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Farmers' Adoption of Cassava Agronomic Practices and Intercrop Technologies in Abia and Imo States, Nigeria

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Abstract

The study analysed farmers' adoption of cassava agronomic practices and intercrop technologies in Abia and Imo States, Nigeria. Purposive and multi-stage random sampling techniques were used to select two hundred and forty (240) cassava farmers (120 each for Abia and Imo states). Data were collected with a structured questionnaire and analysed using percentage, Probit regression and Z–test analysis. Results revealed that farmers sourced information on cassava production technologies mostly from radio programmes (91%) and 90% respectively in Imo and Abia, extension agents (80%) across the states and fellow cassava farmers (79.1%) in Abia and (77%) in Imo. Results also showed that Abia farmers had adoption index of 86% and 80% (Imo farmers) of cassava agronomic practices with mean adoption scores of 4.3 and 4.0 respectively. Gender (-0.0653), age (0.0581), education (0.3904) and extension contact (0.0652) influenced farmers' adoption of cassava agronomic practices in Abia state, while gender (-0.0525), age (0.0421), household size (0.7211), education (0.2799), farm size (0.6099) and extension contact (0.0597) influenced farmers in Imo state. The result showed no significant difference between group of farmers' adoption of cassava agronomic practices (0.54) and intercrop technologies (0.14) in Abia and Imo States. Awareness on cassava intercrop technologies to farmers should be intensified in order to facilitate increased adoption.

Keywords: *Technologies, adoption, cassava, agronomic practices, intercrop, technologies*

Introduction

Cassava production in Nigeria has been increasing at the rate of 5 per cent every year (National Root Crops Research Institute, 2012). The trend according International Fund for Agricultural Development (2014) and African Farming (2013) has increased from 38 million metric tons in 2014 to 51million metric tons in the 2017. The cassava transformation programme in Nigeria cannot achieve its objectives without adoption of recommended production technologies by farmers. This programme targets to achieve food security and poverty reduction through enhanced adoption and utilization of

agricultural knowledge and information (Federal Ministry of Agriculture & Rural Development, 2012; Food and Agricultural Organisation, 2007).

Intercropping is the practice of growing more than two crops on the same piece of land such that the period of overlapping is long enough to include the vegetative stage. In Nigeria, as in many other countries, mixed cropping often involves the intercropping of root and tuber crops with legume or cereal. The root or tuber crops being the main crop while, legumes and cereals are regarded as a component crop (Odion, Asiribo, Singh, Ogunleha and Tarawali, 2007).

The National Root Crops Research Institute Umudike and International Institute for Tropical Agriculture Ibadan have developed and disseminated through the ADPs many cassava agronomic and intercrop technologies for farmers to effectively adopt and utilize in their farms and maximize profit. These technologies include cassava/maize *egusi*, cassava/maize/*teleferia*, yam/cassava/maize single alternate row and yam/cassava/maize double alternate row which was developed in the 80's by National Root Crops Research Institute and International Institute for Tropical Agriculture Ibadan to maximize and utilize lands meant for arable crop farming (Agricultural Development Programme, 2000; International Institute for Tropical Agriculture, 2011; National Root Crops Research Institute, 2006). The agricultural scientists in these research institutes as well as the universities proved that their improved crop varieties outyields local varieties and their new methods of farming is far better than the traditional methods of farming (Nwachukwu, 2014). Little or no efforts have been made by the researchers to investigate how these innovations are compatible with the farmer's social and economic environment. Akudugu, Guo and Dedzie, (2012) recommended the incorporation of social, cultural and economic factors into evaluations of agricultural innovations and thus, results should be taken into consideration before they are recommended to farmers for adoption and utilization.

The Research institutes and Agricultural Development Programmes (ADP's) that has the mandate to effectively transfer cassava improved technologies to farmers seems not to have yielded commensurable result especially in the study area (Onyemauwa, 2010). Thus, the institutions focus more on agronomic practices such as site selection, spacing, planting dates, rates of fertilizer and herbicide application, disease control among others, with little or no attention to the adoption of intercrop technologies. In view of the foregoing, this study was designed to analyse farmers' adoption of cassava agronomic practices and intercrop technologies in Abia and Imo States, Nigeria. Specifically the study described selected socio-economic characteristics of farmers, examined sources of agricultural information of the respondents, ascertained levels of adoption of cassava agronomic practices and intercrop technologies by farmers in the study area.

