Determinants of Farmers' Adoption of Sasakawa Global 2000 Cassava-Maize Intercrop Technologies in Abia State, Nigeria
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Abstract

This study assessed adoption of cassava-maize intercrop technologies of the Sasakawa Global 2000 African Agronomy Initiative among farmers in Abia State, Nigeria. Multistage sampling procedure was used to select sixty (60) cassava farmers for the study. Data were collected with a structured questionnaire and analyzed using percentage and multiple and Pearson product moment correlation analyses). Mean farm size of the farmers was 1.3 hectares, fortnight contact with extension services (68.3%) and mean annual farm income of ₦291,774.00. Farm visits (100%) were majorly used in disseminating these technologies to farmers. Farmers had favourable perception ($\bar{x} = 3.0$) to Sasakawa cassava-maize intercrop technologies. Multiple regression result showed that household size (β=3.593), education (β=2.8324), farming experience (β=2.8260), farm income (β=2.6243), farm size (β=-2.7001) and extension contact (β=2.8227) influenced farmers' adoption of Sasakawa cassava-maize intercrop technologies in the study area. There is need to

promote human capacity and technical assistance to extension agents for effective dissemination and adoption of these technologies by farmers in the study area.

Keywords: *Sasakawa cassava-maize intercrop, adoption and cassava-maize intercrop*

Introduction
Cassava/maize intercropping seemed to be the most popular and productive bio-specific mixture grown in tropical Africa especially Nigeria, as it could be intercropped without affecting the cassava yield with early maturing maize under optimum soil nutrients, particularly nitrogen which can maintain high mixture productivity (National Root Crops Research Institute (NRCRI) (2019). Due to the past failures of agricultural extension in Nigeria, there have been introduction of different extension approaches and models with many institutional and donor agencies in extension delivery. These institutions have varied backgrounds, qualifications, trainings, field experiences and subject matter specializations engaged in effective dissemination of extension services to their clientele (Montoeli, 2022).

In order to complement the efforts of extension delivery and technology transfer in Nigeria, the African Cassava Agronomy Initiative (ACAI) programme has helped African smallholder farmers in Nigeria to improve their livelihoods through better farming practices (Faleke, Nabueze and Buhari, 2021). It is used for demonstrating better methods of production of cassava-maize intercrop on the farmers' plot of 0.25 – 0.50 ha in which the farmer is trained to implement the technological package. The programme became operational in Abia State in May, 2017 and operates in four (4) local government areas of the State namely; Umuahia North, Isiala Ngwa North, Isuikwuato and Arochukwu with one extension agent (EA) covering each local government area (Agricultural Development Programme (ADP) (2017).

Generally, the main focus of the project was to test and promote higher-yielding technology for maize, wheat, rice, grain legumes, roots and tubers production. The new technologies promoted by Sasakawa Global (SG) 2000 programmes were developed by African National Research Organization in collaboration with the International Agricultural Research Centers. SG 2000's role has been a catalytic one, working primarily with national ministries of agriculture to mount dynamic field demonstration programs so that farmers can evaluate for themselves the value of these improved technologies (Sasakawa Africa Association, 2021).
The improved agronomic practices (appropriate planting date, good quality improved seed, proper row-to-row and plant-to-plant spacing resulting in a correct plant population per unit area, appropriate seed planting depth, timely application and method of fertilizer application at the correct rate) applied in the management training plots (MTPs) stem from experimental findings from the National Agricultural Extension Research and Liaison Services (NAERLS) (Sassakawa Africa Association (SAA) 2020). Studies of Oladele, (2021), Toungo (2018), showed that Sasakawa Global 2000 promoted technologies are carried out mainly for maize especially in the

Northern part of the country but in the South, the project is carried out by few users that inter-crop cassava with maize as their adoption scenarios are yet to be ascertained in the study area. In order to fill the research gap, this study assessed the adoption of *Sasakawa* cassava-maize intercrop technologies among small holder maize farmers in Abia State, Nigeria. It specifically,

   i.   examined methods adopted by extension agents in transferring the project technologies;
  ii.   assessed farmers' perception of Sasakawa cassava-maize intercrop technologies; and
 iii.   ascertained level of adoption of Sasakawa cassava-maize intercrop technologies among farmers

Hypotheses of the study

The following hypotheses were tested in the study:
H_o1: There is no significant relationship between socio-economic characteristics of respondents and their adoption of cassava-maize intercrop technologies of Sasakawa Global 2000 African Agronomy Initiative technologies
H_o2: There is no significant relationship between the respondents' perception and adoption of Sasakawa cassava-maize intercrop technologies in the study area.

