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# Why do Farmers not Use Fertilizer? A Case of Multistorey Cropping System with Abaca under Coconut in Zamboanga Peninsula, Philippines

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A B S T R A C T

The Zamboanga Peninsula region significantly contributes to the Philippine coconut production, wherein abaca is also cultivated as an additional crop within coconut plantations. Still, coconut farmers belong to the country's poverty sector. Abaca plays a significant role in providing an alternative source of income as a perennial intercrop in agroforestry systems like coconut. However, the productivity and sustainability of this farming system are affected by practices such as nutrient management, which is not explicitly known. Using a mixed-methods approach, this study applies a combination of quantitative and qualitative data-gathering techniques to assess the nutrient management practices adopted by the 33 qualified respondents, including challenges encountered and perceptions to abaca under the coconut farming system and fertilizer use. Quantitative data were analyzed using IBM SPSS Statistics version 29, and thematic analysis was utilized for qualitative data. Results indicate that most (88%) of the farmers in the area did not apply fertilizers for their abaca. Yet, they still consider abaca as one of the income-generating crops besides coconut. The lack of financial resources and irregular harvesting operations are significant challenges that hinder fertilizer application. Findings revealed the need to develop low-cost and practical nutrient management technology for abaca under coconut, which shall be complemented with an effective human resource management system of skilled harvesters for the continuous harvesting operation of abaca to translate good crop growth into good yield and income. This will serve as a basis for government institutions and other stakeholders in developing and implementing programs and policies to improve the abaca and coconut industries.

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## Introduction

There is no denying that farming has become more challenging over time. Decreased agricultural land area, low productivity, low income, extreme weather conditions, and climate change threaten food security and agricultural production. These issues, which have impacted the world's major agricultural systems, are unresolved and only worsen with time.

In the Philippines, coconut farming is one of the country's critical agricultural systems and accounts for most agricultural exports. It is cultivated by 2.5 million coconut farmers in 69 out of 82 provinces with a total land area of 3.6 million hectares, an annual nut production of 14.7 metric tons, and average export earnings of 91.4 billion pesos for 2014–2018 (PCA, n.d.). However, most coconut growers and their families face the most challenging obstacles to achieving a steady living above the country's poverty line (Andriesse, 2018). According to Mendoza et al. (2018), the low income from coconut is attributed mainly to the low yield. Diversifying coconut farms can help improve productivity, especially in places where there are old coconuts. Farm diversification is a strategy to address the challenges of stagnant yields, soil degradation, environmental concerns, diseases, pests, and weeds (Hufnagel et al., 2020).

Intercropping is a common form of diversification applied in coconut-growing regions across the Philippines. The suitability of intercrops shall be based on light requirements. Light transmitted under coconut stands varies with planting distance and age of coconut trees; at 40 years of age, 37% of light is transmitted and is suitable for shade-tolerant crops as well as crops with a wide range of light requirement such as bananas and sweet potatoes, (Dauzat et al., 1997). Similar to bananas, abaca thrives in the presence of coconut and serves as a lucrative intercrop (Eroy, 2012). As a shade-loving plant, abaca is a potential component of farm diversification. Abaca, also known by its scientific name *Musa textilis* Nee, is a native perennial fiber crop of the Philippines that belongs to the Musaceae family, like banana. It grows well in the shade of coconut, ipil-ipil, anii, dapdap, and similar trees (PhilFIDA, n.d.-a). Abaca has many economic uses and is one of the country's agricultural exports. More than 80% of the world's supply of abaca fiber comes from the Philippines. Exports of abaca fiber and products generated an annual average of 119 million US dollars (2010–2019) from pulp, cordage, fabrics/yarns, fibercrafts, and raw fiber (PhilFIDA, n.d.-b). Harvesting abaca typically spans 16-24 months from planting, followed by consecutive harvests every three to four months, resembling the pattern observed in well-established coconut farms.

For perennial plants like abaca and coconut, a continuous nutrient supply is essential for long-term productivity. As the plant grows, it requires an increasing quantity of crucial elements. Soil health and nutrient management are necessary for plant growth and development. It is associated with several plant responses, including enhancements to crop yield and quality (Miner et al., 2020) and resistance to plant pests and diseases (Thakur et al., 2021). According to Crisostomo et al. (2023), most coconut plantations in the Philippines do not usually use fertilizer, which leads to significant differences in yield of 31 to 87% between farmers' areas and well-managed farms.

