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Abstract

This study provides valuable insights into the practices of mango growers in San Ildefonso, Bulacan, Philippines focusing on their farm profile, production and cultural practices, marketing management and post-harvest handling. A descriptive method was used using an adopted survey questionnaire as the primary tool in gathering data. The mango growers are predominantly middle to old-aged, married males with elementary education. Farming is their primary source of income. Most mango farms are located in low-lying areas and depend on rainfed irrigation. The average grower manages 10-50 mango trees that are between 10 to 20 years old. The majority of growers perform basic practices like pruning, sanitation, and basal fertilizer application. Techniques like flower induction, flush induction, fruit bagging, and irrigation are not widely practiced, which could affect overall yield and quality. Mangoes are typically sold through ambulant street selling, packed in carton boxes, and transported by tricycles. Most growers harvest an average of 499 kgs of mango per season, with family members involved in harvesting and sorting at the farm. The study found that recordkeeping for tracking capital, profit, and expenses is not commonly practiced among the farmers, which limits their ability to manage and optimize their operations effectively. These findings point to several areas where improvements could be made to enhance mango farming in San Ildefonso. By addressing these gaps, particularly in the adoption of more advanced production techniques and the implementation of better marketing and recordkeeping practices, the local mango industry could see significant growth and increased profitability.

Keywords: *management practices, mango industry, mango sustainability, recordkeeping*

Introduction

The Philippine mango is the third most important fruit crop in the country, next to bananas and pineapples, and its significance extends beyond export value (Briones, 2013). The mango is the national fruit, beloved by Filipinos for its versatility in being consumed fresh or as an ingredient in various processed forms like ice cream, pastries, and other delicacies.

Global mango production has increased in recent years, primarily due to the expansion of harvested areas rather than enhanced productivity (Philippine Mango Industry Roadmap of 2017-2022). Mango growers' production practices on flushing and flower induction helps to optimize flowering and fruiting stages of the mango trees for positive yield performance (Ventura et al., 2021). Cultural strategies in integrated pest management like open center pruning and sanitation, pest monitoring and chemical control has also been used (Medina et al., 2005). The application of optimal water amounts using sap flow meters, which provide precise measurements of water usage in mango orchards, is considered an efficient and effective irrigation practice (Valdez et al., 2024).

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The Philippine mango production reached 596.34 metric tons in the second quarter of 2023 (PSA, 2023).The Ilocos Region emerged as the top producer, contributing 20.5% to the national total, while Central Luzon ranked 10th, contributing just 3.78% (22,585.36 MT) despite having the highest number of mango trees among all regions (PSA, 2023). The provinces of Nueva Ecija and Bulacan have the highest number of fruit-bearing mango trees, with approximately 77% of mango growers knowledgeable about the Bureau of Product Standards (BPS) grades for exportable mangoes, which include criteria such as size and appearance (PCAARD-DOST, 2000). However, the region's mango production has been severely affected by the cecid fly (Procantarinia sp.) infestation and increasing cost of production that led many growers to abandon their mango orchards or convert the land to other crops (Paguia et al., 2019). The declining fruit quality, low profit margin and unstable production and technology gaps affect the sustainability of the production supply of mango locally and globally.

The study is aligned with the objectives of the Philippine Mango Industry Roadmap (2021-2025), which aims to ensure the survival and resilience of mango growers amidst climate change. It focuses on the evaluation of production and management practices of mango growers in San Ildefonso, Bulacan by determining their socio-demographic profile, their production and cultural practices, marketing strategies, and post-harvest handling. The study also seeks to support the industry's goals of providing safe, nutritious, affordable, and accessible mango products to consumers, while also strengthening the global competitiveness of Philippine mangoes. This context underscores the need for targeted interventions to support mango farmers, particularly in regions like Central Luzon, where both production potential and challenges are significant. Addressing these issues is crucial for sustaining the industry's contributions to the economy and preserving the cultural importance of mangoes in the Philippines.

