



# Measuring Small Island Disaster Resilience Towards Sustainable Coastal and Fisheries Tourism: The Case of Guimaras, Philippines

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## Abstract

Small islands have unique environmental characteristics that make them prone or vulnerable to natural and human-induced hazards. The ability of a community to measure and assess its own characteristics (i.e., connectedness, risk and vulnerability, procedures on disaster planning, response and recovery, and available resources) contributes to the improvement of its capacity to better deal with, survive, and recover from disasters. Thus, we undertook this study to measure the resilience of a small island community using a tool developed by the Torrens Resilience Institute. We conducted a survey among 37 local government officials and 192 local community residents in the Island Province of Guimaras from August to December 2018 using a structured questionnaire following a simple random sampling method. Our results show that Guimaras is facing various natural and anthropogenic hazards. However, local officials and community residents agreed that Guimaras is in the “Going Well Zone” (i.e., the island community is likely to be extremely resilient to any disaster) and that there is no significant difference (t-test,  $\alpha=0.05$ ) in their ratings on disaster preparedness. As sun, sand, and sea tourism is a growing industry worldwide, the assessment that small island tourist destinations such as Guimaras is a resilient community would have positive impacts on the tourism industry, possibility leading to the sustainable development of coastal communities with tourism as a major source of supplemental or alternative livelihoods while reducing pressure on overexploited fish stocks.

**Keywords** Small island · Community disaster resilience · The Torrens Resilience Institute framework · Sustainable tourism · Island Province of Guimaras · Philippines

## Introduction

Small islands are features in archipelagic countries and they often possess high biodiversity (Sharpley 2012; Hess 1990). However, this biodiversity does not directly translate into natural resources available for use by human inhabitants. Small islands are highly exposed to natural and anthropogenic hazards (Kuriawan *et al.* 2016; Beller *et al.* 1990) with potentially disastrous consequences (SFDRR 2015; UNISDR 2009) for resource availability and local livelihoods (Monteclaro *et al.* 2018). Since such disasters are frequently unanticipated in terms of timing, magnitude, and location it is extremely difficult to avoid, mitigate, or address

all associated threats, both natural and anthropogenic. Consequently, a community’s degree of resilience (Moreno *et al.* 2019; Berkes *et al.* 2016; FAO 2010; UNISDR 2009) can become crucially important (Mohanty *et al.* 2019; Freddie and de Sylva 2018; Cutter *et al.* 2008). The Philippine government defines resilience as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions” (RA 10,121 2010:10).

Ensuring resilience of both human and natural organisms in small islands is vital because of their unique environmental characteristics and exposure to the harmful consequences of natural and human-induced hazards. The ability of a community to measure and assess its own degree of resilience in terms of connectedness, risk and vulnerability, procedures for disaster planning, response and recovery, and ability to secure availability of resources, enhances its capacity to

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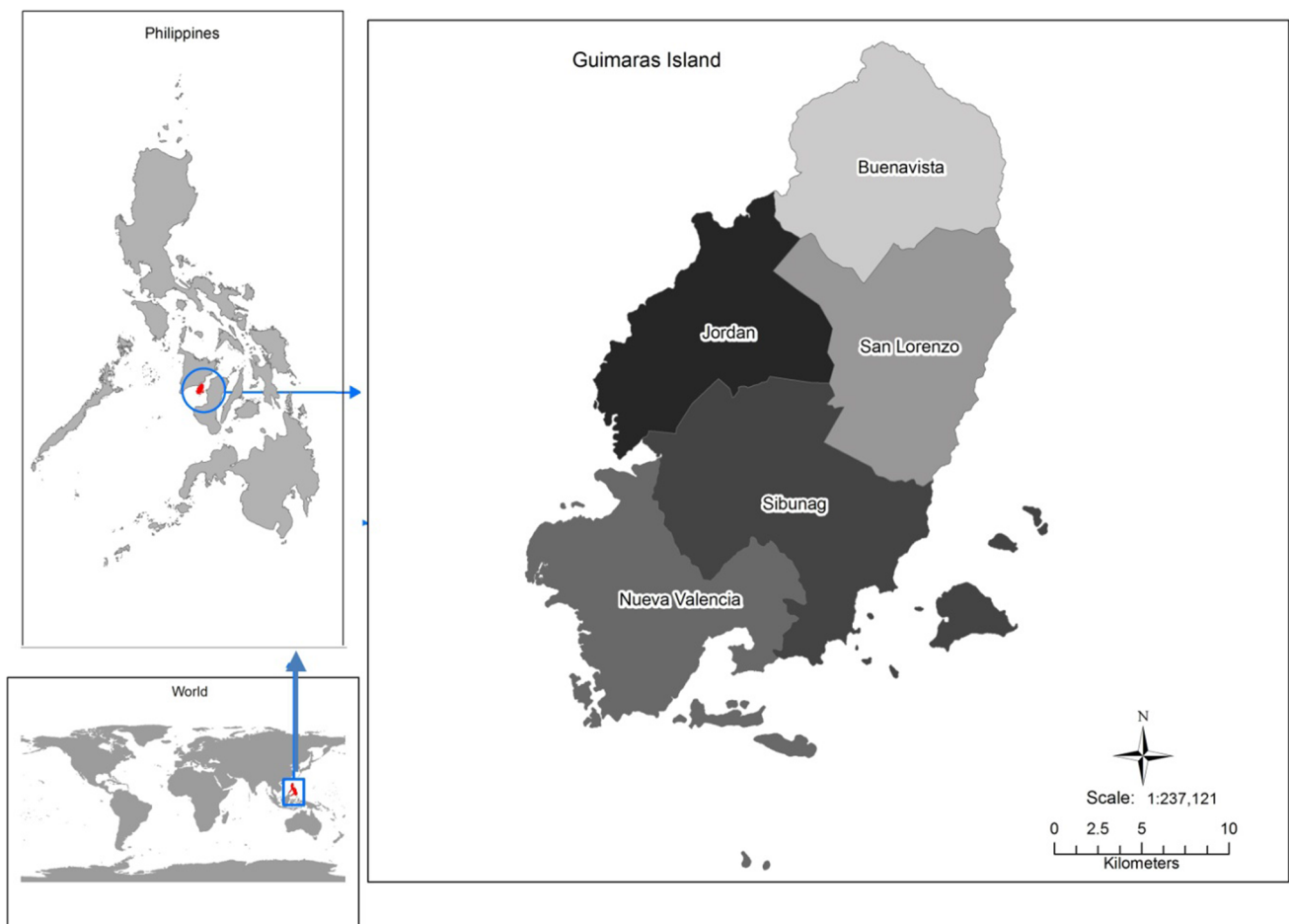
cope with and recover from disasters (SFDRR 2015; TRI 2015; Farhan and Lim 2010).

