ASIAN JOURNAL OF AGRICULTURE
Volume 10, Number 1, June 2026
Pages: 10
E-ISSN: 2580-4537
https://doi.org/10.13057/asianjagric/g100115

Assessing the profitability of hybrid coconut farms in the Second District of Bohol, Philippines

TRESHA NADINE Q. PILAYRE, MERLYN G. BUSCATO, JENFER MARIE M. GASATAN, ETHEL ZEAN M. AÑOSA♥
Department of Agriculture, College of Agricultural Sciences, Bohol Island State University. Zamora, Bilar 6317, Bohol, Philippines.
Tel.: +63-926-924-0644, ♥email: ethelzean.anosa@bisu.edu.ph

Manuscript received: 1 October 2025. Revision accepted: 12 February 2026.

Abstract. *Pilayre TNQ, Buscato MG, Gasatan JMM, Añosa EZM. 2026. Assessing the profitability of hybrid coconut farms in the Second District of Bohol, Philippines. Asian J Agric 10: g100115. https://doi.org/10.13057/asianjagric/g100115.* Hybrid coconut farming has emerged as a promising innovation to revitalize the coconut industry and improve smallholder livelihoods in the Philippines, yet its economic performance under real farm conditions remains insufficiently documented. This study assessed the profitability of hybrid coconut farms in the Second District of Bohol, where hybrid varieties are being promoted amid early bearing stages and ongoing post-Typhoon Odette recovery in 2021. Using a descriptive research design, data were gathered from 63 farmer-respondents through semi-structured interviews and questionnaires. Respondents had an average age of 57.13±11.21 years and farming experience of 19±12.38 years, cultivating farms averaging 1.34±1.72 hectares. Cost and return analysis, explicitly excluding imputed family labor to reflect cash-based profitability, revealed an average yield of 57 nuts per tree per year and a net income of ₱10,608.33 per hectare, with a Benefit-Cost Ratio (BCR) of 2.14. The modest profitability observed is primarily attributed to the early bearing stage of hybrid trees and the lingering impact of Typhoon Odette, which reduced farm productivity. Despite these constraints, hybrid coconut production remains economically viable and holds potential for increased profitability as plantations mature. Findings highlight the need for targeted interventions such as capacity building, input subsidies, and climate-resilient management practices to enhance productivity and income stability. Overall, the study provides empirical evidence to guide policymakers, investors, and development planners in promoting a sustainable and inclusive hybrid coconut industry in the Philippines.

Keywords: Bohol, cost and return analysis, hybrid coconut farming, profitability analysis, smallholder farmers

INTRODUCTION

The Philippine coconut industry remains a vital pillar of the country's agricultural economy, providing income and livelihood to about 3.5 million smallholder farmers across 68 provinces (Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) 2022). In recent years, hybrid coconut varieties have been promoted as a strategy to increase productivity and improve farm profitability. Developed through controlled crossbreeding of selected parental lines, these hybrids exhibit superior traits such as early bearing, higher nut yield, and enhanced disease resistance (Pamplona 2018; Philippine Coconut Authority (PCA) 2021). According to the PCA (2023), hybrid coconuts can produce between 15,000 and 22,000 nuts per hectare annually, compared with traditional tall varieties that yield only 6,000 to 8,000 nuts. This potential yield advantage presents an opportunity for smallholder farmers to raise income and strengthen sector resilience. However, yield potential alone does not guarantee profitability, particularly for smallholders who face multiple operational constraints. High input costs-including fertilizers, seedlings, and labor-limited access to financing, weak market linkages, and insufficient technical support often limit the ability of farmers to fully realize the economic benefits of hybrids.

Despite these advantages, the profitability of hybrid coconut farming remains uncertain for many smallholders. Farmers often face constraints such as limited access to financing, high input costs, inadequate market linkages, and insufficient technical support (Food and Agriculture Organization (FAO) 2020). Moreover, environmental risks-including typhoons and droughts-can significantly reduce yields and delay returns on investment. The impact of Typhoon Odette in 2021, for example, damaged millions of coconut trees across the Visayas, including Bohol, resulting in substantial income losses. Understanding hybrid coconut profitability, therefore, requires an integrated perspective that considers both biological yield potential and economic and climatic realities.

Globally, studies on perennial crops highlight that yield advantage alone does not guarantee higher income; profitability depends on cost management, input efficiency, and market stability. In the Philippines, most research on hybrid coconuts has focused on agronomic performance rather than detailed financial assessments of costs and returns, such as seedling procurement, fertilizer, labor, and irrigation (Omar and Fatah 2020). Empirical profitability analyses are essential for guiding smallholders' investment decisions and informing policy interventions-including input subsidies, access to credit, and capacity-building programs-to support sustainable hybrid adoption and climate-resilient production.

From a policy standpoint, this research holds significance for both farmers and decision-makers. For smallholder producers, profitability assessments provide evidence-based guidance in evaluating whether hybrid coconut cultivation is a worthwhile investment. For policymakers, understanding cost-return relationships can inform interventions such as input subsidies, access to credit, and capacity-building programs to enhance the sustainability of hybrid adoption. Empirical studies that quantify profitability are also essential for aligning local initiatives with national strategies for coconut industry revitalization and climate resilience.

