PROPENSITY OF COWPEA (*VIGNA UNGUICULATA*) FARMERS TO ADOPT NEEM IN CONTROLLING PEST IN DELTA STATE, NIGERIA

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ABSTRACT

This study was conducted to determine the factors that influence the propensity of cowpea farmers to adopt neem in controlling pests in Delta State, Nigeria. Data were collected from a sample population of 125 cowpea farmers from ten randomly selected Local Government Areas of Delta State. The data were elicited from the respondents with the use of structured interview schedule and questionnaire, while descriptive statistics and multiple regression analysis were used to analyze the data. The recommended neem technologies at different stages of adoption process were neem seed oil/extract; neem leaves solution, neem seed powder, and neem kernel powder. The grand mean adoption score and adoption index were 0.70 and 0.140 respectively. The low level of adoption was attributed to lack of extension contact, scarcity of neem, and poor level of subscription to farmers' groups. The level of education, age of farmers, farm size, farm income, household size, extension contact, membership of farmers' groups, cost of technology were the major factors that influenced the propensity of cowpea farmers to adopt neem technologies in pest control at 0.05 level of significance. It was recommended that more extension agents be employed; progressive approaches to extension delivery be encouraged and propagation of neem plants be encouraged.

INTRODUCTION

The best control of the numerous pests that attack cowpea, *Vigna unguiculate* (L) is largely obtainable by the use of synthetic insecticides (Jackai 1993). The use of insecticides (pesticides) increases cowpea yields tremendously. However, because of the high cost implication, these synthetic insecticides are out of the reach of most cowpea farmers, considering their small holdership scale of production (Jackai and Daoust 1986; Afun *et al.* (1990). As a result, cowpea grain yields in Africa are abysmally low (50 – 150kg/ha) (Jackai 1993). Apart from the grains farmers also benefit from the fodder yields which they use to feed their livestock.

Frivolous insects like *Orthopterans* infest cowpea and severely reduce the quantity and quality of both the grains and fodder yields. This implies losses in both grain and fodder. Other measures used to reduce insect damage to cowpea are biointensive approaches that rely more on manipulating the plant or its environment. These include use of resistant varieties habitat modification and biological control. Inspite of the use of these methods, Jackai (1993) ob-

serves that control may not be optimal because of great diversity of pests involved. This prompted the investigation into alternative insecticide.

It is a widely known fact, in this era of environmental awareness that the use of synthetic pesticides pose some environmental problems, which makes it unsuitable for farming. However, as asserted by Amason *et al* (1989), there are insecticides of plant origin that can be used without the problems associated with synthetic chemicals. One of such plants that have been widely studied in this context is the neem tree, *Azadirachta indica.* According to Schmutterer (1990), its derivatives are also known to have distinct antifeedant and growth inhibitory effects.

Schmutterer (1985); Jacobson (1986); Saxena (1989) obseve that neem products have shown activity on a wide range of insects pest of many crops worldwide. In their study, Ulrichs *et al.* (2001) discovered that commercial neem, NeemAzal – T/S significantly reduced the number of *A. craccivora* in cowpea. Similarly, Epidi *et al.* (2005) reported that *Aroplocremis curpes* and *Clavigralla shadaba* can be con-

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trolled with neem seed extract. Emeasor *et al.* (2005) suggested that neem seed powder from *Azadirachta indica* was effective on stored cowpea grains pest, *Callosoabrunchus maculatus.*

In Nigeria, organic pesticide is being preached to farmers as a result of its environmental and human health friendliness especially in this era when the effect of human activities on the environment is being felt adversely. Akinbode (1982) as cited by Ofuoku *et al.* (2008) opined that the Agricultural Development Programme (ADP) was designed to stimulate and motivate small scale farmers to use modern techniques through extension service. The extension service has a vital role to play in solving the menace of field and storage pests of cowpea through farm extension education. This implies that extension service has very important role to play in order to increase and improve cowpea production through their linkage between researchers and end-users The available neem seed products include neem kernel extract and neem seed powder. However, there is need to advance reasons why cowpea farmers do not adopt these neem seed based technologies. Without extension service, most research endeavour will be futile exercise (Adebolu and Ikotun 2001). The adoption level of neem seed products is an index of the success of extension delivery service.

