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FACTORS ASSOCIATED WITH ADOPTION OF SUSTAINABLE CASSAVA WEED MANAGEMENT TECHNOLOGY FOR CASSAVA SYSTEMS IN NIGERIA

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Abstract

The study was conducted to investigate the factors associated with adoption of sustainable cassava weeds management technology for cassava systems (SCWMTCS) in Nigeria. A total of 384 respondents were selected through a multi-stage sampling procedure for the study using a well-structured interview schedule. Data were analysed with the use of descriptive and inferential statistical tools such as means percentages, and regression analysis. Results revealed that the mean age of respondents was 44.55 ± 10.79. the means of household size, years of formal schooling, years of farming experience, farm size and annual income were 7.3±4.69, 9.74 ± 7.30, 17.71 ± 10.33, 1.89 ± 1.99, N356,013.02 ± N1,099,998.61 respectively. Majority (65.88%) were male and the respondents were of high orientation. Among the factors that contributed to adoption of SCWMTCS included household size (β =2.05, Oyo State; β = 2.51, Abia State), income (β = 3.25, Oyo State;β = 4.14, Abia State), farm size (β = 3.98, Oyo State, β = 4.62, Abia State), frequency of farm visits (β =2.88, Benue State), external orientation (β =2.93, Oyo State, β = 1.70, Abia State) social- cultural related factors (β = 3.30, Benue State) institutional related factors (β = 3.28. Abia State, β = 5.70, Benue State). Overall regression model summary shows that R2 value of (0.276 Oyo State, 0.382 Abia State and 0.512 Benue State) was obtained in the analysis. Also, F value of (3.084 in Oyo State, 5.166 in Abia State and 7.277 in Benue State) obtained was significant at P ≤ 0.01. Thus, R^2 value of (0.276 Oyo State) indicates that significant variables among the selected variables could only explain (27.6 percent Oyo State, 38.2 percent Abia State and 51.2 percent Benue State) of the variation in the level of adoption of SCWMTCS.

Key words**:** *adoption, weed management, cassava systems, sustainability, factors, technology*

INTRODUCTION

For Nigeria to be self-sufficient and food secured, genuine efforts must be made by institutions responsible for the promotion of agricultural innovation and modern technology to encourage and sustain the adoption of appropriate technologies [10]. This is because modern technology in agriculture is a key factor in enhancing productivity, promoting sustainable rural development, and stimulating economic growth, making it a vital component of a thriving agricultural sector. Various technologies have been employed in the agricultural sectors in the past to accelerate economic growth and reduce drudgery associated with farming. These were often designed to solve the prevailing problems of farmers within certain agro-ecosystems and farming systems.

Cassava holds significant value, not only as a staple food source but also as a vital income-generating crop for rural communities. With an impressive annual production of over 34 million tonnes of tubers, Nigeria stands out as the world's leading producer of cassava, underscoring its critical role in the country's agricultural sector.

The determinant items influencing cassava production and farmers' income have been studied by [2, 3, 12] who pointed out that technologies applied, farm size, education level, the behaviour versus the adoption of

new modern technologies are among the main constraining factors.

One of such technologies is the Sustainable Cassava weed Management Technology for Cassava Systems (SCWMTCS) [8]. This technology offers a comprehensive approach to managing weeds in cassava farms, incorporating a range of techniques and good agricultural practices, including the judicious use of agro-chemicals, to minimize the harmful impact of weeds and reduce the laborious task of manual weeding. The development of this technology was a collaborative effort between scientists from the International Institute of Tropical Agriculture (IITA) in Ibadan and partner institutions, including the University of Agriculture in Makurdi, National Root Crops Research Institute (NRCRI) in Umudike, and Federal University of Agriculture in Abeokuta (FUNAAB), as well as regulatory bodies such as NAFDAC, SON, and NESREA, and extension service providers. The project was made possible through funding from the Bill and Melinda Gates Foundation. In the dissemination of the innovation, Participatory Research and Extension (PRE) was employed and this was accomplished by grouping farmers into Farmers Field Schools under the supervision of researchers and extension agents in different communities, local government areas and states to participate fully in evaluating and selecting the best set of weed control strategy in their farming school. The best set of practices selected was packaged into the one technology and named Sustainable Cassava Weed Management Technology for Cassava System (SCWMTCS).