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Hypotheses

The following hypotheses were tested;

Ho_1: There is no significant relationship between socio-economic characteristics of farmer's and their adoption of cassava agronomic practices in Abia state.

Ho_2: There is no significant relationship between socio-economic characteristics of farmer's and their adoption of cassava intercrop combination technologies in Imo state.

Ho_3: Farmers in Abia and Imo states do not differ in adoption of cassava agronomic practices.

Ho_4: Farmers in Abia and Imo states do not differ in adoption of cassava intercrop technologies.

Methodology

The study was carried out in Abia and Imo states. Abia state lies between Longitudes $7^0 23'$ and $8^0 2'$ east of the Equator and Latitudes $4^0 47'$ and $6^0 12'$ N of the Greenwich Meridian. Imo state lies within Latitudes 4^o 45'N and 7^o 15'N, of the equator and Longitude 6^o 50'E and 7^o 25'E of the Greenwich Meridian. The two states are located within the rainforest belt of Nigeria. The major crops produced are cassava, yam, cocoyam, maize and melon. The population for this study comprised of all cassava farmers in the six agricultural zones of the states Abia (Umuahia, Aba and Ohafia) and Imo (Owerri, Orlu and Okigwe). Purposive and multistage random sampling techniques were adopted in the study. First, the three agricultural zones that make up Abia state (Umuahia, Aba and Ohafia) and Imo (Owerri, Orlu and Okigwe) were selected. Furthermore, 2 blocks each were randomly selected in Abia state namely; Isiala Ngwa and Ubakala (Umuahia zone), Aba zone: Osisioma and Ugwunagbo and Isiukwuato and Bende (Ohafia zone) to give a total of 6 blocks out of 21 blocks that make up the three agricultural zone. In Imo state, 2 blocks were randomly selected from Owerri zone (Oforola, and Mbaise); Orlu zone (Ohaji/Egbema and Oguta); Okigwe (Obowo and Ihitte Uboma) to give a total of 6 blocks out of 24 blocks. This gave a grand total of 12 blocks from the study areas. Furthermore, 2 circles each were randomly selected from the selected 6 blocks in Abia to give 12 circles out of 36 circles and 2 circles each from the selected 6 blocks in Imo that gave 12 circles out of 42 circles. This gave a grand total of 24 circles. Purposively, 10 farmers each who are engaged intensively in cassava cultivation were randomly selected from the selected 12 circles in Abia and 12 in Imo state to give a grand sample size of 240 cassava farmers (120 each for Abia and Imo state). Percentage, mean scores, tobit regression and Z - test, were used to analyse the data.

Measurement of variables

To ascertain the levels of adoption, cassava agronomic practices and intercrop 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) adoption model (Madukwe, Ayichi and Okolie, 2000; Agwu,

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Ekwueme and Anyanwu, 2008) 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. The adoption index was obtained by dividing the total mean adoption score by 5 – steps of adoption stages.