This study was carried out to investigate the factors that influenced the propensity of adoption of neem seed technologies and specifically to determine the level of adoption of neem seed technologies; ascertain the adoption index and identify the factors that influence farmer's propensity to adopt neem seed technologies among cowpea farmers in Delta State, Nigeria. It is therefore hypothesized that the socio-economic characteristics of farmers and technology related factors do not significantly influence their propensity to adopt neem pest control technologies.

Theoretical framework
Farmers are engaged in decision making on daily basis to settle questions which arise from the day-to-day and season-to-season operations of the farm (Agbamu 2006). Similarly, they are involved in decision making as a result of their daily experiences on their farms. This indicates

mental confrontation with the structure of ideas, problems and the settlement of these issues into concrete action guidelines or actionable opinions (Ofuoku *et al.* 2008). It involves taking into account all factors neither the farm's production and social environment, making choices, discriminating on the basis of feasibility, and have identifying consequences for alternative actions.

Farmer's propensity to adopt technology is prompted by such challenges they confront while carrying out their farming activities. In this process, the farmer's sources of information fundamentally determine the decision they make or take. Agbamu (2006) suggest that sources of information and acquired knowledge from those sources constitute the foundation on which decisions of farmers are based. Consequently, the sources of information which farmers depend on to improve their production level gird the theoretical issues in decision-making of the farmers.

The technology (neem seed products in this case) related factors such as accessibility to the technology, the complexity and the relative advantage of the technology are equally as fundamental as the sources of information. All the aforementioned technology related factors guide the farmer's adoption decision, hence propensity to adopt.

A conceptional framework for decision-making on neem seed products adoption consists of sources of neem seed products information; neem seed technologies to use; decision criteria/technology related factors that the farmers must use ; stages of adoption; and the preserved benefits from the adoption of neem seed products.

The socio-economic characteristics of the farmers cannot be over-looked as they contribute immensely to propensity to adopt neem seed products. Neem seed products adoption benefits will be attained if the farmers do not encounter challenges in decision making. The conceptual framework for analyzing decision-making in Figure 1 is therefore educational level; age of farmers; farm size; households; farm income; extension contact; membership of farmers' group; contact with other farmers/ friends; cost of neem seed products (money)

cost of neem seed (health); availability; complexity of technology relative advantage.

Farmer's decision for or against the adoption of any science – based technology is described as a mental process, consisting of several stages Ofuoku *et al.* (2005). Such activity will provide firm knowledge on which action could be based, with regard to persuading farmers to try new technologies, to provide the information necessary for actual implementation, and provide information needed to assess results of decisions and hopefully to confirm it.

METHODOLOGY

This study was conducted in Delta State, Nigeria. The state is demarcated into three agricultural zones namely: north, central and south agricultural zones. It consists of 25 local government areas (LGAs). The multi-stage random sampling method was applied in the selection of the respondents. Ten local government areas were randomly selected from the 25 LGAs. Farmers were then selected randomly form a list of cowpea farmers in each of the selected Local Government Areas on the basis of 10%; This list was provided by Delta State Agricultural Development Programme (DTADP) extension agents in each of the Local Government Area (extension block) selected. This gave a total number of 125 cowpea farmers.

The data for the study were collected by using structured interview schedule for less formally educated and those who had no formal education, while questionnaire was used for better formally educated farmers. The service of enumerators drawn from among agricultural science teachers in the selected Local Government Areas was employed. The collected data were analyzed using descriptive statistics such as frequency percentage and means; while multiple regression analysis was used to address the hypothesis. The adopters were categorized into low, medium and high with those who adopted 0 - 1 technology, 2 technologies and above 2 technologies respectively. The level of adoption, the dependent variable, was determined by counting the number of neem technologies adopted by the cowpea farmers in the study area. Adoption index was computed by dividing the grand mean (overall) adoption score by the number of adoption stages. The multiple regression model is implicitly specified as follows:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 + b_9 x_9 + b_{10} x_{10} + b_{11} x_{11} + b_{12} x_{12} + b_{13} x_{13}$$

Four functional forms of mode, linear, double log and semi-log were fitted to determine the best of fit. The level of significance used was 5%.

