Determinants of participation in livelihood strategy among coconut-based farmers in Camiguin, Philippines

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Abstract. Benefits and opportunities of coconut agroforestry adoption are widely studied in literature, especially on its role in conservation initiatives. This study aimed to address the gap in understanding why farmers participate in a livelihood strategy in coconut-based agroforestry and how demographic, economic, and farm attributes influence their participation. The study utilized a quantitative, cross-sectional research method. The study was administered to 391 respondents in Camiguin, Northern Mindanao, Philippines. The collected data was analyzed using free software R 4.5.1 and RStudio. Results revealed that livelihood diversifications positively influenced off-farm, non-farm, and self-employment. Men tend to engage in non-farm employment, while women tend to engage self-employment. Land ownership had positive influence on-farm employment and a negative influence on off-farm employment. The study recommends facilitating the expansion of skills development and strengthening mechanisms for micro-enterprise support for men and women. Also, the design of conservation programs may be integrated into existing livelihood strategies to ensure effective conservation outcomes. Further studies may be conducted to assess the relationship between agroforestry practices and farmers' livelihood assets. Moreover, it is relevant to evaluate gender and generational differences in the agroforestry practices they employed and in their livelihood assets.

1 Introduction

Coconut, as one of the world's important commodities with multiple uses, is vital to millions of smallholder farmers in tropical countries. As of 2024, two of the three major exporters of coconut oil are from Southeast Asia, specifically Indonesia and the Philippines, and the top 3 in terms of export commodity group in the Philippines, with a production value of 250 million US dollars, next to electronic products, and other manufactured goods. In the Philippines, coconut industry occupies approximately 3.6 out of 9.7 million hectares of agricultural land, is produced in 69 out of 82 provinces of the country and supports about 3.5

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million coconut farmers and their families. This reinforces the significant importance of coconut industry to the Philippine economy.

Despite the global importance of coconut, the sector still faces obstacles such as unfavorable supply chain, limited assortment of items, inconsistent quality, and reliance on monoculture farming practices. Low productivity systems characterize monoculture farming practices in most coconut production. This, combined with price instability, leads to income vulnerability for smallholder farmers and ecological degradation due to nutrient depletion, pest susceptibility, and reduced biodiversity. Human-induced climate changes, including extreme weather events, erratic rainfall, droughts, and rising temperatures, also hinder global agricultural systems, particularly in small islands where conservation strategies play a significant role. The need to transform the coconut industry has led to increased interest in agroforestry as a strategy to promote sustainable land-use and conservation initiatives, as well as to improve the livelihood of smallholder farmers.

In this context, while previous studies highlighted the benefits and opportunities associated with the adoption of coconut agroforestry systems, little has been known about how smallholder farmer's participation in a particular livelihood strategy within coconut-based agroforestry is shaped by its demographic, economic, and farm-related attributes. Thus, this study aims to address the gap in understanding why farmers participate in a livelihood strategy in coconut-based agroforestry and how demographic, economic, and farm attributes influence their participation. This approach is vital in understanding how these underlying attributes either enable or constrain adoption of diversified livelihoods, which in turn directly or indirectly affect conservation mechanisms using agroforestry system as a tool.

2 Literature Review

Adoption of coconut agroforestry systems in several studies has already provided a relevant contribution to conservation initiatives at both farm and landscape levels. For instance, the economic benefits of coconut agroforestry include improving crop productivity, producing variety of food items relevant to food security of households, and potential to enrich the agrobiodiversity [1]. Also, coconut agroforestry performs well in terms of yield, income, and resilience to climate change. Moreover, to fully realize the potential of coconut agroforestry, it requires extensive farmer knowledge-sharing networks that will accelerate peer learning and adoption of technology [2]. The increasing interest of agroforestry can be attributed to the growing recognition of its benefits across tropical regions, which aim to improve agricultural ecosystems and farmer's livelihoods [3]. Nonetheless, coconut agroforestry provides economic, social, ecological, and climate-resilient opportunities for successful conservation and livelihood initiatives.

