

Determining Factors Influencing Filipinos' Flood Disaster Response Perceived Effectiveness through Multiple Regression: A Case on Typhoon Vamco (Ulysses)

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Abstract. In the Philippines, the 2020 Typhoon Vamco brought people catastrophic and resulted in severe flooding, congested evacuation centers, and stranded people amidst the COVID-19 pandemic. This study intended to identify the statistically significant variables influencing Filipinos' flood disaster response's perceived effectiveness with the 2020 Typhoon Vamco using multiple regression analysis. 567 participants voluntarily participated in the self-administered questionnaire distributed online. The researchers used convenience sampling due to the limitations brought by the COVID-19 pandemic. Results show that factors such as Government support (p-value = 0.033), Perceived behavioral control (p-value = 0.000), Social norms (p-value = 0.000), Intention to follow (p-value = 0.000), and Behavior (p-value = 0.000) were identified to be statistically significant variables affecting the flood disaster response's perceived effectiveness of Filipinos during the 2020 Typhoon Vamco. This study will be advantageous for researchers and local government units to develop the appropriate flood disaster response to minimize typhoon effects resulting from floods. Likewise, the framework adapted in this study can be expanded and extended to countries susceptible to the impacts of natural disasters.

Keywords: floods, disaster risk management, Typhoon Vamco, Macroergonomics

1. Introduction

The Philippines has been known to experience natural disasters yearly, such as typhoons, floods, volcano eruptions, landslides, and earthquakes [1,2]. According to USAID [2], the country experiences an average of 19-20 cyclones yearly, attributed to floods and may result in catastrophic destructions and casualties. In 2020, Typhoon Goni, known as year 2020's strongest typhoon, hit the Philippines (recorded winds of 225 km/hr), causing extreme winds and heavy rainfall, resulting in power outages and asset damage among Filipinos [3]. Several days after, another typhoon hit the Luzon Island and was named Typhoon Vamco (recorded winds of 169 km/hr). Typhoon Vamco may be considered as not as strong as Typhoon Goni. However, because it occurred when people were still recovering from the catastrophic effects of Typhoon Goni, it brought severe effects to people as more flooding resulted in congested evacuation centers and stranded people amidst the COVID-19 pandemic [3].

Perceived effectiveness is defined as people's perception regarding the effectiveness of the latent variables in flood risk response of Filipinos during Typhoon Vamco. This paper represents people's actual effectiveness, as this study characterized perceived effectiveness as people's subjective feelings concerning the disaster risk response [4].

Studies have been done to measure perceived effectiveness in healthcare and disaster risk management. Suka et al. [4] aimed to create rating scale measures to evaluate the perceived effectiveness of health messages with Japanese people through focus groups, interviewer-administered questionnaires, individual interviews, and self-administered questions. Moreover, Eccles et al. [5] studied the perceived effectiveness of

web-based mental health programs used to motivate people with a high depression risk to utilize. Finally, Prasetyo et al. [6] evaluated factors that affect Filipinos' perceived effectiveness to COVID-19 prevention procedures, incorporating theories such as Theory of Planned Behavior (TPB) and Protection Motivation Theory (PMT).

Disaster mitigation studies in the Philippines have been done by numerous researchers recently. Prasetyo et al. [7] identified the factors concerning the Filipinos' response action in the 2020 Taal volcano eruption. Moreover, Ong et al. [8] intended to assess the factors that affects Filipinos' intent to prepare to alleviate the possibility of The Big One earthquake. Kurata et al. [9] determined the statistically significant elements influencing Filipinos' perceived effectiveness in flood disaster response during the 2020 Typhoon Vamco utilizing the structural equation modeling. The studies were done by Prasetyo et al. [7], Ong et al. [8], and Kurata et al. [9] extensively integrated the behavioral theories of Theory of Planned Behavior (TPB) and Protection Motivation Theory (PMT) in their theoretical models. Since the Philippines commonly experiences natural disasters such as typhoons [1,2], few studies have been done concerning the perceived effectiveness of people towards disaster risk management.

