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Knowledge and Vulnerability to Climate Change: The Case of Selected Barangays in Negros Occidental

Carmen C. Menes[1], Mona Freda N. Secondes[2], Ismael A. Haguisan III[1], Theresa Jennifer H. Mendoza[1], Josephine G. Lumagbas[1], and Ashraf R. Khater[2]

[1] La Consolacion College-Bacolod, Bacolod City, Philippines
[2] University of Negros Occidental-Recoletos, Incorporated, Bacolod City, Philippines

ABSTRACT

The climate regulates the temperatures and rainfall essential for sustaining plant, animal, and human life. Without suitable conditions, plants and trees wouldn't grow, animals would lack food, and human survival would be impossible. This paper looked into the Negrense's knowledge, exposure, sensitivity and vulnerability to climate change. Their adaptive capacity was also determined. This descriptive quantitative study used a modified adapted survey questionnaire to collect data from purposively chosen respondents from identified barangays which met the inclusion criteria of the study. Data were analyzed using frequency, percentage, mean, standard deviation, and standard scores of exposure, sensitivity, adaptive capacity and vulnerability indices. The Negrenses trust a lot the educational institutions and government agencies as source of climate change. Furthermore, Negrenses agree that climate change is a global issue and that the society is poorly educated as to effects of climate change. However, they are divided in their idea of its effect in the Philippines. Negrenses consider that climate change is due to various activities of both the developing and developed countries but developing countries contribute more. Among the four study sites, Brgy. Cadiz Viejo, a coastal barangay in Cadiz City is the most vulnerable while the inland Barangay 40 and Resource in Handuman are the least vulnerable. The Negrense's trust on educational institutions and government agencies may be capitalized by both print and broadcast media in educating the people on the causes and effects of climate change.

Keywords
climate change, Negrense, descriptive research, Negros Occidental, knowledge, vulnerability

INTRODUCTION

Climate change refers to long-term shifts in normal weather patterns across the globe, typically observed over decades or longer (Stone & Chacón León, 2010). Our climate determines the temperatures and rainfall necessary for sustaining plant, animal, and human life. Without these, plants wouldn't grow, animals wouldn't have food, and humans couldn't survive (Stone & Chacón León, 2010). This has led to growing global concern over climate change (Caserini, 2017; Henderson, Reinert, Dekhtyar, & Midgal, 2016; Ochieng & Koske, 2013; Narain, Ghosh, Saxena, Parikh, & Soni, 2009), as its impacts are being felt not only

globally (Henderson et al., 2016) but also at regional, national, and local levels (PAGASA, 2011). In Asia, Southeast Asia is considered the most vulnerable region to climate change (Islam, Sultan, & Afroz, 2009; Anbumozhi, Breiling, Pathmarajah, & Reddy, 2001).

The sharp rise in temperatures since the mid-20th century is particularly alarming for poor developing countries like the Philippines, which are highly vulnerable to even small increases in temperature (PAGASA, 2011). Globally, temperature and precipitation trends show consistent patterns of change (Backlund, Janetos, & Schimel, 2008).

Natural factors such as variations in solar irradiance, changes in Earth's orbital parameters, and volcanic activity contribute to climate change (Sivaramanan, 2015). Human activities also play a major role, including the burning of fossil fuels (Dale et al., 2017; EPA, 2016; Sivaramanan, 2015), driven by population growth and consumption patterns (Caserini, 2017).

Climate change manifests in various ways, such as forest fires, biodiversity loss, habitat shifts, pest outbreaks, and reduced ecosystem services (UNDP Bhutan, 2016). Rising temperatures lead to coral bleaching and ocean acidification, which hinder coral skeleton formation (Henderson et al., 2016; Hijioka et al., 2014; Sivaramanan, 2015).

Health impacts are widespread, including waterborne and vector-borne diseases like dengue and malaria due to increased mosquito breeding in flooded areas (Sivaramanan, 2015). Respiratory diseases from air pollution and vulnerabilities in women, children, and infants are notable concerns (Narain et al., 2009). Infrastructure damage, such as broken water pipes and contaminated drinking water, exacerbates health risks (Sivaramanan, 2015). Adapting to climate change is a dynamic process involving psychological, social, and institutional strategies to address chronic and disaster-related impacts (Caserini, 2017). Water management strategies must improve resilience to water scarcity, El Niño effects, droughts, and flooding (ADB & Postdam Institute, 2008). Governments worldwide have agreed to significantly reduce emissions to mitigate climate change impacts (OECD, 2008).

