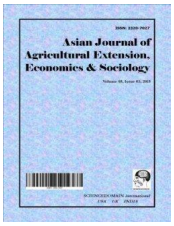

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Socio-economic Determinants of Adoption of Recommended Agrochemical Practices among Crop Farmers in Kaduna and Ondo States, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author FOI designed the study, wrote the protocol. Authors TKA, JGA and SAS supervised the work. Author FOI carried out all field work, performed the statistical analysis, managed the analyses of the study, wrote the first draft of the manuscript and managed the literature searches. Authors TKA, JGA and SAS edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This study analyzed the socio-economic determinants of adoption of recommended agrochemical practices of agrochemicals (RAPs) among crop farmers in Kaduna and Ondo States of Nigeria. A total of 260 crop farmers who have sustained the use of agrochemicals for at least five years were selected for the study using multi-stage sampling technique. Descriptive statistics (mean and percentages) and inferential statistics (Multiple regression) was used for data analysis. Data was collected using pretested, structured interview schedule. The results obtained revealed that adoption of RAPs is positively significantly affected by being experienced, literate, cosmopolite, and social participation in both State at varying level of significance. There are no exclusions to adopt RAPs based on age, farm size, gender, household size, and social participation. This study

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therefore, recommends that regular training on the use of agrochemical should be organized for farmers by extension agencies in collaboration with relevant stakeholders. Also, all forms of communication through the print and electronic media should be used by extension agencies in appealing to farmers to enhance their positive attitude in adoption of RAPs.

Keywords: Recommended agrochemical practices; adoption; crop protection chemicals; Nigeria.

1. INTRODUCTION

While population is rising and creating the need for more food, many diseases, pests and other inhibitors of crop growth contribute to reducing crop production. However, many types of chemicals have been developed through science and technology to fight these plant diseases and pests and control the effects of inhibitors in crop production. The introduction of these chemicals is, therefore, an important farm innovation which when used by farmers can significantly improve crop production. The Crop Protection Chemicals (CPCs) particularly useful to farmers consist of different types of insecticides, fungicides, herbicides, rodenticides and nematicides available in the market. The other group consists of seed treatment chemicals and growth regulators, which are mainly chemicals that eliminate the effect of inhibitors. In Nigeria, the strategy has always been to encourage the establishment of private agrochemical plants in the country or their importation by interested investors. The existing plants only re-formulate and package CPCs for sales.

The use of agrochemical is very beneficial in crop production. Lomborg [1] said if pesticides were abolished, the lives saved would be outnumbered by a factor of around 1000 by the lives lost due to poorer diets. Secondary penalties would be massive environmental damage due to the land needs of less productive farming, and a financial cost of around 20 billion US Dollars. Denis Avery (1999) Director of the Centre for Global Food Issues at the Hudson Institute in the US wrote in the Wall Street Journal that humanity in the 21st century can banish hunger, end nutritional deficits in its children, and save virtually all of the remaining wild lands in the process. But there are only two ways to do it: either murder four billion people, or use chemicals and biotechnology to maintain and increase yields on land already under farming.

Pests cost developing countries billions of dollars in national income [2] and farm and post-harvest losses contribute to hunger and malnutrition. Malnutrition kills 500,000 children in Nigeria annually [3]. According to Carol Bellamy, Executive Director of The United Nations Children's Fund (UNICEF) malnutrition is largely a silent and invisible emergency, exacting a terrible toll on children and their families. It would neither be logical nor ethical to expect poor people to forego the benefits of technologies used in the richer countries to grow and protect crops.

Nigeria has an estimated total land area of 98.3 million hectares, 74% or 72.7 million hectares of which were certified cultivable. However, less than 50% of this is actually under cultivation. This picture depicts that Nigeria has a very good potential for large agricultural output with only the right combination of resources. Increase in food production is not proportionate with population growth.

In recent decades, there has been a steady increase in the amount of pesticides marketed for argicultural use. In the European Union alone, more than 200,000 tonnes of pesticides (active ingredients) are used annually [4]. Between 2005 and 2010, the total volume of global sales rose from US$ 31 billion to US$ 38 billion [5,6]. The amount of pesticides used internationally has risen fifty-fold since 1950 [7] with China being the highest user and producer of pesticides [8].

