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Farming amidst climate change: The contextual vulnerability of farmers in Cotabato, Philippines

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Abstract

This research investigated the contexts of farmers in Cotabato, Southern Philippines, and the various aspects of their vulnerability to climate change. The response of the government to address the climate vulnerability of farming communities was also examined. A mixed-methods approach that included document analysis, surveys, interviews, and focused group discussions was used to gather the data for the study. Salient themes from qualitative data were discussed side by side with the results generated from quantitative data. The different aspects of contextual vulnerability investigated—the nature of farming itself, population age groups, education, income, multiple deprivations, farm assets, farming practice, and limited government response—work together to characterize the vulnerabilities of farmers. They also exacerbate, compound, and reify each other. The susceptibilities and multiple deprivations of farmer households through limited formal education, poverty, and lack of social support challenge their adaptation and resilience to climate change. Farmers remain vulnerable to the impacts of climate change despite the existence of a government plan that recognizes their plight. A holistic view of these vulnerabilities is highly recommended in drafting programs and optimal solutions for the issues related to climate change.

Introduction

Over the years, climate change has had vast impacts and consequences in the Philippines. A 2019 Global Index Report covering a 20-year period (1998-2018) identified the Philippines as one of the top ten countries most affected by climate change. In fact, the country has the most number of extreme events recorded during this period (Eckstein et al., 2020).

Extreme weather condition has been identified as the country's main risk. In fact, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA, 2022) reported that there are more tropical cyclones entering the Philippine area of responsibility than anywhere else in the world, with an average of 20 cyclones in a year. Moreover, typhoons in the Philippines are also becoming more unpredictable and intense in recent years (Board, 2021). Climate change is also severely felt throughout the country through high temperatures and long droughts. In 2015-2016, the country recorded the most severe El Niño drought that lasted for 18 months (Sutton et al., 2019). The disaster affected the agriculture sector the most.

The long spate of drought in 2015-2016 had a significant impact on Cotabato Province in Southern Philippines which is composed of many farming communities. Food scarcity brought about by the intense drought prompted some hungry farmers to leave their farmlands and go to the city to protest and demand food and aid, ending up in chaos (Macas, 2016). Taking this into consideration, The Asia Foundation (2017) has reported that climate change can add to or exacerbate conflicts and tensions in the Philippines. This is because climate change exposes people's vulnerabilities that can create tensions (Koubi, 2019).

The International Panel on Climate Change (IPCC) recognizes the multiplier effects of climate change, which adds to the burden of people living in poverty (Olsson et al., 2014). The extent of these effects vary across communities as well as the government's capacity to respond to climate-related problems. These effects are likely to impact the agriculture sector due to its heavy dependence on weather conditions (Koubi, 2019).

Vulnerability is framed in two different ways in literature—outcome vulnerability and contextual vulnerability (O'Brien et al., 2007; Okpura et al., 2016). The vulnerability of Cotabato farmers within the outcome vulnerability framework has already been explored in other studies (e.g., Gomez, 2015). However, there is a dearth of research focusing on their contextual vulnerability.

An understanding of contextual vulnerability of farmers is vital in providing the needed support and assistance to systematically respond to the effects of climate change. In lieu of the importance of contextual vulnerability assessment, this paper focuses on the local situation and experiences of Cotabato farmers to understand their vulnerability which, at one point in time, resulted in a climate change-induced conflict. It also aims to examine the response of the local government to address the climate vulnerability of farming communities.

Contextual vulnerability is far less visible in scientific and policy discourses (O'Brien et al., 2007). Addressing this aspect is intended to contribute to more comprehensive adaptation policies and appropriate programs for farmers not only in response to climate change but to other forms of hazards that occur in the province.

Relevant Literature

Knowledge and discourse on climate change vulnerability have been framed in two significant complementary ways—as an outcome and contextual vulnerability (O'Brien et al., 2007, Okpura et al., 2016). Outcome vulnerability is referred to as "endpoint" vulnerability. This vulnerability framework focuses on vulnerability interpretation on estimates of potential climate change impacts, considering possible adaptive responses (Okpura et al., 2016). Its orientation is toward the quantification of biophysical vulnerability in relation to the level of susceptibility that takes place after adaptation (Hopkins, 2015). Just like any other framework, this type of assessment is challenged by quantification problems because as a latent variable, vulnerability cannot be directly measured (Ziervogel & Downing, 2004). Also, a wide-scale model conceals a variety of contextual conditions (O'Loughlin et al., 2012). As Adger and Vincent (2005) emphasize, "the contextual nature of the vulnerability, the difficulties of validating indicators, and considerations of timescale provide challenges to the development of robust indicators." For these reasons, contextual vulnerability considerations are becoming central, especially in climate conflict scholarship and gaining traction in science and policy debates.

Contextual vulnerability is grounded on the human security framework that nature and society are inseparable aspects of the same context. In a contextual framework, vulnerability is interpreted as the current susceptibility to climate change and variability that occurs in the context of social, cultural, technological, institutional, political, and economic processes of change (O'Brien et al., 2007). These contexts can compound the individuals' and communities' level of exposure to climate change that results in risks.

Contextual vulnerability assessments explore why some groups, like the farmers of Cotabato province, are more affected by climate change than others. This type of vulnerability assessment is believed to reveal the complex nuances of vulnerability. O'Brien et al. (2007) posit that this complexity can possibly drive a transformative process for better governance, resilience, and adaptability, and can be a driver of more socially focused policies and adaptation initiatives (Okpura et al., 2016).

The entry point in contextual vulnerability analysis is the current climatic, biophysical, and contextual conditions driving vulnerability including social, economic, political, and institutional structures and dynamics. Methods employed by studies within the contextual vulnerability framework include longitudinal and cross-sectional surveys, household surveys, quantitative/qualitative case studies, and context-specific indicator approaches (Okpura et al., 2016).

Conceptual Framework

Vulnerability is the degree to which a system is susceptible to or unable to cope with the adverse effects of climate change, including climate variability and extremes (IPCC, 2007). Social vulnerability includes factors that weaken the community's ability to prevent human suffering and financial loss in the event of a disaster.

Climate Variability

Conditions resulting from climate change have intense and serious consequences to the socio-economic activities of farming households. Disruptions in livelihood result in lost income that exacerbates poverty (Herrera et al., 2018).

Frequency Exposure

Human activities such as economic enterprises are exposed to climate variability and hazards on a periodic basis (e.g. drought, flooding, tropical cyclones). Such exposures may result in adverse impacts that exceed the coping capacities of communities, particularly when there are underlying social factors that enhance vulnerability (Preston et al., 2009).

Vulnerable Age Group

Climate change can interact with demography in exacerbating its impacts. The most affected are usually the most vulnerable groups (Allen et al., 2018) like children and adolescents in developing countries who are considered the most at-risk to disasters (Bartlett, 2008).

Education Vulnerability

Education positively contributes to demographic and health outcomes (Gakidou et al., 2010). Educated individuals are more capable and empowered to be more prepared and adaptive to disasters because they have more access to information, technology, and resources (Muttarak & Lutz, 2014).

Income Vulnerability

Climate change increases the income vulnerability of small farmers who are highly reliant on farm income (Jalal et al., 2021). Insufficient financial capital and low income constrain families from recovering or bouncing back from climate shocks and other disasters (Cutter et al., 2003).

