

Analysis of Factors Influencing the Perceived Effectiveness of Disaster Relief Operations Using Structural Equation Modeling

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Abstract

The Philippines is frequented by natural disasters and around 74% of its population of more than 100 million is subject to various impacts from these disasters, and the country routinely ranks among the top 10 natural disaster-prone countries in the world. Mitigation efforts depend on a network of early-warning systems and on establishing mechanisms to respond more quickly to natural disasters. The latter concern, specifically disaster relief operations, is of utmost importance before, during and after a disaster and needs continual improvement of mechanisms for effective and efficient disaster response. In view of the need of government institutions involved to improve institutional mechanisms for immediate and effective disaster response, this study took on the interest to analyze the factors that significantly contribute to effective practices and innovative approaches in the implementation of the disaster response services. Structural Equation Modeling (SEM) approach was employed to examine these factors that influence the perceived effectiveness of disaster relief operations by integrating the Protection Motivation Theory (PMT) that is anchored on threat appraisal and coping appraisal, factors of which were incorporated in 29 survey questions fielded to 150 respondents who experienced disaster in flood-prone areas. Results showed that both appraisal and its factors had significant direct on stakeholder strategy which consequently has a mediating effect on the perceived effectiveness of disaster relief operations.

Keywords

Protection Motivation Theory, threat and coping appraisal, stakeholder strategy, Structural Equation Modeling (SEM)

1. Introduction

In the past years, natural disasters, such as earthquakes, floods, and volcanic eruptions, often caused big economic damage to society and disturb millions of human lives (Wex, et al., 2014). According to United Nations Office for Disaster Risk Reduction (UNISDR, 2018), there are 7,255 disasters that occur from 1997-2018 in which 4.4 billion of people were affected. Furthermore, 43.25% were flood-related disasters. With the intensive impact and increasing number of natural disasters, most researchers have paid attention to the concept of Disaster Management.

According to the World Risk Index Report (2018), the Philippines ranked third as the most disaster-prone country with an average of twenty typhoons every year, which led to massive flooding. In November 2013, Typhoon Haiyan or locally known as “Yolanda” hit the Philippines, which affects 14.1 million people and causes 6,000 fatalities (OCHA, 2014). Due to heavy physical damage and losses on buildings and infrastructure, the communication system in the entire Central Visayas went down, which makes the disaster relief operations a challenging one (National Disaster Risk Reduction and Management Council, 2014).

Jovita et al. (2018) stated in their study that despite the implementation of Republic Act 10121 (2009), the Philippine law on disaster management, the effects of typhoons remain tremendous in the country. Additionally, it might be deduced that the policy is being implemented ineffectively and that the Philippine government is performing poorly. According to the Department of Social Welfare and Development's (2015) disaster response operations standards, not all affected persons receive adequate support. Based on the problem tree analysis conducted by DSWD, some of the possible causes are lack of coordination between the concerned units, poor targeting and prioritization due to

insufficient knowledge on the number and characteristics of potentially affected people, depleted stocks in the market, transport and other logistics support are insufficient, infrastructure is unserviceable, lack of volunteers, and lack of trained backup emergency staff. To summarize, these problems happen due to a lack or unclear policies, guidelines, and processes on the disaster response. Moreover, there are different stakeholders that can affect the performance of the disaster relief operations. The stakeholders are the following: (1) victims, (2) local government unit, (3) government agencies, (4) non-government organization; and (5) partners (suppliers/logistics companies). The local government unit, government agencies, non-government organization, and suppliers/logistic companies provide assistance and help to the victims.