A community is said to be resilient if its members recognize the importance of social support mechanisms such as neighbor, family and kinship networks, social cohesion, mutual interest groups, and mutual self-help groups (Mohanty *et al.* 2019; ODI 2016; Norris *et al.* 2008). To date there remains a need for additional studies that quantify community resilience (Moreno *et al.* 2019; Berkes *et al.* 2016; Johansen *et al.* 2016; FAO 2010; Adger *et al.* 2005) especially in archipelagic and developing countries like the Philippines. We therefore undertook this study to measure the perceived disaster resilience of Guimaras Island using the Torrens Resilience Institute (TRI) framework. Specifically, we aim to (i) describe the disaster risk reduction management structure in Guimaras; (ii) determine the hazards and level of hazard awareness based on the perceptions of the local community and officials; (iii) measure the perceived level of resilience among community members and officials; and (iv) compare the perceptions of the level of disaster preparedness of various local stakeholders.

Our findings are important for the development of sustainable management strategies for coastal and marine resources and in formulating mitigation strategies in the face of extreme events worldwide (Pearson and Pelling 2015; SFDRR 2015). Since many countries such as the Philippines are economically dependent on the potential for tourism in coastal areas, it is important to establish the resilience of their small island tourist destinations (Kurniawan *et al.* 2019, 2016; Ernawati *et al.* 2017; Pilapil Añasco and Lizada 2014; Fabinyi 2010; UNEP 2009).

## Study Area

Guimaras is an island province located in Western Visayas, Philippines (Fig. 1). It has a land area of about 604.57 km<sup>2</sup>, a population of 174,613 with a density of 289 persons/km<sup>2</sup>, and an average annual population growth rate of 1.33% (PSA 2015). Fishing, farming, and tourism are the major livelihoods of its 40,575 households, including the Indigenous Ati (PSA 2015). Guimaras Island is reliant on community-based rural



**Fig. 1** Map of Guimaras Island showing its location in the Philippines

tourism for economic development (McDaniels and Trousdale 1999) but it is exposed to various natural and anthropogenic-induced hazards. For example, four out of the 12 worst typhoons in the Philippines between 1947 and 2009 directly hit the island (Alojado and Padua 2010). It was also affected by several oil spill incidents including the country's worst such disaster in 2006, and more recently in July 2020 (Aguirre 2020; Burgos 2020; Yap 2020b; Murga 2019; Tan and Pulhin 2012; Yender and Stanzel 2011; Yender *et al.* 2008).

### Governance Structure of Disaster Risk Reduction Management of Guimaras Island

In the Philippines, the government structure is hierarchical with the *barangay* or village as the basic political unit headed by a *punong barangay*. A group of villages compose a municipality or city that is headed by a municipal/city mayor. Municipalities and cities together form a province under the leadership of a provincial governor. At the highest level, the national government headed by the President (RA 7160 1991). The barangay, municipality, and province comprise the local government units (LGUs). The LGUs play an important role in disaster resilience by developing, reviewing, and assessing effective disaster management practices and ensuring that the communities under its jurisdiction have disaster mitigation, response, and recovery plans in place. These disaster management practices are tailored based on an area's unique characteristics in coordination with the national government.

The island province of Guimaras is composed of 98 barangays belonging to five municipalities: Nueva Valencia, Buenavista, Sibunag, Jordan, and San Lorenzo (PSA 2015). Each level of government has its own Disaster Risk Reduction Management (DRRM) council or committee: the Provincial DRRM Council, the Municipal DRRM Council, and the Barangay DRRM Committee (RA 10,121).

### Methods

We used both qualitative and quantitative research methods in this study. We conducted a survey of 37 personnel of the various DRRM Councils and officials of the local government units (LGUs), and 192 members of the local community in August to December 2018 using a structured questionnaire. We developed the English-language questionnaire based on the Torrens Resilience Institute (TRI) framework and tailored to the small island context with inputs from local officials through key informant interviews. Pilot testing of the questionnaire was done in Pan de Azucar, another small island in the region, which has similar characteristics to Guimaras to check for comprehensibility and appropriateness. The principal investigator personally conducted the

interviews in the local language to avoid interviewer variability as source of sampling error.

We selected respondents from the local community using simple random sampling. Respondents were individuals who were able to adapt and rebuilt their lives after experiencing an extreme event, specifically fishers who were also engaged in farming and tourism and whose livelihoods were usually impacted whenever a disaster hit the island. We asked them to identify local hazards and rate perceived degree of preparedness for themselves, their community, their village council officials, and their municipal and provincial LGUs in dealing with disaster using a Likert scale ranging from 1 “not at all prepared” to 5 “very prepared” (Table 1).

