INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print); 2222-5234 (Online)
Website: https://www.innspub.net
Email contact: info@innspub.net
Vol. 29, Issue: 1, p. 104-113, 2026

RESEARCH PAPER OPEN ACCESS

Factors affecting the adoption of hybrid coconut (*Cocos nucifera* L.) among coconut farmers in the third District of Bohol

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Key words: Adoption, Binary logistic regression, Hybrid coconut, Senile coconut, Seed availability

Received: June 29, 2026 **Accepted:** July 09, 2026 **Published:** July 16, 2026

DOI: https://dx.doi.org/10.12692/ijb/29.1.104-113

ABSTRACT

Understanding the factors affecting the adoption of hybrid coconut (*Cocos nucifera* L.) is vital for enhancing productivity and sustainability among coconut farmers. This study analyzed the factors affecting the adoption of hybrid coconut among coconut farmers in the Third District of Bohol. The study involved 393 coconut farmers and used descriptive statistics and binary logistic regression to identify significant determinants of hybrid coconut adoption. Findings revealed that farmers are mostly older, male, and have an average of 28 years of farming experience. Farmers generally operated small farms with a mean of 0.98 hectares and cultivated predominantly tall coconut varieties. The model is statistically significant ($p < 0.05$), and the results show that the model explains 34.3% and 61.7% of the variation in adoption, with moderate to strong power of the predictors. The logistic regression analysis identified five significant variables: seed availability, farmers' knowledge of hybrid coconut, frequency of extension visits, and farm size were significantly and positively associated with the adoption of hybrid coconut, whereas the age of coconut trees had a significant negative influence on adoption decisions. In addition, the major constraints reported by farmers included the prevalence of senile trees, pests, and diseases. Enhancing seed distribution, increasing extension services, and implementing replanting programs could significantly improve the adoption of hybrid coconut.

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INTRODUCTION

Coconut (*Cocos nucifera* L.) is a monocot belonging to the family Arecaceae, subfamily Cocoideae, and is the sole species of the genus Cocos (Gurbuz and Manaros, 2019). The Philippines is the world's second-largest producer and exporter of coconut products. Over the past decades, the industry has contributed an average of 35% of the country's agricultural exports, supporting millions of Filipinos (PCA, 2022).

Coconut is a major commercial crop in Bohol, accounting for approximately 35,278 hectares of agricultural land. There are an estimated 4.68 million coconut palms, with approximately 87% bearing and 13% non-bearing or senile trees in the province. The average planting density for coconut is 132 trees per hectare. Approximately 96%, or 1,067 out of 1,109 barangays in the province, have coconut areas (PPDO, 2019).

Hybrid coconuts are the result of crossing two distinct coconut varieties chosen for their beneficial characteristics. In this context, the Philippine Coconut Authority (PCA) has developed several promising local coconut hybrids and cultivars that have been recommended for the government's National Planting/Replanting Program and the Small Coconut Farms Development Program (SCFDP). These new varieties are intended to replace extensive areas of senile and low-yielding coconut palms across many coconut-growing regions. According to Rivera (2023), hybrid coconuts grow faster, produce higher, more consistent copra yields, and have the potential for high-value products. Their uniformity and ease of harvesting result in efficient resource utilization, and they are resistant to water stress (Rivera, 2023).

In 2016, Bohol coconut production declined by 11.8% compared to previous years. The decline of production was caused by senile coconut trees, the existence of pests and diseases (PPDO, 2019). According to Javier (2020), the key to the coconut industry's productivity, competitiveness, sustainability, and equity is to increase the genetic potential of the coconut plant itself by widespread replanting with hybrids to replace unproductive and senile coconut trees. Despite the exceptional characteristics of the hybrid coconut, the adoption has been generally low. Before embarking on hybrid coconut cultivation, factors to consider included pilferage vulnerability in shorter varieties, smaller nut size in certain hybrids, the need for increased inputs, susceptibility to certain diseases, limited seed availability, and perceptions about their economic lifespan in comparison to tall varieties (Rivera, 2023). Hence, this study aims to analyze and identify what factors affect the adoption of hybrid coconut among coconut farmers in the Third District of Bohol.