Developing countries, despite their high vulnerability, often lack awareness of climate change impacts (Ochieng & Koske, 2013). Low incomes and weak adaptive capacities further increase vulnerability (UN ESCAP, 2016). Impacts are widespread, affecting ecosystems, food and water security, health, and infrastructure (Holmes, 2015). Rising sea levels, extreme weather events, and depressed crop yields, such as rice in warmer Asian regions, are key challenges (Hijioka et al., 2014). Differences in vulnerability and exposure result from non-climatic factors and inequalities shaped by uneven development processes. These factors influence the risks associated with climate change (IPCC, 2014). South Asia regularly faces disasters like floods, cyclones, landslides, and droughts, which highlight vulnerabilities in human and natural systems (Islam et al., 2009).

Changing rainfall patterns threaten agriculture (Cosbey, 2012). Forest ecosystems are affected by shifts in productivity, species composition, and disturbances (Backlund et al., 2008). Rising temperatures and sea levels make some areas uninhabitable for humans, plants, and animals (Stone & Chacón León, 2010). Governments and communities are increasingly incorporating adaptation into broader development plans (IPCC, 2014). Enhancing adaptive capacity is critical to protect current and future development from climate variability and extreme weather events (Anbumozhi et al., 2001).

In order to reduce climate change vulnerabilities and improve the sustainability of local livelihoods and biodiversity of the country, the Philippine government has issued several laws strengthen climate change mitigation. These laws highlight the role of the academe in climate change and environmental education. Thus, this study is one of the contributions

of the Commission on Higher Education and the two higher education institutions involved in the study, namely, the University of Negros Occidental-Recoletos and La Consolacion College Bacolod.

METHODOLOGY

This descriptive quantitative study used a modified adapted survey questionnaire to collect data from purposively chosen respondents from identified barangays which met the inclusion criteria of the study. The five identified barangays were Brgy. 40 (inland), Resource in Handumanan (inland) and Tangub (coastal) in Bacolod City; Brgy.Lopez Jaena (upland) in Murcia; and Brgy. Cadiz Viejo (coastal) in Cadiz City. A total of 774 respondents were requested to answer the questionnaires. These respondents come from Barangay 40 (181), Barangay Tangub (257), Resource in Barangay Handumanan (43), Barangay Lopez Jaena, Murcia (141), and Barangay Cadiz Viejo (152).

The survey questionnaire used to collect the data is a combination of researcher made and adapted and modified questions from Ochieng (2014) on climate change mitigation, from Buloshi & Ramadan (2015) on climate change mitigation and adaptation and from (United Nations Development Programme Bhutan, 2016) on climate change vulnerability and adaptation. The survey questionnaire was validated by a jury of experts using content validity ratio resulting to a CVI of 0.99. Pilot testing of the questionnaire was done to establish the reliability using Cronbah's alpha and yield a coefficient of 0.93 for climate change manifestation, 0.754 for climate change mitigation and adaptation, 0.877 for exposure index, 0.85 for sensitivity index and 0.77 for adaptive capacity. Data were analyzed using frequency, percentage, mean, standard deviation, and standard scores of exposure, sensitivity, adaptive capacity and vulnerability indices.

RESULTS, DISCUSSION, AND IMPLICATIONS

Trust on Sources of Information. The Negrenses consider the educational institutions (f=397;51%) and

Table 1
Extent of Trust of Respondents in Four Study Sites on the various sources of information about climate change

How much would you trust information about climate change if you heard it from Person/Entity	A lot		A Little		Not Very Much		Not al All		Can't Choose	
	f	%	F	%	F	%	F	%	f	%
1. A family member or friend?	296	38%	400	51%	36	5%	13	2%	29	4%
2. A scientist?	249	32%	374	48%	72	9%	30	4%	49	7%
3. The Government? (DOST, DENR, PAG-ASA)	389	50%	273	35%	49	6%	20	3%	43	6%
4. An Energy Supplier? (EDC, CENECO, MERALCO)	342	44%	309	40%	69	9%	22	3%	32	4%
5. An Environmental Organization? (Greenpeace, Worldwide Fund)	313	40%	317	41%	62	8%	34	4%	48	6%
6. The Media (i.e. both traditional and online)?										
6.1 Traditional	372	48%	308	40%	43	6%	18	2%	33	4%
6.2 Online	239	31%	300	39%	138	18%	57	7%	40	5%
7. Educational Institution?	397	51%	253	33%	62	8%	30	4%	32	4%

