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Knowledge, Attitudes, and Agricultural Practices of Coconut Farmers on the Impacts of Climate Change on Coconut Productivity and Sustainability in Barangay Capasnan, Manay, Davao Oriental, Philippines

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Abstract

Coconut, a vital tropical crop, and the Philippines' leading agricultural export, particularly in Davao Oriental, the "Coconut Capital" of the country, is profoundly impacted by climate change, which disrupts its productivity and agricultural practices, thereby threatening its sustainability. This study evaluated the knowledge, attitudes, practices, perceived impacts, and preparedness of coconut farmers in Barangay Capasnan, a major contributor to Davao Oriental's coconut production. A descriptive research design was employed, with 145 farmers (out of 227 registered) participating through purposive sampling. Data were collected through validated surveys, analyzed with descriptive statistics, and conducted under ethical guidelines. Results showed that most farmers (30%) were over 61 years old, with 59% male and 41% female participants. A majority (63%) had only elementary-level education, and most households (56%) comprised 1-4 members. Nearly all farmers (94%) owned their farms, but 59% had a monthly income below PHP 10,000 (~USD 170.24). Farmers demonstrated a high awareness of climate change, recognizing its effects on temperature, rainfall, seasonality, and its role in exacerbating extreme weather, pests, and diseases. They perceived climate change as a significant threat to agriculture, advocating for education and action, though engagement in community coping strategies remained moderate. Farmers implemented practices such as knowledge-sharing, exploring alternative income sources, investing in protective infrastructure, and planning for renewable energy use. However, moderate adoption was observed in water-saving irrigation, drought-resistant crops, soil conservation, and pest management practices. Climate change was perceived to have severe impacts on coconut yields, quality, soil fertility, seasonal patterns, and labor demands, while moderate impacts included extreme weather, water scarcity, and heat stress. Recommendations include providing emotional and mental support, financial assistance, access to resilient crop varieties, climate-smart agricultural training, affordable adaptive technology, and increased distribution of coconut seedlings by the Philippine Coconut Authority to address declining quality and productivity caused by weather changes.

Keywords: agricultural productivity, climate adaptation, community coping strategies, crop resilience, farmer awareness, sustainable farming.

Introduction

Coconut (*Cocos nucifera*) is a tropical crop native to warm, humid climates and thrives in regions within the tropical belt (Subramanian et al., 2024). It is particularly significant in countries like the Philippines and Indonesia, where it provides a primary source of income for millions of farmers. Known as the "Tree of Life" for its exceptional versatility, the coconut tree has been an indispensable resource for over 500,000 years, supplying a wide variety of products, including copra, coconut oil, coconut water, and fibers, along with food, fuel, medicine, shelter, and timber (Hebbar et al., 2024). As such, it plays a vital role in tropical agriculture, contributing significantly to the economy, culture, and daily life of millions of people.

Coconut is one of the most important crops in the Philippines, which is the second-largest producer in the world, following Indonesia, the global leader with 30-35% of total production (17.5 million metric ton or MT), while the Philippines produces approximately 15 million MT (FAO, 2024). Coconut remains the

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Philippines' top agricultural export, valued at 91.4 billion PHP (approximately 1.63 billion USD), with 3.62 million hectares dedicated to its production (PCA, 2024). According to the Philippine Coconut Authority (PCA, 2024), 69 of the country's 82 provinces are coconut-producing areas, yielding a total of 14.9 billion coconuts annually. Among the regions in the Philippines, the Davao Region is the leading coconut producer, accounting for 1.99 million metric tons (13% of the national total), with the province of Davao Oriental, known as the "Coconut Capital of the Philippines," contributing 640,120.75 metric tons (PCA, 2024).

This study was conducted in Barangay Capasnan, located in the Municipality of Manay, Davao Oriental, which spans 882 hectares and is home to 227 registered coconut farmers, making it a key contributor to coconut production in the area, as noted by the PCA Provincial Office. Despite this, there are no existing records from the PCA regarding the coconut production levels in the barangay. Climate variables such as temperature, rainfall, soil salinity, and elevated CO_2 concentrations significantly affect the growth and development of coconut palms, influencing their yield and quality (Hebbar et al., 2024). Furthermore, climate change, including rising temperatures, altered rainfall patterns, and more frequent extreme weather events, is expected to increase the prevalence of pests like whiteflies, which threaten both coconut productivity and farm sustainability (Madushani and Sirisena, 2024). Given these challenges, this study aimed to assess the knowledge, attitudes, and practices of coconut farmers in Barangay Capasnan regarding climate change, as well as their perceptions of its impact on coconut production. Additionally, the study sought to evaluate the farmers' preparedness for future climate change challenges and identify their support and information needs to enhance the resilience and sustainability of coconut farming in the area. Through this research, the study aims to contribute to a better understanding of how climate change affects local coconut farming practices and inform strategies for adaptation and long-term farm sustainability.

This study addresses key research gaps in tropical crop science related to the impacts of climate change on coconut productivity and sustainability. It examines the knowledge, attitudes, and practices of coconut farmers, an area with limited research, particularly in rural tropical farming communities. The study also explores how climate change affects coconut growth, yield, and quality, contributing new insights into how environmental factors like temperature, rainfall, and extreme weather impact coconut farming in the Philippines. Furthermore, it assesses farmers' preparedness for climate challenges and the socio-economic factors, such as education and income, that influence their ability to adopt climate-smart practices. The research highlights the adoption of practices like water-saving irrigation and pest management, identifying barriers to broader implementation. By addressing these gaps, the study provides valuable insights for designing targeted support and strategies to improve resilience and sustainability in coconut farming.