Furthermore, this study intends to identify statistically significant variables influencing Filipinos' flood disaster response's perceived effectiveness with the 2020 Typhoon Vamco using multiple regression analysis. Factors studied in this paper include geographical perspective, government support, and typhoon-flood experience and knowledge. This study will benefit researchers and local government units to develop effective flood disaster responses to minimize the catastrophic effects of floods due to typhoons. Moreover, the study can be adapted to other countries prone to natural disasters, particularly typhoon-related flooding. The theoretical research framework adapted in this paper is shown in Figure 1.

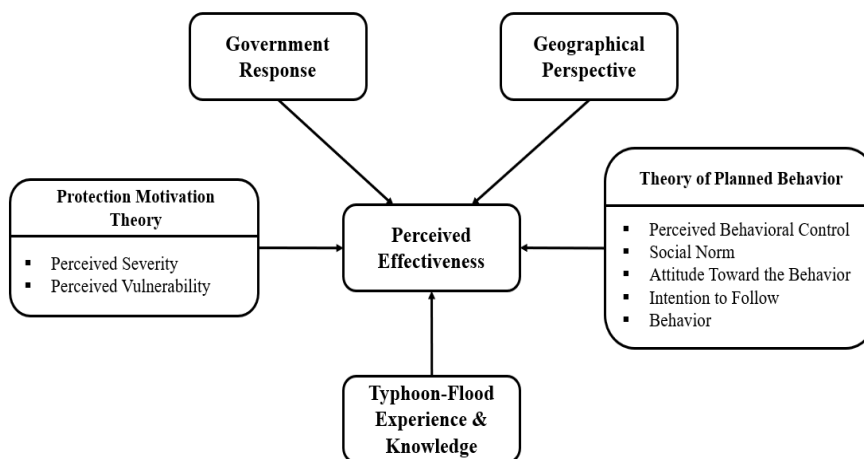


Fig. 1: Theoretical research framework (adapted from [9]).

2. Methodologies

2.1. Participants

The study gathered 567 participants who voluntarily participated in the disseminated self-administered questionnaire online. These participants experienced the effects of Typhoon Vamco when it hit the Philippines in November 2020. The researchers used convenience sampling due to the limitations brought by the COVID-19 pandemic.

50.44% were male respondents, and 49.56% were female respondents. Most are between the age of 15 to 24 years old, and students and unemployed (62.61%).

Most respondents have experienced flooding from the data gathering, while 66.84% are not enrolled in any health insurance. Filipinos are not fond of considering insurance as part of their daily expenditures. They focus their monetary expenses more on other aspects of life, such as food, shelter, and different physiological needs [10].

TABLE I. SUMMARIZED DATA OF DEMOGRAPHICS (ADAPTED FROM [9])

Characteristics	Category	N	%
Gender	Male	286	50.44
	Female	281	49.56
Age Bracket	15 to 24	368	64.90
	25 to 34	126	22.22
	35 to 44	36	6.35
	45 to 54	29	5.11
	55 to 64	7	1.23
	Above 65	1	0.18
Employment Status	Students / Unemployed	355	62.61
	Full Time	152	26.81
	Freelance / Contractor	15	2.65
	Part-Time	12	2.12
	Self-employed	30	5.29
	Retired	3	0.53
Marital Status	Others	6	1.06
	Divorced	1	0.18
	Living Together	7	1.23
	Widowed	5	0.88
	Married	82	14.46
	Single	466	82.19
Residency	Provincial	257	45.33
	Metropolitan	310	54.67
City/Province of Residence	NCR	310	54.67
	Region 1	7	1.23
	Region 2	15	2.65
	Region 3	51	8.99
	Region 4A	150	26.46
	Region 4B	22	3.88
	Region 5	12	2.12
Experienced flooding	Yes	402	70.90
	No	165	29.10
Enrolled in Health insurance?	Yes	188	33.16
	No	379	66.84