Smallholder farm characteristics, such as land size, ownership patterns, education, and farm management practices, also influence economic outcomes. Evidence suggests that smaller farms are often intensively managed, with higher labor input per hectare, whereas larger farms may achieve scale economies through mechanization and optimized input allocation (Knezevic et al. 2023). However, without appropriate technical support, even larger farms may underperform relative to their yield potential. Education and access to training are particularly important in determining the efficient use of inputs and the adoption of best management practices, which directly affect profitability (Pamplona 2018; Mgendi et al. 2021).

This study provides a post-typhoon, early-adoption stage profitability assessment of hybrid coconut farming among smallholder farmers in the Second District of Bohol. It evaluates yield performance, production costs, and net returns to generate an evidence-based understanding of hybrid farm economics during the early bearing stage following Typhoon Odette. The study aims to: (i) describe the socio-demographic and farm characteristics of hybrid coconut farmers; (ii) analyze the costs and returns of hybrid coconut production; and (iii) determine the factors influencing profitability. Labor imputation is excluded to focus on cash-based profitability indicators. It is hypothesized that hybrid coconut farming is economically viable under early-bearing and post-typhoon conditions, with farmer training and labor input significantly influencing profitability. The results are intended to inform both farm-level decision-making and broader strategies for enhancing the economic viability and sustainability of hybrid coconut farming in Bohol and other coconut-growing regions.

MATERIALS AND METHODS

Study area

Figure 1 shows the study sites in Philippines, namely Ubay, Talibon, and Sagbayan. Out of the municipalities in Bohol's Second District, Ubay, Talibon, and Sagbayan rank as the top three in terms of the number of hybrid coconut farmers, based on the 2020 master list provided by the PCA. Ubay, a first-class municipality, recorded the highest number of hybrid coconut farmers and is recognized for its strong agricultural presence in the province. Talibon, also a first-class municipality, ranks second and continues to play a vital role in coconut production and other agricultural activities. Sagbayan, a fourth-class municipality, ranks third and remains notable for its active participation in hybrid coconut farming despite its smaller economic classification.

Participants of the study

The sampling frame for this study was based on the (PCA 2023) master list of hybrid coconut farmers in the Second District of Bohol, which recorded a total of 102 registered farmers. Using Slovin's formula at a 5% margin of error, a representative sample size of 80 was initially computed. To ensure adequate representation across municipalities, simple random sampling was applied according to the distribution of hybrid coconut farms in the PCA database. However, due to specific contextual constraints-particularly the relatively recent establishment of many hybrid plantations that had not yet reached bearing age, and the severe damage caused by Typhoon Odette, the study ultimately employed complete enumeration of all farmers who were already generating income from hybrid coconut production. This adjustment resulted in 63 qualified respondents, equivalent to a 61.8% final response rate from the total population of 102.

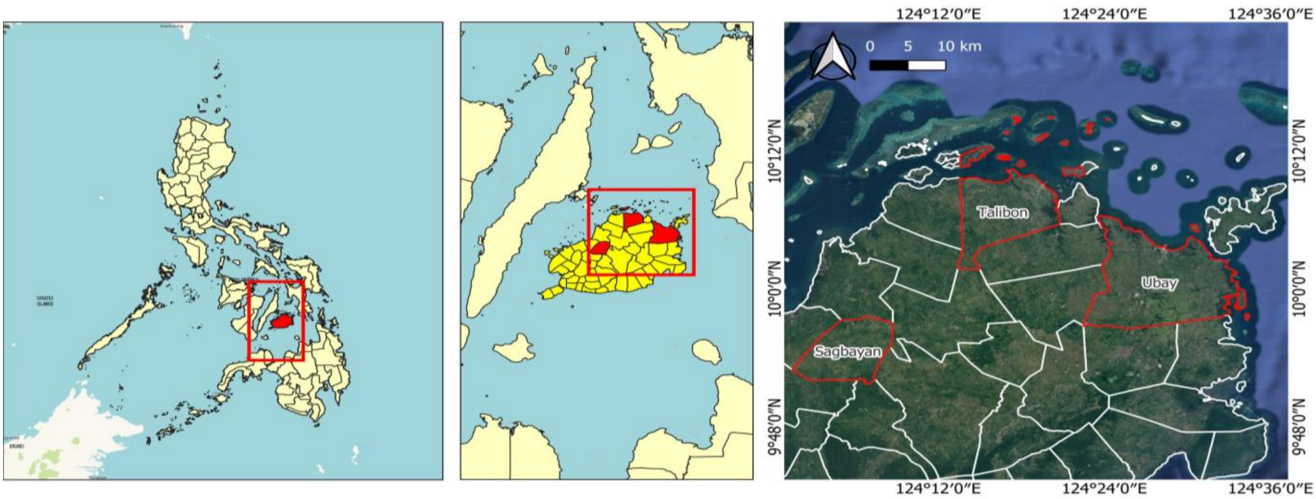

Figure 1. Map of Bohol Province, Philippines, indicating the study site

Only farmers with productive hybrid coconut trees and available income records were included in the analysis, while those with non-bearing or newly planted hybrids were excluded to ensure that profitability computations reflected actual production and income. This purposive sampling strategy, while necessary to obtain meaningful financial data, introduces potential selection bias, as it may overrepresent more established or better-performing farmers. Consequently, the findings should be interpreted with caution, particularly when generalizing to all hybrid coconut farmers in the district, including those with non-productive or early-stage plantations.