Material and Methods

Study Area

The study was conducted in Barangay Capasnan, Municipality of Manay, Davao Oriental, a key coconut-producing area in the region over a three-month period from January to March 2024. Located at approximately 7.2244° N, 126.4292° E on the island of Mindanao, the barangay sits at an elevation of 345.7 meters (1,134.2 feet) above sea level and covers a total land area of 881.63 hectares (Figure 1). According to the 2023 census, the barangay has a population of 678, representing 1.63% of Manay's total population. It is home to 227 registered coconut farmers, as reported by the Philippine Coconut Authority (2024), underscoring Barangay Capasnan's significance as a major contributor to Davao Oriental's coconut production.

Research Design

In this study, a descriptive research design was employed to assess the knowledge, attitudes, and agricultural practices of coconut farmers in Barangay Capasnan, Manay, Davao Oriental, with a particular focus on the impacts of climate change on coconut productivity and sustainability. Purposive sampling was used to select participants who could provide valuable insights into the farmers' knowledge, attitudes, and practices, as well as their perceptions of climate change impacts, future planning, and support needs. Participants were selected based on their ability to share relevant experiences and perspectives regarding climate-related challenges in coconut farming. The study targeted adults aged 18 years and above, ensuring that all respondents were legally able to provide informed consent, by ethical research standards. This demographic focus was essential for capturing informed responses that reflect the real-world conditions and challenges faced by coconut farmers in the area. Using Slovin's Formula, the sample size for the survey was calculated to be 145 out of the 227 registered coconut farmers in Barangay Capasnan, based on a 5% margin of error.

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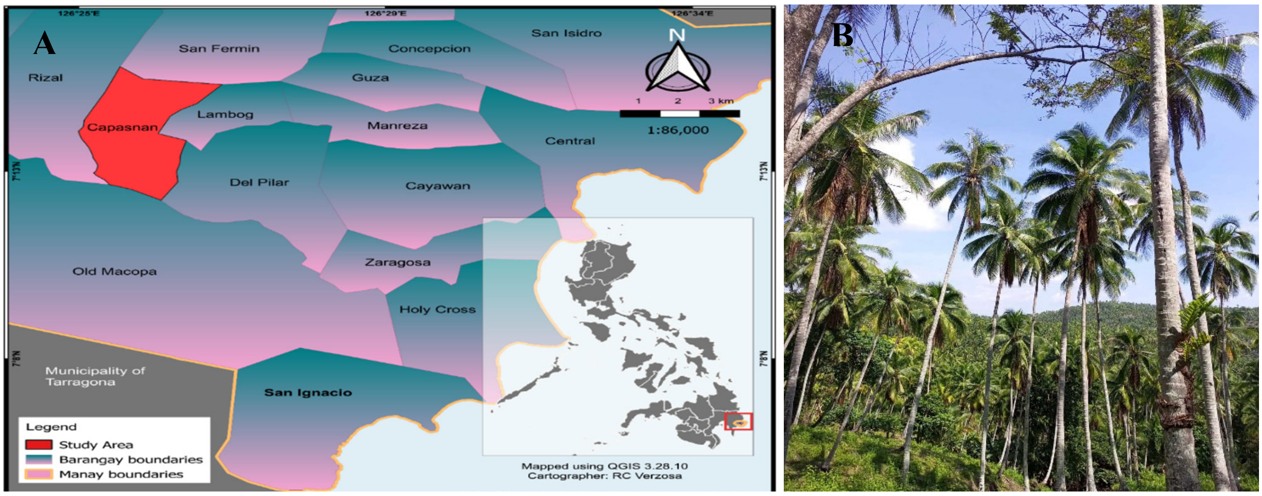

Figure 1. Map of the study area (A) showing the location of Barangay Capasnan (red area) and the coconut agroecosystem (B).

The inclusion criteria for this study required participants to be coconut farmers aged 18 years and above, ensuring they could legally provide informed consent. Participants were also required to be registered coconut farmers in Barangay Capasnan, as per the records of the Philippine Coconut Authority (PCA), ensuring that the sample reflects individuals actively involved in coconut farming. Additionally, participants had to be residents of Barangay Capasnan, Manay, Davao Oriental, as the study specifically focuses on this geographic area. Finally, participants needed to voluntarily agree to participate and provide informed consent. Exclusion criteria included individuals under the age of 18, as they cannot legally provide informed consent and non-registered coconut farmers who are not listed with the PCA. Non-residents of Barangay Capasnan were also excluded to maintain the focus on the local community. Lastly, individuals involved in agriculture but not in coconut farming were excluded, as the study specifically targets coconut farming practices.

Data Collection

Data collection for this study was carried out using a survey questionnaire developed by the researchers, designed to gather comprehensive information on the knowledge, attitudes, and practices (KAP) of coconut farmers regarding the impacts of climate change on coconut farming. The questionnaire focused on assessing the farmers' perceptions of climate change, its effects on their farms, their future planning and preparedness, and their support and information needs for enhancing resilience and sustainability in coconut farming. The survey began by collecting basic demographic information from the respondents, followed by questions addressing the perceived impacts of climate change on coconut productivity and practices, as well as their thoughts on adapting to these changes in the future.

