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ACCESS TO CREDIT AND ITS INFLUENCE ON COCOA FARMERS' WILLINGNESS TO PAY FOR EU-APPROVED PESTICIDES IN ONDO AND OSUN STATES

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Abstract: *The efficient use of certified and environmentally safe pesticides is essential to sustaining cocoa production in Nigeria, particularly as international markets increasingly demand compliance with residue and quality standards. In the cocoa sector, EU-approved pesticides are recommended for effective pest and disease control; however, their adoption depends largely on farmers' capacity and willingness to pay for these inputs. A clear understanding of how credit access and other socioeconomic factors influence willingness to pay is, therefore, necessary to support farmer compliance. This study investigated the effect of credit access on cocoa farmers' willingness to pay for EU-approved pesticides in Ondo and Osun States, Nigeria. A multi-stage sampling procedure was used to select 240 cocoa farmers. Data were analysed using descriptive statistics, the double-bounded contingent valuation method, and a logit regression model. The results showed average values of 46 years for age, 23 years for farming experience, 7 persons for household size, and 8.54 hectares for farm size. The majority (85%) of farmers expressed willingness to pay for EU-approved pesticides, with 62.5% willing to pay a 25% premium above the market price. Logit regression estimates revealed that gender, age, marital status, education, access to extension services, cooperative membership, quantity of pesticide used, household size, farm size, and access to credit significantly influenced willingness to pay. Credit access in particular increased the probability of willingness to pay, indicating that liquidity constraints play a major role in the adoption of approved pesticides. The study concluded that access to credit is a critical determinant of cocoa farmers' willingness to pay for EU-approved pesticides. This suggests that policy interventions aimed at improving pesticide compliance must incorporate strategies that strengthen farmers' access to affordable credit. The study recommends that young farmers be encouraged to participate in cocoa production, cooperative associations be strengthened, and*

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INTRODUCTION

The cocoa tree (Theobroma cacao) remains one of Nigeria's most economically significant perennial crops due to its adaptability to diverse agro-ecological conditions and varying soil and climatic environments (Ogunjimi & Farinde, 2012; Kehinde et al., 2016; Kolawole et al., 2020). Currently, fourteen states—Abia, Adamawa, Akwa Ibom, Cross River, Delta, Edo, Ekiti, Kogi, Kwara, Ogun, Ondo, Osun, Oyo, and Taraba—actively engage in cocoa cultivation, collectively contributing a substantial share of national supply (Oluyole & Sanusi, 2009; Adeola et al., 2021; Kehinde et al., 2021; Oyenpemi et al., 2023). Production in these regions is dominated by smallholder farmers for whom cocoa functions not only as a primary income source but also as a foundation of livelihood security (Amujoyegbe et al., 2018; Adeniyi & Adebayo, 2022). Beyond farm-level importance, cocoa generates employment across the value chain—harvesting, fermentation, drying, processing, transportation, and marketing—positioning it as a key driver of rural development and poverty reduction (FAO, 2023; Kehinde & Ogundeji, 2023; Kolade & Komolafe, 2021). Nationally, cocoa remains a major foreign exchange earner, with output for the 2023/2024 season estimated at 320,000–350,000 tonnes (BusinessDay, 2024; ICCO, 2024). The crop also supports state and local government finances through taxes and levies. Recognising its eco-

nomic potential, the Nigerian government has increasingly prioritised cocoa as a strategic non-oil export commodity for economic diversification and rural growth (Adesiyan et al., 2023; FAO, 2023; Nwankwo et al., 2022). Cocoa production further stimulates numerous agro-industrial and service activities, including agrochemical distribution, packaging, and transport logistics (Adeniyi & Adebayo, 2022).

Despite its economic relevance, cocoa production continues to be undermined by pervasive pest and disease pressures. These biotic stressors—including mirids, cocoa pod borer, and black pod disease—can cause yield losses of up to 45 percent, with severe outbreaks resulting in losses exceeding 80 percent (Mokwunye et al., 2012; Adepoju et al., 2021; Kehinde & Tijani, 2021). Consequently, farmers increasingly rely on pesticides to manage field and storage pests (Bateman, 2010; Faloni et al., 2022). Proper pesticide application supports plant health, stabilises yields, and enhances bean quality for domestic and export markets (Damalas & Eleftherohorinos, 2011; Alabi et al., 2022). However, recent studies report rising concerns about harmful residues—particularly organophosphates and organochlorines—on cocoa beans from Nigerian producing regions, which threaten food safety and jeopardise international market access (Oluwajobi et al., 2023; Akande et al., 2023; Adeoye et al., 2021). The European Union (EU) maintains strict Maximum Residue Limits (MRLs), requiring cocoa imports to meet thresholds of 0.01 mg/kg for several pesticide compounds (ICCO, 2008; EU Commission, 2021). In response, the Nigerian government has promoted a list of EU-compliant pesticides, including Actara 25WG, Esiom 150SL, Funfurun-OH, Champ DP, Ridomil Gold 66WP, Ultimax Plus, Kocide 2000, Roundup Clear Weed, Touchdown, and Phostoxin, supported by farmer enlightenment campaigns and extension programs (FMARD, 2022). Nevertheless, many farmers continue to use banned or unapproved chemicals due to cost constraints, misinformation, and limited access to EU-approved inputs (Olayemi & Adegbola, 2020; Oluwajobi et al., 2023; Kehinde & Tijani, 2024). This persistent non-compliance underscores the need to understand the determinants of farmers' decisions regarding the purchase and proper use of approved pesticides.

A critical issue that emerges is whether farmers are willing and financially able to pay for EU-approved pesticides, which are often more expensive than widely available alternatives. Willingness to Pay (WTP)—the maximum monetary value a farmer is prepared to offer for an input—reflects perceived benefits such as higher yields, improved bean quality, or better access to premium export markets (Marine Le Gall-Ely, 2009; Oke et al., 2019; Adesiyan & Kehinde, 2024). In the cocoa sector, WTP is shaped by socioeconomic and institutional characteristics, including income, education, household size, farm size, market access, and risk perceptions (Adedeji et al., 2023; Kehinde et al., 2024). Among these, access to credit is particularly influential, as it enables farmers to overcome liquidity constraints and purchase costly but compliant inputs (Kehinde & Alabi, 2025; Kehinde et al., 2025). Extensive empirical evidence shows that access to credit increases farmers' adoption of improved technologies such as fertilizers, certified seeds, and approved pesticides (Ojo & Kehinde, 2021; Bawuah et al., 2022; Kehinde, 2025). Yet many cocoa farmers lack access to credit due to inadequate collateral, unfavourable interest rates, and limited financial awareness, hindering their ability to purchase EU-approved pesticides despite recognising their benefits (Adedeji et al., 2023; Ayanlade & Ojebisi, 2024). Despite this well-acknowledged relevance of credit, empirical studies specifically examining how credit access influences cocoa farmers' WTP for EU-approved pesticides remain scarce, representing a key knowledge gap. Addressing this gap is vital because WTP shapes long-term adoption, compliance with international standards, and the global competitiveness of Nigeria's cocoa exports.

