DISASTER RISK PERCEPTION AND PREPAREDNESS OF HOUSEHOLDS IN YANGON, MYANMAR: DISASTER EXPERIENCES, SOCIO-DEMOGRAPHIC FACTORS AND SPATIAL VARIATION

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Summary: In disaster-prone countries, it is of great concern that societies as a whole, as well as households and individuals, should become as resilient to disasters as possible. In Myanmar, with its frequent natural hazards like floods, cyclones and droughts and its high probability of earthquakes, raising awareness of and preparedness for disasters is of eminent importance in order to increase the resilience of society, households and individuals. Disaster research shows that the awareness and perception of people regarding disasters and thus also their risk preparedness can vary substantially. This seems to stem from various sources: the socio-demographic characteristics of households and people as well as former experiences of disaster seem to play a crucial role. Information of such variables and understanding how they influence the disaster risk perception and preparedness of households and people can provide an important background against which to improve individual disaster risk awareness and preparedness – with the final aim of making society, households and individuals more resilient. In this paper, the results of a household survey carried out in eight townships of Yangon (Myanmar) are presented. The analysis investigates how socio-demographic characteristics and the previous experiences of disaster of the respondents and their households influence their disaster risk perception and preparedness in different areas of Yangon City. The results show strong differences in disaster risk perception and preparedness according to socio-demographic characteristics and previous experiences of disaster in different areas of Yangon City. Finally, the findings feed into and inform about successful disaster management.

Zusammenfassung: In risikogefährdeten Ländern ist die Resilienz von Gesellschaften als Ganzes sowie von Haushalten und Einzelpersonen von großer Bedeutung. In Myanmar mit seinen zahlreichen Naturgefahren, wie Überschwemmungen, Wirbelstürmen, Dürren und Erdbeben, sind adäquate Risikosensibilisierung und -prävention zur Erhöhung der Resilienz von Haushalten essentiell. Die Risikoforschung zeigt, wie unterschiedlich Risikobewusstsein und -prävention von Menschen sein können und welche Ursachen zu sozialräumlich differenzierter Resilienz beitragen: Soziodemographische Merkmale sowie frühere Katastrophenerfahrungen spielen dabei eine entscheidende Rolle. Detaillierte Untersuchungen zu diesen Variablen und ein vertieftes Verständnis davon, wie sie die Wahrnehmung des Katastrophenrisikos und die -prävention von Haushalten und Individuen beeinflussen, können einen wichtigen Beitrag zur Verbesserung von Risikoprävention und Resilienz leisten. In dem Beitrag werden die Ergebnisse einer Haushaltsbefragung in acht Townships von Yangon (Myanmar) zusammengefasst. Untersucht wurde, wie soziodemographische Merkmale und frühere Katastrophenerfahrungen der Befragten und ihrer Haushalte die Risikowahrnehmung und -prävention in verschiedenen Townships von Yangon City beeinflussen. Die Ergebnisse zeigen starke Ungleichheiten der Risikowahrnehmung und -prävention, die in ein verbessertes Katastrophenmanagement einfließen.

Keywords: Disaster risk perception, disaster risk preparedness, disaster experience, socio-demographic factors, spatial variation, Yangon (Myanmar)

1 Introduction

Myanmar is among the most disaster-prone countries in Asia with a high probability for natural hazards like floods, cyclones, earthquakes and droughts (Fig. 1). Cyclone Nargis in 2008 was the most devastating disaster in the history of the country. About 140,000 people died and 2.4 million people were affected by loss of property and livelihoods (Kraas et al. 2017: 50–51, Howe & Bang 2017: 62). As disasters hit individuals and households as the basic and smallest entities, community-based risk management addresses their preparedness for disasters in order to improve resilience.

In Myanmar, township and ward administrations are the most influential institutions to put community-based risk management into action. This is legally established in laws and regulations set up for

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the handling of disasters, in particular the Natural Disaster Management Law 2013 (Republic of the Union of Myanmar 2013), the Disaster Management Rules 2014 (Republic of the Union of Myanmar 2015) and, based on the latter, the Myanmar Action Plan on Disaster Risk Reduction (NDMC 2017, last version), which describes in detail the duties and responsibilities of the institutions involved in disaster risk management.