To ensure the reliability and validity of the survey, the questionnaire underwent a rigorous validation process. This included expert reviews from specialists in climate change, agriculture, and survey design, who assessed whether the questions comprehensively addressed the research objectives and accurately measured the intended constructs. A pilot test was conducted with a small sample from the target population to identify any issues with the questionnaire and refine the questions based on their feedback, ensuring the instrument's clarity and relevance.

The data collection process employed KoboCollect, a mobile data collection tool developed by KoboToolBox (https://www.kobotoolbox.org/), which allowed the researcher to efficiently gather data using smartphones. The software enabled offline data collection, ensuring that data could be recorded even in areas with limited internet connectivity, and later synchronized when an internet connection was available. This approach eliminated the need for paper surveys, improving the efficiency, reliability, and security of data gathering, while facilitating timely and accurate insights into the KAP of coconut farmers regarding climate change impacts.

Data Analysis

The data analysis for this study involved the use of descriptive statistics to analyze and summarize the responses from the survey questionnaire. The data were processed using Microsoft Excel (2007). The responses from participants were organized, interpreted, and presented in the form of tables, while

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the yearly coconut production and environmental data correlated with climate change were visualized using graphs for clearer representation and analysis. The researchers first reviewed the data to become familiar with the content and ensure its accuracy. Descriptive statistical techniques were then applied to draw conclusions based on the participants' answers, helping to address the research questions and provide insights into the community's knowledge, attitudes, and practices (KAP) related to the impacts of climate change on coconut farming. To quantify the KAP of respondents, the study calculated the percentage of farmers exhibiting specific levels of knowledge, attitudes, and practices regarding climate change impacts. The analysis used measures of central tendency, including the mode, mean, and standard deviation, to summarize the data and identify patterns in the respondents' awareness, perceptions, and practices. These statistical methods allowed the researcher to interpret the data effectively and draw meaningful conclusions that support the study's objectives. Table 1 shows the interpretation guide for the data analysis.

Ethical Considerations

The researchers conducted the study with strict adherence to ethical principles to protect participants and uphold the integrity of the research. Ethical considerations included obtaining written informed consent from all participants, clearly explaining the study's purpose, data usage, and the voluntary nature of participation, as well as the right to withdraw at any time without consequence. To ensure anonymity and confidentiality, all survey data was anonymized, safeguarding participants' privacy and encouraging honest responses. The researchers also treated all participants with respect and dignity, ensuring cultural sensitivity and avoiding any discriminatory or offensive questions. The study prioritized beneficence by aiming to maximize benefits for the participants and the community, minimizing potential risks, and ensuring that the findings were shared with relevant agricultural extension agencies or NGOs working on climate change adaptation. Transparency was maintained by clearly communicating the purpose, benefits, and potential risks of the study, along with the participant's right to withdraw at any point. Data protection regulations were rigorously followed to secure participant information and maintain the integrity of the data analysis.

Result and Discussion

Coconut Farmers' Demographic Profile

As shown in Table 2, the demographic profile of coconut farmers in Barangay Capasnan reveals that 30% of the 145 respondents are aged 61 and above, while only 8% are aged 30 or below, highlighting a significant generational gap in the local farming community. This aging workforce poses considerable challenges to both the productivity and sustainability of coconut farms (Akdemir et al., 2021). Older farmers may experience physical limitations, which can hinder their ability to perform labor-intensive tasks such as tree climbing, pruning, and harvesting, leading to labor shortages and a decline in farm productivity. Additionally, the aging population threatens the transfer of knowledge and skills to younger generations, as fewer young people are entering the sector. This could prevent the adoption of modern farming practices and technologies, further limiting productivity improvements (Kumar et al., 2020). Older farmers may also face difficulties accessing resources and training, restricting their ability to adopt innovations that could enhance farm efficiency and sustainability. To mitigate these issues, it is crucial to promote youth engagement in coconut farming through targeted incentives, training, and mentorship programs. By fostering intergenerational collaboration and encouraging younger farmers to take an active role in the industry, the sector can ensure long-term growth, improved productivity, and the adoption of sustainable farming practices.

The gender distribution of coconut farmers shows that 59% are male and 41% are female, indicating a relatively balanced gender ratio. This presents a unique

Table 1. Mean, standard deviation, count value, and level used in the analysis of the knowledge, attitude, and practices of coconut farmers in Barangay Capasnan, Municipality of Manay, Davao Oriental, Philippines

Mean	Standard deviation	Count Value	Level
1	1.79	1	Very Low
1.8	2.59	2	Low
2.6	3.39	3	Moderate
3.4	4.19	4	High
4.2	5	5	Very High

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opportunity for gender empowerment to positively impact both the productivity and sustainability of coconut farming in the area. Promoting equal access to resources, training, and leadership roles for both men and women can enhance farm efficiency by leveraging the diverse skills and perspectives each gender brings to farming practices (Manlosa et al., 2019). Empowering women, in particular, to take on leadership and decision-making roles can drive innovation, improve farm management, and introduce more sustainable practices, such as diversifying farm products or adopting eco-friendly technologies (Arintyas, 2024). When both men and women are equally involved in farm operations, it creates a more resilient and collaborative farming community, capable of adapting to challenges and increasing productivity (Rao and Moharaj, 2023). Gender equality in farming can lead to a more prosperous and sustainable coconut industry, benefiting both farmers and the broader community.

