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Challenges and Adaptation Practices of Farmers on Climate Change

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Abstract. Climate change presents the agricultural industry with unforeseen difficulties, impacting livelihoods, food security, crop productivity, and sustainability. This descriptive study aims to illuminate the prevalent challenges in production and cropping patterns experienced by farmers due to climate change, along with their primary adaptation practices to mitigate adverse effects. It employs statistical tools such as ranking, mean, standard deviation, frequency count, and percentage distribution for data analysis. The respondents primarily consisted of high school graduate women with extensive farming experience and land ownership. Results indicate that climate change has exacerbated challenges in crop production, with low yields, pest and disease outbreaks, and flood damage being the most prominent issues. Farmers encounter numerous challenges in deciding on cropping patterns, mainly due to limited knowledge about viable techniques such as crop mapping, intercropping, pest and nutrient management, and water scarcity in non-irrigated fields. The results also show that farmers have adopted several strategies, including reducing the use of pesticides and petroleum-based fertilizers, conserving water during dry seasons, and improving drainage and soil mulching to prevent weed growth. Interestingly, indigenous methods have also been continuously utilized to mitigate the effects of climate change. This emphasizes the importance of innovative farming methods and ongoing farmer education initiatives for capacity building. Additionally, the results found no statistically significant association between challenges and adaptation practices.

Keywords: Climate change; Challenges on climate change; Adaptation on climate change; Agriculture; Production; Crop patterns; High value crops farmers.

1.0 Introduction

The Philippines, with its more than 7,100 islands, relies heavily on agriculture, making it highly vulnerable to the socioeconomic impacts of natural disasters such as typhoons, floods, landslides, and earthquakes. Recent data shows that 78.7% of the nation's GDP is at risk from these natural disasters, "posing significant challenges to agricultural sustainability (Saldivar-Sali, 2016). This vulnerability has spurred a growing body of research focused on the impact of climate change on Philippine agriculture. For instance, a study by David et al. (2020) examined how certain provinces' rice production is vulnerable to climate change, highlighting the urgent need for adaptation measures to safeguard food security. Similarly, Santos and Castillo (2019) analyzed the effect of climate variability on maize output in Mindanao and emphasized the importance of implementing resilient agricultural techniques to minimize crop losses. Moreover, Reyes et al. (2021) stated climate change significantly disrupts livelihoods and food security. These findings underscore the pressing need for targeted interventions to enhance the ability of agricultural communities to cope with climate-related challenges.

The current study aims to quantitatively analyze the cropping and production patterns of Philippine agricultural communities. It seeks to quantify the specific challenges encountered by farmers during the process of adaptation to these patterns. The ultimate objective is to collect empirical data that can be used to develop quantitative mitigation and adaptation strategies for these communities in response to climate change.

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The systematic review conducted by Barbeiri, Bittner, Adair, and Wollenberg (2024) revealed a predominant focus within agricultural mitigation and adaptation literature on sustaining or enhancing agricultural production as the primary strategy for addressing climate change impacts. Correspondingly, Mazur et al. (2019), Kibue et al. (2021), and Swe et al. (2020) emphasize the importance of mitigation processes in strengthening resistance to climate change. For that reason, the study considers assessing the primary challenges and the adaptation techniques posed by climate change.

2.0 Methodology

2.1 Research Design

The study utilized a descriptive-correlational research design along with a comprehensive research framework. Descriptive research, as elucidated by McCombies (2019), was employed to facilitate a detailed understanding of the challenges faced by farmers, encompassing issues such as low yields, pest infestations, and crop damage. Furthermore, as discussed by Cherry (2019), relational research was utilized to explore the relationships between challenges and adaptation practices as the study aimed to uncover patterns and associations that could inform effective mitigation strategies. The design is well-suited for this study as it describes phenomena under investigation and explores the underlying relationships between variables. This approach is essential for developing comprehensive strategies to enhance agricultural systems' resilience to climate change's impacts.

2.2 Research Locale

The study was carried out in one of the component cities located in the northern part of Negros Occidental.

2.3 Research Participants

Using Yamane's formula with a 5% margin of error, 80 participants were determined as a sample size from 100 high-value commercial crop farmers. The distribution of respondents based on association affiliation is as follows: Victorias Organic Farmers Association (VOFA) has 22 participants, Minuro Agrarian Reform Beneficiaries-Multi-Purpose Cooperative (MARBE-MPC) with 17, Kailo Farmers Association (KAFA) with 8, Victorias Integrated Social Forestry Farmers Association (VISFFA) with 14, and Rural Improvement Club of Hda. San Jose (RIC) with 19. The study employed stratified random sampling to ensure proportional representation from each subgroup, minimizing biases and ensuring equal chances of selection among the High-Value Crops Farmers Association members.