Additional contextual factors further limit generalizability. Many hybrid trees in the study area are still in their early bearing stage, resulting in lower yield and profitability estimates than fully mature farms. Moreover, the lingering effects of typhoon Odette caused substantial damage to plantations, reducing nut production and increasing production costs. Collectively, these limitations suggest that the profitability figures reported here may underestimate the long-term economic potential of mature and fully rehabilitated hybrid coconut farms. By explicitly acknowledging these constraints, this study provides a contextualized understanding of hybrid coconut profitability while transparently noting the boundaries for generalization.

Research instrumentation

A semi-structured questionnaire was used to collect quantitative and qualitative data from hybrid coconut farmers in the Second District of Bohol. The instrument covered four sections: (i) socio-demographic characteristics of the respondents; (ii) farm and production profile; (iii) yield performance and input utilization; and (iv) cost and return analysis. Originally developed in English, the questionnaire was translated into Cebuano for clarity and cultural appropriateness.

Content validity was ensured through expert review by a three-member panel of an agricultural economist, an agribusiness expert, and an extension specialist, whose feedback guided minor revisions to improve accuracy and alignment with study objectives. The questionnaire was pre-tested with 10 farmers from neighboring barangays, and adjustments were made to simplify cost items, clarify yield units, and standardize open-ended questions. The final questionnaire was clear, comprehensive, and appropriate for the target respondents.

Ethics and consent

This study complied with institutional and ethical standards for research involving human participants. Participation in the study was entirely voluntary, and all respondents were informed of the study's objectives, procedures, and their rights before the interviews were conducted. Each participant provided verbal informed consent, acknowledging their willingness to participate and their right to withdraw at any time without penalty. Respondents were assured that all information collected would be treated with strict confidentiality and used solely for academic and research purposes. Personal identifiers were excluded from the dataset to protect respondent anonymity. Given that the study involved no invasive procedures and posed minimal risk to participants, it was conducted in accordance with the principles of ethics.

Data analysis

Data were organized, tabulated, and analyzed using Microsoft Excel and IBM SPSS Statistics. Descriptive statistics included means, Standard Deviations (SD), ranges, frequencies, and percentages to summarize socio-demographic and farm characteristics. Selected key variables (e.g., farm size, years of farming, yield) were also reported with 95% Confidence Intervals (CI) to reflect uncertainty.

For subgroup comparisons, continuous variables (e.g., farm size, yield) and categorical variables (e.g., land ownership, variety planted) were summarized by municipality to identify local patterns that may influence profitability outcomes. Yield performance was analyzed as mean ± SD per tree, with minimum and maximum values reported. Cross-tabulations by hybrid type were performed where relevant.

Cost and return analysis included total production cost, gross income, net return per hectare, and major cost components expressed as percentages (labor, fertilizer, seedlings, irrigation). Profitability indicators-gross margin, net income, and benefit-cost ratio (BCR)-were compared across municipalities. Labor imputation, depreciation, and opportunity costs were excluded to focus on cash-based profitability.

RESULTS AND DISCUSSION

Socio-demographic profile of the respondents

Table 1 presents the socio-demographic profile of the 63 hybrid coconut farmers surveyed. The average age of the farmers is 57.13±11.21 years, indicating an aging farming population. Males accounted for 63% of the respondents, while 75% were married. Mean household size is 3.06±2.23 members. Educational attainment is generally modest; an average number of years in school is 4.16±1.60.

Farm profile

Table 2 shows that the mean farm size was 1.34±1.72 hectares, and 90% of respondents owned their land. Farmers had an average of 19±12.38 years of farming experience. The most common hybrids were CATD×TAGT and TACD×TAGT, although 22% of farmers could not identify their planted variety. Copra was the dominant final product (86%), while other outputs (sap, young nuts, and fresh nuts) were less common.

Average nut yield

Table 3 and Figure 2 present the average nut yield (nuts per tree per year) of hybrid coconuts in the Second District of Bohol. The results show that a majority of the farmers (66%, n=41) reported yields of fewer than 50 nuts per tree per year, while 31% (n=20) achieved 51-100 nuts per tree per year. Only 3% (n=2) reported yields of 101-150 nuts per tree per year. The overall mean yield was 57.13±11.21 nuts per tree per year, with a median of 54 nuts.

Gross income of hybrid coconut farming

Table 4 and Figure 3 present the percentage distribution of gross income from hybrid coconut farm activities in the Second District of Bohol. Results show an average of ₱10,170.20 or 51.10% of the total gross income. The second-largest contributor is toddy (coconut wine), which accounts for ₱7,067.12 or 35.51%, reflecting a growing shift toward sap-based products. Income derived from mature coconuts (₱2,054.31 or 10.32%) and young coconuts (₱611.49 or 3.07%) is relatively lower, underscoring the limited returns from selling unprocessed nuts.