Although abaca is endemic in the country, there is limited available knowledge of nutrient management in multistorey cropping under coconut. Abaca planted under coconut in the region is observed to have poor growth. High fertilizer cost had hindered the farmers to apply fertilizer for maintenance. Therefore, it is vital to identify the practical methods farmers use and examine their perspectives on nutrient management of abaca under coconut. This information will provide the foundation for national government agencies such as the Philippine Fiber Industry Development Authority (PhilFIDA), the Philippine Coconut Authority (PCA), and the Department of Agriculture (DA), as well as local government units, and other stakeholders, to develop and implement policies, programs, and projects aimed at enhancing crop productivity and income of abaca and coconut farmers while also addressing food security, promoting a climate-resilient farming system, and encouraging sustainable agriculture.

## Materials and Methods

### *Study Area*

The study was conducted in the southernmost part of the Philippines at the Zamboanga Peninsula Region, island of Mindanao (Figure 1). The study areas included two provinces comprising one city and twelve municipalities, specifically the municipalities of Aurora, Bayog, Josefina, Kumalarang, Lakewood, Tigbao, and Sominot in the province of Zamboanga del Sur, and the city of Dapitan and municipalities of Baliguian, Jose Dalman, Mutia, Pinan, and Sindangan in the province of Zamboanga del Norte. These provinces are among the country's top-producing provinces of coconut (PCA, n.d.), where abaca is also grown. In 2018, the area planted to coconut was 127,354 hectares in Zamboanga del Sur province and 240,298 hectares in Zamboanga del Norte, (PCA, n.d.). According to the land suitability map for abaca developed by the Bureau of Soils and Water Management (BSWM), the provinces of Zamboanga del Sur (BSWM, 2019b) and Zamboanga del Norte (BSWM, 2019a) have the potential of planting abaca under coconut areas by 88,923 and 133,033 hectares respectively. However, the total abaca areas planted in the entire Zamboanga Peninsula region is only 2,501 hectares with an annual average (2010-2019) fiber production of 614 metric tons that is 0.9% from the national production of 67,545 metric tons (PhilFIDA, n.d.-b).

### *Participants of the Study*

The participants of this study were the farmers who cultivated abaca under coconut for at least two years. Participants did not receive prior assistance in terms of cash incentives and fertilizer subsidies for abaca. This purposive identification of participants provided a better exploration of data from the farmers who utilized their own capabilities and resources to establish and maintain their farms. This also facilitated the identification of original farmers' practices in abaca under coconut farming. The identification of beneficiaries was coordinated with the Philippine Fiber Industry Development Authority Regional Office IX. This study utilized total enumeration for the qualified participants identified in the list. Out of the 37 farmers listed, only 33 had participated.

### *Method of Data Collection*

This study employed a mixed-methods approach, incorporating both quantitative and qualitative data. Quantitative data collection used a farmer's survey, reinforced by qualitative data from in-depth interviews and focus group discussions (FGD). The interview questionnaires and guide questions were tested outside the locale of the study with similar farming system and local dialects at Sibantang, Talisayan, Misamis Oriental, Philippines and were finalized. The survey was done in an interview format composed of sections on personal and farm profiles, nutrient management practices, and their perceptions of abaca farming and fertilizer use. The in-depth interview was conducted using open-ended questions that focused on describing the nutrient management practices of abaca and its challenges. To further expound and validate the data, the focus group discussion was conducted after the in-depth interview in areas that involved several numbers of farmers in a barangay such as in Bolisong, Kumalarang, Zamboanga del Sur and Nanganangan, Tigbao, Zamboanga del Sur. Before conducting the survey and in-depth interview, a courtesy call was made to local officials in the vicinity of the respondents. At the start of the interview, the participants were informed about the purpose of the research. Their consent was obtained, including permission to use video, camera, and recorders and utilize the data obtained for publication. Audio-video recording and a reflective notebook were done to support data collection. Data gathering started from October 2023 to December 2023.

