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Analysis of Technology Attributes Influencing Non - Adoption of Apiary Production Technologies: The Case IFAD Bee Farmers in Cross River State, Nigeria

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Abstract

Beekeeping as a technology package disseminated to target farmers in Nigeria seems to suffer setbacks ranging from negative perception of farmers about the technology to technical contents of the package. This study therefore analyzes the technology attributes that influence non adoption of apiary technology packages in Cross River State, Nigeria. Purposive and multistage random sampling techniques were used to select sixty (60) apiary farmers. Data for the study were collected through a structured questionnaire and analyzed with descriptive statistics such as; frequency counts, mean scores and percentages and inferential statistics (bivariate probit analysis). The socio-economic characteristics of the farmers indicate that majority (93.33%) of the farmers were males, with mean age of 38.50 years, mean farming experience of 11.5 years, mean annual farm income of ₦175, 500 (973.97USD) and mean number of 9 hives. The result also revealed that the farmers adopted apiary technology packages such as; setting of hive ($\bar{X}$=3.6) and baiting of bee hives ($\bar{X}$ =3.1) with mean adoption score of 2.5 and an adoption index of 32%. The result of bivariate probit regression estimates showed that coefficients for complexity of technology, adaptability of technology and technical competency influenced non adoption of apiary technologies by farmers in the study area. The study therefore recommends increase in number of extension contacts, cooperative formation and adequate campaign on beekeeping to facilitate adoption of apiary technologies in the study area.

Keywords: Technology, attributes, non adoption, apiary, technologies

1. Introduction

Bee keeping (apiculture) is defined as the art of keeping bees for the purpose of producing honey and other by-products (Obialor, 2003). Abubakar, (2011) stated that a number of developing countries including Nigeria found beekeeping for honey production as a profitable enterprise. It is also an important foreign exchange earner for those who export honey and bee wax. Much of the knowledge about honey bees is derived from managed colonies especially those kept in movable combination hives. Bee keeping as an enterprise has a lot of potentials for the development of households, providing self employment and employment for others

(Anyaegbulam et al., 2006). Bee keeping has been identified as a viable agricultural practice option that can alleviate poverty and sustain rural employment in Nigeria. The most commonly found honey bee in Nigeria is the Apis Melifera.dansoni which lives in the colonies through the year. Other species of honey bees include Apis Dorsata, A. l abonocer, A. mellifera, A. larnica and A. mellifera linquistica (Marieke, 1991). The demand for bee honey in Nigeria is on the increase but organized bee keeping as an enterprise is low (Eluagu and Nwali, 1999). In recent times, modern beekeeping is becoming popular in Nigeria with the use of modern hives and beekeeping equipment such as smoker, bee dress, with veil and gloves which it possible to work in the day rather than at night (Okunola, 2014). Beekeeping needs a relative small investment. It uses unused resources like pollen and nectar and it can be combined with other investments because it is not labour intensive neither is it time consuming (Oladipo, 2011). It is the only agricultural production that does not need much resource like large expense of land, water, feed and fertilizer to thrive. It has also been discovered as a far more profitable and cost effective type of farming when compared to crop farming (Ja’afar-furo et al., 2006).

The adoption of improved technologies depends on the number of factors, principal among which is the dissemination of technologies through the organized channels of input and output delivery (Muzari et al., 2012). Agricultural extension is the principal organ saddened with the transfer responsibility in Nigeria. For information to be of benefit, farmers must possess a positive attitude towards the information being disseminated. Information must be communicated and internalized effectively to its intended beneficiaries for it to be effective (FAO, 2003; Shuaib et al., 2011). It is important that the technologies being transferred are appropriate and adaptable to the particular environment, effectively taught to the farmers and the end users are properly disposed to use them (Korsi, 2001). Agricultural innovations and diffusion of new technologies are important factors in developing countries’ quest for food security (Tokula et al., 2013). When a technology is introduced in a given area, the choices available to farmers are not just adoption or rejection as many researchers think, but farmers’ choice whether to adopt an entire package of a recommended technology. This is influenced by factors such as attributes of technology as well as the degree to which the technology is appropriate for the farmers’ farming environment, provision of technical advice and economic motivation that is, if a technology is perceived to be unprofitable (Nwaobiala, 2013; Nwaobiala, 2014a).