2.2. Self-administered Questionnaire

The questionnaire used in this study is designed to establish the factors influencing the of Filipinos' flood disaster response perceived effectiveness with the occurrence of 2020 Typhoon Vamco. Sixty-three (63) indicators were computed using a 5-point Likert scale, wherein "1" is equivalent to Strongly disagree and "5" to Strongly agree. The factors assessed are Demographics, Geographical perspective, Government support, Typhoon-flood knowledge and experience, Perceived vulnerability, Perceived severity, Attitude toward the behavior, Social norms, Perceived behavioral control, Intention to follow, Behavior, and Perceived effectiveness. Table 2 summarizes the constructs used in the study.

TABLE II. STUDY CONSTRUCTS AND QUESTIONS (ADAPTED FROM [9])

Items	Measures / Questions	Supporting References
GR1	I receive government support during the flooding.	[11]
GR2	I receive government support after the flooding.	[11]
GR3	I think that there is a strong bonding tie within the community I live in during the disaster.	[11]
GR4	I think my community resources are mobilized.	[11]
GR5	I think my community disseminates information and knowledge across groups regarding rescue operations during the disaster.	[11]
GR6	I think my community collaborates with organizations for social and technical facilitation for livelihood reconstruction after the disaster.	[11]
TPE1	I have experienced typhoons in my residence.	[12]-[14]
TPE2	I have experienced flooding in my residence.	[12]-[14]
TPE3	I think I am alert and prepared for any weather events and natural calamities that may occur.	[12]-[14]

TPE4	I know how to prepare myself to deal with typhoons.	[13]-[16]
TPE5	I know how to prepare myself to deal with flooding.	[13]-[16]
TPE6	I know how to locate and shut down the electrical hazards in my house.	[13],[14]
GL1	I think my location is often likely to experience typhoons.	[17]
GL2	I think my location is often likely to be flooded.	[17]
GL3	I know the nearest evacuation facility I could go to in case of flooding.	[18],[19]
GL4	I am aware that I am living in a low-lying area that is prone to flooding.	[17],[20]
GL5	I think that residing in nearby bodies of water will cause me to experience flooding.	[21]
PS1	I find flooding is a severe outcome of typhoons.	[22],[23]
PS2	I find flooding may lead to death among people.	[22]-[25]
PS3	I find the flooding in my community is much more severe than in other places.	[26]
PS4	I believe that the flooding may affect my livelihood.	[24]
PS5	I think it would cause me much money to rebuild my resources affected by the flooding.	[24]
PS6	I think the flooding will continue for at least the next three months.	
PS7	I think I am prone to experience hypothermia if submerged in flood.	[24],[27]
PV1	I think I am vulnerable to flooding.	[24],[26]
PV2	I think my community is vulnerable to flooding.	[24],[26]
PV3	My experience makes me believe that I am likely to experience flooding when other people experience flooding.	[24],[26]
PV4	I have a history of susceptibility to natural disasters.	[24],[26]
PBC1	The preventive measures are completely up to me.	[16]
PBC2	I believe preventive measures are implemented easily.	
PBC3	I am confident that I can prevent experiencing flooding.	
PBC4	I am confident that I have enough knowledge in responding to flooding.	[16]
SN1	Most people I know are following the preventive measures given by the local government units.	[26]
SN2	Most people I know receive the disaster relief aid of the government.	[26]
SN3	Most people I know go to the evacuation centers provided before the flooding starts.	
SN4	Most people I know practice safety measures during flooding.	[16],[25]
SN5	Most people I know get the emergency items and supplies (i.e., ID, Passport, money, water) when alerted of flooding.	[16],[25]
ATB1	I feel stressed during flooding.	[28],[29]
ATB2	I am afraid that any of my family members will be affected by the flooding.	[28]
ATB3	I feel not secured when my neighbors do not prepare for flooding.	
ATB4	I feel anxious when there is heavy rainfall.	[29]
ATB5	I am worried when my neighbors fear when there is flooding.	
ATB6	I am familiar with my community's flood warning system.	[17],[23],[26]
ATB7	I make sure that my family is familiar with the flood warning system of my community.	[17],[23],[26]
IF1	I am willing to follow the instructions given by public safety officials.	[26]
IF2	I am willing to give my contact details to the community leaders to call me for warnings or dangers.	
IF3	I am willing to give my contact details to my neighbors to call me for warnings or dangers.	
IF4	I am willing to undergo immunization to prevent being sick due to flooding.	[17],[23]
IF5	I am willing to stay in the evacuation areas up until the local government officials have said that it is safe to do so.	[26],[30]
B1	I always make myself updated on emergency information about the flooding.	[16],[25]
B2	I always contact my loved ones or friends and let them know where I am and who am I with.	[28]
B3	I always go to higher grounds when the flood starts to rise.	[16]
B4	I always keep the emergency items and supplies (i.e., ID, Passport, money, water) prepared in case of flooding and evacuation.	[16]
B5	I am practicing taking only well-cooked foods and boiled water to prevent contamination.	[17]
PE1	I think the preventive measures for disaster response in my community are informative.	[25]
PE2	I think the preventive measures for the disaster response imposed by the local government unit is effective.	[25]
PE3	I think that emergency warning awareness will prevent me to be affected by flooding.	[16],[25],[31]
PE4	I think that being up to date on social media will prevent me to be affected by flooding.	[32]
PE5	I think preparing for floating devices will increase my chance to survive in case of flooding.	[16],[25]
PE6	I think that early evacuation will prevent me to be affected by flooding.	[16],[25]
PE7	I think that developing an emergency communication plan is an effective way to flood disaster response.	[16],[25]

