficiency, and losses due to pests, respectively. Food sufficiency was measured through a composite index consisting of available food, months of shortage, dietary diversity, and income generated through agriculture, respectively. Moderating variables such as institutional support, socio-cultural factors, and availability of productive resources were also included, as recommended by FAO et al. (2020).

3.8 Data Analysis Techniques

Data were analysed using descriptive and inferential statistical techniques. The analyses were conducted using the "Statistical Package for the Social Sciences (SPSS)". The level of significance was set at 0.05. These techniques are widely

applied in social science and development research for testing complex conceptual models (Van der Waladt, 2020).

3.8.1 Descriptive Statistics

Exploratory analysis were used to summarise respondents' characteristics and key study variables. The arithmetic mean (\bar{X}) and standard deviation (SD) were computed as follows:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i \quad (1)$$

Where: \bar{X} = sample mean; X_i = individual observation; and n = total number of observations.

The standard deviation was computed as:

$$SD = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2} \quad (2)$$

These statistics were used to assess the level of women's participation in agriculture through TVET and the perceived effectiveness of fabricated agricultural tools.

3.8.2. Independent Samples t-Test

To examine differences in agricultural productivity between women with access to TVET-fabricated tools and those without access, an independent samples t-test was employed.

The test statistic is given by:

$$t = - \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (3)$$

Where \bar{X}_1, \bar{X}_2 = group means (Women with access to TVET fabricated tools and women without access); S_1^2, S_2^2 = group variances; and n_1, n_2 = group sample sizes.

This test determined whether access to institution-fabricated tools significantly influenced agricultural productivity.

3.8.3. Simple Linear Regression Analysis

To examine the effect of fabrication effectiveness on agricultural productivity based on women involvement in agriculture, simple linear regression analysis was employed. The model is expressed as:

$$AgrP = \beta_0 + \beta_1 \cdot FE + \epsilon_i \quad (4)$$

where: $AgrP$ = agricultural productivity; β_0 = constant; β_1 = regression coefficient; FE = Fabrication effectiveness; and ϵ_i = error term which is assumed to be normally and independently distributed with mean 0 and constant variance σ^2 .

More so, regression analysis was also fitted to examine the effect of drone effectiveness on pest-related crop loss reduction. The model is specified as:

$$DrE = \beta_0 + \beta_1 \cdot PRCLR + \epsilon_i \quad (5)$$



where: DrE = Drone Effectiveness; β_0 = constant; β_1 = regression coefficient of PRCLR; $PRCLR$ = Pest-related Crop Loss Reduction; and ϵ_i is as stated in equation (3).

3.8.4. Multiple Linear Regression Analysis

To examine the effect of TVET participation variables (training duration and practical hours training hours) on women's agricultural skill competency, multiple linear regression analysis was employed.

The general regression model is expressed as:

$$SC = \beta_0 + \beta_1 \cdot TD + \beta_2 \cdot PHR + \epsilon_i \quad (6)$$

Where SC = Skill competency; β_0 is as defined above; β_1, β_2 regression coefficients to be estimated; TD, PHR = training duration, and practical training hours respectively.

The coefficient of determination (R^2) was computed as:

$$R^2 = \frac{\text{Sum of Square Regression (SSR)}}{\text{Sum of Square Total (SST)}} \\ = \frac{\sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2}{\sum_{i=1}^n (Y_i - \bar{Y})^2} \quad (7)$$

where: Y_i = observed value of the response variable; \hat{Y}_i = predicted value from the regression model; and \bar{Y} = mean of the dependent variable.

It is of note that SST represents the total variability in Y before considering any explanatory variables; while SSR captures the portion of total variation that is explained by the dependent variable(s).

The F-statistic used to test overall model significance is given by:

$$F = \frac{MSR}{MSE} \quad (8)$$

where $= \frac{SSR}{K}$; $MSE = \frac{SSE}{n-k-1}$; k = number of predictors; and n = sample size

3.8.5 Logistic Regression Analysis (Prediction of Drone Use)

To examine whether drone awareness significantly influence the likelihood of drone use among women, binary logistic regression was employed. Logistic regression is appropriate where the dependent variable is dichotomous (Hosmer, Lemeshow, & Sturdivant, 2013).