Against this backdrop, the present study examines how access to credit affects cocoa farmers' willingness to pay for EU-approved pesticides in Ondo and Osun States—two of Nigeria's leading cocoa-producing regions. These states provide a suitable context for assessing how differing socioeconomic conditions and credit environments shape farmers' purchasing behaviour. The first objective is to describe farmers' socioeconomic characteristics, including age, education level, income, farm size, household composition, and access to credit or financial services, thereby establishing the economic context of pesticide purchasing decisions. The second objective is to profile pesticide-use patterns, distinguishing between EU-approved and non-approved chemicals while documenting frequency of use, sources of supply, application methods, and the underlying rationale guiding farmers' preferences. This assessment provides insight into prevailing pesticide practices within the cocoa belt. The third objective is to determine farmers' willingness to pay for EU-approved pesticides by estimating the maximum price they would offer given their socioeconomic conditions and perceived benefits. Finally, the study evaluates the influence of credit access on WTP, testing the hypothesis that farmers with access to formal or informal credit demonstrate higher WTP for compliant pesticides than those without credit access. Findings from this study are expected to inform targeted policy interventions—including input-financing schemes, credit programs, and subsidy mechanisms—aimed at strengthening pesticide compliance, enhancing export competitiveness, safeguarding public health, and improving the livelihoods of cocoa-growing households in Ondo and Osun States.

MATERIALS AND METHODS

Study Area

The study was conducted in Osun and Ondo States, two of the most prominent cocoa-producing areas in southwestern Nigeria. Osun State is located in the south-western geopolitical zone and lies within latitudes 7.0° and 9.0°N and longitudes 2.8° and 6.8°E. The state covers a landmass of approximately 8,602 km² and has an estimated population of 4,137,627 people (NPC, 2006; NPC, 2023 projections). Osun lies between 300 and 600 m above sea level and is characterised by a gently undulating terrain interspersed with low hills. The state experiences a tropical climate marked by distinct wet and dry seasons. Annual rainfall ranges from about 1,125 mm in the derived savannah zone to nearly 1,475 mm in the rainforest belt,

supporting the cultivation of a wide variety of crops. Mean annual temperatures fluctuate between 27.2°C in June and 39.0°C in December, reflecting the influence of the West African monsoon and dry north-easterly winds. Administratively, Osun State comprises 30 Local Government Areas (LGAs) grouped into three senatorial districts, each subdivided into two administrative zones. The state is culturally homogenous, predominantly inhabited by sub-ethnic groups of the Yoruba, such as the Ife, Ijesa, Oyo, and Igbomina, although migrants from other parts of Nigeria also reside in the urban centres. Yoruba and English serve as the principal languages of communication. Agriculture forms the backbone of Osun State's economy, engaging a significant proportion of the rural population. The favourable climatic and edaphic conditions support the cultivation of major food crops, including maize (Zea mays), yams (Dioscorea spp.), cassava (Manihot esculenta), cocoyams (Colocasia spp.), rice (Oryza sativa), and various leafy vegetables (Amaranthus spp.). The state is also notable for its production of cash crops such as cocoa (Theobroma cacao), kolanut (Cola nitida), and oil palm (Elaeis guineensis). Cocoa farming, in particular, provides income for thousands of smallholder farmers and constitutes a vital economic activity that shapes rural livelihoods.

Ondo State, popularly referred to as the "Sunshine State," is also situated in southwestern Nigeria with Akure as its administrative capital. The state lies between latitude 7° 10′ North and longitude 5° 05′ East, covering a total land area of approximately 14,793 km². Ondo State has a population of 3,441,024 people based on the 2006 National Population Census, with projections indicating significant growth over the past decade. The state is divided into 18 Local Government Areas comprising both inland and coastal communities, the latter extending towards the Atlantic shoreline through Ilaje and Ese-Odo LGAs. The people of Ondo State are predominantly Yoruba, speaking various dialects such as Akoko, Akure, Idanre, Ikale, Ilaje, Ondo, and Owo, with pockets of non-Yoruba-speaking groups, including the Ijaw in riverine areas. The state's physical environment ranges from the coastal mangrove belt in the south to lowland rainforest and derived savannah in the central and northern districts. The tropical climate supports a high diversity of agricultural activities with a long rainy season and average annual rainfall well above 1,500 mm in some areas. Ondo State has an agrarian economy with farming, fishing, lumbering, and trading as predominant occupations. It is Nigeria's leading cocoa-producing state, consistently contributing the largest share of national cocoa output. Cocoa production in Ondo benefits from favourable rainfall distribution, fertile forest soils, and a long history of cocoa cultivation dating back to the colonial period. Other important crops produced in the state include rice, yam, maize, cassava, cocoyams, taro, coffee, vegetables, and various fruits. Agricultural production is largely undertaken by smallholder farmers using traditional technologies, although recent interventions by government and development agencies aim to enhance input access, extension services, and value-chain development.

Together, Osun and Ondo States form a major component of Nigeria's cocoa belt and provide an ideal setting for examining cocoa farmers' access to inputs, pesticide use behaviour, and willingness to pay for EU-approved pesticides.

Figure 1: Map of Ondo and Osun States

Sampling Procedure

A multistage sampling procedure was employed to select respondents for the study. In the first stage, two Local Government Areas (LGAs) were purposively selected from each state based on their high concentration of cocoa-producing households. In Osun State, Ife Central and Ife East LGAs were chosen, while Idanre and Ile-Oluji/Okeigbo LGAs were selected in Ondo State. These four LGAs are recognised as major cocoa-producing zones and therefore provide an appropriate setting for assessing farmers' pesticide use behaviour and willingness to pay for EU-approved pesticides. The second stage involved the simple random selection of six cocoa-producing communities from each of the four LGAs, giving a total of 24 communities. This approach ensured that the sample captured geographical and socio-economic diversity within the selected LGAs. In the third stage, a simple random sampling technique was employed to select ten cocoa farmers from each of the selected communities. The community lists of cocoa farmers, obtained with the assistance of local extension agents and community leaders, served as the sampling frame for this stage. In total, 240 cocoa farmers (10 farmers × 24 communities) were selected and interviewed for the study. This sample size was considered adequate for generating reliable estimates and conducting multivariate statistical analysis related to pesticide use and willingness to pay.

