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RESEARCH ARTICLE

SUSTAINABLE MITIGATION SYSTEMS USING GIS MAP IN CLIMATE CHANGE VULNERABLE SCHOOLS IN PANGASINAN, PHILIPPINES

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ABSTRACT

Climate change is an area of science that has been studied for many years. We now live in a unique time in that our scientific abilities have not only given usa precise age of the planet, but of the universe itself. The study aimed to identify and design a school-based climate change mitigation system, determine the attributes of the personnel in terms of knowledge and attitudes towards climate change, participation, and climate change mitigation practices of the vulnerable schools. Furthermore, it also aimed to determine the attributes of the schools vulnerable to flooding based on the climate change adaptable buildings and availability of rescue and retrieval facilities and equipment. The descriptive method of research was employed in this study. Descriptive research included studies that purport to present facts concerning nature and status of anything. The Geographical Information System were used to determine the location of schools vulnerable to flooding and a questionnaire-checklist were used to gather data. The respondents of the study were the School heads, DRRM School Officer, Physical Plant & Facilities School Officer/Supply Officer or 3 respondents per school of the climate change vulnerable to flooding schools of Pangasinan. The study found out that the knowledge and attitude of the personnel of the different schools vulnerable to flooding were cognizant and agree on the effect of climate change. Also, The different schools often practice climate change coping mechanisms. Moreover, the infrastructures of the different schools vulnerable to climate change are generally adaptable to climate change.

INTRODUCTION

The Philippine archipelago is composed of 7100 islands, clustered in 3 major island groups — namely, Luzon, Visayas, and Mindanao — with a total land area of 300000 km^2. The country's climate is influenced by large-scale atmospheric phenomena that bring in substantial amounts of rains almost all year round. Global warming is expected to occur due to increased carbon dioxide concentration in the atmosphere. Global surface temperature will increase by at least 2.0°C by the next century (IPCC 1996). Significant changes in the earth's climatic system, particularly an alteration of rainfall and temperature in both time and space is expected. During the past few decades, extreme climatic events have adversely affected the Philippine economy. Climate is commonly defined as the average weather for a long period of time for the given region. Climate encompasses different components like, temperature, precipitation, wind etc. Climate change is a statistically significant change in measurement of either the mean state or variability of the climate for a place or region over an extended period of time due to natural variability or as a result of human interventions (Prevention Consortium, 2007). This is resulting in the increase in the emission of the greenhouse gases reflecting variation in the climate statistics like temperature, precipitation and wind.

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The study of climate change is now a productive science that is in full expansion. Researchers in this field study local and international realities, create scenarios, forecast impacts, invent concepts to designate their discoveries: vulnerability (the degree to which a community has been weakened due to the harmful effects of climate change) (Smith and Wandel, 2006), risk management, carbon sequestration, and so on, and think about solutions. Many researchers have recognized the importance of communicating their results to citizens to help them become aware of the urgency to act, and to enable them to carry out mitigation and adaptation actions. However, this is one of the trickiest or most sensitive educational projects that the fields of education and communication have ever faced. The population that must be educated includes people of all ages, with varying levels of scientific literacy and interacting in multiple social, economic and political spheres. The educational objectives are as equally ambitious: helping citizens understand complex environmental and meteorological concepts, changing their daily lifestyles and adapting to a phenomenon that harbors several yet unpredictable impacts. The importance of education in promoting and enabling Disaster Risk Reduction (DRR) has already been identified by researchers and policy makers. In doing so, there is a renewed focus on disaster risk education in primary and secondary schools. Mainstreaming DRR into school curricula aims to raise awareness and provide a better understanding of disaster management for children, teachers and communities. Accompanying structural changes to

improve safety in building schools will not only protect children and their access to education, but will also minimize long term costs. How can people reach these difficult educational objectives that are so essential in a day to day reality in which there are already several very tangible climate change impacts, like torrential rains, intense coastal erosion, decreasing levels of the water tables in developing countries, and so on. The author summarized the research that has dealt with people's ideas concerning climate change. Next, the authortackles the cognitive, social, psychological and behavioral challenges that may restrict awareness, education and communication efforts regarding climate change. Finally, the authordraw from environmental communication and education in order to suggest promising avenues to improve citizens' training and involve them in mitigation and adaptation actions. The other side of the geographical location of Pangasinan gives way to problems on disasters. The province is frequently visited by typical typhoons and other natural calamities. The development gains and advances in living are being affected by alarming adverse effects of natural and man-made disasters. The Center for Research and Epidemiology of Disasters (CRED), Belgium, stated, "The Philippines which includes Region I and the Province of Pangasinan, is one of the most disaster-prone country in the world for the past century." Thus, this situation holds bigger responsibility to the provincial government.