2.4 Research Instrument

The study employed a researcher-made survey questionnaire formulated from reviewed literature. Divided into five parts, it gathered data on participants' profiles, challenges in production and cropping patterns due to climate change, and adaptation practices. Likert Five-point Scales were used for rating statements, ensuring comprehensive insight into farmers' experiences and strategies. The survey instrument underwent a validity test using Content Validity Ratio (CVR) and was administered online. Jurors, including senior agriculturists and coordinators from various institutions, evaluated the questionnaire's relevance. Twenty-three test items deemed essential with a CVR of 59% or higher were retained. Reliability, tested with Cronbach's alpha, showed a highly reliable instrument with a coefficient of 0.908.

2.5 Data Gathering Procedure

A formal request letter was dispatched to the City Agriculturist and various chairpersons of farmer's associations seeking approval for the study among their members. Reproduced survey questionnaires were distributed to eighty high-value commercial crop farmers. The researcher conducted face-to-face surveys, adhering to health protocols, and ensured questionnaires were accurately translated into the local language. All completed surveys were diligently collected, consolidated, and tabulated. The weight assigned to quantitative scales in each questionnaire was meticulously considered for data analysis. Statistical findings were presented, consolidated, interpreted, and analyzed in tabular form.

2.6 Ethical Considerations

This research study followed ethical guidelines throughout the study. Respondents participated voluntarily, understanding that their responses would be handled with the utmost confidentiality solely for academic

purposes, without any financial incentives involved. Upon study completion, filled-out survey questionnaires were responsibly disposed of by recycling paper into charcoal, ensuring environmental sustainability.

3.0 Results and Discussion

3.1 Profile of the Respondents

The data in Table 1 presents the demographic profile of participants, such as age, sex, household size, land ownership, monthly average income, educational attainment, and marital status. An equal distribution was observed among age groups, with half of the respondents aged 49 and below and the remainder aged 50 years and above. Females comprised the majority at 56.3%, while males represented 43.8%. Household size predominantly fell within the range of 1-5 members (61.3%), followed by 6-10 members (35%), with a small fraction residing in households with over ten members (3.8%). Land ownership primarily rested with the farmers themselves (66.3%), with a minority leasing (5%), acting as tenants (12.5%), or under alternative agreements (16.3%). Monthly income predominantly ranged from 1,000 to 5,000 pesos (83.8%), followed by 6,000 to 10,000 pesos (13.8%), and a minority earning 11,000 to 15,000 pesos (2.5%) monthly. Educational attainment varied, with the highest percentage holding high school diplomas (47.5%), followed by those with elementary education (33.8%) and a college degree (5%). Marital status indicated that the majority were married (86.3%), with smaller proportions identified as single (3.8%), widowed (6.3%), or in a live-in relationship (3.8%). These insights highlight the diverse demographic landscape among farmers and underscore the need for tailored interventions to address their distinct challenges in agricultural practices.

Table 1. Frequency and percentage distribution of respondents in terms of demographic profile

Demographic Profile	Frequency	Percentage
Age		
(Below 49 years old)	40	50.0
(49 years old and above)	40	50.0
Sex		
Male	35	43.8
Female	45	56.3
Household size		
1 - 5 members	49	61.3
6 - 10 members	28	35.0
10 and above members	3	3.8
Land ownership		
Lease	4	5.0
Tenant	10	12.5
Owned	53	66.3
Others	13	16.3
Monthly Average Income		
1,000 to 5,000	67	83.8
6,000 to 10,000	11	13.8
11,000 to 15,000	2	2.5
Educational Attainment		
Elementary	27	33.8
High school	38	47.5
College level	11	13.8
College Graduate	4	5.0
Marital Status		
Married	69	86.3
Single	3	3.8
Widow	5	6.3
Live-in	3	3.8

3.2 Challenges Encountered by Farmers on Climate Change

Production

Data in Table 2 reveals the significant challenges faced by farmers in relation to climate change impacts on production. The most notable challenge identified by farmers which received the highest mean rating is the climate-induced impacts on crop yields (Mean=4.61, SD=0.54). Following closely behind are uncontrollable changes in the atmosphere leading to pest and disease outbreaks (Mean=4.59, SD=0.63), crop damage due to floods caused by heavy rains (Mean=4.55, SD=0.59), and the complexity of crop cultivation arising from water scarcity (Mean=4.50, SD=0.66), all rated as "Very High" challenges, respectively. Additionally, the disruption of plant

development due to extreme weather conditions received a mean rating of 4.48 (SD=0.59), indicating a "High" level of concern among farmers. The findings underscore the consistency of farmers' experiences with climate-related challenges, reflecting a heightened awareness among respondents.