In developing countries, the effects of acute poisoning due to exposure to dangerous levels of pesticides in food are apparently more severe than in industrialized countries. Two examples from Africa: In 2008 Nigeria reported that 112 people had been poisoned by pesticide-contaminated food. Two children died as a result. Another report from Nigeria recorded 120 cases of poisoning of students who had eaten beans contaminated with lindane [9,10]. Some pesticides that are restricted and banned in industrialized countries are used in many third-world countries [11].

Some studies have been conducted on the adoption of plant protection measures against pests and diseases of different fruits, yet some others have been carried out on the use of

pesticide spray. Most other studies are limited to just the adoption of agrochemicals. But little specific work has been carried out on the adoption of the recommended practices on the use of agrochemicals and its socio-economic correlates. Hence, this study analyses the extent to which some socio-economic characteristics influence the adoption of recommended agrochemical practices.

Rashid [12] studied some personal and socio-economic factors associated with adoption of recommended agricultural practices in rural Egypt. He reported that education and income were associated with the uses of pesticide. However, age of farmer was not related to the said uses [13]. Ahmad [14] conducted a study on the adoption of plant protection measures by citrus growers and found that there was a positive relationship between age group, educational level, social status, size of holding, size of orchard and adoption of plant protection measures.

This study analyzed the socio-economic determinants of adoption of recommended agrochemical practices among crop farmers in Kaduna and Ondo States of Nigeria.

2. METHODOLOGY

Kaduna and Ondo States from the Northern and Southern Nigeria respectively was used for this study. Both States have the highest record of use of agrochemicals in the different agroecology where they belong. Kaduna State lies between longitude 06′00 and 09′10′East of the Greenwich Meridian between and latitudes 09°00 and 11°30 North of the Equator. Occupying an area of approximately 48,473.2 square kilometers [15]. Kaduna State shares common borders with Kano and Katsina States to the north; Bauchi and Plateau States to the north-east; the Federal Capital Territory and Nasarawa State to the south; and Niger and Zamfara States to the south-west.

Kaduna State has 23 local government areas and its population was put at 6, 066, 526 people [16] and had a projected population of 7, 619, 557 people in 2014 using an annual growth rate of 3.2%.

Ondo State lies between latitudes 5°45' and 7°52'N and longitudes 4°20' and 6°05'E. Its land area is about 15,500 square kilometres. Ondo State is bounded on the east by Edo and Delta states, on the west by Ogun and Osun States, on the north by Ekiti and Kogi States and to the south by the Bight of Benin and the Atlantic Ocean. In Nigeria, Ondo State top the list in cocoa production [17,18] which involves heavy use of fungicides for the control of fungal diseases. A wide range of fungicides are available in the State [19]. Ondo State has 18 Local Government Areas and its population was put at 3, 460, 877 people [16] and had a projected population of 4, 346, 862 people in 2014 using an annual growth rate of 3.2%.

Quantities of agrochemical procured by the two States and distributed to farmers for use between 2008 and 2014 indicated that an estimated 143,330 liters was used in Kaduna State while 308,053 liters was used in Ondo State. Agrochemical supplying companies operating in Ondo State include Saro Agro Science, FITSCO Nigeria Limited, INSIS Nigeria Limited, and Dizengof. African Agro, Jubaili, Saro, Dizengof were the major sources of agrochemical in Kaduna State. Since 2008 to date, the incidences of pests and diseases on major crops in Kaduna State include rice blast, mango mealybug, brown leaf spot of citrus, maize borer, sorghum stem borer, cassava leaf blight, cocoyam leafblight, maize striga, rice blast, cowpea anthrachnose, cowpea aphids, and cowpea pod borer. Incidences of pests and diseases on major crops in Ondo State include aphids, birds, beetle, cotton stainer, grasscutter, stemborer, streak, leaf curl, and downy mildew affecting major food crops [20]. The two States have markedly different agroecological condition. This difference could make crop protection practices (as well as the type of agrochemicals used) to vary substantially in the two States. However, both States are noted for heavy use of agrochemicals.