Ganpat and Seepersad (1996) opined that for a successful adoption of new technology, farmers must not only know about it but must be able to follow the recommendations given. This implies that the farmer must have the knowledge before putting the received package to practice. It is a well known - fact that not all the farmers adopt technologies at the same rate due to difference in behaviour to the technology components of the innovation (Van den Ban and Hawkins, 1996). Innovation or technology according to Yusuf (2009) can be transferred primarily through authoritarian imposition and through voluntary adoption and emulation. Adoption by voluntary methods depends solely on the effectiveness of demonstration, which may be rapid or slow (Jamilu et al., 2014). Technology attributes and characteristics such as; complexity, compatibility, trialability, obeservability, adaptability, accessibility, divisibility, cost effectiveness influence farmers’ decision to adopting innovations (Rogers, 1995). However, most farmers are still ignorant of new innovation and their productivity is extremely below expectation. But the assessment of average yield at farmers level indicates that only a few improved technologies have been adopted (IITA, 2001).

As Obinne (1992) put it, the problem with Nigerian agriculture is no longer lack of research results but utilization of the research results for increased and sustainable productivity. Another problem has to do with the adoption process which is a combination of stages which a farmer goes through from awareness of a new idea to adoption (Smith et al., 1992). Somewhere along this process, a problem could occur. Furthermore, a farmer could, after adoption of an idea, decide to discontinue. This is what Rogers (1995) referred to as discontinuance – a decision to stop the use of innovation after previously adopting it for sometime (Shannori et al., 1995) continued that not all famers persist with an innovation even after adopting it.

According to Rogers (1995), the extent of discontinuance varies with the nature of the idea and the innovativeness of adopting by individuals. Harris et al., (1995) implicated such factors as lack of proper understanding of the innovation and improper implementation as causes of discountenance. These could lead to unsatisfactory outcomes (Sarors et al., 2009). Sangiga (1998) noted that discontinuance could result from poor yield, pests and diseases as well as ill health of farmers. The possibility also exists that the abandonment of an earlier adopted innovation could lead to a decline in agricultural productivity. In order to provide a complementary role in extension delivery, the World Bank in conjunction with Federal Government of Nigeria in 2005 established the International Fund for Agricultural Development - Niger Delta Development Commission/Community Based Natural Resource Management Programme to improve the living standards of the rural and alleviate poverty through active participation of communities in crop, livestock, fisheries and apiary technologies in the nine Niger Delta States of Nigeria (Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers States) (CBNRMP, 2002; IFAD, 2002).

On the other hand, for policy design and effective management of extension programmes, information on the extent of adoption and non adoption of disseminated technologies, understanding of the attributes of such practices in the study area would help to come up with workable recommendations to improve the performance of the sector. However, there is a gap in knowledge on factors responsible for the non adoption or discontinuance of apiary technologies in the study area rather studies were centred on socio-economic characteristics with little or no emphasis on the attributes of the technology. Therefore, this study was undertaken to analyze the apiary technology attributes that influence the non adoption of the technologies among farmers in Cross River State, Nigeria.

The specific objectives were to;

i. describe selected socio-economic characteristics of apiary farmers in the study areas.

ii. ascertain the levels of adoption of apiary technology technologies by farmers in the study area.

iii. determine technology attributes that influence non adoption of apiary technologies among farmers in Cross River Sate, Nigeria.

