Factors Related to Coastal Communities' Water-Related Natural Disaster Awareness, Preparedness, Resilience and Recovery in Three Cyclone Nargis Affected Areas in the Ayeyarwaddy Delta Region, Myanmar

Zay Yar Min[1], Kampanad Bhaktikul[1*], Sayam Aroonsrimorakot[1], Saranya Sucharitakul[1], Allan Sriratana Tabucanon[1], and Budi Eko Siswoyo[2]

[1]*Faculty of Environment and Resource Studies, Mahidol University, Nakhon Pathom 73170, Thailand*
[2]*Faculty of Social Sciences and Humanities, Mahidol University, Nakhon Pathom 73170, Thailand*

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*** Corresponding author:**
E-mail:
kampanad.bha@mahidol.ac.th

ABSTRACT

Natural disasters have a negative impact on the socio-economy of a country. This cross-sectional analytical study determined the factors that influence coastal communities' water-related disaster awareness, preparedness, resilience and recovery in Cyclone Nargis affected areas in Myanmar. A total of 390 respondents from the three townships most affected by Cyclone Nargis in the Ayeyarwaddy Delta Region were purposively selected. Data were analyzed using SPSS Version 22.0. Associations between variables were analyzed by using binary logistic regression with $p<0.05$. Multivariate analysis was performed for the final model and interpreted with adjusted odds ratio and 95% confidence interval. Among respondents, more than 75% were not only aware and prepared before the disaster but had recovered and demonstrated resilience following the disaster. The respondents who had problems recovering on the "financial" index were 0.5 times less likely to exhibit recovery (OR=0.558, 95% CI=0.346-0.899, p=0.016) in binary analysis. The respondents who had problems recovering on the "health" index were 0.3 times less likely to demonstrate recovery (OR=0.387, 95% CI=0.194-0.772, p=0.007) in multivariate analysis. It is recommended that awareness and disaster management education programs that shape behavioral change are initiated which target both rural and urban areas in Myanmar.

1. INTRODUCTION

Natural disasters such as floods, tornadoes and cyclones have negative impacts on human life and the environment as well as economic implications. Globally, an average of 60,000 people die from natural disasters every year (OWID, 2019). Over the past decade, natural disasters have been responsible for 0.1% of deaths across the world (OWID, 2019). According to the UNDP (2014), it is estimated that disasters, mostly cyclones, hurricanes and earthquakes, cost >$ 180 billion (US) per annum and have become key global issues.

Disasters can be caused not only by nature but also by human error. Human societies are often created which lack sufficiently strong infrastructure to withstand natural pressures. This can lead to societies being placed in a vulnerable position. People who live in poorer countries are most vulnerable such that 90% of disaster fatalities occur in developing countries (UNDP, 2014). More generally, the same people are often the most affected by disasters because of poorly planned infrastructure and their inability to access resources. There are several factors that need to be considered to prevent disasters which impact on human environments, and it is essential to apply strategies to reduce the negative outcomes of natural disasters. To address this need, the United Nations Strategy for Disaster Risk Reduction (UNISDR) has

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developed a systematic approach called Disaster Risk Reduction (DRR), which mainly focuses on proactive activities to reduce disaster risks, and to strengthen capacities in vulnerable communities with information that supports sustainable development (UNISDR, 2005).

The occurrence of natural hazards which can lead to disasters has become more frequent, and repercussions more widespread due to vulnerability and a lack of resilience. Developing countries such as Myanmar are particularly vulnerable, and the effects of natural hazards can have a negative effect on their progress in achieving the Sustainable Development Goals (SDGs) set by the United Nations. This paper focuses on the Ayeyarwaddy Delta Region which is one of the low-lying disaster-prone areas in Myanmar where flooding frequently occurs as a consequence of storm surges, tropical storms and cyclones.

In May 2008, Myanmar suffered a severe and slow-moving cyclone, Nargis, which crossed the south of the country during a period which lasted over two days. The Ayeyarwaddy Delta Region, and its coastal communities, experienced the worst water- related natural disaster in the history of the region. According to the UN estimate, a total of 2.4 million people were affected (IFRC, 2011; PONJA, 2008). The number of people who died totaled 84,500 while 53,800 people were declared missing (IFRC, 2011). Although Myanmar had experienced disasters before Cyclone Nargis, the lack of public awareness and disaster preparedness exacerbated the effects of the cyclone. Awareness and preparedness were not limited to disaster risk reduction and sustainable resource management (UNEP, 2009), but technically refer to awareness on places to stay, community leaders' instruction, and water and food relocation; while preparedness includes evacuation plans and measures, early warning information sources, and government-supported training/drill exercises.