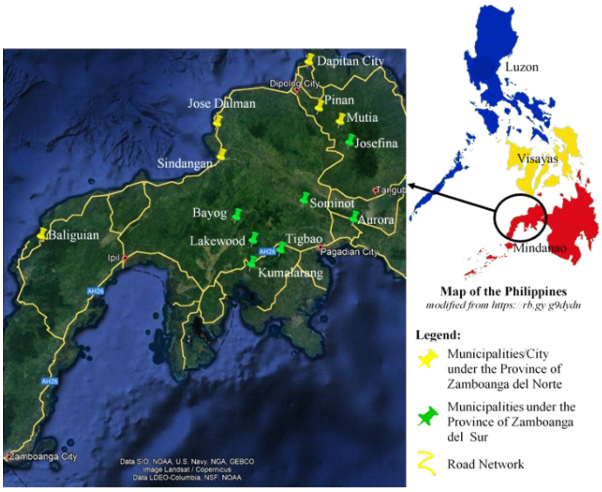


Figure 1. Map of the study area in Zamboanga Peninsula Region of Mindanao, Philippines modified from Google Earth Pro

***Data Analysis***

After data collection, quantitative data were analyzed using IBM SPSS Statistics version 29 for frequency and weighted arithmetic mean statistical measurements. Using the same software, a Kruskal-Wallis Test was done to evaluate the differences in fiber yield across the different nutrient management practices and a Fisher's exact test was done for the nonparametric evaluation of socio-demographic profiles across nutrient management. In order to provide additional support for the findings derived from the quantitative data, a qualitative analysis was conducted. Qualitative analysis offers a distinct and valuable understanding of individuals' experiences beyond quantitative analysis (Ayre & McCaffery, 2022). It is instrumental in exploring the challenges encountered by the respondents in the nutrient management of abaca under coconut. The qualitative analysis technique employed in this study was thematic analysis, following the guidelines established by Kiger and Varpio (2020). These guidelines involved familiarizing oneself with the data, coding the data, identifying themes, reviewing the themes, defining the themes, and finally, producing the report.

**Results and Discussion**

***Socio-demographic and farm profile***

The descriptive analysis (Table 1) shows that farmers who cultivated abaca under coconut in the Zamboanga Peninsula Region were predominantly male (64%). Most (84%) were above 40 years old and were generally married. Most of the respondents (36%) were at the elementary level, and only 12% had graduated from college. Regarding ethnicity, Bisaya (76%) was the dominant group, compared to Subanen (24%). Regarding farm profiles, almost all the respondents (91%) own the farmland, and only 9% were tenants. Moreover, more than half of the respondents were cultivating abaca under coconut in relatively small areas, less than 5 hectares, with the majority (94%) planting the Kutaykutay cultivar of abaca than the Lunhan cultivar (6%). Meanwhile, the maximum number of years recorded in abaca cultivation under coconut in the region was 23 years. However, most (79%) respondents had planted abaca under coconut within 2-10 years. It also shows that the coconut areas planted with abaca were already old, with coconut established already ahead of abaca more than ten years ago (24% were planted 10-19 years ago, and 30% were planted more than 50 years ago).

***Influence of socio-demographic profile on nutrient management***

The Fisher's exact test (Table 2) revealed no significant difference in the response distribution across the variables of age, sex, marital status, education, and ethnicity against the variable of nutrient management, as indicated in all P-values greater than 0.05. The result showed that the distribution of responses among males and females, married or not, with high educational attainment or not, young or old, and whatever ethnicity they belong to does not influence the nutrient management of abaca under coconut. This result is similar to the observation of Valleser et al. (2020) in cacao plantations where similar socio-demographic profiles did not affect their performance. Socio-demographic factors do not influence the decision to use fertilizer for abaca under coconut. Future interventions in this regard may not be discriminatory to the said sociodemographic profiles.

***Nutrient management practices and yield***

Three nutrient management practices for abaca under coconut were identified in this study: 1) applying no fertilizer at all; 2) using synthetic fertilizer exclusively in the first year of farm establishment; and 3) using both synthetic and organic fertilizers in the first year of farm establishment only. Result shows (Figure 2A) that majority of the farmers (88%) in the region did not apply fertilizer throughout the growth duration of abaca under coconut, only 6% of the respondents applied purely synthetic fertilizers like urea (46-0-0) and complete fertilizer (14-14-14) and the remaining 6% used both organic and synthetic fertilizer (carbonized rice hull + 14-14-14 and chicken manure + 16-20-0 + 14-14-14). Fertilizers were applied only during the first year of farm establishment and no succeeding application followed. Since majority of the respondents did not use fertilizer, result indicates that most farmers rely solely on the inherent capacity of the soil to supply nutrients to the crops. Bande et al. (2013) stated that supplementing NPK fertilizer during the early stage of abaca growth positively impacted crop growth and net assimilation rates. According to Armecin (2008), the predominant decline in soil fertility of abaca areas due to the depletion of nutrients as a result of no fertilizer application causes a significant reduction in fiber yield and income.