This study focused on crop farmers who have been using agrochemicals for at least five years in Kaduna and Ondo States of Nigeria. The selections were based on high volume of crop production and prominent use of agrochemical as reported by [21]. A multi-stage sampling technique was employed in selecting a total of 135 and 125 respondents from Kaduna and Ondo States respectively aggregating to a total of 260 respondents.

Data for this study were collected from primary source with the use of pretested, validated, structured interview schedule. Personal observation was also used. Secondary sources

such as reports of Agricultural Development Programmes (ADPs), published materials like textbooks, journals, bulletins and extension guides as well as reports from relevant institutions among others were utilized. Internet materials were also used.

Multiple regression analysis was used to determine the relationship between dependent and independent variables and make inferences. This is the measurement used when a given dependent variable is affected simultaneously by several independent variables. Regression analysis shows the quality or magnitude of the change in the dependent variable, brought about by all the independent variables put together [22].

Multiple regressions was determined using:

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots b_nx_n + e$$

Where:

Y = Adoption level (recommended agrochemical practices)
X_1 = Age (in years)
X_2 = Gender
X_3 = Farm size (in hectares)
X_4 = Years of formal education (years)
X_5 = Years of farming experience (number of years in farming)
X_6 = Income (in Naira per anum)
X_7 = Household size (in numbers)
X_8 = Social participation (in number of organization and membership status)
X_9 = Cosmopoliteness
a = a constant
e = Error terms
Xt = period of adoption (years)

2.1 Measurement of Variables

2.1.1 Adoption of recommended agrochemical practices (Y)

Adoption is the decision of farmers to make full use (apply) of specific recommended practices of agrochemicals on continuous basis (for at least 5 years) as the best course of action available. Recommended practices describe the efficient and effective use of a specific agrochemical in a worthwhile manner as suggested by relevant authority (producer or regulatory agent). A list of twenty-five recommended practices on the usage of agrochemicals in crop production was drawn. Responses were rated on a 3-point Likert's type scale thus: very often (3), seldom (2), and never (1) for each RAP. Responses were counted with respect to the weight. The score for each variable was multiplied by the corresponding weight to

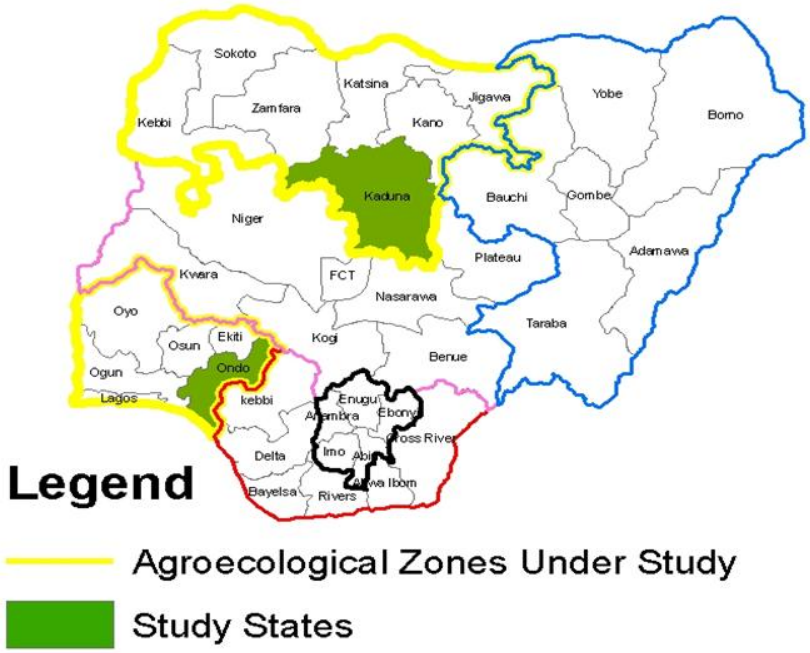

Fig. 1. Map of Nigeria showing the study area

obtain a weighted score. Further, the weighted scores were summed to obtain a weighted sum. The weighted sum was further divided by the number of respondents to obtain a weighted mean for each variable. Finally, the weighted means were sorted in descending order against the decision rule. The mid-point values of the scale were summed up and further divided by 3 to obtain a mean of 2. Any variable with weighted mean or above the cut-offf mean of 2 was considered to have "high" adoption, while any variable with weighted mean of less than 2 was considered to have "low" adoption. These were used to determine the relationship between the dependent variable (level of adoption of RAPs), and other independent variables. The index was used as the dependent variable in the regression.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Crop Farmers

