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Assessing Vulnerability and Prioritizing Risk Level Based on Students' Perceived Hazards in a University Environment

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Abstract

This study assessed the environmental vulnerability and prioritized risk level in a Philippine state university based from the students' perceived hazards. It employed quantitative non-experimental cross-sectional design to one hundred thirteen students (n=113). Results showed that most of them perceived the following as hazards in their university: building collapse, hazardous materials incident onsite, earthquake, fire, flood, storm, landslide, contamination of food/drinking water/air/soil and contagious infectious disease. In assessing the university's vulnerability, most of them believed that their campus is vulnerable to the said hazards because of its likelihood of occurrence; and ability to cause damage or loss of school property and injury or death. Considering the university's risk priority level, most of them believed that their campus should prioritize risks from perceived hazards because of its occurrence's frequency, magnitude, school warning and impact to their campus. In view of these, the conduct of the following are recommended: continuous monitoring of the hazards' occurrences, vulnerability assessments and risk assessments in the university. Also, an environmental management team can be organized to develop a sustainable environmental management program, thus maintaining a safe and secured university environment for the students, faculty, staff and other stakeholders.

INTRODUCTION

Universities can also be affected by environmental problems and may become sensitive or vulnerable due to these crises. As Barrow (2006) remarked, "even the safest area could be subjected to natural or anthropogenic problems". Environments like in a university setting may become vulnerable due to harsh climate; remoteness; impact of natural disasters; narrowness; as a result of easily damaged vegetation or soil and of excessive human demands (Barrow, 2006). Accordingly, universities in the Philippines may be sensitized due to the impact of numerous natural disasters like strong typhoons and earthquakes occurring every year. The Philippines has been known as a disaster-prone country and being ranked as the second highest country worldwide at risk of natural disasters (Guha-Sapir, Hoyois & Below, 2013; World Risk Report, 2014).

For instance, the province of Quezon in the southern part of Luzon in the Philippines has been prone to storms and earthquakes in the past few years. Recently, the said province has been affected by typhoon Tisoy where buildings and other facilities were damaged. Also, several trees and other plants were uprooted. As a result, the university environments in the said province can pose threats to students, faculty and staff due to possible hazards brought by the typhoon. Further, while natural hazards such as tornadoes, floods, hurricanes and earthquakes may be thought of more commonly as emergencies, schools are also at risk from other hazards such as school violence, infectious disease, and terrorist threats (U.S. Department of Education, 2008). In such situations, the school environment becomes vulnerable, unsafe and unsecured for its students and other stakeholders.

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According to United Nations International Strategy for Disaster Reduction (UNISDR), hazard is "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage". On the other hand, vulnerability refers to "the characteristics and circumstances of a community, system or assets that make it susceptible to the damaging effects of a hazard." Lastly, risk is "the combination of the probability of an event and its negative consequences" (UNISDR, 2009). The relationship of the three variables can be seen from the risk equation, as shown below, provided by UNISDR Report:

RISK = HAZARD X VULNERABILITY

The equation shows that risk is a function of hazard and vulnerability (Ciurean, Schröter & Glade, 2013). This study utilized the abovementioned framework.

With regards to vulnerability, there are generally five components that need to be investigated in vulnerability assessment: (1) the physical dimension or the predisposition of a structure, infrastructure or service to be damaged due to the occurrence of a harmful event associated with a specific hazard; (2) the economic dimension or the economic stability of a region endangered by a loss of production, decrease of income or consumption of goods due to the occurrence of a hazard; (3) the social dimension or the presence of human beings, individuals or communities, and their capacities to cope with, resist and recover from impacts of hazards; (4) the environmental dimension or the interrelation between different ecosystems and their ability to cope with and recover from impacts of hazards and to tolerate stressors over time and space; and (5) the political/institutional dimension or political or institutional actions e.g. livelihood diversification, risk mitigation strategies, regulation control, or characteristics that determine differential coping capacities and exposure to hazards and associated impacts (Vogel & O'Brien, 2004). This study focused on the environmental dimension of vulnerability assessment.