The greatest challenge in the overall planning of the disaster relief operations is to avoid unnecessary use of the resources as faster relief operations or response time means a greater likelihood of saving lives (Wisetjindawat, 2014). Thus, a stakeholder approach in this regard will be of utmost importance in influencing the response time, being a function of relief resource availability, flooded area accessibility, and transport from a relief resource center to a flooded area. Given the Philippines' vulnerability to perennial rainy typhoons and susceptibility to flooding disasters, it will be of great interest to seek an answer to a research question, "What would be the best strategy in effectively and efficiently responding to flood-disaster prone areas?" Hence, the focus of this study will be the response phase of disaster management which consists of allocating and delivery of relief resources effectively and efficiently to the flood-disaster-prone areas. Furthermore, this study aims to achieve the following objectives:

1. To assess the perceived threat between flood-disaster-prone areas and the perceived effectiveness of the current approach in the correspondence of relief distribution.
2. To recommend a response policy framework in allocating and delivering the relief resources to flood-disaster-prone areas.

The results of the study will significantly contribute to improving the disaster relief operations in the Philippines by way of recommending a response policy framework in the allocation and delivery of relief resources in the flood-disaster areas while considering the various significant factors affecting the perceived effectiveness of disaster relief operations. Through the improved disaster relief operations, this can help the stakeholders to lessen the number of casualties and provide immediate assistance to the affected areas in a timely fashion.

2. Methods

A cross-sectional study will be carried out based on the researcher's survey questionnaire which examines the relationship between the perceived effectiveness of the relief distribution and other variables of interest in the Philippines. The main objective of this study is to identify how the affected individuals and families perceived the threat of a natural disaster and how they perceived the effectiveness of the disaster relief operations of the National Disaster Risk Reduction and Management Council. Thus, this study will be guided by the operational framework as shown in figure 1.

H1₀: There is no significant relationship between threat appraisal and the stakeholders' strategy.

H1_a: There is a significant relationship between threat appraisal and the stakeholders' strategy.

H2₀: There is no significant relationship between the coping appraisal and the stakeholders' strategy.

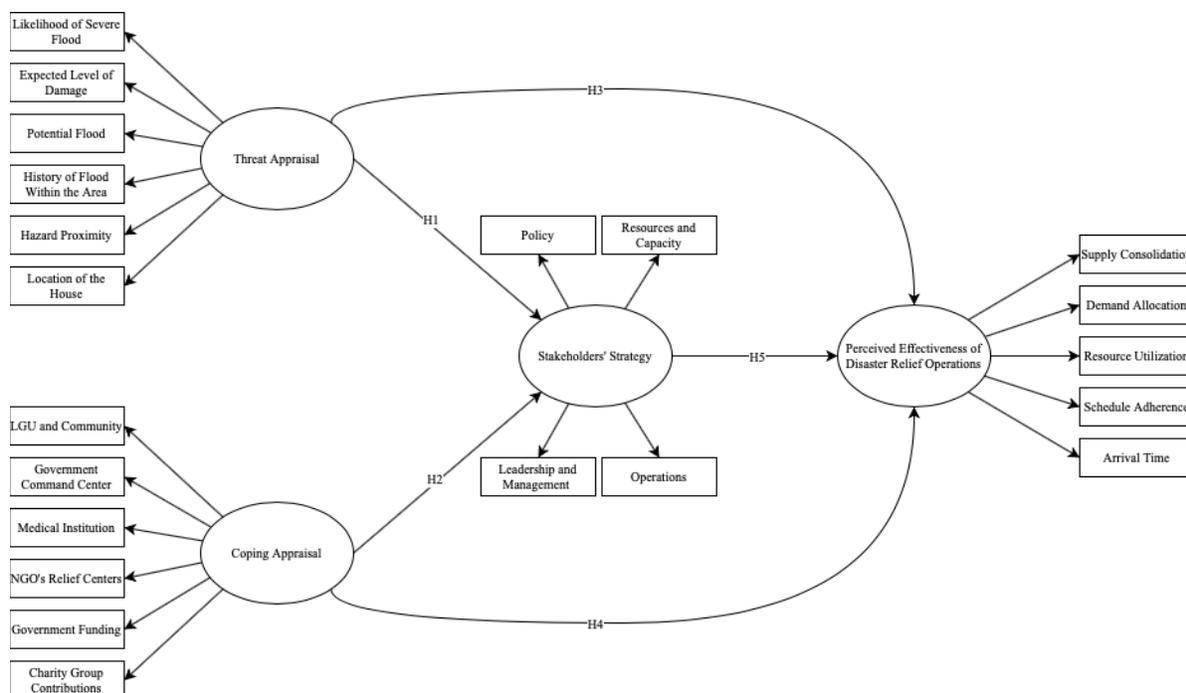
H2_a: There is a significant relationship between the coping appraisal and the stakeholders' strategy.