The mean age of the respondents in Kaduna State was 44, while that of Ondo States was 51 years. This implies that majority of them were still in their active years, thus vibrant in carrying out farm work. This means that the farmers were comparatively younger and within the age defined by [23] as economically productive and this should have a positive influence on the farmers' probability of adopting RAPs. Similar findings were reported by [24] that only 19% of rice farmers in Aninri local government area of Enugu State, Nigeria were above 50 years old. This is an advantage for adoption and spreading of recommended agrochemical practices. Majority (93%) of the respondents were males. Male domination in farming has been reported by several authors [25-28]. Only 3.7% were females in Kaduna State compared to Ondo State with 11.2%. This indicates that more females were engaged in farming in Ondo State than in Kaduna State. This findings negates the claim by [29,30] that African agricultural system is female dominated. The Islamic culture which predominates in Kaduna State could have accounted for the wide difference. The culture of Islam practiced in Kaduna State restricts unguarded mixture with female folks.

The result in (Table 1) revealed that the average farm size cultivated by respondents was 3.01 and 4.08 ha in Kaduna and Ondo State, respectively. This shows that farming in the study area is still dominated by small-holder farmers and production is done on highly fragmented lands. Similar result was found by [31]. Results also revealed that the mean years of farming experience by farmers was about 25 years in both States. This means that farmers had relatively many years of farming experience. This is an advantage for adoption of RAPs. Ani [32] and [33] also indicated that farming experience of farmers to a large extent affects their managerial know-how and decision making.

The mean years of formal education was 11 (for Kaduna) and 13 years for Ondo State. This indicates that the enterprise had a good proportion of literate people (Table 1). This means that a good number of the farmers were literate, especially at primary (30.8%) and secondary (41.2%) levels and this could have enhanced the transfer of recommended agrochemical practices. Rapidly increasing unemployment in industries, ministries and government parastatals has caused many school leavers to opt for agriculture and other menial jobs to sustain life. The literacy level of these farmers is capable of promoting the adoption of recommended agrochemical practices. More so, an educated farmer understands an innovation that may appear complex compared to an illiterate farmer [34]. Literate farmers tend to read, participate in relevant fora listen to and find out more for themselves. Comparatively, farmers in Ondo State seem more educated (M=13.39) than those in Kaduna State (M=11.5).

The mean household size of the respondents was 8 in Kaduna State, while that of Ondo State was 6. This indicates that household sizes were larger in Kaduna State where most (46.5%) of the respondents had household sizes of between 6 and 10 persons. The relatively high number of household sizes could be an indication of the desire for manpower benefits. This implication was buttressed by the fact that 60% of the respondents exclusively use family labour for their farm operations.

From the results, membership of association had a mean of 1.47 (for Kaduna) and 1.51 (for Ondo State). This indicates that most of the respondents belonged to one association or the other. Further analysis revealed that majority (70.3%) of the respondents belonged to an average of 3 social organizations indicating high social participation. Such social organizations may provide a forum for exchange of idea about new farm practices [35,36]. However, farmers in the study area were communalistic and traditionally would like to belong to many social groups as that is indicative of social status.

Majority (above 80%) of the farmers belonged to more than one association. Investigation on respondents' participation in different association gave an insight into their involvement in the different associations. Majority (78.7%) of respondents who indicated membership of associations were members of cooperative society. Majority of them also play roles of holding one office or the other. The involvement of the respondents in all the categories of organizations investigated in this study shows a form of social participation. In Kaduna State, majority (57.7%) of the respondents were ordinary members in religious associations while most (47.3%) of the respondents were members of cooperative societies.

Most (46.5%) of the respondents made between ₦101, 000 and ₦200,000 as farm income annually. Income derived from the farming activities indicates the level of profit of the farmers. The expectation was that farmers would have as much capital to plough back into the production process in order to increase profit. Wealthier farmers are more likely to be able to afford and apply expensive inputs aimed at increasing productivity; hence income is expected to influence the adoption of RAPs positively. The mean farm income of respondents in Ondo State was ₦157,000 and that of Kaduna State was ₦125,000 indicating that farming business is more profitable in Ondo State.