This study is anchored under Diffusion of Innovation Theory popularized by Rogers in 2003, which explains how new ideas or practices are adopted over time based on the factors such as perceived benefits. Moreover, this theory is complemented with Sustainable Livelihood Framework (SLF)—established in 1990s, which emphasized how households utilize different form of capital to sustain their livelihoods. The Diffusion of Innovation Theory argues that participation is not random; it is shaped by how farmers perceive an innovation—in this context, livelihood strategies participated, and how it fits within their agroforestry systems. Participation in a livelihood strategy is a decision-making process under uncertainty, where they weigh benefits and risks based on their circumstances.

Demographic attributes shape how farmers perceive and process innovations. For instance, sex, age, education, and household size influences understanding, openness to change, access to information, and labor availability, which affects their participation in livelihood strategy [4–6]. On the other hand, economic attributes determine the capacity of

the farmer to participate which affect their ability to invest, reduces financial barriers to entry, and increases perceived relative advantage [7]. Farm attributes influence the practical suitability of their participation in a livelihood strategy. For instance, farm size allows flexibility, land tenure security encourages long term investments and farming experience shapes knowledge and risk perception among farmers [8, 9].

3 Methodology

3.1 Study Area and Sampling

The study was conducted in the second smallest island province in the Philippines. Camiguin is a small island and one of the five provinces of Northern Mindanao (see Figure 1). It is a biodiversity hotspot, known to have active volcanoes, evident in its rich volcanic soil. Moreover, the island province is known for farming, fishing, and tourism. As of PSA consensus of 2020, the province has a total population of 92,808 individuals and 22,281 households, distributed across five municipalities, with Mambajao serving as the capital. The top 3 grown crops in the province include coconuts, Lanzones and bananas based on 2024 volume of production expressed in metric tons.

The study utilized a quantitative, cross-sectional research design approach. The study employed two-stage sampling techniques: purposive sampling and stratified random sampling. The first stage involved sampling only coconut farmers from the official list provided by the Philippine Coconut Authority – Camiguin Provincial Office. The list served as the sampling frame i.e. only registered coconut farmers were considered in the study. The second stage involved stratified random sampling and was applied across the five municipalities of the province of Camiguin. Each municipality served as stratum, and from each, a proportionate number of respondents were randomly selected. The PCA Camiguin consolidated a total of 16,324 registered coconut farmers as of 2024, distributed to different municipalities such as Catarman (5,211), Mahinog (3,633), Mambajao (3,337), Sagay (2,519), and Guinsiliban (1,634)

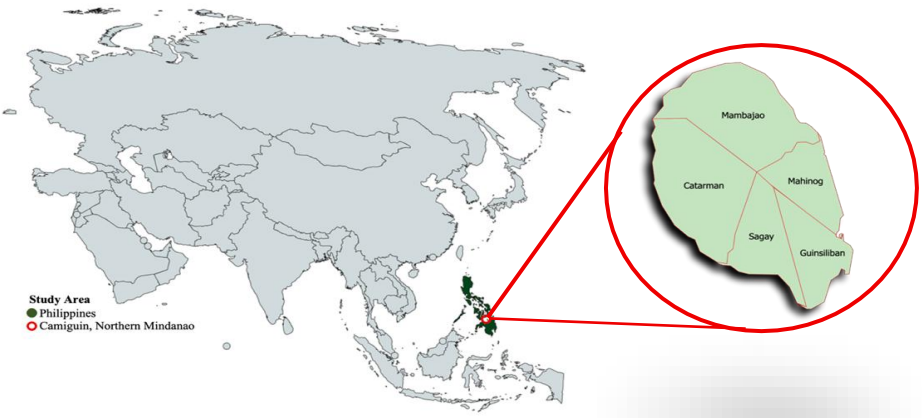

Fig. 1. Map of the study area

The study utilized Sloven's formula to determine the appropriate sample size (see equation 1). The total population, *N*, was obtained from the official list of coconut-based farmers registered with PCA Camiguin. After computing, a total sample size of 391 was

obtained using the formula, the final sample was distributed proportionally among the five municipalities based on their share in the total coconut farmer population.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

where:
n = sample size of registered coconut farmers
N = total population of registered coconut farmers (based on PCA official list)
e = margin of error

The 391 samples were distributed across the following municipalities: Catarman (125 respondents), Mahinog (87 respondents), Mambajao (80 respondents), Sagay (60 respondents), and Guinsiliban (39 respondents).