Multiple Poverty

The vulnerability of poor communities is generally superimposed on existing vulnerabilities (Ecosystems Division et al., 2002). The combinations of deprivations result in a multiplicity of burdens that act together to keep a household poor (Alkire & Santos, 2010). Multiple forms of poverty experienced by farmer households expose them to more environmental risks and make it more difficult for them to cope with the impacts of climate change.

Farm Ownership

Farm ownership enables farmers to combine a set of physical resources and farm tenure to carry out strategies to adapt to climate change (Defiesta & Rapera, 2014). It gives owners the right to build farm infrastructure, which non-farm owners cannot simply do (Eakin & Bojorquez-Tapia, 2008).

Farm Size

Marginal farm size is associated with the vulnerability of farmers (Gomez, 2015) as gains from improved technical efficiency is much higher on large than on small farms (Lowder et al., 2016).

Crop Diversification

Crop diversification distributes risks across different crops, making failure recovery easier. Low occupational diversification exposes farmers to the risks of climate change (Abera & Tesema, 2019). Diversity in crops is associated with success in achieving livelihood security under improving economic conditions as well as with livelihood distress, such as a lack of funds to restore agricultural production in deteriorating conditions (Ellis, 1998).

Government action

Existing institutional and governance networks to deploy resources are essential while any existing socio-political barriers may impede successful adaptation to climate change (Hulme et al., 2007; Lorenzoni et al., 2007).

Materials and Methods

Study Site

This study was conducted in Cotabato, a landlocked province in Mindanao, an archipelago in Southern Philippines having a Type III climate. Cotabato is the largest among the four provinces comprising Region XII or the SOCCSKSARGEN region. The province has 17 municipalities and one city clustered into three districts. This study covered Kidapawan City and 16 out of the 17 municipalities in the province. The municipality of Banisilan was excluded due to accessibility concerns. Collection of survey and interview data began in September 2018 and was completed in March 2019.

Research Method

A mixed methods research approach, specifically the convergent parallel design, was used in this study. In a convergent parallel design, quantitative and qualitative data are collected concurrently in one phase. This study simultaneously collected survey and interview data. This procedure was used to confirm, cross-validate, or corroborate findings. Table 1 summarizes the methodology used in this study.

Desktop research and analysis of existing reports and publications were done to gather data about demographic, economic, agricultural, and climate profile of Cotabato Province. The Philippine Statistics Authority (PSA) portal was explored to obtain links to online sources of data relevant to the study. The provincial field personnel of PSA and the Bureau of Agricultural Statistics (BAS) were interviewed to validate and gather details on some data accessed online.

The National and Local Climate Change Action Plans (NCCAP/LCCAP) were also reviewed. Separate focused group discussions and follow-up interviews with personnel of Cotabato provincial government offices of the Disaster Risk Reduction Management (DRRM), Department of Agriculture (DA), and the Provincial Planning Office (PPO) were likewise conducted. Discussion topics included climate change, impacts of climate change-related disasters as well as climate-related government policies and programs for farmers.

The survey was part of a bigger study funded by the Commission on Higher Education (CHED). Information gathered through surveys included households' socio-demographic profiles, social contexts such as economic condition and farm assets, and their practices with regards to climate change. Respondents also completed the slightly modified Multiple Poverty Index (MPI) questionnaire developed by the Oxford Poverty and Human Development Initiative (OPHI) (Olsson et al., 2010). Trained enumerators implemented the survey. When needed, they assisted respondents by reading the questions aloud and writing the responses in the questionnaire.

Simultaneous with the survey, one-on-one interviews were conducted with five household members in each of the identified barangays. The interview participants were different from the survey respondents. They were asked to provide elaborate responses on some items included in the survey questionnaire and detailed descriptions of households' experiences with climate variability and change, their socio-economic conditions, and farming experiences and concerns.

Table 1. Summary of data collected, method used, sources, and analysis.

Data Collected	Data gathering method	Source	Data analysis
Population, agriculture, and climate profile of Cotabato	Desktop research and document review	Existing reports and publications	Descriptive and Test of Relationship
	Interviews	Provincial personnel of Philippine Statistics Authority (PSA) and Bureau of Agricultural Statistics (BAS)	
Socio-economic vulnerability of farmers and their farming practices	Survey	1,526 Farmer Households from 32 barangays	
	Interviews	Provincial Office Personnel (Cotabato Provincial Planning Office, Disaster Risk Reduction and Management [DRRM], Department of Agriculture [DA])	Thematic Transcript/ Document Analysis
Government climate change actions	FGD and interviews	Provincial Office Personnel	
	Review of documents	Intended Nationally Determined Contributions (INDC), National Climate Change Action Plan (NCCAP), Local Climate Change Action Plan (LCCAP)	

Respondents and Sampling Procedure

A target of 1,065 households equally divided among three clusters (Table 2) out of a total of 320,567 households in Cotabato was initially considered as a sample. The total number of households was taken from the latest available census data (2015) and the sample size was computed at 95% confidence level and 3% margin of error. The actual sample size however, reached 1,526 households, as more respondents volunteered during the survey. This resulted in a higher confidence level, a narrower confidence interval and a more precise estimate of population characteristics.

Multi-stage sampling was used, starting with the selection of at most two barangays to represent each municipality. The selection of barangays was intended to be random. However, during actual data gathering, some mayors or their representatives advised against visiting certain barangays, primarily for security reasons. Respondents' permission to participate in the survey or interview was also crucial for data gathering. Thus, the inclusion of household samples in identified barangays was largely based on their availability and willingness to participate. Under these conditions, one barangay was selected from Kidapawan City and from the municipality of Alamada; two barangays were selected from each of the 15 other municipalities, for a total of 32 barangays.

Interview respondents were selected by purposive sampling. Household members with at least ten years of farming experience in the barangay were the main criterion in the selection. An elderly household member was specially targeted during the conduct of interviews as they had more experience with local climate variability and how farming changed over time. In most cases, family members present at the time of the survey or interview altogether provided the information for the study.

Table 2. Distribution of sample by legislative district with clustered municipalities.

District (Municipalities)	Household Population	Target Sample Size (at 95%, CI = 5)	Actual Sample (99%, CI = 3.3)	Percentage
1 (Alamada, Aleosan, Libungan, Midsayap, Pikit)	106444	355	509	33.35
2 (Antipas, Arakan, Kidapawan, Magpet, Makilala)	106501	355	524	34.38
3 (Carmen, Kabacan, Matalam, Mlang, Tulunan)	107622	355	493	32.30
Total	320,567	1065	1526	100.00

Data Analysis

Quantitative analysis was done using descriptive summaries such as frequencies, percentages, and means. Data from survey are represented visually using graphs and tables to illustrate trends, and generalizability whenever necessary was shown using some inferential statistics such as the chi-square test.

Qualitative data from interview of farmer households was processed using NVivo 12. Salient themes and nodes that came out of the process included climate variability, climatic events and hazards, changes in farming patterns, impacts of changing weather patterns and other hazards, knowledge of climate change, local government assistance, other vulnerabilities, reliance on farming for income, and social impact of climate change.

Data presentation for the study made use of side-by-side comparison merged data analysis strategy as described by Bian (2018). Quantitative and qualitative analyses were intended to complement each other to provide an elaborate perspective on the vulnerabilities of farmers. When juxtaposed with each other, they can provide in-depth portrayal of how these vulnerabilities interact with climate change impacts.