Y	Level of adoption of neem technologies (number of technologies)
X_1	Level of education (years)
X_2	Age of farmers (years)
X_3	Farm Size (ha)
X_4	Household size (number of persons in household)
X_5	Farm Income (N)
X_6	Extension contact (number of visits by extension agents
X_7	Membership of farmer's group (dummy – yes = 1 No = 0)
X_8	Contact with friends (Number of times visits friends)
X_9	Cost of neem technology
X_{10}	Health cost (N)
X_{11}	Availability (dummy, Yes = 1, No = 0)
X_{12}	Complexity of technology (Dummy, Simple = 1, Not simple = 0)
X_{13}	Relative advantage (has advantage over previous tech = 1, has no = 2)
e	Error term

RESULTS AND DISCUSSION

Level of adoption of neem technologies
To estimate the level of adoption of the identified four recommended technologies, which are used at various stages – field and postharvest, by the farmers, adoption score and index were comp0uted. These scores were arranged in descending order for all the technologies. Farmers were categorized into low, medium and high levels of adopters. This breath showed that the adoption level was generally low as most (70.4%) of the cowpea farmers fell under the category (Table 1).

Table 1 and 2 indicate that the cowpea farmers are yet to fully adopt most of the neem pest control technologies. The low adoption levels, according to the respondents emanated from scarcity of neem trees in the study area inadequate numbers on unavailability of extension agents to introduce, teach and demonstrate the technologies to them, and poor level of subscription to farmers' groups/associations.

Table 1: Distribution of farmers according to neem technologies adoption score

Adoption score	Frequency	Percentage (%)
Low (0 – 1)	88	70.4
Medium (2)	22	18.4
High (>2)	14	11.2
Total	125	100

The observation non-availability of extension agents were congruent with the findings of Ofuoku *et al.* (2005) who affirmed that lack of extension contact was the most serious problem besetting adoption of technologies. This calls for a change of approach to extension delivery. Ofuoku *et al.* (2008) suggests that farmers field school and farmer group, approaches that emphasize participatory demonstration and technology development are very useful in this situation.

These approaches will enable the few extension against to reach many farmers at the same time and consequently, every farmer in his block will be reached. These approaches employ the principles of adult and experimental learning and as such, the extension agent be-

Table 2:Distribution of farmers according to adoption on neem seed pest control technologies

Adoption stages	Seed oil/ extract	Leaf Solution	Neem Seed powder	Neem Kernel powder
Awareness	7.2	22.4	3.2	6.4
Interest	14.4	10.4	18.4	13.6
Evaluation	32.0	24.8	22.4	17.6
Trial	28.8	10.4	16.8	30.4
Adoption	17.6	12.0	18.4	22.4
Rejection	0	20.0	12.8	9.6
Total	100	80.0	79.2	90.4
Mean Adoption Score	0.80	0.64	0.63	0.72

Mean of means (Grand mean) adoption score = 0.70
Adoption Index   =   0.140

comes a facilitator of knowledge creation; such a situation makes farmers to become motivated to become interested in further learning and technology development through experimental learning. The replacement of the traditional, World Bank training and visit system (t & v) by these approaches will improve the adoption index of farmers in the future as the new approaches promote motivation through adult learning and technology development. The use of contact farmers as in the training and visit approach cannot be tenable in the present day situation, since the contact farmer has no teaching skills of extension delivery and his own case may be different from that of other farm-

ers in his cell. Information transferred to farmers may be distorted as he may not be able to transfer the technology to the farmers exactly the way it is given to him.

Ofuoku and Urang (2009) discovered that farmers subscribe to groups for the reasons of gaining access to extension service and exchange of ideas/experience among others. The farmers' groups form clearing houses for knowledge and ideas as the members tend to interact on fraternal-like manner. This is more so when they have similar challenges.

Agricultural innovation could, however, be adopted if among other factors, the input and output relationships are favourable, ensure that procurement cost is low, risk of adoption is low, success of the innovation is glaring sooner or later and the innovation simple to handle (Heidues 1994). This implies that apart from the factors related to the farmer, other factors relating to the production process and the technology involved will enhance or inhibit adoption.

