

Causal Impact of Approved Pesticide Use on Cocoa Farmers' Welfare in Nigeria

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INTRODUCTION

- The cocoa industry plays a vital role in rural livelihoods and Nigeria's national economy (Oyenpemi et al., 2023).
- However, the sector faces persistent challenges — notably pests and diseases that threaten yields and quality.
- Many farmers respond by overusing pesticides, leading to:
 - Poor cocoa quality due to excessive chemical residues (Faloni et al., 2022).
 - Cocoa beans exceeding international Maximum Residue Limits (MRLs).
 - Resulting in price penalties and rejection in export markets.
- To mitigate these issues, the Federal Government of Nigeria, through CRIN and NAFDAC, has:
 - Reviewed and recommended a list of approved pesticides compliant with European Union MRL regulations.
- Despite these efforts, adoption of approved pesticides remains low, limiting improvements in cocoa quality, farmer welfare, and sustainability of production systems.

AIMS/OBJECTIVES

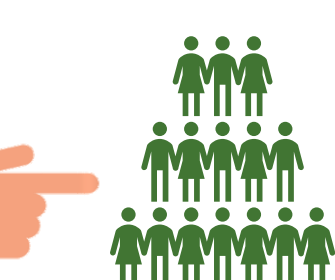
- To predict factors influencing the use of approved pesticides among cocoa farmers.
- To estimate the causal impact of using approved pesticides on farmers' welfare (profit, and productivity).

METHODS

- Study conducted in Osun State, Nigeria, Africa.
- 4 LGAs were selected based on their high level of cocoa production.



Multi-stage sampling techniques

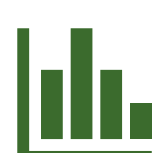


240 COCOA FARMERS

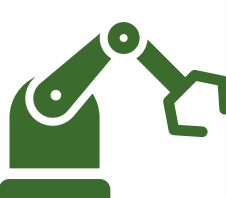
Socioeconomic and demographic data were collected through questionnaire & personal interview



Analytical Techniques



• **Descriptive Statistics** – to summarize socioeconomic characteristics and pesticide use patterns.



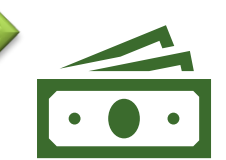
• **Supervised Machine Learning Model** - to predict factors influencing the adoption of approved pesticides.

• **Causal Inference Methods** – Causal Forest (main model) was used to estimate the impact of approved pesticide use on profit and output.



Impact

YIELD



APPROVED PESTICIDE

PROFIT

RESULTS & DISCUSSION

Logistic Regression Coefficients and Odds Ratios

Feature	Coefficient	Odds Ratio
Awareness	0.441200	1.554000
offfarm	0.328500	1.389000
Married	0.245800	1.279000
Education	0.104000	1.110000
farmsize	0.084100	1.088000
Age	0.035000	1.036000
offincome	-0.000000	1.000000
Experience	-0.015800	0.984000
Hhsize	-0.071600	0.931000
Sex	-0.101600	0.903000
Association	-0.163700	0.849000
Extension	-0.283300	0.753000
credit	-0.531800	0.588000

Note: Hhsize represents Household size

Drivers of Approved Pesticide Adoption

- Awareness (+55.4%), off-farm income (+38.9%), marital stability (+27.9%), and education (+11.0%) increase adoption, showing that informed and stable farmers better understand and follow approved pesticide practices.
- Credit (−41%) and extension (−25%) reduce adoption, suggesting inefficiencies or mismatches in support delivery.



Causal Inference Results

Method	Estimated Effect (Profit)	Estimated Effect (Output)
PSM	0.657	0.535
IPW	24.583	16.981
Casual Forest	0.449	0.416

Note: PSM - Propensity Score Matching, IPW - Inverse Probability Weighting

- Causal Forest estimate: Use of approved pesticides led to a 44.9% increase in profit and a 41.6% increase in output among farmers.
- SHAP analysis: Treatment effects were heterogeneous, showing that farmers who were more experienced, association members, with larger farms and higher awareness benefited more from approved pesticides.

CONCLUSION

- Awareness, education, and income stability are key drivers of adoption, emphasizing the need for more effective and farmer-focused extension and credit initiatives.
- Adoption of approved pesticides significantly boosts productivity and profitability, particularly among informed and experienced farmers, highlighting the importance of knowledge-centered agricultural policies.

FUTURE WORK / REFERENCES

- Measure how high Maximum Residue Limits (MRLs) affect cocoa export volumes and market access.

Oyenpemi, L.O., Tijani, A.A., and Kehinde, A.D. (2023). What determines a sustained use of approved pesticides for cleaner production and its impact on yield? Evidence from the cocoa industry in Osun State, Nigeria. *Cleaner and Responsible Consumption*, 9(1), pp. 100- 113. doi:10.1016/j.clrc.2023.100113.

Faloni, K.B., Tijani, A.A., and Kehinde, A.D. (2022). Economic impact of cocoa farmers' compliance to EU pesticide regulations in Osun State, Nigeria. *Agriculturae Conspectus Scientificus*, 87(2), pp.165-180.