It can be seen from Table 1 that 65.5% of the respondents visited other wards in the Local Government Area (LGA). Also (61.1%) of them had visited other States in the country for agricultural purpose. The main purpose of visiting the nearby town as expressed by them was to purchase farm inputs and sell farm produce. Some of them were visiting the nearby town to visit friends and relatives, to get banking services, for medical treatment and for entertainment purposes. However, 21.9% of the respondents had not visited other places for agricultural purpose (Table 3). Most (92.8%) farmers in Kaduna State visit other places for agricultural purposes compared to farmers in Ondo State. This could be due to the high concentration of agricultural institutions within Kaduna State.

Cosmopoliteness is a character for delineating ones exposure towards the environment and to the source of information. It can be through training, exposure visit etc. For this, a farmer can better know about his surroundings in case of agriculture as well as livelihood. Cosmopoliteness is the degree of orientation of the respondents towards outside social system to which he or she belongs. It can be measured by frequencies of visits to outside his or her area of residence for several reasons. Cosmopoliteness as independent variable is expected to have positive relationship with the adoption of innovation [37]. It provides more chance of exposure to external information and environment.

It can be seen from Table 4 that 65.5% of the respondents visited other wards in the LGA. Also (61.1%) of them had visited other States in the country for agricultural purpose. The main purpose of visiting the nearby town as expressed by them was to purchase farm inputs and sell farm produce. Some of them were visiting the nearby town to visit friends and relatives, to get banking services, for medical treatment and for entertainment purposes. However, 21.9% of the respondents had not visited other places for agricultural purpose (Table 3).

3.2 Factors Influencing Adoption of RAPs by Crop Farmers

The major objective of this study was to analyze the socio-economic determinants of adoption of RAPs. Results of multiple regression analysis is presented in Table 5. The adjusted R^2 was 0.63, and 0.67 for Kaduna and Ondo State, respectively. This implies that 63% of the variations in the adoption of RAPs in Kaduna State was contributed by the independent variables specified in the model while 67% of the variations in the adoption of RAPs in Ondo was contributed by the independent variables specified in the model. Some variables were found to significantly influence adoption of RAPs ($P<0.01$, $P<0.05$, and $P<0.10$) in both States. It was hypothesized that there is no significant relationship between farmers' socio-economic characteristics and adoption level of RAPs. In Kaduna State, level of education (0.058, $P<0.05$), farming experience (0.017, $P<0.05$), and cosmopoliteness (0.057, $P<0.10$) were found to significantly influence adoption of RAPs. For Ondo State, the variables were level of education (0.015, $P<0.01$), farming experience (0.032, $P<0.05$), cosmopoliteness (0.004, $P<0.05$). These variables were strong determinants of adoption of RAPs among crop farmers. Therefore, contrary to the stated null hypothesis; farmers' socio-economic characteristics had

significant influence on adoption of RAPs. Hence, the null hypothesis was rejected.

A strongly positive and significant relationship was found between respondents' educational level and adoption of RAPs (0.058, P<0.01) and (0.015, P<0.01) for Kaduna and Ondo State, respectively. Farmers with higher education were better adopters, a result consistent with the findings of [38]. The probability of adoption given literacy is 63% and 67% in Kaduna and Ondo States, respectively, making this factor the greatest driver of RAPs' adoption by respondents. Education creates a favorable mental attitude for the acceptance of new practices. Education affords a person the ability to read and understand sophisticated information that may be contained in a package thereby increasing adoption. Farmers' exposure to education increases their ability to obtain, process and utilize information relevant to the adoption of IPM technologies [39].

Cosmopoliteness was also found to have positive and significant relationship with adoption of RAPs in Kaduna (0.060, P<0.05) and Ondo State (0.004, P<0.05). This means that farmers who were more cosmopolite adopted RAPs more than the less cosmopolite ones. Okuthe et al. [40] found a significant relationship between cosmopoliteness and adoption of INRM technologies. However, [41] by an analysis in Mysore district observed that cosmopoliteness had a significant association with the knowledge level of small scale sericulturists but were hampering the adoption of improved practices among small scale farmers.