Materials and Methods

The study employed a descriptive method of research using an adopted questionnaire from the study of Paguia et al. (2019). A purposive sampling was done in selecting the mango growers of San Ildefonso, Bulacan based on the status of activity and ownership in the mango orchard, their production practices and their willingness to cooperate in the study. The researchers used Cochran’s formula to compute the sample using a 5% margin of error to determine the sample size of 55 from a population of 63. However, a 90% retrieval rate or 50 mango growers was collected for the study. The study was limited to the number of retrieved mango growers in the municipality due to restrictions caused by the COVID-19 pandemic while conducting the survey. According to Lakens (2022), choosing a sample size based on resource constraints is considered depending on the effect of the sample size and the extent to which data collected informs inferences. Informed consent, privacy and confidentiality were discussed and implemented in the conduct of this study.

The data collected contain variables which describe the farm profile, production and cultural practices, marketing management and post-harvest handling activities of the selected mango growers. The questionnaire for mango growers consisted of three parts, Part 1 dealt with the socio-demographic and practices employed in mango production and Part 3 consisted of their post-harvest handling practices. Letters seeking permission to the Municipal Agriculture Office and Mango Growers Association of the San Ildefonso, Bulacan were given before the conduct of the study. Scheduling of survey interview to selected mango growers followed upon the approval of the request.

The data collected were presented based on the responses of the respondents. Frequency count and percentage distribution were computed to describe the variables given.

Results and Discussion

Profile of Mango Growers in San Ildefonso, Bulacan

The findings from Table 1 provide the socio-demographic profile of mango growers in San Ildefonso, Bulacan. The table shows 60% of the mango growers are aged between 51-61 years and older, indicating an aging population dedicated to mango production. This highlights a potential concern for the future sustainability of the industry, as younger generations may not be as involved. The predominance of older farmers raises concerns about the continuity of mango farming practices and the potential lack of succession planning. The study aligns with findings by Palis (2020), who also noted that the average age of farmers in the Philippines is around 53 years, with most being married and having elementary-level education.

Table 1 also shows that the majority of the respondents are male (72%), which is consistent with the physically demanding nature of mango farming activities such as spraying, pruning, and harvesting. The data reflects traditional gender roles in agriculture, where men are more involved in physically demanding outdoor tasks, while women are generally confined to indoor activities. This division of labor is consistent with previous studies (Hasan et al., 2006), which observed that men are more active in both indoor and outdoor farming activities.

Table 1.

Socio-demographic Profile of Mango Growers in San Ildefonso, Bulacan

Profile of Mango Growers	Frequency	%
Age		
31-40 yrs old	10	20%
41-50 yrs old	10	20%
51 years old and above	30	60%
Sex		
Male	36	72%
Female	14	28%
Marital Status		
Married	48	96%
Widow	2	4%
Educational Attainment		
Elementary	21	42%
High School	9	18%
College	14	28%
Vocational	1	2%
Source of Income		
Farming	38	76%
Business	8	16%
Employee	1	2%
Others (OFW)	3	6%

n=50

Results also showed that 96% of the respondents are married, suggesting that mango farming is typically undertaken by individuals with family responsibilities, possibly to provide a stable source of income. In terms of education, 42% of the respondents have completed at least elementary education.

This indicates that while basic literacy is present, there may be limitations in adopting more advanced farming techniques or managing farm operations. The relatively low level of education among farmers could impact their ability to access and implement modern farming techniques, which are essential for improving productivity and addressing issues like pest infestations. Farming, including mango production, is the primary source of income for the majority of the respondents, reinforcing their reliance on agriculture for their livelihood. Since farming is the primary income source, disruptions in mango production due to factors like pests or climate change could have economic impacts on these farmers.

Table 2.