Rarely, though, have the disaster risk perception and preparedness of private households and individuals been addressed explicitly in literature on disaster risk management in Myanmar. Some are focusing on the health sector (Hla Htay 2006, Nyan Win Myint et al. 2011, Smith & Chan 2017), but also the preparedness of institutions (Zin Mar Than et al. 2020) has been a topic. However, numerous activities to raise awareness and preparedness of households and individuals exist as for instance the report on an initiative on urban disaster risk reduction in Yangon certifies (MDN 2019). Different stakeholders from government, academics and CSOs were involved in a project, which employed practical tools for disaster risk reduction and aimed for local people to be enabled to build resilience. It has taken place in 21 townships of Yangon Region, including Hlaingtharyar Township, which is also part of this study.

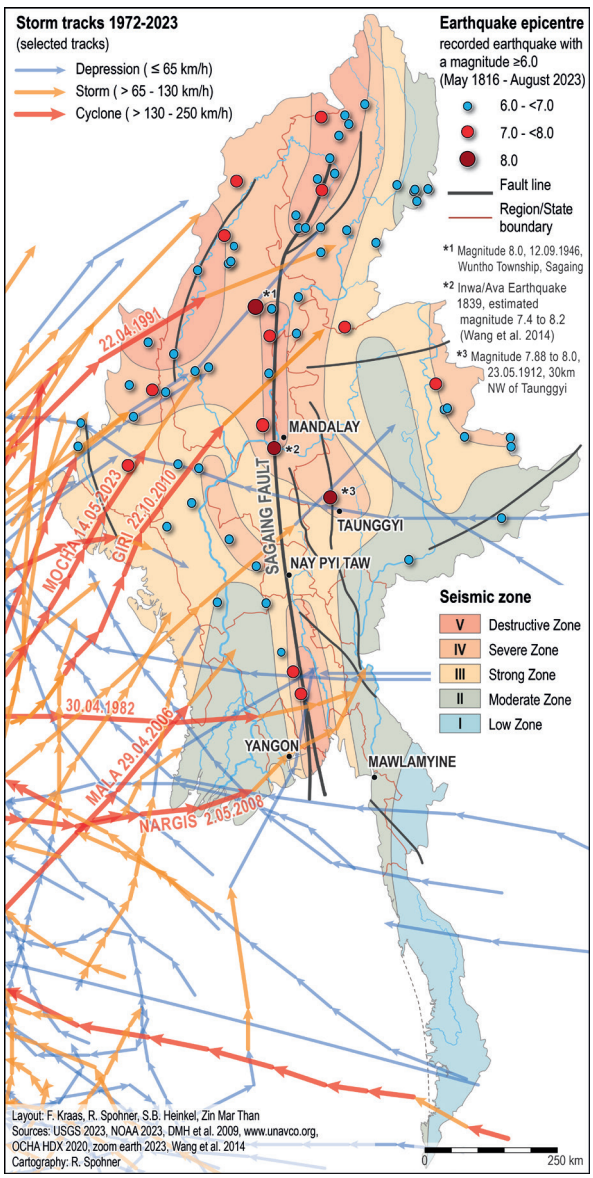

Fig. 1: Storm tracks and earthquakes in Myanmar

As people have different backgrounds (e.g. demographic and social characteristics, disaster experiences) and behave differently, to achieve comprehensive disaster risk management and improve resilience on a community-based level it is necessary to gain deeper insights into the way in which socio-demographic characteristics, people's disaster experiences and specific local settings influence disaster risk perceptions and preparedness. This knowledge can contribute substantially to more adequate, people-oriented and place-based disaster risk management to render society as a whole, individuals and households more resilient in their different locations. This paper aims at understanding the spatial and societal differences of disaster risk perception and preparedness of households in Yangon City, a megacity with more than five million inhabitants, the former capital of Myanmar and the economic hub of the country.