Results and Discussion

Selected Socio-Economic Characteristics

Data in Table 1 show that 60% (Abia) and 61.7% (Imo) of the respondents were females. This suggests that female farmers dominated cassava farming in the study area. The result is in consonance with Osondu, Ezeh, Emerole and Anyiro, (2013) that more women were involved in small holder cassava farming in Fadama II and Fadama III in Imo state, Nigeria. The mean ages of the farmers were Abia (43.2 years) and Imo (43.8 years) with mean household sizes of 4 and 5 persons for Abia and Imo farmers respectively. This result implies that farmers are still at their productive age. A considerably large household size typical of rural setting in developing countries like Nigeria could be a useful source of labour for farming activities. This result concurs with Usman, Salihu and Musa (2016) as they affirmed that household size is a human capital available that contribute to family labour. However, result shows that 35.4% (Abia) and 45.7% (Imo) farmers acquired secondary education. This implies that the farmers were literates to accept improved agricultural technologies. Ogunbameru, (2001) noted that education enhances adoption of modern farm technologies, thereby increasing farm output. The result also reveals that mean farm sizes of farmers was 2.4 hectares (Abia) and 2.2 hectares (Imo) with mean farming experience of 20.7 and 22.2 years for Abia and Imo farmers respectively The result suggests that cassava farmers in the study areas were small scale farmers that cultivate less than 3 hectares of land. Small land holdings in the study areas are major constraint to technology adoption (Ezebuiro, Ekumankama and Unamma, 2016). With more experience, a farmer can become less averse to the risk implied by adopting a new technology. Furthermore, Abia farmers realized mean annual income of ₦278, 2575.83 as against their counterpart in Imo with annual income of ₦269, 431.68. The income levels of farmers depend largely on combination and intercrop of crop varieties and farm size (Anyanwu, Agwu and Okoroji, 2016). Again, Abia and Imo farmers had 2.2 and 2.0 monthly contact with extension respectively. Farmers contact with extension enhances their ability to adopt a production recommended technology. This result agrees with Ajala, Ogunjimi and Farinde, (2013) as they obtained a similar result among cassava farmers in Oyo state, Nigeria. However, 55% and 64% of Abia and Imo farmers respectively affirmed they practiced mixed cropping. Mixed cropping has proved to provide different varieties of crops and increased revenue for farmers (Oloche, 2013).

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Table 1: Socio-economic characteristics of respondents

Variables	Abia (n =120)	Imo (n =120)
Gender (%)	60 (females)	61.7(females)
Mean Age (years)	43.2	43.8
Household size (numbers)	4	5
Secondary Education (%)	35.4	45.7
Farm size (hectares)	2.4	2.2
Farming Experience (years)	20.7	22.2
Annual Farm income (₦)	278,275.83	269,431.68
Mean Monthly Extension contact	2.2	2
Mixed cropping (%)	55	64

Source: *Field Survey, 2015*

Sources of information

Results in Figure. 1a and Figure 1b show different sources of agricultural information on cassava production technologies available to the respondents in the study areas. Results indicated that the majority of farmers in Abia (90%) and Imo (91%) of Abia and Imo farmers sourced information on cassava production technologies from radio programmes. Also, 80.0% of farmers in both states received information from extension agents as against 79.1% (in Abia) and 77% (Imo) that sourced from fellow cassava farmers. In Nigeria, the use of mass media especially radio is one of the fastest methods of disseminating information to farmers and encourages adoption of improved agricultural practices (Badiru and Yekinni, 2015; Ebewore and Enoch 2013; Issah and Kagbu, (2017).

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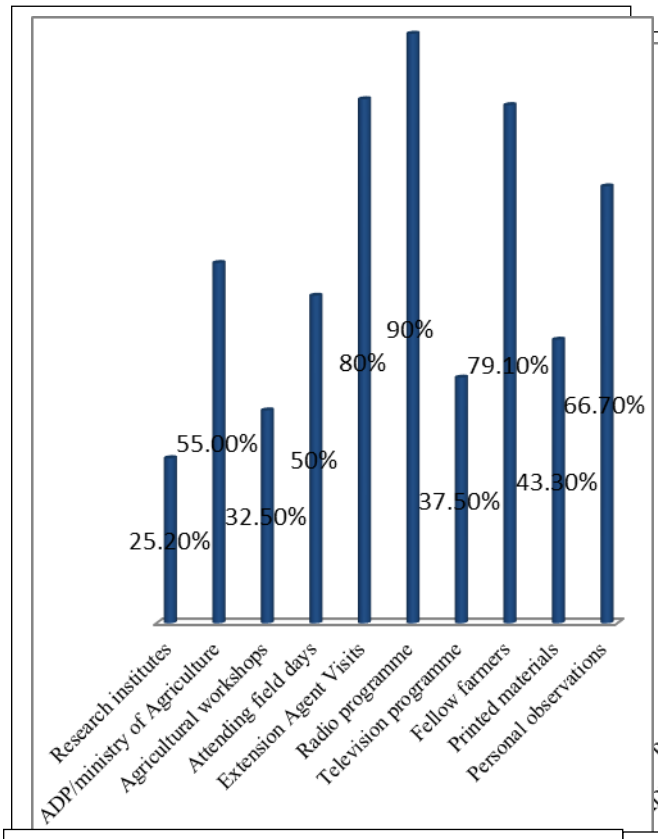