3.2 Data Collection

To determine the population of the coconut farmers in Camiguin, the study formally requested and obtained an official list of registered coconut farmers from the provincial office of the Philippine Coconut Authority in Camiguin. To guarantee clarity, consistency, and content validity, the semi-structured survey questionnaire underwent validity and reliability tests. Next, a courtesy visit was made to obtain permission and approval to conduct the study through the office of the municipal mayors of five municipalities of Camiguin. This request was made to ensure that community-level coordination, ethical, and administrative concerns regarding the conduct of the study were considered.

The study was administered to samples of 391 registered coconut farmers from August to November 2024, with trained enumerators. A face-to-face interview using the semi-structured survey questionnaire as a research instrument was done. This is to ensure clarity, and that farmers with limited literacy could still participate. All respondents were informed about the purpose and nature of the study and participated voluntarily with the option to withdraw at any time and were assured that all personal information was kept strictly confidential and used solely for research and academic purposes. This process was considered to abide by the ethical consideration of the respondents of the study. After data collection, data entry and validation were performed to ensure that no data was missing from the study.

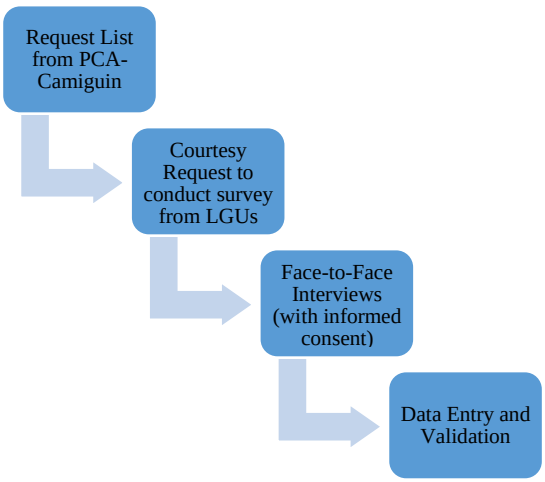

Fig. 2. Data collection process

3.3 Data Analyses

3.3.1 Descriptive statistics

The study employed descriptive statistical analysis to synthesize the demographic, economic, and farm attributes of the respondents of the study. Moreover, it presented the percentage of responses regarding the farmer's participation on a particular livelihood strategy, such as on-farm employment, off-farm employment, non-farm employment, and self-employment. Frequency counts and percentages were calculated for variables such as sex, education, and tenurial status. Mean averages were calculated for age, household size, annual farm tree income, farm size, and number of years in farming experience.

3.3.2 Inferential statistics

Probit regression analysis was employed in the study to examine the predictors affecting the farmer's participation in a particular livelihood strategy. Dependent variables in this study are any of the livelihood strategies such as on-farm employment, off-farm employment, non-farm employment, and self-employment. Independent variables are the number of livelihood strategies employed, sex, education, land tenure, and farm size, as presented in Table 1.

Table 1. Description of dependent and independent variables

Variables	Description	Reference
***Dependent** Variable*		
Farmer's participation to a livelihood strategy	Nominal variable, 1 if on-farm employment; 0 if otherwise	
	Nominal variable, 1 if off-farm employment, 0 if otherwise	
	Nominal variable, 1 if non-farm employment, 0 if otherwise	
	Nominal variable, 1 if self-employment, 0 if otherwise	
***Independent** Variables*		
Sex	Nominal variable, 1 if female, 0 if otherwise	[4]
Age	Continuous variable expressed in years	[5]
Education	Nominal variable, 1 if college graduate, 0 if otherwise	[6]
Number of livelihood strategies	Continuous variable expressed in numbers	[7]
Land Tenure	Nominal variable, 1 if owner, 0 if otherwise	[8]
Farm Size	Continuous variable expressed in hectares	[9]

The formula for the probit model is as follows:

$$Y = \begin{cases} 1 & if\ Y* > 0 \\ 0 & if\ Y* \leq 0 \end{cases} \quad (2)$$

Where:

Y = observed binary outcome (whether a farmer participates in a particular livelihood strategy)

Y* = latent, unobserved variable representing an underlying propensity to exhibit an outcome.