The educational background of coconut farmers shows that 63% have only completed elementary school, 19% have finished high school, and 18% hold a college degree. This suggests that a significant portion of the farming community has limited formal education, which may hinder their ability to adopt modern farming practices, new technologies, and other improvements that could enhance farm productivity. The relatively low education levels pose a challenge to both productivity and sustainability, as farmers may struggle to access, understand, or implement innovations that could increase yields and reduce costs (Bancin et al., 2024). To overcome this, there is an urgent need for targeted training programs, accessible extension services, and simplified resources that make modern farming techniques more approachable (Naika et al., 2021). Promoting agricultural education and offering lifelong learning opportunities for both current farmers and younger generations will help build a more skilled, knowledgeable workforce, capable of implementing efficient, sustainable practices that will drive productivity and ensure the long-term viability of coconut farming in the area.

Results on the monthly family income show that 59% of coconut farming households earn below 10,000 pesos, while only 10% earn 21,000 pesos or more. This significant income disparity highlights the financial challenges many farmers face, which can severely limit their ability to invest in farm improvements, adopt modern equipment, or access vital training and resources. Such financial constraints can result

Table 2. Demographic profile of the coconut farmers in Barangay Capasnan, Municipality of Manay, Davao Oriental, Philippines

Characteristics	Group	Frequency	Percentage (%)
Age (in years)	30 and below	12	8.28
	31 - 40	23	15.86
	41 - 50	40	27.59
	51 - 60	27	18.62
	61 and above	43	29.66
Gender	Male	86	59.31
	Female	59	40.69
Educational background	Elementary Level	91	62.76
	High School Level	28	19.31
	College Level	26	17.93
Monthly family income	10,000 and below	85	58.62
	11,0000-20,0000	45	31.03
	21,000 and above	15	10.34
Household size	1-4 members	81	55.86
	5-8 members	58	40.00
	9-12 members	6	4.14
Years of stay	30 years and below	23	15.86
	31-40 years	21	14.48
	41-50 years	36	24.83
	51-60 years	26	17.93
	61 years and above	39	26.90
Land holding	Farm owner	136	93.79
	Farm tenant	9	6.21

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in poor farm maintenance, reduced productivity, and limited adoption of sustainable farming practices (Myeni et al., 2019). Without the means to upgrade technology or implement best practices, farmers may struggle to increase yields or improve farm resilience to environmental challenges. Moreover, low income often correlates with limited access to credit, further hindering farmers' ability to expand or modernize operations (Kambali and Panakaje, 2022). To address these barriers, targeted financial support, access to affordable loans, and capacity-building programs are essential. These measures can help increase farmers' income, enabling them to invest in better tools, technologies, and sustainable practices, which in turn will enhance both productivity and the long-term sustainability of coconut farming in the region.

The data shows that 56% of coconut farming households have 1 to 4 members, which can impact farm productivity in both positive and negative ways. Smaller households often face labor shortages, especially during peak seasons, which can delay or reduce the quality of essential tasks like planting, harvesting, and maintenance (Pierotti et al., 2022). This can directly affect farm productivity and coconut yields. However, smaller households may also allocate resources more efficiently, with each member taking on specialized roles, improving farm management. Still, the limited labor force can hinder the adoption of modern farming practices that require more time and skill. To address this, providing labor-saving technologies, cooperative farming models, or seasonal labor support could help alleviate the labor shortage and allow for more efficient, sustainable farming practices (Carlisle et al., 2019).

The demographic profile data shows that 25% of coconut farmers have been farming for 41 to 50 years, indicating significant experience in coconut cultivation. While this long-term experience provides valuable knowledge of traditional practices, it may limit the adoption of modern farming techniques that could enhance productivity (Patel et al.,2020). Experienced farmers may be hesitant to embrace newer technologies, such as mechanized harvesting or integrated pest management, which could improve efficiency and reduce labor costs (Bueno et al., 2021). Furthermore, without access to ongoing training or modern tools, these farmers may struggle to keep up with changing market demands or environmental challenges, potentially hindering farm productivity and sustainability. To address this, providing training that combines traditional knowledge with modern innovations can help boost productivity and ensure long-term farm success.

Results reveal that 94% of coconut farmers are landowners, while only 6% are tenants. This high percentage of landowners can positively impact coconut farming productivity, as ownership provides farmers with greater control over their land, allowing them to make long-term investments in farm improvements, sustainable practices, and crop diversification (Adesida et al., 2021). Landownership also fosters a sense of security and commitment, potentially leading to better farm management. However, the small proportion of tenant farmers may face more challenges, such as limited access to resources, decision-making power, and long-term planning, which could impact their ability to invest in modern farming practices or improve productivity. Supporting tenants with access to land rights or resources could help increase overall farm efficiency and sustainability in the community (Basche and Carter, 2021).