Figure 2B comparatively illustrates the corresponding yield of the three nutrient management practices. Respondents that did not apply fertilizer at all have reported an average annual fiber yield of 681.67 kg, while respondents who applied synthetic fertilizer obtained 700 kg per year and respondents who applied both synthetic and organic fertilizer obtained an annual average production of 900 kg. However, the Kruskal-Wallis Test revealed no significant difference in fiber yield across three nutrient management practices. This indicates that all practices are still deemed insufficient, falling short of the attainable yield of 1700 kg per hectare set by the Bureau of Agriculture and Fishery Standards (2019) for the Kutaykutay cultivar under good agricultural practices.

Table 1. Socio-demographic profile of farmers and farm characteristics of abaca under coconut in Zamboanga Peninsula Region

| Variables | | Frequency N=33 | Percentage% |
|---|---|---|---|
| Sex | Male | 21 | 64 |
| | Female | 12 | 36 |
| Age | Below 18 | 0 | 0 |
| | 18-29 | 2 | 7 |
| | 30-39 | 3 | 9 |
| | 40-49 | 10 | 30 |
| | 50-59 | 11 | 33 |
| | 60 and above | 7 | 21 |
| Marital Status | Single | 2 | 6 |
| | Married | 29 | 88 |
| | Widow/er | 2 | 6 |
| Educational Attainment | Elementary Level | 12 | 36 |
| | High School Level | 8 | 24 |
| | College Level | 9 | 27 |
| | Graduate Level | 4 | 12 |
| Ethnicity | Subanen | 8 | 24 |
| | Bisaya | 25 | 76 |
| Land Ownership Status | Landowner | 30 | 90.91 |
| | Tenant | 3 | 9.09 |
| Area Planted with Abaca under Coconut (hectares) | Less than 1 | 5 | 15.15 |
| | 1-2 | 13 | 39.40 |
| | 3-4 | 8 | 24.24 |
| | 5-6 | 4 | 12.12 |
| | 7-10 | 2 | 6.06 |
| | More than 10 | 1 | 3.03 |
| Age of Abaca from Planting (Years) | 2 | 5 | 15.15 |
| | 3-5 | 13 | 39.40 |
| | 6-10 | 8 | 24.24 |
| | 10-15 | 2 | 6.06 |
| | 15-20 | 2 | 6.06 |
| | More than 20 | 3 | 9.09 |
| Abaca cultivar used | Kutaykutay | 31 | 93.94 |
| | Lunhan | 2 | 6.06 |
| Age of Coconut from Planting (Years) | Less than 10 | 0 | 0 |
| | 11-19 | 8 | 24.24 |
| | 20-29 | 6 | 18.18 |
| | 30-39 | 6 | 18.18 |
| | 40-49 | 3 | 9.10 |
| | 50 and more | 10 | 30.30 |

Table 2. Fisher's exact test on the correlation of age, sex, ethnicity, educational attainment, and marital status to nutrient management of abaca under coconut

| Variables | P-value |
|---|---|
| Age | 0.586 |
| Sex | 0.271 |
| Marital Status | 1.000 |
| Education | 0.587 |
| Ethnicity | 1.000 |

This result is comparable to the observation of Armecin et al. (2011) in Leyte, where abaca fiber yield in the same cropping system is low. Similarly, Calica et al. (2024) also observed low production for abaca in North Cotabato, Mindanao, Philippines at 600 Kg per hectare per year with less farm inputs like fertilizer and chemicals. Gliessman (2016) explained that in an agroecosystem like this, a substantial amount of nutrients is lost due to crop removal, so sustainability requires nutrient recycling mechanisms and soil amendments.

With poor fiber production, the income is also low. Based on the findings of Calica et al. (2024), the 600 kilogram per hectare per year fiber output can generate a net income of Php7,600. This is calculated by taking into account the purchasing price of fiber at Php55 per kilo with a gross sale of Php33,000, deducted by the expenses on harvesting or the share of harvesters (60% of the gross sales or Php19,800), weeding expense (Php5,000), and transportation costs (Php1 per kilo or Php600).