In a bid to establish an effective disaster operational preparedness in Pangasinan, Governor Amado T. Espino, Jr. came up with the strategic plan to put up various evacuation centers in the different parts of the province. This developed as a coordinating conference between the provincial Disaster Risk Reduction Management Council (PDRRMC) led by the Governor and the Philippine National Police.Gov. Espino said that there are three necessary things to prioritized to level up the Province's disaster operational preparedness which include:proper coordination of organizational members, proper positioning of assets and logistics of the police force, and identification of evacuation center not necessarily located in the affected low-lying municipalities. "We really have to make the necessary preparations and get ready for any eventualities of unexpected calamities," the Governor said as he added the things that occur today are something that is not normally happening before. As for mitigating and adaptation actions toward climate change, some individuals thought that this problem must be resolved as quickly as possible (Owen, 2005; Patchen, 2006). They claimed that actions should already have been carried out. Some think that the government and industries are first and foremost responsible in the struggle against climate change. The perception of the human capacity to solve the climate change problem varies from person to person. Some people believed that climate change is a natural phenomenon and that humans cannot control it. (Patchen, 2006; Pruneau, *et al*. 2001). Others were convinced that their actions could make a challenges and possibilities in climate change education .difference yet, perceiving a resistance against action by their fellow citizens, they fear ending up alone in their endeavor (Patchen, 2006). The optimal objectives of education and communication about climate change are to involve people in mitigating and adaptation actions. Major challenges arise from these objectives, because they involve changing individual and collective behaviors regarding pollution and overconsumption, which often satisfy people's instinctive needs to have fun, gain power, receive exciting stimuli and be loved (Seider, 1998). Thus, buying too many household or beauty products corresponds to the need for having fun, for showing that one is in a position of power or for being loved. The behaviors associated to instinctual needs are difficult and take a long time to change. Moreover, these needs distract people from environmental dangers that they should be confronting. They are expressed through vanity, jealousy and excessive ambition, which are emotions that decrease the necessary will to collaborate in order to work towards solving environmental problems. Exemplary stories showing people in their home who have begun to adopt behaviors concerned with the climate can be exhibited in order to gradually create social values that encourage these behaviors. Behaviors that are easy to develop (stop idling, turn off electric appliances, use fluorescent lights, lower the thermostat, and so on) should initially be privileged in these stories. Benefits other then environmental stemming from the desired behaviors could be communicated. Thus, it is worth testing the improvement of residential neighborhoods by implanting green zones or reinforcing national pride after the early implantation of adaptations (Futerra Sustainability Communication, 2007). Similarly, the story of adaptation actions successfully carried out in various regions of the world could be told in order to encourage hope among citizens all the while informing them. Pedro (2010) studied the adaptation and coping strategies of households which were affected by flooding and/or storm surge/sea level rise in selected municipalities in Southern Leyte in 2007. A household survey was conducted in selected sites among households using random sampling. Presenting descriptive statistics, the study found that majority of households (77.3%) has implemented adaptation measures to minimize the impact of climate related disasters. Of these measures, the more common ones practiced by more than 35 percent of the households were to transfer to an evacuation temporarily and to restructure the housing unit.

The other measures used were to relocate residence to a safe place permanently, build stone breakwaters, improve dike system or canal water near residences, change land use to fit new condition, change livelihood and sources of income, and prepare household needs and safety precautions.On the calamities encountered by the vulnerable schools in Pangasinan, in the study of Samson (2013) on Flood Mitigation and Control Program Implementation in the Municipality of Bayambang, Pangasinan, the researcher stressed the extent of implementation of the flood mitigation and control program in Municipality of BayambangPangasinan along mitigation and preparedness, response, and rehabilitation. The results from the study served as basis for designing a manageable and viable municipal risk reduction and management program toward flood free municipality of BayambangPangasinan.Katsuma (2010) studied how capacity building reduced flood risks and the accompanying negative consequence of flooding under climate change. It utilized a conceptual model to identify capacity-related flood management problems and their interrelationships and to clarify needs for capacity building at institutional, organizational, and individual levels throughout the flood management processes. Then, the research established and tested capacity building methodologies, which consist of principles and procedures to implement the principles. The objective of the research was to formulate and test capacity building methodologies to enhance flood management in developing countries under climate change. Pedro (2010)