Methodology

The study was conducted in Abia State. The State lies between Longitudes $7^023'$ and $8^02'$ east of the Equator and Latitudes $4^047'$ and $6^012'$ North of the Greenwich Meridian. It occupies a land mass of $5,833.11km^2$ (Abia State Planning Commission (ABSPC), 2018). The projected population growth of Abia State at 2.6% from 2006 population figure is 10,3157 people (National Population Commission (NPC), 2020). Multistage sampling procedure was employed. First, three (3) out of four (4) local government areas (LGAs) that participated in the programme were randomly selected for the study namely; Umuahia North, Isiala Ngwa North and Isuikwuato.

The lists of cooperators co–operators from these selected participating local government areas (LGAs) were obtained from the Abia State Agricultural Programme (ADP) Umuahia. From the selected local government areas (LGAs), two (2) out of four (4) cooperative societies were randomly selected to give a total of six (6) cooperative societies. Furthermore, ten (10) co-operators (farmers) each were randomly selected from the selected cooperative societies to give a sample size of 60 co-operators (farmers). Percentages and mean scores were adopted to realize the objectives, while hypothesis 1 and 2 were tested using multiple regression and Pearson product moment correlation analyses respectively.

Measurement of variables

Perception of respondents about cassava-maize intercrop technologies of Sasakawa Global 2000 African Agronomy Initiative was measured and rated on a 4-point Likert-type rating scale of; strongly agree=4, agree= 4, disagree= 2, strongly disagree = 1.

Based on the ten (10) perception item statements, respondents mean scores were computed for each perception statement by adding the weights of 4+3+2+1 = 10/4=2.5. Mean scores greater than 2.5 implied favourable perception and below 2.5, unfavourable perception of technologies.

To ascertain the levels of adoption of cassava-maize intercrop of Sasakawa Global 2000 African Agronomy Initiative practices among farmers, eight (8) technologies were listed out and each respondent was asked to indicate the stage he/she was on, in the adoption scale. The 5 – steps; aware (1), interest (2), evaluation (3), trial (4) and adoption (5) were used. A midpoint was obtained by adding up the adoption stages to derive the total adoption score and dividing it by number of adoption stages. In order to identify the different stages of adoption of these technologies by farmers, the categorization followed in accordance with Nwaobiala (2018); 1.0 – 1.49 = Awareness stage; 1.50 – 1.99 = Interest stage; 2.0 – 2.49 = Evaluation stage; 2.50 – 2.99 = Trial stage; 3.0 and above = Adoption stage of the technology.

Model Specification

Hypothesis 1 was tested with the four functional forms of regression model viz: linear, semi-log, exponential and Cobb-Douglas were tried.

The four functional forms are expressed as follows:
i.   **Linear Function**
    $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + X_{12} + e_i \ldots\ldots\ldots (1)$$
ii.   **Semi – log function**
    $$Y = L_n\beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + \beta_{11} L_n X_{11} + X_{12} + e_i \ldots\ldots\ldots (2)$$
iii.   **Exponential function**
    $$LnY = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + X_{12} + e_i \ldots\ldots\ldots.. (3)$$
iv.   **Cobb Douglas Function**
    $$LnY = L_n\beta_0 + \beta_1 L_n X_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + \beta_6 L_n X_6 + \beta_7 L_n X_7 + \beta_8 L_n X_8 + \beta_9 L_n X_9 + \beta_{10} L_n X_{10} + \beta_{11} L_n X_{11} + X_{12} + e_i \ldots\ldots\ldots (4)$$
Where;

Y = levels of adoption of cassava-maize intercrop technologies of Sasakawa Global 2000 African Agronomy Initiative (measured by number of mean adoption scores of the respondents)

X_1 = gender (male – 1, female=0)
X_2 = age of respondents (years)
X_3 = marital status (married =1, otherwise = 0)
X_4 = household size (number of people in household)
X_5 = education level (years spent in school)
X_6 = farming experience (years)
X_7 = farm size (hectares)
X_8 = occupational status (farming= 1, otherwise = 0)

X_9 = farm income (₦)
X_{10} = non - farm income (₦)
X_{11} = membership of social organizations (numbers)
X_{12} = extension contact (numbers)
e_i = error term

Results and Discussion

Selected Socio-Economic Characteristics

Table 1 shows that mean farm size of the farmers was 1.3 hectares. This result is in consonance with the findings of Olarinde, Ogunniyi, Adio, Fanifosi & Akanbi, (2020), that FADAMA farmers had similar farm sizes in south-western Nigeria. In addition, farmers had fortnightly extension visit (68.3%). This result is in consonance with the findings of Abdulmumini, Norsida, Nur, & Nitty, (2022) that increase in extension visits will lead to increase in adoption of cassava agronomic practices.