Analytical technique

The data collected for this study were analyzed using a combination of descriptive and inferential statistical techniques. Descriptive statistics were employed to summarize and present the socio-economic characteristics of the respondents, including measures such as frequencies, percentages, means, and standard deviations. The Contingent Valuation Method (CVM) was used to estimate respondents' willingness to pay (WTP) for the interventions or services under consideration, providing a monetary valuation of their preferences. Additionally, the logit regression model was applied to examine the factors influencing respondents' binary choices or decisions, allowing for the identification of significant determinants of their behavior.

Descriptive statistics

Descriptive statistics were employed to summarize the

socio-economic characteristics of cocoa farmers and to profile the various types of pesticides they handle, including information on frequency of use, categories of chemicals, and handling practices.

Contingent valuation method

We employed the double-bounded contingent valuation method (CVM) to estimate cocoa farmers' willingness-to-pay (WTP) for European Union (EU)–approved pesticides in this study. The WTP framework is grounded in the stated preference approach, which seeks to obtain valuations for goods or services that lack observable market prices. Under this approach, respondents are presented with a carefully designed hypothetical market scenario and directly asked to indicate the maximum amount they are willing to pay for the good in question (Kimenju et al., 2005). This technique is particularly suitable for evaluating products such as EU-approved pesticides, for which market penetration may still be limited, and price information is not yet well established among farmers. CVM has been widely applied for more than three decades to value non-market goods, including environmental amenities, public services, and agricultural innovations. Its usefulness stems from its flexibility in capturing both use values (e.g., productivity gains from pesticide use) and non-use values (e.g., compliance with export standards or environmental safety). The method is often preferred in contexts where revealed preference approaches—such as market-based or behavioral observation methods—are unfeasible because the relevant markets do not exist or are poorly developed. In agricultural economics research, CVM has proved especially valuable in understanding farmers' preferences for new technologies, input quality improvements, and sustainability-enhancing innovations. Previous studies highlight its effectiveness in eliciting WTP for improved seed varieties, enhanced fertilizer blends, disease-resistant crops, and integrated pest management options (Yadav et al., 2012). Accordingly, its application in this study provides an appropriate and rigorous means of capturing cocoa farmers' valuation of EU-approved pesticides, which are relatively new in the Nigerian cocoa sector and essential for meeting international regulatory requirements, particularly within the European Union export market.

The theoretical foundation of WTP is rooted in utility maximization. Let U(X)represent an individual's preference function, where X=(X_1,…,X_n)denotes a vector of private goods available at market prices:

p=(p_1,…,p_n) (1)

The individual maximizes utility subject to an income constraint y. The indirect utility function is expressed as:

V(p,y)=max{u(x)|p.x≤y} (2)

The dual minimum expenditure function is:

m(v,u)=min{p.x|U(x)≥u} (3)

Differentiating the expenditure function with respect to price yields the Hicksian (compensated) demand function:

x_i^u (p,q,u)=m_pi (p,q,u) (4)

Similarly, the Marshallian (ordinary) demand function is obtained as the negative ratio of the partial derivatives of the indirect utility function with respect to price and income:

$$x_i(p,q,y) = \frac{-V_{pi}(p,q,y)}{V_y(p,q,y)} \quad (5)$$

An individual will therefore express willingness to pay for a good if the purchase increases utility, subject to the income constraint.

The double-bounded dichotomous choice format proposed by Hanemann et al. (1991) was adopted because it enhances the statistical efficiency of WTP estimates by allowing each respondent to provide two price-related responses rather than one. After the initial bid is presented, the respondent is offered a higher follow-up bid if the initial response is "yes" or a lower one if the initial response is "no." This sequential structure generates more information about each individual's underlying WTP and significantly reduces the variance of the estimated parameters when compared with single-bounded formats. In addition, the double-bounded approach yields tighter confidence intervals, increases the precision of the WTP distribution, and minimizes strategic bias that often arises in open-ended formats (Arrow et al., 1993).

To ensure that respondents had a clear understanding of what they were valuing, farmers were first briefed on the key features, safety advantages, residue compliance benefits, and productivity-enhancing effects of EU-approved pesticides. These explanations were complemented with visual aids, labels, and demonstrations to provide concrete illustrations of pesticide use and the regulatory requirements associated with EU markets. This sensitization step was essential because EU-approved pesticides are relatively new in the study areas, and farmers' prior awareness varied considerably. Providing uniform information helped minimize information asymmetry and ensured that WTP responses were based on comparable levels of understanding.

Following the briefing, each respondent was randomly assigned an initial bid price representing the hypothetical cost of purchasing EU-approved pesticides. The double-bounded elicitation procedure is then followed by a structured decision sequence. If the respondent accepted the initial bid ("yes"), a higher follow-up bid was offered to determine whether they were willing to pay more than the first amount. Conversely, if the respondent rejected the initial bid ("no"), a lower follow-up bid was presented to determine the minimum price they would be willing to pay.

This procedure leads to four possible combinations of responses (Kimenju et al., 2005):

Yes–Yes (yy): Respondent accepts both the initial and higher follow-up bid.

Yes–No (yn): Respondent accepts the initial bid but declines the higher follow-up bid.

No–Yes (ny): Respondent rejects the initial bid but accepts the lower follow-up bid.

No–No (nn): Respondent rejects both the initial and lower follow-up bid.

These response patterns provide interval data that allow the researcher to infer bounds around each respondent's true WTP, thereby improving the reliability and robustness of the final WTP estimates.

The corresponding probabilities are expressed as:

$$Pr_{yy}(B, B^u) = 1 - F(B^u) \quad (6)$$

$$Pr_{yn}(B, B^u) = F(B^u) - F(B) \quad (7)$$

$$Pr_{ny}(B, B^d) = F(B) - F(B^d) \quad (8)$$

$$Pr_{nn}(B, B^d) = F(B^d) \quad (9)$$

where:
B= initial bid;
B^u= higher bid for "yes" responses;
B^d= lower bid for "no" responses;
$F(\cdot)$= cumulative distribution function of WTP.