studied the adaptation and coping strategies of households which were affected by flooding and/or storm surge/sea level rise in selected municipalities in Southern Leyte in 2007. A household survey was conducted in selected sites among households using random sampling. Presenting descriptive statistics, the study found that majority of households (77.3%) has implemented adaptation measures to minimize the impact of climate-related disasters.

Theoretical Framework

Fig. 1. Disaster Risk Management Model

Conceptual Framework

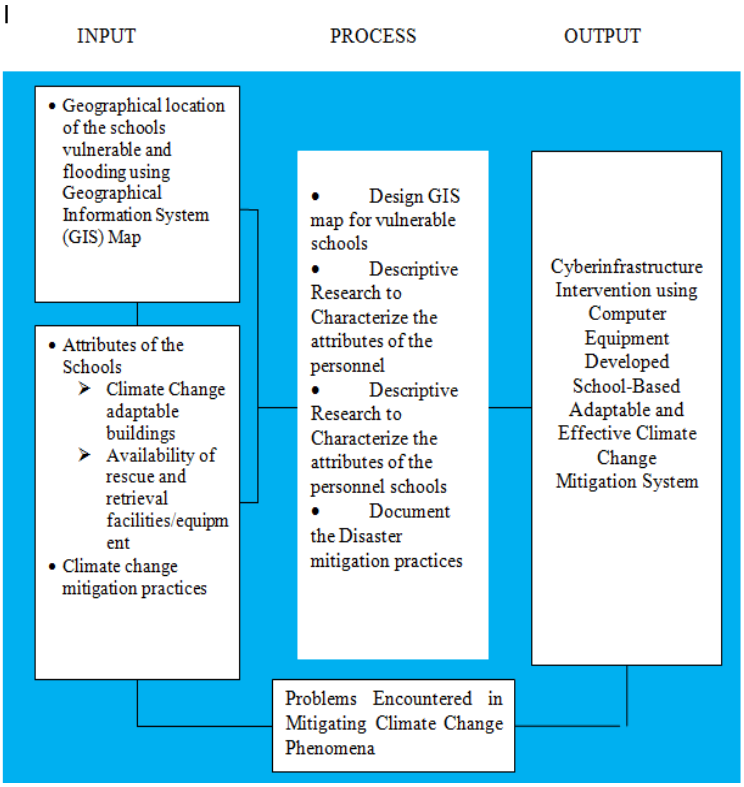

Fig. 2. Conceptual paradigm showing the schematic diagram of the relationship and interaction of the different variables of the study

Of these measures, the more common ones practiced by more than 35 percent of the households were to transfer to an evacuation temporarily and to restructure the housing unit. The other measures used were to relocate residence to a safe place permanently, build stone breakwaters, improve dike system or canal water near residences, change land use to fit new condition, change livelihood and sources of income, and prepare household needs and safety precautions. The GIS maps that were generated from this study will greatly help the school administrators, teachers and students and other stakeholders to easily identify the location of the schools that are climate change vulnerable and knew the school's attributes to climate change vulnerability and exploit these to develop a sustainable mitigation system.

Disaster risk management as an effect of climate change synthesized in terms of the following functions: 1) Risk identification which included hazard analysis and monitoring, vulnerability analysis and determination of risk; 2) Prevention and mitigation which encompassed land use planning, land management and non-structural measures; 3) Preparedness

which included early warning, evacuation and emergency planning; and in cases of an event happens, 4) Recovery, which focused on rehabilitation, reconstruction and rescue services. Figure 2 showed the IPO model employed in the study to facilitate the development of an adaptable and effective school-based climate change mitigation system in the province of Pangasinan. The input included the geographical location of the schools; attributes of the schools in terms of: Climate Change adaptable buildings; climate change mitigation practices of the faculty and staff; availability of rescue and retrieval facilities/equipment; climate change mitigation practices; and climate change mitigation system. The use of GIS, hazard maps of the different schools included in the study, attributes of the schools and documentation of the climate change practices were used as processes. Consequently, the output was the developed adaptable and effective climate change mitigation system. The study generally aimed to identify and design a school-based climate change mitigation system to combat climate change impact in Pangasinan. Specifically, it aims to determine the following: 1. Determine the attributes of the personnel in terms of knowledge on climate change, attitudes towards climate change; and participation on mitigation on climate change. 2. Determine the attributes of the schools vulnerable to flooding based on the climate change adaptable buildings and availability of rescue and retrieval facilities and equipment and 3. Determine the climate change mitigation practices of the vulnerable schools in the area.