3. RESULTS

The data gathered through the distribution of self-administered questionnaires were subjected to correlation analysis to measure the factors that have supported the study's results. Furthermore, the researchers utilized Multiple Regression analysis and Stepwise Regression using the Minitab 19 Statistical software to determine the statistically significant variables affecting Filipinos' flood disaster response during

the 2020 Typhoon Vamco. Section A covers the Correlation Analysis, and Section B discusses the results based on the Multiple Regression.

3.1. Correlation Analysis

Correlation analysis was conducted to assess the magnitude and degree of relationship among variables in the study [33]. Table 3 shows the correlation coefficient between the factors and the dependent variable.

TABLE III. MINITAB 19 RESULTS - CORRELATION

Factors	Correlation Coefficient	Relationship
Government Support	0.466	Moderate correlation
Typhoon – Flood Experience and Knowledge	0.528	Moderate correlation
Geographical Perspective	0.394	Weak correlation
Perceived Severity	0.439	Moderate correlation
Perceived Vulnerability	0.360	Weak correlation
Perceived Behavioral Control	0.564	Moderate correlation
Social Norms	0.637	Moderate correlation
Attitude Toward the Behavior	0.633	Moderate correlation
Intention to Follow	0.738	Strong correlation
Behavior	0.872	Strong correlation

Based on the Spearman rank correlation results, the researchers determined the correlation coefficient to establish the depth of the connection among the independent variables and the dependent variable. Factors such as Intention to follow and Behavior showed a strong correlation with Perceived effectiveness. Thus, Typhoon-flood knowledge and experience, Perceived severity, Social norms, Perceived behavioral control, Government support, and Attitude toward the behavior presented a moderate correlation with the dependent variable. Finally, the Geographical perspective and Perceived vulnerability variables caused a weak correlation over Filipinos' perceived effectiveness.

3.2. Multiple Regression

The data gathered was further processed using the Minitab 19 statistical software. The researchers also used the Stepwise regression to determine the statistically significant variables and remove the values identified as outliers through the multiple regression analysis.