H3₀: There is no significant relationship between threat appraisal and the perceived effectiveness of disaster relief operations.

H3_a: There is a significant relationship between threat appraisal and the perceived effectiveness of disaster relief operations.

H4₀: There is no significant relationship between the coping appraisal and the perceived effectiveness of disaster relief operations.

H4_a: There is a significant relationship between the coping appraisal and the perceived effectiveness of disaster relief operations.



H5₀: Stakeholders' strategy has no mediating effect between the relationship between threat appraisal and coping appraisal to perceived effectiveness of the disaster relief operations.

H5_a: Stakeholders' strategy has a mediating effect between threat appraisal and coping appraisal to perceived effectiveness of the disaster relief operations.

Figure 1. Operational Framework

3. Data Gathering

The primary instrument of this study will be in a form of a survey questionnaire that will be distributed to residents in flood-prone areas in the National Capital Region (NCR), Philippines. Since latent structures are not observed, it is based on the variables of interests given in a 5-point Likert-scale operational framework measured by the survey answers. Five (5) sections of the survey are included in this questionnaire: (1) a socio-demographic profile, (2) a risk assessment, (3) a coping assessment, (4) a stakeholder strategy, and (5) a perceived disaster relief operation effectiveness.

4. Data Analysis

The analysis of constructs and its indicator variables reflected on the initial SEM model in Figure 2 will be aimed at determining the significant factors that affect the perceived effectiveness of disaster relief operations in disaster-prone areas.

Structural Equation Modeling (SEM) will be applied in this study to examine the specified hypotheses regarding the relationships of the interacting variables. Additionally AMOS 22, an SPSS module with a maximum likelihood estimation methodology will be used to obtain a model fit for causal links. The SEM construct has four (4) latent variables, one (1) mediating variable (the stakeholders' strategy), and one (1) endogenous variable (the perceived effectiveness of disaster relief operations).

On the other hand, six measurements will be utilized to examine the model's fit in order to ascertain the model's percentage of variation. These include the Incremental Fit Index (IFI), the Tucker Lewis Index (TLI), the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), the Adjusted Goodness of Fit Index (AGFI), and the Root Mean Square Approximation Error (RMSEA).

The results of the data analysis will be separated into two sections. To begin, the SEM results will yield hypotheses test findings indicating which elements are significant, and path analysis of the built structural model will reveal the direct and indirect effects of significant factors and relationships. Second, the aforementioned findings will provide insight into how to leverage and reinforce the major aspects influencing stakeholders' strategy to influence the perceived efficacy of disaster relief operations.