The “rating of self” was the perception of the respondents in terms of their own level of preparedness in dealing with disasters based on the TRI indicators; the “community” referred to the respondents' neighborhood; the “barangay council” included village officials, while the “LGUs” were the municipal and provincial government representatives.

### The Torrens Resilience Institute Framework

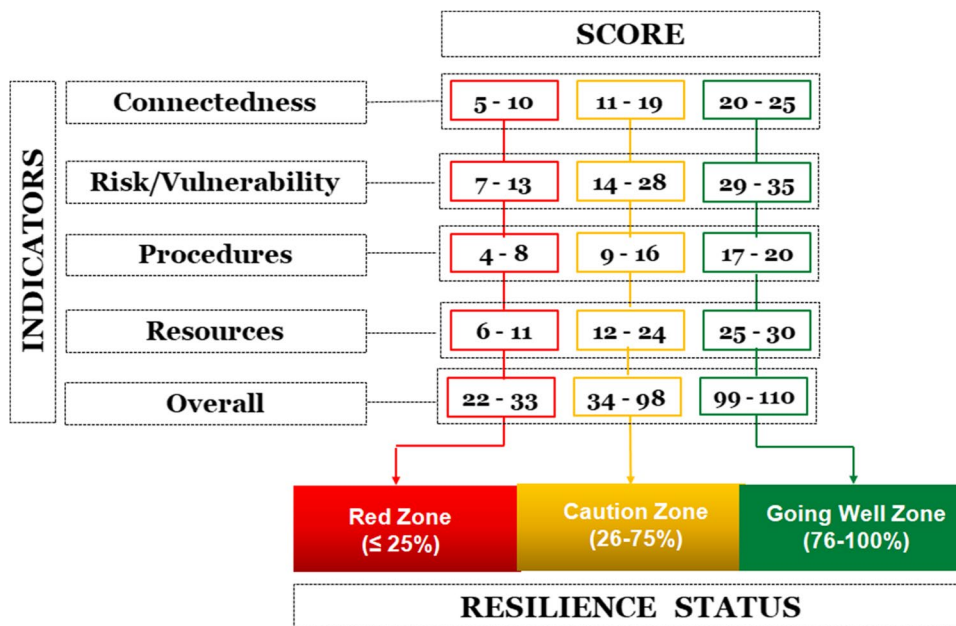
The Torrens Resilience Institute (TRI) framework (TRI 2012, 2015) is one of the 39 frameworks and approaches adopted by the Overseas Development Institute (ODI 2016) on resilience measurement and is appropriate for use in a small island community. Developed at Flinders University in Australia, the framework is designed to strengthen local communities against disasters by enabling them to determine their level of resilience to adverse situations in terms of: 1) connectedness of the people in a community; 2) level of risk and vulnerability of a community; 3) procedures that support community disaster planning, response, and recovery; and 4) emergency planning, response, and recovery resources that are available. These factors are used to measure community disaster readiness and to strengthen planning for extreme events to determine whether the community/island is in the Red Zone, Caution Zone, or Going Well Zone based on the total scores of a 5-point Likert Scale rating for the indicators (Fig. 2).

If the overall score is within the Going Well Zone, the community is extremely resilient to any disaster; but if the

**Table 1** Preparedness rating in Likert scale (Adapted from TRI, 2015)

Entity	Very prepared			Not at all prepared	
	5	4	3	2	1
Self	5	4	3	2	1
Community	5	4	3	2	1
Barangay council	5	4	3	2	1
Local government units	5	4	3	2	1

**Fig. 2** The TRI resilience evaluation framework used in this study



overall score is within the Red Zone the community is more likely to experience adverse impacts from a disaster. Significantly lower scores in one indicator signal that area should be the priority for community action, although all scores are useful in highlighting areas of resilience that require attention from community members, leaders, and decision-makers (TRI 2015).

**Data Management and Statistical Analysis**

We developed a database using MS Excel. We cleaned the data and formatted variables for descriptive statistics and other statistical analyses using SPSS 16.0. We conducted a priori test to check if fundamental assumptions (i.e., randomness, normality distribution, and homoscedasticity) were all satisfied before applying statistical techniques. We used simple random sampling to ensure randomness assumption wherein respondents were selected from the sampling frame through drawing of lots. Normality was fulfilled as the sample sizes of both respondent types were large (i.e., n > 30). We checked the homogeneity of variance assumption prior to application of each statistical tests using Levene’s test to ensure the appropriateness of statistical tools used to determine significant differences of dependent variables (i.e., the levels of hazard awareness, resilience and preparedness) due to the independent variables (i.e., the ratings of the DRRM and/or local government officials and the local community members).

We used statistical tests: 1) t-test to determine significant difference between ratings of fishers and officials, 2) general linear model full factorial analysis of variance (ANOVA) to evaluate significant rating differences among respondent

type and local stakeholders’ preparedness level, and their interactions to the disaster preparedness in the island, and 3) Tukey and Scheffe for the multiple comparison tests. The Type III sum of squares was used in the statistical analysis to address the unbalanced number of respondents from the fishers’ and LGU officials’ groups. The t-test is an established test statistic for evaluating significant differences between two groups (e.g., fishers and officials) while ANOVA is used to determine significant differences of three or more groups (e.g., perception of disaster preparedness of self, community, village officials and LGUs) as elucidated by Walpole *et al.* (2012) and Siegel and Castellan (1988), among others.