Combining these probabilities, the log-likelihood function for the sample is:

$$InL = \sum_{i=1}^{N}\left[yy_i lnPr_{yy}(B_i, B_i^U) + yn_i lnPr_{yn}(B_i, B_i^U) + ny_i lnPr_{ny}(B_i, B_i^d) + nn_i lnPr_{nn}(B_i, B_i^d)\right] \quad (10)$$

To tailor the double-bounded CVM approach to the specific context of EU-approved pesticides, several steps were undertaken to ensure that farmers' responses reflected informed and realistic valuations. First, respondents were provided with hypothetical yet contextually accurate information regarding the key attributes of EU-approved pesticides, including their productivity-enhancing effects, health and safety implications, compliance with European export standards, and associated environmental benefits. This preliminary sensitization helped create a uniform understanding among cocoa farmers, many of whom had varying degrees of prior exposure to EU-certified inputs. The initial bid price offered to each farmer represented the prevailing market-equivalent cost of EU-approved pesticides. This served as the baseline for elicitation and reflected a price that farmers might reasonably encounter if such products were widely available in the local market. For respondents who accepted the initial bid, higher follow-up bids were sequentially presented at 25%, 50%, 75%, and 100% premiums above the initial price. This ascending bid structure helped determine the upper bound of the respondent's maximum willingness-to-pay. Conversely, respondents who rejected the initial bid were presented with progressively lower bid amounts in line with the double-bounded elicitation framework. This descending sequence made it possible to identify the lower bound of each farmer's WTP and to distinguish between outright non-payers and farmers who were willing to pay but only at reduced prices. By incorporating both upward and downward adjustments to the initial bid, this bidding strategy enabled the study to generate robust interval-based estimates of farmers' WTP for EU-approved pesticides. It also allowed the analysis to capture heterogeneity in price sensitivity, potential liquidity or credit constraints, and farmers' perceptions of the relative benefits of certified EU-compliant pesticide products

Logit regression model

A binary logit regression model was used to examine the effect of credit access on cocoa farmers' willingness to pay (WTP) for EU-approved pesticides. The choice of this model was informed by the nature of the dependent variable, which is categorical and dichotomous—taking the value 1 if the farmer accepts the offered bid for the EU-approved pesticide and 0 otherwise. When the outcome variable captures a yes/no, accept/reject, or willing/not willing decision, discrete choice models such as logit or probit are typically recommended because they are designed to estimate the probability of an event occurring as a function of explanatory variables. Although logit and probit models generally yield similar empirical outcomes, the binary logit model is widely regarded as more practical and advantageous from a mathematical and interpretive standpoint. The logit specification offers ease of estimation, more intuitive interpretation of coefficients through odds ratios, and greater flexibility when modelling behavioural responses to price changes or policy interventions (Foster et al., 1984). These characteristics make the logit model particularly suitable for studies investigating farmers' adoption decisions, perceptions of risk, and valuation of agricultural technologies such as certified pesticides. Furthermore, the application of a binary logit regression aligns with methodological choices in previous willingness-to-pay studies. Several authors have employed logit models to evaluate the socio-economic and institutional factors influencing farmers' WTP for improved agricultural inputs and natural resource management interventions. For example, earlier research has used binary logit models to assess farmers' WTP for irrigation water improvements, water conservation technologies, and agricultural innovations (Kidane et al., 2019; Abdelhafidh et al., 2022; Biswas & Venkatachalam, 2015; Tang et al., 2013). By adopting a similar modelling framework, this study ensures methodological consistency with established empirical literature while allowing for robust estimation of the determinants of cocoa farmers' WTP for EU-approved pesticides—particularly the role of credit access, which is expected to influence liquidity constraints and investment decisions.

The underlying latent WTP variable is expressed as:

$$Y_i^* = \beta^i X_i + \varepsilon_i \quad (11)$$

where:

- β is the vector of parameters to be estimated,
- X_i is the vector of explanatory variables,
- Y_i^* represents the unobservable (latent) WTP for EU-approved pesticides, and
- ε_i is the error term assumed to follow a normal distribution $N(0, \sigma)$.

$$Y_i = \begin{cases} 1 & if\ Y_i^* \geq b_i \\ 0 & if\ Y_i^* < b_i \end{cases}$$

where b_i denotes the bid amount randomly assigned to the i^{th} farmer.

Parameter estimation for the binary logit regression model was carried out using the Maximum Likelihood Estimation (MLE) procedure, following the approach outlined by Greene (2004). MLE is the standard estimation technique for discrete choice models such as the logit because it identifies the parameter values that maximize the probability of observing the sample outcomes given the model assumptions. In other words, MLE selects the set of coefficients that makes the observed pattern of farmers' willingness (or unwillingness) to pay for EU-approved pesticides most likely.

Under the logit framework, the probability that a cocoa farmer iaccepts the offered bid for an EU-approved pesticide (i.e., Y_i=1) is expressed as a logistic cumulative distribution function:

$$L(\mu, \sigma) = \sigma^{-n}(2\pi)^{-n/2} exp\left[-\frac{1}{2\sigma^2}\sum_{i=1}^{n}(\tau_i - \mu)^2\right] \quad (12)$$

The maximum likelihood estimator is:

$$\theta = \frac{1}{n}\sum_{1=1}^{n} x_i \quad (13)$$

Where θrepresents the parameter vector that maximizes the probability of observing the sample responses. Once the parameters were estimated, it was essential to evaluate how well the binary logit model explained farmers' willingness to pay for EU-approved pesticides. To assess the overall goodness of fit, the Hosmer–Lemeshow test was employed. This test is widely used in logistic regression analysis because it compares the predicted probabilities generated by the model with the observed outcomes across subgroups of the sample, thereby assessing whether the model's predictions differ significantly from actual behaviour. In the context of this study, the Hosmer–Lemeshow test provided a formal statistical measure of how accurately the logit model captured cocoa farmers' acceptance or rejection of the offered bid for EU-approved pesticides. A p-value greater than 0.05 indicates that there is no statistically significant difference between predicted and observed values, implying that the model fits the data well (Hosmer et al., 1989). This threshold, therefore, serves as evidence that the explanatory variables—including credit access—appropriately describe variations in farmers' WTP decisions within the sample.