Factors that influence the propensity of farmers to adopt neem pest control technologies

The hypothesis of the study states that socio-economic characteristics of the soya beans farmers and technology related factors do not significantly influence their propensity to adopt neem pest control technologies in cowpea production.

The choice of the lead equation was based on the magnitude of the coefficient of determination (R^2), the number of significant variables and the conformity of the signs borne by the variables to *a priori* expectation. The table reveals on R^2 value of 0.851. This implies that 85.1% of the propensity of adoption by the cowpea farmers where explained by the independent variables included in the model. The F-ratio is statically significant. This attests to the fact that the model fits the data. All the variables except complexity of technology (X_{12}) and relative advantage (X_{13}) were statistically significant.

Level of education (X_1) positively correlated with the propensity of farmers to adopt neem seed pest control technologies at 0.05 level of

significance this is in consonance with *a priori* expectation. This means that education is one of the salient variables that enhance propensity of cowpea farmers to adopt neem technologies in pest control. This is congruent with Ofuoku *et al* (2008), who noted that educated farmers readily adopt improved technologies. Ewuola and Ajibefun (2000), Lemchi *et al.* (2003) also noted that technological change is achieved through formal education. Formal education, according to Agbamu (2006), enables farmers to obtain useful information from bulletins, agricultural newsletters and oter sources. Formal education usually aid farmers and lead them to accept improved farm technologies more readily in order to enhance their income them those without formal education (Ofuoku *et al.* 2008).

In Nigeria and other developing countries, generally, most farmers are tradition bond. They are understandably risk averse and will not accept to take risks until they are convinced that new technology is safe, will pay off and will not be at variance with their norms and values. Agbamu (2006) stated that there is the contention that most farmers were tradition bound and a lot has been done by extension workers to erase some of these superstitious beliefs. This

calls for the utilization of the farmer group approach. This will make agricultural extension service more client-oriented thus reducing the risk of an innovation that will violate the tradition and custom of the farmers.

The age of the cowpea farmers (X_2) negatively and significantly correlated with adoption of neem pets control technologies at 5% level of significance. The implication is that the older the farmers become, the more risk averse they are. This confirms the findings of Maduakor (2001) and Lemchi *et al.* (2003) who stated that the older one becomes, the more risk averse he is. This means that a unit increase in farmers' age leads to a unit decrease in his propensity of adoption of technologies by him. As farmers grow older, they find it difficult to adopt technologies.

Farm size (X_3) positively and significantly correlated with adoption of neem pest control technologies. This indicates that cowpea farmers with large farms more readily adopt improved innovations than those operating on small scale. This agrees with Ofuoku *et al.* (2005) who discovered that farmers with large farm sizes readily adopted fish farming technologies. The larger the farm size, the stronger the propensity of farmer to adopt neem cowpea pest control technologies.

Household size (X_4) had positive significant relationship with propensity of cowpea farmers to adopt neem cowpea pest control technologies. This implies that the larger the household size the higher the propensity of cowpea farmers to adopt the neem technologies in pest control. This means that the farmers, in order to increase their income, tend adopt new technologies. Higher income to them, means better standard of living for the household.

Farm income (X_5) also had positive and significant relationship with the propensity of farmers to adopt the neem in controlling cowpea pest. Madukwe (1993) opined that wealth and adoption of innovation go hand in hand. This is the reason why when new technologies are costly because it requires large amount of money initially, the wealthy farmers readily adopt them (Ofuoku *et al.* 2008). The confirms the findings of Eze et al. (2006) and (Ofuoku *et al.* 2008) in their studies on adoption of cassava technologies and fish production technologies respec-

Table 3: Estimates of the Influence of Cowpea farmer's Socio-Economic Characteristics and neem pest control technology