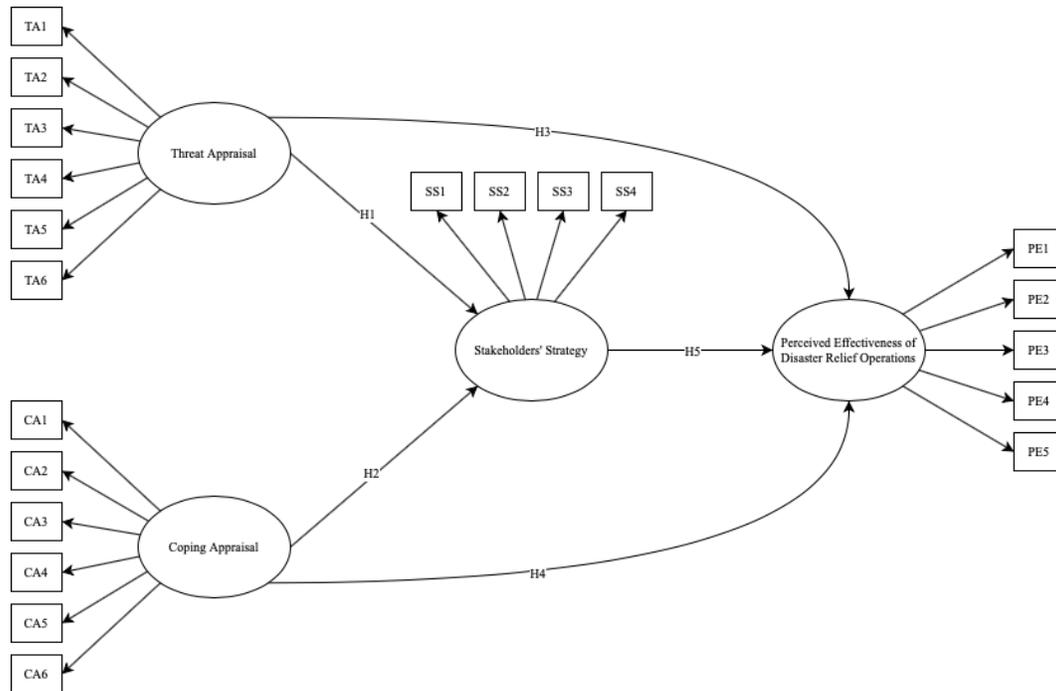


Figure 2. Initial SEM

5. Results and Discussion

Table 1 represents the demographic profile of the respondents. Among the 150 respondents, 56% of them were female and 44% of them were male. Most of the respondents were between the ages of 18 to 35 years old (64.67%). About 46% of them were between the ages of 36 to 55 years old, 4% were older than 55 years old, and only 2% for ages below 18 years old. Approximately 75.33% of the respondents have a bachelors degree, 10% were highschool graduates and have masters degree, 2% were elementary graduates and has taken only technical vocational courses, and only 0.67% has a PhD degree. Most of the respondents mentioned that there are 2 adults (older than 18 years old) in their household (23.33%). Approximately 22.67% mentioned having 3 adults in their household, 18% with 4 adults, 16.67% with more than 4 adults, 15.33% with only 1 adult, and only 4% mentioned having no adult in their household aside from themselves. On the other hand, most of the respondents mentioned that there are no children in their current household (55.33%). Approximately 17.33% has 2 children in their current household, 15.33% has 1, 4.67% has 3 and 4 children, and only 2.67% has more than 4 children in their current household. Based on the result of the survey, 88% of the respondents live in a household with a person with limited mobility. Most the respondents owns a car (66.67%) while others do not (33.33%). Finally, approximately 66.67% of the respondents' properties are not insured for natural disasters while only 33.33% has.

Table 1. Demographic Profile (n=150)

Characteristics	Category	N	%
Gender	Male	66	44.00
	Female	84	56.00
Age	Below 18 years old	3	2.00
	18 to 35 years old	97	64.67
	36 to 55 years old	46	30.67
	Older than 55 years old	4	2.67
Educational Attainment	Elementary	3	2
	Highschool	15	10
	Technical Vocational	3	2
	Bachelor	113	75.33
	Master	15	10
	PhD	1	0.67
Number of Adults in Household (Older than 18 years old)	None	6	4.00
	1	23	15.33
	2	35	23.33
	3	34	22.67
	4	27	18.00
	More than 4	25	16.67
	Number of Children in Household (3 to 18 years old)	None	83
1		23	15.33
2		26	17.33
3		7	4.67
4		7	4.67
More than 4		4	2.67
Living in Household with Limited Mobility	Yes	132	88
	No	18	12
Car Ownership	Yes	100	66.67
	No	50	33.33
Property Insured	Yes	50	33.33
	No	100	66.67