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	5	6619.65	87.19%	6619.65	1323.93	526.91	0.000
GR	1	1720.57	22.66%	11.44	11.44	4.55	0.033
PBC	1	1241.70	16.36%	142.76	142.76	56.82	0.000
SN	1	572.31	7.54%	130.69	130.69	52.01	0.000
IF	1	2290.18	30.17%	187.62	187.62	74.67	0.000
B	1	794.89	10.47%	794.89	794.89	316.36	0.000
Error	387	972.39	12.81%	972.39	2.51		
Lack-of-Fit	375	972.39	12.81%	972.39	2.59	*	*
Pure Error	12	0.00	0.00%	0.00	0.00		
Total	392	7592.04	100.00%				

Fig. 2. Minitab results – Analysis of variance.

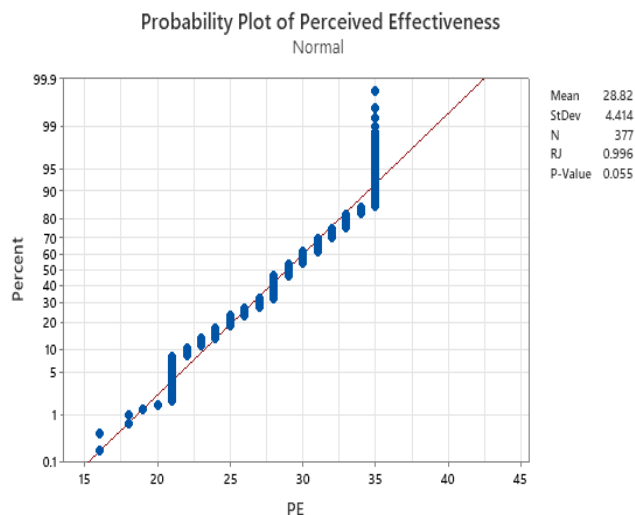


Fig. 3. Probability plot of Filipinos' perceived effectiveness in flood disaster response.

Based on the results reflected in Figure 2, factors such as Government support (p-value = 0.033), Perceived behavioral control (p-value = 0.000), Social norms (p-value = 0.000), Intention to follow (p-value = 0.000), and Behavior (p-value = 0.000) were identified to be statistically significant variables contributing to Filipinos' perceived effectiveness on flood disaster responses during the 2020 Typhoon Vamco.

A normality test was done to check the data validity data. The probability plot showed a p-value of 0.055 providing an indication that the data is normally distributed at a 0.05 level [34] (see Figure 3).

Furthermore, the multiple regression model provided an R-sq value of 87.19%, signifying model fitness. Also, the R-sq value decreases by 0.16% from the R-sq (adj) value, affirming that if a predictor is included in the regression model, the data enhances below the projected possibility [33].

TABLE IV. MINITAB RESULTS – MODEL SUMMARY

S	R-sq	R-sq(adj)
1.58513	87.19%	87.03%

Figure 4 shows the variance inflation factor (VIF) results. Based on Necio et al. [33], if there are no values of the VIF equal to 1, all predictors and factors are correlated to one another. Furthermore, all variance inflation factor values are lower than the value of 5.00, indicating that no multicollinearity has occurred, as evident in the studies of Kurata et al. and Ong et al. [8,34].

Term	Coef	SE Coef	95% CI	T-Value	P-Value	VIF
Constant	0.671	0.569	(-0.449, 1.790)	1.18	0.240	
GR	0.260	0.122	(0.020, 0.500)	2.13	0.033	1.75
PBC	0.972	0.129	(0.718, 1.225)	7.54	0.000	1.44
SN	0.985	0.137	(0.716, 1.253)	7.21	0.000	2.04
IF	1.506	0.174	(1.163, 1.849)	8.64	0.000	2.34
B	3.264	0.184	(2.903, 3.625)	17.79	0.000	2.62

Fig. 4. Minitab results – Variance inflation factors.