Figure 1a: Sources of agricultural information among farmers in Abia state

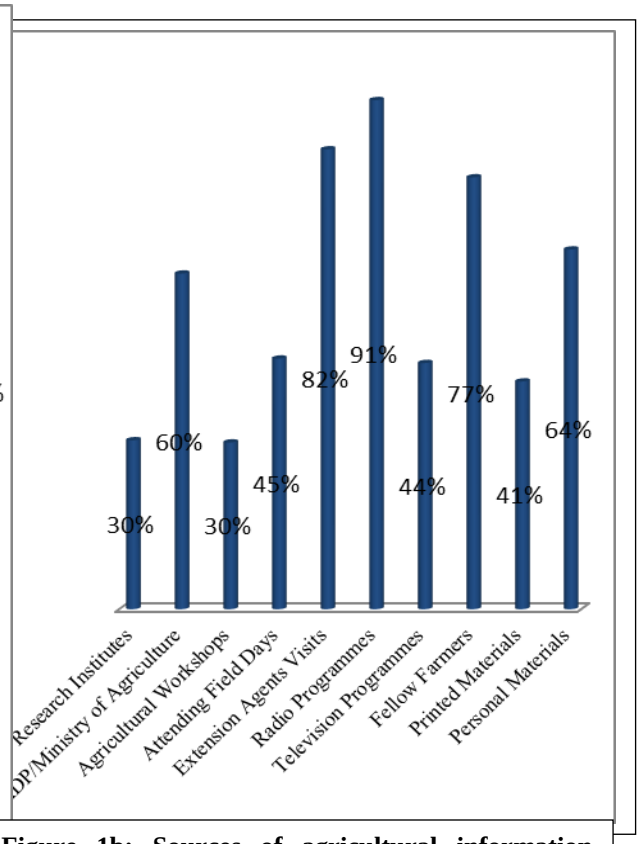

Figure 1b: Sources of agricultural information among farmers in Imo state

Table 2 shows that Abia and Imo farmers adopted improved cassava cuttings with mean scores of 4.7 and 4.1 respectively as against ridge/mound making ($\bar{x}$ =4.6) Abia and Imo state ($\bar{x}$ =4.1). Also, farmers in both states adopted planting dates ($\bar{x}$ =4.5), Abia farmers adopted site selection/land and fertilizer application mean scores of 4.4 and Imo for farmers ($\bar{x}$=4.2) and ($\bar{x}$=4.0). Again, Abia farmers adopted weeding interval ($\bar{x}$=4.3) and Imo ($\bar{X}$= 3.8), while pest and diseases control ($\bar{X}$=4.2) and ($\bar{X}$=3.9) were adopted by Abia and Imo farmers respectively. Time of harvest were also adopted by Imo farmers ($\bar{x}$=4.1) and Abia ($\bar{x}$=4.2) farmers, while they adopted plant spacing ($\bar{x}$=3.9) for Abia and ($\bar{x}$=3.5) for Imo farmers. The mean adoption scores for Abia farmers was 4.3 and Imo farmers ($\bar{x}$=4.0). This suggests an adoption index of 86% for (Abia farmers) and Imo farmers (80%) of cassava agronomic practices. Akudugu, Guo and Dedzie, (2012) posit that adoption provide firm knowledge of technology packages thereby persuading farmers .to try them. The result is in consonance with Agwu, Njom and Umeh, (2017) as cassava farmers obtained a similar result in Enugu state, Nigeria.