Annual Coconut Production Correlated with Climate Change

Figure 2 presents data on annual coconut production, average annual temperature, and annual rainfall for the years 2018 to 2023 in Davao Oriental, with a focus on Barangay Capasnan. Coconut production fluctuated within a narrow range over the 6-year period, peaking in 2020 at 6.61 x 10^5 MT and reaching its lowest point in 2023 at 6.4 x 10^5 MT. While production showed slight increases from 2018 (6.16 x 10^5 MT) to 2020, it then stabilized around 6.6 x 10^5 MT from 2021 to 2022 before experiencing a slight decline in 2023. This fluctuation could be influenced by various factors such as climatic conditions, farming practices, and external factors like pests or diseases. Overall, production remained relatively stable over the period.

The average annual temperature showed a general upward trend, increasing from 2.74 x 10ºC in 2018 to 2.9 x 10ºC in both 2022 and 2023. The highest temperature recorded was in 2022, with 2.9 x 10ºC, representing a 0.16 x 10ºC increase from the previous year. This consistent rise in temperature aligns with global patterns of climate change, where warmer conditions may influence agricultural productivity, including coconut farming.

Rainfall patterns steadily increased from 2,000 mm in 2018 to 2,892 mm in 2022 before stabilizing at 2,500 mm in 2023. The increase in rainfall from 2018 to 2022 suggests a trend toward more precipitation, which could be linked to climate variability, such as more frequent or intense monsoons and rainstorms. However, the slight drop in rainfall in 2023 could indicate variability within the weather patterns. High rainfall, along with increasing temperatures, may impact coconut growth cycles, influencing the quantity and quality of the crops.

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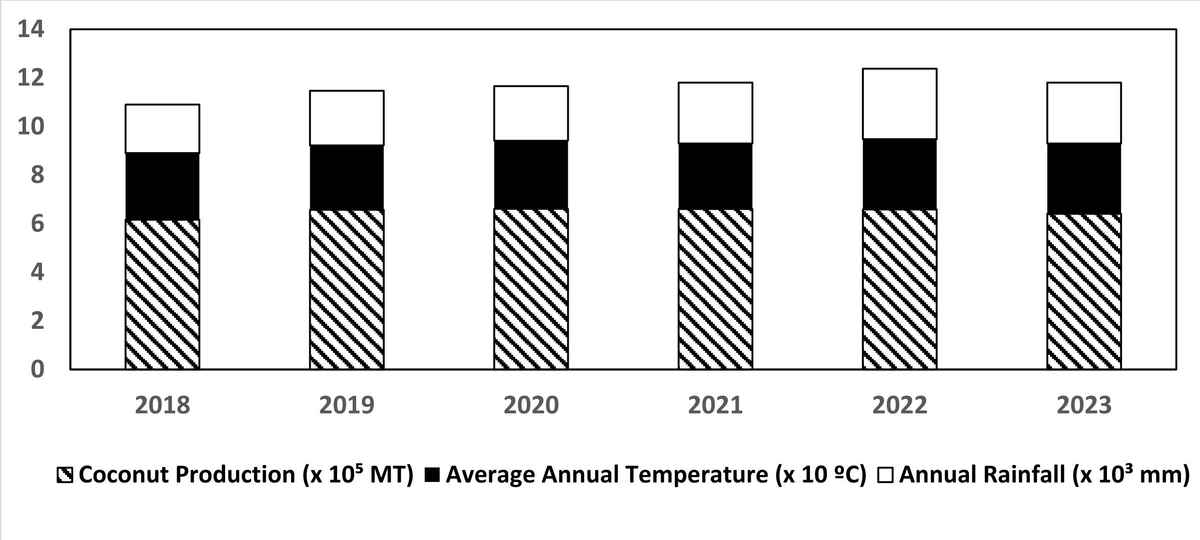

Figure 2. The Davao Oriental's annual coconut production in correlation with average yearly temperature and annual rainfall (Data sources: Philippine Coconut Authority and Philippine Atmospheric, Geophysical, and Astronomical Services Administration).

The data suggest that while coconut production remained fairly stable, the average temperature showed an upward trend over the years, with increasing rainfall until 2022. These climate factors may have significant implications for coconut productivity, as both temperature and rainfall directly influence the growth and yield of coconut palms. The decline in production in 2023, despite relatively consistent climatic conditions, could be attributed to factors other than climate, such as market demand, agricultural practices, or other regional challenges. Further research and continued monitoring of climate patterns would be essential to understand the precise relationship between these variables and coconut production in the region.

Coconut Farmers' Level of Knowledge on Climate Change Impact

Table 3 shows the level of knowledge of coconut farmers regarding the impact of climate change. All the statements have an average score in the "High" range, indicating that farmers generally understand climate change and its effects on coconut farming. The mean scores for individual statements range from 3.52 to 3.88, with the highest score (3.88) reflecting the farmers' strong awareness that climate change is caused by human activities and the lowest score (3.52) concerning the change in the intensity and frequency of typhoons. The relatively consistent scores across all statements suggest that farmers recognize various aspects of climate change, including its influence on temperature, rainfall patterns, pest and disease prevalence, and extreme weather events like floods and typhoons. The standard deviation (SD) values, ranging from 0.70 to 0.96, indicate some variability in the responses. Still, overall, the data suggests that the coconut farmers in the area have a generally high level of knowledge about climate change and its potential impacts on their farming practices. The farmers' high level of awareness about climate change suggests they are likely more receptive to adopting climate-smart agricultural practices. However, continued education and resources would further support their efforts in mitigating the effects of climate change on coconut farming (Johnson et al., 2023).