Let

$$Y = \begin{cases} 1 & \text{if respondents uses agricultural drone} \\ 0 & \text{if respondents does not use agric drone} \end{cases}$$

The logistic regression model is expressed as:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \cdot DrA + \epsilon_i \quad (9)$$

where: $p = P(Y = 1)$ = probability of drone use; $\frac{p}{1-p}$ = odds of drone use; $\ln\left(\frac{p}{1-p}\right) =$ logit (log-odds); DrA = Drone Awareness.



Odds Ratio

The exponential of the regression coefficient gives the odds ratio (OR) as:

$$\text{Odds Ratio} = e^{\beta_1} \quad (10)$$

The odds ratio is interpreted as: if $e^{\beta_1} > 1$, the predictor (drone awareness) increases the likelihood of drone use; if $e^{\beta_1} < 1$, the predictor decreases the likelihood of drone use; but if $e^{\beta_1} = 1$, no effect exists.

Wald Test

The statistical significance of each predictor was tested using the Wald statistic:

$$W = \left(\frac{\beta}{SE(\beta)} \right)^2 \quad (11)$$

Where $SE(\beta)$ = standard error of the coefficient.

The Wald statistic follows a Chi-square distribution with 1 degree of freedom.

Overall model significance was assessed using the Omnibus Test of Model Coefficients, based on:

$$\chi^2 = -2 \ln L_0 - (-2 \ln L_1) \quad (12)$$

where: L_0 and L_1 represents likelihood of null and fitted models respectively.

Pseudo- R^2 measures such as Cox & Snell and Nagelkerke were used to estimate explanatory power.

The classification accuracy was computed using a cut-off probability of 0.50. This is estimated as:

$$\text{Accuracy} = \frac{\text{Correct Predictions}}{\text{Total Observations}} \times 100 \quad (13)$$

At a 5% level of significance, if $p < 0.05$, the predictor significantly influences drone use. Otherwise, it does not significantly influence drone use.

3.9 Ethical Considerations

Clear ethical clearance was obtained before the start of the research from the relevant ethical boards. The study was purely voluntary, and all the participants provided their consent to be part of the research. The participants were also assured of confidentiality and anonymity. The participants were made aware of their right to withdraw at any point during the research, as is the ethical requirement for all social research studies (American Psychological Association, 2019).

4.0 Results

All variables were checked for completeness and suitability for analysis. The data set consisted of 799 valid cases, and there were no missing values. The Likert-scale variables were within the expected range, i.e., 1-5. Descriptive statistics showed adequate variability, and the assumptions for regression analysis were met.

4.1 Involvement of Women in Agriculture through TVET

4.1.1 Descriptive Statistics

Women’s participation in agriculture through TVET was measured using skill competency, duration of training, and practical training hours.

Table 2: Descriptive Statistics of variables measuring women involvement in Agriculture

Variable	Mean	Std. Dev.
TVET Skill Competency	3.82	0.59
Training Duration (years)	2.46	1.12
Practical Hours per Month	32.19	15.71

Source: Extracted from SPSS Output, version 26

The mean skill competency score (M = 3.82) in Table 2 indicates a high level of agricultural skill acquisition among women enrolled in TVET programmes.

4.1.2 Regression Analysis

Regression analysis was conducted to examine whether training duration and practical training hours significantly predicted women’s agricultural skill competency.

Table 3: Regression Results (Dependent = Skill Competency)

Predictor	B	t-value	p-value

Training Duration	0.31	9.44	< 0.001
Practical Hours	0.42	12.67	< 0.001

$R^2 = 0.472$; $Adj. R^2 = 0.343$; $F(2, 796) = 125.41, p < 0.001$

Source: Extracted from SPSS Output, version 26

Table 3 shows that training period and training hours posed direct impact on the involvement of women in agriculture through TVET, supporting the conclusion that experiential exposure in TVET greatly enhances the skills of women in agriculture.