Table 1: Selected socio-economic characteristics of farmers

Variables	Indices	Standard deviation
Farm size (hectares)	1.3	± 0.72
Extension visits (fortnightly) (%)	68.3	± 59.7

Source: *Field Survey, 2021*

Farmers' Perception of Cassava–Maize Intercrop of Sassakawa Global 2000 African Agronomy Initiative Technologies

Data in Figure 2 show that the farmers had favourable perception of cassava-maize intercrop technologies of the project ($\bar{x} = 3.0$). Farmers' perception of agricultural programme enhances farmers' ability to participate and adopt promoted production technologies disseminated by rural development extension agents (Ikuerowo & Tehinloju, 2021).
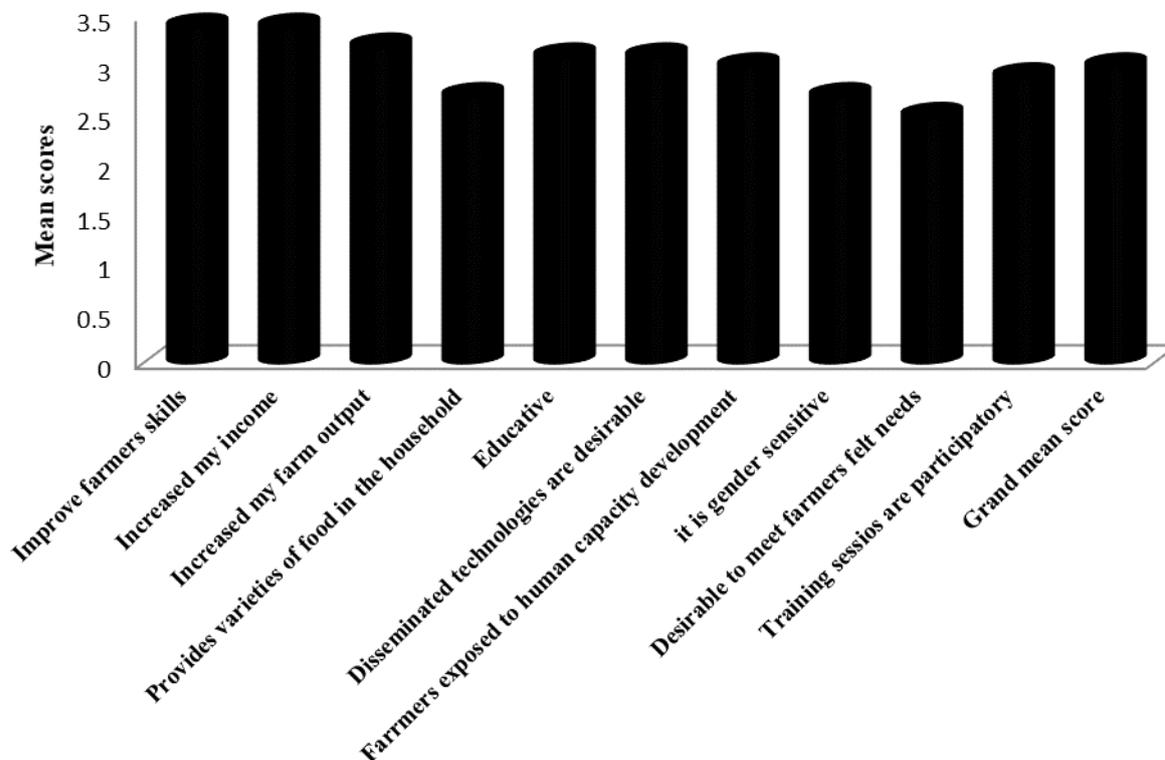
Figure 2: Farmers' perception of cassava–maize intercrop of Sassakawa technologies