Results

Vulnerability of Farming to Climate Risks

The climate type of Cotabato province was originally Type IV, along with all other provinces in the SOCCSKSARGEN Region (Coronas' Modified Classification of Climate 1951-2003). Climate Type IV is characterized by rainfall which is evenly distributed throughout the year. This climate type greatly favored the farming activities of the province. The even distribution of rainfall in a year sustained the water needs of its farm areas which mostly are non-irrigated.

However, in recent years, Kidapawan City, together with 16 of the 17 municipalities, was reclassified to climate Type III (see Figure 1). According to the Cotabato PPO only the municipality of Arakan and some of the elevated portions of Magpet, Makilala, Tulunan, and Kidapawan City remained totally classified as Type IV climate. The reclassification of almost all parts of Cotabato to climate Type III indicates that seasons in the province are currently no longer very pronounced. Among the four provinces in the SOCCSKSARGEN, only Cotabato was reclassified to Climate Type III, indicating a more drastic change in climate experienced in this part of the region.

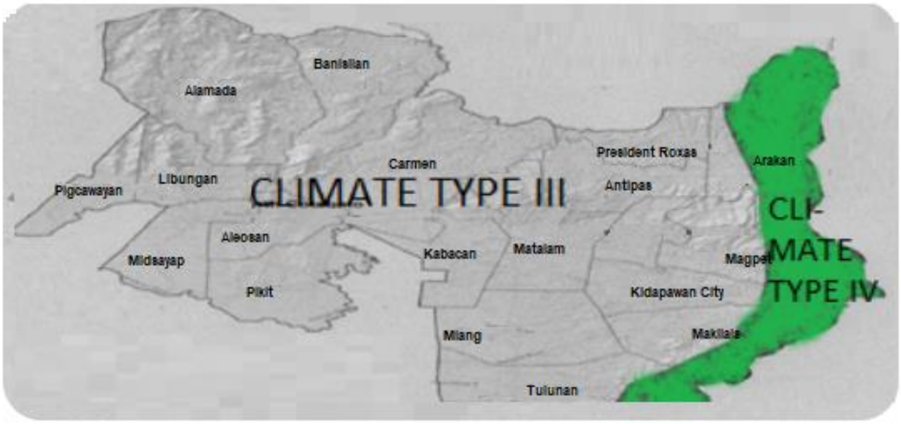

Figure 1. Climate type classification of Cotabato municipalities.
(Source: Cotabato Provincial Planning Office)

Under the mid-range scenario, the projected increase from historical observed mean temperature in Cotabato was 1.0 to 1.3 by 2020 and 2.1 to 2.5 by 2050 (PAGASA, 2011). This projected mean temperature increase in Cotabato Province is higher than in other provinces and in the whole country. Under the medium emission range scenario, average temperature in the Philippines is estimated to increase annually by 0.9°C to 1.1°C in the 2020s and 1.8°C to 2.2°C in the 2050s (PAGASA, n.d.).

Climate variability in the province was highly noted among interview respondents. They particularly indicated the erratic, unpredictable weather pattern. The unpredictable weather condition renders farmers vulnerable as their traditional knowledge of seasonal calendar no longer applies. The planting season has shifted and no longer coincides with the farmers' usual schedule. This has a significant impact on farming activities, especially of farmers in non-irrigated areas who engage in seasonal crops such as rice and corn.

In previous years, planting was synchronized with the rainy season to sustain crop water requirements. Harvesting was done on dry months to facilitate easy transport of produce and sun-drying activities. The long years of farmers' exposure to predictable weather patterns enabled them to create a definite seasonal calendar for rice and corn crops. The changes in weather patterns have disrupted the established seasonal calendar. According to interview respondents, current farming condition is hard because their calendar no longer applies. The season becomes dry during the expected months of rain for the planting season. Rain arrives unsuspectedly during harvest season and causes damage to crops. Farmers lament the damage to crops because of long droughts and heavy rains especially if planting involved borrowed capital with interest. In the study of Galang (2020), the borrowing incidence is 56.57% among palay households and 30.52% among corn farmer households in the Philippines. Some farmers choose not to "gamble" with planting for fear that their households would suffer more if the borrowed capital cannot be recovered in the event of crop failure.

Climate change presents dire consequences among farmers of Cotabato Province as agricultural production and the number of cropping seasons can be significantly reduced. In non-irrigated areas, rice farming was reduced to one cropping per year (Digal & Balgos, 2017). Table 3 reflects the reduction in rainfed rice and corn crop yields. The year 2014 is used as baseline, being the year prior to the 2015-2016 drought.

Table 3. Rice and corn area and production in Cotabato Province, 2014-2019.

Year	Irrigated rice		Rainfed rice		Corn	
	Area (ha)	Production (MT)	Area (ha)	Production (MT)	Area (ha)	Production (MT)
2014 (Baseline)	93,600	418,669	35,852	111,360	130,699	414,630
2015	91,561	377,350	34,045	97,735	125,695	369,766
2016	83,517	348,735	28,881	85,222	108,820	317,336
2017	93,011	402,130	32,857	98,108	111,946	343,070
2018	93,620	419,615	33,510	104,344	113,022	355,917
2019	93,054	385,328	30,493	82,409	109,160	294,569
Average	91,394	391,971	32,606	96,530	116,557	349,215

During the five-year period, rainfed rice and corn crops were not able to recover and match the 2014 production in area and volume. Rainfed rice production area was reduced by 14.9% and yield by 25.9% in 2019 against the baseline. On the other hand, from 2014 to 2019, corn production area was reduced by 16.5%, while yield was reduced by 29.0%. Irrigated crop yields were also significantly reduced during the 2016 drought. In times of drought, limited water source results in constraints and rationing of irrigation services to farmers. Irrigated areas are also subjected to pest damage when surrounding non-irrigated farmlands are abandoned or left unproductive due to insufficient rainfall.

Table 3 also shows that rice production is significantly lower in rainfed than irrigated areas during the five-year period (2.96 $MT \cdot ha^{-1}$ and , 4.29 $MT \cdot ha^{-1}$ respectively). The majority of the farms in Cotabato Province are rainfed-dependent. Among the survey respondents, 58.3% work in rain-fed farm areas (Figure 2). Of the areas planted with various crops in the province, only 22.3% are irrigated as of 2019 (PSA, 2020b). These irrigation facilities are restricted to rice only. As of December 2015, only 29.94% of the estimated irrigable area in Cotabato province, the lowest in Region XII, was reported to be serviced by an irrigation system (National Irrigation Administration-Region XII, 2015). A National Economic and Development Authority (NEDA, 2017) report also indicated a reduction in the number of irrigated areas in the SOCCSKSARGEN Region between 2014 and 2015. In Cotabato, this downward trend continued as of 2019. The reduction in irrigated areas is partly due to the damages in irrigation facilities, which interview respondents attribute to strong rains, poor management, and the rice field owners' failure to pay for the irrigation fees resulting in poor maintenance. The use of water pump is not an economical option for farmers as it requires extra fuel because the water table in Cotabato areas such as Mlang is too deep (Digal & Balgos, 2017).

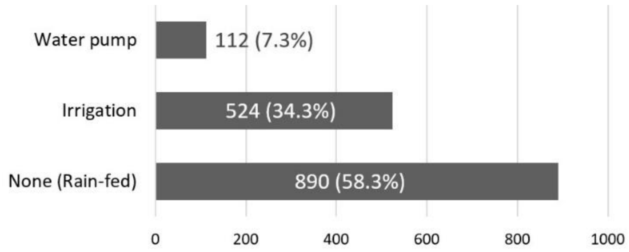

Figure 2. Water resource of household respondents (n=1526).