Farm profile of mango growers in San Ildefonso, Bulacan

Farm Profile	Frequency	%
Topography of Mango Farm		
Lowland	26	52
Mountainous	24	48
Soil Type		
Sandy soil	8	16
Clay soil	29	58
Loam soil	13	26
Irrigation Sources		
Groundwater from well	17	34
Rainwater	26	52
Surface water	7	14
Average farm size		
Less than 1 hectare	4	8
1.0 ha – 1.9 ha	12	24
2.0 ha – 2.9 ha	7	14
3.0 ha – 3.9 ha	7	14
4.0 ha – 4.9 ha	3	6
5.0 ha and above	17	34
Average number of bearing mango trees		
10-50 trees	32	64
51-100 trees	4	8
101-150 trees	7	14
151 trees and above	7	14
Average age of mango trees		
10-20 year	27	54
21-30 years	9	18
31-40 years	5	10
41 years and above	9	18
Average Planting Distance		
10 meters	12	24
15 meters	38	76

n=50

The data presented in Table 2 provides the profile of mango farms in San Ildefonso, Bulacan, with regards to its topography, soil type, irrigation sources, farm size, number of bearing mango trees, age of mango trees and planting distance that influence mango production. Results showed that the majority (52%) of mango farms are located in low-lying areas, which is typical given the town's geography at an elevation of 25.3 meters above sea level (philatlas.com). Most of these farms are situated on clayey soils

(58%), which are common in lowland areas. Clayey soils can retain moisture well, which is beneficial in rainfed farming systems but might require careful management to prevent waterlogging.

The majority of mango farms (52%) rely on rainwater for irrigation. This dependence on natural rainfall makes mango production highly susceptible to climate variability, especially during critical growth periods. Mangoes thrive in a wide range of soils, including the clayey soils found in San Ildefonso. The combination of low-lying topography, suitable soil types, and reliance on rainwater aligns with the broader understanding that mangoes do well in well-drained, aerated soils with a pH range of 5.5-7.5. However, the dependency on rainfall could pose risks during critical periods such as flowering, where excessive rain or cloud cover can adversely affect fruit set and increase pest and disease incidence (Ganeshamurthy et al., 2018). The reliance on rainfed irrigation, combined with the low-lying topography, makes these farms particularly vulnerable to climate variability, which could impact production consistency and quality.

Most farms are relatively large, with 34% covering 5.0 hectares or more. This indicates that mango farming is practiced on a commercial scale by many growers in the area. The majority of farms (64%) have between 10 and 50 mango trees, suggesting that while some farms are large, the density of mango trees per hectare might be lower than the optimal levels recommended for maximizing production. The average age of mango trees in the area is between 10 and 20 years (54%). These are considered young trees, which are still in their productive years but may not have reached their full potential in terms of yield (San Juan and Fujimoto, 2008). The mango trees are typically planted at least 15 meters apart (76%). This distance is greater than the improved practice of 5x5 meters with a recommended planting density of 278 plants per hectare (Singh et al., 2010). The wider spacing might be a traditional practice, but it could result in lower overall tree density and potentially lower yields per hectare. The large farm sizes and the relatively young age of the trees present opportunities for increasing production, especially if more intensive practices are adopted, such as optimizing planting distances and improving irrigation methods. The current practice of planting trees 15 meters apart could be revisited to increase planting density, which could lead to higher productivity.

The data presented in Table 3 provides important insights into the production practices of mango growers in San Ildefonso, Bulacan. Results showed that the majority of mango growers (66%) manage their own production, with 68% not having any contract agreements with mango contractors or sprayers. This suggests that most farmers operate independently, which may limit their ability to implement regular pest and disease management practices. The lack of such management could negatively impact the health and quality of mango trees, leading to inconsistent yields. Many farmers have experienced poor harvests due to typhoons and pest infestations, which has led to a reluctance to engage in contract agreements. This lack of external support can result in suboptimal farming practices, potentially lowering overall productivity and profitability. Encouraging the use of pre-harvest financing or contract agreements, as suggested by Karyani et al. (2016), could help farmers cover costs related to investment, operations, and maintenance. These agreements can provide more consistent and reliable access to the necessary resources for maintaining healthy mango orchards..