MATERIALS AND METHODS

Research Design

The descriptive method of research was employed in this study. Descriptive research included studies that purport to present facts concerning nature and status of anything. It gave meaning to the quality and standing of facts. It is described that descriptive research concerned with the analysis of the relationship between non-manipulative variables and the development of generalization extending its conclusion beyond the samples observed. The researcher employed descriptive method of research. It described all relevant data and information on the personnel and schools attributes to climate change, their mitigations systems and problems encountered in implementation. A description of the Geographical Information System (GIS) on location of schools vulnerable to flooding and a questionnaire-checklist were used to gather data to answer major and specific problems of the study. Interviews were also conducted by the researcher to augment information which was gathered.

Target Respondents

The target respondents of the study were the School heads, DRRM School Officer, Physical Plant & Facilities School Officer/Supply Officer or 3 respondents per school of the climate change vulnerable to flooding schools of Pangasinan. There were six (6) DepEd Divisions in the province of Pangasinan, namely: Alaminos City; Dagupan City; San Carlos City; Urdaneta City; Pangasinan I and Pangasinan II.

Sampling Procedure

The Probability Proportional to Size (PPS) is a sampling technique for use with surveys or mini-surveys in which the probability of selecting a sampling unit (e.g., village, zone, district, health center) is proportional to the size of its population. It gives a probability (i.e., random, representative) sample was employed in this study to determine the number of sites (schools) and number of respondents. It is most useful when the sampling units vary considerably in size because it assures that those in larger sites have the same probability of getting into the sample as those in smaller sites, and vice versa. This method also facilitates planning for field work because a pre-determined number of respondents are interviewed in each unit selected, and staff can be allocated accordingly. The Highly Susceptible Areas (HAS) municipalities where the schools are located and the number of target respondents were subjected to PPS Sampling Technique to arrive at the actual number of schools within the municipalities and the number of respondents used in the study.

The Research Instrument

Quantum Geographic Information System (QGIS) software: This was utilized to determine the schools vulnerable to flooding. The software also provided the cluster nodes which suggest the location of the school vulnerability to climate change.

Satellite maps: These were downloaded from Google earth and were used in the participatory mapping.

Questionnaire/Survey Checklist: This was used for the generation of data on the attributes of the personnel and schools vulnerable to climate change specifically flooding.

Statistical Treatment and Analysis of Data

The data that were obtained from the responses of the respondents were collected, tabulated, categorized, analysed and interpreted to provide significant answer to the specific problem of the study. The data gathered for this study were subjected to statistical treatment using the following measures: To answer specific problem 1, a description of the Geographical Information System (GIS) geographical location of the school were used. To answer specific problem 2 and 3, frequency counts and average weighted mean(AWM) were used by the researcher in order determine the attributes of the personnel and schools vulnerable to climate change in a tabular form. Identification by themes or enumeration were used to answer problem 5 on climate change mitigation system that can be adopted by other schools. The average weighted means (AWM) were used to answer problem number 5.

Presentation, analysis of data and interpretation of findings

Knowledge on Climate Change

It can be noted from Table 1 that the school personnel were cognizant about climate change. This was shown by the overall mean value of 1.94. This implies that the school personnel are aware of climate change. The school personnel were found most knowledgeable on agromet data, hydrolic cycle, and rain formation. A mean value of 2.08 was computed, descriptively rated as cognizant. It is important to note that the personnel were cognizant with climate change adaptation practices as well as adaptation strategies. Average

weighted mean values of 2.02 and 1.84 were computed respectively. Likewise, the personnel were found cognizant on the effect of climate change on agriculture and in animal production. Results of the study show that the school personnel have knowledge about climate change, its effects, mitigation and adaptation, the technologies, and the data or information that are of importance on climate change. However, the level of knowledge of the school personnel is not adequate, thus, there is a need for them to become more informed and aware about climate change. Seminars on climate change adaptation and mitigation should be provided by government and non-government agencies to make people more knowledgeable about the causes, effects, and ways or strategies to mitigate or combat the effect of climate change.