Concerted efforts were made by NGO and government institutions to transfer modern agricultural technologies to farmers over the years but the rate and intensity of adoption has not been very remarkable. To accelerate agricultural development, it is essential to identify and comprehend the key factors influencing the swift adoption of technologies. This research seeks to explore and elucidate these factors, providing valuable insights for future development.

The main objective of the study was to assess the factors associated with adoption of Sustainable Cassava Weed Management technology for Cassava systems (SCWMTCS) in Nigeria. The study intends to investigate the following specific objectives:

(i)described selected personal and social-economic characteristics of the respondents

(ii)examine the factors influencing the adoption of SCWMTCS.

MATERIALS AND METHODS

Study area

The study area was the three main cassava agro-ecosystems in Nigeria. One state was selected in each agro-ecosystem as follows; Abia state located in the forest zone, Benue state located in the Southern guinea savannah and Oyo State located in the forest-savannah transition zone of the country.

Sampling Technique

In choosing respondents, a multistage sampling technique was employed. The initial stage involved purposive selection of three states with each located in the three cassava agro-ecological zones of Nigeria. This was followed by random selection of eight local government areas (LGAs) in each state giving a total of twenty-four LGAs. The next stage involved random selection of four communities from each LGA which gives a total of thirty-two communities. In each of the thirty-two communities, a farmer's field school (FFS) having twenty participating farmers were selected. Finally, in each farmer's field school, twenty percent or four of the participating farmers were selected as respondents and administered with interview schedule. This gives a total of 384 respondents.

Data Collection and Analysis

Using a structured questionnaire, data on famers' age, sex, household size, years of formal schooling, years of farming, farm size, annual income, external orientation were the selected personal and socio-economic characteristics, technological variable, economic variable, social cultural and institutional variable were collected to

determine the extent of their influence on the adoption of SCWMTCS.

Data generated in this study were analysed using descriptive statistics such as simple frequency distribution, percentages, means and standard deviations while inferential statistics were accomplished using multiple linear regression analysis.

Measurement of variables

The independent variables considered in this study included selected personal socio-economic characteristics of respondents such as age, sex, household size, year of formal schooling, year of farming experience, farm size, annual income and external orientation. Also, the dependent variable considered for the study consists of five groups of factors and some selected socio-economic variables identified as variables associated with the adoption of SCWMTCS. This included human capital related factors, technological related factors, economic related factors, community related factors and institutional related factors. Also, age, sex, years of formal schooling, income, farm size, perception-total, years of farming experience, frequency of farm visits and external orientation were also collected.

RESULTS AND DISCUSSIONS

Socio-economic characteristics of respondents

Table 1 reveals that more than half (55.43%) of the respondents in the study area are in their prime productive years, aged between 41 and 60. The mean age of the respondents is 44.55 years, with a standard deviation of 10.79, highlighting a concentration of middle-aged individuals. This implies that most of the respondents were in their active years and as such participated effectively in the Farmers Field School (FFS) that evaluated SCWMTCS in their respective community. According to [6], age is usually considered as one of the major parameters for evaluating the level of biological and intellectual maturity and experience. Older farmers are assumed to have gained knowledge and experience over time and are better able position to evaluate the qualities of new technologies than younger farmers. This could also suggest that older farmers are more risk averse than younger farmers subsequently reluctant to adopt new agricultural technologies [5]. It was also revealed that 65.88% of the respondents were male while 34.12% are female. This might be due to the fact that women are not usually much involved at this stage in the cassava value chain. This might also have to do with culture, women are considered as vulnerable and are not expected to take leadership or unilateral decision or role in accepting or rejecting an innovation. This finding confirms the assertion by [7] which explains that gender variable is associated with embedded norms, behaviour and practices in the society that encourage or discourage the adoption of a particular technology by members of the society. Table 1 shows that the average household size is 7.3, with a standard deviation of 4.69, suggesting a moderate size, which is often associated with adequate labour availability. The mean number of years of formal schooling is 9.74, with a standard deviation of 7.30, indicating a moderate level of educational attainment in the household. The result also shows that respondents in the study area were moderately educated with 64.30% having more than primary education. Farmers' education has been assumed to have a positive influence on farmers' decision to adopt new technologies [6], [11]. This is because education increases their ability to obtain, process and utilize information relevant to the adoption of new technology [1]. The results indicate that the respondents in the study area have a substantial amount of farming experience, with an average of 17.71 years and a standard deviation of 10.33 years. This level of experience suggests that they are well-equipped to evaluate the effectiveness of SCWMTCS and make sound decisions. Furthermore, the average farm size in the area is 2.15 hectares, with a standard deviation of 2.26 hectares. By [4] classification, most of the farmers in the study area falls within medium scale classification.