Stakeholders at the state and local level in Myanmar tend to put more effort into emergency relief and humanitarian assistance than reinforce the concept of "resilience" for sustainable integrated DRR. Disaster resilience is embedded in perspectives of sustainability, capability, and the capacity of individual, communities, organizations, and states to cope in response to a disaster. In this regard, disaster recovery can offer a strategic approach to increase resilience in farming communities to combat future shocks through risk-informed development activities (Parsons et al., 2016). The recovery process tries to ensure "build back better", to reduce pre-disaster risks (UNISDR, 2005) and consider aspects of restoration and reconstruction. A literature search revealed a limited number of natural disaster studies in Myanmar; in fact, no studies were found to have reported on factors related to disaster awareness, preparedness, resilience and recovery at community level in Myanmar. Accordingly, this paper studies the factors influencing disaster awareness, preparedness, resilience and recovery of water-related disaster among coastal communities in the Cyclone Nargis affected Ayeyarwaddy Delta Region of Myanmar.

2. METHODOLOGY

2.1 Study design and study area

This cross-sectional analytical study uses a mixed-methods approach and semi-structured questionnaires to investigate the coastal Ayeyarwaddy Delta Region which was purposively selected due to its long history as a water-related natural disaster-prone region in Myanmar. The paper is written with specific reference to the aftermath of the severe Cyclone Nargis in 2008. Based on The World Bank (2014) data, the three most Cyclone Nargis affected coastal communities, namely the townships of Bogale, Pyapon, and Ngapudaw, (Figure 1), were selected for this present study.

2.2 Sample size, sampling technique and data collection tools

The survey sample size of 390 respondents selected from three townships was calculated using Cochran's formula (Barlett et al., 2001). The survey respondents were selected through a multi-stage sampling process, using a mix of purposive and random sampling methods. Simple random sampling, the lottery method, was adopted to select respondents. This design includes the collection, analysis, and integration of qualitative and quantitative data in a single or multiphase study (Hanson et al., 2005).

A semi-structured questionnaire, adapted from an earlier study on knowledge and perceptions of natural disasters (Cvetković et al., 2015; Ozkazanc and Yuksel, 2015; OECD, 2010), was administered to respondents. The questionnaire, which mostly used Likert scale, consisted of six parts: Socio-demographic characteristics, Knowledge of the history of Cyclone Nargis, Awareness of disaster, Preparedness for disaster, Resilience arising from the 2008 Cyclone Nargis and Recovery from the 2008 Cyclone Nargis (Cvetković et al., 2015).