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Table 2: Levels of adoption of cassava agronomic practices

Agronomic Practices	Abia Mean	Imo Mean
Site selection	4.4	4.2
Ridge/mound making	4.6	4.0
Use of improved cassava cutting	4.7	4.1
Planting date (April - October)	4.5	4.5
Planting spacing (1mx1m @ angle of 45^0	3.9	3.5
Fertilizer application (NPK 15:15:15 @ 8 – 12 weeks)	4.4	4.0
Pest and disease control	4.2	3.9
Weeding interval	4.3	3.8
Time of harvest	3.9	4.1
Grand mean	4.3	4.0
Adoption index (%)	0.86	0.80

Source: *Field Survey, 2015*

Levels of Adoption of Cassava Intercrop Technologies

Data in Table 3 indicate that Imo and Abia farmers adopted Cassava/maize/*egusi* intercrop with mean scores of 4.3 and 4.2 respectively. Furthermore, Abia farmers adopted cassava/maize/*telferia* ($\bar{x}$=4.2) as against Imo farmers ($\bar{x}$=4.0). However, Abia and Imo farmers adopted yam/cassava/maize single alternate row with mean ratings of 3.0 respectively. The mean adoption scores for Abia farmers was 3.1 and Imo farmers ($\bar{x}$= 3.2). This implied that the technologies were adopted, with an adoption index of 62% (Abia farmers) and Imo farmers (64%) of cassava intercrop technologies. Farmers derive maximum economic benefits from crop combination which in turn lead to increased yields and income (Giroh, Ornan and Nudamatiya, 2013). Multiple cropping is further practiced by arable crop farmers due to the ability of the farmland to accommodate one type of crop or the other per cropping season. This enhances better distribution of labour throughout the farming season, maintenance of organic matter, covering of the soil throughout the year (Osuji, Ukoha, Nwaru and Onyenweaku, 2017).

Table 3: Levels of adoption of cassava intercrop technologies

Intercrop Technologies	Abia Mean	Imo Mean
Cassava/maize/*egusi*	4.3	4.2
Cassava/maize/*telferia*	4.2	4.0
Cassava/maize/sweet potato	2.8	2.7
Yam/Cassava/maize single alternate row	3.0	3.0
Yam/Cassava/maize double alternate row	2.1	2.2
Grand Mean	**3.1**	**3.2**
Adoption Index (%)	**62**	**64**

Source: *Field Survey, 2015*

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Socio-Economic Factors Influencing Farmers' Adoption of Cassava Agronomic Practices in Abia and Imo States

Table 4 shows the Tobit model estimates for determinants of adoption of cassava agronomic practices in Abia and Imo states. The Chi^2 (χ^2) was significant at P≤ 0.1 level of probability in Abia and Imo states with Pseudo R^2 of 50.59% (Abia) and 40.49% (Imo) indicating goodness of fit. The coefficients for gender (- 0.0653) and (- 0.0525) were negative and significant at P≤ 0.5 and P≤ 0.10 levels of probabilities in Abia and Imo states respectively. This implies that female farmers dominated cassava farming in the study area. This result is consistent with Umoh, Nkeme and Ekanem, (2016) that cassava farming is dominated by women farmers in Akwa Ibom state, Nigeria. The coefficient for age (0.0581) and 0.0421 was positive and significant at P≤ 0.1 level of probability in Abia and Imo states respectively. This implies that any increase in age is expected to lead to increase in adoption of cassava agronomic practices in the study areas. This is expected because the older respondents engaged in this technology tend to be willing to bear risk involved in farming. This result corroborates with Ejechi, (2015) that age has direct relationship with adoption of cassava production technologies. The coefficient for household size (0.7211) was positive and highly significant at P≤ 0.1 level of probability in Imo state. This implies that any increase in household size will lead to an increase in adoption of cassava agronomics practices. This in agreement with a *priori expectation* because larger households are more likely to provide the labour that might be required in farm operations. The result is in tandem with Aniedu, (2016) as he found a positive relationship between household size and adoption. The coefficient for education (0.3904) and 0.2799 was positive and significant at P≤ 0.1and P≤ 0.5 levels of probability in Abia and Imo states respectively. Generally, high level of literacy is expected to encourage adoption of improved practices. This result is in consonance with Chukwu (2013) that education facilitates adoption of improved agricultural technologies. The coefficient of farm size (0.6099) was positive and significant at P≤ 0.5 level of probability in Imo state. This implies that increase in farm size will lead to increase in adoption of cassava agronomic practices. The result corroborates with the findings of Adoulaye, Bamire, Adewale and Akinola, (2015) in their studies that farm size is a strong determinant of adoption. The coefficient of farm income (0.0592) was positive and highly significant at P≤ 0.1levels of probability. This implies that increase in farm income will lead to increase in adoption of cassava agronomic practices. Kehinde, (2013) noted that the decision to adopt an innovation has correlation with investment decision. The coefficient for extension contact (0.0632) and 0.0597 were positive and significant at P≤ 0.5 and P≤ 0.10 in Abia and Imo state respectively. This implies that any increase in extension contact will lead to increase in adoption of cassava agronomic practices. Studies have shown positive correlation between adoption of extension recommendations by farmers and crop yields which translate to increased income and improved quality of life of farmers (Nwaobiala, 2017).