Table 1. Distribution of respondents by socio-economic characteristic (n=384)

Variables	**Freq.**	**%**
Age (Years)		
21-40	143	37.24
41-60	214	55.73
61+	27	7.03
Mean±SD 44.55±10.70		
Sex		
Male	252	65.88
Female	131	34.12
Household size		
0-6	198	51.5
7-12	175	45.60
12 and above	11	2.90
Mean± SD=7.30±4.69		
Years of formal schooling		
1-6	137	36.68
7-12	113	29.43
13+	134	34.90
Mean±SD=9.74±7.30		
Years of farming experience		
1-10	121	31.51
11-20	238	61.98
21+	25	6.51
$\bar{x} \mp SD$ Mean= 17.71	384	100.0
Farm size 2019/2020		
0-5	376	97.92
6-10	5	1.30
11+	3	0.78
Total X±SD	384	100.0
Farm size 2020/2021		
0.5	376	97.92
6-10	5	1.30
11+	3	0.78
Total X±SD	2.15	±2.26
Annual income 2018/2019		
<360,000	349	90.89
360,001-764,000	34	8.85
>760,000	1	.0.26
Total	384	108.0
Annual income 2020/2021	Total (n=384) X = 356,013.02 SD = ±1,019,998.61 Freq %	
<360,000	371	96.62
361,000-760,000	11	2.86
>760,000	2	0.52
Social status in comm dev association		
Comm. Dev. Org.	228	59.37
Cultural Org.	93	24.12
Descendant Org.	46	11.98
Political Org.	212	55.21

Source: Field Survey, 2021.

The implication of farm size on adoption is that it can enable farmers to test or evaluate the benefits of technology because farmer can devote part of their farm to test the technology. The study area's mean annual income from cassava farming using SCWMTCS showed a significant increase over the three-year period. In 2018/2019, the mean annual income was N148,973.96, followed by a slight increase to N149,360.68 in 2019/2020. However, in 2020/2021, the mean annual income more than doubled to N356,013.02, indicating a substantial rise in earnings from cassava farming in the study area.

This implies that SCWMTCS impacted positively on cassava farming in the study area.

[9] posited that income determines access to inputs required for adoption of new technology.

Access to credit or more income suggests that respondents could be motivated to adopt SCWMTCS as a result of increase in their annual income. The respondents participated in multiple social organizations and served at various capacities. The respondents that participated in political organization, community development organization, cultural organization and descendant organization were 55.21%, 59.37%, 24.12% and 11.98% respectively implying that the respondents in the study area possess a moderate level of social standing and engage in various forms of community involvement. As suggested by [6], participation in community-based organizations can have either a positive or negative impact on the adoption of new technologies, highlighting the complex relationship between social engagement and technological uptake.