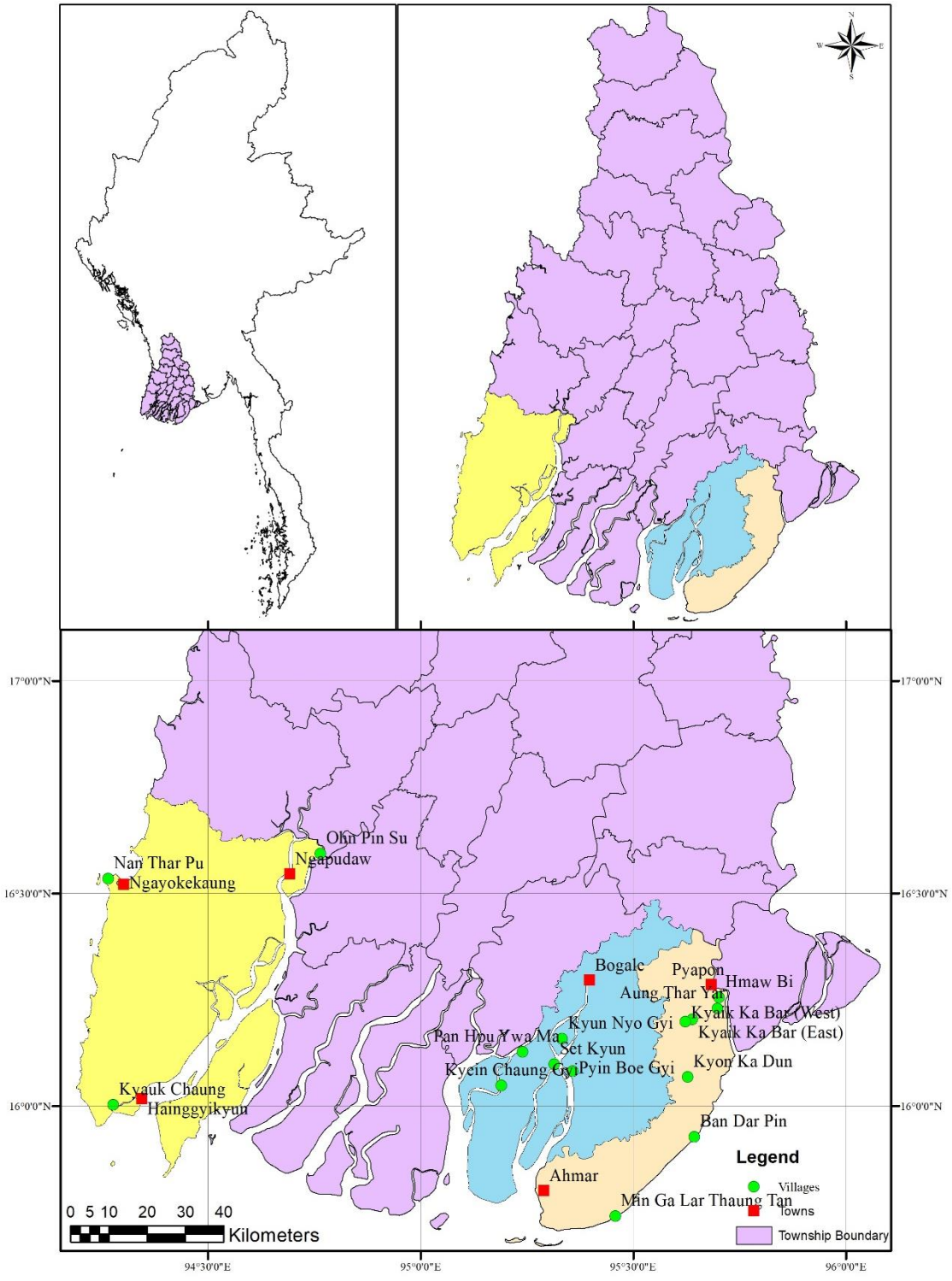

Figure 1. Selected study area in the Ayeyarwady Delta Region, Myanmar Myanmar (MIMU, 2019)

In the Awareness part of the survey, the total score varied from 0 to 7 where "0" represented "poor awareness" and "more than and equal to one" represented "active awareness". This variable consists of indicators related to play to stay, leader of the community, water for drinking, and food for store. In the Preparedness part, the total score varied from 0 to 11 where "0 to 3" represented "poor preparedness" and "more than and equal to 4" represented "active preparedness". This variable consists of indicators related to plans for evacuation, measures to prepare for natural disasters, finding the source of disaster predictions for early warning, and the status of local government in conducting training/drill. The use of the term "Government" which didn't specifically

mentioned its level, indicates government at all three levels, national, regional and local.

In the Resilience part of the survey, the total score varied from 0 to 3 where "0" represented "less resilience" and a score of "more than and equal to one" represented "high resilience". This variable consists of indicators related to hours/day closed before being evacuated, status of receiving food and water, and person organized for distribution of food and water. The Recovery question was categorized into "yes" and "no". This variable refers to current recovery of household after ten years from previous disasters.

2.3 Data analysis

Data analysis was performed using the software package Statistical Product and Service Solutions (SPSS) Version 22.0. All categorical variables were measured by frequency and percentage (Table 1). Associations between independent variables (socio-demographic characteristics, knowledge of the past history of Cyclone Nargis 2008) and dependent variables (awareness, preparedness, resilience and recovery) were analyzed using binary logistic regression (Table 2-5). Multivariate analysis was performed using multiple logistic regressions to check for a clear association between independent and dependent variables (Table 2-5). The results were interpreted with adjusted odds ratio (OR) and 95% confidence interval (95% CI). Statistically significant association was determined at a significance level of 0.05.