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Table 1a
Extent of Trust of the Respondents on the Various sources of Information About Climate Change when they are grouped Per Site (Part 1)

How much would you trust information about climate change if you heard it from Person/ Entity	Study Site	A lot		A Little		Not Very Much		Not al All		Can't Choose	
		f	%	F	%	F	%	F	%	f	%
1. A family member or friend ?	Murcia	118	46%	119	46%	12	5%	4	1.5%	4	1.5%
	Brgy 40	62	34%	91	50%	8	4%	5	3%	15	9%
	Tangub	51	36%	80	56%	5	4%	4	3%	1	15
	Cadiz Viejo	57	37%	83	55%	9	6%	0	-	3	2%
2. A scientist?	Murcia	91	35%	116	45%	20	8%	11	4%	19	7%
	Brgy 40	44	24%	92	51%	26	14%	7	4%	12	7%
	Tangub	40	28%	81	57%	9	6%	5	4%	6	4%
	Cadiz Viejo	69	45%	60	39%	15	10%	4	3%	4	3%

government agencies (f=389;50%) as trustworthy ("trusted a lot") sources of information about climate change (see Table 1). Remarkably, the scientists ad the lowest frequency as a source that is trusted a lot by the Negrenses.

When grouped according to study sites, results from Barangay Cadiz Viejo are consistent with the over-all result with the highest percentage of respondents who trusted a lot the educational institutions (45%) and government agencies (64%) (see Tables 1a and 1b).

Educating people about climate change is essential, as raising awareness through education encourages individuals at all levels of the community to actively participate in mitigation and adaptation efforts (Ochieng & Koske, 2013). Climate Change and Environmental Education (CCEE) and Education for Sustainable Development (ESD) are powerful tools for protecting the environment and promoting sustainable development (UNICEF, 2012).

To effectively implement climate change education in schools, it is important to assess the extent of its integration into the curriculum and address any gaps (Boakye, 2015). School children share their perspectives on climate change and disaster risk reduction through informal channels like conversations with friends, parents, teachers, and other adults, as well as formal channels such as school committees and community organizations (UNICEF, 2012).

Both the print and broadcast media, as another source of information which has the facility to reach more people, may capitalize the Negrenses trust on educational institutions and government agencies in educating the people as to the causes and effects of climate change.

Manifestations of Climate Change. Among the twenty identified climate change manifestations (see Tables 2 and 2a), the respondents agree that their environment has become hotter than it was in the past having the lowest mean ($\bar{x}$=2.16) and most cohesive responses (lowest sd = 1.17). They also agree that poor solid waste management contributes to climate change having the second lowest mean ($\bar{x}$=2.26; sd=1.25) and that the world's global temperature has increased over the past few years ($\bar{x}$=2.26; sd=1.21).

Climate change is evident through phenomena such as rising temperatures, droughts, and extreme

Table 1b
Extent of Trust of the Respondents on the Various sources of Information About Climate Change when they are grouped Per Site (Part 2)