Production cost of producing hybrid coconuts

Table 5, Figures 4 and 5 present the production cost structure of hybrid coconut farming in the Second District of Bohol. The total average production cost was ₱9,294.79 per hectare per year, consisting of ₱8,456.62 variable costs and ₱840.17 (9.01%) Sub-total fixed cost. Among the variable costs, harvesting incurred the largest share at ₱3,894.73, underscoring the labor-intensive nature of hybrid coconut production. Other key expenses include fertilizers (₱1,209.95), planting (₱1,088.30), and seedlings (₱1,028.10), which reflect the cost of essential inputs needed to establish and maintain young hybrid stands. Fixed costs, such as fuel (₱450.31) and rental of machinery or equipment (₱360.09), were also notable.

Table 1. Socio-demographic profile of hybrid coconut farmer respondents in the Second District of Bohol, Philippines, in 2024

Variables	Frequency (n=63)	Percentage
Age		
20 and below	0	0.00
21-30	0	0.00
31-40	5	8.00
41-50	5	8.00
51 and above	53	84.00
Average=57		
Minimum=34		
Maximum=88		
Gender		
Male	40	63.00
Female	23	37.00
Civil status		
Single	7	11.00
Married	47	75.00
Widowed	9	14.00
Education Attainment		
Elementary Level	13	21.00
Elementary Graduate	8	13.00
High School Level	19	30.00
High School Graduate	9	14.00
College Level	7	11.00
College Graduate	7	11.00

Table 2. Farm profile of coconut hybrid farmer respondents in the Second District of Bohol, Philippines, in 2024

Variables	Frequency	Percentage
Farm Size		
Less than 1 hectare and below	22	35.00
1-3	37	59.00
4-6	3	5.00
7 hectares and above	1	1.00
Average=1.34		
Minimum=0.24		
Maximum=7		
Land Ownership		
Owned	57	90.00
Sharecrop	3	5.00
Others	3	5.00
Farming Experience		
5 years and below	4	6.00
6-10	16	25.00
11-15	11	18.00
16-20	7	11.00
21-25	7	11.00
26-30	5	8.00
31 and above	13	21.00
Average=19		
Minimum=3		
Maximum=54		
Varieties Planted*		
Catigan Dwarf x Tagnanan Tall (CATD X TAGT)	26	41.00
Tacunan Dwarf x Bago Oshiro Tall (TACD X BAOT)	9	14.00
Tacunan Dwarf x Tagnanan Tall (TACD X TAGT)	22	35.00
Catigan Dwarf x Laguna Tall (CATD X LAGT)	12	19.00
Malayan Red Dwarf x Tagnan Tall (MRD X TAGT)	10	16.00
Malayan Red Dwarf x Baybay Tall (MRD X BAYT)	4	6.00
Not Identified	14	22.00
Final product*		
Copra	54	86.00
Mature coconut	10	16.00
Young coconut	10	16.00
Coconut toddy	6	6.00
Others	1	2.00

Note: *: Multiple responses allowed. Percentages for hybrid varieties and final products are based on the total respondents (n=63)

Table 3. Average nuts per tree per year of the hybrid coconut tree in the Second District of Bohol, Philippines, in 2024

Variables	Frequency	Percentage
Less than 50	38	66.00 (n=41)
51-100	18	31.00 (n=20)
101-150	2	3.00 (n=2)
151-200	0	0.00
Average=57		
Minimum=6		
Maximum=144		

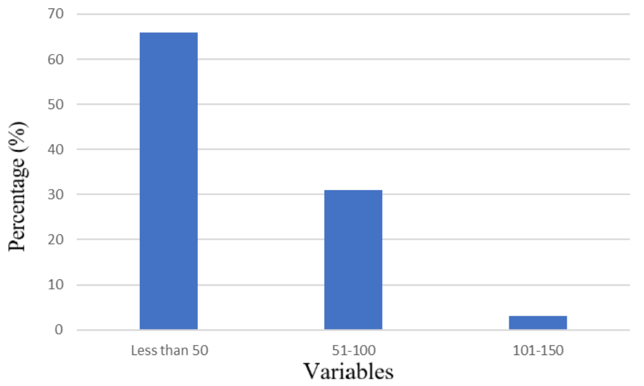

Figure 2. Average nuts per tree per year of the hybrid coconut tree in the Second District of Bohol, Philippines, in 2024