The measurement model for evaluating and deciding the significant factors that influence the perceived effectiveness of disaster relief operations in the Philippines is depicted in Figure 3. The researcher used the SEM approach to estimate the parameters' values to capture the model's measurement's reliability. Based on the result of the model fit test in table 2, the initial model met the suggested cut-off, which means it qualified for a good model fit. Thus, a revision of the model through modification of indices is no longer required. Finally, the direct, indirect, and total effects are presented in table 3.

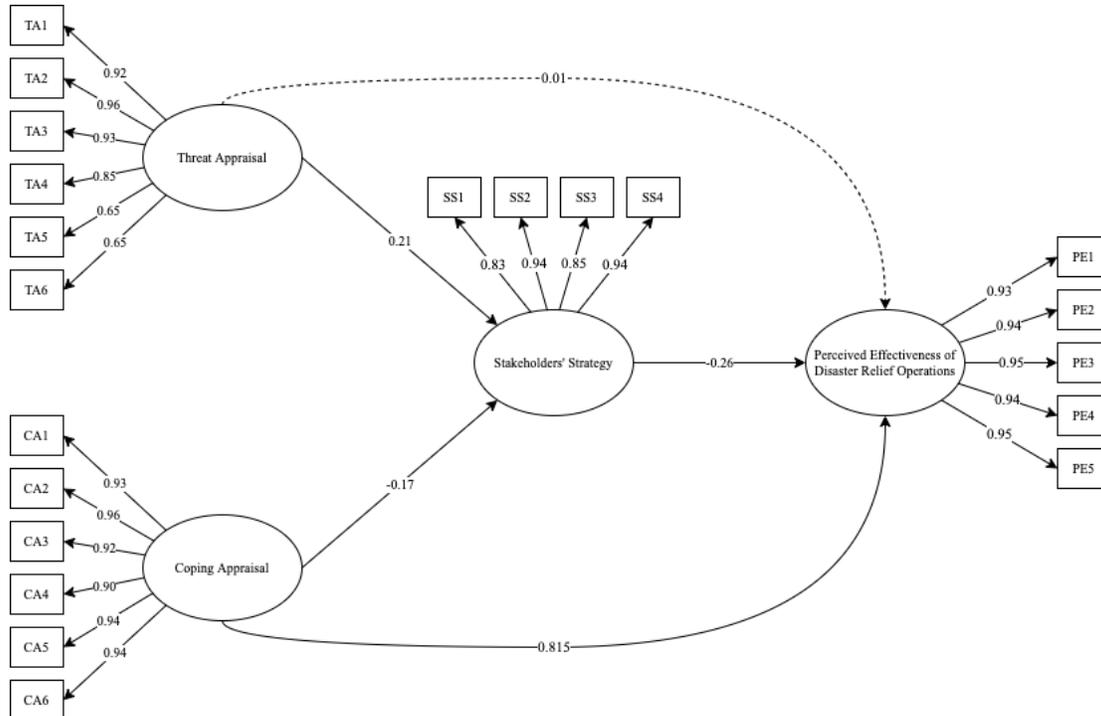


Figure 3. Final SEM Output Model

Table 2. Model Fit Test

Measure	Parameter Estimates	Minimum Cut-off	Suggested By
IFI	0.947	> 0.90	Hair (2010)
TLI	0.934	> 0.90	Hu and Bentler (1999)
CFI	0.946	> 0.90	Hair (2010)
GFI	0.829	> 0.80	Gefen et al. (2000)
AGFI	0.809	> 0.80	Gefen et al. (2000)
RMSEA	0.069	≤ 0.05 – 0.08	Steiger (2007)

