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Research Article
Influence of Innovation Attributes on Adoption of Pesticides Safety Management Practices among Maize Farmers in Abuja, Nigeria

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Abstract

Background and Objective: The perceived attributes of an innovation influence the rate of its adoption in a social system. Against this backdrop, the study examined the influence of innovation attributes on the adoption of pesticides safety management practices among maize farmers in Abuja, Nigeria. Abuja is also referred to as the Federal Capital Territory. **Materials and Methods:** A multi-stage and random sampling technique were employed in selecting 480 maize farmers in the six Abuja Agricultural Development Programme (FCT-ADP) zones. Data were collected using a structured questionnaire. **Results:** The results showed that 96.5% of the maize farmers perceived pesticide safety management practices as compatible with their maize production, 66.6% of them indicated that pesticide safety management practices were not complex to adopt, 95.6% of the farmers perceived that pesticide safety management practices could be tried on their maize farm, 99.4% of the farmers perceived that adoption of pesticide safety management practices had a relative economic advantage while 98.9% of the farmers thought that adoption of pesticide safety management practices was observable and could be communicated to others. The major constraints to the adoption of pesticide safety management practices by maize farmers were the discomfort arising from wearing personal protective clothing because of heat ($\overline{X}$ = 3.58), not being taught of these pesticide safety management practices ($\overline{X}$ = 3.12) and inability to read pesticide label before use ($\overline{X}$ = 3.11). **Conclusion:** It is, therefore, recommended that more awareness of pesticide safety management practices should be enhanced.

Key words: Innovation attributes, adoption, pesticide safety, management practices, maize farmers

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Maize (*Zea mays* L.) is a major staple food for the people of Nigeria. The maize production in Nigeria has shown an upward trend from 10,439,708 tons to 12,023,861 tons in 2016 to 2020[1]. Interestingly, Abuja falls within the grain belt of Nigeria where a vast majority of crop farmers produce maize using pesticides. Pesticide is variously used to protect maize seeds against insect pests, nematodes and rodents, control weeds and storage pests. Invariably, pest and disease control are critical to the production of maize in Nigeria. The problems associated with weeds, insect pest, diseases, rodents and, very recently, fall army worm in maize production, has resulted in high demand and use of pesticide with less caution to pesticide safety management practices. Most maize farmers rarely practice safety precautions when handling, mixing and spraying chemicals[2]. Yet, the unsafe use of pesticides in agriculture represents a major hazard to the environment and human health[3]. Farmers, especially those directly involved in the handling of pesticides are at a high risk of exposure to pesticides through contact with pesticide residues on treated crops, storage of pesticide close to consumable foodstuff, treatment of foodstuff with pesticide, unsafe handling, the use of pesticide containers by households, improper storage and disposal of used containers, poor maintenance of spraying equipment and the lack of protective equipment or failure to use it properly[4,5,6].

It is on record that maize farmers' exposure to synthetic pesticides results in cancer, reproductive abnormalities, immune suppression, diminished intelligence, hormone disruption, loss of man-days and death[7]. The most affected people are the maize farmers who are directly involved in the application of these pesticides, the members of their families and the general public who consume food products laced with pesticides. There is, therefore, the need for maize farmers in the study area to adopt pesticide safety management practices.

In reviewing Rogers' study on adoption, Sahin[8] reported that 49-87% of the variance in the rate of adoption of innovation is accounted for by the five attributes of the technology. The theory of perceived attributes of innovation is based on the notion that individuals adopt an innovation if they perceive that the innovation can add value, easy to use and compatible with their existing infrastructure[9]. The study, therefore, examined the influence of innovation attributes on the adoption of pesticides safety management practices among maize farmers in Abuja, Nigeria.

The overall objective of the study was to examine the influence of innovation attributes on the adoption of pesticides safety management practices among maize farmers in Abuja (The Federal Capital Territory), Nigeria. Specifically, the study sought to determine the perceived attributes of pesticide safety management practices among maize farmers in the study area and identify the maize farmers' constraints in the adoption of pesticide safety management practices.

MATERIALS AND METHODS

Study area: The study was conducted in Abuja, Nigeria, The Federal Capital Territory. It covers an area of 7315 square kilometers[10]. Abuja is located between latitudes 8°25' and 9°25' North of the equator and longitudes 6°45' and 7°45' East of Greenwich Meridian[11]. The study area has 2 distinct climatic seasons (rainy season and dry season). The soil characteristics are determined by the basement complex as well as sedimentary rocks which have a strong influence on the morphological characteristics of the local soils[12]. The areas are underlain by the sedimentary rocks covered about 52% of the total area of the FCT and largely constitute the undulating plains while the basement complex is made up of igneous and metamorphic rocks and covered about 48% of the territory[12]. The major occupation of the farming population is crop production[13].