Farmers have expressed that groundwater is becoming insufficient. The extreme heat has also caused groundwater to easily evaporate. According to them, even with a week's worth of rain, the soil easily dries up and the water dissipates in just four or five days because of extreme heat. In Kidapawan City, dry spells reduced the water production from spring sources by 15-20% (Cadelina-Manar, 2020). Natural forests that can hold water under the soil are absent in most areas where the research team visited. Patches of trees and shrubs that are present in some farm and residential areas are objectively not enough to hold water in the ground.

Aside from physical impacts, the farmers' labor patterns have also shifted following changes in the climate. Extreme warm conditions have made farming activities difficult and unbearable for farmers. Observed data for Cotabato in the last decade shows daily high temperature averages ranging from 30.9°C to 32.3°C and the corresponding heat index is usually above 37°C. This condition is directly felt by farmers and the unbearable heat results to reduced farm hours. According to interview participants, this has forced them to significantly shorten on-farm engagements to at most half a day, with workers taking a break between 10AM to 3PM.

Socio-economic Impact of Climate Variability

Figure 3 shows the socio-economic impacts of climate variability to farmer respondents. Low agricultural production was identified by about 74.8% of survey respondents. Interview participants elaborated that this is due to the decline in planting activities, crop damage, or decline in quality of the crops produced due to insufficient rainfall, unexpected heavy rains, and/or extreme heat.

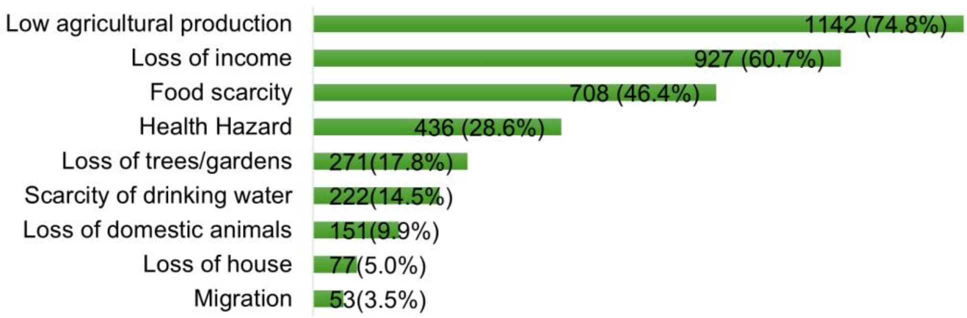

Figure 3. Socio-economic impacts of climate change to respondents. (multiple response item, n=1526)

The low production naturally leads to loss of income. This is the second most impactful effect of climate change identified by 60.7% of survey respondents. Interview respondents also associated loss of income to the increasing expenses in farming. They emphasize the present difficulties in tending a farm such as the decline in soil quality; hence the need for fertilizers as well as increase in pests that need to be controlled. Farm inputs have also become expensive especially because of the pressing need to choose seeds that can better survive the weather. Moreover, irregular rainfall and extreme heat cause ground water to dissipate quickly that necessitates farmers to outsource water to feed the plants. This results to additional expenses for outsourcing water using water pumps in increasing frequency among some farmers. Poor marketability of low-quality farm produce due to unfavorable weather is another source of income loss to farmer respondents.

Extreme heat also limits the work input of farm owners and forces them to hire help, which adds up to their expenses. On the other hand, there is a significant number of farm workers whose main incomes are derived from farm labor. Lack of rainfall and drought events significantly reduce or even totally cut their income during times when agricultural activities are minimized or even halted. Moreover, even when labor is available, on-farm engagement is also reduced because workers cannot bear the heat of the sun and consequently, lose their income. According to interview respondents, the limited capacity of laborers during extreme conditions eventually led some farm owners to mechanize farm activities. This shift to technology is claimed to be efficient and beneficial to farm owners but impacts the income of farm laborers.

The limited production and income contribute to the scarcity of food in farmer households. Scarcity of safe drinking water during long droughts was also reported as well as health hazards mostly associated with extreme temperatures. There was also a loss of trees/gardens, domestic animals, and even the loss of houses to floods. The climatic events that occurred in the province also caused the migration of some relatives to other places.

Farmers' Exposure to Climate Hazards

The frequency of climatic events experienced in Cotabato exacerbate farmers' vulnerability. Figure 4 shows the hazards experienced in the past years as recalled by survey respondents. Among the climatic hazards, a large majority (79%) has recalled drought, and many respondents also experienced pests (59%) and floods (37%). Interview respondents also indicated that the frequency of climatic events in the province increased in recent years. For example, according to them, drought used to happen around once in every ten years but has occurred more frequently in recent years. Confirming this observation are various sources reporting droughts happening in the Philippines in 1911, 1958, 1968, 1972-73, 1982-83, 1986-87, 1997-1998, 2010, 2015-2016, 2019 (Flores, 2019; Israel & Briones, 2013; "Remarkable drought in the Philippines", 1913; van Huysen, 2015). Cotabato Province is affected by the recent droughts that hit the Philippines. In addition to climatic events, respondents mentioned to have experienced other hazards such as epidemics or health concerns (4%) and armed conflict (13%).

The intensity of climatic events occurring in the province has also increased according to interview respondents. Most recalled the intense droughts in 2016 that caused massive damage to their lives. A strong wind was considered as second most damaging calamity especially to permanent crops such as rubber and banana. Almost all affected farmers considered a massive effect of this calamity because replanting permanent crops means longer years to wait before income can again be realized. Pests and landslides emerged as the third most damaging calamity to farmers. In 2016 alone, rats famished due to the long droughts which consequently destroyed PhP 84.5 million (about $1.66 million) worth of crops in Cotabato (Cervantes, 2016). Climate change is expected to alter pest and disease outbreaks (Harvey et al., 2014).

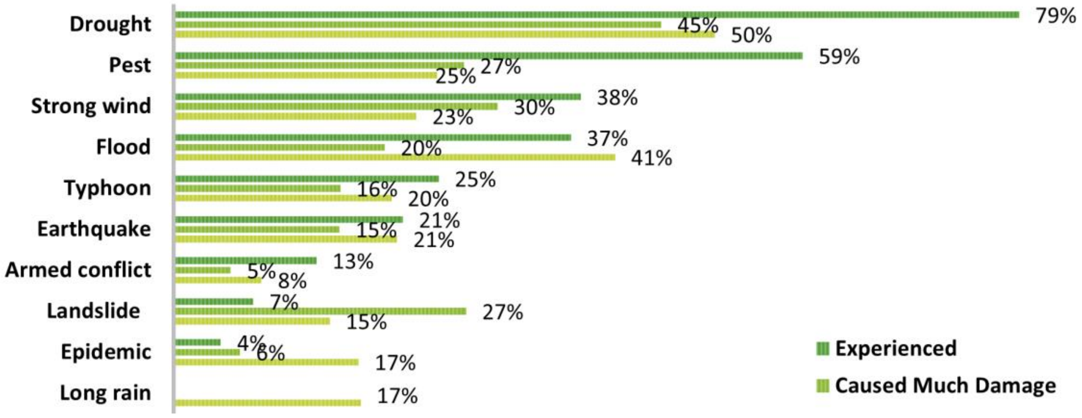

Figure 4. Percentage of respondents according to experienced hazards recalled, caused massive damage, and expected to recur (multiple response item, n=1526).