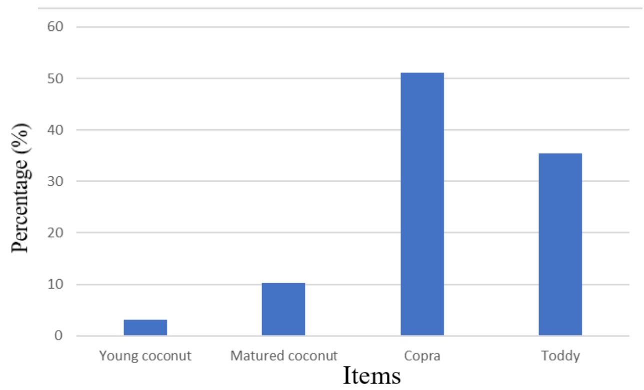

Figure 3. Gross income from coconut hybrid farming

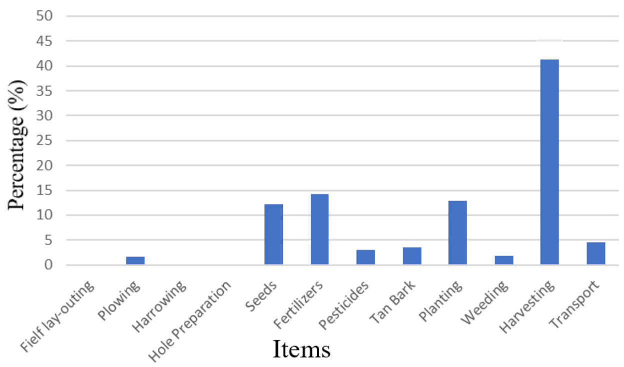

Figure 4. Variable cost distribution for the hybrid coconut

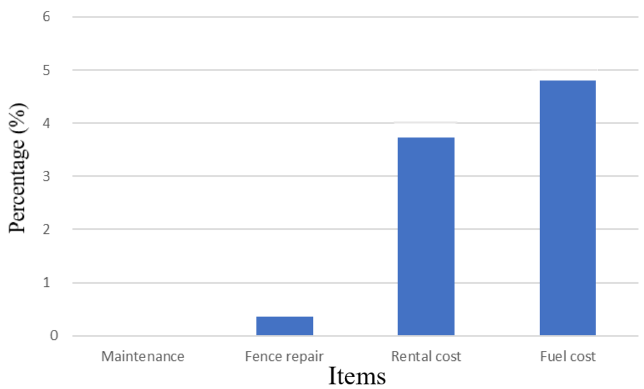

Figure 5. Fixed cost distribution for the hybrid coconut

Table 4. Gross income of hybrid coconut farmer respondents in the Second District of Bohol, Philippines, in 2024

Item	Amount (₱)	Percentage
Young coconut	611.49	3.07
Matured coconut	2,054.31	10.32
Copra	10,170.20	51.10
Toddy	7,067.12	35.51
Total Gross Income	19,903.12	100.00

Profitability analysis

Table 6 shows that hybrid coconut farming in the Second District of Bohol generates an average net income of ₱10,608.33 per hectare with a Benefit-Cost Ratio (BCR) of 2.14, indicating that farmers obtain ₱2.14 for every peso invested under current post-typhoon and early-bearing conditions. Because imputed family labor was excluded, this estimate reflects cash-based profitability and suggests that returns remain modest for smallholder households that depend heavily on unpaid labor.

Determinants of profitability

Training (p=0.004) and labor input (p=0.008) were the only statistically significant predictors of hybrid coconut profitability. All other variables were not significant at conventional levels.

Access to training showed a strong positive effect on net income, indicating that farmers who received training achieved higher profitability. This suggests that technical knowledge in hybrid management, pest control, and input application plays a central role in converting biological potential into financial returns. Similar results were reported by Mgendi et al. (2021), who found that training substantially improves smallholder productivity when paired with extension support.

Labor input was likewise significant, reflecting the labor-intensive nature of hybrid coconut farming, particularly during establishment, maintenance, and harvesting. Adequate labor availability allows timely field operations, which directly affects yield and income. This result is consistent with smallholder production systems where labor remains a binding constraint to farm performance. In contrast, farm size, farmer age, education, farming experience, access to credit, volume of production, and quantities of fertilizer and pesticides were not statistically significant.

Discussion

Socio-demographic profile of the respondents

While the findings align with national and international research linking aging populations to slower technology adoption and productivity declines (Kumar et al. 2020; Akdemir et al. 2021), and underscore the growing role of women in sustainable farm management (Manlosa et al. 2019; Valleser et al. 2020). The predominance of older farmers with small farms suggests potential constraints in labor availability and long-term innovation capacity. Low educational levels may also affect farmers' ability to adopt improved hybrid management practices and participate in higher-value markets.

Farm profile

The average farm size aligns with documented small-scale operations in comparable provinces, reaffirming the persistence of fragmented landholdings that influence production capacity and investment potential. The landownership reflects tenure security, which, according to agrarian theories, is pivotal for facilitating long-term input adoption and sustainable farm management. This tenure stability underpins an enabling environment for the adoption of technological uptake and diversification strategies. The farming experience parallels national observations where aging coconut farmers contribute to the sector's sluggish modernization.

On the other hand, the preference for CATD×TAGT and TACD×TAGT cultivars is due to agronomic suitability to local edaphoclimatic conditions (PCA nd). The preference for CATD×TAGT and TACD×TAGT hybrids also supports findings from Santos et al. (1995) and PCA (2023).

Coconut farming indicates a limited value chain diversification. The dependency on conventional markets exposes farmers to price volatility and income instability. Expanding product portfolios to include high-value coconut derivatives, such as virgin coconut oil and coco sugar, can provide income stabilization and enhance rural livelihoods.

Average nut yield

The observed yield is consistent with the established hybrid coconut performance characteristics, which indicate significant productivity gains become evident typically from the fourth to fifth year onward (Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD 2023). This underlines that the current productivity profile represents a traditional phase toward the full yield potential, currently constrained by juvenile growth stages. In addition, the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD 2015) reported a national average of 46 nuts per tree per year, while the Food and Agriculture Organization (FAO 2020) estimated 70-100 nuts per tree per year globally. The average yield obtained in this study (57.13 nuts per tree) is thus slightly higher than the national mean but below global estimates, which is reasonable considering the trees' young age and the typhoon's lingering effects.