personnel are not only knowledgeable on the effects of climate change in the environment, the community and that climate change is now being experienced by them not only in their community but worldwide. The school personnel themselves have observed the effects of climate change in their environment. The school personnel also agree on the technologies and coping mechanism provided by the government agencies on climate change. The school personnel agreed the most that the Philippine Crop Insurance Corporation will help us cope with adverse effects of extreme climate/weather events. Average weighted mean value of 3.81 was computed, descriptively rated as agree. The school personnel also agree that the National Irrigation Administration's new design will be beneficial to them and the

Table 1. Level of Knowledge of the School Personnel on Climate Change

Area	AWM	Descriptive Rate
a. Agromet Data, Hydrologic Cycle, Rain Formation	2.08	Cognizant
b. Climate change adaptation practices	2.02	Cognizant
c. Weather–related effects on agriculture	2.01	Cognizant
d. Weather and climate information products	2.00	Cognizant
e Adaptation and Mitigation Initiatives in Agriculture	1.98	Cognizant
f. Climate variability	1.97	Cognizant
g. Forecast interpretation, translation, and communication	1.96	Cognizant
h. Standard Rain Gauge	1.95	Cognizant
i. Climate Change Impact on Animal Production	1.94	Cognizant
j. Integrated farming system	1.94	Cognizant
k. Managing Risks in Fisheries Due to Climate Change	1.94	Cognizant
l. Application in Disaster Risk Reduction Management	1.92	Cognizant
m. Managing Risks in Livestock Due to Climate Change	1.89	Cognizant
n. Climate change mitigation and adaptation strategies	1.84	Cognizant
o. Climate Change Technologies in Water	1.81	Cognizant
p. Weather index based crop insurance and other insurance lines	1.78	Oblivious
OAWM	**1.94**	Cognizant

Table 2. Attitude of the School Personnel on Climate Change

Indicator	AWM	Descriptive Rate
d. Typhoons are now much stronger than they were 10 years ago.	3.94	Agree
l. The Philippine Crop Insurance Corporation will help us cope with adverse effects of extreme climate/weather events.	3.81	Agree
c. Water levels are now higher during high tide than they were ten years ago.	3.79	Agree
h. We are now experiencing climate change in this community.	3.76	Agree
f. Weather events in our barangay are more variable now than they were 10 years ago.	3.74	Agree
k. The small automated weather station will give us adequate information about rainfall, temperature, and other weather-related information.	3.73	Agree
e. Floods are now more rampant than they were 10 years ago.	3.69	Agree
g. Weather is more difficult to predict now than it was 10 years ago.	3.68	Agree
p. It is the sole responsibility of the government to ensure that the country must adapt to climate change.	3.68	Agree
m. The National Irrigation Administration's new design will be beneficial to us.	3.65	Agree
n. Climate change is here to stay.	3.65	Agree
i. The Enhanced Climate Field School gives us the appropriate technologies to adapt to climate change.	3.64	Agree
j. The decision support system (DSS) of IRRI will help us adapt to climate change.	3.63	Agree
b. It gets much hotter these years compared to ten years ago.	3.58	Agree
a. The climate now is much different from what it was years ten years ago.	3.45	Agree
o. It is my responsibility to adapt to climate change.	3.39	Undecided
OAWM	3.68	Agree

School Personnel's Attitude towards Climate Change

It can be noted on Table 2 that the school personnel agree on the effect of climate change and the relevance on the technologies provided by government agencies to adapt on climate change. This was shown by the overall mean value of 3.68. Of the different effects of climate change, the school personnel agreed the most that typhoon now are much stronger than they were 10 years ago, followed by water levels are now higher during high tide than they were 10 years ago. Average weighted mean values of 394 and 3.79 were computed respectively. Results of the study show that the school

Enhanced Climate Field School gives us the appropriate technologies to adapt to climate change. Likewise, the school personnel agree that the decision support system (DSS) of IRRI will help them adapt to climate change. Average weighted mean values of 3.65, 3.64, and 3.63 were computed respectively. Results of the study show that the school personnel are not only knowledgeable on the effect of climate change in the environment. The school personnel themselves have observed the effects of climate change in their environment.