The relationship between latent, unobserved variable (Y*) and the independent variables is modelled as:

$$Y^* = \beta_0 + \beta_1 \cdot NLS + \beta_2 \cdot S + \beta_3 \cdot A + \beta_5 \cdot E + \beta_6 \cdot LT + \beta_7 \cdot FS + + \epsilon \quad (3)$$

Where:

β_0 = intercept

$\beta_1 \cdot NLS$ = coefficient estmates for number of livelihood strategies employed

$\beta_2 \cdot S$ = coefficient estimates for Sex

$\beta_3 \cdot A$ = coefficient estimates for Age

$\beta_4 \cdot E$ = coefficient estimates for Education

$\beta_5 \cdot LT$ = coefficient estimates for Land Tenure

$\beta_6 \cdot FS$ = coefficient estimates for Farm Size

ϵ = error term

This model evaluates the predictors affecting coconut farmers' participation on a livelihood strategy that can be represented through coefficient estimates of each independent variable within the Camiguin context. The study analyzed using free software R version 4.5.1 and RStudio.

4 Results and Discussion

4.1 Demographic, Economic and Farm Attributes of Farmers in Coconut-based Agroforestry

To determine mean average, frequency count, and percentages, the study employed descriptive statistics. The data obtained contains demographic, economic and farm attributes of the coconut-based agroforestry smallholder farmers. The data showed male (54%) dominance over female (46%) respondents of the study. The mean age was 58 years, indicating an ageing farming population, while the mean household size was five members. Only 12% of the respondents completed college education, indicating limited formal educational attainment of farming respondents in the study area. It was observed that the livelihood strategies employed by the respondents averaged two. Annual income from farm trees averages 30,189 Philippine pesos (approximately 539 US dollars). Most farmers (80%) own their land, with remaining 20% cultivating as tenants. The farm size is small, averaging 1 hectare and average farming experience exceeds 26 years, as detailed in Table 2.

Table 2. Demographic and Farm Attributes of Coconut-Based Agroforestry

		n = 391
Demographic Attributes		
Sex	Female	179 (46%)
	Male	212 (54%)
Average Age (expressed in years)		58
Average Household Size (expressed in number of members)		5
Education	College Graduate	45 (12%)
	Others	346 (88%)
Economic Attributes		
Number of Livelihood Strategies Employed		2
Average Annual Farm Tree Income (expressed in Philippine Pesos [a])		30,189
Farm Attributes		
Land Tenure	Owner	313 (80%)
	Tenant	78 (20%)
Average Farm Size (expressed in hectares		1
Average Farming Experience (expressed in number of years)		26

[a]1 USD = 56 PhP as of November 2024

4.2 Livelihood Strategies Employed in Coconut-based Agroforestry

Livelihood strategies employed in the study area were divided into four: on-farm employment, off-farm employment, non-farm employment, and self-employment, see Figure 3. In this study, off-farm employment refers to jobs related to agriculture, such as land tenancy agreements and working on other farms. On the other hand, non-farm employment refers to non-agricultural jobs which include working in construction sites for building and road infrastructure, and transportation such as driving for motor cabs or motorcycles (locally known as *habal-habal*). Self-employment refers to owning micro to small businesses such as mini convenience stores (locally known as *sari-sari* stores), vulcanizing shops, and beauty salon or barber shops. On-farm employment remains foundational, with 82% of them employing this strategy. In the study, while only 18% of farmers do not, it indicates that the majority are leveraging their available land resources and knowledge, along with training on agricultural production. Off-farm and non-farm employment emerge as a crucial buffer when on-farm income is uncertain and insufficient. It is evident that only 21% and 29% employed such strategies, respectively. Self-employment accounts for 39% of the responses.