**Results and Discussion**

Based on the results of key informant interviews and the survey, the following sections are presented according to the order of our research objectives.

**Disaster Risk Reduction Management Structure in Guimaras**

As mandated by the Philippine Disaster Risk Reduction and Management Act of 2010 (or Republic Act 10121 2010), each level of government from the national down to the village levels should constitute a DRRM Council, which are decreed as the first disaster responders and should be at the forefront of DRRM in their geographical jurisdiction (RA 10121 2010; RA 7160 1991). RA 10121 further stipulates that the DRRM Council should

be headed by the Governor and the Mayor at the provincial and municipal levels, respectively, and be composed of 17 heads or representatives of the following offices: 1) Planning and Development; 2) Local Disaster Risk Reduction and Management Office; 3) Social Welfare and Development; 4) Health; 5) Agriculture; 6) Gender and Development; 7) Local Engineering; 8) Local Veterinary; 9) Budget; 10) Division Head/Superintendent of Schools of the Department of Education; 11) Armed Forces of the Philippines assigned in the area; 12) Philippine National Police; 13) Fire Marshall of the Bureau of Fire Protection; 14) Association of Barangay Captains; 15) Philippine National Red Cross; 16) Four accredited Civil Society Organizations; and 17) a private sector representative.

Based on key informants' responses and legal documents acquired from the local governments, local DRRM Councils are active in the whole province. As mandated by law, DRRM initiatives in the province were financed through the local DRRM Fund, which derived from at least 5% percent of the estimated revenues from regular sources of each local government level.

### Provincial Level DRRM Council

In Guimaras, the Provincial DRRM Council led the formulation of a framework for DRRM and supervised preparations for responses to natural calamities and human-induced disasters. It was mandated to be at the frontline of emergency measures in the aftermath of disasters to promote the general welfare of the people to ensure systematic implementation of policies, coordination mechanisms, and programs with budget appropriation for disaster risk reduction (DRR) from the national down to local levels towards building disaster resilient communities (RA 10121 2010; RA 7160 1991). The implementation of programs and activities was in coordination with the Barangay DRRM Committee, which had direct interaction with community residents.

The Provincial DRRM Council initiated the DRRM program in 2012, implementing a province-wide project in coordination with experts from the Korea Maritime Institute which proposed a DRRM Framework for the whole island that eventually guided the formulation of the Guimaras DRRM Plan. This project was instrumental in enhancing the capability of local officials in developing a DRRM plan and in meeting the challenges related to the ocean and environment. Surveys, training sessions, and meetings were part of this initiative to increase people's awareness on DRRM. Moreover, a province-wide multi-hazard mitigation/protection plan was established with the construction of physical infrastructure and disaster preparedness systems as stipulated in the Provincial Comprehensive Land Use Plan 2005–2035.

### Municipal Level DRRM Council

At the time of our study, only Nueva Valencia among the five municipalities had completed its Municipal DRRM Plan. The guiding principles of this plan emphasized: 1) Governance, by making DRR a priority agenda for sustainable development; 2) Risk assessment by improving warning systems; 3) Knowledge and education building, culture of safety and resiliency among vulnerable communities; 4) Vulnerability reduction by reducing the risks of key sectors; and 5) Disaster preparedness and response for timely and effective response mechanism (Nueva Valencia Municipal DRRM Plan, [nd](#)).

The municipal DRRM plans, together with the framework proposed in 2012, were intended to serve as the bases for the formulation of the provincial DRRM plan. While the DRRM plans were not yet complete, the local government units had already been engaged in DRR and climate change adaptation initiatives. For instance, the Municipal DRRM Council together with the Barangay DRRM Committee had been conducting barangay community risk assessments, contingency planning, and community drills including awareness building on DRR and climate change adaptation. The municipal DRRM initiatives in Guimaras were recognized by the Regional DRRM Council when it named three municipalities in the province as the best Municipal DRRM Offices in 2019 (Daily Guardian 2019; Panay News 2019).

### Barangay Level DRRM Committee

Based on the provisions of Republic Act (RA) 10121 of 2010, the Barangay DRRM Committee has been serving as a regular committee of the Barangay Development Council and as front liners during emergencies. The *punong barangays* ensured the participation of at least two civil society organizations' representatives from among the active community-based organizations that represented the most vulnerable and marginalized groups. The Barangay DRRM Committee served as the implementing arm of the DRRM programs and projects of the Municipal DRRM and the Provincial DRRM Councils.

### Hazard Awareness

To measure the indicators of resilience in small islands like Guimaras, it is critical to identify the hazards present in the area. Hazard is defined as “a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihood and services, social and economic disruption, or environmental damage” (RA 10121 2010, p.8). Survey respondents identified 38 types of hazards (Table 2). The five most frequently cited were typhoons, oil spills, rising