Landslide has a massive effect on farmers because eroded lands are lost forever, which leaves affected farmers totally landless. Cotabato is highly exposed to rain-induced and ground-shaking-induced landslides. The erosion problem in the province has reached alarming levels. According to Cotabato PPO, over the past 10 to 15 years, 23% percent of the land area in Cotabato has been severely eroded. Only 11.4% remains stable from erosion.

The province is also most exposed to earthquakes. Further, the level of exposure of the agriculture sector in 17 of its 18 municipalities/cities is high. Table 4 shows the number of municipalities in Cotabato province with population and agriculture exposed to different levels of hazards.

Table 4. Number of municipalities in Cotabato exposed to different levels of hazards (n=18).

Hazard	To Population			To Agriculture		
	Level of Exposure			Level of Exposure		
	Low	Medium	High	Low	Medium	High
Flood	9	3	6	10	0	6
Landslide	17	1	0	17	1	0
Earthquake	1	1	16	1	0	17
Liquefaction	11	2	5	11	2	5

Source: Cotabato Enhanced DRR/CCA Enhanced Provincial Framework Plan, 2013-2019

Drought was also perceived by survey respondents as having the most chance of recurring followed by floods, landslides, typhoons, and long rains. Farmers in the province feel more vulnerable due to the recurrence of calamities before fully recovering from the previous one. This has a major impact on the social conditions of farmers, which is another aspect of the farmers' vulnerability.

Social Vulnerability of Cotabato Province

Social vulnerability refers to the susceptibility of the community to adverse conditions such as the effects of climate variability and extremes. It includes factors that weaken the community's ability to prevent human suffering and financial loss in the event of a disaster.

In the case of Cotabato, the age group and education of the province population are some sources of its social vulnerability.

Vulnerable Age Group

Cotabato Province has a population of 1,490,698 in the 2020 census—the highest among the four provinces in the SOCCSKSARGEN Region (PSA, 2021). Its annual population growth rate is 1.64%, which is highest among the provinces in the region and higher than the national population growth rate of 1.63%.

Children and adolescents in developing countries are considered the most at-risk to disasters (Bartlett, 2008). Children and adolescents (up to 19 years old) constitute 43% of the total population in Cotabato Province with children in the age group of five to nine years old having the highest percentage (PSA, 2022). Children, particularly, if living in poor conditions are most vulnerable to the resulting health risks from climate change and lower exposure to health consequences (World Health Organization, 2021). They are also dependent on their parents or guardians for needs, provisions, and decisions. As such, their welfare is largely contingent upon the adults' capacity to respond to their needs.

The elderly (65 years old and above), which is also another vulnerable group, form 7.7% of the population. The low percentage can be attributed to the high birth rate; hence, the surge in the young populace, as well as low life expectancy in the province. Based on the 2015 census, the life expectancy of males in Cotabato Province is only 62.27 years (PSA, 2020b). This is lower than the national life expectancy of 68.72 years (PSA, 2020b) and significantly lower than the world average life expectancy of 72.6 years (Roser et al., 2019). On the other hand, the female life expectancy is 72.58 years, which is also lower than the national life expectancy of 74.74 years. The low life expectancy has implications for the health status of farmers in the province which was also highlighted by the interview participants of this study.

Census data show the percentage of the population in the vulnerable age groups constitutes more than half of Cotabato's population. Combined, the youth and old age dependency ratio as defined by the United Nations (2007) shows that for every 100 actual or potential working population, 61 dependents share the income.

Education Vulnerability

In the 2015 census (Figure 5), a large percentage (3.2%+6%+41%=50.2%) of Cotabato's population aged 5 years old and above have not stepped beyond the elementary level. Estimates show that about 35% of the population aged 15 years and above did not go beyond elementary education. College graduates constitute only 7.2% of the population. As such, a large number of Cotabato farmers are potentially vulnerable to the impacts of climate change based on their level of education.

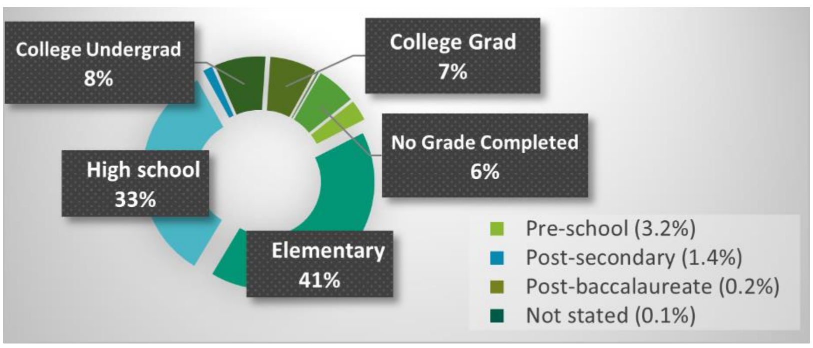

Figure 5. Distribution by educational attainment in Cotabato Province 2015 census of population (Source: PSA, 2020b).

Socio-economic Vulnerability of Farmer Households

Social conditions significantly affect the degree to which farmer households are affected by climate change and their ability to cope with the impacts of climate change. The multiple poverty, low formal education, limited farm assets, and constrained farming practice of farmers can compound the challenges posed by climate change and vice versa.

Table 5. Household size and dependency rate among survey respondents (n=1420 responses).

Household Size	Frequency	Percent
3 Below	357	25.1
4 - 6	827	58.2
7 - 9	202	14.2
10 Above	34	2.4
Standard deviation: 1.92		
Average number of working household member: 1.5		
Average number of non-working household member: 3.3		
Average household dependency rate: 67%		

Household Size and Income Sources

Table 5 shows that the majority (58.2%) of households in the survey have four to six members. The average household size is 4.8 and the average number of earning members per household is only 1.5. The household dependency rate of 67% was computed by dividing the number of non-earning household members by the total. Larger households require more food and other basic needs, which strain the household's ability to cope with climate shocks. This is exacerbated by the condition that most of the family members are economically dependent, and the primary source of earning family members is unstable. Table 6 shows that the main source of income among earning family members is contingent on farming activities (57.1%) and the availability of labor/service contract jobs.

Table 6. Primary source of income among earning household members (n=1547 responses).

Source of Income	Frequency	Percent
Farming	883	57.1
Farm labor	144	9.3
Service labor (ex. carpentry)	133	8.6
Vending	101	6.5
Tenured employment (ex. teaching)	82	5.3
Contractual employment (Ex. guard)	64	4.1
Rubber tapping	56	3.6
Barangay local government unit work (ex. Citizen Armed Force Geographical Unit)	26	1.7
Domestic employment (ex. helper)	22	1.4
Work outside Philippines	18	1.2
Others (business, livestock)	18	1.2

Economic Condition

Economic condition is a significant factor in understanding the capabilities of a household. Households can have difficulties adapting to climate change if they do not have sufficient income to sustain their needs.

The majority (66%) of the farming households indicated a meager monthly family income of PhP 5,000 (about $98) or below (see Figure 6). The average income during the survey is PhP 6,002.00 (about $118) for households of about five members on the average. Results of the 2018 Family Income and Expenditure Survey (FIES) indicated that the economic threshold for a Filipino family with five members is PhP 10,727 (about $210) per month (PSA, 2019). The average income of household respondents is far below the poverty line which is why about 74% of households surveyed indicated they are experiencing bad economic conditions with 34% of them stating that it is very bad.