Table 3 also showed that almost 62% of the respondents are affiliated with cooperatives and/or farmer associations. This is a positive indicator, as these affiliations can provide access to financial support, shared resources, and collective bargaining power. However, the benefits of these affiliations may not be fully realized due to the lack of formal agreements with contractors and sprayers. Membership

in these groups can offer financial support for production costs through institutions and improve technical efficiency and yields (Rahaman & Abdulai, 2018). Strengthening these affiliations could be key to addressing the challenges of production and marketing faced by the farmer. Leveraging the existing affiliations with cooperatives and farmer associations could be a way to introduce these improvements. Cooperatives can play a critical role in providing access to resources, training, and financial support, which could help farmers adopt better practices and improve their yields.

Table 3.

Production practices of Mango Growers in San Ildefonso, Bulacan

Production Practices	Frequency	%
Own production management	33	66%
Owner-Contractor	8	18%
Contract Sprayer	9	16%
Contract Agreement in Mango Production		
70-30	7	14%
60-40	9	18%
No contract agreement	34	68%
Affiliation		
Cooperative	15	30%
Farmer's Association	16	32%
No Affiliation	19	38%
Record-keeping Practices		
Yes	13	26%
No	37	74%

n=50

Results also shows that 74% of mango growers do not practice recordkeeping to track their capital, profit, and expenses. This lack of financial and operational tracking suggests a gap in farm management skills, which could hinder the farmers' ability to make informed decisions, plan for future investments, and assess the profitability of their operations. The absence of recordkeeping makes it difficult for farmers to manage their finances effectively, potentially leading to inefficiencies and missed opportunities for growth. Despite the potential benefits of keeping records, many farmers believe that such practices are not beneficial to them, which aligns with findings from Tham-Agyekum et al. (2010). There is a need to change the perception that recordkeeping is not beneficial. Educating farmers on the advantages of maintaining accurate records—such as better financial planning, improved profitability, and easier access to loans—could encourage more farmers to adopt this practice.

The data in Table 4 highlights the pre-harvest practices employed by mango growers in San Ildefonso, Bulacan. Data shows that 64% of mango growers practice in pruning. This practice is essential for maintaining tree health, controlling tree size, and ensuring high-quality mango production. Pruning helps maintain a balance between growth and fruiting, which is crucial for sustained yield and fruit quality (Uddin et al., 2014). Proper canopy management, which includes pruning, is critical for optimizing light penetration and air circulation, both of which are important for fruit development and reducing disease incidence (Balamohan et al., 2016).

About 70% of the mango growers apply basal fertilizer using organic matter. While the use of organic fertilizers enhances soil fertility and its fertilization capacity (Chen, 2015), relying solely on organic

inputs may not meet the complete nutritional needs of mature mango trees, especially during the fruiting period (Dessalgn et al., 2014). In regions like Hainan, China, a higher percentage of farmers use commercial organic fertilizers, which suggests a more intensive approach to nutrient management (Gao et al., 2019). Integrating both organic and inorganic fertilizers could provide a balanced nutrient supply for the mango trees.

Table 4.

Cultural practices employed in mango production

Cultural Practices Employed	Percent Response	
	Yes (%)	No (%)
Pruning	64	36
Application of Fertilizer	70	30
Flush Induction	12	88
Flush Protection	20	80
Flower Induction	14	86
Irrigation	16	84
Field Sanitation and Weed Management	90	10
Use of growth regulator	14	86
Bagging	12	88
Pesticide Application	12	88

* *multiple response*

A large proportion of mango growers do not practice flower induction (86%), flush induction (80%) and flush protection (80%). This is mainly because they rely on the natural flowering cycle of mango trees and are hesitant to invest in such practices due to unpredictable climate conditions. The absence of flower induction practices may limit the growers' ability to manipulate the flowering and fruiting cycle, potentially reducing the overall yield and fruit quality. The mango growers in San Ildefonso rely heavily on traditional practices that are familiar and cost-effective but may limit their productivity and profitability. Introducing more advanced techniques, such as flower induction, improved irrigation methods, and the use of a balanced mix of organic and inorganic fertilizers, could significantly enhance their yields and fruit quality. Flower induction techniques, when properly implemented, can significantly enhance fruit production by ensuring that trees flower even in off-seasons (Maloba et al., 2016).