2. Materials and methods

2.1 Study Area Description

The study was conducted in Cross River State, which is one of the beneficiary states of the programme. Cross River State lies between Latitude $5^0 5^1$ and $6^0 40^1$ North of the Equator and Longitude $8^0 10^1$ and $8^0 5^1$ East of the Greenwich Meridian. The State is bounded on the North by Benue State, on the South by Akwa Ibom State, on the East by Cameroon Republic and the West by Ebonyi State. The State is located within the forest belt of Nigeria and temperature ranges between 20^oC and 30^oC with relative humidity between 70% and 90%. Most people in the rural areas engage in artisanal fishing. The major farms crops grown include cassava, yam, maize, plantain, banana among others. The cash crops include oil palm and cocoa trees, livestock reared are sheep and goat, pigs, poultry birds among others (CRSPC, 2006). Multistage random sampling technique was used in the selection of local government areas (programme areas), participating communities, farmers groups and participating farmers. First, three (3) Local Government Areas (LGA's) were randomly selected from the State, namely Yala, Yakurr and Obubra. Second, two (2) participating communities each were randomly selected from the 3 LGA's to give a total of six (6) participating communities. Furthermore, from the selected participating communities, two (2) farmer groups each were randomly selected, which gave a total of twelve (12) farmer groups. Finally, five (5) apiary farmers each were randomly selected from the selected farmer groups to give a sample size of one hundred and twenty (60) farmers. Data for the analysis were obtained from a structured questionnaire. Descriptive statistics such as frequency distribution table, mean counts and percentages were used in the analysis, while bivariate probit regression analysis was adopted to test the hypothesis. The adoption of recommended apiary technology packages by bee farmers were ascertained using adoption score analysis. The respondents were asked to indicate their adoption stages for the various practices using the 6 point likert type scale (unaware, aware, interest, evaluation, trial and accept) with values of 0, 1, 2, 3, 4 and 5 respectively (Nwaobiala, 2014b). A midpoint was obtained thus; 5+4+3+2+1+0 =15/5 =3.00. The following decision rule was used.

Decision rule;

$\bar{X}$ =1.00 - 1.49 (aware)

$\bar{X}$ =1.50 - 1.99 (interest)

$\bar{X}$ =2.00 - 2.49 (evaluation)

$\bar{X}$ =2.50 - 2.99 (trial)

$\bar{X}$= 3.00 and above is adoption.

The adoption indices of the respondents were calculated according to Nwalieji *et al*., (2014):

a) Computation of the total mean adoption score per technology. This was computed by dividing the total adoption score by the number of respondents involved.

b) Computation of the grand mean adoption score. This was calculated by adding all the mean adoption scores and dividing by the number of innovations considered.

c) Computation of the adoption index. This was carried out by dividing the grand mean adoption score by 7 (i.e. the 7-stages of adoption).

2.2 Model Specification

Independent probit and logit models have been widely used to analyze factors that influence discrete behaviour such as the adoption decisions (Greene, 1993) in some cases farmers make two interrelated discrete decisions that require some modification of previous approaches. First, is farmers' decision as to whether to adopt or not to adopt a technology? Once a farmer adopts a technology, they decide either to continue or discontinue.

We can specify these decisions independently of each other using probit or logit models. However, such specifications would provide inefficient estimates of the parameters of non adoption models since it ignores the potential correlation between the unobservable (captured by the error terms) of the two decisions, because the non adoption decision is contingent on the adoption decision. This can be fully addressed by a bivariate probit with sample selection option (Aklilu and Graaf, 2007).

The models in this study are based on the assumption that non adoption is likely to be impacted by many of the very factors that influence adoption (Motuma et al., 2002). These factors are related to technology attributes such as; complexity of technology, affordability, adaptability, durability, time consuming, environmentally friendliness and technical competence.

The model parameters are estimated by maximizing this log likelihood function with respect to parameters that is, the parameters reported in the paper are those of which the likelihood function is at maximum.

The estimate of bivariate probit model has the following specifications;

$$y = \beta_o + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 + e_1$$

Where,

y = 1, if a farmer decides to adopt all apiary technology packages, 0 otherwise.

β_o = A vector of estimated parameter

β_1 = Complexity of technology (yes = 1, otherwise 0)

β_2 = Affordability (yes = 1, otherwise 0)

β_3 = Adaptability (yes = 1, otherwise 0)

β_4 = Durability (yes = 1, otherwise 0)

β_5 = Time consuming (yes = 1, otherwise 0)

β_6 = Environmentally friendliness (yes=1, otherwise 0)

β_7 = Technical competence (yes = 1, otherwise 0)