The results also revealed that the respondents have high external orientation in the past one year in the study area. Majority (85.40%) of the respondents have travelled to other communities in the last one year. Also, majority (76.82%) have travelled to other LGAs in the last one year, about 21.61% have travelled to other regions in the last one year while 4.17% have travelled out of the country in the last one year. This indication of high orientation of the respondents suggests access to cheap information source among the

respondents. The extent to which farmers interact and learn from each other and the influence of social network play a vital role in accepting and disseminating new agricultural technology to a large population. The main source of information for farmers are other farmers because information is easily available and it is not too costly to utilized it [13].

Factors influencing adoption of SCWMTCS

The results in Table 2 shows that household size ($\beta = 2.05$; $p < 0.05$ in Oyo state and $\beta = 2.51$; $p < 0.01$ in Abia state), income ($\beta = 3.25$; $p < 0.00$ in Oyo state and $\beta = 4.14$; $p < 0.00$ in Abia state), farm size ($\beta = 3.98$; $p< 0.01$ in Oyo state and $\beta = 4.62$; $p< 0.01$ in Abia state), frequency of farm visits ($\beta = 2.88$; $p < 0.01$ in Benue state), external orientation ($\beta = 2.93$; $p< 0.00$ in Oyo state $\beta = 1.70$; $p < 0.10$ in Abia state), social-cultural related variable ($\beta = 3.30$; $p< 0.00$ in Benue state), institutional related factor ($\beta = 3.28$; $p< 0.00$ in Abia state and $\beta = 5.70$; $p < 0.00$ in Benue state), were positive and significantly contributed to adoption of SCWMTCS in the study area at $p< 0.01$. The analysis reveals that in Oyo state, a one-person increase in household size is associated with a 0.22 increase in the likelihood of adopting SCWMTCS, while in Abia state, the same increase in household size is linked to a 0.24 rise in adoption likelihood. Furthermore, a one-unit increase in income is tied to a 0.33 increase in adoption likelihood in Oyo state, and a 0.40 increase in Abia state, indicating a positive relationship between income and SCWMTCS adoption in both regions.

Table 2. Factors influencing adoption of SCWMTCS
Regression analysis between variables and adoption of SCWMTCS in Nigeria

Variable	Regression Coefficient (b)	β-Value	ABIA P-Value	Regression Coefficient (b)	β-Value	P-Value	Regression Coefficient (b)	β-Value	P-Value
Age	0.24	0.161	0.872	0.029	0.193	0.847	-0.048	-0.281	0.780
Household Size	0.223	2.047	0.043*	0.235	2.508	0.014*	0.024	0.200	0.842
Years of Residence	0.029	-0.319	0.750	0.043	0.468	0.641	0.067	0.696	0.488
Sex	0.102	1.139	0.257	0.103	1.018	0.311	0.052	0.680	0.498
Years of formal schooling	-0.083	-0.937	0.351	-0.087	-1.007	0.316	-0.015	-0.170	0.866
Income	0.332	3.248	0.002**	0.403	4.137	0.000**	-0.015	-0.166	0.869
Farm size	0.269	3.978	0.011*	0.298	4.624	0.011*	0.161	1.363	0.176
Perception total	-0.176	-1.996	0.048	-0.073	-0.804	0.423	0.041	0.577	0.565
Years of farming experience	-0.027	-0.188	0.851	-0.027	-0.188	0.851	0.031	0.224	0.823
Frequency of farm visit	-0.118	-1.045	0.298	-0.118	-1.045	0.298	0.221	2.882	0.005**
Social status	-0.168	-1.454	0.149	-0.168	-1.454	0.149	-0.026	-0.288	0.774
External Orientation	0.304	2.933	0.004**	0.199	1.701	0.092*	0.005	0.047	0.963
Human Capital related	-0.120	-1.190	0.237	-0.120	-1.190	0.237	-0.036	-0.387	0.699
Technological related	-0.019	-0.200	0.842	-0.019	-0.200	0.842	-0.008	-0.093	0.926
Economic related	0.045	0.376	0.708	0.045	0.376	0.708	0.129	1.447	0.150
Social culture related	0.170	1.498	0.137	0.170	1.498	0.137	0.337	3.304	0.001**
Institutional related	0.162	1.262	0.210	0.291	3.283	0.001**	0.465	5.694	0.000**

** Significant at ≤ 0.01; * Significant at $p \leq 0.05$
Model summary: F = Oyo State = 3.084; Abia State = 5.166; Benue State = 7.277, sig = 0.000
R^2 = Oyo State = 0.382; Abia State = 0.382; Benue State = 0.572
R = Oyo State = 0.525; Abia State = 0.618; Benue State = 0.716
Source: Field Survey, 2021.

