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 Min¹, Kampanad Bhaktikul*, Sayam Aroonsrimorakot¹, Saranya Sucharitakul¹, Allan Sriratana Tabucanon¹, and Budi Eko Siswoyo²

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

ARTICLE INFO
Received: 15 Jan 2020
Received in revised: 12 May 2020
Accepted: 26 May 2020
Published online: 12 Jun 2020
DOI: 10.32526/ennrj.18.3.2020.29

Keywords:
Awareness/ Preparedness/
Resilience/ Recovery/ Coastal communities/ Water-related natural disaster

* 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

Citation: Min ZY, Bhaktikul K, Aroonsrimorakot S, Sucharitakul S, Tabucanon AS, Siswoyo BE. 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. Environ. Nat. Resour. J. 2020;18(3):304-313. DOI: 10.32526/ennrj.18.3.2020.29
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).
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 their 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.

| Variable                                      | Awareness     | p-value |
|-----------------------------------------------|---------------|---------|
| Residence township                            |               |         |
| Bogale (ref.)                                 | 1             |         |
| Pyapon                                        | 3.796 (1.320-10.917) | 0.013* |
| Ngapudaw                                      | 2.569 (1.101-5.995)  | 0.029* |
| Residence area                                |               |         |
| Urban (ref.)                                  | 1             | 0.054   |
| Rural                                        | 2.413 (0.986-5.905)  |         |
| 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 (ref.)                                     | 1             |         |
| Yes                                           | 16.008 (1.492-171.739) | 0.022* |
| Preparedness                                  |               |         |
| Poor (ref.)                                   | 1             |         |
| 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 | 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.)     |          |
| Yes                                                  | 5.674 (1.577-20.419) | 0.008* |

*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=0.3025, 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** | | | |
| No                                           |                   | 1 (ref.)     |         |
| Yes                                          |                   | 4.214 (2.040-8.702) | <0.001** |
| **Medium-term Support for Livelihoods after 2008 Cyclone Nargis** | | | |
| 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.

ACKNOWLEDGEMENTS

This research was conducted with financial support provided a “Mahidol University-Norway Capacity Building Initiative for ASEAN” scholarship. The authors would like to thank the reviewers for their constructive comments on the earlier version of the paper. Local stakeholders, facilitators and assistance offered by the local administrations in Bogale, Pyapon and Ngapudaw Townships in the Ayeyarwady Delta Region of Myanmar are also gratefully acknowledged for their cooperation and contribution along with field data collection. Our greatest appreciation goes to the participating respondents for their time in answering the questionnaires which provided vital information for this study.

REFERENCES

Ainuddin S, Routray JK, Ainuddin S. People’s risk perception in earthquake prone Quetta city of Baluchistan. International Journal of Disaster Risk Reduction 2014;7:1-11.
Barlett JE, Kotrlik JW, Higgins CC. Organizational research: Determining appropriate sample size in survey research. Information Technology, Learning, and Performance Journal 2001;19(1):43-50.
Bethel JW, Foreman AN, Burke SC. Disaster preparedness among medically vulnerable populations. American Journal of Preventive Medicine 2011;40(2):139-43.
Birkmann J, Buckle P, Jaeger J, Pelling M, Setiadi N, Garschagen M, Fernando N, Kropp J. Extreme events and disasters: A window of opportunity for change? analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. Natural Hazards 2010;55:637-55.
Cvetković V, Ivanov A, Sadiyeh A. Knowledge and perceptions of students of the academy of criminalistic and police studies about natural disasters. International Scientific Conference “Archibald Reiss Days”-Thematic Conference Proceedings of International Significance; 2015 Mar 3-4; Belgrade: Serbia; 2015.

Cvetković VM, Roder G, Ocal A, Tarolli P, Dragicievic’ S. The role of gender in preparedness and response behaviors towards flood risk in Serbia. International Journal of Environmental Research and Public Health 2018;15(2761):1-21.

Dufty N. Using social media to build community disaster resilience. Australian Journal of Emergency Management 2012;27(1):40-5.

Gwee QR, Shaw R, Takeuchi Y. Chapter 2 disaster education policy: Current and future. In: Shaw R, Shiwaku K, Takeuchi Y, editors. Disaster Education. Bingley: Emerald Group Publishing; 2011. p. 23-44.

Hanson WE, Creswell JW, Clark VLP, Petska KS, Creswell JD. Promotion of resilience. Australian Journal of Emergency Management 2012;27(1):40-5.

Hoffmann R, Muttarak R. Learn from the past, prepare for the future: impacts of education and experience on disaster preparedness in the Philippines and Thailand. World Development 2017;96:1-20.