Table 5. Production cost of producing hybrid coconut in the Second District of Bohol, Philippines, in 2024

Item	Amount (₱)	Percentage
Variable costs		
Field Lay-outing	0.00	0.00
Plowing	140.56	1.51
Harrowing	0.00	0.00
Hole Preparation	12.03	0.13
Seeds	1,028.10	11.06
Fertilizers	1,209.95	13.02
Pesticides	249.62	2.69
Tan Bark	298.24	3.21
Planting	1,088.30	11.71
Weeding	153.17	1.65
Harvesting	3,894.73	41.90
Transport	381.92	4.11
Sub-total variable cost	8,456.62	90.99
Fixed costs		
Maintenance	0.00	0.00
Fence Repair	29.77	0.32
Rental cost	360.09	3.85
Fuel cost	450.31	4.84
Sub-total fixed cost	840.17	9.01
Total cost	9,294.79	100.00

Table 6. Average cost and return analysis of growing hybrid coconut in the Second District of Bohol, Philippines, in 2024

Item	Amount (₱)	Percentage
Gross Income	19,903.12	100.00
Field Lay-outing	0.00	0.00
Plowing	140.56	1.51
Harrowing	0.00	0.00
Hole Preparation	12.03	0.13
Seeds	1,028.10	11.06
Fertilizers	1,209.95	13.02
Pesticides	249.62	2.69
Tan Bark	298.24	3.21
Maintenance	0.00	0.00
Fence Repairs	29.77	0.32
Planting	1,088.30	11.71
Weeding	153.17	1.65
Harvesting	3,894.73	41.90
Rental cost	360.09	3.85
Fuel cost	450.31	4.84
Transport	381.92	4.11
Total Production Cost	9,294.79	46.70
Net Income	10,608.33	53.30
Profit Margin (%)	53.30	
Benefit-Cost Ratio (BCR)	2.14	

Note: Imputed family labor was excluded from the computation of production costs. Including it would reduce profitability estimates and may alter the benefit-cost ratio

Table 7. Determinants of hybrid coconut profitability

	t-value	Sig	Significance level
Constant	0.06	0.952	
Access to training	2.99	0.004	Significant at 1%
quantity of labor	2.754	0.008	Significant at 1%
Farm size	0.371	0.712	Not significant
Age of farmer	0.061	0.951	Not significant
Educational level	-442	0.660	Not significant
Farming experience	-0.673	0.504	Not significant
Access to credit	-0.903	0.371	Not significant
Volume of Production	1.98	0.236	Not significant
Quantity of Pesticide	0.905	0.369	Not significant
Quantity of Fertilizer	-955	0.344	Not significant

Samarasinghe et al. (2018) observed that drought stress can significantly reduce nut production through nutrient limitation and premature nut fall. Sudha et al. (2021) emphasized that integrated nutrient management-combining organic and inorganic inputs-enhances yield stability and soil fertility in coconut systems. Likewise, Syazliana and Khairuddin (2022) reported that access to farm inputs, pest control measures, and the use of technology are key determinants of coconut productivity among smallholder farmers. These findings explain the heterogeneity observed among farmers in the study area, where access to resources and management intensity vary.

Distribution of gross income and production cost of hybrid coconut farming

The PCA (n.d.) has documented that copra remains the dominant source of income for smallholder coconut farmers nationwide, accounting for more than 50% of their gross earnings. Meanwhile, DOST-PCAARRD (2023) noted the increasing adoption of coconut sap-based products such as coco sugar and vinegar in the Visayas regions as part of livelihood diversification strategies. These reports support the observed trend in Bohol, where hybrid coconut farmers are beginning to integrate sap collection and processing alongside traditional copra production.

Production cost of hybrid coconut farming

The production costs that labor and input-related expenses dominate production costs, consistent with smallholder coconut systems across Southeast Asia (PCA 2021). The substantial expenditures on fertilizers, planting, and seedling costs further highlight significant pre-productive and maintenance investments necessary to realize hybrid yield potential-investments aligned with national replanting programs aimed at coconut sector revitalization (DOST-PCAARRD 2023). In a broader context, Bohol's cost structure mirrors patterns observed internationally. For instance, studies in Indonesia and India report similar labor cost shares ranging between 35% and 45% of the total production costs, reflecting comparable smallholder management patterns and limited mechanization (FAO 2019). Fertilizer and planting material expenses in these countries constitute roughly 15-20% of costs, slightly higher than Bohol's shares, attributed to more intensive soil fertility management and varied hybrid adoption rates (FAO 2019).

Sri Lanka's research highlights slightly lower labor cost ratios (30%) due to more widespread cooperative labor arrangements and mechanized harvesting, yet total production costs remain in the range of PhP7,000.00-PhP10,000.00 per hectare annually when converted, closely matching Bohol's estimates. Further, Papua New Guinea studies showcase higher relative fixed costs driven by transportation and equipment rental, given challenging terrain, although labor remains the dominant expense, aligning with patterns observed in Bohol's geographically fragmented smallholder farms (Bourke and Harwood 2009).