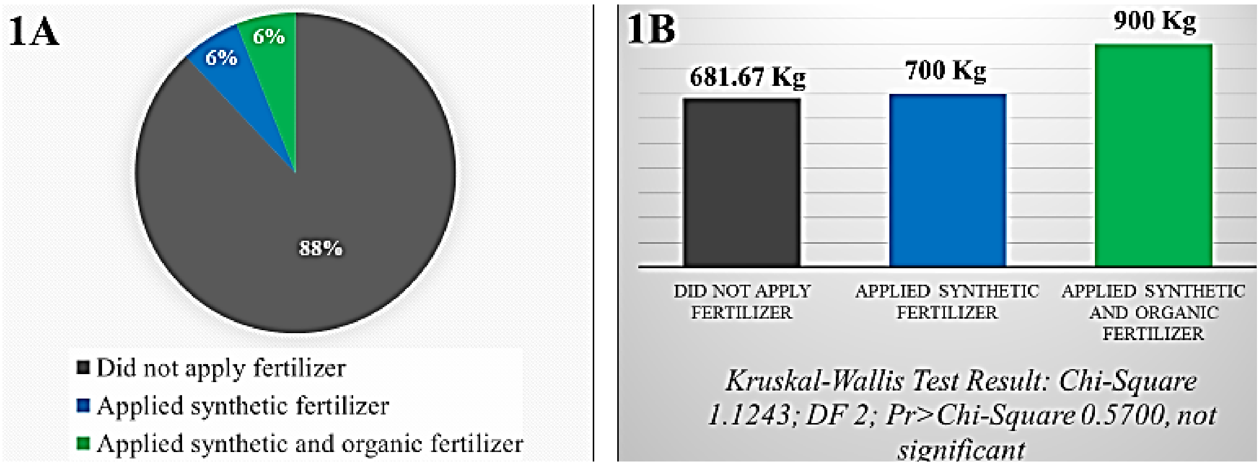


Figure 2. Percentage of respondents who adopted fertilizer application in abaca under coconut (1A) and the corresponding annual average yield per hectare (1B)

Using similar price and costs, a farmer who did not applied fertilizer in this study can earn an income of Php9,315 while the farmers who applied pure synthetic fertilizer earned Php9,700 and the farmers who applied both synthetic and organic fertilizer earned Php13,900. The earnings of farmers who utilized fertilizers do not include fertilizer costs since they only used fertilizer during the first year of abaca farm establishment, and the respondents' abaca farms were more than two years old, hence maintenance costs omit fertilizer. Moreover, considering the potential yield set by BAFS at 1700 kilograms, a gross sale of Php93,500 per hectare per year can be attained using good agricultural practices which includes fertilizer application.

### *Factors Affecting Fertilizer Use*

Two themes emerged from the qualitative analysis regarding the challenges in nutrient management of abaca under coconut: insufficient financial resources and inconsistent harvesting. We described insufficient financial resources as the most prevalent challenge of nutrient management among the respondents who did not apply fertilizer. Farmers bear the financial strain of high fertilizer capital requirements, whereas abaca can continue to generate income for them even without fertilizer application. This belief is well elaborated in the statement of Bienvenido,

"Nowadays, prices of household needs are extremely high, including fertilizers. Our income is good only for our basic household needs and the school needs of our children. That is why we cannot afford to buy fertilizer for our abaca. Also, abaca can still grow without fertilizer, it only needs to be free from weeds". This result conforms to the findings of Ayoo (2022), where the lack of financing is the major constraint for economic prosperity in many developing countries. The results of this study illustrated the actual circumstances experienced by the respondents as they struggled with the financial requirements of sustaining an ideal farm, explicitly concerning the substantial expense of fertilizers given their limited economic means and other competing needs. Moreover, this result also conformed to the findings of Calica et al. (2024) in North Cotabato and Cortez et al. (2015) in Catanduanes, wherein farmers provided only low farm inputs in their abaca farms. Camilo also remarked,

"If the government provides fertilizer support for abaca, it would boost our yield. However, if it is only us, we should prioritize our household needs before buying fertilizer".

For sustainability and productivity to take place, there should be a wise consideration between what is ideal and what is real. In this case, the insufficient funds for fertilizer must be considered. In addition, aside from fertilizers, other factors such as planting density, climatic and environmental factors, and other cultural and farm management practices must also be optimized for sustainable productivity, as Bande et al. (2016) explained in their study with the abaca-based agroecosystem.