MATERIALS AND METHODS

Locale of the study

The study was conducted in the Third District of Bohol. Based on PCA data, a total of 43,826 coconut farmers are registered in the Third District. Five municipalities had been selected as the study sites: Garcia Hernandez, Carmen, Guindulman, Candijay, and Jagna (Fig. 1).

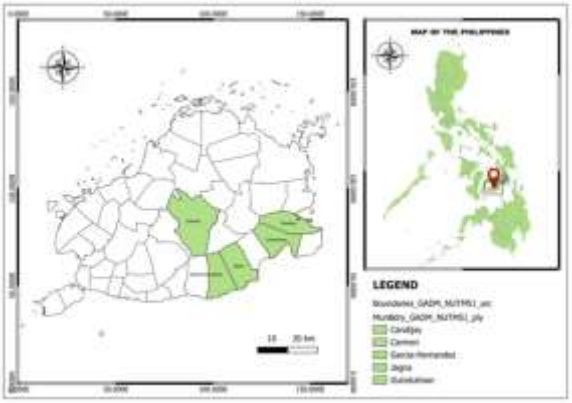

Fig. 1. Map showing the target sites of the study

Participants of the study

The target participants were identified using data from the Philippine Coconut Authority. A total of 19,784 coconut farmers were included in the study. Slovin's formula was used to calculate the required number of respondents from the five municipalities to determine the exact number of participants; 393 farmers were selected. The study specifically included only farmers who are registered under the National

Coconut Farmers Registry Systems (NCFRS), regardless of farm size and number of coconut trees, to ensure that all respondents are officially recognized coconut farmers, thereby enhancing the reliability and validity of the data collected.

Sampling design

The study employed a probability sampling technique, specifically stratified random sampling, which involves dividing the target population into distinct subgroups, or "strata," based on shared characteristics. This ensures that the population is adequately represented in the sample, preventing potential biases that could arise if certain groups were underrepresented or overrepresented.

Research instrumentation

The study employed a semi-structured questionnaire intended for coconut farmers in the selected municipalities of the Third District of Bohol. The design of the instruments ensured that the data collected would completely address the study's objectives. The questionnaires were written in English and translated into Cebuano words to ensure the respondents easily understood them.

The questionnaire covered sections on farmers' socio-demographic information, such as age, gender, civil status, educational attainment, household size, major source of income, off-farm income, and membership in organizations. It also gathered details about their farming profile, such as tenurial status, farm size, number of years in farming, planting system, and the farming practices and type of coconut planted. Additionally, the instrument collected data on factors affecting the adoption of hybrid coconut and problems encountered by coconut farmers.

Data collection

The researcher obtained permission to conduct the study by submitting formal request letters to the Campus Director and Municipal Mayors in the selected municipalities in the Third District of Bohol. After receiving approval, pilot testing was conducted with a small group of coconut farmers to evaluate its clarity, reliability, and validity. The researcher then personally visited the respondents to conduct interviews and administer the surveys to obtain accurate responses and minimize bias. Throughout the process, the researcher ensured that the responses and their identities would remain confidential, fostering a trustworthy environment.

Data analysis

The study used both descriptive and logistic regression analysis. The collected data were tabulated, analyzed, and interpreted using descriptive statistics (frequency counts, mean, ranges, and percentages) and binary logistic regression. To determine the respondents' socio-demographic and farming profiles, descriptive statistics such as percentages and frequency distributions were used to show the distribution of respondents across categories, while the mean was used to identify the average and most common values for numerical data. The use of range further demonstrated the diversity of respondents' characteristics, providing a thorough overview of the farmers socio-demographic and farming profile backgrounds.