3. RESULTS AND DISCUSSION

3.1 Descriptive results

3.1.1 Descriptive results of independent variables

Most respondents (53.8%) were aged between 40-60 years, (83.1%) were married, 64.9% were self-employed, and among the 390 respondents, 69.2% were male and 30.8% were female. Regarding their resident township, 34.9% were from Bogale Township, 36.1% from Pyapon Township and 29% were from Ngapudaw Township. Among the respondents, almost all of them (82.6%) were from rural areas and 77.4% of their households were close to the river or coast. With regard to households, 53.3% of respondents had fewer than 4 household family members. In this study, most of the respondents (79.2%) received some storm warning before Nargis hit and among the 390 respondents, 72.2% received information from government, 16.8% from NGO and 11% from community leader respectively. Most of the respondents (83.1%) traveled to an evacuation shelter during Nargis by themselves, 30.5% got medical help from the government and 24.1% from an NGO. Regarding the most affected impact after one year of 2008 Nargis, 30.3% had an impact to their household income, 27.4% to theie livelihood, 22.3% to their health status and 20% to their related-education.

3.1.2 Descriptive results of dependent variables

According to the findings, more than 80% of respondents had an active awareness of water-related disaster. Among the respondents, almost all of them: 77.9% had an active preparedness, 82.7% had high resilience, and 74.4% of the households fully recovered overall. This result was supported by a study conducted in India among postgraduate students in a private dental institute on disaster management (Rajesh et al., 2011) and a study in Nepal on disaster risk reduction knowledge among local people (Tuladhar et al., 2015), which reported that more than 80 % of the respondents had an active awareness. Study on the impact of education and experience of disaster preparedness in the Philippines and Thailand (Hoffmann and Muttarak, 2017) also reported that about 78% of respondents had active disaster preparedness consistent with the disaster preparedness action.

Table 1. Level of awareness, preparedness, resilience and recovery of Ayeyarwaddy Delta Region respondents (n=390)

Variables	Frequency (n)	Percentage (%)
Awareness		
Active	326	83.6
Poor	64	16.4
Preparedness		
Active	304	77.9
Poor	86	22.1
Resilience		
High	343	87.9
Low	47	12.1
Recovery		
Yes	290	74.4
No	100	25.6

3.2 Associations between independent and dependent variables

3.2.1 Final model for the factors associated with awareness

Education level of the household head showed a statistically significant association with disaster awareness in the binary analysis, but the association was not statistically significant in multivariate analysis. These results are consistent with a study in Pakistan of the earthquake-prone city of Quetta on risk perception among households which showed that the higher the education level of a respondent, the more active awareness they had (Ainuddin et al., 2014). Another global project on reducing vulnerability to natural disasters (Muttarak and Lutz, 2014) stated that the promotion of public education would enhance adaptive capacity and reduce vulnerability in natural disasters. The 390 respondents in the Ayeyarwaddy Delta Region study who received "NGO" storm-warning information were found to be 3.6 times more likely to have active awareness than those who received information from their "Government" (OR=3.570, 95% CI=1.059-12.031, p=0.040) in binary analysis, and this association was statistically significant in multivariate analysis (OR=4.087, 95% CI=1.059-15.773, p=0.041). These local results were consistent with findings from a contemporary study on community-based disaster reduction activity in Sri Lanka (Kurita et al., 2007). It seems that "NGO" engagement with the local coastal communities in Myanmar was greater than that of the "Government" due to awareness-raising programs being widely conducted by NGOs after Cyclone Nargis in 2008. Findings of the key informant interviews reported that the community leaders, NGOs, and religious leaders also organized distributions of food, water, and medical assistance. Below, Table 2 shows the final model for the factors associated with awareness.

Table 2. Final model for the factors associated with awareness

Variable	Awareness	
	AOR (95% CI)	p-value
Residence township		
Bogale	1 (ref :)	
Pyapon	3.796 (1.320-10.917)	0.013*
Ngapudaw	2.569 (1.101-5.995)	0.029*
Residence area		
Urban	1 (ref :)	
Rural	2.413 (0.986-5.905)	0.054
In 2008, Received Warning Information from		
Government	1 (ref:)	
Community leader	0.398 (0.147-1.077)	0.070
NGO	4.087 (1.059-15.773)	0.041*
Longer-term support for crops after 2008 Cyclone Nargis (provision of rice seeds, fertilizers etc. for 2 to 8 years)		
No	1 (ref :)	
Yes	16.008 (1.492-171.739)	0.022*
Preparedness		
Poor	1 (ref :)	
Active	2.628 (1.167-5.916)	0.020*