Table 3. Direct Effects, Indirect Effects, and Total Effects

Variables	Direct	P-value	Indirect	P-value	Total Effect	P-value
TA → SS	0.205	0.012	-	-	0.205	0.012
CA → SS	-0.170	0.032	-	-	-0.170	0.032
TA → PE	0.014	0.792	-0.120	0.792	0.134	0.792
SS → PE	-0.264	0.027	-	-	-0.264	0.027
CA → PE	0.815	0.001	-	-	0.815	0.001

Based on the result of the SEM, threat appraisal has a significant direct effect ($\beta:0.21$, $p=0.012$), while coping appraisal has a negative significant direct effect ($\beta:-0.17$, $p=0.032$) on stakeholder's strategy on disaster relief operations. It could be interpreted that people who live in an area with a high expected level of damage think that the government command center should have a well-organized emergency plan for natural disasters, local government unit (LGU) and communities are well-coordinated, and a sufficient medical institution that can accommodate affected people. However, people are not confident with the sufficiency of NGO's relief centers for the distribution of humanitarian aid after a disaster. They often feel that there no sufficient government funds for natural disasters when disaster relief and initial recovery assistance are not adequate for their needs and not consistent with any applicable international standards of quality. Luna (2001) mentioned that with the volume of resources pouring in for relief distributions, questions are often raised about the government's use of these funds. Non-Governmental Organizations (NGOs) in the Philippines express disappointment with the bureaucratic rules governing disaster response, claiming that mandatory protocols result in unreasonable delay. For instance, the LGU's calamity fund may be used only after a state of catastrophe has been proclaimed if at least one-third of the area is impacted; but, if a disaster strikes in a smaller, isolated area, no state of calamity can be established. As a result, the calamity fund cannot be accessed. On the other side, numerous Philippine NGOs have been vocal in their criticism of the government in a variety of areas. NGOs are frequently seen on the street, protesting and pushing for improved disaster preparations, mitigation, and response, as well as condemning the government's policies. The primary issue is that the Philippine government administration tends to be reactive, which is an outcome of not having enough institutional capability but poor processes and practices. While many regulations could go a considerable way to preventing and/curtailing disasters, they are not sufficiently enforced in the Philippines. Laws are seen as being flaccid because of government initiatives. When calamity strikes, corruption spreads rapidly.

Regarding stakeholder's strategy, SEM showed that it has a negative significant direct effect on the perceived effectiveness of disaster relief operation ($\beta:-0.264$, $p=0.027$). Based on the result, one of the significant problems in disaster relief operations is that people do not think that the relief goods came on time as they expected due to inefficient distribution of relief goods schedule. Hence, affected people feel that the stakeholders were not able to accommodate all of the demands. It could also be interpreted that stakeholder's strategy has a mediating effect on the perceived effectiveness of disaster relief operations. Therefore, Policymakers should ensure that the government command center for natural disasters should be well-coordinated and has a well-organized emergency plan. Moreover, policymakers should also ensure that the assistance should be consistent with the international standards of quality and is conducted sensitively to cultural, social, and religious customs and traditions.

Surprisingly, coping appraisal has a significant direct effect on the perceived effectiveness of disaster relief operations ($\beta:-0.815$, $p=0.001$). It could be interpreted that having sufficient relief centers for the distribution of humanitarian aid after a disaster makes people think that the stakeholders have sufficient and adequate resources to accommodate all the demands. Moreover, people feel confident that the government funding for natural disasters is sufficient when stakeholders were able to utilize all the resources for the distribution of relief goods. On the other hand, threat appraisal was found to have no significant direct effect on the perceived effectiveness of the disaster relief operations but a negative indirect effect. This could mean that when people are less threatened by the disaster, they more likely to think that stakeholders have provided them confidence and perceived that their disaster relief operations are effective.

5.1 Response Policy Framework

Previous research has mentioned the substantial efforts of the stakeholders in managing the allocation and delivery of relief goods during natural disasters. However, the absence of a disaster relief operations framework for natural disaster management has limited their effectiveness. Figure 4 was developed based on findings from SEM to address the second objective of this study.