**Table 2** Hazards identified by fishers and officials of Guimaras Island with frequency of mention

Hazard in the Island	Hazard Type	Count*	%
1 Typhoons	Natural	196	85.59
2 Oil spill	Human-induced	192	83.84
3 Rising sea levels slowly alters the island's coastline	Natural	163	71.18
4 Earthquake	Natural	140	61.14
5 Overbearing heat	Natural	120	52.40
6 Lightning	Natural	111	48.47
7 Tornado	Natural	110	48.03
8 Big waves	Natural	100	43.67
9 Drought/El Niño	Natural	96	41.92
10 Erosion	Natural/Human-induced	90	39.30
11 Rock and land slide	Natural	81	35.37
12 <i>Habagat</i> (Southwest monsoon)	Natural	76	33.19
13 <i>Amihan</i> (Northeast monsoon)	Natural	73	31.88
14 Sedimentation	Natural/Human-induced	72	31.44
15 Blast fishing	Human-induced	70	30.57
16 Flood	Natural	64	27.95
17 Pollution	Human-induced	53	23.14
18 Tsunami	Natural	47	20.52
19 Too much rain	Natural	45	19.65
20 Storm surge	Natural	40	17.47
21 Fault lines	Natural	33	14.41
22 Flash flood	Natural	25	10.92
23 Red tide	Natural/Human-induced	16	6.99
24 Tidal Wave	Natural	9	3.93
25 Illegal fishing	Human-induced	5	2.18
26 Strong Wind	Natural	4	1.75
27 Terrorism	Human-induced	4	1.75
28 Fire/Burning	Natural/Human-induced	4	1.75
29 Drugs	Human-induced	2	0.87
30 Fallen trees	Natural	2	0.87
31 <i>Pugada</i> (squall)	Natural	2	0.87
32 Sinkhole	Natural	2	0.87
33 Vehicular accident	Human-induced	2	0.87
34 Disease outbreak	Natural/Human-induced	1	0.44
35 Jelly fish, sea snake or sea urchin attack	Natural	1	0.44
36 <i>Kanaway</i> (Northwest wind)	Natural	1	0.44
37 <i>Salatan</i> (Easterly wind)	Natural	1	0.44
38 Volcanic eruption	Natural	1	0.44

\* n 229, multiple answers given

sea levels that slowly altered the coastline, earthquake, and increasing temperatures that led to warm/hot weather. Among these, oil spills were increasing in frequency (Yap 2020a; Burgos 2020; Murga 2019) as more passenger, cargo, and tanker vessels regularly ply Guimaras waters. The majority (68%) of the identified hazards were natural.

Such hazards usually impact communities and disrupt societal mechanisms that serve to organize and sustain community capacities and functions (Paton 2007). For example, Typhoon Haiyan in 2013 and oil spills in

2006 and 2020 resulted in significant loss or disruption of established social processes, functions, activities and interactions. In Guimaras, the level of hazard awareness of fishers as community members (mean rating = 4.67) was significantly higher than those of local officials (mean rating = 4.43; *t*-test, *p* = 0.002). Fishers' higher level of hazard awareness could be attributed to their local knowledge and experiences as highlighted in hazard studies in other small islands (Hernandez *et al.* 2018; Taupo 2018).

## Level of Resilience

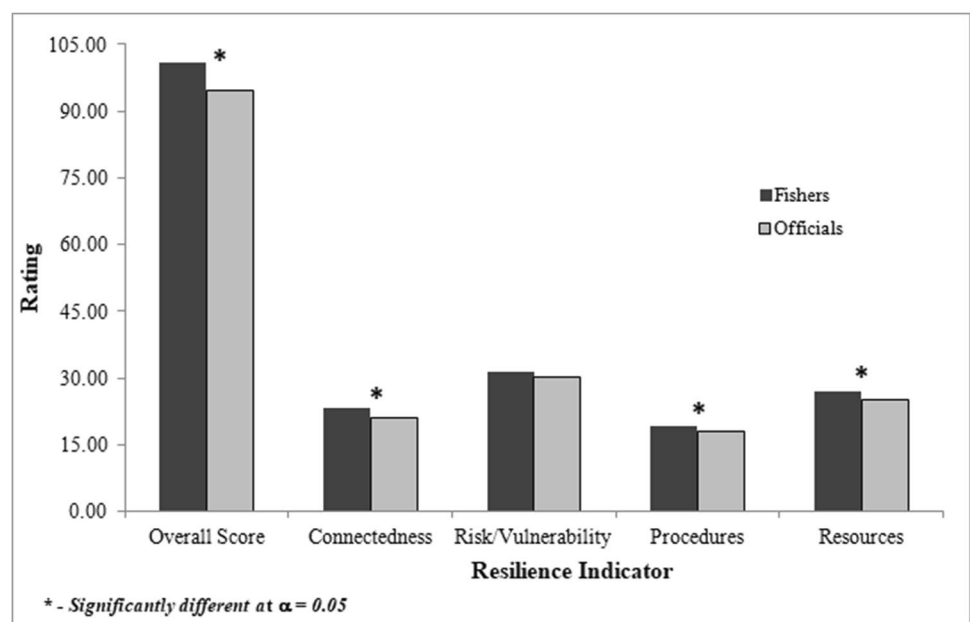
Measuring the level of resilience is vital for the inhabitants of small islands to gauge their readiness to mitigate impacts of a disaster. The ratings on perceived overall resilience (range of 94.5 to 100 out of 110 perfect score or 86% to 91.9%), connectedness of local community members (21.2 to 23.3 out of 25 or 84.7% to 93%), level of risk and vulnerability of the island community (30.16 to 31.51 out of 35 or 86.18% to 90.01%), procedures supporting community disaster planning, response, and recovery (18.14 to 19.10 out of 20 or 90.68% to 95.49%), and emergency planning, response and recovery resources available (25.08 to 27.19 out of 30 or 83.60% to 90.63%) were all within the Going Well Zone (Table 3).