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Table 4: Factors influencing farmers' adoption of cassava agronomic practices

Variables	Parameters	Abia State	Imo State
Constant	X_0	43.1627	41.8721
		(11.65)***	(10.73)***
Gender	X_1	- 0.0653	- 0.0525
		(- 2.41**)	(- 2.04*)
Age	X_2	- 0.0584	0.0421
		(- 4.28)***	(3.81***)
Household size	X_3	0.1543	0.7211
		(0.17)	(3.66)***
Education	X_4	0.3904	0.2799
		(3.45)***	(2.64)**
Farm size	X_5	0.02345	0.6099
		(0.02)	(2.42)**
Farming experience	X_6	0.0061	0.0034
		(1.23)	(0.23)
Farm income	X_7	0.0592	0.0032
		(10.12)***	(0.05)
Extension Contact	X_8	0.0632	0.0597
		(2.9)**	(2.3)*
LR Chi^2	χ^2	10.11***	9.84***
Prod Chi^2		0.0095	0.0079
Pseudo R^2		0.5059	0.4798

Source: *Field Survey Data, 2015*
*P≤ 10, ** P≤ 0.5 and ***P ≤ 0.1

Socio-Economic Factors Influencing Farmers' Adoption of Cassava Intercrop Technologies in Abia and Imo States

Table 5 shows the Tobit model estimates for determinants of adoption of cassava intercrop technologies in Abia and Imo states. The Chi^2 (χ^2) was significant at P≤ 0.1 level of probability in Abia and Imo states with Pseudo R^2 of 48.59% (Abia) and 46.80% (Imo). The coefficient for gender (- 0.0534) in Abia and - 0.0785 in (Imo) were negative and significant at P≤ 0.5 level of probability. This implies that female farmers dominated cassava farming in the study area. The coefficient for education (0.0210) and 0.0259 were positive and significant at P≤ 0.5 level of probability in Abia and Imo state respectively. This implies that any increase in education will lead to increase in adoption of cassava intercrop technologies among farmers in the study area. This corroborates the findings of Ganiyu (2015) who posited that education facilities adoption of technology. The coefficient of farming experience in Abia (0.0441) and Imo (0.0438) were positive and significant. This implies that increase in farming experience will lead to increase in adoption of cassava intercrop technologies. With more experience a farmer can become

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more or less averse to the risk implied by adopting a new technology. This result is in agreement with the findings of Ibitoye, Shaibu and Akwu, (2014) that the more farmers remained in any farming activity; the more they are acquainted with risks and uncertainty involved in the business. The coefficient of farm income (0.0572) in Abia and 0.0332 in Imo were positive and significant at P≤ 0.5 and P≤ 0.10 levels of probability respectively. This implies that increase in farm income will lead to increase in adoption of cassava intercrop technologies. This result is in agreement with Nwaobiala and Uchechi, (2016) that farm income influenced adoption of agricultural production technologies. The coefficient for extension contact was positive (0.0297) at P≤ 0.5 (Abia) and 0.0017 at P≤ 0.10 in Imo State. This suggests that any increase in extension contact will lead to increase in adoption of cassava intercrop technologies. The result agrees with that of Ahmadu (2010), that extension contact was related to adoption of agricultural technologies in Nasarawa state, Nigeria.