The empirical specification of the logit model used to assess the determinants of cocoa farmers' WTP for EU-approved pesticides is expressed as:

$$Y = \beta 0 + \beta 1X_1 + \beta 2X_2 + \beta 3X_3 + \beta 4X_4 + \beta 5X_5 + \beta 6X_6 + \beta 7X_7 + \beta 8X_8 + \beta 9X_9 + \beta 10X_{10} + \beta 11X_{11} + \beta 12X12 + ei \quad \ldots. \quad (14)$$

Y= willingness to pay ((1=yes, 0=otherwise)

The explanatory variables are: X1= Age of farmers (in years); X2= Sex of the farmer (Male=1, female=0); X3= Education (years spent in formal education); X4= marital status (1= married; 0= otherwise); X5= Farm size (hectares), X6= Farming experience (years), X7= Membership of cooperative (yes=1, no=0), X8= household size (actual number), X9= Quantity (kg), X10= Access to credit (access=1, no access=0), X11= Income (Naira), X12= Access to extension service (access =1, no access = 0).

Table 1 presents the dependent and explanatory variables incorporated into the logit regression model used to determine cocoa farmers' willingness to pay (WTP) for EU-approved pesticides. The dependent variable is a binary indicator coded 1 for farmers who accept the offered bid price and 0 otherwise, consistent with discrete choice modeling approaches used to estimate the probability of adopting improved agricultural inputs (Greene, 2012; Wooldridge, 2010).

The selection of explanatory variables is grounded in theory and supported by empirical studies on technology adoption, farm investment decisions, and pesticide-use behavior. Socio-demographic characteristics such as age, sex, marital status, educational attainment, and household size are included to capture variations in preferences, risk perception, and intra-household decision-making. The a priori expectation for these variables is mixed (±) because their influence may be context-specific. For instance, age may either enhance adoption through accumulated experience or reduce WTP due to risk aversion at older ages (Adesina & Baidu-Forson, 1995; Feder et al., 1985). Education is generally expected to positively influence WTP by improving understanding of the benefits of EU-approved pesticides (Nkamleu & Adesina, 2000), although its effect may vary depending on farmers' exposure to agricultural innovations. Farm-related variables—farm size, farming experience, and cocoa output—are included as indicators of productive capacity and the economic incentives driving investment in certified pesticides. Larger farm sizes and higher output levels are expected to have a positive influence

Table 1. Description of Dependent and Explanatory Variables

Dependable Variables	**Description**	
Willingness to Pay (WTP)	Dummy variable; 1 if the farmer is willing to pay/accepts the bid for EU-approved pesticides, 0 otherwise	
Independent Variables	**Description**	**Expected Sign**
Age	Age of farmer in years (continuous)	±
Sex	Dummy; 1 if male, 0 if female	±
Education	Years of formal education completed (continuous)	±
Marital status	Dummy; 1 if married, 0 otherwise	±
Farm size	Size of cocoa farmland in hectares (continuous)	+
Farming experience	Number of years spent in cocoa farming (continuous)	±
Cooperative membership	Dummy; 1 if member of a cooperative, 0 otherwise	+
Household size	Number of persons in the household (continuous)	±
Quantity of cocoa output	Cocoa output in kilograms (continuous)	+
Access to credit	Dummy; 1 if the farmer has access to credit, 0 otherwise	+
Income	Monthly/annual farm income in Naira (continuous)	+
Access to extension services	Dummy; 1 if the farmer has access to extension services, 0 otherwise	+

Notes: 1. ± indicates that the expected effect could be positive or negative depending on context. 2. + indicates a positive relationship is expected with farmers' willingness to pay.

on WTP because farmers with more commercial orientation tend to invest in productivity-enhancing technologies (Doss, 2006; Langyintuo & Mungoma, 2008). Farming experience may exhibit either a positive or negative sign: experienced farmers may better appreciate the benefits of compliant pesticides, but may also rely on traditional practices, thereby lowering WTP (Uaiene et al., 2009). Institutional and economic variables—cooperative membership, access to credit, income, and access to extension services—are expected to positively affect WTP. Cooperative membership often enhances exposure to new technologies, reduces information asymmetry, and strengthens collective bargaining, thereby promoting adoption (Abebaw & Haile, 2013). Access to credit and higher income levels relax liquidity constraints and enable farmers to invest in certified pesticides, implying a positive a priori sign (Foster & Rosenzweig, 2010). Similarly, extension contact is expected to positively influence WTP by improving farmers' knowledge of safe pesticide use and international market requirements (Anderson & Feder, 2004; Mabe et al., 2018).

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The socio-economic characteristics of the respondents are presented in Table 2. The majority of the respondents (79.2%) are male, indicating that cocoa production in the study area is male-dominated. This aligns with cultural norms in many cocoa-producing communities where men typically control access to farmland and inheritance, and are therefore more actively involved in tree-crop cultivation. Cocoa farming is also labour-intensive, involving tasks such as land clearing, pesticide application, and pod breaking, which often require significant physical effort that discourages female participation. Similar findings are reported by Kehinde and Adeyemo (2017), Amujoyegbe et al. (2018), Adeyemo & Kehinde (2020), and Abidogun et al. (2019). The mean age of respondents is approximately 46 years, suggesting that most farmers are within their economically active years. This age distribution implies a workforce that is still capable of meeting the physical demands of cocoa production, thereby sustaining productivity. This also indicates that although farmers are gradually ageing, they remain productive participants in the cocoa value chain. This trend is consistent with the findings of Omoare et al. (2016), Kehinde and Ogundeji (2022b), and Oladoyin and Aturamu (2022). Age is important because it influences farmers' labour availability, managerial ability, and decision-making style, confirming the observations of Akintelu et al. (2019) and Adeyemo et al. (2020). A majority of the sampled farmers (61.7%) are married, indicating that cocoa producers typically have family responsibilities that may encourage greater commitment to farming. The availability of family labour in married households is also a key factor supporting cocoa production activities. This observation is supported by earlier studies, including Ayanwale et al. (2024), Sowunmi et al. (2019), and Fadipe et al. (2012), which found that marital status is closely linked to labour availability and household economic decisions. Formal education is relatively widespread among the respondents, with 73% having at least some level of formal schooling. Educated farmers are generally better positioned to understand pesticide instructions, interpret extension messages, and appreciate the benefits of using approved chemicals. This may positively influence their willingness to adopt improved production technologies. Similar conclusions were reached by Kehinde et al. (2021), Kehinde (2021), and Awoyemi and Aderinoye-Abdulwahab (2019), who reported that education enhances farmers' capacity to comprehend agricultural innovations. The average household size is approximately seven persons, consistent with the findings of Awoyemi and Aderinoye-Abdulwahab (2019). Large household sizes are common in rural Nigeria and provide an important source of family labour for farm work and domestic activities (Oluponna et al., 2023). This suggests that respondents could rely on household members to support labour-intensive cocoa farming operations.