A positive and significant relationship was found between years of farming experience and adoption RAPs in Kaduna (0.017, P<0.05) and Ondo State (0.032, P<0.05). The number of years that farmers had been using agrochemicals was high recording a mean of 24.7. The general indication is that individuals with more experience in using agrochemicals would likely adopt agrochemicals perhaps reflecting their experience. Ani [32,33] also indicated that farming experience of farmers to a large extent affects their managerial know-how and decision making. Namwata et al. [42] reported that increased farming experience was positively and significantly associated with overall adoption of improved agricultural technologies among farmers in Tanzania. However, on the contrary, [43] found an inverse relationship between adoption and farming experience which means that those with less farming experience have higher adoption level.

Experience of the farmer is likely to have a range of influences on adoption. Experience will improve farmers' skill at production. A more experienced farmer may have a lower level of uncertainty about the innovation's performance. Farmers with higher experience appear to have often full information and better knowledge and are able to evaluate the advantage of the technology considered. Therefore, it was hypothesized that farming experience has a positive influence on adoption of INRM technologies [40,44].

The relationship between adoption of RAPs and household size was weak and negative in Kaduna (-0.011) and Ondo State (0.002), which indicates that size of holding did not affect the adoption of RAPs in the study area. This implies an inverse relationship, a finding consistence with [38]. The result implies that the larger the household size; the less the likelihood of adoption of RAPs. It is logical that larger households means more imposition of pressure which can make adoption of some RAPs very difficult. Tokula et al. [45] however found household size to positively influence the adoption of improved cassava production technologies in Kogi State, Nigeria.

The farmer's sex had a negative but statistically insignificant coefficient in the model for both Kaduna (-0.005) and Ondo State (-0.005). It is important to discuss the implications of this result. Contrary to previous studies suggesting gendered patterns in adoption due to women's limited access to resources including land and credit [46] the results suggest no significance difference between male and female farmers. However, this result is similar to that of [47] who observed that the adoption of maize varieties and fertilizer is not associated with the sex of maize farmers in Ghana. This may be due to increased efforts by government policy as well as development agents in widening opportunities for hitherto vulnerable groups especially women. Indeed at 11 percent significant level, there is a 6 percent probability that women farmers would adopt agrochemicals rather than men [48].

Age, farm size, and income had no significant relationship with adoption level in both Kaduna (0.002, 0.006, and 0.102, respectively) and Ondo State (0.002, 0.006, and 0.110, respectively). These results negate the findings of [49] that

Table 1. Distribution of crop farmers based on socio-economic characteristics

Variables	Minimum		Maximum		Mean		SD		SE	
	Kaduna	Ondo	Kaduna	Ondo	Kaduna	Ondo	Kaduna	Ondo	Kaduna	Ondo
Age (years)	24	20	63	82	44	51	9.777	12.439	0.546	0.669
Farm Sizes (ha)	1	1	15	17	3.01	4.08	2.827	2.892	0.025	0.032
Farming experiences (years)	5	5	45	60	24	25	9.890	12.467	0.490	0.584
Years of formal education (years)	0	0	16	18	11	13	3.690	5.171	0.228	0.352
Household sizes (number)	1	1	32	22	10	7	6.854	3.247	0.417	0.321
Membership of associations (dummy)	0	0	5	4	2	2	1.15	1.12	0.069	0.058
Levels of farm income (₦)	50,000	95,000	1,500,000	2,000,000	432,320	752, 463	238,722.00	275,900	15,783	17,446
Cosmopoliteness (number of times respondent travelled for agricultural information)	1	1	36	26	14	11	9.183	6.854	0.835	0.748

Table 2. Distribution of respondents by level of participation in association* (n=183)

Organization	Don't belong	Level of participation		
		Ordinary member	Committee member	Office holder
Cooperative society (n=144)	39 (21.3)	78 (54.2)	33 (22.9)	33 (22.9)
Religious group (n=111)	72 (39.3)	62 (55.9)	29 (26.1)	20 (18)
Community-based group e.g. village council (n=74)	109 (59.6)	39 (52.7)	21(28.4)	14 (18.9)
Social club (n=61)	122 (66.6)	38 (62.3)	13 (20.9)	10 (16.4)