Levels of Farmers' Adoption of Sasakawa Cassava-Maize Technologies

Result in Figure 3 shows that the farmers had high adoption ($\bar{x} = 4.2$) of all the project technologies in the study area. This result is in tandem with the findings of Ikuerowo & Tehinloju, (2021), Nwaobala, (2018) as they affirmed that adoption of innovation disseminated to farmers through agricultural promoted programmes had shown to improve the farming practices of farmer which is geared towards improving their livelihoods and ensuring food security.
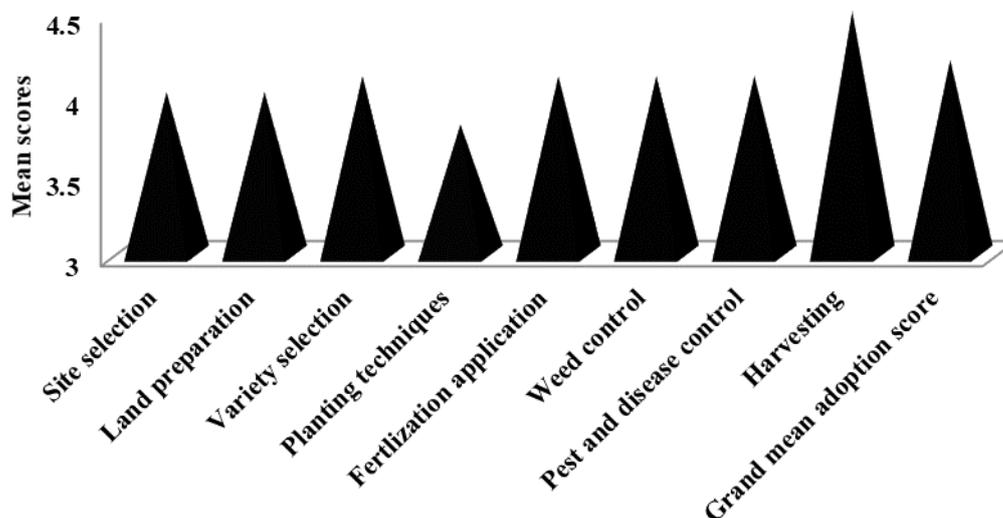
Figure 3: Farmers' level of adoption of sasakawa cassava-maize technologies

Relationship between Socioeconomic Characteristics and Adoption of Sasakawa Cassava-Maize Intercrop Technologies

Results in Table 2 show the semi-log form was chosen as the lead equation based on a high R^2 value. The F-value was significant at 1.0% level indicating a regression of best fit. The R^2 value of 0.5635 shows that 56.35% of the variability in level of adoption was explained by the independent variables.

The result shows that a coefficient of household size (β=3.593) was positive and significant. This implies that a unit increase in the number of household size will lead to increase in adoption of cassava-maize intercrop technology. This is expected and in accordance with a *priori* expectations. Similar results were reported by Omotesho, Adesiji, Akanbi, Awoyemi & Ekwemuka, (2019) as household size explains the need to feed more people compels farmers to adopt options that guarantees high productivity

The coefficient of education (β=2.8324) and farming experience (β=2.8260) were positive. These implies that a unit increase in these variables will lead to an increase in the adoption of Sasakawa cassava-maize inter crop in the study area. Educational levels increase the ability to obtain process and use information relevant to the adoption of a new technology (Ali, Awuni & Danso-Abbeam, (2018). The result corroborates with that of Olorunfemi, (2018) that education is a helpful tool for farmers in analyzing choices and making decisions about forecasts of the anticipated benefits of adopting technologies. The result of findings on farming experience is in line with the study by Olarinde, Ogunniyi, Adio, Fanifosi & Akanbi, (2020), Ullah, Khan, Zheng & Ali, (2018) as they found that longer farming experience implies

accumulated farming knowledge and technical know-how and skills, all of which contribute to technology adoption.

The coefficient for farm income (β=2.6243) was significant. This implies that an increase in farm income will lead to an increase in adoption. In this case, farmers with higher farm income are more likely to have the necessary funds to finance the initial cost of adopting innovation, for example, sourcing planting materials, such as stem cuttings, and the labour requirement for planting and maintaining subsequent farm operations. In a study by Declaro-Ruedas, (2019), farm income was found to be positively and significantly related to adoption.