International Federation of Red Cross and Red Crescent Societies (IFRC). Myanmar: cyclone nargis 2008 facts and figures [Internet]. 2011 [cited 2019 Dec 24]. Available from: https://www.ifrc.org/en/news-media/news-stories/asia-pacific/myanmar/myanmar-cyclone-nargis-2008-facts-and-figures.

Kurita T, Ikeda M, Suzuki K, Colombage SRN. Promotion of community-based disaster reduction activity through hands-on training in Sri Lanka. Journal of Natural Disaster Science 2007;29(2):41-51.

Muttarak R, Lutz W. Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? Ecology and Society 2014;19(1):42.

Myanmar Information Management Unit (MIMU). Ayeyawady region [Internet], 2019 [cited 2019 Dec 16]. Available from: https://themimu.info/stats_regions/ayeyarwady.

Organisation for Economic Co-operation and Development (OECD). Policy Handbook on Natural Hazard Awareness and Disaster Risk Reduction Education. Publishing Paris, 2010.

Our World in Data (OWID). Natural disasters [Internet]. 2019 [cited 2019 Dec 20]. Available from: https://ourworldindata.org/natural-disasters.

Ozkazanc S, Yuksel UD. Evaluation of disaster awareness and sensitivity level of higher education students. Procedia - Social and Behavioral Sciences 2015;197:745-53.

Parsons M, Glavac S, Hastings P, Marshall G, McGregor J, McNeill J, Morley P, Reeve I, Stayner R. Top-down assessment of disaster resilience: A conceptual framework using coping and adaptive capacities. International Journal of Disaster Risk Reduction 2016;19:1-11.

Paul BK, Dutt S. Hazard warnings and responses to evacuation orders: The case of Bangladesh’s cyclone SIDR. Geographical Review 2010;100(3):336-55.

Post-Nargis Joint Assessment (PONJA). Post-nargis joint assessment report [Internet]. 2008 [cited 2019 Dec 16]. Available from: https://www.gfdrr.org/sites/default/files/GFDRR_Myanmar_Post-Nargis_Joint_Assessment_2008_EN.pdf.

Rafiey H, Momtaz YA, Alipour F, Khankhel H, Ahmadi S, Khoshnami MS, Haron SA. Are older people more vulnerable to long-term impacts of disasters? Clinical Interventions in Aging 2016;11:1791-5.

Rajesh G, Chhabra KG, Shetty PJ, Prasad KVV, Javali SBJ. Survey on disaster management among postgraduate students in a private dental institution in India. American Journal of Disaster Medicine 2011;6(5):309-18.

Somers S, Svara J. Assessing and managing environmental risk: Connecting local government management with emergency management. Public Administration Review 2009;69(2):181-93.

Son J, Aziz Z, Pen A-Mora F. Supporting disaster response and recovery through improved situation awareness. Structural Survey 2008;26(5):411-25.

Tanner T, Mitchell T, Polack E, Guenther B. Urban governance for adaptation: assessing climate change resilience in ten Asian cities. IDS Working Paper 2009;315:1-47.

Tierney KJ. Disaster preparedness and response: research findings and guidance from the social science literature. US-ROC Workshop on Natural Disaster Reduction; 1993 June 24-26; Taipei; Taiwan; 1993.

Torani S, Majid PM, Maroufi SS, Dowlati M, Sheikh RA. The importance of education on disasters and emergencies: A review article. Journal of Education and Health Promotion 2019;8(85):1-7.

Tuladhar G, Yatabe R, Dahal RK, Bhandary NP. Disaster risk reduction knowledge of local people in Nepal. Geoenvironmental Disasters 2015;2(5):1-12.

United Nations Development Programme (UNDP). Fast facts: disaster risk reduction and recovery [Internet]. 2014 [cited 2019 Dec 16]. Available from: https://www.undp.org/content/dam/undp/library/corporate/fast-facts/english/FF_DRR_11042014.pdf.

United Nations Environment Programme (UNEP). Learning from cyclone nargis: investing in the environment for livelihoods and disaster risk reduction - A case study [Internet]. 2009 [cited 2019 Dec 16]. Available from: http://hdl.handle.net/20.500.11822/14116.

United Nations International Strategy for Disaster Reduction (UNISDR). Hyogo framework for action 2005-2015: building the resilience of nations and communities to disasters [Internet]. 2005 [cited 2019 Dec 16]. Available from: https://www.unisdr.org/we/coordinate/hfa.

World Bank. Another nargis strikes every day post-nargis social impacts monitoring five years on [Internet]. 2014 [cited 2019 Dec 16]. Available from: https://www.gfdrr.org/sites/default/files/publication/Another-Nargis-Strikes-Every-Day.pdf.