Participation in Promoting Climate Change Adaptation Strategies: Climate change mitigationis actions to limit the

magnitude and/or rate of long-term climatechange. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhousegases (GHGs). Mitigation may also be achieved by increasing the capacity of carbonsinks, e.g., through reforestation. Mitigation policies can substantially reduce the risks associated with human-induced global warming. The participation of the school personnel in promoting climate change adaptation strategies is presented in Table 3. It can be noted from Table 3 that the school personnel are partners in promoting climate change adaptation strategies.

Table 3. Participation of School Personnel in Promoting Climate ChangeAdaptation Strategies

Practice/Activity	AWM	Descriptive Rate
1. Weather and climate information products	1.99	Partner
2. Weather–related effects on agriculture	1.95	Partner
3. Climate change adaptation practices	1.95	Partner
4. Forecast interpretation, translation, and communication	1.95	Partner
5. Climate variability	1.83	Partner
6. Integrated farming system	1.82	Partner
OAWM	**1.92**	Partner

This was shown by the overall mean value of 1.92. Of the different strategies, the school personnel are found most involved in promoting weather and climate change information products followed by weather-related effects on agriculture, and forecast interpretation, translation, and communication. Average weighted mean values of 1.95 and 1.95 were computed respectively. On the other hand, the school personnel were least involved in promoting integrated farming system. Result of the study show that the school personnel are not playing significant roles in promoting climate change adaptation strategies. The school personnel should be more active in promoting climate change adaptation strategies. They should discuss the effects of climate change on the environment and people's lives with their students and the parents.

Attributes of the schools vulnerable to climate change

Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change. The attributes of the different schools which are vulnerable to climate change in terms of level of adaptability of the school infrastructures to climate change and availability of rescue and retrieval facilities and equipment's were determined in the study.

Level of Adaptability of the School Infrastructures to Climate Change

It can be noted from Table 4 that the infrastructures of the different schools vulnerable to climate change are generally adaptable to climate change. This was shown by the overall mean value of 2.68. The most adaptable infrastructures to climate change of the different schools are the offices followed by classrooms and clinics. Average weighted mean values of 2.82, 2.79, and 2.70 were computed respectively. Results show that in the design and construction of the new buildings, offices, and clinics of the different schools, the vulnerability of the schools to climate change phenomena were considered. However, the stockrooms for foods, and beddings and the designated evacuation center of the schools are not adaptable to climate change. This was shown by the average weighted mean values of 5.59 and 2.58. The school administrators should consider improving or renovating the stockrooms and evacuation center for the infrastructures to be safe when needs arises. These infrastructures should be of good conditions and can withstand the adverse impact of different calamities to ensure the safety of those who will be using the evacuation center.

Table 4. Level of Adaptability of the School Infrastructures to Climate Change

Infrastructure	AWM	Descriptive Rate
1. Offices	2.82	Adaptable
2. School rooms	2.79	Adaptable
3. Clinic	2.70	Adaptable
4. Comfort rooms	2.60	Inadaptable
5. Stock rooms for food, beddings etc	2.59	Inadaptable
6. School Evacuation Centers	2.58	Inadaptable
OAWM	**2.68**	Adaptable

Table 5. Availability of Rescue and Retrieval Facilities and Equipment

Facilities/Equipment	AWM	Descriptive Rate
1. Food & Basic Needs	2.21	Inadequate
2. Computer, Camera, Xerox Copier, LCD Projector	2.18	Inadequate
3. Medical/ First Aid Supplies such as medicine, stretcher, bandages, spine board and Oxygen inhalator	2.09	Inadequate
4. Radio/ Communication (VHF Radio and handheld radios)	2.04	Inadequate
5. Evacuation Centers	2.00	Inadequate
6. Firefighting equipment (Fire trucks, hose, nozzles, ladders, and water tanks)	2.00	Inadequate
7. Back hoe, shovels, crane, pay loader, bulldozer, grader, dump truck and the like	1.94	Inadequate
8. Ropes, flash lights, crow bars, Acetylene and bolt cutters, chainsaw, hydraulic spreader	1.90	Inadequate
9. Ambulance, Pick-ups, Ford Fierra, Shuttle buses, Minicabs and the like	1.89	Inadequate
10. Motorized Boat and Rubberboat, and Floating Devices (Water Transportations)	1.88	Inadequate
OAWM	**2.01**	Inadequate