On the other hand, a risk assessment gives information about any risks related to facilities or activities, which can then be used in engaging in preventive actions (Bernardo et al., 2006; Sobiech, et al., 2012). In a risk assessment, injuries that can be incurred to people should be considered first. Then, the determination of vulnerability from hazards of other at-risk facilities such as buildings, equipment, utilities and materials should be considered next (Nouri et al., 2011). Past studies have shown that risk assessment facilitates an effective way in handling probable incidents using appropriate risk assessment. Further, researches suggested that conducting regular exercises based on a specific incident scenario can be useful in preparing people during the time of incidents (Marincioni & Fraboni, 2012).

Ensuring a safe and secured school environment is one of the services that universities provide for the students. Specifically, the university's Office of Student Services is tasked to develop programs which include disaster risk management program which may employ the regular conduct of fire and earthquake drills, seminar-workshops on disaster-preparedness and first-aid treatment. These activities may decrease the vulnerability of the students, faculty and staff from natural and man-made hazards but may not decrease the vulnerability of the school environment from the said hazards. In this regard, it is crucial for the universities to develop a sustainable environmental management program which can identify the hazards present, assess the vulnerability and risk of the school environment and plan mitigating actions to address them and monitor them for sustainability. However, the researcher found limited literature and studies which investigate the universities specially in local setting on their sustainable environmental management program and on their conduct of vulnerability and risk assessments as part of it. One related study is conducted by Anilan (2014) showing that the risk perception and environmental awareness levels of high school students were very high in the following environmental factors: active and passive smoking, global warming, HIV, nuclear waste, and the use of alcohol and drugs. Further, the study conducted by Dehdashti et al. (2020) revealed that the type of hazard had a significant relationship with university site and risk severity. The authors

suggested that universities should provide training in risk reduction programs to increase the awareness of students, staff and faculties, which can improve life safety in a university environment.

Through the vulnerability assessment process, schools can take steps to prevent, mitigate, and lessen the potential impact of these risks by developing customized district and school emergency management plans in collaboration with community partners. Vulnerability assessments are integral to, rather than separate from, the ongoing emergency management activities of school districts and schools (U.S. Department of Education, 2008). In the Philippines, the Department of Education has mandated the implementation of Disaster Risk Reduction Management (DRRM) or School Safety Program in elementary and secondary schools across the country. The said program has its own comprehensive school safety monitoring tool which serves to assess the school environment through hazard mapping, vulnerability and risk assessment, monitor and plan in accordance to the principles and guidelines contained in RA 10121 (Philippine DRRM Act of 2010, 2010). However, the researcher found limited school safety monitoring tools similar to the abovementioned which are being implemented in the tertiary level. Universities may have disaster risk management program but may not use vulnerability and risk assessment tools to assess the safety and security of the university environment from natural and man-made hazards.

In view of the abovementioned claims, the researcher worked on assessing the environmental vulnerability and prioritizing the risk level in a Philippine state university based from the students' perceived hazards in the said campus. This is in line with a past research suggesting that it's necessary for different institutions to assess their vulnerabilities which can then be used as basis for planning their risk mitigation (Salazar-Escoboza et al., 2020). Similarly, an educational institution like a university is recommended to develop Health, Safety and Environmental (HSE) education programs which can include activities such as safe evacuation at accidents, emergencies, fire drills and practice exercises based on the most probable accident scenarios as part of the risk action plan for all students, faculty and staff (Zavotsky, Valendo & Torres, 2004). The results of this study can significantly provide baseline data to the campus administration on the current status of the school environment which can then serve as basis in developing sustainable environmental management programs related to emergency and mitigation planning for the identified hazards, vulnerability and risk priority level in the said campus.