While the ratings of officials and fishers were both within the Going Well Zone, the overall resilience rating of fishers

**Table 3** Level of resilience as perceived by fishers and officials of Guimaras Island based on the TRI resilience evaluation scoring system

Criteria	Guimaras Score (2019)		
	Fishers	Officials	Composite
Connectedness	93.04% (23.26)	84.65% (21.16)	91.69% (22.92)
Risk/Vulnerability	90.01% (31.51)	86.18% (30.16)	89.39% (31.29)
Procedures	95.49% (19.10)	90.68% (18.14)	94.72% (18.94)
Resources	90.63% (27.19)	83.60% (25.08)	89.49% (26.85)
Overall Score	91.87% (101.05)	85.95% (94.54)	90.91% (100.00)

**Fig. 3** Comparison of disaster resilience as perceived by fishers and officials of Guimaras Island where x-axis shows the resilience indicators and y-axis is the disaster resilience ratings of respondents. Asterisks indicate that ratings of fishers are higher than that of the officials for all indicators



was significantly higher than the rating of officials ( $t$ -test,  $p=0.002$ ). Results signify that based on specific indicators, ratings of fishers were also significantly higher except for risk and vulnerability (Connectedness:  $t$ -test,  $p=0.001$ ; Procedures:  $t$ -test,  $p=0.012$ ; Resources:  $t$ -test,  $p=0.001$ ; See Fig. 3).

Our results indicate that officials recognized the need for more initiatives to further strengthen disaster readiness. In contrast, fishers were more confident that members of the island community can readily rebuild after a disaster based on their experiences with extreme events. Both groups of respondents agreed that the island was vulnerable to the identified hazards. The existing DRRM initiatives and institutions in the island served as strong foundations in implementing strategies to prevent, mitigate, and cope with disasters akin to other small islands around the world (Kurniawan *et al.* 2019; Partelow and Nelson 2018; Jackson *et al.* 2017; CCS *et al.* 2011).

## Connectedness

Our results show that community connectedness in Guimaras is high (Table 4). More than 80% of residents were members of fishers' organizations, women's or youth clubs, service groups, sports teams, and religious organizations. They perceived that they had a high access to a wide range of damage-resistant communication equipment (e.g., radio and mobile phones) through which they could gather and share information in emergency situations. Handsets used by the members of the barangay council came in handy whenever the phone signal was weak or absent. While there were villages with telephone landlines, frequent power outages hindered access.

**Table 4** Average rating of perceived level of disaster resilience according to the given indicators

Factor and Indicators	Mean Rating
<b>Connectedness</b>	
1. More than 80% of the members of the households in the island are members of organizations	4.67
2. Access to a wide range of damage-resistant communication equipment to gather and share information in times of emergency	4.66
3. Active level of communication between LGU and population	4.57
4. Regular conduct of planning and other activities with other towns/region are participated in by members of the community	4.48
5. Support for and active involvement in cultural/cross-cultural events is evident in the island	4.54
<b>Risk/Vulnerability</b>	
1. Hazards are mapped indicating low probability of high impact events	4.09
2. The permanent resident population forms > 80% of the daytime (worker) population	4.72
3. The rate of the resident population change in the last 5 years is less than 5%	4.33
4. More than 80% of the population has the capacity to independently move to safety	4.55
5. Less than 5% of the population prefers communicating in a language other than the local language	4.88
6. Transient population (e.g., tourists, transient workers) has been included in planning for response and recovery	4.17
7. The risk that the island could be isolated during an emergency is low	4.55
<b>Procedures</b>	
1. Households actively engaged in planning for disaster response and recovery	4.69
2. Planned activities about all-hazards resilience reach the entire community	4.80
3. Community members are trained for disaster readiness	4.71
4. Inclusion of all community stakeholders in post-event action plan	4.74
<b>Resources</b>	
1. Integration of infrastructure emergency system in all hazard protection plan	4.31
2. More than 81% of households have members with skills useful in emergency response/ recovery	4.34
3. Active participation of schools in emergency preparedness	4.82
4. Public health/medical system plan are in place to support response and recovery	4.67
5. Availability of well-known, sufficient sites with water/ food/ information resources	4.46
6. Most households have over five days supply of food/water/fuel	4.24

The level of communication between the LGU and residents was rated as active. Community members would inform the LGUs of their needs and the LGUs acted upon them, although a feedback system was lacking. They regularly participated in planning activities initiated by the Municipal DRRM Council or the Office of the Governor. Support for cross-cultural events to increase the degree of connectedness among community groups (e.g., sub-cultures, age groups, new residents) was evident. The Indigenous Ati who resided in the municipalities of Nueva Valencia, Buenavista, and Sibunag were actively involved in cross cultural events such as festivals and Children's Day in schools, where a few were employed as teachers.

### Risk/Vulnerability

In terms of risks and vulnerability, known risks of all identified hazards were mapped indicating low probability of high impact events (see Table 4). Some barangays were provided with hazard maps but others, even with known hazards, had none. Hazard maps were displayed at the DRRM Offices or barangay halls although not all respondents had seen nor

studied these maps. Still, they were confident that they were available at the Planning Office and the Mines and Geosciences Bureau based on signs installed in hazard prone areas around the island, which they argued would not have been put up without any basis. In fact, information and warnings about all-hazard resilience plans were communicated to communities through signs (e.g., "Route to evacuation center" and "Sinkhole Danger Area"). However, responses indicated that more initiatives were needed to effectively disseminate information to all residents. In particular, the DRRM law mandated that hazard maps and signs should be installed in appropriate areas of the community.

In Guimaras, the permanent resident population constituted more than 80% of the daytime (working) population. This suggests that very few people from neighboring islands came to work there. The rate of the resident population change in the past five years was less than 5% with new residents coming in from Iloilo City (located in nearby Panay Island) to take advantage of the emerging tourism in the island. More than 80% of the population had the capacity to independently get to the evacuation center whenever necessary. In contrast, there were also those who refused to leave



their houses despite warnings from local officials. There were even fishers who persisted in fishing even after typhoon warnings had been issued and were consequently described as “bone-headed” by the local government officials.