4.2 Fabrication of Agricultural Equipment and Women’s Productivity

4.2.1 Independent Samples t-Test

Table 4: Independent Samples t-Test between women with access to TVET-fabricated tools and those without access

Group	Mean Productivity	t-test
With Fabricated Tools	3.91	$T_{(797)} = 8.73, p < 0.001$
Without Fabricated Tools	3.46	

Source: Extracted from SPSS Output, version 26

Table 4 presents an independent samples t-test for agricultural productivity between women with and without TVET-fabricated tools. Women with access to TVET-



fabricated tools had a higher mean for agricultural productivity than those without. The mean for those with access to TVET-fabricated tools is 3.91, while that of those without is 3.46. This is a significant difference, $t(797) = 8.73, p < 0.001$.

Hence, there is a significant improvement in the agricultural productivity of women with access to TVET-fabricated tools. This is a clear implication of the significance of institutional fabrication of tools, which leads to better labour efficiency, thereby promoting better agricultural output

4.2.2 Regression Analysis on the effect of Fabrication Effectiveness on Agricultural Productivity

A regression analysis examined the effect of fabrication effectiveness on agricultural productivity.

Table 5: Regression analysis of Fabrication Effectiveness on Agricultural Productivity

Predictor	β	t-value	p-value
Fabrication Effectiveness	0.48	15.21	0.001

$R^2 = 0.536$; $Adj. R^2 = 0.428$; $F(1, 796) = 14.384, p < 0.001$

Source: Extracted from SPSS Output, version 26

The effectiveness of fabricated tools in Table 5 had a strong and statistically significant effect on agricultural

productivity ($\beta = 0.48, t\text{-value} = 15.21, p < 0.001$), demonstrating the critical role of TVET-based fabrication in achieving bumper harvests.

4.3 Drone-Based Pest Control and Crop Protection

Table 6: Frequency Distribution of Drone awareness and use

		Yes	No	Total
Drone awareness	<i>f</i>	471	328	799
	%	58.9	41.1	100
Drone use	<i>f</i>	285	64.3	799
	%	514	35.7	100

Source: Extracted from SPSS Output, version 26

Table 6 indicates that 471 (58.9%) of the respondents are aware of agricultural drones, while 328 (41.1%) are not aware of them. This shows that the awareness of drone technology among women affiliated with TVET institutions is moderate to high. Regarding the use of drone technology, 285 (35.7%) of the respondents are using drone technology, while 514 (64.3%) are not using it. This shows that there is a significant gap between awareness and usage of drone technology.

4.3.1 Logistic Regression (Drone Use)

Logistic regression analysis was conducted to determine if awareness of using agricultural drones is a predictor of their use for pest control.

Table 7: Classification Table

Classification Table ^a					
	Observed	Predicted			
		Drone Use		Percentage Correct	
		0	1		
Step 1	Drone Use	0	514	0	100.0
		1	285	0	.0
	Overall Percentage				

a. The cut value is .500

Source: Extracted from SPSS Output, version 26

Table 7 indicates that the logistic regression classified all non-users correctly but failed to classify actual users, resulting in an accuracy of 64.3%. This is because the sample is dominated by non-users.

Table 8: Prediction of drone use

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	Odds Ratio
Drone Awareness (1)	-.181	.151	1.440	1	.230	.834	2.302
Constant	-.516	.095	29.406	1	.000	.597	1.817

Nagelkerke $R^2 = 0.483$

Source: Extracted from SPSS Output, version 26

From Table 8, it is clear that awareness of drones does not have a significant effect on the use of drones by respondents ($B = -0.181, p = 0.230 > 0.05$). Although $\text{Exp}(B)$

$= 0.834$ shows that the use of drones decreases slightly with increased awareness of drones, it is clear that awareness of agricultural drones is not sufficient for their use. The significance of the intercept ($p < 0.001$) shows that other factors influence the use of drones. Nevertheless, from $\text{Exp}(B) = 0.834$, it is clear that women who were aware of agricultural drones were more than twice as likely to use the agricultural drones in pest control than those who were not aware (Odds = 2.302). All these findings indicate that structural and institutional factors are more central in explaining the use of drones than awareness.