2 Former experiences and socio-demographic characteristics and location as factors influencing disaster risk perception and preparedness

Quite a number of studies have pointed to the close relation between the disaster risk perception, awareness and preparedness of people and their socio-demographic characteristics. An overview of social aspects and their influence on disaster risk perception was provided (in particular for floods) by Qasim et al. (2015). In their literature review, age, income and house ownership are often named as influential factors, as are former experiences with disasters. Research by Kellens et al. (2011: 1065) on flood risk perception at the Belgian North Sea coast in the Ostend region came to the conclusion that risk perception is higher for respondents who are older, are female and have flood experience, but found that

home ownership is not related to risk perception. In contrast, Qasim et al. (2015) in their research on flood events in the Khyber Pukhthunkhwa Province of Pakistan found that risk perception indicators are significantly influenced by house ownership, education, distance from the water source, and past experience with floods. Quite often socio-demographic factors are related to disaster risk perception and preparedness, but their influence is quite marginal. For instance, research by Nikkanen et al. (2021: 8) on storm events in Finland suggests that socioeconomic factors (e.g. education level and employment status) seem to have only a marginal influence on how people prepare for winter storms. Similarly, Sjöberg (2000: 7) states that gender, education and income are very weakly related to risk perception. The study of Tohan et al. (2023) on demographic predictors of disaster preparedness in flood-prone communities in Bangladesh explores several factors such as monthly income and loss of household member, which have a certain influence, education the highest. Other studies (e.g. Botzen et al. (2009) on flood perception in the Netherlands, Haijto et al. (2015) regarding awareness and perception of hazards (like flood and drought) in Ethiopia and Onuma et al. (2017) on disaster preparedness in Japan) also found that age and education are influencing factors as well as past experiences. Kim & Kim (2022) focus on factors influencing disaster preparedness in South Korea, pointing to the result that preparedness is influenced by past experience and to some extent by age and income, but gender and education do not. Hoffmann & Muttarak (2017) looked into disaster preparedness in the Philippines and Thailand and interestingly found that education raises disaster preparedness only for households that have not been affected by a disaster in the past, when people have experienced a disaster then education does not significantly influence disaster preparedness. While research often focuses on low-density urbanised areas, the study of Ng (2023) is asking for the role of perception, experience and socio-demographic characteristics in disaster preparedness and response toward typhoons in Hong Kong, a megacity even denser populated as Yangon. Regarding preparedness, also here prior experience had a remarkable influence and some influence could be found for age and income, while gender and education did not influence significantly. Castañeda et al. (2020) explored the influence of experience and sociodemographic variables on natural disaster (earthquakes, tsunamis) preparedness among inhabitants of the Chilean coast (cities of Iqueque and Concepcion). Three domains of preparedness were investigated: household, community and work. In general, direct experience and higher frequency of exposure to disaster generate a higher level of preparedness. Also, middle-aged adults as well as higher education and higher income lead to higher preparedness. A further result is, that for the three domains – household, community and workplace – often different sociodemographic characteristics influence the preparedness (e.g. living with a partner, gender and age for household domain; gender for community; education and family income for workplace).

Regarding the influence of experience on disaster perception the study of Bronfman et al. (2020) brought interesting new insights. Previous results (e.g. Wachinger et al. 2013, Becker et al. 2017, Demuth 2018) showed that disaster experience can be subdivided into subtypes, which interact with each other. For instance, Wachinger et al. (2013) are defining two, Becker et al. (2017) differentiate into four subtypes. Bronfman et al. (2020) subdivided 'experience' into two subtypes, namely physical (i.e. physical and material consequences of a disaster) and emotional experience (i.e. the feeling of fear when a disaster happened), and added a third element, 'worry', which plays an intermediate role between the experience variables and perception. The paper contributes to uncover the direct influences of the two experience subtypes on disaster perceptions as well the indirect ones via the element 'worry' based on data of a survey conducted shortly after an earthquake in Northern Chile in 2014. The results show that the experience subtypes influence disaster perception quite strongly directly as well as indirectly via the element 'worry'. Moreover, the results of studies conducted in different countries vary quite significantly. This is not too surprising given, for instance, strong cultural and educational differences. Additionally, variables measuring disaster preparedness or risk perception are differently defined in the studies, at least to some extent. The same holds true for socio-demographic variables (e.g. education as a dichotomous variable [high, low] or in more detailed categories; similarly for age).