More than 95% of the island residents spoke Hiligaynon, suggesting that communicating the DRRM plan and necessary announcements and warnings was relatively easy (mean rating = 4.88). In addition, the transient population (e.g., tourists, transient workers) had been included in planning for response and recovery. The risk that the island could be isolated during emergency event was rated low (e.g., transport of people or goods and services was readily available) as shown in the 4.55 mean rating. This perception may be attributable to the fact that Guimaras is a mere 15-min boat ride to and from Iloilo City.

## Procedures

In terms of procedures that support community disaster planning, response and recovery, households within the community were actively engaged in planning for disaster response and recovery. The community was required to take part in disaster readiness activities such as public information, communication planning, and regular drills or exercises. Furthermore, the post-event action plan based on responses included all community stakeholders such as government, business sector, and non-governmental organizations (Table 4).

## Resources

On resources available to the community for emergency planning, response and recovery, our results showed that infrastructure emergency systems (e.g., water supply, sewerage, electricity) were all integrated into hazards protection (Table 4). The use of *kingki*, a traditional lamp fuelled with kerosene or oil, candles, rechargeable lights and flashlights were available during electricity outage. Solar lights, privately owned or donated by the government, were also available in some areas, while with the aid of machines and power generators, dug wells provided water supply. More than 81% of the population had skills useful in emergency response and recovery (e.g., first aid application, food safety handling) which could be mobilized if needed. Most schools (i.e., public and private) actively participated in training sessions on emergency preparedness. A public health/medical system plan to support response and recovery was in place at the Barangay Health Station or Health Centers.

Three hospitals were operational and strategically situated in the different municipalities of the province. These were Dr. Catalino Gallego Nava Provincial Hospital with a Level 2 Service Capability (DOH 2013) in the provincial capital; Camp Jossman Hospital in the municipality of Buenavista;

and the District Hospital in the municipality of Nueva Valencia. The Provincial Government had a current memorandum of agreement with service providers (e.g., pharmacies) to supply medicines at times of disasters. Evacuation or recovery centers such as schools and gymnasiums were accessible with water/food/information resources, and they were widely advertised and included in all planning (mean rating = 4.46). A hazard protection plan was in place wherein the community had insurance (5% of the barangay budget) paid by the barangay through the Barangay DRRM Committee. An evacuation management plan was also in place and training for community stakeholders had been conducted. Rapid Damage Assessment and Needs Analyses were routinely performed whenever a disaster threatened.

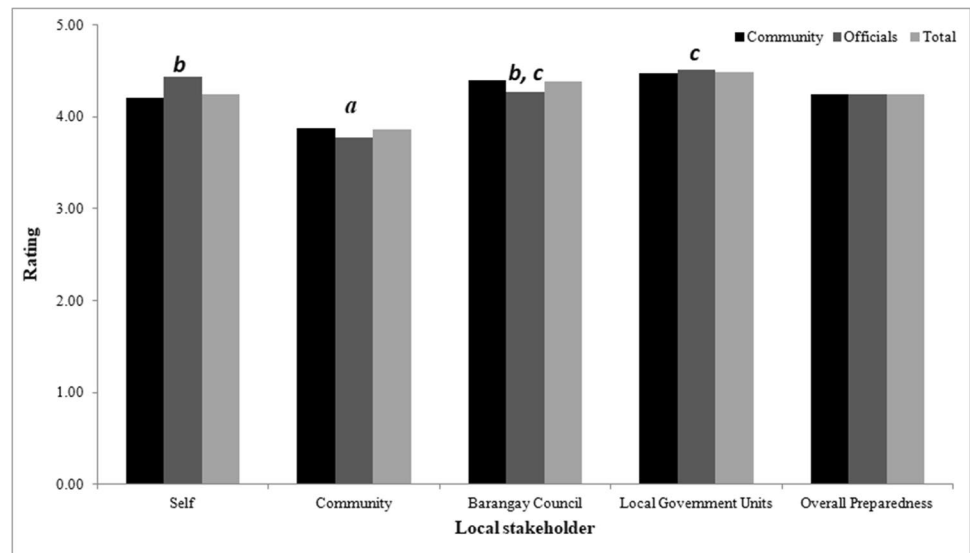
Furthermore, in some areas, households were required to always keep an *e-balde*, a bucket filled with emergency necessities. However, there were areas where evacuation centers were still under construction or construction had stopped since they were no longer a priority of current officials. Most households stocked up over five days' supply of food, water, and fuel whenever an extreme event was predicted. They could manage without any relief goods because root crops (e.g., *kayos*, an endemic root crop in the island, cassava, and sweet potato) and fruits (e.g., coconut juice and meat, papaya, and banana) were readily available. Our respondents were also aware that there were existing contracts between the government and the store owners for the latter to provide supplies during disasters.

Previous studies (Moreno *et al.* 2019; Lessy *et al.* 2018; Taupo 2018; Rampengan *et al.* 2014; Tita 2014) have shown that local community members, particularly fishers, are directly or indirectly affected by disasters in small islands, reflecting our findings in this study that the fishing community managed to survive despite the magnitude of catastrophe with no report of casualties. Indeed, community resilience plays a vital role during the response period as underscored by, among others, Moreno *et al.* (2019), Johansen *et al.* (2016), and Rampengan *et al.* (2014).