Of 1145 households who provided complete data on financial status, only 86 (7.5%) have earnings falling within the range of what they consider sufficient. Figure 6 illustrates that most respondents (69%) indicated that they needed a monthly income ranging from PhP 7,501 to PhP 20,000 (about $147 to $392) to sufficiently sustain the needs of their households. On average, farming households indicated a monthly income of PhP 13,952.00 (about $274) to be economically sufficient. The farmers' actual average earnings only constitute half of what they need. Farmers, therefore, need to be facilitated to at least double their present earnings to meet their needs.

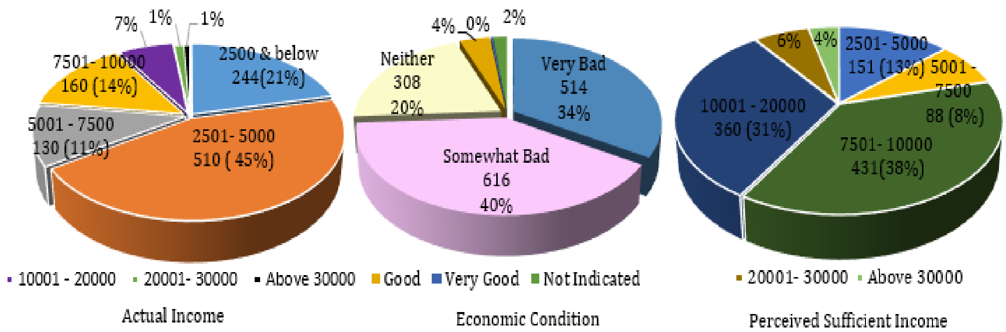

Figure 6. Economic condition of household respondents.

Multiple Poverty

The Multiple Poverty Index (MPI) used to identify indicators of poverty among farmer households corroborates the census data. The MPI is an international measure of acute multidimensional poverty which reveals combinations of deprivations. Table 7 reveals the incidence of deprivation on each indicator in the sample households.

The global MPI computation (OPHI, 2010) was followed to capture multiple deprivations in the following indicators: education, health, and living standards. Results in Figure 7 show that 45% of farming households are multidimensionally poor. These households experience combinations of deprivations that result in a multiplicity of burdens acting together to keep a household poor (Alkire & Santos, 2010). The highest deprivations among multidimensionally poor households were in the realm of living standards in mobility assets (98%), clean cooking fuel (94%), and safe house type (82%). Schooling deprivation is higher among multidimensionally poor farmer households at 64%. It can continue to plague these households as 33% of them revealed that there are school-aged children in their households not attending schools for Grades 1 to 8. Malnutrition is also high at 34% with a mortality incidence of 13% in these households. Although this study failed to include chronic illnesses in the survey as part of health indicators, it was revealed in the interviews that health problems such as renal failure, diabetes, and hypertension severely exacerbate the vulnerability of many farming households primarily because of health expenditures and living constraints.

Table 7. Incidence of deprivation among farmer households (HHs) (n=1526).

Dimension	Indicator	Deprived if...	% Deprived
Education	Schooling	No HH member has completed at least 6 yrs. of school*	39.3
	School attendance	School-aged child in the HH is not attending school in Grades 1 to 8	18.1
Health	Mortality	Any child has died in the family	10.2
	Nutrition	Any adult or child is malnourished	18.1
Standard of living	Electricity	The HH has no electricity*	13.6
	Water	The HH does not have access to clean drinking water within a 30-minute walk*	13.6
	House type	The HH has soil or sand floor/house made of light materials	66.0
	Sanitation	The HH has no clean toilet or shared with other HHs*	17.6
	Fuel	The HH does not use clean cooking fuel (The HH cooks with wood or charcoal)	95.6
	Assets	The HH does not own communication and mobility assets*	95.8

*These indicators were worded positively in the survey questionnaire

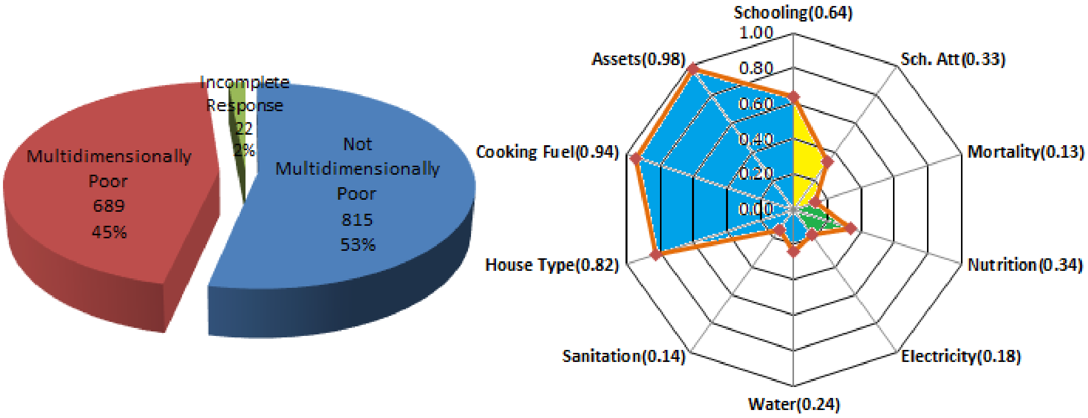

Figure 7. MPI classification of household respondents (n=1 526) and interaction of MPI indicators among multi-dimensionally poor households (n=689).

Farm Ownership and Size

Table 8 shows that only 49% of the households own farms they themselves cultivate with land areas ranging from one-fourth to 20 hectares. Farm ownership enables farmers to combine a set of physical resources and farm tenure to carry out strategies to adapt to climate change (Defiesta & Rapera, 2014). It also provides them extra privileges. Several government projects are contingent on farm ownership rendering a large percentage of farmer households as not eligible beneficiaries. For example, assistance in the form of distribution of crop seedlings by the Department of Agriculture were available to farm owners only.

Table 8. Tenureship and farm areas owned or cultivated by respondents (n=1526 households).

Land tenureship			Farm areas owned/cultivated				
Category	n	%	Mean	s.d.	Min (ha)	Max (ha)	Mode/ Median
Owner	746	49.0	2.5	2.3	¼	20.0	2.0
Lessee	79	5.0	1.7	1.3	¼	7.0	1.0
Lessor	27	2.0	1.5	0.8	¼	3.0	2.0
Tenant	348	23.0	1.9	1.4	¼	10.0	2.0
Worker	326	21.0	--	--	--	--	--

About 5% are amortizing owners or lessees of the land they cultivate with areas up to seven hectares. As non-owners of land, lessees are bound to their contract with landowners and hence, their options are constrained. Some of these households are financially capable but unable to own land, especially inherited land because ownership was not properly transferred. Also, farm owners who are financially constrained are only willing to temporarily lease the area. About 2% of the households had all their farm areas on lease with areas ranging from ¼ to three hectares. According to respondents, farmlands are temporarily leased for various and/or compounded money needs such as school expenses, hospitalization, or to finance a family member's application for work abroad.

About 23% of the households are tenants or maintainers who constitute respondents under tenancy farming—the second largest group in the survey. These farmers do not own the land, but for an agreed period permanently tend the farm of some landowners. A significant population of farmers (21%) consists of farm laborers or harvesters. Because farm labor is not permanently available, laborers do not have fixed work and income. They mostly live according to day-to-day income; their survival depends on getting work for the day. Combined, 44% of the respondents are totally landless and work as tenants or laborers. The income of farmer households leaves them incapable to own and maintain farms.