A striking 84% of mango growers do not practice irrigation, relying solely on natural rainfall. While mango trees are relatively drought-tolerant, water stress during critical growth stages can severely impact productivity (Zuazo et al., 2021). The lack of irrigation may lead to inconsistent yields, particularly in years with less rainfall. Regular and timely irrigation is necessary to support the trees during dry periods and optimize fruit development (Mirjat et al., 2011).

A large majority (90%) of the mango growers consistently engage in field sanitation and weed management throughout the year. This is typically done using grass cutters and manual weeding, which are traditional but effective methods. While these methods are beneficial, they are labor-intensive and may not always be sufficient to manage weed competition effectively. More modern techniques, such as reduced weed establishment and integrated weed management, could provide better long-term results (Radicetti, 2017).

Bagging is not widely practiced (88%), nor is pesticide application (88%). Growers are aware of the benefits of bagging but are discouraged by the costs, which they believe outweigh the potential profits. Despite the costs, bagging is considered as one of the most effective methods for protecting mango fruits from pests, sunburn, and blemishes. It also helps produce fruits with better appearance and quality, which could command higher market prices (Karara et al., 2019). While bagging can be more expensive upfront, it can be more economical in the long run compared to other pest control methods, especially if it leads to higher quality fruits that fetch better prices.

Table 5.

Post-harvest handling and Marketing Management of Mango Farmers

Post-harvest Handling Practices	Frequency	%
Total Harvested (kg)		
1-499 kg	28	56
500-999 kg	9	18
1000-1999 kg	7	14
2000 kg and above	3	6
No. of people harvesting mangoes		
1-10	39	78
11-20	4	8
21-and above	7	14
System of marketing mangoes		
“All in” or assorted (not classified by class and size	15	30
Ambulant selling	35	70
Location of mango sorting and packaging		
At the mango farm	35	70
Farmer’s house	15	30
Packaging materials used		
Bamboo basket (kaing, 15 kg capacity)	1	2
Carton (20-25kg capacity)	49	98
Types of transportation used		
Tricycle	35	74
Jeepney	7	10
Truck	8	16

n=50

The findings in Table 5 illustrate the post-harvest handling practices of mango growers in San Ildefonso, Bulacan, providing insights into their yield and labor force used. These practices are crucial for understanding the challenges and potential areas for improvement in the mango production chain. The data indicates that 56% of mango growers have a relatively low yield, harvesting between 1 to 499 kilograms of mangoes per season. This equates to about 1 to 33 carton boxes, each weighing 15 kilograms. This yield is significantly lower than the ideal yield reported by the Lilongwei and Malawi (2011) where a well-managed mango orchard could produce 16,000 kg per hectare annually. The lower yield in San Ildefonso could be attributed to factors like pest infestations, diseases, and suboptimal climatic conditions, which have been mentioned by the farmers as major challenges.

Table 5 shows that a majority of the mango growers (78%) rely on a small labor force, typically between 1 to 10 individuals, who are often relatives or family members. This reliance on family labor is likely due to the decreasing harvest volumes, making it economically unfeasible to hire external labor.

The use of family labor can reduce costs, but it also limits the scalability of operations. As the yield decreases, the capacity to employ more labor diminishes, further impacting the overall efficiency of the harvest.