For Myanmar, there is little research on the influence of socio-demographic characteristics on risk perception and preparedness. The study of Fernandez et al. (2018) focuses on factors influencing the risk perception of fire, earthquake and cyclone in two wards of Yangon City (No. 2 Ward of Pazundaung Township and Byaing Kwet Thit Ward of Tamwe Township). Both wards are part of the highly urbanised area of Yangon. Importantly,

the results suggest that socio-demographic and experiential factors influence disaster risk perception to some extent (but not always and not very much) and that different factors influence the perception of the three disaster risk types (Fernandez et al. 2018: 144–146). The spatial perspective (differences between the two wards) has not yet been taken into consideration. Such a perspective is contained in a recent study of Ko Ko Lwin et al. (2020), which is focused on flood resilience. Based on four villages in the Ayeyarwady Delta a survey was done to analyze the relations between the five components: social demographics, sense of place, adaptive capacity, flood risk level, and the social resilience status of the community. The villages can be subdivided into two village types: high flood-prone and low flood-prone. A main result is that the preparedness in the high flood-prone areas is significantly higher than in the low flood-prone ones. The article of Heinkel et al. (2022) focuses on disaster preparedness and resilience at household level, investigating how specific measures could improve disaster risk preparedness in four townships of Yangon.

Thus, there is a need for further research on disaster risk perception and preparedness in Myanmar and their relation to socio-demographic characteristics as well as to past experiences. This could provide deeper understanding of influences on disaster risk perception and preparedness in order to develop and improve adequate urban disaster risk management in Yangon as the leading megacity of Myanmar. Additionally, spatial differences within Yangon City require investigation. Against this background, three key questions have guided the research: 1. Which spatial variations can be identified regarding the disaster risk perception and preparedness of households and individuals? 2. How do previous disaster experiences influence the disaster risk perception and preparedness status of the households and individuals? 3. How do socio-demographic aspects influence the disaster risk perception and preparedness of households and individuals?

3 Research area and methods

The main database is a survey of 896 households, which was conducted in 2019 in 7 out of the 33 townships of Yangon City, namely Pabedan, Latha, Insein, North Okkalapa, Hlaingtharyar, Shwepyithar, Dagon Seikkan, and in Twantay, which belongs to Yangon Region (Fig. 2). All questionnaires were conducted in Myanmar language and were carried out by teams from Yangon City Development Committee and Myanmar Environment Institute, research partners in the project. Each participant was asked verbally whether she/he agrees to participate. Only if the participant agreed a questionnaire was conducted.

The townships were selected (Fig. 2) in line with their specific disaster risk exposure, which includes exposure to earthquakes, cyclones, storms and floods as summarized for the Yangon area and its surroundings (Fig. 3). According to the assessment of the Myanmar Earthquake Committee, most of the buildings in Pabedan are hardly protected against seismic activities. Due to tidal fluctuations, the lower blocks of Latha are often flooded. North Okkalapa, Hlaingtharyar, Shwepyithar, Dagon Seikkan, Twantay and Insein sometimes suffer from floods due to heavy rain. Additionally, the townships cover differently urbanised areas of Yangon. For instance, Pabedan and Latha are located in the inner-city area, whereas Hlaingtharyar belongs to the urban fringe and Twantay still has quite a rural character. The socio-demographic variables show the variations between the townships (Tab. 1). For instance, the inner-city townships have a smaller proportion of young people, but a remarkably higher number of graduated people. The outer city township, Twantay, has a very small urban population, similarly most of the urban fringe townships have low proportions of urban population. In these townships, the share of people with just primary education is also quite high.

In each of the eight townships about 110 household questionnaires were collected. The households in the townships were chosen according to a randomized stratified sampling. The questionnaire data was statistically analysed with IBM SPSS software. In the survey, the households were asked about their disaster risk perception and preparedness and about their experiences with disasters.

Disaster risk perception was investigated by asking how the respondents evaluate their feelings regarding hazards, namely floods, cyclones and earthquakes. The respondents could express their feelings on a 3-point Likert scale (1 = very afraid, 2 = afraid, 3 = not afraid). This gives information about people's evaluation and perception of these types of disaster. In a further step the respondents were asked whether they think they could reduce losses caused by floods, cyclones or earthquakes via proper preparedness measures (0 = having no proper measures, 1 = having proper measures). This gives information about whether people are aware of the risk of disasters, the results in their action and how they assess the risks in order to get better prepared.