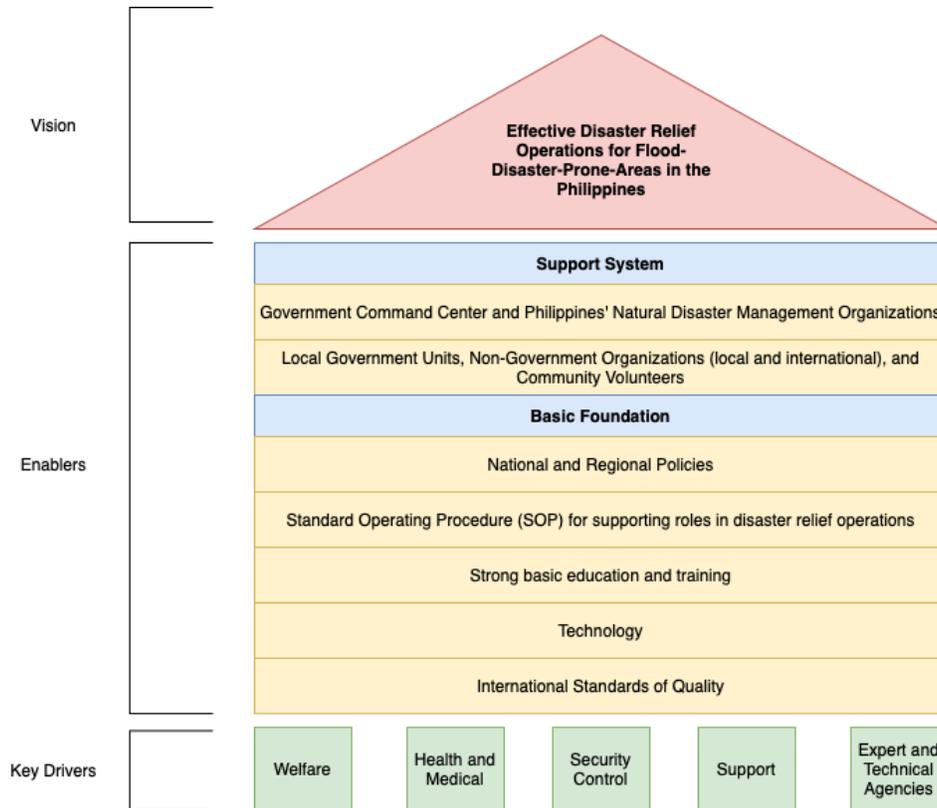


Figure 4. Proposed Disaster Relief Operations Framework

The main vision of the proposed framework is to provide effective disaster relief operations for natural disasters, specifically in flood disasters. All the respondents of this study agreed that all disaster relief operations stakeholders should have the coordination to provide an effective and efficient emergency plan during and post-disaster.

The term “key drivers” in figure 4 is defined as the leading factors affecting the perceived effectiveness of disaster relief operations based on the SEM result. A detailed explanation is presented below as follows:

1. Welfare in disaster relief operations entails locating and securing all impacted victims, preparing meals for vulnerable communities and duty officers, providing and supervising evacuation sites, as well as giving first assistance and counseling to disaster victims.
2. Health and medical personnel are responsible for emergency treatment, forensic services, and public health during disaster relief operations. All disaster victims should receive medical treatment in medical facilities or evacuation centers during a crisis.
3. During disaster relief operations, security control's responsibility is to maintain control at the location of the incident, conduct an investigation, and facilitate community dialogue.
4. Assistance is a necessary component of disaster relief operations. Support's function is to aid with logistics, relationships, and other aid necessary to smooth out the operation's movement control in order to overcome the disaster.
5. Expert and technical agency services are needed to examine the disaster situation and assist stakeholders in mitigating the crisis's impacts.