$\beta_o - \beta_7$ = parameters to be studied

e_1 = Error term

3. Results and discussion

3.1 Socio economic Characteristics of Apiary Farmers

The socio-economic characteristics of respondents are shown in Table 1. The result reveals that majority (93.33%) the farmers were males while, 6.67% were females. This result indicates that beekeeping in the study area is dominated by males. Probably because women are involved in domestic activities as they perceive beekeeping as a dangerous enterprise because of the fear of bee stings. The mean age of the respondents was 38.50 years, which implies that the farmers were in their productive ages and are capable of handling the rigorous activities in beekeeping. Also, 43.33% of the farmers acquired secondary education with mean farming experience 11.5 years. Education has to do with the ability to acquire new knowledge and use relevant information of technologies. The level of education is sufficient enough to support adoption of technology through information sharing and distribution. The result tallies with the assertions of Imo and Essien (2005) that education increases adoption and enhances farmers' ability to understand and evaluate new production techniques. Years of farming experience has shown to help farmers bear risk - averse technologies and make decision on the benefits accruing from it. The findings revealed that mean annual farm income of the apiary farmers was ₦175, 500.00 (973.97USD), while 36.67% of them ascribed that they had bi-monthly contact with extension and owned a mean of 9 hives. The implication of extension contact result could affect farmers' knowledge on modern bee farming management practices (Chah *et al*., 2013).

3.2 Levels of Adoption of Apiary Technology Packages of the Programme in Cross River States, Nigeria

The distribution of farmers according to adoption of apiary technology components is shown in Table 2. The result reveals that Cross River State IFAD farmers adopted apiary technology packages such as, setting of hive ($\bar{x}$=3.6) and baiting of bee hives ($\bar{x}$=3.1). The total mean adoption score of the technology was 2.5. This indicates that technology was at the Trial stage, since the adoption score fell within a range of 2.50 – 2.99. Furthermore an adoption index of 0.32 for the apiary technologies means that the farmers had 32% adoption of the technologies. The non adoption of apiary technology may be linked to technology attributes which influences adoption of an innovation by farmers (IITA, 2001 and Rogers, 1995).

Table 1. Distribution of Selected Socio-economic Characteristics of IFAD Farmers in Cross River State, Nigeria.

Variables	Frequency	Percentage	Mean
Gender			
Male	56	93.33	
Female	4	6.67	
Age (years)			
26 – 35	7	11.67	
36 – 45	45	75.00	38. 50 years
46 – 55	8	13.33	
56 - 65	2	3.33	
Education			
No Formal Education	7	11.67	
Primary School Education	23	28.33	
Secondary School Education	26	43.33	
Tertiary School Education	3	5.33	
Farm Experience (years)			
1 – 5	19	31.67	
6– 10	30	50.00	
11 – 15	9	15.00	11.5 years
15 – 20	2	3.33	
Annual Farm income (₦)			
50, 000 – 100,000	5	8.33	
101,000 – 150,000	16	26.67	₦175,500.00 ($ 973.97)
151,000 – 200,000	29	48.33	
Extension Contact			
None	7	11.67	
Weekly	12	20.00	
Fortnightly	7	11.67	
Monthly	12	20.00	
Bi- monthly	22	36.67	
Number of Beehives			
1 – 5	20	33.33	
6 – 10	30	50.00	9 hives
11 – 15	10	16.67	

Table 2. Distribution of Farmers According to Levels of Adoption of Apiary Technology Packages in Cross River State, Nigeria.

Technology Packages	Unaware	Aware	Interest	Evaluation	Trial	Accept	Reject	Total	Mean
Setting / location of hive	4	3	6.	10	15	20	2		
	(0)	(3)	(12)	(30)	(60)	(100)	(12)	223	3.6
Cleaning of hive/	16	11	3	4	9	7	10		
Inspection of hive	(0)	(22)	(6)	(12)	(36)	(35)	(60)	171	2.8
Baiting of hive	6	6	10	12	12	10	4		
	(0)	(6)	(20)	(36)	(48)	(50)	(24)	184	3.1
Smoking/supering of hive	13	12	10	5	7	6	7		
	(0)	(12)	(20)	(15)	(28)	(30)	(42)	147	2.4
Harvesting of honey	13	15	10	6	8	5	3		
	(0)	(15)	(20)	(18)	(32)	(30)	(18)	123	2.1
Processing of honey	15	19	10	5	5	4	2		
	(0)	(19)	(20)	(15)	(20)	(20)	(18)	112	1.9
Total Mean Adoption Score									174.8
Mean Adoption Score									2.91
Adoption Index									0.32

*Figures in parentheses are Likert values multiplied by frequencies

Table 3. Bivariate Probit Regression Estimates of the Influence of Technology Attributes on Non Adoption of Apiary Technology in Cross River State, Nigeria