To determine the factors affecting the adoption of hybrid coconut in the Third District of Bohol. The research employed binary logistic regression. This method is suitable for understanding how various independent variables affect the dependent variable, namely, the adoption of hybrid coconuts. The regression model quantified the relationship between these factors and the adoption intention of farmers to hybrid coconut, providing insights into which variables are found to have a statistically significant effect on the adoption of the hybrid coconut.

$$Y_1 = \beta_0 + \beta_1X_1+\beta_2X_2+\beta_3X_3+ \beta_4X_4+\beta_5X_5 +\beta_6X_6+ \beta_7X_7+\beta_8X_8 +\beta_9X_9+ \beta_{10}X_{10}+\beta_{11}X_{11} +\beta_{12}X_{12}+ \beta_{13}X_{13} +\beta_{14}X_{14}+ \beta_{15}X_{15}+\beta_{16}X_{16} +\beta_{17}X_{17}+ \beta_{18}X_{18}$$

Where; Y_i = adoption of hybrid coconut (1- adopted; 0- not adopted)

X_1 = Age

X_2 = Educational Attainment (years)

X_3 = Household size (numbers)
X_4 = Membership to Organization
(1=yes, 0 =otherwise)
X_5 = Tenurial Status (1=owner, 0=otherwise)
X_6 = Farm size (hectares)
X_7= Number of years in farming (years)
X_8 = Knowledge of farmers regarding hybrid coconut
(1=yes, 0-no)
X_9 = Frequency of Extension Visits (numbers)
X_{10}= Fertilizer application (kilograms)
X_{11} = Seed availability (1=PCA, 0= otherwise)
X_{12} = Distance from farm to market (kilometers)
X_{13} = Land Topography (1=plain, 0= otherwise)
X_{14} = Number of coconut trees (numbers)
X_{15} = Age of coconut trees (years)
X_{16} = Perceived Benefits 1 (early maturity)
X_{17} = Perceived Benefits 2 (high yield)
X_{18}= Income (PhP)

Ethical considerations

The following considerations guided the researcher. Before the study was conducted, the respondents were given a detailed briefing and key information about its purpose. Through informed consent, the respondents shall willingly decide to take part in the study. The researcher informed the respondents that there was no conflict of interest. The study was conducted solely for research. In order to guarantee anonymity, secrecy, and avoidance of potential harm, all information was held and handled with utmost confidentiality by not disclosing the names and identity of the respondents in accordance with RA 10173, generally known as the Data Privacy Act.

RESULTS

Sociodemographic profile

Table 1 presents the socio-demographic characteristics of the coconut farmer respondents. About 35% of the respondents were 51–60 years old, with ages ranging from 31 to 87 years and a mean age of 59 ± 7.87 years, indicating that coconut farming in the study area is primarily managed by older farmers.

In terms of sex, 61% of the respondents were male, while 39% were female, showing that coconut farming is predominantly undertaken by men. Regarding marital status, 68% of the respondents were married, suggesting that most farmers belong to family-based households.

Table 1. Socio-demographic profile of the selected coconut farmers in the Third District of Bohol (n=393)

Variables	Frequency	Percentage
Age		
31-40	18	5
41-50	63	16
51-60	136	35
61-70	123	31
71 and above	53	13
Mean	59	
Minimum	31	
Maximum	87	
Sex		
Male	239	61
Female	154	39
Civil status		
Married	283	68
Widow	73	24
Single	34	7
Separated	3	1
Educational attainment		
Elementary level	52	13
Elementary graduate	119	30
High school level	32	8
High graduate	95	24
College level	32	8
College graduate	63	16
Mean	11	
Minimum	1	
Maximum	14	
Household Size		
1-3	138	35
4-6	212	54
7-9	36	9
10 above	7	2
Mean	4	
Minimum	1	
Maximum	14	

For educational attainment, 30% of the respondents were elementary graduates, with a mean of 11 ± 1.59 years of schooling, indicating a moderate level of formal education among the farmers.

Household size data revealed that 54% of the respondents had 4–6 family members, with an average household size of 4 ± 1.99 members, indicating that most coconut farming households are relatively small to medium-sized.

Table 2. Socio-demographic profile of the selected coconut farmers in the Third District of Bohol (2025) (n=393)