Designing: The sampling design for the study was based on the Abuja Agricultural Development Programme (FCT-ADP) zoning pattern, which stratified Abuja into 6 administrative agricultural zones, namely: Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje and Kwali. The FCT-ADP zones were further stratified into 26 blocks and 131 cells.

Multi-stages: To get a representative sample of the maize farming population and achieve the objectives of the study, a multi-stage sampling technique was used to select the maize farmers from whom data were collected through a structured questionnaire.

- In the 1st stage, the 6 agricultural zones were selected
- In the 2nd stage, 2 agricultural extension blocks were randomly selected from each of the 6 agricultural zones giving a total of 12 agricultural extension blocks
- In the 3rd stage, 4 agricultural extension cells were randomly selected from each of the agricultural extension blocks that were selected giving a total of 48 agricultural extension cells
- In the 4th stage, 10 maize farmers were selected randomly from each cell giving a total of 480 maize farmers. Data for the study were analyzed using descriptive statistical tools such as frequency counts, percentages and mean scores

The attributes of the innovation of pesticide management practices were categorized into relative economic advantage, compatibility, complexity, trialability and observability. Relative economic advantage was measured on a 3-point likert scale as (3) Highly relative economic advantage, (2) Relative economic advantage and (1) No relative economic advantage. Compatibility was measured on a 3-point likert scale as (3) Highly compatible, (2) Compatible and (1) Not compatible.

Complexity was measured on a 3-point Likert scale as (3) Very complex, (2) Complex and (1) Not complex.

Trialability was measured using dummy: Yes = 1, if it is easy to try pesticide safety management practices, No = 0, if it is not easy to try pesticide safety management practices.

Observability (Visibility) was measured on a 3-point likert scale as (3) Highly observable, (2) Observable and (1) Not observable.

Similarly, to determine the constraints to the adoption of pesticide safety management practices among the maize farmers in the study area, a 4-point Likert Scale of (4) Very serious problem, (3) Serious problem, (2) Slightly serious problem point and (1) No problem at all. A mean score greater than or equal to 2.5 ($\geq$2.5) was adjudged significant while any mean score less than or equal to 2.5 ($\leq$2.5) was adjudged not significant. The weighted mean score of each constraint was thus determined.

RESULTS AND DISCUSSION

Perceived innovation attributes on pesticide safety management practices by the maize farmers: Table 1 shows the distribution of maize farmers based on perceived innovation attributes on pesticide safety management practices. The result showed that 19.2% of the respondents perceived pesticide safety management practices as highly compatible with their maize farming system, 77.3% reported that the idea of pesticide safety practices was compatible with their maize production while 3.5% indicated that adoption of pesticide safety management practices was not compatible with their maize production. The overall result revealed that 96.5% of the maize farmers perceived pesticide safety management practices as compatible with their production. This implies that the adoption of pesticide safety management practices may not be against their culture hence maize farmers in the study area could adopt it. This finding is consistent with previous study[14] who stated that the more compatible an innovation is with individual needs, the greater the likelihood of its adoption/acceptance.

The result on the perceived complexity of pesticide safety management practices is also presented in Table 1. The majority (66.6%) of the maize farmers indicated that pesticide safety management practices were not complex to adopt while 24.6% and 8.8% indicated that pesticide safety practices were complex and very complex to practice respectively. This result revealed a worrisome relatively high number (33.4%) of the respondents that did not understand pesticide safety management practices in the study area. This implies that the maize farmers needed more training and enlightenment to understand the dangers of pesticide exposure. This finding is consistent with the report of another study[15] that innovations that are easier to understand lead to a higher rate of its adoption. Additionally, some reserachers[14] stated that innovations that are perceived by the end-users as simple to use are more easily adopted.

The distribution of maize farmers according to perceived Trialability of pesticide safety management practices is presented in Table 1. The result showed that the majority (95.6%) of the farmers perceived that pesticide safety management practices could be tried on their maize farms while 4.4% opined that pesticide safety practices could not be tried. This implies that the maize farmers if motivated, could try pesticide safety management practices. This finding is consistent with Mannan and Nordin[15] who stated that trialability is positively related to adoption. Additionally, another study[16] posited that trialability provides farmers with the ability to evaluate innovation benefits.