Meanwhile, farmers who applied fertilizer during the farm establishment observed good growth of their plants. However, the absence of harvesting or inconsistent harvesting schedules discouraged them, neglecting the farm. Pablo, a farmer who applied organic and commercial fertilizers during the first year of his abaca farm establishment, explained that the delays and irregular harvesting of his abaca due to the lack of skilled harvester had discouraged him to continue providing appropriate care and management for his abaca including fertilizer application.

"Establishing a farm is not only expensive, but it also requires time and attention; seeing your plants grow well is very inspiring, but knowing that it could not be harvested due to the lack of a skilled harvester is disheartening," he said.

Abaca takes two years from planting before its first harvest and requires skilled harvesters in the extraction of fiber; the delay in harvesting can be frustrating, especially for small-scale farmers like him who expect an immediate return to operationalize the farm continually. Harvesting or fiber extraction of abaca is a labor-demanding activity that requires skill in its processes, including machine operation. Small-scale farmers in the area do not have the machines and harvesters and rely only on the group of harvesters to harvest the farm. These groups are pretty few and also engaged in several farm activities. Nevertheless, he observed that applying both organic fertilizers (chicken manure) and commercial fertilizers (16-20-0 and 14-14-14) improved the growth of abaca and the nut yield of coconut.

Table 3. Perception of farmers to abaca under coconut farming system and fertilizer use

| Indicators | Mean | Description |
|---|---|---|
| Abaca under coconut farming system | | |
| 1. Planting abaca under coco provides another source of income. | 4.61 | SA |
| 2. Planting abaca under coco minimizes weeds. | 4.39 | SA |
| 3. Planting abaca under coco improves soil fertility. | 4.12 | A |
| 4. Planting abaca under coco increases the yield of coconut. | 3.97 | A |
| 5. Planting cover crops in abaca under coco is possible even when abaca grows taller. | 2.67 | U |
| Fertilizer use | | |
| 1. Organic fertilizer is more economical than synthetic fertilizer | 4.03 | A |
| 2. Organic fertilizer can improve the growth and yield of abaca and coconut. | 4.00 | A |
| 3. Soil analysis is necessary for the nutrient management of abaca under coconut. | 3.88 | A |
| 5. Abaca and coconut can still be productive even without fertilizer. | 3.79 | A |
| 4. Continuous fertilizer application is essential for abaca and coconut's long-term productivity. | 3.73 | A |
| 6. Fertilizer application is necessary for abaca under coco. | 3.70 | A |
| 8. A combination of organic fertilizer and synthetic fertilizer is more economical and more effective. | 3.58 | A |
| 7. Synthetic fertilizer is more effective than organic fertilizer. | 3.23 | U |

Legend: Mean Value

| Score | Mean Range | Description |
|---|---|---|
| 5 | 4.21-5.00 | Strongly Agree (SA) |
| 4 | 3.41-4.20 | Agree (A) |
| 3 | 2.61-3.40 | Uncertain (U) |
| 2 | 1.81-2.60 | Disagree (DA) |
| 1 | 1.00-1.80 | Strongly Disagree (SD) |

***Farmers' Perception of Abaca Under Coconut Farming and Fertilizer Use***

The respondents in this study expressed their high agreement that abaca provides another source of income and minimizes weeds based on the weighted arithmetic mean of 4.61 and 4.39, respectively, as shown in Table 3. Additionally, the respondents agreed with the succeeding statements as indicated in the corresponding means that planting abaca under coconut improves soil fertility (4.12) and increases the yield of coconut (3.97). On the contrary, the respondents are uncertain about planting under-story crops (2.67) in this farming system.

Despite the low yield obtained by the respondents, they still highly agreed that abaca provides another source of income. Since abaca is planted under coconut, it contributes as a supplementary source of income in the uplands where most of the coconut and abaca are grown. This finding aligns with the research of Lacuna-Richman (2002), which states that abaca serves as an additional source of income for the coconut households in Eastern Visayas, and it only requires minimum input in terms of fertilizers, pesticides, and irrigation as well as in processing. While the respondents see abaca farming as a means of income generation with low input or minimal cost, it can be a potential component of agroecological sustainability. This type of agroforestry encompasses economic, social, and ecological benefits. According to Fahad et al. (2022), agroforestry enhances soil structure, microclimate, and hydrologic functions by promoting soil-related microbial activity and mitigating the effects of rainfall. Additionally, it diminishes the process of soil erosion and the degradation of nutrients. Agroforestry has the potential to enhance and revive soil-based ecosystem services, promote sustainability in agriculture, and mitigate disease risks and vulnerability to climate change.