Variables	Frequency	Percentage
Sources of income		
Coconut Production	88	22
Entrepreneur	69	18
Government employee	65	17
Rice production	62	16
Vegetable production	38	10
Laborer	26	7
Pension	24	6
Family support	21	5
Average monthly income (PhP)		
1,000.00-5,000.00	297	76
5,001.00 -10,000.00	74	19
10,001.00 -15,000.00	14	4
15,001.00 above	8	2
Minimum	1,000.00	
Maximum	50,000.00	
Average	5,000.00	
Off-farm source		
No off-farm source	362	92
Tricycle driver	9	2
Remittance	7	2
Seasonal vendor	7	2
Private sector/ Staff	4	1
Carpenter	4	1
Off-farm income (PhP)		
No Off-farm Income	362	92
1,000.00 below	7	2
1,001.00- 4,000.00	14	4
4,001.00- 7,000.00	6	2
7,001.00 above	4	1
Membership in organization		
Small coconut farmers Association	140	36
Farmers association	117	30
No organization	108	27
Barangay's cooperatives	23	6
Senior citizens association	5	1

Table 2 presents the economic characteristics of the coconut farmer respondents. About 22% of the respondents identified coconut production as their primary source of income. Other major income sources included entrepreneurship (18%) and government employment (17%), indicating that some farmers supplement their livelihoods through non-agricultural occupations.

In terms of monthly income, 76% of the respondents earned between ₱1,000 and ₱5,000, indicating that the majority belong to the low-income group. Regarding off-farm income, 92% of the respondents reported having no off-farm source of income, suggesting a high dependence on coconut farming as their primary livelihood. With respect to organizational membership, 36% of the respondents were members of the Small Coconut Farmers Association, 30% belonged to other Farmers' Associations, while 27% reported having no organizational affiliation.

Factors affecting the adoption of hybrid coconut

The logistic regression model showed a statistically significant improvement over the baseline model. The Omnibus Test of Model Coefficients was significant ($p < 0.001$), indicating that the set of independent variables significantly predicts the adoption of hybrid coconut. The Cox and Snell R^2 value of 0.343 suggests that the model explains 34.3% of the variation in adoption, while the Nagelkerke R^2 value of 0.617 indicates that 61.7% of the variance in farmers' adoption decisions is explained by the predictor variables included in the model.

Table 3 presents the factors affecting the adoption of hybrid coconut. Of the 18 independent variables examined, five variables were found to have a statistically significant influence on adoption at the 1% and 5% significance levels. These significant variables were seed availability ($p < 0.001$), frequency of extension visits ($p = 0.019$), farmers' knowledge ($p = 0.024$), farm size ($p = 0.038$), and age of coconut trees ($p = 0.028$).

Seed availability emerged as the strongest predictor of adoption, with a regression coefficient (B) of 3.280 and an odds ratio (OR) of 26.574, indicating that farmers with access to quality hybrid coconut seeds were approximately 26.6 times more likely to adopt hybrid coconut than those without access.

The frequency of extension visits also had a significant positive effect (B = 0.151; OR = 1.163), indicating that each additional extension visit increased the likelihood of adoption by approximately 16.3%.

Similarly, farmers' knowledge regarding hybrid coconut significantly influenced adoption (B = 1.206; OR= 3.341), suggesting that knowledgeable farmers

were 3.34 times more likely to adopt hybrid coconut than those with lower levels of knowledge.

Farm size likewise had a positive and significant effect (B = 0.428; OR = 1.534), indicating that larger farms were associated with a greater likelihood of adopting hybrid coconut.

Conversely, the age of coconut trees had a significant negative effect on adoption (B = -0.035; OR = 0.965), implying that the likelihood of adopting hybrid coconut decreased as the age of existing coconut trees increased.

The remaining variables—age, educational attainment, household size, organizational membership, tenurial status, years in coconut farming, fertilizer application, distance to market, land topography, number of coconut trees, income, and perceived benefits (early maturity and high yield)—were not statistically significant predictors of hybrid coconut adoption.

Table 3. Factors affecting the adoption of hybrid coconut in the third District of Bohol (2025)

Variables	B	S.E.	Sig.	Exp(B)
Age	-0.016	0.027	0.550	0.984
Educational attainment	-0.033	0.071	0.647	0.968
Household size	0.031	0.123	0.798	1.032
Membership to organization	0.097	0.549	0.860	1.102
Tenurial status	0.165	0.623	0.791	1.179
Farm size	0.428	0.206	0.038**	1.534
Years as coconut farmers	-0.006	0.020	0.747	0.994
Frequency of extension visit	0.151	0.064	0.019**	1.163
Knowledge of farmers	1.206	0.533	0.024**	3.341
Fertilizer application	0.000	0.002	0.988	1.000
Seed availability	3.280	0.528	0.000***	26.574
Distance from farm to market	-0.020	0.084	0.808	0.980
Land topography	0.212	0.464	0.648	1.236
No. of coconut trees	0.000	0.001	0.908	1.000
Age of coconut trees	-0.035	0.016	0.028**	0.965
Income	0.000	0.000	0.589	1.000
Perceived benefit early maturity	-2.136	1.363	0.117	0.118
Perceived benefit high yield	1.712	0.917	0.062	5.540
Constant	-2.740	2.086	0.189	0.065