Findings in Table 6 shows the marketing management of mango growers in San Ildefonso, Bulacan. The results also show that 70% of mango growers engage in ambulant selling, which involves selling their produce directly on the streets. This method is often chosen due to the small quantity of the harvest and potentially lower quality of the fruit. While ambulant selling provides immediate cash flow and a direct connection to consumers, it may also limit the market reach and profitability. Farmers selling on the streets may face challenges in accessing larger markets where they could fetch better prices.

Table 6.

Marketing management of mango growers

System of marketing mangoes	Frequency	%
“All in” or assorted (not classified by class and size	15	30
Ambulant selling	35	70
Packaging materials used		
Bamboo basket (kaing, 15 kg capacity)	1	2
Carton (20-25kg capacity)	49	98
Types of transportation used		
Tricycle	35	74
Jeepney	7	10
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Types of transportation used		
Tricycle	35	74
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Truck	8	16

n=50

The majority of farmers (70%) perform sorting at the farm itself, and almost all (98%) use carton boxes with a capacity of 20-25 kg for packaging. Sorting and grading at the farm level are critical to maintaining quality and meeting market standards. According to Kumar and Alkan (2018), proper sorting and grading based on size, shape, weight, and color are essential to ensuring uniformity and quality. This process helps categorize fruits into different quality grades, which can significantly influence market prices and consumer satisfaction.

Most mangoes are transported using tricycles (74%), which are suitable for small-scale operations but may not be ideal for larger volumes or long distances. This mode of transport could contribute to mechanical damage due to inadequate protection during transit. Transporting mangoes in small vehicles like tricycles may increase the risk of post-harvest losses due to physical damage. According to Hossain et al. (2019), post-harvest losses during transportation and handling are significant, with mechanical damage being one of the leading causes.

The combination of low yield, reliance on ambulant selling, and the use of tricycles for transportation suggests that the quality of mangoes might not meet the highest market standards.

Farmers are likely experiencing post-harvest losses due to mechanical damage, over-ripening, and spoilage, which reduce the overall market value of their produce.

Conclusion

Mango farming industry in San Ildefonso, Bulacan is facing significant challenges due to the ageing mango farmers who rely mostly on their own cultural practices rather than conforming to the standards of mango production. The reliance on pruning, organic fertilizing, sanitation, and weed management—while important—might not be enough to optimize production and profitability. This limited approach can result in lower yields and difficulties in marketing the produce, leading to ambulant selling, which may disrupt the distribution and reduce the value of the mangoes. The demographic trends and traditional practices affect the agricultural productivity of the mango industry thus integration of modern methods into conventional approaches is necessary to sustain the sector. By improving recordkeeping and systematically tracking capital, profit, production, and management practices, farmers can gain insights into their operations, identify areas for improvement, and make more informed decisions. This could help modernize the practices, improve yield and quality, and ultimately secure better market opportunities. Introducing more comprehensive agricultural practices, coupled with proper recordkeeping, could provide a clear direction for the future of mango farming in the area. Systematic recordkeeping helps identify inefficiencies and adopt data-driven strategies that contribute to a body of knowledge emphasizing the role of management practices in farm profitability.

Recommendations

The recommendations from the research emphasize a comprehensive approach to revitalizing mango farming in San Ildefonso, Bulacan. Training and skill development for mango farmers is crucial. Enhancing their knowledge in modern farming techniques will improve productivity. Implementing contract-growing arrangements for mango growers and sprayers could help standardize practices and improve production consistency. Introducing demonstration trials that showcase the latest mango farming technologies will allow farmers to see the benefits of modern methods firsthand. To ensure the sustainability of the mango industry, it is essential to engage the younger generation, making mango farming appealing and viable for them. Investing in post-harvest facilities, trading centers, and a coordinated marketing and distribution scheme will help boost production and income for mango farmers. A successful implementation of these initiatives will require strong collaboration between government agencies, farmers' organizations, and the private sector. There is a need for ongoing research into mango production, marketing management, and product development to continuously improve the industry.

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