Table 5: Factors influencing farmers' adoption of cassava intercrop technologies

Variables	Parameters	Abia State	Imo State
Constant	X_0	33.1786	31.2475
		(9.95)***	(8.93)***
Gender	X_1	- 0.0534	- 0.0785
		(- 3.11)***	(- 3.44)***
Age	X_2	0.0186	0.0021
		(0.81)	(0.01)
Household size	X_3	0.0431	0.7211
		(0.14)	(0.41)
Education	X_4	0.0210	0.0259
		(2.75)**	(2.59)**
Farm size	X_5	0.0731	0.0099
		(0.25)	(0.031)
Farming experience	X_6	0.0441	0.0438
		(2.59)**	(2.54)**
Farm income	X_7	0.0572	0.0332
		(2.62)**	(1.85)*
Extension Contact	X_8	0.0297	0.0017
		(2.7)**	(1.73)*
LR Chi^2	χ^2	9.17***	7.95***
Prod Chi^2		0.0079	0.0058
Pseudo R^2		0.4859	0.4680

Source: *Field Survey, 2015*
*P≤ 10, ** P≤ 0.5 and ***P ≤ 0.1

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Difference Between Farmers' Adoption of Cassava Agronomic Practices in Abia and Imo States

Table 6 shows the Z – Test analysis between adoptions of cassava agronomic practices in Abia and Imo states. The mean levels of adoption of cassava agronomic practices in Abia were 55.591 as against 55.517 for Imo farmers. Since the Z- calculated is less than the Z-tabulated, the result indicates no significant difference between adoption of cassava agronomic practices among farmers in both states.

Table 6: Difference in the adoption of cassava agronomic practices in Abia and Imo states

Variables	N	Mean	Standard Deviation	df	Z
Abia State Cassava Farmers					
Cassava agronomic practices	120	55.591	6.96	2.38	0.54*
Imo State Cassava Farmers					
Cassava agronomic practices	120	55.517	6.84		

*P≤ 0.5 **Source:** *Field survey, 2015*

Difference Between Farmers' Adoption of Cassava Intercrop Technologies in Abia and Imo States

Data in Table 7 show Z – Test analysis between adoptions of cassava intercrop technologies in Abia and Imo states. The mean levels of adoption of cassava intercrop technologies in Abia were 45.801 as against 43.647 for Imo farmers. Since the Z-calculated is less than the Z-tabulated, the result shows no significant difference between adoption of cassava intercrop technologies among farmers in both states.

Table 7: Difference in the adoption of cassava intercrop technologies in Abia and Imo states

Variables	N	Mean	Standard Deviation	df	Z
Abia State Cassava Farmers					
Cassava intercrop technologies	120	45.801	4.89	2.38	0.41*
Imo State Cassava Farmers					
Cassava intercrop technologies	120	43.647	5.91		

*P≤ 0.5 **Source:** *Field survey, 2015*

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Conclusion and Recommendations

Farmers had high adoption of cassava agronomic practices and intercrop technologies. In Abia state, gender, age, education and extension contact influenced farmers' adoption of cassava agronomic practices while gender, age, household size, education, farm size and extension contact influenced farmers in Imo state. Also, gender, education, farming experience, farm income and extension contact influenced farmers' adoption of cassava intercrop technologies in Abia state while gender, education and extension contact influenced farmers' adoption in Imo state. The result also revealed no significant difference between farmers' adoption of cassava agronomic practices and intercrop technologies in the study areas.

Increased extension contacts by agricultural development programmes and research institutes is advocated for enhanced adoption of these production technologies Farmer's should have access to land and improved cassava varieties. This will increase cassava output, thereby encouraging adoption of these cassava production technologies.

There is need to create awareness to farmers especially on cassava intercrop technologies through demonstrations, in order to increase its rate of adoption.

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