Std. Error = S.E; Exp (B) = Odds ratio/(OR); B = Log odds; Cox & Snell (.343), Nagelkerke (.617) Pseudo R-Square values; The overall percentage of correct prediction, 91.6 %, ***Significance at 1% ** Significance at 5%.

DISCUSSION

Sociodemographic profile

The predominance of older farmers suggests an aging agricultural workforce, which may have implications for labor availability, farm succession, and the long-term sustainability of coconut production. The higher proportion of male respondents reflects the traditional gender roles commonly observed in coconut farming, where men are more actively involved in farm management and production activities.

The high percentage of married respondents indicates the importance of family labor and household support in coconut farming. This finding is consistent with the study of Gurbuz and Manaros (2019), who reported that most coconut producers were married and that family cooperation contributes to improved farm productivity.

The respondents' moderate level of formal education suggests that they possess basic educational skills that may facilitate the understanding and adoption of improved farming technologies. This supports the findings of Aguanta *et al.* (2025), who reported that farmers with moderate educational attainment are generally more receptive to innovations and better able to evaluate new agricultural practices.

Finally, the average household size of four members indicates the availability of family labor that can supplement farm operations. As reported by Kwara *et al.*

(2025), larger household sizes can reduce dependence on hired labor and may enhance the adoption of agricultural technologies through increased labor availability.

The finding that coconut production is the primary source of income for many respondents confirms the economic importance of coconut farming among smallholder households. This is consistent with the findings of Seriño *et al.* (2021), who reported that small-scale coconut farmers in Leyte rely heavily on the sale of coconuts and copra as their principal source of livelihood. The presence of respondents engaged in entrepreneurship and government employment suggests that some households diversify their income sources to reduce dependence on agriculture and improve financial stability.

The predominance of farmers earning only ₱1,000–₱5,000 per month indicates limited financial capacity, which may constrain investments in improved production technologies and farm inputs.

Low income is often associated with reduced access to credit and financial resources, thereby limiting opportunities for farm expansion and modernization, as noted by Kambali and Panakaje (2022).

The finding that the vast majority of respondents have no off-farm source of income highlights their strong dependence on coconut cultivation. Such reliance increases farmers' vulnerability to fluctuations in coconut prices, pest outbreaks, and adverse weather conditions, emphasizing the need for livelihood diversification strategies.

Finally, the relatively high membership in farmers' organizations suggests that many respondents have access to collective support mechanisms. Membership in organizations can enhance farmers' access to extension services, training, market information, credit, and new technologies, thereby improving their capacity to adopt agricultural innovations. This finding supports the study of Gurbuz and Manaros (2019), who reported that participation in farmers' organizations positively influences farmers' awareness and adoption of improved technologies.

Factors affecting the adoption of hybrid coconut

The significant Omnibus Test confirms that the logistic regression model adequately explains farmers' adoption behavior, while the Nagelkerke R^2 value of 61.7% indicates that the selected explanatory variables provide substantial predictive power for hybrid coconut adoption.

Seed availability was identified as the most influential determinant of adoption. Farmers with reliable access to quality hybrid coconut seedlings were substantially more likely to adopt the technology. This finding supports Simtowe *et al.* (2019), who reported that the availability of improved seed varieties through local suppliers and government agencies significantly enhances adoption. Similarly, Rustam *et al.* (2025) emphasized that farmers consider seed performance, affordability, and accessibility when deciding to adopt improved crop varieties. The Food and Agriculture Organization (FAO, 2022) also recognized access to quality planting materials as a critical factor in increasing agricultural productivity, food security, and farm income. In Bohol, the presence of the Central Visayas Coconut Seed Production Center (CVCSPC) and the Loay Code Farmer (LCF) nursery provides an institutional mechanism for distributing hybrid coconut seedlings to support replanting and rehabilitation programs.