## Level of Preparedness

Preparedness is vital to reduce the effects of disasters and mitigate their impact on vulnerable populations, and to properly respond and cope with the consequences. Based on the survey among fishers and officials, mean ratings on the level of preparedness of self (4.24), community (3.86), Barangay Council (4.38), and LGUs (4.48) were not significantly different (Fig. 4). ANOVA demonstrated that there was no significant difference in the disaster preparedness of fishers and the officials. However, the levels rated (i.e., self, community, barangay council, and LGUs) were significantly different ( $F = 19.658, p < 0.01$ ). The perceptions of the different local stakeholders (independent

**Fig. 4** Comparison of disaster preparedness of stakeholders as perceived by the community and officials of Guimaras Island where x-axis shows the different local stakeholders and y-axis is the disaster preparedness ratings of respondents. Affixed letters indicate significant difference ratings. Overall disaster preparedness in the island is high



variable) explained 97% of the degree of variability of the level of disaster preparedness (dependent variable) in the island ( $R^2 = 0.972$ ). This means that the perceived level of disaster preparedness significantly increases according to the position of local stakeholders in Guimaras. The responses of the residents to past disasters, and presently to the COVID-19 pandemic, were testaments to this level of preparedness. There had been no effect of the past and present catastrophes that the island residents were not able to manage. During the global COVID-19 pandemic, when other neighboring islands had already recorded many positive cases, Guimaras remained COVID-free for a considerable period until it recorded its first case among returning overseas Filipino workers. However, the COVID-19 cases were readily brought under control and the province maintained its record of no local transmission five months since the pandemic started (DOH 2020).

Community preparedness was lowest among the four levels rated (Tukey,  $p < 0.0001$ ; Scheffe multiple comparison tests,  $p < 0.0001$ ). Self mean rating was not significantly different from that of the Barangay Council, but it was significantly lower compared to the LGUs (Tukey,  $p = 0.002$ ; Scheffe,  $p = 0.005$ ). Preparedness ratings of the Barangay Council and the LGUs were not significantly different, thus, they were perceived as better prepared for extreme events.

The Barangay Council members affirmed that their supply of relief goods was limited due to their smaller disaster fund compared to the municipal and provincial LGUs, which had access to funds from the national government. Results revealed that the community viewed themselves as being highly prepared, but respondents noted that capability building, improvement of communication, and other factors that affect the connectedness and resilience procedures and resources in the island were still needed.

Our results show that the island province of Guimaras is generally well prepared for disasters. Many barangays appear to have good disaster-readiness initiatives though there are still some areas that need improvement. The high resilience and disaster preparedness ratings of Guimaras Island may be explained by the fact that out of the 12 worst typhoons that hit the country between 1947 and 2009, four directly passed over the island with no significant impact (Alojado and Padua 2010). Guimaras was also able to recover from the sinking of the SOLAR 1 (998 GT) tanker in the island's southern waters in 2006, considered the worst oil spill in the province's history (Tan *et al.* 2012). In July 2020, another oil spill affected the island when a power barge of a thermal energy company in neighboring Panay Island exploded spilling about 48,000 L of oil into Guimaras waters. Nevertheless, the community readily recovered with the help of the local and national government, people's organizations, academe, and NGOs that offered technical assistance to restore damaged ecosystems and provided alternative livelihoods to the local communities dependent on natural resources (NDRRMC 2013; Yender *et al.* 2008). This collective action and adaptive capacity of the local community were instrumental in its fast recovery (Prieto-Carolino *et al.* 2018; Tan *et al.* 2012).

In 2013, super typhoon Haiyan also affected 11,593 residents of Guimaras Island but with zero fatalities, although a 40-year-old man was reported missing, and eight residents were hit by a lightning. The cost of damage in Guimaras was estimated to be less than 1% of the national cost of damage in infrastructure, agriculture, and fisheries (NDRRMC 2013). How the LGUs and their constituent communities managed the COVID-19 pandemic was another testament to their perceived high level of disaster preparedness that could further be attributed to the DRR and climate change

adaptation strategies that focused on reinforcing existing capacities to deal with hazards (Rampengan *et al.* 2014) and assigning importance to local knowledge, traditions, and practices (Freddie and de Sylva 2018; Hernandez *et al.* 2018; McMillen *et al.* 2014).

### Conclusions and Recommendations

Small islands are often confronted with various natural and anthropogenic hazards. While officials and community members in Guimaras agreed that their island faced high risk and vulnerability to hazards, our results show that the established DRRM and climate change adaptation initiatives were well communicated to all communities and that their levels of hazard awareness and perceived disaster preparedness were high. Thus, based on the TRI framework, resilience in Guimaras Island was in the Going Well Zone. The measures of each indicator such as community connectedness, procedures that support community disaster planning, response and recovery, and resources available in the community for emergency planning, response, and recovery were high. It was evident that the local community was extremely resilient from any disaster. It was also apparent that there was a shared responsibility among various DRRM stakeholders in the island.

As livelihoods in small islands are dependent on the available natural resources, these findings are crucial in making informed and science-based decisions for the sustainable management of coastal and marine resources especially in the face of a global decline in fisheries. Small islands are also known for coastal and fisheries tourism due to their exceptional resources (e.g., water, beaches, scenic beauty, rich terrestrial and marine biodiversity, and cultural heritage) and the associated activities in both the coastal zone and coastal waters. To establish and promote Guimaras as a resilient small island tourist destination would bring positive impact to its tourism industry as it can readily attract tourists to visit and revisit the island. In addition, coastal and fisheries tourism will provide brighter prospects for livelihoods among the local community.

We therefore recommend that present initiatives for disaster resilience in the island be sustained. Information, education, and communication campaigns should be conducted regularly. While our study is focused on only one small island, our results can guide future research on small island resilience, particularly in the context of sustainable coastal and fisheries tourism.

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