4.3.2 Regression Analysis on Pest Loss Reduction

A regression analysis examined the effect of drone effectiveness on pest-related crop loss reduction.

Table 9: Regression Analysis of Drone Effectiveness on Pest-related crop loss reduction

Predictor	β	t-value	p-value
Drone Effectiveness	0.27	5.31	< 0.001

$R^2 = 0.421$; $\text{Adj. } R^2 = 0.396$; $F(1, 797) = 102.197, p < 0.001$

Source: Extracted from SPSS Output, version 26

Table 9 presents the results of the simple linear regression analysis used to examine the effect of the effectiveness of drones on the reduction of crop losses due to pests.



The regression analysis was significant, as shown by the $F(1, 797) = 102.197$, $p < 0.001$, implying that the effectiveness of drones was a significant predictor of the reduction of crop losses due to pests. The value of the coefficient of determination, i.e., $R^2 = 0.421$, shows that 42.1% of the variance in the reduction of crop losses due to pests was explained by the effectiveness of the drones. The adjusted R^2 value of 0.396 also supports the robustness of the regression model by adjusting for the sample size. The regression coefficient, i.e., $\beta = 0.27$, $t = 5.31$, $p < 0.001$, suggests a positive and significant effect of the effectiveness of the drones on the reduction of crop losses due to pests, implying that the more effective the drones are, the more the crop losses are reduced. This implies that the use of drones in controlling pests significantly contributes to the reduction of crop losses, implying the need to improve the institutional support for the training and use of drones in TVET for the improvement of agricultural productivity and food security outcomes.

4.4 Discussion of Findings

The research provides empirical evidence to support the strategic role of TVET in improving women's agricultural productivity in Nigeria. For example, the findings on women's involvement in agriculture through TVET reveal that training duration and the amount of practical training hours are significant predictors of women's competency levels. This is supported by Human Capital Theory (Becker, 1993), which argues that investments in education and training lead

to improved individual productivity. Similarly, the strong and significant relationship between experiential exposure and competency levels provides support for the argument that TVET improves performance outcomes. This argument is also supported by evidence from other studies on the effectiveness of agricultural training in improving farm management efficiency and productivity (Montes de Oca Munguia et al., 2021; Keerthi et al., 2025).

Additionally, the findings support the argument on the contribution of TVET to agricultural modernization and economic transformation (AfDB, 2018; Young, 2025). The findings reveal a strong and significant relationship between women's competency levels and the amount of practical training hours. This provides evidence from Southwest Nigeria to support the argument on the crucial role of TVET in addressing productivity challenges in agriculture.

On the institutional fabrication of agricultural equipment, the findings reveal a strong and significant relationship between women's access to TVET-fabricated equipment and their productivity levels. This provides support for the theoretical argument on the contribution of small-scale mechanization to labor efficiency and reduction of drudgery in agriculture (FAO, 2016). Similarly, the regression results reveal a strong and significant relationship between fabrication effectiveness and agricultural productivity. This validates the argument on the importance of localized mechanization solutions in environments characterized by



high import costs and lack of access to mechanization (Bakker & Pugeaux, 2025).

These findings are also consistent with Doss (2018), who highlights the importance of the role that structural constraints, such as the availability of inputs and mechanization, play in the productivity differentials between female farmers. Therefore, the findings support the convergence of the Human Capital Theory and the Diffusion of Innovation Theory, suggesting that skill acquisition must be supplemented with the availability of appropriate technological innovations to ensure the bridging of the productivity gap between female farmers (Howaldt, Kopp & Schwarz, 2025).

Regarding the use of drones for pest control, the findings implies that despite moderate levels of awareness about the use of drones, the use of the technology was found to be low, and the level of awareness was not found to predict the use of the technology. This finding is consistent with the Diffusion of Innovation Theory, which suggests that the level of awareness about the use of the technology can only influence the decision to adopt the technology, and that the decision to adopt the technology can only be influenced by the perceived usefulness, compatibility, complexity, and support for the use of the technology (Howaldt et al., 2025). Therefore, the fact that the level of awareness was not found to predict the use of the technology suggests that the use of the technology may be restricted by other factors.