Specifically, this study sought on answering the following research questions:

1. What hazards are perceived by students in the university?
2. What is the level of environmental vulnerability of the university from the students' perceived hazards in terms of:
    a. likelihood of a perceived hazard to occur in the campus;
    b. ability of a perceived hazard to cause damage or loss of school property; and
    c. ability of a perceived hazard to cause injury or death?
3. What is the level of risk priority of the university from the students' perceived hazards based on:
    a. frequency of occurrence;
    b. magnitude;
    c. warning the school should have; and
    d. impact?

METHOD

The study employed quantitative non-experimental design using cross-sectional survey. According to Creswell (2014), survey research provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. It includes cross-sectional - with the data collected at one point in time and longitudinal studies - with data collected over time using questionnaires or structured interviews for data collection- with the intent of generalizing from a sample to a population (Fowler, 2008 cited in Creswell, 2014).

Purposive sampling was employed in choosing the sample of the study which is consisted of one hundred thirteen students (n=113) enrolled during the Term 2 of Academic Year 2019-2020 at a Philippine state university.

After having sought the approval of the concerned teacher education institution and consent of the participants, individual copies of the modified and adapted survey as the research instrument were distributed to the participants to determine their perceived hazards and its level of vulnerability and risk in the university.

The survey was adapted from a report released by U.S Department of Education (2008) with the title "A Guide to School Vulnerability Assessments" which is in the public domain and provides an open access in this website www.ed.gov/emergencyplan without seeking any permission. The said survey was modified by the researcher in the context of the Philippine setting considering the participants of this study.

Descriptive analyses using frequency and percentage distribution and ranking were employed on the data collected from the survey.

RESULTS AND DISCUSSION

Students' Perceived Hazards

The table below shows that among the hazards perceived by the participants in their university, storm got the highest frequency and percentage (111; 98.23%) and ranked first while landslide has the lowest with a frequency and percentage of 54 and 47.79%, respectively and ranked last. These imply that most of the participants perceived storm to be a hazard while few of them considered landslide as a hazard in their campus. In addition, more than 50% of the participants perceived all the occurrences listed in the table below except landslide as hazards in their campus.

Table 1. Frequency and Percentage Distribution of students' Hazards Perception

Hazards	Frequency (f)	Percentage (%)	Ranking
Building Collapse	86	76.11	6
Hazardous Materials Incident Onsite	102	90.27	4
Earthquake	106	93.81	2
Fire	104	92.04	3
Flood	95	84.07	5
Storm	111	98.23	1
Landslide	54	47.79	9
Contamination of Food/Drinking Water /Air/Soil	75	66.37	7
Contagious Infectious Disease	66	58.41	8

University's Level of Environmental Vulnerability

Based from their perceived hazards, participants described the level of environmental vulnerability of their campus based on the three questions from the survey as indicated below.

What is the likelihood of the event occurring at, or in the immediate vicinity of this school?

Table 2. Frequency Distribution on the Likelihood of Occurrence

Hazards	**Likelihood of Occurrence**		
	Low	Moderate	High
Building Collapse	14	69	8
Hazardous Materials Incident Onsite	29	65	9
Earthquake	19	62	26
Fire	26	60	17
Flood	25	56	14
Storm	16	58	39
Landslide	32	29	4
Contamination of Food/Drinking Water/Air/Soil	36	39	6
Contagious Infectious Disease	29	34	7

It can be seen in table 2 that based on participants' perceived hazards, contamination of food/drinking water/air/soil got the highest frequency of 36 in terms of low likelihood of occurrence. Further, building collapse got the highest frequency of 69 in terms of moderate likelihood of occurrence. Whereas, storm got the highest frequency of 39 in terms of high likelihood of occurrence. These results indicate that among the perceived hazards, most of the participants considered their campus to have a low likelihood of occurrence of contamination of food/drinking water/air/soil; moderate likelihood of occurrence of building collapse and high likelihood of occurrence of storm.

Could school property damage, or loss of use of school property result if this event occurred?