Coconut Farmers' Level of Attitude on Climate Change Impact

Table 4 presents the attitudes of coconut farmers regarding the impact of climate change. The data shows generally positive attitudes, with most statements falling within the "High" range, indicating that farmers recognize the importance of climate change and its effects on agriculture. The highest mean scores are for statements related to the belief in the significant threat climate change poses to agriculture (3.82) and the recognition of the actions of individuals and communities in mitigating climate change (3.97). This suggests that farmers are aware of the global threat of climate change and believe in the potential for local action to address it. Additionally, farmers show strong concern about the long-term impact of climate change on essential resources like water (3.97), highlighting awareness of the broader environmental consequences on farming. While the overall attitude is predominantly "High," there is some variation in responses, as reflected in the standard deviations (ranging from 0.79 to 1.05). A slightly lower

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mean score of 3.28 for discussing strategies with the community indicates that while farmers acknowledge climate change, they may not frequently engage in direct discussions about coping strategies with their peers, suggesting room for improvement in collaborative efforts. The farmers' high level of awareness and concern about climate change, coupled with a moderate willingness to engage in discussions and seek information, suggests that they are receptive to adopting climate change mitigation strategies. Continued education, collaboration, and community discussions could further enhance their capacity to adapt to the changing climate and improve agricultural resilience (Antwi-Agyei and Stringer, 2021).

Coconut Farmers' Level of Practices on Climate Change Impact

Table 5 illustrates the level of practices among coconut farmers in response to climate change. The data shows that, overall, the farmers engage

Table 3. Coconut farmers' level of knowledge on climate change impact

Statements	Mean	Standard deviation	Interpretation
1. Climate change is caused by human activities	3.88	0.70	High
2. Climate change increases and decreases the temperature	3.74	0.83	High
3. Climate change increased pest and disease	3.61	0.87	High
4. Climate change is a threat to sustainable development	3.54	0.88	High
5. Climate change causes irregular and erratic rainfall	3.59	0.95	High
6. Climate change affects the duration of seasons	3.54	0.88	High
7. Climate change changes the intensity and frequency of typhoons	3.52	0.96	High
8. Climate change causes the occurrence of heavy floods	3.79	0.82	High
9. Climate change elevated carbon dioxide concentration	3.58	0.96	High
10. Climate change is caused by agriculture	3.59	0.89	High
Overall	3.64	0.87	High

Table 4. Coconut farmers' level of attitude on climate change impact

Statements	Mean	Standard deviation	Interpretation
1. I am aware of the causes and consequences of climate change	3.58	0.81	High
2. I believe climate change is a significant threat to agriculture worldwide	3.82	0.81	High
3. I have observed changes in local weather patterns over the last decade that are attributed to climate change	3.66	0.88	High
4. I feel that climate change will increasingly affect coconut farming in the future	3.65	0.87	High
5. I am confident in my ability to explain the effects of climate change to fellow farmers	3.49	1.05	High
6. I regularly seek out information about climate change and its potential impacts on farming	3.49	0.91	High
7. I believe that the actions of individuals and communities can make a difference in mitigating climate change	3.97	0.79	High
8. I discuss strategies for coping with climate change with my community and fellow farmers	3.28	0.97	Moderate
9. I am concerned about the long-term impacts of climate change on water resources essential for farming	3.97	0.79	High
10. I think more education and awareness about climate change should be provided to farmers	3.65	0.83	High
Overall	3.65	0.87	High

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in "Moderate" to "High" practices for adapting to climate change, with an overall mean score of 3.32, indicating a moderate level of adoption of climate-smart agricultural practices. The highest mean scores (3.60 and 3.49) are for "actively sharing and exchanging knowledge about adaptive strategies" and "exploring alternative income sources." These high scores suggest that farmers are relatively proactive in learning from one another and seeking ways to diversify their income in response to climate change impacts. However, while the willingness to share knowledge and explore alternative incomes is high, other practices like implementing water-saving irrigation (3.32) or using drought-resistant coconut varieties (3.22) show a more moderate engagement. This suggests that while farmers acknowledge the need for adaptive strategies, their implementation of specific practices is still limited or inconsistent. Practices related to infrastructure investment (e.g., windbreaks, shade nets) and soil conservation methods (3.34) also scored moderately, indicating some adoption of physical measures to protect the farm from climate risks. On the lower end, practices like participating in training programs on climate-smart agriculture (3.14) and adopting renewable energy sources (3.37) show a more moderate approach, with farmers not fully integrating these practices into their operations. The relatively high standard deviations (ranging from 1.02 to 1.16) indicate variability in the practices, suggesting that while some farmers are more proactive in adopting adaptive measures, others may be slower or less engaged in these activities. This variability points to a need for more targeted support, such as accessible training, financial incentives, or infrastructure investments, to help all farmers adopt climate-smart practices more consistently (Autio et al., 2021). While coconut farmers show a moderate to high level of awareness and some action on climate change adaptation, there is room for further improvement in the adoption of specific practices that could enhance productivity, sustainability, and resilience to climate impacts.

Coconut Farmers' Level of Perceived Climate Change Impacts on Coconut Production

Table 6 presents the level of coconut farmers' perceived impacts of climate change on coconut production. The data indicates that farmers generally perceive a high level of impact from climate change on various aspects of coconut farming, with an overall mean score of 3.71, suggesting a strong awareness of climate-related challenges. The highest perceived impacts are in areas such as decreased coconut yields (3.63), increased pest and disease outbreaks (3.54), and extreme weather events (3.49). These factors are contributing to reduced farm productivity and are seen as major challenges by the farmers.