The average farm size cultivated by respondents is 1.77 hectares, with owners cultivating significantly bigger farmlands than lessees and lessors. According to the Department of Agriculture Provincial Office, some government projects are also tied to farm size because the efficiency of farm equipment and other inputs cannot be maximized when farm areas are small.

Farming Practice: Mono-cropping Versus Crop Diversification

Table 9 shows the crop area allotment of respondents. Temporary crops such as rice and corn dominate their farm produce (45.1%+18.7%=63.8%) with an average area of 1.49 hectares for rice and 1.34 hectares for corn. Most farm areas in Cotabato are planted with temporary crops (PSA, 2020a). Many of the interviewed households see these short-term crops as their only option because they only need to wait about three months before harvest, and the family can already have money and food. Smallholder farmers are living on subsistence and cannot afford to wait several years before realizing an income as required in permanent crops such as rubber and coconut or longer cropping seasons such as in banana and sugar cane.

Crop diversification or mixed cropping distributes risks across different crops, making failure recovery easier as compared to concentrating capital on a single crop. However, Table 10 shows that only 24.9% of the respondents with land tillage (owner, lessee, and tenants) indicated diversifying crops. A large majority 75.1% engaged in mono-cropping.

Table 9. Area allotment for crops by farmer respondents.

Crops*	Frequency	Percent	Average Size (ha)
Rice	688	45.1	1.49
Corn	285	18.7	1.34
Rubber	283	18.6	2.14
Coconut	219	14.4	1.76
Sugarcane	37	2.4	1.54
Banana	101	6.6	2.19
None	326	21.4	

*Multiple response item

Land size is a significant factor in the farmers' decision whether to maintain mono-cropping or diversify. Owners of small farmlands concentrate their limited area on a single crop. In Table 10, 82.4% of respondents with areas of less than 3 hectares do not diversify crops. The practice of crop diversification becomes more frequent as farm area increases that is, 54.5% among farmers with areas between three to five hectares and 93.2% among farmers with more than five hectares. The chi-square test shows a significant relationship between farm size and crop diversification (χ^2= 227.4, p < .001).

Owners of larger farmlands have more capital and area to invest in a variety of crops. They can as well diversify into long-term crops such as rubber as they have the financial means to sustain family needs during the waiting period for major crops to become productive. This reveals that the practice of crop diversification is not just a matter of farmers' willingness and agency to do so. It is heavily constrained by its financial and physical resources. These constraints need to be addressed to make farmers adapt well to climate change.

Table 10. Farming practice of farmer respondents with land tillage (n=1173 households).

Farm Size	Monocropping		Diversified Cropping		
	n	%	n	%	Total
Below 3 Ha	827	82.4	177	17.6	1004
3 To 5 Ha	50	45.5	60	54.5	110
Above 5 Ha	4	6.8	55	93.2	59
Total	881	75.1	292	24.9	1173

Chi Square Value = 227.4*** df = 2 Probability <.001

Government Actions to Address Climate Change

Agriculture is recognized as a key sector in climate change initiatives as embodied in the Climate Change Law (2009) and Intended Nationally Determined Contributions (INDC, 2015) of the Philippines in the Paris Agreement.

The scope of the Climate Change Act of 2009 is comprehensive. Through it, the Office of the President has mandated the creation of the Climate Change Commission (CCC, 2016). The CCC is tasked to oversee policymaking regarding climate change, create programs and action plans, and apply monitoring and evaluation. One key output of the CCC is the creation of the National Climate Change Action Plan (NCCAP). The NCCAP outlines national frameworks, strategies, and policies in climate change mitigation and adaptation. It highlights the significance of Cotabato as a prime food producer in Mindanao and recognizes the susceptibility of the province to the impacts of climate change, particularly the increasing frequency of droughts. The NCCAP serves as the basis for the Local Climate Change Action Plan (LCCAP) developed by the provincial government and cascaded down to the municipalities and barangays.

The LCCAP of the Cotabato Province focuses on three sectors: power, education, and the cluster of agriculture, fishery, and livestock. Within the agricultural sector, there are 13 planned programs; all of which are under the auspices of the Department of Agriculture in the province. These are shown in Table 11.

The Cotabato Province LCCAP intends to build the resilience of its agriculture sector primarily through the diversification of crops, which is apparent in the 13 planned programs it constitutes. Of the 13 programs, six involve crop diversification (from rice and corn), four on agroforestry, two on organic farming, and one on crop production and protection.

Further, four of the six programs on crop diversification are concerned with the distribution of planting inputs such as 1.) high-value crops, which include rubber, coconut, and coffee; 2.) abaca; 3.) fruit trees; and 4.) root crops. The other two are intended to strengthen high-value crop production through the establishment of high-value crop demo farms and the provision of salt fertilizers for coconut.

However, this study has shown that many of the farmers are unable to participate in crop diversification, not for a lack of willingness but because of constraints in their decisions. The LCCAP, for its part, has not considered other aspects, contexts, and vulnerabilities of farmers that inhibit them from coping and adapting to climate change. Because many of the projects including those of the DA are linked with land ownership, many farmers are not able to partake in the government adaptation projects.

More importantly, the LCCAP only focuses on crops and making crops resilient. Plans that take into consideration the social conditions of farmers are absent in the document. Deprivations in the context of farming communities are not recognized. Many farmers are therefore excluded from the local policies and government programs. They are left to fend for themselves during times of disaster and amid climate change. As such, they are further marginalized and exposed to climate risks.

Gaps in Policies and Implementation

Philippine policies and laws attempt a comprehensive task at defining the Philippine actions towards climate change mitigation and adaptation in the agriculture sector. The NCCAP, for example, includes plans of action for food security, water sufficiency, human security, and capacity development that directly impact Filipino farmers. However, a few gaps in the already established policies and laws were highlighted based on document reviews and discussions with Disaster Risk Reduction Management, Planning and Development, and the Department of Agriculture in the province.

Table 11. Cotabato Province Local Climate Change Action Plan (2017-2019) programs for agriculture sector.

1.	High-Value Crops Development Program, which includes distribution of planting inputs such as rubber, oil palm, coconut, cacao, coffee, banana varieties, bamboo, and forest trees
2.	Creation of the Amas Agro-forest Nursery that is intended to produce as well as disperse fruit tree seedlings that are ready to be planted
3.	Procurement of forest tree seedlings from the Cotabato Provincial Forest Eco-tourism Park (CPFEP) in Amas and their dispersal
4.	Maintenance of the CPFEP
5.	Development of High Value Crops Demo Farm for oil palm, cacao, coconut, rubber, and coffee
6.	Coconut Fertilization Project, which includes the provision of salt fertilizer to coconut farmers
7.	Cotabato Abaca Development Project, which involves the provision of abaca planting materials to farmers
8.	Techno Demo sa *Organikong Pagsasaka sa MRF* (Organic farming program)
9.	Provincial Root Crops Production Program, which involves the production and distribution of planting materials for root crops
10.	Vegetable Production and Seed Dispersal Program
11.	Crop Creation Program, which includes providing trainings on crop production and protection from diseases and pests; and provision of crop protection supplies and materials including environmentally-friendly biological control agents
12.	Trainings on agro-forestry and intercropping
13.	Development of organic farms, which also includes training farmers on how to produce healthy and safe crops

The jurisdiction, responsibilities, and scope of the Climate Change Commission remain unclear. Corollary to this, the delineation of responsibilities and the model for synergies are undefined and are also unclear. The thematic approach of the NCCAP and LCCAP also sacrifices responsibility-taking for each government agency. Climate change policies and programs must be implemented across multiple government agencies and sectors, and effective coordination is necessary to ensure that actions are aligned and mutually reinforcing. Interviews with provincial agencies involved in climate change indicated the problem of inter-agency coordination and jurisdiction in program implementations.