Table 6. Extent of Practice of Coping Mechanism of the Different SchoolsVulnerable to Climate Change

Coping Mechanisms	AWM	Descriptive Rate
1. Conduct of meetings and learning sessions.	3.93	Often
2. Conduct of seminars on climate issues.	3.84	Often
3. Celebrate the World Environment Day.	3.80	Often
4. Conduct of competitions on the arts, academics, and literature that focus on climate change.	3.79	Often
5. Conduct of capacity building workshop and training for the teachers and non-teaching staff on climate change adaptation and mitigation.	3.28	Sometimes
OAWM	3.73	Often

Table 7. Extent of Practice of Adaptation Strategies of the Different SchoolsVulnerable to Climate Change

Strategy	AWM	Descriptive Rate
1. Establishment of school safety committee.	3.65	Often
2. Integration of DRR into planning and school policies.	3.48	Often
3. Integration of DRR prevention education in the different lessons given to the students.	3.40	Sometimes
4. Conduct of emergency drills.	3.31	Sometimes
5. Construction of new green buildings.	3.07	Sometimes
OAWM	3.38	Sometimes

Table 8. Extent of Practice of Mitigation Strategies of the Different SchoolsVulnerable to Climate Change

Strategy	AWM	Descriptive Rate
1. Conduct of tree planting activities.	4.03	Often
2. Implementation of the war-on-waste program which include segregation and non-burning of waste.	3.98	Often
3. Implementation of the 3R program (reuse, reduce, and recycle).	3.95	Often
4. Implementation of the school in a garden program advocating on the use of organic farming.	3.94	Often
5. Implementation of energy conservation programs.	3.88	Often
OAWM	3.96	Often

Availability of Rescue and Retrieval Facilities and Equipment

As shown in Table 5, there is inadequacy of rescue and retrieval facilities and equipment in the different schools that are vulnerable to climate change as shown by the overall mean value of 2.01. The most inadequate materials available are the foods and basic needs, having a mean of 2.21, descriptively rated as inadequate. Computers, camera, photocopier, and LCD projector which are used for instruction were also found inadequate. Fire fighting equipment, heavy equipment, ambulance, and motorized and rubber boats were all found inadequate in the different schools. Results show that the different schools that are vulnerable to climate change are not ready and do not have the capacity to conduct rescue operations whenever the different climate change-related phenomena will occur.

Climate change coping mechanisms, adaptation and mitigation practices of the schools

The challenge of confronting the impacts of climate change is often framed in terms of two potential paths that civilization might take: *adaptation* and *mitigation*. Mitigation involves reducing the magnitude of climate change itself, which can be subdivided into two alternative strategies*: emissions reductions* -- dealing with the problem at its very source, and *geoengineering* -- somehow offsetting the effects of greenhouse gas emissions.

Coping Mechanism Practices of the Different Schools Vulnerable to Climate Change

It can be noted from Table 6 that the different schools often practice climate change coping mechanisms. This was shown by the overall mean value of 3.73. Of the different coping mechanisms, the conduct of meetings and learning sessions was practiced the most. A mean value of 3.93 was computed, descriptively rated as often practiced. Results show that the school administrators, teachers, and non-teaching staff are knowledgeable on the importance of being together to discuss issues and gain knowledge and learn from experiences. In order to gain knowledge on climate change, the schools often conduct seminars on climate issues and sometimes conduct capacity building workshop and training for the teachers and non-teaching staff on climate change adaptation and mitigation. Likewise, the schools often celebrate the World Earth Day and conduct competitions on the arts, academics, and literature that focus on climate change. Researches have shown that individuals and communities have varying degrees to cope with and adapt to climate variability and change including floods and drought. Results of the study show that the different schools that are vulnerable to climate change perform response measures that bring together integrated conservation and development concepts that consider holistic response to climate change.