Table 2. Challenges encountered by farmers on climate change in terms of production

	Challenges on Production	M	SD	Interpretation	Rank
1.	Affects crop growth resulting in low yields.	4.61	0.54	Very high	1
2.	Triggers an uncontrollable change of atmosphere which heads pest and diseases on crops.	4.59	0.63	Very high	2
3.	Damages the crops due to flood caused by heavy rains.	4.55	0.59	Very high	3
4.	Creates complexity in growing crops because of insufficient water supply in the farm.	4.50	0.66	Very high	4
5.	Disrupts the developmental stage of the plants due to extreme weather conditions.	4.48	0.59	High	5

Furthermore, the results imply a notable risk to food security, highlighted by high ratings for challenges such as impacts on crop yields, pest and disease outbreaks, and crop damage due to floods. Urgent adaptation strategies are required, including improved crop varieties and water management techniques, to mitigate these risks. This aligns with the findings of Alhassan et al. (2019) and Amikuzumo et al. (2019), who emphasize the exacerbation of food production challenges by climate change-induced soil degradation and population growth. In response to these challenges, the Climate Change Act of 2009 (R.A. 9729) acknowledges farmers' vulnerability and emphasizes the importance of integrating climate adaptation and mitigation measures into agriculture. Targeted interventions and investments in climate-sensitive sectors are essential to address these challenges effectively.

Cropping Pattern

The analysis of the results shown in Table 3 highlights the unanimous agreement among respondents regarding the challenges encountered regarding cropping patterns due to climate change. Notably, the challenge of low knowledge of adoptable cropping pattern practices received the highest mean score (M=4.53, SD=0.55), indicating a strong consensus among participants. It underscores the critical need for enhanced education and training programs to equip farmers with the necessary skills to adapt to changing agricultural practices. Respondents also concurred that climate change-induced water scarcity significantly affects cropping patterns, particularly in non-irrigated farms during the summer/dry season (M=4.45, SD=0.65), thereby ranked second. The challenges posed by unpredictable changes in water and heat humidity (M=4.30, SD=0.62), weather fluctuations affecting sowing dates (M=4.26, SD=0.71), and intricate crop pattern management in flood-prone areas (M=4.18, SD=0.63), were also acknowledged by respondents.

Table 3. Challenges on climate change in terms of cropping pattern

	Challenges on Cropping Pattern	M	SD	Interpretation	Rank
1.	Affects farming operation due to low knowledge on adoptable cropping pattern practices like intercropping, crop mapping, and integrated pest and nutrient management.	4.53	0.55	Very high	1
2.	Causes water scarcity that affects the cropping pattern that affects the non - irrigated farms particularly during summer/dry season.	4.45	0.65	High	2
3.	Unpredictable change of water and heat humidity brought unfavorable conditions for seasonal crops.	4.30	0.62	High	3
4.	Creates weather fluctuations that affects the sowing date.	4.26	0.71	High	4
5.	Creates intricate crop pattern management on prone to flood environment.	4.18	0.63	High	5

These findings suggest that farmers have encountered explicit challenges due to climate change, disrupting their cropping patterns. The result resonates with literature such as that of Stuecker et al. (2018), emphasizing the increasing importance of skillful seasonal prediction to guide agricultural management in mitigating the compounded impacts of soil moisture variability and temperature stress. As climate change intensifies, addressing these challenges becomes paramount to ensure sustainable farming practices and food security.

3.3 Adaptation Practices on Climate Change

Production

The data presented in Table 4 provides valuable insights into farmers' adaptation practices concerning climate change in production. The findings suggest a strong consensus among farmers regarding the adoption of various adaptation strategies. Notably, practices such as minimizing the use of petroleum-based fertilizers and pesticides (M=4.61, SD=0.58) and water conservation during dry seasons or droughts (M=4.54, SD=0.62) emerged as the topmost adaptation measures. Additionally, farmers recognize the importance of using high-quality seeds (M=4.38, SD=0.74), practicing soil conservation (M=4.20, SD=0.79), and employing compost application to enhance soil fertility (M=4.20, SD=0.79). These findings underscore the proactive approach taken by farmers in addressing the challenges posed by climate change in agricultural production.

Table 4. Adaptation practices on climate change in terms of production

Adaptation practices	M	SD	Interpretation	Rank
1. Minimizing use of petroleum-based fertilizers & pesticides.	4.61	0.58	Very high	1
2. Conserve water use of particularly in times of dry season/drought.	4.54	0.62	Very high	2
3. Use of good quality seeds & planting materials of well-adopted varieties.	4.38	0.74	High	3
4. Encourage practice of soil conservation.	4.34	0.67	High	4
5. Uses compost application to increase organic matter and builds soil fertility.	4.20	0.79	High	5
6. Control of pests and diseases through integrated pest management.	4.18	0.71	High	6
7. Integrating livestock into crop production.	4.08	0.76	High	7