These findings are consistent with the literature on the use of agricultural technology, which suggests that the availability of information on the use of the technology can only influence the decision to use the technology, and that the decision to use the technology can only be influenced by the availability of the support for the use of the technology (Montes de Oca Munguia et al., 2021).

Nevertheless, the results from the regression model show that the effectiveness of drone usage significantly minimizes losses due to pests in crops. This suggests that the adoption and utilization of drone technology have a positive effect on agricultural productivity. This result is in line with FAO (2020), which asserts that technological innovation is vital in improving the strength of food security. This result also supports Woomer et al. (2025), who emphasize the significance of technological transformation in improving the efficiency of African agriculture.

Overall, the results have reinforced the theoretical integration that this study set out to achieve. While human capital development through TVET improves the technical capacities of women in Nigeria, institutional fabrication and technological innovation improve the utilization and application of these capacities. Productivity improvement occurs when these processes occur in synergy. However, the disconnect between the level of awareness and utilization of drone technology suggests Bowles and Gintis (1976) argument that education alone cannot improve the



situation in the presence of structural constraints.

Overall, this study has provided valuable evidence that TVET institutions in Southwest Nigeria are instrumental in empowering women in Nigeria to improve agricultural productivity. Furthermore, this study suggests that improving the capacities for fabrication and enhancing the institutional mechanisms for the adoption and utilization of technological innovations in Nigeria are vital in improving agricultural productivity in Nigeria.

4.5 Policy Implications

The findings of this research hold significant policy implications for the development of Nigeria towards the achievement of the SDGs. First, the significant relationship between women's participation in agriculture-related TVET and productivity suggests that the achievement of SDG 2: Zero Hunger can be realized through the provision of TVET, as it enhances agricultural productivity (Food and Agriculture Organization, 2020). Therefore, the provision of TVET for women can be instrumental to the achievement of SDG 2.

The significant effect of the availability of TVET-fabricated tools on women's productivity can be related to the achievement of SDG 5: Gender Equality, as it addresses the issue of inequality in accessing mechanization for women farmers (Food and Agriculture Organization, 2011; Doss, 2018). Therefore, the provision of institutional

fabrication workshops and the availability of tools for women farmers can be instrumental to the achievement of SDG 5.

The significant difference between the level of awareness and use of drones suggests that the provision of support for innovation can be related to the achievement of SDG 9: Industry, Innovation, and Infrastructure.

5. Conclusion and Recommendations

The study examines the significance of women's engagement in agriculture-related Technical and Vocational Education and Training in raising agricultural productivity and supporting food sufficiency in Nigeria. The study findings offer robust empirical evidence of the significance of hands-on training in raising the competency of women's agricultural skills. Women who were exposed to hands-on training were more skilled, and this confirms the significance of hands-on training in raising agricultural skills. The study also shows that access to institutionally fabricated agricultural equipment is vital in raising women's agricultural productivity. Access to institutionally fabricated equipment helps to reduce labour intensity and operational inefficiency, leading to enhanced agricultural output. This confirms the strategic significance of the expansion of fabrication capacity in raising women's agricultural output and modernization. While awareness of drone use in controlling pests is relatively high, utilization is relatively low. This study shows that awareness is not enough to promote the utilization of drone use in controlling pests. This is because effective utilization of



drone use in controlling pests is dependent on a strong institutional framework. TVET institutions play a pivotal role in raising women's agricultural output and food sufficiency. This is because, when hands-on training is complemented with access to mechanization and a strong innovation support system, women's agricultural output is enhanced. This is a clear pointer to the significance of a strong institutional support system in raising women's agricultural output and food sufficiency.

To enhance the role of TVET in women's productivity in agriculture, there is a need to increase practical and 'hands-on' training and invest in state-of-the-art workshops to fabricate cost-effective tools for the women. This can be done through the formulation of frameworks for practical training and sharing of drone usage. There is a need to integrate TVET in national policies for agriculture and food security to promote inclusive and tech-driven growth in Nigeria.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest in relation to the publication of this manuscript. The research was done independently, and it is also acknowledged that the funding received from TETFund did not influence the research in any way. The authors affirm that this research was done with academic integrity.



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