**Multiple responses indicated*

Table 3. Distribution of crop farmers by cosmopoliteness

Whether respondents visit other places for agricultural purpose	Frequency	Percent
Visit other places	203	78.1
Don't visit other places	57	21.9

Table 4. Distribution of crop farmers by frequency of visit to different places (n=203)

Places visited	Frequency (in the last 1 year)				Mean
	0	1 - 3	4 – 6	Above 6	
Other farms in the community	16 (7.9)	66 (32.5)	56 (27.6)	65 (32)	8.1
Other villages in the Ward	24 (11.8)	102 (50.2)	45 (22.2)	32 (15.8)	4.6
Other Wards in the LGA	31 (15.3)	133 (65.5)	22 (10.8)	17 (18.4)	3.4
Other LGAs in the State	85 (41.9)	92 (45.3)	26 (12.8)	-	3
Other States in the country	124 (61.1)	75 (36.9)	4 (1.9)	-	2
Other countries in the World	197 (97.1)	6 (2.9)	-	-	1

Table 5. Socio-economic determinants of adoption of Recommended Agrochemical Practices (RAPs)

Variables	Kaduna State			Ondo State		
	Coef.	Std. err	Z	Coef.	Std. err	Z
Age	0.0002	0.002	0.13	0.0002	0.002	0.12
Gender	-0.005	0.079	0.07	-0.005	0.078	0.06
Farm size	0.006	0.007	-0.89	0.006	0.007	-0.87
Education	0.058	0.004	15.84***	0.015	0.004	4.17***
Farming exp.	0.017	0.008	2.15**	0.032	0.015	2.12**
Income	0.102	0.912	0.58	0.110	0.994	0.65
Household size	-0.011	0.003	-3.87	-0.009	0.002	-3.21***
Social participation	0.806	0.477	1.69*	0.300	0.500	4.55***
Cosmopoliteness	0.060	0.026	2.32**	0.004	0.002	2.14**
R^2	0.650			0.690		
Adjusted R^2	0.633			0.674		

****P<0.01, **P<0.05, *P<0.1*

personal characteristics, especially age and income influence adoption level. Similarly, [41] found age and area under mulberry significantly influenced the adoption level. Farmer's age had negative and strong correlation with pesticide usage [39]. Tijani and Nurudeen [13] also found same. Bonabana-Wabbi [39] found that farm size is negatively correlated with the adoption of chemicals by plantain farmers in Ghana.

Social participation had significant relationship with adoption of RAPs in both Kaduna (0.806, P<0.10) and Ondo (0.500, P<0.01) States. Iwueke [50] also found out that social participation was one of the variables that positively related to the farmers' decision to adopt new practices and that the adoption of small scale farmers could not be predicted on the basis of family size and farming experience but by peer-group's decisions.

4. CONCLUSION AND RECOMMENDATIONS

This study concludes that education, farming experience, and exposure to training, are important in the adoption of RAPs by farmers. These characteristics to a large extent influences the farmers' understanding of RAPs. Besides, it helps their managerial and technical know-how and decision making. Skill and positive attitude of farmers in the use of RAPs can be greatly enhanced when these characteristics are encouraged in them.

Based on the findings of this study, the following recommendations are made in order to improve the adoption of RAPs by farmers in Nigeria:

It has been shown that education and cosmopoliteness were positively significant

to adoption of RAPs. Therefore, all forms of communication through the print and electronic media could be put to advantageous uses by extension agencies in appealing to farmers to enhance their positive attitude for embracing the adoption of RAPs.

Also, stakeholders [government extension services, Environmental Protection Agency (EPA), National Agency for Food Drugs Administration and Control (NAFDAC), input dealers, Farmer-Based Organizations (FBOs) and Non-Governmental Organizations (NGOs)] should collaborate to fashion out ways to properly train farmers on RAPs. Regular training of farmers should practically emphasize application techniques, as well as personal health and safety measures. Such training should take full advantage of farmers'-based organizations. This is justified by the fact that majority of the respondents in this study belong to one association or the other.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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