Table 5. Coconut farmers' level of practices on climate change impact

Statements	Mean	Standard deviation	Interpretation
1. I have implemented water-saving irrigation techniques in response to climate change	3.32	1.11	Moderate
2. I use drought-resistant coconut varieties to improve resilience to changing climate conditions	3.32	1.08	Moderate
3. I have diversified my farm to include other crops besides coconuts to reduce risk	3.32	1.08	Moderate
4. I practice soil conservation methods (e.g., mulching, terracing) to combat erosion and fertility loss	3.36	1.10	Moderate
5. I engage in integrated pest and disease management to address increased outbreaks.	3.34	1.16	Moderate
6. I have invested in infrastructure (e.g., windbreaks, shade nets) to protect my farm from extreme weather.	3.45	1.08	High
7. I participate in training programs on climate-smart agriculture practices	3.14	1.02	Moderate
8. I actively share and exchange knowledge about adaptive strategies with other farmers.	3.60	1.08	High
9. I have explored alternative income sources to mitigate the economic impacts of climate change	3.46	1.09	High
10. I plan to adopt renewable energy sources (e.g., solar panels) for farm operations	3.49	1.06	High
Overall	3.37	1.09	Moderate

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There is also a high perception that climate change has negatively impacted the overall health of coconut trees (3.66) and that there is a growing need for more labor to manage the added challenges (3.64). These findings highlight concerns about the increasing intensity of climate-related risks, leading to higher labor demands and potential degradation in tree health. However, certain impacts, such as soil fertility decline (3.49) and water scarcity issues (3.16), are seen as somewhat less severe, with the moderate mean scores suggesting that these issues are present but may not be as pronounced or universally experienced as the more severe impacts like extreme weather or pest outbreaks. The variability in the standard deviations (ranging from 0.90 to 1.06) reflects some differences in farmers' experiences, suggesting that while many face similar challenges, the intensity and frequency of the impacts may vary across individual farms. Farmers perceive climate change as having a high impact on coconut production, particularly through extreme weather, pest outbreaks, and declining yields (Rahman et al., 2024). This highlights the urgent need for adaptive strategies, such as improved pest management, resilience-building infrastructure, and more efficient water and soil conservation techniques, to mitigate these challenges and sustain coconut farming in the face of climate change (Bhatnagar et al., 2024).

Coconut Farmers' Level of Futures Thinking and Planning on Climate Change Impact

Table 7 illustrates the level of future thinking and planning among coconut farmers regarding the impact of climate change. The overall mean score of 3.82 indicates a generally high level of future-oriented thinking and planning among the farmers, reflecting their awareness and proactive approach toward adapting to climate change. The highest mean scores are associated with statements such as optimism about the long-term viability of coconut farming (3.83), community-based planning for sustainable agriculture (3.83), and commitment to adapting farming practices for environmental sustainability (3.78). These scores suggest that farmers are relatively confident about the future of coconut farming and see the importance of collective action and long-term sustainability in the face of climate challenges. Farmers also appear to be focused on making strategic, forward-looking decisions that prioritize resilience. However, some areas show moderate engagement, particularly regarding succession planning (3.27), exploring innovative farming technologies (3.37), and regularly assessing sustainability (3.43). These moderate scores indicate that while farmers are aware of the need for future planning, they may not yet be fully implementing these strategies or investing in new technologies as part of their long-term planning. This gap suggests that there is room for further education,

Table 6. Level of coconut farmers' perceived impacts of climate change on coconut production

Statements	Mean	SD	Interpretation
1. I have noticed a decrease in coconut yields over the past years due to changing climate conditions	3.71	0.90	High
2. There has been an increase in pest and disease outbreaks in my coconut farm associated with climate change	3.63	1.01	High
3. Extreme weather events (e.g., typhoons, droughts) have become more frequent and severe on my farm	3.24	0.95	Moderate
4. The size and quality of coconuts produced have declined due to recent weather changes	3.54	1.02	High
5. Soil fertility on my farm has declined, which I believe is partly due to climate change.	3.49	0.96	High
6. I have experienced water scarcity issues affecting irrigation on my farm.	3.16	1.02	Moderate
7. Changes in seasonal patterns have disrupted the usual timing of planting and harvesting coconuts	3.61	0.98	High
8. I have observed increased heat stress on my coconut trees	3.26	1.01	Moderate
9. Climate change has negatively impacted the overall health of my coconut trees	3.66	1.02	High
10. There is a growing need for more labor to manage the additional challenges posed by climate change	3.64	1.06	High
Overall	3.49	0.99	High

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financial support, and resources to help farmers move from awareness to action. The standard deviations (ranging from 0.94 to 1.11) reflect some variability in responses, with a slightly higher degree of variability in areas like succession planning and investment in innovative technologies, indicating that not all farmers are equally engaged in these practices. Coconut farmers in Barangay Capasnan exhibit a high level of future thinking and planning, but more targeted efforts may be needed to encourage investment in innovative technologies, succession planning, and sustainability assessments (Madiclum, 2023). Providing resources and support to help farmers act on their future planning ideas could further strengthen the resilience of coconut farming in the Philippines (PCA, 2024).