The mean farm size is about 8 hectares, indicating that the respondents are predominantly large-scale producers compared to typical smallholder farmers in Nigeria. Larger farm sizes may enhance production capacity and provide economies of scale. In addition, respondents averaged 23 years of farming experience, demonstrating a strong accumulation of knowledge regarding cultivation practices, including pest management. This finding is consistent with Kehinde and Adeyemo (2020) and Adekunle et al. (2023), who noted that extensive farming experience improves farmers' decisions regarding pesticide use. Many respondents (61.67%) belong to cooperative societies, suggesting that farmers value collective action as a means of obtaining technical support, accessing credit, and improving market participation. Cooperative membership also facilitates knowledge sharing on good agronomic practices and enhances farmers' capacity to negotiate for better prices. These functions are well documented in the works of Ayanwale et al. (2023). Access to credit is relatively high among the respondents (76.7%). This indicates that financial support plays a significant role in enabling farmers to procure inputs, including approved pesticides. Access to credit has been shown to influence production efficiency and farmers' ability to adopt recommended technologies. The mean farming experience of 23 years further suggests that respondents are well-established in cocoa cultivation and possess substantial expertise to guide production decisions, including pesticide selection. A significant proportion of farmers (83.3%) reported access to extension services. This implies that extension agents play an active role in disseminating information on improved cocoa production techniques and safe pesticide use in the study area. This finding corroborates Alao et al. (2020) and Olupona & Kehinde (2022). About 85% of respondents are aware of approved pesticides, likely due to consistent extension contact and training programmes. Similarly, 83.33% of respondents reported using approved pesticides, indicating strong compliance with recommended chemical use. However, a minority still use non-approved pesticides due to availability challenges, particularly the continued presence of lindane in open markets, as reported by Aminu et al. (2019). Farmers who used approved pesticides highlighted their effectiveness, consistent with the conclusions of Akinneye et al. (2018) and Kehinde et al. (2018).

Table 2: Socio-economic characteristics of the respondents

Variables	Cocoa Farmers
Age (years)	46.37(±13.33)
Male (%)	79.2
Married (%)	61.7
Formal education (%)	73
Household size (#)	7.23 (±3.22)
Access to credit	76.7
Farm size (ha)	8.54(±5.72)
Years of farming experience	22.97(±11.29)
Extension visit (%)	83.3
Cooperative (%)	63.7

Source: Field Survey, 2020

Profile of Pesticides used by the farmers

Table 3 presents the profile of pesticides used by cocoa farmers in the study area. The results reveal that Redforce is the most widely adopted pesticide, with 83.3% of farmers reporting its use, while 16.7% used Radomil. This dominance of Redforce suggests that farmers perceive it as more effective, more readily available, or more affordable—factors consistently shown to influence pesticide choice in agricultural economics (Akinneye et al., 2018; Kehinde, 2022). From an economic standpoint, the preference for Redforce may reflect a rational cost–benefit calculation by farmers, who seek to maximize crop yield while minimizing input costs. Regarding pricing, a majority of farmers (59.1%) purchased pesticides within the ₦300–₦350 range, with smaller shares obtaining pesticides in the ₦355–₦400 range (19.2%) and the ₦300–₦350 band (21.7%). This concentration at lower price points underscores the role of affordability and liquidity constraints in input adoption decisions, consistent with findings in similar smallholder contexts (Abebaw & Haile, 2013; Foster & Rosenzweig, 2010). Economically, this suggests that cocoa farmers operate under tight budget constraints and are price-sensitive, which can influence both the type and quantity of pesticides they purchase. The packaging preferences further illustrate this economic behavior. Most farmers (89.2%) purchased pesticides in sachet form, favoring smaller, more affordable quantities. This aligns with the principle of liquidity management: smallholder farmers often face cash-flow limitations and risk aversion, making it economically rational to buy inputs in manageable quantities that reduce upfront costs and minimize financial exposure (Adegbola & Bamishaiye, 2014; Mabe et al., 2018). Sachets also enable precise application, reducing wastage and aligning expenditure with farm size, thereby enhancing input-use efficiency. The findings indicate that Redforce and Radomil are the predominant EU-approved pesticides among cocoa farmers, with a clear preference for Redforce. The observed patterns in price sensitivity and packaging choice highlight how economic constraints—particularly affordability, cash-flow limitations, and risk management—directly shape farmers' pesticide adoption decisions. These results reinforce prior studies emphasizing that smallholder compliance with recommended pesticide use is closely tied to economic realities rather than purely agronomic considerations (Aminu et al., 2019; Ayemo & Kehinde, 2018; Ayanwale et al., 2023).

Table 3: Profile of Pesticides used by the farmers

Type of Pesticides	Percentage	Supplier
Redforce	83.3	Marketer
Radomil	16.7	Marketer
Total	100	
Unit Prices (₦)	Percentage	Mean
300- 350	59.1	366
355- 450	19.2	366
455- 500	21.7	366
Total	100	SD ±65.57
Quantity	Percentage	
Litre	10.8	
Sachet	89.2	
Total	100	

Source: Computed from field survey, 2020

Willingness to Pay for EU-Approved Pesticides

Table 4 presents cocoa farmers' willingness to pay (WTP) for EU-approved pesticides in the study area. The results indicate that 85% of respondents are willing to pay for certified, environmentally compliant chemical inputs, reflecting a generally positive disposition toward adopting improved pesticides.

This high WTP aligns with prior studies showing that farmers are more inclined to adopt inputs perceived as effective, safer, or compliant with export standards (Akinneye et al., 2018; Kehinde, 2022).

Using the standard mean price of ₦365 per litre, the analysis shows that the majority of farmers (62.5%) are willing to pay 25% above the market price (₦365–₦466). This suggests a relatively strong valuation of EU-approved pesticides, particularly among farmers motivated by yield quality, adherence to international residue standards, and long-term farm productivity. Similar observations were reported by Anang et al. (2015) and

Akpoti et al. (2019), who found that farmers are generally willing to tolerate modest price increases for inputs that enhance productivity or market access. A smaller proportion of farmers (30%) are willing to pay a 50% premium (₦365–₦548), indicating that WTP declines as prices rise. This pattern reflects the well-documented price sensitivity of smallholder farmers, who operate under liquidity constraints and variable income streams (Abebaw & Haile, 2013; Foster & Rosenzweig, 2010).