Table 3. Frequency Distribution on Possibility of School Property Loss or Damage

Hazards	**Responses**	
	Yes	**No**
Building Collapse	90	3
Hazardous Materials Incident Onsite	91	11
Earthquake	104	3
Fire	105	1
Flood	77	19
Storm	97	12
Landslide	59	9
Contamination of Food/Drinking Water/Air/Soil	48	29
Contagious Infectious Disease	48	24

Table 3 shows that among the perceived hazards, fire got the highest frequency of 105 from the students' responses on the possibility that it can result to damage or loss of school property. On the other hand, both contamination of food/drinking water/air/soil and contagious infectious disease got the lowest frequency of 48. These results indicate that most of the participants confirmed that fire can lead to damage or loss of school property while few of them believed that both contamination of food/drinking water/air/soil and contagious infectious disease can result to the same scenario.

Could any person be killed or injured if this event occurred?

The table below shows that among the perceived hazards, earthquake got the highest frequency of 93 while landslide got the lowest frequency of 59. These imply that most of the participants believed that earthquake can lead to injury or death when it occurred while few of them confirmed that landslide can lead to the same situation.

Table 4. Frequency Distribution on the Possibility of Injury or Death

Hazards	Responses	
	Yes	No
Building Collapse	86	4
Hazardous Materials Incident Onsite	87	15
Earthquake	93	13
Fire	91	11
Flood	61	32
Storm	83	24
Landslide	59	10
Contamination of Food/Drinking Water/Air/Soil	68	9
Contagious Infectious Disease	63	6

Prioritizing Risk Level

Based from the perceived hazards, students prioritized risk in their campus based on the following categories – frequency of occurrence, magnitude, warning that the school should have and impact of the said hazards.

Frequency of Occurrence

Table 5 presents the participants' responses on the frequency of occurrence of their perceived hazards in terms of the scales – highly likely, likely, possible and unlikely. It shows that among the perceived hazards, storm got the highest number of responses under the scales "highly likely" and "likely"; contamination of food/drinking water/air/soil under the scale "possible"; and landslide under the scale "unlikely". These imply that in terms of frequency of occurrence, most of the participants considered that storm is highly likely and likely to occur; contamination of food/drinking water/air/soil is possible to occur and landslide is unlikely to occur in their campus.

Table 5. Frequency Distribution of Occurrence's Frequency of Perceived Hazards

Hazards	Highly Likely	Likely	Possible	Unlikely
Building Collapse	11	18	54	20
Hazardous Materials Incident Onsite	10	35	43	14
Earthquake	21	32	45	4
Fire	17	26	52	6
Flood	15	26	44	18
Storm	32	46	22	3
Landslide	5	9	45	39
Contamination of Food/Drinking Water/Air/Soil	6	18	56	20
Contagious Infectious Disease	10	17	49	25

Magnitude

Table 6 shows the participants' responses on the magnitude of their perceived hazards in terms of the scales – catastrophic, critical, moderate and negligible. It can be noticed that storm got the highest frequency under the scales "catastrophic" and "critical". On the other hand, contamination of food/drinking water/air/soil got the highest frequency under the scale "moderate" while landslide got

the highest frequency under the scale "negligible". These imply that in terms of magnitude, most of the participants considered storm to be catastrophic and critical while contamination of food/drinking water/air/soil is moderate and landslide is negligible.