Support and Information Needs of Coconut Farmers for Climate Resilience and Sustainability

Table 8 presents the level of support and information needs of coconut farmers to enhance resilience and sustainability in response to climate change. The overall mean score of 4.19 indicates a high level of demand for support and resources, highlighting that farmers feel the need for various forms of assistance to better adapt to climate challenges. The highest mean scores are for statements related to financial assistance (4.14), mental and emotional counseling (4.21), and information on adapting farming practices (4.19). This suggests that farmers strongly feel the need for financial support to implement adaptive strategies and for emotional support to cope with the pressures of farming in a changing climate. Mental health support is particularly emphasized, reflecting the stress and uncertainty many farmers face as they adapt to new climate realities. Other areas where farmers report high need for support include access to resilient coconut varieties and other crops (3.99), training on climate-smart agriculture (3.99), and guidance on water management (3.99). These needs point to a clear desire for resources and knowledge to help improve farming practices and mitigate the impacts of climate change. There is also significant interest in affordable technology for monitoring climate impacts (3.87) and networking opportunities with other farmers and experts (3.94), indicating that farmers are seeking both technological solutions and collaborative opportunities to share knowledge and strategies. The relatively low standard deviations (ranging from 0.61 to 0.85) suggest that these needs are generally consistent across farmers, with less variability in responses, indicating widespread agreement on the types of support needed. Coconut farmers in Barangay Capasnan require comprehensive support to enhance their resilience to climate change, with a strong emphasis on financial assistance, training in climate-smart practices

Table 7. Coconut farmers' level of future thinking and planning regarding climate change impact

Statements	Mean	Standard deviation	Interpretation
1. I am optimistic about the long-term viability of coconut farming despite climate challenges	3.82	1.08	High
2. I actively engage in long-term planning to adapt my farming practices to anticipated climate changes	3.68	1.01	High
3. I consider the potential impacts of climate change in all major farm-related decisions	3.70	0.97	High
4. I explore and invest in innovative farming technologies to enhance resilience against climate change	3.37	1.07	Moderate
5. I have a succession plan that includes strategies for dealing with climate change for future generations.	3.27	1.11	Moderate
6. I believe community-based planning and action are crucial for sustainable agriculture under climate change.	3.83	0.94	High
7. I regularly assess the sustainability of my farming practices in the context of changing environmental conditions	3.43	1.09	High
8. I am committed to adapting my farming practices for the benefit of the environment and future sustainability	3.71	0.98	High
9. I prioritize investments in farm resilience and sustainability over short-term gains	3.66	1.08	High
10. I seek out opportunities to learn about and implement eco-friendly and climate-resilient farming methods	3.78	0.91	High
Overall	3.62	1.02	High

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Table 8. Support and information needs of coconut farmers to enhance resilience and sustainability against climate change

Statements	Mean	Standard deviation	Interpretation
1. I need more information on how to adapt my farming practices to climate change	4.19	0.65	High
2. Financial assistance or subsidies would greatly help me implement adaptive strategies on my farm	4.14	0.61	High
3. I would benefit from access to more resilient coconut varieties and other crops	3.99	0.75	High
4. Training and workshops on climate-smart agriculture practices are essential for me	3.99	0.69	High
5. I require guidance on water management and conservation techniques.	3.99	0.85	High
6. Access to affordable technology for monitoring and managing climate impacts is crucial.	3.87	0.83	High
7. I need more support in accessing markets for diversifying my farms' produce	3.94	0.74	High
8. Networking opportunities with other farmers and experts would help me adapt better	3.90	0.80	High
9. I would appreciate legal and policy advice on land use and environmental conservation	4.01	0.76	High
10. Support in the form of mental and emotional counseling is important to cope with the stress of farming under climate change	4.21	0.77	Very High
Overall	4.02	0.74	High

like utilizing ARIMA models to predict the climatic condition earlier, resilient varieties, and mental health support (Begum et al., 2019). Addressing these needs through targeted interventions and resources can significantly improve farmers' ability to adapt and sustain their livelihoods and increase the long-term resilience of coconut farming in the area.

Conclusion

In conclusion, the data highlights the pressing challenges coconut farmers face in Barangay Capasnan, particularly concerning productivity and long-term sustainability. These challenges are shaped by demographic factors such as an aging farmer population, limited formal education, and financial constraints, which impede the adoption of modern farming practices and the investment in necessary technologies. Moreover, while farmers demonstrate a high level of awareness and concern about climate change, their ability to implement climate-smart practices remains uneven, hindered by financial barriers, and a lack of targeted training and infrastructure. As a tropical crop, coconut farming is especially vulnerable to the impacts of climate change, including extreme weather events, shifting rainfall patterns, pest outbreaks, and fluctuating yields, all of which directly threaten productivity. To safeguard the future of coconut farming, it is crucial to address these multifaceted challenges through comprehensive support programs, including financial assistance, educational resources, and climate resilience training. By equipping farmers with the tools, knowledge, and resources they need to adapt, the coconut farming sector can survive and thrive, ensuring that coconut remains a vital and sustainable agricultural crop in Davao Oriental, the "Coconut Capital of the Philippines."

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and professionals who will contribute to the growth and sustainability of the coconut industry in the Philippines.

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