Although the majority of the respondents did not use fertilizer in their actual farms, as they agreed that abaca and coconut can still be productive even without fertilizer (3.79), they also believed that continuous application of fertilizer is needed for long term productivity of abaca and coconut (3.73) and that fertilizer application is required for this type of farming system (3.70). With regards to nutrient management, the respondents agreed that organic fertilizer is more economical than synthetic fertilizer (4.03), it can improve the growth and yield of abaca and coconut (4.00), and they also agreed that soil analysis is necessary for nutrient management of abaca under coconut (4.0) as well as on the statement that the combination of organic fertilizer and synthetic fertilizer is more economical and more effective (3.58). However, they are uncertain about the effectiveness of synthetic fertilizer over organic fertilizer (3.23). This result is further elucidated by Diosdado, a farmer who has been cultivating abaca for about nine years, and Pablo on their observations that, in contrast to costly and non-ecofriendly synthetic fertilizers, organic fertilizers like rice hull and chicken manure, though not quick acting but have long-term effects in plant nutrition which is valuable for perennial crops like abaca and coconut. According to them,

"Synthetic fertilizers are effective, but only for a shorter period; you need to apply again for continuous nutrition compared to the organic fertilizers, which are slow but long-lasting".

The respondents believed organic fertilizer is more advantageous than synthetic fertilizers in the perennial cropping system of abaca and coconut. This statement is supported by Maitra et al. (2021), who stated that using organic fertilizer in multiple cropping is also suitable because this system promotes less incidence of pests and disease and maintains soil fertility. Shah and Wu (2019) also pointed out that organic fertilizers are the best practical alternative to synthetic fertilizers, improving crop productivity and ecological conservation. In addition, Rosati et al. (2021) proved that organic farming exhibits greater resilience in the face of challenging conditions, such as drought, due to its substantial organic matter content and superior water retention ability. Moreover, organic fertilizer is more resistant to nutrient leaching. This is particularly enhanced in agroforestry systems like abaca and coconut, where nutrients are contained and leaching is prevented. Agroforestry enhances soil fertility through the deposition of leaf litter while also mitigating soil acidity and preventing erosion. Even though there have been extensive discussions on this matter, it remains uncertain which specific type of organic fertilizer or fertilizer combination is best for abaca in multistorey cropping under coconut, that is both practical for farmers' needs and can result in a yield comparable to the standards set by BAFS.

## Conclusion

Abaca, under coconut farming, can still provide income to respondents even without using fertilizer. However, farmers believed using fertilizer would enhance productivity that is crucial for sustainability. Due to other competing needs and the high cost of fertilizer, insufficient funds prevent them from using fertilizers on abaca, and the absence of harvesting operations due to a lack of competent harvesters resulted in the farm being neglected, with care and management activities, including fertilizer application, discontinued. Developing and providing low-cost and practical nutrient management technology and an efficient management system for skilled harvesters are vital to ensure continuous abaca harvesting that will translate good crop growth into sustainable income. This will be the basis for government institutions and relevant stakeholders to develop appropriate interventions such as but not limited to fertilizer subsidy program and support for technology and production of organic fertilizer to increase yield. To maintain a continuous harvesting system, feasible options include developing and providing labor and cost-efficient fiber extraction machinery, training out-of-school youth in abaca harvesting skills, and incentivizing harvesting operations.

## Declarations

### *Ethical Approval Certificate*

The experimental procedures of this study were approved by the Institutional Ethics Review Committee of Central Mindanao University, Musuan, Bukidnon, Philippines, under permit number 0656.s.2023.

### *Author Contribution Statement*

Aladin Repaso: Conceptualization, data collection, analysis, and writing the original and final draft

Raquel Salingay: Conceptualization, supervision, review and editing

Zabdiel Zacarias: Conceptualization, data collection, review and editing

Myrna Pabiona: Conceptualization, review, and editing

Maria Estela Detalla: Conceptualization, review, and editing

Ma. Stella Paulican: Conceptualization, review, and editing

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### *Conflict of Interest*

"The authors declare no conflict of interest."

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