	Coefficient	Standard Error	T- Value	P – value
Constant	0.342	0.915	11.291**	0.000
Level of Education (X_1)	0.320	2.329	2.329**	0.023
Age (X_2)	-0.319	0.413	-2.230**	0.029
Farm size (X_3)	1.292	0.625	0.042**	0.042
Household (X_4)	0.054	0.027	0.044**	0.044
Farm Income(X_5)	5.119	1.672	0.002**	0.002
Extension contact (X_6)	0.069	0.027	0.013**	0.013
Membership of farmer's group (X_7)	1.627	0.638	0.013**	0.013
Contact with Friends (X_8)	-0.036	0.018	0.049**	0.049
Cost of neem technology (X_9)	2.728	0.151	18.060**	0.000
Health cost (X_{10})	0.147	0.176	1.862**	0.065
Availability of neem (X_{11})	0.355	0.030	11.900**	0.000
Complexity of Technology (X^{12})	0.342	0.579	0.591	0.556
Relative advantage (X_{13})	0.084	0.048	0.745	0.172
R2	0.851			
F – Ratio	3.266**			

tively. The cowpea farmers who adopted most of the neem pest control technologies were the rich ones as observed in the study area.

Extension contact (X_6) positively and significantly correlated with cowpea farmers' propensity to adopt neem technologies in controlling cowpea pests at 0.05 level of significance. This emanate from the fact that the more extension agents visit the farmers and educate them on the use of neem technologies in controlling cowpea pests, the better that understand and adapt them. This is congruent with Asiabaka (1996), Eze *et al.* (2006) and Ofuoku *et al.* (2008) who reported that the frequency of extension contact influences the adoption behaviours of farmers. This is an indication that more frequent extension-farmer contact promotes the propensity of farmers to adopt neem technologies in controlling cowpea pests. Such frequent contact is nurtured by a change to farmer field school approach to extension delivery, as participation of the farmers in the technology development, based on adult learning principles and experimental learning motivates them (Ofuoku *et al.* 2008). This is known to facilitate farmers to choose, test and adopt technologies according to their needs.

Membership of farmer's group (X_7) had a positive and significant relationship with propensity of farmers to adopt the neem technologies for the control of pest of cowpea. Ofuoku and Urang (2009) observed that farmers subscribe to various farmer's groups in order to access extension service and exchange experiences and ideas among others. The correlation between subscription to farmer's groups and propensity to adopt the innovation emanates from the fact that in these group, as they exchange their experience and ideas, they learn from each other and get a lot of useful information. Such groups are clearing houses for experiences, ideas and knowledge. Most extension services are now carried out in groups. For farmers to have easy and quick access to extension services they have to subscribe to such groups.

Contact with friends (X_8) had significant negative relationship with farmers propensity to adopt neem technologies or the control of cowpea pests. This is contrary to *a priori* expectation as it implies that increase in frequency of the farmer's visits to friends would result to reduced propensity to adopt the technologies. However, the negative relationship may have resulted from the fact that the friends were conservative and culture bound. More frequent contact with these friends made the friends to have great influence on the farmer's thoughts and attitudes towards new innovations.

Cost of neem technologies (X_9) positively and significantly correlated with propensity of farmers to adopt neem technologies in the control of cowpea pests. Low cost of innovations enhances access of every farmers, especially the small scale farmers to such innovations. This means that if the financial cost involved is low, there is the tendency that almost very farmer who needs such technology will procure and adopt it. This is an indication that the cost of procurement of neem technologies is low and this has enhanced its adoption.

Health cost (X_{10}) had a positive correlation with farmers' propensity to adopt neem in the control of cowpea pests. The farmers discovered that they were not injurious to their health, hence they appreciated and adopted them. Every human being values his or her life and the farmers is not an exception to such fact. Availability of neem (X_{11}) was positively significant with propensity of farmers to adopt neem technologies for cowpea pest control. No farmers can adopt a technology that is not available. Availability of neem for the preparation of the technologies by the farmers enhanced their propensity to adopt them. They saw that they would always get it to use easily so they highly welcomed it.

CONCLUSION

Adoption level of neem seed technology is low. This is confirmed by the low grand mean adoption score computed as 0.70, while the index was 0.140. Some of the reasons for non-adoption of the improved technologies were given as scarcity of neem trees, inadequate number of and unavailability of extension workers and poor level of subscription to farmer's groups.

The level of education, farm size, household size, farm income, extension contact, membership of farmer's groups, cost of neem, health cost, and availability of neem were positively

and significantly correlated with the propensity of farmers to adopt neem technologies for cowpea pest control. However, age and contact with friends had negative significant relationship with propensity to adopt the technologies.

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