Notably, none of the farmers is willing to pay a 100% price increase, highlighting a clear economic threshold beyond which additional costs are prohibitive. The observed decline in WTP with rising prices underscores the critical role of affordability in input adoption decisions and is consistent with the law of demand.

Economically, it demonstrates that while cocoa farmers recognize the benefits of EU-approved pesticides, adoption is constrained by cash-flow limitations and risk aversion, a pattern corroborated in similar studies of smallholder agricultural systems (Mabe et al., 2018; Ayanwale et al., 2023).

Table 4: Willingness to pay for EU-approved pesticides

Willingness to pay	Percentage (%)
Yes	85
No	15
Total	100
Price acceptance	
Increase by 25%	62.5
Increase by 50%	30
Increase by 100%	0

Source: Computed from field survey, 2020

Mean price of approved pesticide = N365/litre

Effect of credit access on cocoa farmers' Willingness to pay for EU-approved pesticides

The results of the Logit model indicate that the estimated log-likelihood value was –122.017, and the model was statistically significant, suggesting a good fit to the observed data. The McFadden Pseudo R^2 of 0.47825 implies that approximately 47.8% of the variation in cocoa farmers' willingness to pay (WTP) for EU-approved pesticides is jointly explained by the explanatory variables included in the model. This relatively high pseudo-R^2 reflects the strong explanatory power of the selected socio-economic, institutional, and farm-level factors in accounting for differences in farmers' WTP. Additionally, the Hosmer-Lemeshow goodness-of-fit test confirmed that the model closely aligns with observed outcomes, providing further evidence of its reliability for analyzing determinants of WTP. Table 4 presents the marginal effects of the explanatory variables on cocoa farmers' WTP. Marginal effects offer an intuitive interpretation of how each factor influences the probability that a farmer is willing to pay, while holding all other variables constant. The statistical significance of the log-likelihood value confirms that the variables collectively explain meaningful variations in WTP, reinforcing the robustness of the model. The following discussion interprets the contribution of each variable, highlighting how household characteristics, farm attributes, and institutional factors shape farmers' decisions to adopt EU-approved pesticides.

The marginal effect of gender was positive and statistically significant (0.544), indicating that being male increases the probability of willingness to pay for EU-approved pesticides by 54.4%. This substantial effect highlights the critical role of gender in shaping investment decisions in agricultural inputs. Male farmers often have greater access to productive resources—including land, farm tools, and capital—and generally earn higher farm incomes compared to female farmers. They also tend to exercise stronger decision-making authority within households, allowing them to allocate resources toward adopting improved practices such as certified pesticides. This finding is consistent with Adu-Gyamfi et al. (2019) and Ezekiel (2023), who documented significant gender disparities in the adoption of modern agricultural technologies, emphasizing structural inequalities that influence technology uptake. The result underscores the importance of gender-sensitive interventions aimed at enhancing women farmers' access to productive resources and decision-making power to increase their participation in certified input adoption. Similarly, age exhibited a positive and statistically significant marginal effect (0.043), indicating that each additional year of a farmer's age increases the likelihood of paying for EU-approved pesticides by 4.3%. Older farmers may benefit from accumulated practical experience and knowledge about the risks associated with substandard or banned pesticides, making them more inclined to invest in safer, certified alternatives. They may also have greater awareness of long-term productivity and health implications linked to low-quality inputs, influencing their willingness to pay for quality pesticides. This observation aligns with Leclère et al. (2023), who reported that experience accumulated over time enhances the adoption of improved agricultural inputs. The positive effect of age suggests that policies promoting pesticide adoption could leverage experienced farmers as peer educators or extension partners, thereby encouraging wider adoption among younger or less experienced farmers.

The marginal effect of marital status was positive and statistically significant (0.956), indicating that married farmers are 95.6% more likely to pay for EU-approved pesticides compared to their unmarried counterparts. This substantial effect highlights the important role of household and social structures in shaping investment decisions in agricultural inputs. Marriage often brings additional household labor, reducing the burden of farm work and allowing farmers to focus more on adopting improved practices. It also facilitates cooperative decision-making and shared financial responsibility, creating an enabling environment for investment in higher-quality inputs. This finding aligns with prior studies linking marital stability to greater adoption of modern agricultural technologies (Ezekiel, 2023), suggesting that social support within households can enhance technology uptake. Education exhibited a positive and highly significant marginal effect (1.143), indicating that each additional year of formal schooling increases the probability of paying for EU-approved pesticides by 114.3%. This remarkably strong effect underscores the critical role of education in shaping farmers' awareness, perception of risk, and decision-making regarding safe agricultural practices. Educated farmers are better able to understand pesticide regulations, recognize the potential health and environmental risks associated with substandard or banned chemicals, and appreciate the benefits of adhering to EU standards. They are also more likely to engage with extension services, interpret technical information accurately, and implement recommended practices effectively. This result corroborates Adu-Gyamfi et al. (2019), who emphasized that education enhances the adoption of improved agricultural technologies by equipping farmers with the knowledge and cognitive skills necessary to make informed decisions.

The marginal effect of extension visits was positive and statistically significant (0.044), indicating that farmers with access to extension services are 4.4% more likely to pay for EU-approved pesticides. Extension officers play a crucial role in disseminating knowledge about safe pesticide use, EU compliance standards, and modern agricultural practices. Through training, field demonstrations, and advisory services, extension personnel enhance farmers' awareness of the benefits associated with certified pesticides and provide the technical guidance necessary to facilitate adoption. This finding supports the well-established view that access to extension

services is a key driver of agricultural technology uptake, as documented by Leclère et al. (2023). It underscores the importance of strengthening extension networks, particularly in cocoa-producing regions, to build farmers' capacity to adopt high-quality, certified inputs. Similarly, access to credit exhibited a positive and statistically significant marginal effect (0.044), suggesting that farmers with access to financial resources are 4.4% more likely to pay for EU-approved pesticides. Access to credit alleviates liquidity constraints and enables farmers to invest in relatively higher-cost certified inputs that they might otherwise be unable to afford. It also facilitates the timely purchase of inputs and allows farmers to apply recommended rates, thereby enhancing both productivity and compliance with quality standards. This result aligns with Diagne et al. (2022), who highlighted the pivotal role of credit in enabling smallholder farmers to adopt productivity-enhancing technologies. The positive impact of credit access emphasizes the need for policies and programs that expand affordable financial services for farmers—particularly those cultivating high-value crops such as cocoa—to support the adoption of safe and certified agricultural inputs.