*p-value <0.05, CI=Confidence interval

3.2.2 Final model for the factors associated with preparedness

Binary analysis shows that compared with families where the "father" was the head of household, those headed by "other relatives" were 0.1 times less likely to demonstrate active preparedness (OR=1.138, 95% CI=0.025-0.775, p=0.024). This result was consistent with a recent study in Serbia on the role of gender in preparedness and response behaviors towards flood risk (Cvetković et al., 2018). This consistency could be due to the same cultural context whereby the "father" takes the leading role in the family compared to other relatives in respect of both family affairs and other circumstances. The 390 Ayeyarwaddy Delta Region respondents who received "NGO" storm-warning information, however, were 0.3 times less likely to show active preparedness compared to those who received information from the "Government" (OR=0.256, 95% CI=0.132-0.499, <0.001) in binary analysis and (OR=0.222, 95%

CI=0.106-0.466, p<0.00) in multivariate analysis. This disparity between the effectiveness of "NGO" and "Government" storm-warning information could be due to underestimation of the risk of weather-related disasters by the population of coastal communities, based on their "natural" tendency to think that information-sharing by the "Government" was more accurate than that from other sources (Somers and Svara, 2009). Findings of the key informant interviews also reported that the government department of disaster management not only developed the disaster information and early warning system through TV, FM radio, and social media, but also through the "DAN (Disaster Alert Notification)" as a mobile application platform.

The respondents who received medium- term support (4 months to 2 years) and longer-term support (2 to 8 years) for education were 2.4 and 3.6 times more likely to have active preparedness (OR=2.444, 95% CI=1.033-5.784, p=0.042; OR=3.620, 95% CI=1.575-8.319, p=0.002) than other respondents according to the binary analysis. This result was consistent with another recent study on the importance of education on disasters and emergencies (Torani et al., 2019). These medium- and longer-term programs could be due to support not only for education in general but also for disaster education so that the respondents had active preparedness. The respondents who had "health" problems were 3.2 times more likely to have active preparedness (OR=3.219, 95% CI=1.317-7.870, p=0.010) in binary analysis and (OR=5.674, 95% CI=1.577-20.419, p=0.008) in multivariate analysis. In contrast, medically vulnerable cohorts of the population were less likely to have household disaster preparedness according to a study in the United States on disaster preparedness among medically vulnerable populations (Bethel et al., 2011). However, these medically vulnerable populations were more likely to prepare for their medical supply and this present study in Myanmar did not include detailed and specific questions related to health problems and medications. Below, Table 3 shows the final model for the factors associated with preparedness.

Table 3. Final model for the factors associated with preparedness

Variable	Preparedness	
	AOR (95% CI)	p-value
In 2008, Received Warning Information from		
Government	1 (ref :)	
Community leader	0.299 (0.131-0.682)	0.004*
NGO	0.222 (0.106-0.466)	<0.001**
In 2008, when Nargis hit your village/town, who took you to the evacuation place (Refuge/ Shelter)?		
Family member/myself	1 (ref :)	
Government	0.901 (0.274-2.965)	0.864
Community leader/NGO	0.276 (0.098-0.777)	0.015*
Awareness		
Poor	1 (ref :)	
Active	2.053 (0.969-4.350)	0.060
Longer-term Support for Education after 2008 Cyclone Nargis (from 2 to 8 years)		
No	1 (ref :)	
Yes	2.809 (1.218-6.481)	0.015*
Health problems from which to recover (problems to recover from 2008 Cyclone Nargis)		
No	1 (ref :)	0.008*
Yes	5.674 (1.577-20.419)	

* p-value <0.05, **p<0.001, CI=Confidence interval

3.2.3 Final model for the factors associated with resilience

The respondents who received storm-warning information before 2008 Cyclone Nargis were 2.2 times more likely to have high resilience (OR=2.207, 95% CI=1.140-4.275, p=0.019) according to binary analysis. This analysis pointed out that "receiving storm-warning information" was important in strengthening the resilience of the respondents during natural disasters as they needed to prepare for the disaster and to gain resilience. This result was consistent with another study that encouraged developing integrated and people-centered early warning systems to make progress toward the