Profitability analysis

Despite being economically viable, current profitability remains constrained by low yield levels. Most farms consist of young, early-bearing hybrid palms, and production has not yet approached the 15,000-22,000 nuts per hectare expected from fully mature hybrids (PCA 2021). In addition, Typhoon Odette (2021) caused extensive damage, increasing replanting and rehabilitation costs while delaying fruiting, thereby reducing short-term income.

Cross-country evidence places Bohol's performance within the lower-middle range of regional profitability. For example, Indonesia reports BCRs of 1.8-2.3 for smallholder hybrid farms (Reddy et al. 2020), comparable to Bohol's 2.14, while Sri Lanka reports slightly higher values (2.2-2.7) where mechanization and cooperative labor reduce costs (De Silva 1985). These comparisons suggest that Bohol's farms are not underperforming structurally but are currently limited by biological maturity and post-disaster recovery.

Determinants of profitability

The training program likely improved farmers' knowledge of hybrid coconut management, disease/pest control, yield optimization, and input application, thereby contributing to improved financial outcomes. This aligns with prior evidence of Mgendi et al. (2021) that training programs significantly improved smallholder productivity, particularly when combined with appropriate resources and extension services.

Farming coconut, even hybrid varieties, may still rely heavily on manual labor, maintenance tasks, harvesting, and management. A recent case study in cacao farming (Tennhardt et al. 2024) found that household labor plays a central role in the sustainable intensification of smallholder farms. The implication is that labor must be effectively allocated for improved profitability.

The lack of significance of other variables warrants consideration. Farm size, age of the farmer, educational level, farming experience, access to credit, volume of production, pesticide, and fertilizer quantities did not show statistically significant effects. This may reflect several underlying realities: e.g., small farms may be more efficiently managed than larger ones (Knezevic et al. 2023, on small farm productivity), or that input quantities (pesticides/fertilizers) may not necessarily translate to improved profitability unless they are used efficiently and accompanied by knowledge/training. Moreover, access to credit, while potentially beneficial, may be underutilized or directed to non-productive uses in this sample.

In conclusion, hybrid coconut farming in the Second District of Bohol is currently marginally profitable, with an average net income of ₱10,608.33 per hectare and a BCR of 2.14. The computed Benefit-Cost Ratio (BCR) of 2.14 indicates that hybrid farming remains economically viable, providing ₱2.14 in return for every peso invested. Yield performance averaged 57 nuts per tree per year, reflecting the early bearing stage of most hybrid palms and the ongoing recovery from Typhoon Odette, which significantly suppressed production levels and increased rehabilitation costs. Regression analysis revealed that only access to training (p=0.004) and labor input (p=0.008) significantly influenced profitability, highlighting the crucial role of farmer capacity-building and adequate labor allocation in optimizing hybrid coconut farm performance. The findings of this study are constrained by the inclusion of only income-generating farmers, which excludes newly planted or non-bearing hybrid farms and may introduce selection bias. Key agronomic variables, such as soil fertility status, pest and disease pressure, water availability, and climatic variability, significantly influence coconut growth, yield stability, and input efficiency, yet were not adequately addressed in this research. Incorporating these factors through field measurements and modeling would provide a more holistic assessment of farm performance, allowing better identification of yield constraints and cost drivers. Ecological considerations, including varietal resilience and sustainable cropping systems (e.g., mixed or agroforestry practices), also play crucial roles in maintaining long-term productivity and profitability under varying environmental conditions.

Moreover, future profitability assessments should incorporate additional financial metrics such as Internal Rate of Return (IRR) and Net Present Value (NPV), alongside traditional measures like net income and Benefit-Cost Ratio (BCR), which are recommended. IRR provides a comprehensive percentage return accounting for the time value of money, enabling assessment of whether the investment yield surpasses the required rate of return. NPV offers an absolute monetary value reflecting the present worth of all future net cash flows discounted to the current period, thereby capturing the long-term economic viability of the investment. Incorporating IRR and NPV enhances the robustness of profitability analyses by addressing investment timing, risk, and capital cost considerations, which are especially pertinent in agriculture due to inherent uncertainties and varying cash flow patterns.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support of Bohol Island State University (BISU), Philippines-Bilar Campus, Philippines, for providing institutional assistance in the conduct of this study. Appreciation is also extended to the Local Government Units of Ubay, Sagbayan, and Talibon, Philippines, for their cooperation and logistical support. Most importantly, the authors express their sincere gratitude to all the farmer respondents whose valuable time and insights made this research possible.

REFERENCES

Akdemir Ş, Kougnigan EA, Keskin F, Akçaöz HV, Boz İ, Kutlar İ, Miassi YE, Küsek G, Türker M. 2021. Ageing population and agricultural sustainability issues: Case of Turkey. New Medit 20 (4): 49-62. https://doi.org/10.30682/nm2104d.

Bourke RM, Harwood T (eds). 2009. Food and Agriculture in Papua New Guinea. ANU Press, Canberra. https://doi.org/10.22459/FAPNG.08.2009.

De Silva HWS. 1985. An economic analysis of government intervention measures in the coconut industry of Sri Lanka. Coconut Res Dev J 1 (1): 34-45. https://doi.org/10.37833/cord.v1i01.182.

Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD). 2015. Coconut Genomics Program to Boost Coconut Production. Retrieved from https://pcaarrd.dost.gov.ph/index.php/quick-information-dispatch-qid-articles/coconut-genomics-program-to-boost-coconut-production.

Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD). 2023. Initial Yield Performance of 4 New Coconut Hybrids. DOST-PCAARRD S&T Media Services.

Food and Agriculture Organization (FAO). 2019. The State of Food and Agriculture 2019: Moving Forward on Food Loss and Waste Reduction. FAO, Rome. http://www.fao.org/3/ca6030en/ca6030en.

Food and Agriculture Organization (FAO). 2020. Managing Coconut Pests and Diseases: A Guide for Farmers. https://www.fao.org.

Knezevic I, Blay-Palmer A, Clause CJ. 2023. Recalibrating data on farm productivity: Why we need small farms for food security. Asian J Agric 15 (19): 14479. https://doi.org/10.3390/su151914479.

Kumar A, Takeshima H, Thapa G, Adhikari N, Saroj S, Karkee M, Joshi PK. 2020. Adoption and diffusion of improved technologies and production practices in agriculture: Insights from a donor-led intervention in Nepal. Land Use Pol 95: 104621. https://doi.org/10.1016/j.landusepol.2020.104621.

Manlosa AO, Schultner J, Dorresteijn I, Fischer J. 2019. Leverage points for improving gender equality and human well-being in a smallholder farming context. Sustain Sci 14 (2): 529-541. https://doi.org/10.1007/s11625-018-0636-4.

Mgendi G, Mao S, Qiao F. 2021. Is a training program sufficient to improve the smallholder farmers' productivity in Africa? Empirical evidence from a Chinese Agricultural Technology Demonstration Center in Tanzania. Asian J Agric 13 (3): 1527. https://doi.org/10.3390/su13031527.

Omar Z, Fatah FA. 2020. Unravelling the factors affecting the agriculture profitability of enterprises: Evidence from coconut smallholder production. Accounting 6: 493-500. https://doi.org/10.5267/j.ac.2020.4.009.

Pamplona P. 2018. Hybrid coconut: Its potential to help overcome poverty. Philippine Coconut Authority (PCA), Manila. https://pca.gov.ph/index.php/10-news/194-hybrid-coconut-its-potential-to-help-overcome-poverty.

Philippine Coconut Authority (PCA). 2021. Coconut farmer's guide: Planting systems and spacing. https://www.pca.gov.ph/pdf/technical-bulletins/plantingsystems.

Philippine Coconut Authority (PCA). 2023. Advantages and yield potential of hybrid coconut varieties (as cited in Manila Bulletin/industry reports). https://mb.com.ph/2023/6/15/coconut-hybrids-revolutionizing-the-philippine-coconut-industry-for-increased-productivity.

Philippine Coconut Authority (PCA). n.d. PCA 15-4 (CATD × TAGT) Hybrid Coconut Technical Description. https://www.pca.gov.ph/pdf/techno/pca15-4.pdf.

Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD). 2022. Impact of Typhoon Odette on Coconut Farms and Recovery Efforts. PCAARRD, Philippines. https://www.pcaarrd.dost.gov.ph.

Reddy MS, Kumar P, Rao AV. 2020. Profitability and constraints of hybrid coconut production in smallholder farms of Indonesia. J Plant Crop 48 (2): 121-130. https://doi.org/10.1007/s40003-020-00476-7.

Samarasinghe CRK, Meegahakumbura MK, Dissanayaka HDMAC, Kumarathunge D, Perera L. 2018. Variation in yield and yield components of different coconut cultivars in response to within-year rainfall and temperature variation. Sci Hortic 238: 51-57. https://doi.org/10.1016/j.scienta.2018.03.058.

Santos GA, Sarmiento MV, Maravilla LA. 1995. Comparative investment analysis of recommended coconut hybrids/cultivars for the national planting/replanting program in the Philippines. Coconut Res Dev J 11 (2): 34. https://doi.org/10.37833/cord.v11i02.292.

Sudha B, John J, Meera AV, Sajeena A, Jacob D, Bindhu JS. 2021. Coconut-based integrated farming: A climate-smart model for food security and economic prosperity. J Plant Crop 49 (2): 104-110. https://doi.org/10.25081/jpc.2021.v49.i2.7256.

Syazliana SN, Khairuddin F. 2022. Risk assessment on factors affecting coconut field operation among smallholders to enhance coconut production. Intl J Acad Res Bus Soc Sci 12 (1): 260-271. https://doi.org/10.6007/IJARBSS/v12-i1/11436.

Tennhardt LM, Lazzarini GA, Schader C, Kagimu M, Lambin EF. 2024. The role of household labour for sustainable intensification in smallholder systems: A case study in cocoa farming systems. Reg Environ Chang 24 (2): 83. https://doi.org/10.1007/s10113-024-02243-2.

Valleser VC, Aradilla AR, Paulican SM. 2020. Establishment of gender-inclusive coconut-based multistorey farm model in Bukidnon, Philippines. Agric Socio-Econ J 20 (1): 57-66. https://doi.org/10.21776/ub.agrise.2020.20.1.8.