Table 6. Frequency Distribution on the Magnitude of Perceived Hazards

Hazards	Catastrophic[a]	Critical[b]	Moderate[c]	Negligible[d]
Building Collapse	8	30	51	14
Hazardous Materials Incident Onsite	4	24	59	14
Earthquake	17	34	46	5
Fire	9	36	46	9
Flood	9	17	60	17
Storm	19	39	41	4
Landslide	5	9	46	38
Contamination of Food/Drinking Water/Air/Soil	1	14	61	24
Contagious Infectious Disease	5	19	53	25

[a]Catastrophic - Loss of life; complete equipment loss
[b]Critical - Accident level injury and equipment damage
[c]Moderate - Incident to minor accident damage
[d]Negligible - Damage probably less than accident or incident levels

School Warning

The table below shows the participants' responses on the warning that the school should have on their perceived hazards. It can be observed that contamination of food/drinking water/air/soil got the highest frequency under the scale minimal/none while contagious infectious disease got the highest frequency under the scale 6-12 hours. Whereas, building collapse got the highest frequency under 12-24 hours and storm under more than 24 hours. These indicate that most of the participants believed that, in terms of warning the school should have, contamination of food/drinking water/air/soil needs minimal or none while contagious infectious disease needs 6-12 hours; building collapse needs 12-24 hours and storm needs more than 24 hours of warning.

Table 7. Frequency Distribution on the School Warning on Perceived Hazards

Hazards	Minimal/ None	6-12 hours	12-24 hours	24+ hours
Building Collapse	23	19	42	18
Hazardous Materials Incident Onsite	28	28	30	15
Earthquake	18	23	37	23
Fire	15	29	36	20
Flood	28	24	32	18
Storm	10	25	36	31
Landslide	37	25	19	15
Contamination of Food/Drinking Water/Air/Soil	39	21	26	13
Contagious Infectious Disease	29	30	24	16

Impact

In terms of impact of the perceived hazards, the table below shows that building collapse, earthquake and storm got the highest frequency under the scale catastrophic; storm under critical; flood under moderate; and landslide under negligible. These imply that most of the participants considered that

building collapse, earthquake and storm can have catastrophic impact; storm can have critical impact; flood can have moderate impact and landslide can have negligible impact in their university.

Table 8. Frequency Distribution on the Impact of Perceived Hazards

Hazards	**Catastrophic[a]**	**Critical[b]**	**Moderate[c]**	**Negligible[d]**
Building Collapse	15	28	45	15
Hazardous Materials Incident Onsite	7	27	49	19
Earthquake	15	44	34	9
Fire	13	44	33	9
Flood	6	24	55	18
Storm	15	47	35	4
Landslide	5	22	45	31
Contamination of Food/Drinking Water/Air/Soil	3	18	51	28
Contagious Infectious Disease	6	26	46	23

[a]Catastrophic - Loss of life; complete equipment loss
[b]Critical - Accident level injury and equipment damage
[c]Moderate - Incident to minor accident damage
[d]Negligible - Damage probably less than accident or incident levels

Level of Risk Priority

Based on the abovementioned categories used by the participants in prioritizing risk in their campus, the participants determined the level of risk priority of their campus. The table below shows that storm got the highest frequency under the scale "high"; hazardous materials incident onsite under "medium" and landslide under "low". These indicate that most of the participants believed that storm has a high-risk priority level; hazardous materials incident onsite has a medium risk priority level and landslide has a low risk priority level.

Table 9. Frequency Distribution on the Risk Priority of Perceived Hazards

Hazards	**Level of Risk Priority**		
	High	Medium	Low
Building Collapse	34	41	27
Hazardous Materials Incident Onsite	17	58	26
Earthquake	41	42	18
Fire	38	44	17
Flood	23	46	31
Storm	52	31	18
Landslide	12	27	58
Contamination of Food/Drinking Water/Air/Soil	14	37	48
Contagious Infectious Disease	19	39	41

RESULTS

This study assessed the level of environmental vulnerability and prioritized the level of risk in a Philippine state university based from the hazards perceived by the students.
The significant findings of the study were the following:

Students' Perceived Hazards in the University

Results showed that most of the participants perceived the following as hazards in their university: building collapse, hazardous materials incident onsite, earthquake, fire, flood, storm, landslide, contamination of food/drinking water/air/soil and contagious infectious disease. Significantly, most of them perceived storm as a hazard and very few of them perceived landslide as a hazard.