Furthermore, livestock integration into crop production emerged as a notable adaptation strategy (Mean=4.08, SD=0.76), aligning with Musara, Tibugari, Moyo, & Mutizira (2021), who emphasize farmers' efforts to increase productivity for crops and livestock to target rewarding markets. However, challenges persist, as highlighted by Peñalba (2019), who underscores limited knowledge and financial constraints hindering farmers from adopting new adaptation techniques and technologies. Nevertheless, studies such as TeGrate (2018) highlight the resilience of farmers in adapting to changing climate conditions by adjusting crop selection, timing field operations, and implementing sustainable agricultural practices. This indicates that despite challenges, farmers can adapt to climate change through innovation and resourcefulness, suggesting the importance of providing support and resources to facilitate adaptation efforts and enhance resilience in agricultural systems.

Cropping Pattern

Table 5 presents data on farmers' adaptation practices concerning climate change in terms of cropping patterns. Among the implemented practices, drainage improvement to reduce stress on the root system (Mean=4.53, SD=0.57) and control weeds using them for soil mulching or animal feeding (Mean=4.50, SD=0.64) were strongly agreed upon. Additionally, farmers indicated agreement with practices such as enhancing knowledge and preparedness for climate-proof farming (Mean=4.46, SD=0.64), diversifying crop plans and rotations (Mean=4.45, SD=0.57), practicing soil conservation to reduce erosion and nutrient leaching (Mean=4.34, SD=0.64) and improving crop cultivars tolerant to drought and other stresses (Mean=4.25, SD=0.65) as measures to mitigate climate change impacts on their cropping patterns.

These findings suggest that farmers are actively engaged in implementing adaptive strategies to enhance the resilience of their agricultural systems. Mase et al. (2017) and Xiaomeng (2020) also highlight various adaptation options available to farmers, including crop switching, altering planting times, improving irrigation measures, and enhancing soil conservation practices, which align with the practices reported by the surveyed farmers.

Table 5. Adaptation practices on climate change in terms of cropping pattern

Adaptation Practices	M	SD	Interpretation	Rank
1. Improve drainage that reduces stress to the root system.	4.53	0.57	Very high	1
2. Control weeds by using it for soil mulching or animal feeding.	4.50	0.64	Very high	2
3. Enhance knowledge and preparedness for a climate-proof farming practice.	4.46	0.64	High	3
4. Diversifying crop plans and crop rotations.	4.45	0.57	High	4
5. Practice soil conservation to reduce soil erosion & nutrient leaching.	4.34	0.64	High	5
6. Improving crop cultivars more tolerant to drought and other stresses.	4.25	0.65	High	6

3.4 Relationship Between Challenges and Adaptation Practices

Table 6 presents the relationship between the challenges encountered by farmers and their adaptation practices concerning climate change on both production and cropping patterns. The analysis revealed a non-significant relationship [r (77) = 0.206, p = 0.069] at the 0.05 level of significance, indicating no association between challenges and adaptation practices. These findings suggest that despite facing challenges related to climate change in production and cropping patterns, farmers' adaptation practices are not significantly influenced by the severity of these challenges.

Table 6. Relationship between challenges and adaptation practices on climate change

Variables	df	r-value	p-value	Interpretation
Challenges * Adaptation	77	0.500 0.206	0.069	Not Significant

*Significant if α is ≥ .05

This result may be attributed to a need for more knowledge among farmers regarding appropriate mitigation strategies, as indicated in Table 3, which may hinder their ability to address the challenges they encounter effectively (Chowdhury, Hasan, & Islam, 2022). Further research and targeted education efforts could help bridge this gap, enabling farmers to adopt more effective adaptation practices and build resilience in the face of climate change.

4.0 Conclusion

The study reveals that the farming community, predominantly comprising women, possesses extensive experience in farm production and cropping patterns, often with a background of completing high school education and land ownership. While farmers demonstrate a commendable awareness of the challenges posed by climate change in production and cropping patterns, their adaptation practices are hindered by a perceived lack of knowledge regarding advanced technologies and methodologies. The study highlights the importance of introducing climate-smart agricultural technologies alongside ongoing farmer training and capacity-building initiatives involving local stakeholders, including government units and civil society organizations. Furthermore, the study underscores the absence of a significant relationship between the challenges faced and the adaptation practices employed by farmers, indicating a potential gap in effective mitigation strategies. Therefore, there is a critical need for targeted interventions, such as capacity-building programs and access to relevant resources, to enhance farmers' resilience to climate change and ensure sustainable agricultural practices in the region.

5.0 Contributions of Authors

AA – editing, writing, processing of data electronically, data analyses, etc.
BA – writing, data gathering, encoding, etc.

6.0 Funding

The research was conducted without financial support from any external organizations. All costs associated with the research were covered by the researchers personally.

7.0 Conflict of Interests

The authors confirmed no conflicts of interest regarding this study.

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