Adaptation Strategies of the Different Schools Vulnerable to Climate Change

It can be noted from Table 7 that the different schools that are vulnerable to climate change sometimes practice adaptation strategies on climate change. This was shown by the overall mean value of 3.38.Establishment of school safety committee was the most practiced adaptation strategy by the schools. A mean value of 3.65 was computed, descriptively rated as sometimes practiced. It is worthy to note that Disaster Risk Reduction is being integrated into the plans and policies of the schools. Likewise, DRR prevention education was integrated in the different lessons given to the students. Average weighted mean values of 3.48 and 3.40 were computed respectively, descriptively rated as sometimes practiced. The schools also sometimes practice emergency drills as part of their adaptation strategies. Moreover, in the construction of

their new buildings, the schools apply geoengineering. Adaptation involves efforts to limit vulnerability to climate change impacts through various measures, while not necessarily dealing with the underlying cause of those impacts.

Mitigation Strategies of the Different Schools Vulnerable to Climate Change

As shown in Table 8, the different schools that are vulnerable to climate change often practice mitigation strategies. This was shown by the overall mean value of 3.96, of the different mitigation strategies, the conduct of tree planting activities was the most practiced strategy with a mean value of 4.03, descriptively rated as often practiced. The different schools also often practice war-on-waste, the 3R program, and school – in – a garden. Average weighted mean values of 3.98, 3.95, and 3.94, descriptively rated as practiced often. The different schools also implement energy conservation programs as part of their mitigation practices. It has to be noted that the war-on-waste, 3Rs, and the school – in – a garden are DepEd programs implemented even in the 1990s. Climate change mitigation is actions to limit the magnitude and/or rate of long-term climate change. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs). Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Mitigation policies can substantially reduce the risks associated with human-induced global warming. Mitigation is a public good; climate change is a case of 'the tragedy of the commons'" "Effective climate change mitigation will not be achieved if each agent (individual, institution or country) acts independently in its own selfish interest suggesting the need for collective action. Results of the study show that the different schools that are vulnerable to climate change employ strategies to decrease the large amount of carbon dioxide in the atmosphere through their tree planting activities, war-on-waste, 3Rs, and the school – in – a garden and in their implementation of energy conservation programs

Conclusions

- The school personnel are aware of climate change but are not fully knowledgeable on the effects, causes, mitigation, and adaptation strategies. The school personnel are knowledgeable on the effects of climate change in the environment, the community and that climate change is now being experienced by them not only in their community but worldwide. The school personnel are not playing significant roles in promoting climate change adaptation strategies. The school personnel should be more active in promoting climate change adaptation strategies.
- The DepEd divisions in the province of Pangasinan which is situated in the eastern, central and western parts of the province are traversed by major river systems, namely: Agno River tributary, Sinocalan River and Angalacan river tributary and other minor river tributaries. Various schools are situated in the mountainous terrain and low lying areas which is vulnerable areas of flash floods, landslides and erosion. These are the main reasons why the most frequently encountered phenomena is flooding, liquefaction and mudflows.The different schools that are vulnerable to climate change are not ready and do not have the capacity to conduct rescue operations whenever the different climate change-related phenomena will occur.
- The different schools that are vulnerable to climate change perform response measures that bring together integrated conservation and development concepts that consider holistic response to climate change. Adaptation strategies that are being practiced by the schools vulnerable to climate change involves efforts to limit vulnerability to climate change impacts through various measures, while not necessarily dealing with the underlying cause of those impacts.
- The different schools that are vulnerable to climate change perform response measures that bring together integrated conservation and development concepts that consider holistic response to climate change. Adaptation strategies that are being practiced by the schools vulnerable to climate involves efforts to limit vulnerability to climate impats through various measures, while not necessarily dealing with the underlying cause of those impacts.

Recommendations

Based from the findings of the study and the conclusions generated, the researcher recommends the following:

- The school personnel should strengthen their knowledge on the causes, and effects of climate change on the environment. They should be more supportive and participative on the different adaptation and mitigation strategies on climate change that are being employed by their schools.
- The school personnel of the different schools that are vulnerable to climate change phenomena should keep themselves abreast and updated on information especially during typhoons for them to be able to implement measures that could reduce the impact of the perceived phenomena on their schools, the students, and to the personnel themselves.
- The different schools that are vulnerable to climate change phenomena should continue practicing coping mechanisms, adaptation and mitigation strategies to combat the occurrence and effects of climate change.
- The need to institutionalize disaster mitigation and risk management in the DepEd to capacitate personnel and students on best practices generated by other schools to minimize the impact of climate change.

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