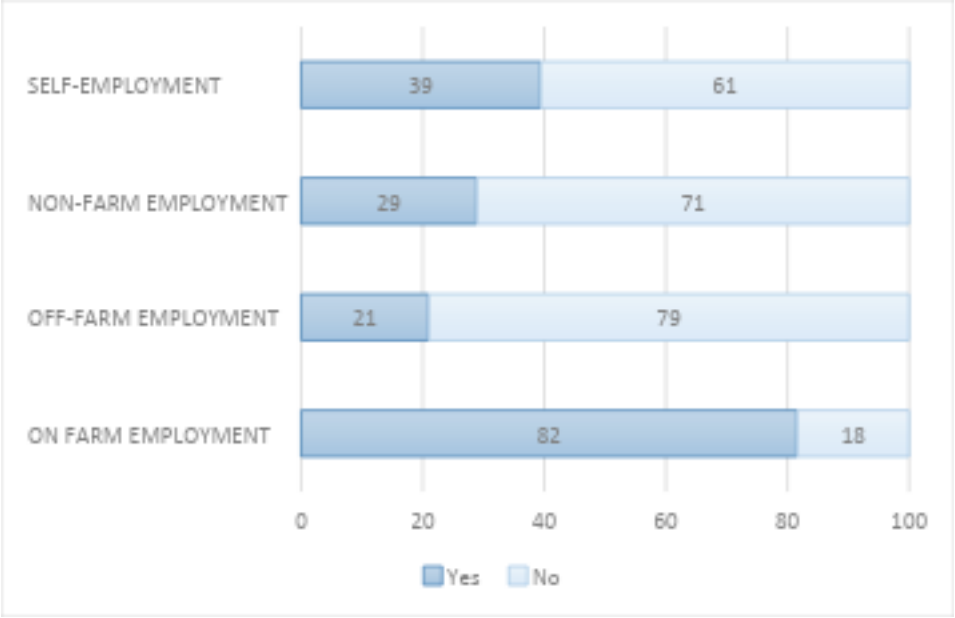

Fig. 3. Livelihood Strategies Employed in Coconut-based Agroforestry

4.3 Influence of demographic, economic, and farm attributes farmers' participation in a livelihood strategy

The collected data were subjected to probit regression analysis to examine the relationship between the farmer's participation on a particular livelihood strategy i.e. on-farm employment, off-farm employment, non-farm employment, and their demographic, economic, and farm attributes such as number of livelihood strategies (NLS), sex (S), age (A), Education (E), Land Tenure (LT), and farm size (FS). The model revealed strong explanatory power for on-farm employment (r^2=0.84), off-farm employment (r^2=0.80), non-farm employment (r^2=0.62) and self-employment (r^2=0.71) **(**Table 3**).**

4.3.1 Livelihood diversifications influence off-farm, non-farm and self-employment

Livelihood diversification positively influenced farmers to participate in off-farm (H1, p-value=0), non-farm (H2, p-value=0), and self-employment (H3, p-value=0). Off-farm employment such as land tenancy arrangements and working with other farms, as observed in this study, provided farmers with only limited flexibility. Thus, engaging in more diversified income portfolios provided them with a complementary strategy to increase their livelihood resilience.

Non-farm employment, such as construction work and driving (locally known as *rela* and *habal-habal*), offers alternative sources of income; however, it is often the primary source of income on the island. Such employment options may not require formal qualifications like other professions, making them practical for farmers to participate in and expand their livelihood strategies. Alternatively, self-employment opportunities, such as owning a micro to small business, including mini convenience shops, vulcanizing shops, and beauty parlors and barber shops, provide access to opportunities tailored to farmer's specific skills and local market needs. It enables them to combine multiple income sources as safety net, sometimes the primary source of income against risks and uncertainties.

These findings were supported by the study in rural Andes, where households incorporating off-farm employment also employed diversified livelihood strategies [7]. A study in Assosa Wereda, Western Ethiopia, indicates that self-employment can involve one or a combination of agricultural production, processing, small-scale manufacturing, service provision, and trading, especially in less developed regions [10].

4.3.2 Livelihood strategies differ by gender roles

Male respondents (-0.57, p-value=0.001) tend to participate in non-farm employment while female respondents (0.64, p-value=0.001) tend to participate in self-employment. This likely reflects persistent gender-based structural barriers that limit women's access to non-farm employment. Moreover, non-farm employment remains a barrier for women due to limited job opportunities and mobility. In many rural settings, traditional social and gender-norms, combined with domestic responsibilities, often limit participation in non-farm employment.