The positive influence of extension visits demonstrates the important role of agricultural extension services in technology adoption. Frequent interaction with extension personnel provides farmers with technical knowledge, practical guidance, and confidence in implementing improved production practices. This finding is consistent with Danso-Abbeam (2022), who reported that greater exposure to extension services significantly increases technology adoption, and with Inutan *et al.* (2025), who emphasized that effective extension programs improve technology transfer and encourage the adoption of modern farming practices.

Farmers' knowledge regarding hybrid coconut also significantly influenced adoption decisions.

Farmers who possess greater awareness and understanding of hybrid coconut production are more likely to appreciate its potential benefits and are therefore more willing to adopt the technology. This finding agrees with Bentayao *et al.* (2025), who observed that higher levels of farmer knowledge and awareness increase receptiveness to climate-smart agricultural technologies. The result highlights the importance of continuous farmer education, training programs, and information dissemination to strengthen informed decision-making.

Farm size positively affected adoption, indicating that farmers with larger landholdings are more willing to invest in hybrid coconut production. Larger farms provide greater flexibility for experimentation and reduce the financial risks associated with adopting new technologies. This finding supports Baiyegunhi *et al.* (2022), who reported that larger farm sizes increase the probability of adopting improved crop varieties because farmers have greater capacity to allocate land and resources for innovation.

In contrast, the age of coconut trees negatively influenced adoption. Farmers with older coconut stands were less likely to replace existing trees with hybrid varieties, likely because removing mature trees involves substantial opportunity costs and additional investment. Farmers may also perceive tall coconut varieties as more durable due to their longer productive lifespan compared with hybrid coconuts, which generally require higher management inputs and regular fertilizer application to maintain productivity. This finding is consistent with Wongnaa and Babu (2020), who similarly reported that older perennial crop plantations discourage the adoption of improved planting materials.

Finally, several socio-economic and farm characteristics—including age, educational attainment, household size, organizational membership, tenurial status, years of farming experience, fertilizer application, distance to market, land topography, number of coconut trees, income, and perceived benefits—were not statistically significant predictors of hybrid coconut adoption.

Although some variables exhibited positive relationships with adoption, their effects were insufficient to demonstrate a significant influence within the study area. These findings suggest that access to planting materials, extension services, farmer knowledge, farm resources, and existing plantation characteristics play a more decisive role in adoption decisions than general demographic or farm characteristics.

CONCLUSION

Most of the coconut farmers are aging, predominantly male, married, and have a moderate level of educational attainment, with a household size of 4-6 members. Most belonged to low-income individuals, primarily relied on coconut production as their main source of income, and were members of the organization.

The coconut farmers were mostly landowners managing small-sized farms, with an average of 28 years of coconut farm experience, practicing intercropping, and mostly planting tall coconut varieties with no specific planting systems in their farms.

The factors affecting the adoption of hybrid coconut are seed availability, knowledge of farmers regarding the hybrid coconut, frequency of extension visits, and farm size, which have statistically significant positive effects on adoption, whereas the age of coconut trees has a significantly negative effect predictor in the adoption of hybrid coconut.

RECOMMENDATION(S)

Strengthen the capacity-building of farmers by providing targeted programs that align with the farmers' needs, such as hands-on and field training services, strengthening financial services to support low-income farmers to improve their capacity to invest in new agricultural technologies, and encouraging

young farmers to engage in coconut farming to ensure sustainability in the coconut industry.

Promote modern and efficient farming systems among smallholder coconut farmers through diversified cropping strategies and integrating traditional practices to maximize land use efficiency and improve farm management and productivity.

Enhance the seed distribution systems and establish additional on-farm coconut nursery sites to ensure the availability of improved, high-quality coconut seedlings, especially in remote areas, to promote wider adoption. Also, strengthen the extension visits by increasing the frequency and coverage of extension services that focus on educating farmers about the benefits and proper management of hybrid coconut varieties. Training programs could further enhance farmers' awareness about hybrid coconut cultivation.

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