How much would you trust information about climate change if you heard it from Person/ Entity	Study Site	A lot		A Little		Not Very Much		Not al All		Can't Choose	
		f	%	F	%	F	%	F	%	f	%
1. The Media (i.e. both traditional and online)?	Murcia	122	47%	93	36%	17	7%	6	2%	19	7%
	Brgy 40	82	46%	85	47%	8	4%	2	1%	4	2%
	Tangub	64	45%	61	44%	9	6%	4	3%	3	2%
a. Traditional	Cadiz Viejo	82	54%	58	38%	7	5%	2	1%	3	2%
	Murcia	104	40%	85	33%	40	16%	14	5%	14	5%
	Brgy 40	61	33%	69	38%	40	22%	4	2%	9	5%
b. Online	Tangub	34	24%	63	44%	22	16%	14	10%	8	6%
	Cadiz Viejo	34	22%	67	44%	30	20%	15	10%	6	4%
	Murcia	143	56%	50	19%	27	11%	21	8%	16	56%
2. Educational Institution?	Brgy 40	78	43%	79	43%	12	7%	3	2%	9	5%
	Tangub	70	50%	53	38%	12	9%	4	2%	2	1%
	Cadiz Viejo	84	55%	54	36%	9	6%	2	1%	3	2%
	Murcia	126	49%	82	32%	21	8%	8	35	20	8%
3. The Government? (DOST, DENR, PAG-ASA)	Brgy 40	75	41%	81	45%	7	4%	5	3%	13	7%
	Tangub	73	52%	53	38%	9	6%	3	2%	3	2%
	Cadiz Viejo	97	64%	40	26%	10	7%	2	1%	3	2%
	Murcia	108	42%	109	42%	21	8%	5	2%	14	5%
4. An Energy Supplier? (EDC, CENECO, MERALCO)	Brgy 40	65	36%	82	45%	19	10%	10	6%	5	3%
	Tangub	66	47%	60	42%	10	7%	4	3%	2	1%
	Cadiz Viejo	81	53%	45	29%	17	11%	3	2%	6	4%
	Murcia	124	48%	86	33%	17	7%	9	4%	21	8%
5. An Environmental Organization? (Greenpeace, Worldwide Fund)	Brgy 40	59	32%	87	48%	15	9%	10	5.5%	10	5.5%
	Tangub	49	35%	68	48%	11	8%	9	6%	4	3%
	Cadiz Viejo	71	47%	52	34%	17	11%	3	2%	9	6%

Table 2
Perception or Opinion of the Respondents on the Manifestations of Climate Change per Study site and When Taken as a Whole (Part 1)

	Manifestations of Climate Change (adapted with changes from (Ochieng, 2014))	Murcia (n=257)			Tangub (n=141)			Barangay 40 (n=181)			Cadiz (n=152)			Handumanan (n=43)		As a whole (774)
	Statement	$\bar{x}$	SD	VI	$\bar{x}$	SD	VI	$\bar{x}$	SD	VI	$\bar{x}$	SD	VI	$\bar{x}$	VI	$\bar{x}$
1.	Air pollution from industries contributes to climate change.	2.46	1.81	Agree	2.32	1.37	Agree	2.42	1.19	Agree	2.13	1.25	Agree	2.28	Agree	2.35
2.	The presence of open dump sites does not contribute to climate change.	2.77	1.24	Neutral	2.87	1.17	Neutral	2.77	1.23	Neutral	2.82	1.30	Neutral	2.90	Neutral	2.80
3.	The burning of fossil fuels does not contribute to climate change.	2.63	1.31	Neutral	2.84	1.18	Neutral	2.58	1.22	Agree	2.93	1.19	Neutral	2.44	Agree	2.71
4.	The world's global temperature has increased over the past few years.	2.34	1.24	Agree	2.38	1.21	Agree	2.20	1.15	Agree	2.16	1.23	Agree	2.02	Agree	2.26
5.	Increased frequencies of droughts and floods are due to climate change.	2.26	1.25	Agree	2.59	3.66	Agree	2.32	1.14	Agree	2.12	1.26	Agree	2.00	Agree	2.29
6.	Poor solid waste management contributes to climate change.	2.28	1.37	Agree	2.21	1.11	Agree	2.42	1.19	Agree	2.16	1.25	Agree	2.05	Agree	2.26
7.	Bacolod has become hotter than it was in the past.	2.20	1.20	Agree	2.14	1.11	Agree	2.27	1.08	Agree	2.12	1.22	Agree	1.77	Strongly Agree	2.16
8.	Food shortages are not a result of climate change.	2.64	1.79	Neutral	2.72	2.07	Neutral	2.42	1.08	Agree	2.48	1.25	Agree	2.26	Agree	2.55
9.	El Niño is not caused by climate change.	2.44	1.33	Agree	2.70	1.24	Neutral	2.56	1.35	Agree	2.66	1.29	Neutral	2.45	Agree	2.56
10.	Deforestation causes climate change.	2.39	1.26	Agree	2.27	1.30	Agree	2.27	1.23	Agree	2.27	1.33	Agree	1.81	Agree	2.28
11.	Current climate change is due to factors other than human activities.	2.61	1.28	Neutral	2.73	1.35	Neutral	2.63	1.25	Neutral	2.55	1.28	Agree	2.12	Agree	2.60
12.	The Philippines is not affected by climate change.	2.56	1.32	Agree	2.61	1.41	Neutral	2.58	1.26	Agree	2.95	1.50	Neutral	2.40	Agree	2.64