The result on the perceived "Relative Economic Advantage" of pesticide safety management practices is presented in Table 1. The majority (55.6%) of the farmers indicated that pesticide safety management practices have a "Relative Economic Advantage" while 43.8% indicated that pesticide safety management practices had a "Highly Relative Economic Advantage". Only 0.6 % of the respondents indicated that adoption of pesticide safety management practices had "No Relative Economic Advantage". This shows that 99.4% of the farmers perceived that the adoption of pesticide safety management practices had a relative economic advantage. This implies that the farmers were aware of the necessity of adopting pesticide safety management practices to safeguard their health and environment. This finding agrees with other study[14] that innovations that have a clear relative economic advantage in cost-effectiveness are more easily adopted. Similarly, a research[8] posited that the greater the perceived relative economic advantage of an innovation, the more rapid the adoption.

Table 1: Perceived attributes of pesticide safety management practices

Variables	Frequency (n = 480)	Percentage
Compatibility		
Highly compatible	92	19.2
Compatible	371	77.3
Not compatible	17	3.5
Complexity		
Very complex	42	8.8
Complex	118	24.6
Not complex	320	66.6
Trialability		
Yes	459	95.6
No	21	4.4
Relative economic advantage		
Highly relative economic advantage	210	43.8
Relative economic advantage	267	55.6
No relative economic advantage	3	0.6
Observability/Visibility		
Highly observable	194	40.4
Observable	281	58.5
Not observable	5	1.1

Source: Field survey analysis, 2019

Table 2: Distribution of maize farmers according to constraints to adoption of pesticide safety management practices (n = 480)

Constraints	Mean ($\overline{X}$)	Standard error	Standard deviation
The cost of personal protective clothing is high	2.4312	0.048	1.054
Unable to read pesticide label before use	3.1083	0.052	1.136
Do not have money to build a small shop for my chemicals	2.7417	0.045	0.995
Uncomfortable to wear personal protective clothing because of heat or high temperature	3.5833	0.038	0.831
Do not know that the use of empty pesticide containers to fetch water or put foodstuff is bad and can cause sickness	2.9625	0.059	1.287
The farm is not big so I do not need to wear personal protective equipment	3.4729	0.045	0.992
Have not been taught these safety practices	3.1229	0.055	1.209
Do not know how to get all this personal protective clothing	3.2792	0.045	0.978

Source: Field survey, 2019

On perceived observability (visibility) of pesticide safety management practices (Table 1), the majority (58.5%) of the farmers indicated that pesticide safety management practices were "Observable" while 40.4% indicated that it was "Highly Observable". Only 1.1% of the respondents indicated that adoption of pesticide safety management practices was not observable. This revealed that about 98.9% of the respondents thought that adoption of pesticide safety management practices was visible. It implies that pesticide safety management practices could be observed and the knowledge could be shared with other maize farmers for consequent adoption. This assertion is in tandem with another study[15] who stated that the results of some ideas could easily be observed and communicated to others.

Constraints to the adoption of pesticide safety management practices: Constraints to the adoption of pesticide safety management practices are presented in Table 2. The result showed that the major constraints to the adoption of pesticide safety management practices were, the discomfort arising from wearing personal protective clothing because of heat ($\overline{X}$ = 3.58), the small size of farmland cultivated hence no need to wear personal protective equipment ($\overline{X}$ = 3.47), unawareness of the sources of personal protective clothing ($\overline{X}$ = 3.28), have not been taught of these safety practices ($\overline{X}$ = 3.12), Unable to read pesticide label before use ($\overline{X}$ = 3.11) and not aware that the use of empty pesticide container to fetch water or put foodstuff is bad and can cause sickness ($\overline{X}$ = 2.96).

CONCLUSION

The study examined the influence of innovation attributes on the adoption of pesticides safety management practices among maize farmers in Abuja, Nigeria. Based on the findings, the paper concludes that pesticide safety management practices were not complex but compatible with the culture of maize farmers in the study area. The practices were also observable with relative economic importance to the maize farmers if adopted. However, the farmers need skills to

effectively adapt pesticide safety management practices in the study area. It is, therefore, recommended that more awareness and training on pesticide safety management practices should be carried out.

SIGNIFICANCE STATEMENT

Understanding the influence of innovation attributes theory on pesticide safety management practices is vital to providing valuable information that can be beneficial for maize farmers' capacity development and policy recommendations aimed at preventing or reducing the health hazards associated with pesticides in the study area. This study, therefore, will help researchers to uncover the critical areas of theory of innovation attributes concerning the adoption of pesticide safety management practices that many researchers were not able to explore. Thus, a new theory on the dissemination of information on pesticide safety management practices may be arrived at in promoting more safe and sustainable use of pesticides for food security programmes in Abuja, Nigeria.

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