Variables	Parameters	Standard Error	Coefficients	t-ratio
Constant	β_o	- 7.432	- 2.367	- 4.987***
Complexity of technology	β_1	- 3.453	- 1.0523	- 3.153***
Adaptability	β_2	-1.457	- 0.956	- 3.071***
Durability	β_3	0.114	0.047	0.024
Time consuming	β_4	0.543	0.002	0.451
Affordability	β_5	0.815	0.001	0.088
Technical competence	β_6	- 2.409	- 0.232	- 2.013**
Chi^2	$\varkappa^2$			21.23***
Pseudo R^2				0.682
Log likelihood				245.231

3.3 Determination of Technology Attributes Influencing Non Adoption of Apiary Production technologies

The results in Table 3 shows the bivariate probit regression estimates of the influence technology attributes on the non adoption of apiary technology in Cross River State, Nigeria. The Chi^2 (x^2) of 21.23, was highly significant at 1.0% level of probability indicating goodness of fit of the bivariate probit regression line. The pseudo R^2 of 0.682 indicate 68.20% variability in probability in the non adoption of apiary technology by farmers in the study area.

The coefficient for complexity of technology was negative and significant at 1.0 % level of probability. This implies that any increase in complexity of technology is expected to lead to decrease in probability to adoption of apiary technology in the study area. Harris *et al*., (1995) opined that when a technology is complex farmers tend to lose interest thereby leading to discontinuance of the technology by the beneficiary farmers.

The coefficient for adaptability of technology was negative and significant at 1.0% level of probability. This implies that any increase in adaptability of technology will probably lead to decrease in the adoption of apiary technologies in the study area. This is in conformity with *a priori* expectation probably because bee keeping requires selective environment to enable hives to colonize easily. This makes it difficult for bee farmers to identify the natural environment taking cognize of the fact that there are special plants and flowers that attract bee for pollination restricting them to far places rather than as a homestead business. In addition the type of wood used in constructing the hives is also a determinant for the hives to colonize (Atanda, 2010). Udeh *et al.*, (2011) opined that at present, there is limited knowledge of the behaviour of tropical races of *Apia mellifera* which most bee farmers described as ferocious temperamental, apt to abandoning their hives any time.

The coefficient of technical competency is negatively signed and significant at 5.0% level of probability and is in line with *a priori* expectation. This implies an increase in technical competency will lead to a corresponding decrease in adoption of apiary technology. Technologies that require high skilled and technical competence is adversely affected by the educational status of the farmer. The farmer therefore needs competency in knowledge, skills and techniques involved in the efficient management of apiculture practices to maximize production. Farmers' competences in apiculture could be enhanced through persuasion to adopt agricultural innovations, by transferring technology and knowledge from scientists to farmers to trigger development. Rogers (1995) assert that technologies developed by researchers and disseminated to farmers must be concise and simple to the target farmers understanding. Bee farming requires skills especially in using smokers before routine check on the bee hives to ascertain whether it has colonized or needs relocation. Also certain gadgets used in the business are improvised (locally made) instead of the recommended one, thereby making beekeepers feel insecure because of bee stings. This handicap has made extension workers and subject matter specialists to be biased over beekeeping component, rather they concentrate on disseminating crop production technologies. The chi^2 (x^2) value of 21.23 was significant at 1.0% level indicating `that the bivariate probit regression was a good fit. The pseudo R^2 of 0.682 indicate 68.2% variability in non adoption of apiary production technologies as explained by the technology attributes.

4. Conclusion and Recommendations

Result from the study showed that adoption of apiary technologies among IFAD farmers in the study area was in the trial stage, whereby only two (setting of hive and baiting of bee hives) out of six technology components were adopted by the farmers. Complexity of technology, adaptability of technology and technical competence were Education, pond size, farm income and extension contacts were attributes that influenced farmers' non adoption of apiary technologies in the study area.

It is therefore recommended that;

1. Frequent training and re-training of extension staff was advocated for effective delivery of apiary technologies to benefitting farmers in the study area.

2. Apiary farmers should be encouraged to form cooperative societies. This will facilitate easy access to credit and recommended apiary materials such as wears, smokers and hives.

3. Campaign on beekeeping should be intensified by relevant authorities in the media, schools and communities to diffuse peoples' perception that beekeeping is a dangerous venture.

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