Table 2a
Perception or Opinion of the Respondents on the Manifestations of Climate Change per Study Site and Taken as a Whole (Part 2)

Manifestations of Climate Change (adapted with changes from (Ochieng, 2014))		Murcia (n=257)			Tangub (n=141)			Barangay 40 (n=181)			Cadiz (n=152)			Handumanan (n=43)			As a whole		
	Statement	$\bar{x}$	SD	VI	x $\bar{x}$	SD	VI	$\bar{x}$	SD	VI	$\bar{x}$	SD	VI		SD	VI		SD	VI
13.	Climate change is a global issue.	2.29	1.31	Agree	2.31	1.57	Agree	2.38	1.24	Agree	2.39	1.36	Agree	2.02	1.37	Agree	2.32	1.36	Agree
14.	Society is poorly educated about the effects of climate change.	2.51	1.79	Agree	2.43	1.28	Agree	2.39	1.14	Agree	2.66	1.16	Neutral	2.17	1.17	Agree	2.48	1.42	Agree
15.	Rise in sea levels has not been caused by climate change.	2.65	1.24		2.71	1.19	Neutral	2.60	1.14	Neutral	3.09	2.73	Neutral	2.05	1.25	Agree	2.70	1.63	Neutral
16.	The pollution of the soil is not an effect of climate change.	2.57	1.28	Agree	2.59	1.25	Agree	2.71	1.13	Neutral	2.79	1.20	Neutral	2.40	1.29	Agree	2.64	1.23	Neutral
17.	Climate change poses a serious threat to the Philippines.	2.33	1.26	Agree	2.23	1.23	Agree	2.32	1.23	Agree	2.20	1.21	Agree	2.40	1.38	Agree	2.29	1.24	Agree
18.	Air pollution from everyday cars does not cause climate change.	2.58	1.29	Agree	2.69	1.28	Neutral	2.73	1.20	Neutral	2.77	1.25	Neutral	3.33	6.32		2.71	1.92	Neutral
19.	The shrinking of lakes and rivers is due to climate change.	2.37	1.22	Agree	2.20	1.24	Agree	2.32	1.19	Agree	2.17	1.25	Agree	2.24	1.28	Agree	2.28	1.23	Agree
20.	We should not be worried about climate change.	2.70	1.12		2.69	1.33	Neutral	2.66	1.29	Neutral	3.07	1.16	Neutral	2.56	1.20	Agree	2.75	1.22	Neutral

Table 3
Perception/Opinion of the Respondents on the Causes of Climate Change

Causes of Climate Change	Frequency	Percentage
1. From a global perspective, which countries are responsible for causing climate change?		
Developed Countries (Ex. USA, Canada, Singapore)	79	10%
Developing Countries (Ex. Philippines, Colombia, Kenya)	213	28%
Both	482	62%
2. From a local perspective, which sector is most responsible for causing climate change? (n=774; but multiple responses allowed)		
Residential	185	21%
Agricultural	139	16%
Industrial	234	27%
Transportation	243	28%
Commercial	44	5%
Recreational	24	3%

weather events like cyclones and floods (UNICEF, 2012). In Asia, more frequent and intense heatwaves are expected to increase mortality and illness among vulnerable populations (Hijioka et al., 2014).

Urban waste generation correlates with population size, average income, and factors like climate, education levels, and public attitudes, which influence the composition of waste (S.M.S. Rahman, Shams, & Mahmud, 2010). The waste sector has the potential to transition from a minor source of global emissions to a significant contributor to emission reduction (United Nations Environment Programme, 2014).

Raising awareness about proper waste disposal and its impact on climate change is crucial. Encouraging compliance with R.A. 9003 (Solid Waste Management Act) by segregating recyclable and organic materials using separate collection containers can play a key role in reducing emissions and mitigating climate change.

Causes of Climate Change. From the global perspective, climate change is due to the various activities in both developing and developed countries (f=482; 62%). Although, there are also some respondents who consider that only the developing countries contribute to climate change (f=213; 28%) and those who opined that only the developed countries contribute to climate change (f=79;10%) (See Table 3).