In contrast, household size exhibited a negative and statistically significant marginal effect (–0.865), indicating that each additional household member reduces the likelihood of willingness to pay for EU-approved pesticides by 86.5%. Larger households typically face higher consumption needs and competing financial obligations, which can constrain their ability to allocate resources toward relatively more expensive certified inputs. This negative effect highlights the financial pressures that large households encounter, limiting their capacity to invest in quality-enhancing agricultural technologies. This observation aligns with Ali et al. (2020), who noted that large household burdens often reduce investments in improved farm inputs. Similarly, farm size had a negative marginal effect (–0.073), suggesting that increases in farm size reduce the probability of paying for EU-approved pesticides by 7.3%. Larger farms require proportionally greater volumes of pesticide, and the associated cost of using EU-approved products can become substantial. This cost factor may discourage adoption, particularly among resource-constrained smallholder farmers, and underscores the influence of input cost intensity on investment decisions. This finding is consistent with prior evidence indicating that higher input costs can negatively affect farmers' willingness to purchase premium agricultural products (Ali et al., 2020). Finally, the quantity of pesticides used also demonstrated a negative marginal effect (–0.022), indicating that farmers who apply larger amounts of pesticides are 2.2% less likely to pay for EU-approved products. Higher pesticide usage translates into increased expenditure, and the price premium of certified pesticides may act as a deterrent to adoption. This result corroborates previous studies highlighting that rising input demands can limit farmers' willingness to adopt costlier but higher-quality alternatives (Ali et al., 2020). It suggests that interventions promoting EU-approved pesticide adoption should consider strategies to reduce the cost burden for farmers who require large pesticide volumes, such as bulk subsidies, cooperative purchasing schemes, or targeted financial support programs.

Table 5: Effect of credit access on Cocoa farmers' willingness to pay for EU-approved pesticides

Willingness to Pay	Coefficient	P >|z|	Marginal effect
Gender	2.865*	0.075	0.544*
Age	0.342**	0.040	0.043**
Marital Status	2.123**	0.026	0.956**
Education	3.180**	0.030	1.143**
Income	5.288	1.000	0.676
Experience	0.169	0.152	0.643
Extension	4.970**	0.023	0.035**
Credit	4.258**	0.028	0.044**
Cooperative	1.535	0.351	0.766
Household size	-1.071**	0.023	0.865**
Farm size	-0.067**	0.032	0.073*
Quantity	-0.020**	0.034	0.022**
Constant	15.510***	0.000	
Log likelihood = -122. 017			
Log likelihood ratio (X2) = 123.8483***			
Hosmer-Lemeshow= 1.659***			
Mc Fadden Pseudo R2= 0.47825			
Prob>chi2 = 0.004			

Source: Field survey, 2020

CONCLUSION

This study provides empirical evidence on the influence of credit access on cocoa farmers' willingness to pay for EU-approved pesticides in Ondo and Osun States, Nigeria—an area where limited prior studies have linked financial capacity, pesticide regulation compliance, and farmers' adoption behaviour. Unlike earlier research that focused largely on pesticide use patterns or agronomic considerations, this study integrates socioeconomic, institutional, and farm-level variables to reveal the multifaceted determinants of farmers' valuation of certified pesticide inputs. Findings from the logit model show that factors such as gender, age, education, marital status, cooperative membership, access to extension services, household size, farm size, and quantity of pesticide used significantly shape farmers' willingness to pay. Among these variables, access to credit emerges as one of the most critical determinants, confirming that liquidity constraints substantially influence the capacity of cocoa farmers to purchase approved pesticides. The study further reveals that most farmers are willing to pay up to a 25% premium above the current market price of EU-approved pesticides, demonstrating strong perceived value for quality, safety, and export-compliant inputs. However, willingness declines sharply at higher price levels, underscoring the role of affordability and financial constraints. These results highlight the dual importance of economic empowerment and regulatory compliance in sustaining Nigeria's position in the international cocoa market. Overall, the findings underscore that enhancing access to credit—alongside strengthening ex-

tension services and farmer organizations—is vital for promoting wider adoption of EU-approved pesticides and ensuring compliance with global residue standards. The study, therefore, contributes to policy efforts aimed at aligning sustainable cocoa production with pesticide regulation, farmer welfare, and international market requirements.

Recommendations

Based on the empirical findings and policy relevance of the study, the following measures are recommended to enhance farmers' willingness to pay for EU-approved pesticides and strengthen the competitiveness of Nigeria's cocoa sector:

1. Although many farmers use approved pesticides, a proportion still use cheaper or mixed chemicals. Regulatory agencies such as NAFDAC and CRIN should intensify monitoring, market inspection, and enforcement to ensure compliance with EU-approved pesticide standards and safeguard Nigeria's cocoa export quality.

2. Education significantly increases farmers' likelihood of adopting approved pesticides. Therefore, training initiatives should focus on less-educated and older farmers, emphasizing safe handling, residue limits, environmental protection, and market benefits associated with EU-certified inputs.

3. Cooperative membership positively influences willingness to pay. Strengthening cooperatives as platforms for distributing input, implementing group purchase schemes, delivering training, and monitoring can enhance adoption rates and reduce input costs through collective bargaining.

4. Because credit access is a key determinant of willingness to pay, government agencies, microfinance institutions, and development partners should expand credit opportunities through low-interest cocoa input loans, cooperative-based lending programs, and government-backed agricultural credit initiatives. This will help farmers overcome liquidity constraints and purchase certified pesticides in required quantities.

5. Variables such as gender, age, and household size significantly influence WTP outcomes. Policy interventions should ensure equitable resource allocation by providing targeted support to women farmers, younger farmers, and households with high dependency ratios, ensuring broad-based adoption of approved pesticides.

6. Since willingness to pay declines sharply at higher premium levels, input subsidies, bulk-purchase discounts through cooperatives, and seasonal price-support programmes can make approved pesticides more affordable, especially for farmers with large farm sizes or high pesticide requirements.

Policy Implication

The findings of this study demonstrate that improving cocoa farmers' access to credit is essential for increasing their willingness to pay for EU-approved pesticides and ensuring compliance with international residue standards. Since socioeconomic factors such as education, cooperative membership, and extension contact significantly influence adoption, policies that integrate financial support with farmer training and institutional strengthening will have the greatest impact. Enhancing credit availability, expanding extension services, and strengthening farmer organizations can collectively increase the uptake of certified pesticides, improve cocoa bean quality, and safeguard Nigeria's competitiveness in global markets. These results highlight the need for coordinated interventions that address both financial and knowledge-based constraints faced by cocoa farmers.

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