The NCCAP does not prescribe specific climate change activities. Specific activities and programs that can tackle the capacity and resilience of farmers are meant to be offered by the LCCAP and addressed through needs-based projects. There is however a disjoint between national policies and how they are conceptualized on the ground. For example, the NCCAP emphasizes social protection mechanisms, but this is lacking in the LCCAP. The 2019 LCCAP of the province only focuses on three key sectors and does not yet cover the extent and comprehensiveness of the NCCAP. Also, the programs and policies focus only on the crops and not necessarily on the social lives of farmers.

There is also an issue with implementation capacity. Effective implementation of climate change policies requires strong institutional capacity, including personnel and adequate systems for monitoring and evaluation. In the context of Cotabato Province, there is still a lack of capacity to address climate change mitigation and adaptation, particularly within the context of farming communities. For example, the province does not have enough physical, financial, and human resources. The province is still less effective when it comes to scientific assessments. The provision of early warning systems is also limited to certain municipalities only. As reflected in the interviews with the officials of the Cotabato Province, there is a need to strengthen capacities in knowledge management and establish a comprehensive database to enhance the province's overall capacity to address climate change. A work in progress is the SOCCSKSARGEN Regional Geographic Information Network (SOXRGIN) Geoportal. Informed decision making is important since many of the proposed policies and programs are yet to materialize.

Lastly, the programs and policies mostly focus on the crops and making crops resilient, not necessarily on the social lives of farmers. Mitigation in the Philippines is concentrated on Land Use, Land Use Change, and Forestry (LULUCF). There is also a high consideration for high-value crops which does not benefit the majority who are smallholders or landless farm workers.

Discussion

Climate change is a pressing threat in the lives of Cotabato farmers because of their contextual vulnerability to climate change. This vulnerability manifests itself in social, economic, and structural ways.

First, the livelihoods of farmers are at stake because of the dependency of their crops on the weather. The observed changes in climate brought with it disruptions in their livelihoods such as loss of reliability of their previously established and held-on seasonal calendars as well as the destruction of crops and crop failures. The previous climate permitted as much as three planting seasons for rice and corn in one cropping year (Gerpacio et al., 2004). These crops, according to the PSA (2020a), occupy the largest production area in the province. Seasonal calendar guided farming activities in the province and farmers are heavily reliant on it. Disruptions in livelihood result in loss of income that exacerbates poverty (Herrera et al., 2018).

Second, there is a high percentage of vulnerable groups in the population of Cotabato. These vulnerable groups consist of the aged and young populations who are dependent on adults for their needs, sustenance, and decision-making. The presence of many vulnerable groups in the population and in the households has implications on overall productivity and can put a strain to resources as they may require additional support.

Third, the vulnerability in the province is tied to education. Education capacitates people and gives them tools to cope and adapt (Muttarak & Lutz, 2014). However, based on the census, a large percentage of people in Cotabato lacks education. This is also true among the farmers surveyed for this research.

Fourth, farmers maintain big households with a high dependency rate. The income of the farmers is not enough to sustain the needs of their households, much less for non-basic expenditures. In fact, according to the farmers themselves, they need twice as much of what they presently earn to be able to live sufficiently. However, the main source of earning family members in most households is contingent on farming activities and the availability of service contract jobs. The lack of financial capital limits families from recovering or bouncing back from climate shocks and other disasters (Cutter, et al., 2003).

Fifth, using the Multiple Poverty Index, deprivations among Cotabato Province farmers are revealed to be multidimensional which result in a multiplicity of burdens that act together to keep a household poor (Alkire & Santos, 2010). The multiple forms of poverty experienced by farmer households expose them to more environmental risks and make them more difficult to cope with the impacts of climate change. Multiple deprivations are difficult to manage, especially with the constraints on the financial resources of farmers. When climate change and disasters coincide with these deprivations, families further sink into poverty and are unable to recover and challenge adaptation and resilience to climate change.

Sixth, farm assets are unequally distributed among farmers in Cotabato Province. A large percentage of households do not own farmlands. People who do not own lands such as lessees, tenants and maintainers, and laborers are particularly vulnerable because they cannot make long-term decisions on farming practices and activities. Laborers are particularly vulnerable because their income is reliant on available jobs. Marginal farm size constrained farmers to take adaptation strategies such as crop diversification.

Seventh, many Cotabato Province farmers practice mono-cropping despite the benefits of crop diversification for climate change adaptation. This is, however, not because of the lack of willingness or information. Rather, constraints in terms of land ownership, land size, and financial capacities are major factors in choosing not to diversify crops. Monocropping is counterproductive in terms of cost-income benefits and its effects on climate change and land degradation (European Commission, 2021).

Lastly, local government policies and programs, largely overlook these contexts and conditions. Government programs tend to focus more on crop resiliency rather than on human lives. Several government programs are also tied with land ownership, thus, excluding the majority who are landless farmers. Furthermore, government actions are focused on crop diversification and seed distribution, which exclude the particular needs of farmers. Hence, farmers remain vulnerable to the impacts of climate change despite the existence of a plan that recognizes their plight.

Conclusion and Recommendation

Cotabato farmers are highly exposed to climate change and other hazards. Climate change is severely felt by farmers through increasing temperatures and erratic weather patterns that had repercussions on their seasonal calendar of farm activities and farm engagements and increased farmers' exposure to health hazards. Farmers' reliance on income from farming engagements with no stable water resources renders them highly vulnerable to the impacts of climate change. The decline in farm and labor engagement was apparent, consequently leading to low income and food scarcity. Their socio-economic conditions such as income and income sources, farm ownership, and farm size limit their capacity to cope with climate change stresses to a large extent. These vulnerabilities are exacerbated by the need for high farm inputs due to climate-induced factors such as a decline in soil quality, the emergence of pests, and the need for seeds that can better survive the weather. The multiple forms of deprivation experienced by farmer households expose them to more environmental risks and make them more difficult to cope especially since a series of calamities come with them having not fully recovered from the previous disasters.

The different aspects of vulnerability investigated—the character of farming itself, population age groups, education, income, multiple deprivations, farm assets, farming practice, and limited government response—work together to characterize the vulnerabilities of farmers. They also exacerbate, compound, and reify each other. For example, the lack of income restricts farm acquisition, resulting in limited access to government programs that are contingent to land ownership. Hence, the vulnerabilities of farmers can be pictured as a web that produces and reproduces itself. Their susceptibilities and deprivations through education, poverty and lack of social support challenge their adaptation and resilience to climate change. A holistic view of these vulnerabilities is highly recommended in drafting programs and optimal solutions for the issues related to climate change in Cotabato Province. There are constraints in government actions that need strong inter-agency coordination, investments in capacity building of government agencies and personnel, and clear provisions of social protection or safety nets for marginalized farmers.

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No potential conflict of interest was declared by the authors.

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