In recent decades, following the industrial revolution, greenhouse gas (GHG) levels in the atmosphere have significantly increased due to human emissions and the removal of natural sinks like forests and oceans through deforestation and pollution (Dale et al., 2017; EPA, 2016; Sivaramanan, 2015; OECD, 2008). As developing countries industrialize, they burn more fossil fuels, produce more electricity, and establish industries, many of which contribute to pollution. Currently, developed countries remain the largest sources of pollution and GHG emissions (Trenberth et al., 2000). Additionally, human activities such as

energy production, agriculture, waste management, and industrial processes are major contributors to GHG emissions, driving climate change (Sivaramanan, 2015).

From the local perspective, the top three contributors to climate change are transportation (f=243;28%), industrial sector (f=234; 272%), and residential sector (f=185; 21%) (See Table 3).

Demographic trends, such as urbanization in coastal areas and the encroachment of populations into ecologically fragile areas like hillsides or degraded land, can amplify climate risks (Population Action International, 2011). Human activities further influence climate by increasing concentrations of CO_2 and other greenhouse gases, altering aerosol levels, and changing land cover, which affects Earth's surface reflectivity (Holmes, 2015). Additionally, improper or irresponsible waste disposal by the residential sector can lead to environmental pollution and pose significant public health risks (Rahman, 2000).

Mitigation and Adaptation to Climate Change. Among the ten identified climate change mitigation and adaptation strategies, the respondents strongly agree that people should practice the three Rs namely, reduce, reuse and recycle ($\bar{x}$=1.56;sd=0.92). The practice of this strategy is consistent across all five study sites, namely Murcia ($\bar{x}$ =1.64;sd=0.98), Tangub ($\bar{x}$=1.43;sd=0.82), Barangay 40 ($\bar{x}$ =1.60;sd=0.81), Cadiz Viejo ($\bar{x}$=1.56;sd=1.06), and Resource in Handumanan ($\bar{x}$ =1.27;sd=0.55).

The Philippines, like other nations, stands to gain substantial economic, public health, and environmental benefits by taking swift action to significantly reduce global warming emissions (Union of Concerned Scientists, 2009). In controlled landfills, the practice of burying waste and covering it with low-permeability materials creates conditions that encourage the production of methane by bacteria (United Nations Environment Programme, 2014).

Vulnerability Indices. Among the five study sites, Barangay Cadiz Viejo in Cadiz City is the most vulnerable having the highest exposure index (10.8) and vulnerability index (90.4; standardized index = 0.98). The least vulnerable area is Barangay 40 with the lowest exposure index (9.0), sensitivity (7.8), vulnerability (68.7) but not having the lowest adaptive capacity (8.9) which is second to Barangay Tangub (8.7).

Climate change is already affecting agriculture and food security, complicating efforts to eradicate hunger and malnutrition (FAO, 2016). Extreme climate events have caused unprecedented destruction to lives, homes, and the environment. For example, strong winds, heavy rains, and storm surges have devastated communities, drowning many residents in affected areas (Zalameda, 2015).

Coastal areas and small islands are particularly at risk from both direct and indirect impacts of climate change, such as storms, extreme weather events, coastal erosion, infrastructure damage, sea level rise, flooding, water shortages, and water contamination. This vulnerability is heightened by the concentration of infrastructure near shorelines (WTO & UNEP, 2008).

The rapid pace of global temperature rise underscores the urgency of reducing the vulnerability of developing countries to climate change, enhancing their adaptive capacity, and implementing national adaptation plans (Dale et al., 2017). By fostering cooperation, sharing knowledge, and adopting innovative and sustainable practices, such as green growth and political commitment, the risks of climate change can be mitigated. In essence, taking action on climate change now is the only viable path toward a sustainable future in Asia (Norman, 2016).

CONCLUSION AND RECOMMENDATIONS

The Negrense's trust on educational institutions and government agencies may be used by the media, both broadcast and print, in educating the

Negrense's on what climate is, its manifestations, and the appropriate mitigation and adaptation strategies. With this, the local government of the municipality and the province may consider designing various strategies to address sensitivity and vulnerability of the communities. These efforts will be vital in the proactive direction taken in understanding the need to enhance a deeper appreciation of the effects of climate change on society.

The inherent construct of the climate change perspective involves assessing the level of knowledge and the inherent awareness that may stem from the insights at hand. The vulnerability of the population would be carefully assessed, wherein further planning may be cultivated in the environment of progressive outcomes. The sustainability aspect is important in the due consideration of change that must be propagated through proactive measures. These measures may be engaged only when proactive steps are taken to review and amend policies that will support the environment.

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