Generally, men have the flexibility to participate in non-farm employment due to cultural and gender-norms associated with being men. Non-farm jobs, such as construction work and driving require strength and agility, and are traditionally male-dominated occupations. Moreover, women tend to participate in self-employment. Owning a micro to small business such as mini convenience shop (*sari-sari* stores) and beauty salons, implies flexibility and adaptability to domestic responsibilities, such as care for children.

These findings are consistent with the study in Southern Africa, where females are less likely to participate in non-farm activities due to cultural factors, particularly in naturally assigned household activities [11]. Interestingly, what motivates women to participate in self-employment is principally linked to family concerns and opinions of their family and peers [12]. Also, women tend to choose self-employment due to flexibility factors, caring reasons, and home working [13], which is related to their traditional household obligations .

4.3.3 Land ownership drives on-farm engagement, limits off-farm labor.

Land ownership (3.59, p-value=0) positively influenced on-farm employment. Farmers with landholding are more likely to engage in on-farm employment, i.e. they allocate labor towards agricultural activities on their farms. Additionally, land ownership enhances sense of security and encourages investment in on-farm activities, such as diversifying farm portfolio. Conversely, land ownership (-3.78, p-value=0) negatively influenced off-farm employment. Farmers with no land tenure tend to engage in land tenancy arrangements to expand their participation in farming activities. For land-poor farmers, land tenancy arrangement serves as a compensatory mechanism that facilitates their inclusion in agricultural systems despite the absence of land tenure.

These findings emphasized the vital role of secure land access in sustaining on-farm productivity and profitability. In Thailand, full land ownership has access to higher land values, bank loans, and the ability to invest in mechanization, compared to no land ownership [14]. Moreover, owner-cultivator in rural Pakistan with secure tenure rights primarily target long-term benefits from their investment, which includes soil conservation measures and agricultural productivity [15].

Table 3. Coefficient estimates of farmer's participation in livelihood strategy on demographic, economic, and farm attributes of coconut-based agroforestry

Variables	on-farm employment (n=319)		off-farm employment (n=82)		non-farm employment (n=113)		self-employment (n=154)	
Intercept	-1.84	*	-0.82		-3.17	***	-6.67	***
Livelihood Strategies	0.24		0.81	***	2.10	***	2.87	***
Sex	0.15		0.04		-0.57	**	0.64	**
Age	0.00		0.02		-0.16		0.01	
Education	-0.18		-0.06		-0.36		-0.03	
Farm Ownership	3.59	***	-3.78	***	-0.17		0.23	
Farm Size	-0.03		0.03		-0.09		0.14	
R^2	0.84		0.80		0.62		0.71	

*** - p-value=0, ** - p-value=0.001, * - p-value=0.01

5 Conclusion and ways forward

The study area has more males than females, with average age of 58 years old, an average household size of 5 and only few finished a degree. An average of 2 livelihood strategies is employed by the respondents. About 82% of the respondents employed on-farm activities, 21% off-farm employment, 29% non-farm employment, and 39% self-employment. Livelihood diversification influenced farmers to participate in off-farm, non-farm, and self-employment. Male farmers tend to participate in non-farm employment while female farmers tend to participate in self-employment. Land ownership influenced farmers to participate in on-farm employment rather than off-farm employment.

Expanding access to skills development and job may be facilitated. These skills development initiatives may include vocational training and capacity building initiatives to equip both men and women with skills relevant to off-farm and non-farm employment such as product value-adding, ICT-related jobs. This will help them make informed decisions about investing in diverse livelihood strategies in their locality, which is highly relevant in the 21st century. Moreover, mechanisms for micro-enterprise support may be strengthened. This includes providing financial literacy training, microcredit facilities, and market linkages to encourage social entrepreneurship, especially for men and women interested in self-employment ventures.

This present study may serve as needs assessment outcome for the stage college, such as Camiguin Polytechnic State College. She may utilize these outcomes to align them with their respective research, development, and extension agenda, initiatives, and activities for agriculture and natural resources-related programs. Finally, the design of conservation programs may be integrated into existing livelihood strategies to ensure ecologically sound, socially equitable, and effective conservation outcomes. Further studies may be conducted to assess the relationship between agroforestry practices and farmer's livelihood assets. Moreover, it is relevant to evaluate gender and generational differences in the agroforestry practices they employed and in their livelihood assets.

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