The coefficient for farm size (β=-2.7001) was negatively related and significant with level of adoption of Sasakawa cassava-maize intercrop. This implies that a unit increase in farm size will lead to a decrease in adoption. Invariably, this indicates that farmers with small farm holdings were more likely to adopt the cassava-maize intercrop in the programmes than their counterparts with large farm holdings. In support of the study, Shehu, Kdafur, & Idris, (2020) demonstrated that small land area provides dual-purpose cultivation (such as cassava and maize intercropping) possibly to meet up with other needs. Bala, Abdulkarim, Yahaya, & Yahaya, (2020) also observed that with small farms, there is possibility of large fixed costs which become a constraint to technology adoption especially if the technology is costly.

Table 2 reveals that coefficient for extension contact (β=2.8227) was positive and significantly related to farmers to adopt Sasakawa cassava- maize technology. This implies that respondents with high numbers of extension contact have greater chance of adopting the technology. Extension agents are expected to provide farmers with useful information on production technologies, efficient input combinations and market information, all aimed at enhancing farm productivity and incomes (Kathuri, Ndirangu & Gichimu, 2021; Olorunfemi, Olorunfemi, & Oladele, (2020). The result is consistent with the findings of Bala, Abdulkarim, Yahaya & Yahaya, (2020) that extension contact influences adoption of technology.

Table 2: Determinants of adoption of Sasakawa cassava-maize intercrop among farmers

Variables	Linear	Exponential	Double Log	Semi-Log+
Constant	31.1034	3.4119	3.1654	24.4781
	(5.37)***	(15.43)***	(10.61)***	(3.13)**
Gender	0.2682	0.0165	0.0173	0.2887
	(0.19)	(0.30)	(.032)	(0.21)
Age	0.0007	0.00003	0.0302	0.8483
	(0.49)	(0.46)	(0.66)	(0.70)
Marital status	0.4332	0.0111	0.0150	0.5321
	(0.21)	(0.41)	(0.19)	(0.26)
Household size	0.5673	0.0213	0.1457	3.8503
	(1.43)	(2.10)*	(3.22)**	(3.73)***
Education	0.2259	0.0079	0.0081	2.8324
	(1.10)	(1.00)	(1.07)	(2.71)**
Farming experience	0.2428	0.0094	0.0088	2.8260
	(2.53)**	(2.90)**	(1.53)	(2.76)**
Farm size	-0.6986	-0.0221	-0.0155	-2.7001
	(-0.52)	(-0.43)	(-0.31)	(-2.65)**
Occupation	-2.338	-0.1070	-0.1071	-0.1418
	(-2.27)*	(-1.72)*	(-1.81)*	(-0.52)
Farm income	-0.6986	5.27e-07	-5.02e-07	2.6243
	(-0.52)	(1.79)*	(-1.80)*	(2.50)**
Non-farm income	0.00002	-4.51e-07	5.51e-07	0.5221
	(2.08)*	(-1.46)	(2.03)*	(0.40)
Years of cooperative membership	0.0252	-0.00007	0.00009	0.0310
	(0.13)	(-0.01)	(0.01)	(0.16)
Extension contacts	0.2306	0.0010	3.46e-07	2.8227
	(0.17)	(0.19)	(0.11)	(2.69)**
F- Ratio	3.05**	3.82**	4.17***	5.44***
R^2	0.3987	0.4223	0.4872	0.5635
Adjusted R^2	0.3287	0.3855	0.4120	0.4146

Source: *STATA 13 Results 2021*

***p≤ 0.01, ** p≤ 0.05 and ** p≤ 0.10   + = lead equation

Perception and Adoption of Sasakawa Cassava-Maize Intercrop Technologies

Data on Table 3 show that there is a positive (r = 0.3819) correlation between adoption and perception of Sasakawa cassava-maize intercrop technologies among farmers. This implies that there is a strong relationship between Sasakawa cassava-maize intercrop technologies. It further implies that increase in perception will lead to an increase in Sasakawa cassava-maize intercrop technologies by approximately 38% and vice versa.

Table 3: Correlation of perception and adoption of Sasakawa cassava-maize intercrop technologies among farmers

Variables	Coefficient (r)	t-value	*p*-value
Perception	1.000		
Adoption	0.3819	(0.0005)**	1.000

Source: *STATA 13 Results.*

Conclusion and Recommendations

Farm visit by extension agents was mostly used in disseminating Sasakawa cassava-intercrop technologies to farmers. The respondents had favourable perception and adoption of these technologies. Household size, farming experience education, farm income, farm size and extension contact influenced farmers in adopting Sasakawa cassava-maize intercrop technologies. There is need to promote human capital formation through trainings in order to enhance adoption of cassava-maize intercrop technologies by farmers.

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