Moreover, the regression coefficient (b) for farm size also reveals that for a unit increase in farm size, there will be a 0.27 unit increase in adoption of SCWMTCS in Oyo state, while for Abia state a unit increase in farm size will lead to a 0.30 in adoption of SCWMTCS. The regression coefficient (b) for perception total reveals that a unit increase in perception total will lead to a 0.18 increase in adoption of SCWMTCS in Oyo state. The regression coefficient (b) also for frequency of farm visits reveals that for a unit increase in frequency of farm visits there will be a 0.22 increase in adoption of SCWMTCS in Benue state. The regression coefficient (b) for external orientation reveals that a unit increase in external orientation will lead to a 0.30 increase in adoption SCWMTCS in Oyo state, while for Abia state, a unit increase in external orientation will lead to a 0.20 increase in adoption of SCWMTCS. The regression coefficient (b) for social- cultural related factor reveals that a unit increase in social-cultural related factor will lead to a 0.34 increase in adoption of SCWMTCS in Benue state. The regression coefficient (b) for institutional- related factor also reveals that a unit increase in institutional-related factor will lead to a 0.29 increase in adoption of SCWMTCS in Abia state, while for Benue state, a unit increase in institutional-related factor will lead to a 0.47 increase in adoption of SCWMTCS.

The implications of the significant relationship between adoption of the SCWMTCS and selected factor such as household size, income, farm size, frequency of farm visits, external orientation, social-cultural related factor and institutional-related factor that household size could suggest availability of labour or heavy toll on spending and unavailability of funds to purchase necessary inputs for adoption, income determines access to farm inputs required for adoption, farm size could enable farmers to test or evaluate benefits of technology, hence decision to adopt, frequency of farm visits allow effective performance of the various practices contained in the technology package, external orientation could determine access of farmers to information on technology, social-cultural related factor could suggests the strength of community decision-making standards and institutional-related factors may suggests farmers access to infrastructures, loans, extension services and participation in technology testing.

The study finds that institutional-related factors, including access to funding, markets, and infrastructure, have the greatest influence (b = 0.465 in Benue state) on the adoption of SCWMTCS, while frequency of farm visits has the smallest impact (0.221 in Benue state). Institutional factors are the key predictors of SCWMTCS adoption, and frequency of farm visits has no significant predictive power. This indicates that the higher the level of institutional support, the greater the likelihood of adopting SCWMTCS, emphasizing the importance of a supportive institutional environment for technology adoption. Hence, the higher the level of institutional-related factor consisting of access to funds from financial institutions, all-season markets, public and private infrastructures, land preparation and processing equipment, road transportation, the higher the level of adoption of SCWMTCS in the study area.

Overall regression model summary show that R^2 value of (0.276 Oyo state, 0.382 Abia state and 0.512 Benue state) was obtained in the analysis. Also, F value of (3.084 Oyo state, 5.166 Abia state and 7.277 Benue state) obtained was significant at $p \leq 0.01$. Thus, R^2 of (0.276 Oyo state) indicates that significant variables among the selected variables could only explain (27.6 percent Oyo state, 38.2 percent Abia state and 51.2 percent Benue state) of the variation in the level of adoption of SCWMTCS in the study area.

CONCLUSIONS

The study concluded that the factors that determines adoption of SCWMTCS were household size, income, farm size, frequency of farm visits, external orientation, social-cultural factors and institutional factors. The study recommended that farmers need institutional provisions and empowerments such as farm inputs, and extension services to

enable them to adopt SCWMTCS and other appropriate technologies for maximum returns.

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