resilience (Tanner et al., 2009). The respondents who had problems in recovering from "house destroyed and reconstruction constraints" were 3.9 times more likely to have higher resilience than those who did not have reconstruction constraints (OR=3.923, 95% CI=2.058-7.476, p<0.001) in binary analysis. Those two variables also maintained a statistically significant association in multivariate analysis where the value of p<0.001 (OR=3.906, 95% CI=2.037-7.489). Although respondents' houses were destroyed, they showed higher resilience than those whose houses were not destroyed. Their resilience could be due to support from the Government, local authority and NGOs in settling housing issues. Findings of the key informant interviews also reported that there is a Myanmar national action plan and framework for community disaster resilience and it has a short, medium, and long term mitigation strategies and activities plan. The Ministry of Home Affairs was in charge on maintaining law and order during the disaster, while the Department of Meteorology and Hydrology was responsible for disaster warnings. Below, Table 4 shows the final model for factors associated with resilience.

Table 4. Final model for factors associated with resilience

Variable	Resilience	
	AOR (95% CI)	p-value
In 2008 Cyclone Nargis, received storm warning		
No	1 (ref:)	
Yes	2.126 (1.061-4.260)	0.033*
Who organized medical help and assistance for injured people?		
Family member/Myself	1 (ref:)	
Government	0.473 (0.211-1.059)	0.069
Community leader/NGO	0.962 (0.420-2.206)	0.928
Longer-term Support for Education after 2008 Cyclone Nargis (from 2 to 8 years)		
No	1 (ref:)	
Yes	2.043 (0.956-4.365)	0.065
Problems from which to recover (House destroyed and reconstruction constraints) following 2008 Cyclone Nargis		
No	1 (ref:)	
Yes	3.906 (2.037-7.489)	<0.001**

* p-value <0.05, **p<0.001, CI=Confidence Interval

3.2.4 Final model for the factors associated with recovery

In multivariate analysis, respondents who were more than 60 years of age were 0.3 times less likely to recover than those who were below 40 years of age (OR=0.0325, 95% CI=0.148-0.712). The result of this study was consistent with a study on long-term impacts of natural disasters among survivors of a disaster in Azerbaijan which found that older population cohorts made less recovery and were more vulnerable compared to younger population cohorts (Rafiey et al., 2016). Less recovery and more vulnerable conditions could be due to factors associated with age such as chronic health conditions including cognitive ability and sensory awareness in terms of the long- term impacts of natural disaster (Rafiey et al., 2016). Those with a "high school" level of education among Cyclone Nargis survivors was 4.4 times more likely to lead to recovery compared with those who had attended "no school/ illiterate" (OR=4.413, 95% CI=1.425-13.668, p= 0.010) in binary analysis and (OR=5.250, 95% CI=1.386-19.888, p=0.015) in multivariate analysis. This result was supported by a study on reducing vulnerability to natural disasters which found that a higher education level led not only to better ability in situations of vulnerability but also a better perception of understanding risks thereby enabling those who participated in the study to act on threats and recover from natural disasters (Muttarak and Lutz, 2014). The respondents who received storm-warning information before Cyclone Nargis in 2008 were 1.7 times more likely to recover (OR=1.739, 95% CI=1.025-2.950, p=0.040) in binary analysis. This finding was consistent with an earlier study which demonstrated that those respondents who received storm-warning information before a disaster showed greater recovery which could have been due to personal responses to disaster management evacuation orders (Paul and Dutt, 2010). The Ayeyarwaddy Delta Region respondents who had problems recovering from "financial" difficulties were 0.5 times less likely to experience recovery than those who did not have home reconstruction constraints

(OR=0.558, 95% CI=0.346-0.899, p=0.016) in binary analysis. The respondents who had problems recovering in terms of their "health" were 0.5 times less likely to have experienced recovery than those who did not have health problems (OR=0.496, 95% CI=0.279-0.885, p=0.017) in binary analysis and (OR=0.387, 95% CI=0.194-0.772, p=0.007) in multivariate analysis. As respondents in these three coastal communities had low incomes, they needed financial support to recover from the disaster because they had suffered negative impacts including financial and health problems. On the other hand, findings of the key informant interviews also reported that the main challenges for the disaster management in Myanmar not only related to community knowledge and participation, but also budget capacity for emergency response, preparedness, and recovery. Below, Table 5 shows the final model for the factors associated with recovery.