Level of University's Environmental Vulnerability

The participants described the level of environmental vulnerability based on three questions which focused on the following:

Likelihood of a Perceived Hazard to Occur in the Campus

Results showed that there are higher number of participants who considered their campus to have moderate likelihood of occurrence than high likelihood of occurrence of their perceived hazards. Noticeably, most of the participants considered their campus to have a low likelihood of occurrence of contamination of food/drinking water/air/soil; moderate likelihood of occurrence of building collapse and high likelihood of occurrence of storm.

Ability of a Perceived Hazard to Cause Damage or Loss of School Property

Results showed that a higher frequency of participants confirmed that their perceived hazards can cause damage or loss of school property when they occurred in their university. Specifically, most of the participants confirmed that fire can lead to damage or loss of school property while few of them believed that both contamination of food/drinking water/air/soil and contagious infectious disease can result to the same scenario.

Ability of a Perceived Hazard to Cause Injury or Death

Results showed that a higher frequency of participants confirmed the ability of their perceived hazards to cause injury or death. Significantly, most of the participants believed that earthquake can lead to injury or death when it occurred while few of them confirmed that landslide can lead to the same situation.

Prioritizing Risk in the University

The participants prioritized the risk based on the following categories:

Frequency of Occurrence

Results showed that most of the participants considered most of the said hazards to possibly occur in the university except in the case of their responses on storm wherein most of them considered it to likely occur. Noticeably, most of the participants considered that storm is highly likely and likely to occur; contamination of food/drinking water/air/soil is possible to occur and landslide is unlikely to occur in their campus.

Magnitude

Results showed that most of the participants considered that all the perceived hazards are moderate. Specifically, most of the participants considered storm to be catastrophic and critical while contamination of food/drinking water/air/soil is moderate and landslide is negligible.

Warning that the School Should Have

Results showed that most of the participants believed that contamination of food/drinking water/air/soil needs minimal or none while contagious infectious disease needs 6-12 hours; building collapse needs 12-24 hours and storm needs more than 24 hours of warning.

Impact

Results showed that there is a higher frequency of responses on the moderate impact of all the perceived hazards than under other scales. Significantly, most of the participants considered that building collapse, earthquake and storm can have catastrophic impact; storm can have critical impact; flood can have moderate impact and landslide can have negligible impact in their university.

Level of Risk Priority of the University

The participants determined the level of risk priority based on the abovementioned categories. Results showed that most of the participants believed that their university should put a high-risk priority level on storm; medium risk priority level on hazardous materials incident onsite; and low risk priority level on landslide.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this study, it can be concluded that most of the participants perceived different occurrences as hazards in their university specially the storm which is a natural hazard. Further, in view of the level of vulnerability of the university from the perceived hazards, it can be concluded that most of the participants believed that their campus is vulnerable to the said hazards because of its likelihood of occurrence especially storm; and the ability of the said hazards to cause damage or loss specially fire and cause injury or death especially earthquake. In addition, considering the level of risk priority of the university, it can be concluded that most of the participants believed that their university prioritizes their perceived hazards because of its frequency of occurrence especially storm, magnitude especially storm, warning that school should have especially storm and impact to their campus specially building collapse, earthquake and storm.

In view of these conclusions, it is recommended that continuous monitoring and recording of the occurrences of the said hazards be conducted by the university since other hazards may be observed in the future. The records may serve as baseline data by the university for future planning and developing of sustainable environmental management program. In addition to environmental vulnerability assessments, human or social vulnerability may be conducted in the future since students may also be affected by hazards occurring in the school. Further, it is recommended that risk assessments be also conducted in addition to vulnerability assessments which can greatly help the university in prioritizing risks of perceived hazards. Overall, it is recommended that the university organize an environmental management team which can work on developing a sustainable environmental management program. The said program can collaborate with the Office of the Student Services in maintaining a safe and secured university environment for the students, faculty, staff and other stakeholders.

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