The term "enabler," on the other hand, refers to a person or organization that enables something. The researcher classified enablers into two categories: support system and fundamental foundation. For the support system, disaster relief operations are separated into two categories: primary stakeholders (i.e., government command centers and disaster management organizations) and secondary stakeholders (non-governmental groups such as LGUs, NGOs, etc.).

In terms of foundations, disaster relief operations require four fundamentals. To begin, there is a need for a clear national and regional policy for disaster relief management. The policy serves as the framework for a holistic disaster management procedure that encompasses pre-disaster, disaster response, and post-disaster phases. The policy's implementation could save wastage, misunderstanding, conflict, inconsistencies, or duplication of tasks in responding to the disaster. Second, each government agency that participates in disaster relief operations follows a standard operating procedure (SOP) that is based on national policy and the needs of their department. All government actions should be conducted in accordance with the SOP. However, it was mentioned previously that there is no standard SOP for all NGOs as a supporting stakeholders to become involved in the disaster relief operations. Hence, policymakers should provide a standard SOP for supporting stakeholders to avoid any problems during a disaster occurrence. Third is the training and education. Respondents of this study mentioned that disaster relief operations participants should be trained properly before involving in such activities. Both training and education are critical for increasing awareness and knowledge about the duties and duties associated with humanitarian aid management. Finally, technology. The use of technology to transmit catastrophe information could increase communication, collaboration, and coordination among disaster management stakeholders. People feel that if appropriate technology is employed in humanitarian relief, various issues such as fake reports (Gao et al., 2011; Ha, 2016) or redundancy of information (Gao et al., 2011) about a disaster will be eliminated. Food redundancy, unequal distribution of food supplies to catastrophe victims, and food insecurity are all challenges (Hussain & Ismail, 2011).

5.2 Limitations

Despite the substantial contributions of this study, the researcher would like to acknowledge several limitations. To begin, statistical tests require a greater sample size to establish a representative distribution of the population and to be regarded as reflective of the groups of people to whom results will be generalized or transferred. Future research should collect a larger sample size to obtain a more thorough conclusion, as this affects the calculated parameters' correctness and model fit statistics. Second, this study was mainly focused on the perceived effectiveness rather than the effectiveness of disaster relief operations. A future study to correlate the perceived effectiveness and preparedness of the stakeholder's on disaster relief operations. And lastly, this study did not consider the disaster management communications in the stakeholder's strategy. Future studies should also take consideration of the early warning systems and responsible agencies for early warning to improve the effectiveness of disaster relief operations in the Philippines.

6. Conclusion

The Philippines is frequently affected by a natural disaster, placing third in the World Risk Index with a risk proportion of 27.98 percent and ranking as the third most vulnerable country to natural disasters. Tropical cyclones and flash floods are the country's two most devastating natural calamities, affecting over 132 million Filipinos. These two phenomena are frequently linked, as typhoons frequently bring torrential rains that cause flash floods. The current study used Protection Motivation Theory (PMT) to examine factors influencing the perceived effectiveness of disaster relief operations in flood-prone areas of the Philippines, specifically in the National Capital Region (NCR). The online questionnaire elicited responses from 150 individuals and featured 29 questions.

The results of Structural Equation Modeling (SEM) indicated that awareness and preparedness of the people greatly influence the threat appraisal of this study as it showed a significant direct effect on stakeholder's strategy. The coping appraisal also showed a significant direct effect on the stakeholder's strategy indicating that policymakers should give importance to relief and debriefing before and after a flood disaster. Also, stakeholder's strategy had a negative significant direct effect on the perceived effectiveness of disaster relief operations. In this study, it was also proven that stakeholder's strategy had a mediating effect on the perceived effectiveness of disaster relief operations. Therefore, a proposed disaster relief operation was established considering the various significant factors identified in this study. The proposed disaster relief operations can help the stakeholders lessen the number of casualties and provide immediate assistance to the affected victims quickly.

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Biography

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