Table 5. Final model for the factors associated with recovery

Variable	Recovery	
	AOR (95% CI)	p-value
Age		
<40 years	1 (ref:)	
40-60 years	0.958 (0.495-1.852)	0.898
>60 years	0.325 (0.148-0.712)	0.005*
Residence Township		
Bogale	1 (ref:)	
Pyapon	0.676 (0.306-1.495)	0.333
Ngapudaw	2.087 (0.994-4.379)	0.052
Education level of Household		
No school/Illiterate	1 (ref:)	
Primary school	3.754 (1.111-12.691)	0.033*
Middle school	7.974 (2.241-28.377)	0.001*
High school	5.250 (1.386-19.888)	0.015*
University education	16.869 (2.455-115.917)	0.004*
Number of household members		
<4	1 (ref:)	
>4	1.678 (0.978-2.881)	0.060
Medium-term Support for Crops after 2008 Cyclone Nargis (provision of rice seeds, fertilizers etc. (for_4 months to 2 years)		
No	1 (ref:)	
Yes	4.214 (2.040-8.702)	<0.001**
Medium-term Support for Livelihoods after 2008 Cyclone Nargis (from 4 months to 2 years)		
No	1 (ref:)	
Yes	0.441 (0.244-0.798)	0.007*
Health problems from which to recover (problems requiring recovery from 2008 Cyclone Nargis)		
No	1 (ref:)	
Yes	0.387 (0.194-0.772)	0.007*
Awareness		
Poor	1 (ref:)	
Active	0.465 (0.202-1.069)	0.071

* p-value <0.05, **p<0.001, CI=Confidence interval

3.3 Moving forward

In this present study, socio-economic index factors and health were not the focuses of inquiry, so further studies should be conducted to address these determinants with regard to disaster awareness, preparedness, resilience and recovery. Disaster management planning to strengthen disaster awareness, preparedness, resilience and recovery always requires some form of change in behavior, and change is often difficult to bring about. Government, private-sector organizations, or other social units have many priorities other than disaster planning, and societal and community needs are invariably greater than the resources that are available (Tierney, 1993). On the

other hand, disaster introduces greater uncertainty into decision making and this uncertainty calls for an understanding of the social processes that shape behavioral change pre- and post-disaster (Birkmann et al., 2010). Therefore, appropriate risk communication should be emphasized to reach the targeted audiences and induce the desired changes in behavior and perception (Gwee et al., 2011), which can be applied both to coastal communities' water-related disaster awareness, preparedness, resilience and recovery in Ayeyarwaddy Delta Region. Government has developed the disaster information and early warning system through TV, FM radio, social media, and DAN mobile application, however Son et al. (2018) emphasized to consider complex socio-behavioral-technical interaction, situation awareness approach through IT-based systems designed is important for effective situation aware decision making support. The perception of 'community' changes and sustained behavioral change through social media use from a geographic locality to communities of interest and, ideally, disaster resilience communities of learning (Dufty, 2012) can also be considered.

4. CONCLUSION

All the collected data were analyzed and interpreted to determine the factors that influence coastal communities' water-related disaster awareness, preparedness, resilience and recovery. It can be concluded that active awareness and preparedness, high resilience and high recovery were demonstrated by all 390 respondents in the coastal communities of the Ayeyarwaddy Delta Region of Myanmar. However, as more than 80% of the respondents were from rural areas, it can be suggested that future awareness-raising programs and disaster management planning should be focused not only in rural area but also in urban areas. Although Government has a disaster warning system in the Ayeyarwaddy Delta Region, it should be extended to all low-lying disaster-prone areas in Myanmar as well as strengthen public-private partnership (i.e., NGOs and community leader engagement) to emphasize intended sustained behavioral change. There were only a few organizations and activities regarding emergency evacuation and assistance; therefore, the Government should have a plan and trained teams readied for emergency evacuation alongside medical teams with available health professional networks and organizations to strengthen disaster preparedness and management. Furthermore, the Government should conduct monitoring and evaluation visits to disaster-prone areas with the help of NGOs and multi-sectoral involvement to develop specific policies, procedures and practices for disaster management. As the population in this study was affected by Cyclone Nargis in 2008, with 25% of them still needing to recover from a previous cyclone, especially for the informal workers who were self-employed with more than 4 household family members, it is necessary to consider strategies to achieve full recovery in terms of short, medium and long term support of their needs, effectively with available resources. It is recommended that further studies are conducted including qualitative studies to investigate factors relating to the socio-economic index factors and health, and their impacts on disaster awareness, preparedness, resilience and recovery in order to know and solve problems at a variety of scales from households and townships to regions.

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