4. Discussion

Typhoon Vamco hit the Philippines in November 2020. Filipinos experienced catastrophic damages, as Typhoons Goni and Vamco resulted in severe flooding in the National Capital Region and other provinces as it moved over the Luzon Island in the Philippines. To optimize people's disaster response, it is evident to learn the substantial factors that may affect its effectiveness.

Results show that Government response was considered a significant variable in the flood disaster response perceived effectiveness. The Philippines is known to be susceptible in numerous natural disasters like typhoons, the local government units should be in the core responsibility in providing and guiding the people to facilitate the core response in their community [35]. Domingo et al. [35] highlighted that providing essential learning about a disaster, information dissemination among people, awareness training and enrichment activities to communities, and determination and building of safe evacuation centers constitute community leaders' necessary functions and responsibilities. However, as people usually seek the aid of local government units, its disaster plans should be flexible enough as natural disasters differ from one another [36].

Perceived behavioral control was also determined significant to the disaster response's perceived effectiveness. People's behavior in experiencing flood disasters contributed to personal sensibility in recognizing the possibility of the hazardous effects of natural disasters. Furthermore, experiential learning of affected families impacts how people respond to disasters, particularly their response actions [37]. Curiously, as people improve the sense of developing the importance of response to natural disasters, it is evident that Filipinos still do not see the importance of getting insurances. Most Filipinos see acquiring insurances as an additional cost to their finances, as insurances in the Philippines are voluntary rather than mandated except for employment-related insurances, and people do not realize its benefits [38].

Most people adapt their actions based on the people that surround them. This behavior results from the community's communal interaction and the increasing anxieties among people due to disasters, based on the study of Moussaïd et al. [9, 39]. The local community can encourage people in their communities to engage in activities that can enhance their skills in dealing with disaster preparedness.

With this, the community adapts to how local government units implement their safety guidelines, increasing the possibility of devastating effects [40-42]. This finding substantiates that Intention to follow, Social norms, and Behavior significantly affect Filipinos' flood disaster response's perceived effectiveness.

Even though the study was able to provide promising results, the researchers acknowledge the limitations of the study. First, due to the COVID-19 pandemic restrictions placed in the country, the study's dataset was gathered through a self-administered survey distributed online. Interviews with Filipino residents affected by the flooding may be done to capture more variables that may be evident with the perceived effectiveness in the disaster response. Second, the study considered only three factors affecting the flood disaster response: Geographical perspective, Government response, and Typhoon-flood knowledge and experience. Future research may consider factors such as Culture, Socio-demographic attributes, Disability, and Social diversity may also affect people's effectiveness in responding to natural disasters. Lastly, future studies may consider using other tools such as machine learning algorithms such as Random Forest Decision Tree, XG Boosted Decision Tree, and Artificial Neural Networks to develop more diversified and optimized results.

5. Conclusion

In November 2020, the Philippines experienced Typhoon Goni, the 2020's strongest typhoon that hit Luzon Island, shortly followed by Typhoon Vamco. With the short period between the occurrence of these typhoons, the 2020 Typhoon Vamco brought people catastrophic and resulted in severe flooding, congested evacuation centers, and stranded people amidst the COVID-19 pandemic. This study intended to identify the statistically significant variables influencing Filipinos' flood disaster response's effectiveness with Typhoon Vamco. Several factors were investigated in the study such as Geographical perspective (GL), Government response (GS), and Typhoon-flood knowledge and experience (TPE), incorporating the behavioral theories of TPB and PMT. These variables were simultaneously assessed using the multiple regression analysis and stepwise regression.

Results indicated that Government response, Perceived behavioral control, Intention to follow, Social norms, and Behavior were statistically significant to Filipinos' flood disaster response perceived effectiveness with 87.19% model fitness. The behavior of people contributes to their receptivity in realizing their vulnerability to the effects of natural disasters. This behavior is evident in their adaptation to their environment. Though some limitations were recognized, the study is advantageous for researchers and local government units to develop the appropriate flood disaster response to minimize typhoon effects resulting from floods.

6. References

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