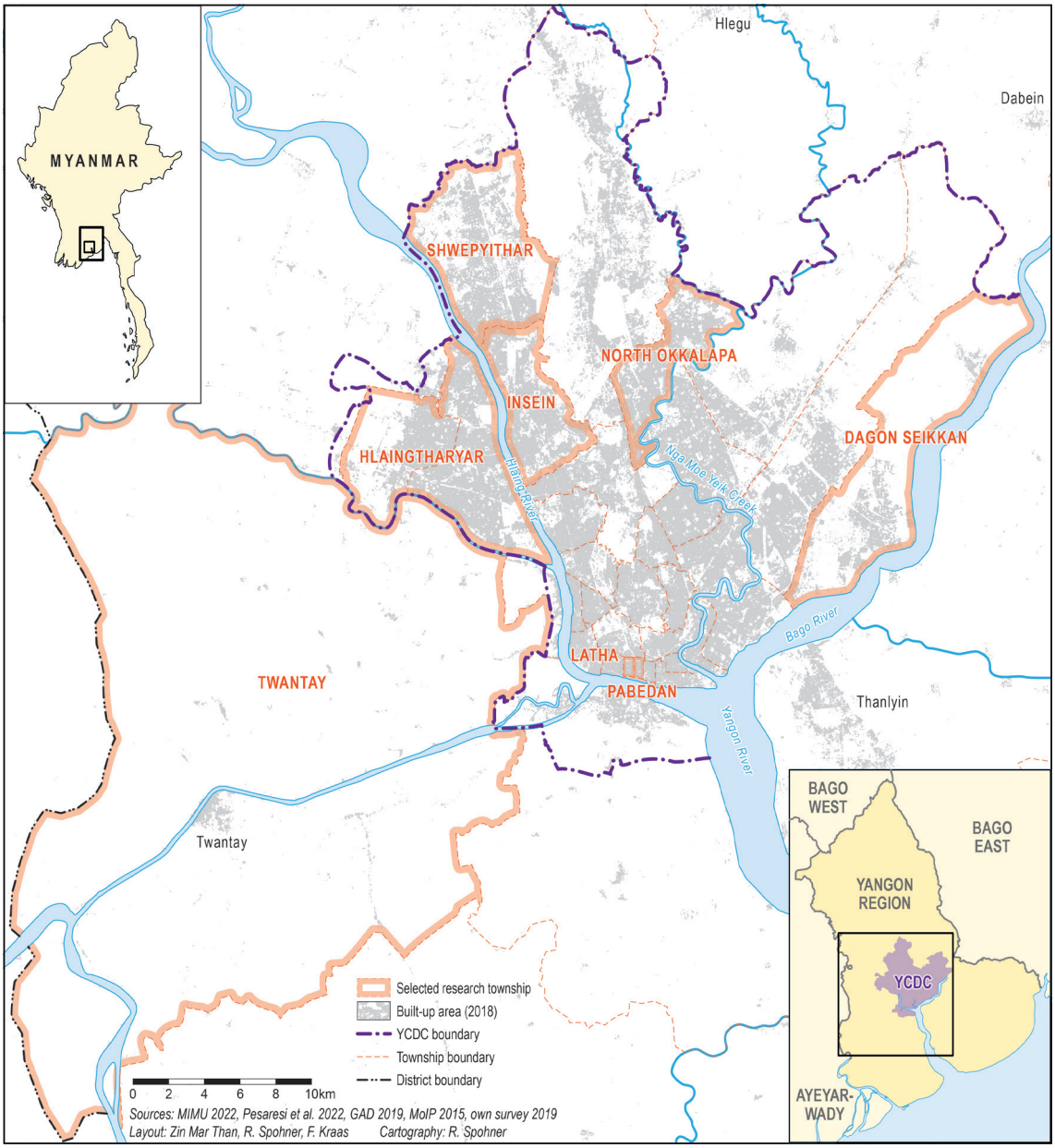

Fig. 2: Administrative map of Yangon City with the selected townships under study

To measure the disaster preparedness of the households, seven preparedness variables were defined. All respondents were asked whether the households have first aid knowledge, know if a fire extinguisher is available and know how to use such an extinguisher. Further, it was asked if the households know what an emergency kit is, have prepared such kit, regularly check the household equipment (i.e. electric cable, gas, stability of furniture) and have discussed a meeting place with other household members in case of a disaster. In the questionnaire the variables are measured dichotomously (0 = no, 1 = yes). The first three are related to all kinds of disasters (e.g. natural, human-made, accidents (also little ones like a wound or a small fire in the house)). The other four are more orientated to severe disasters (e.g. flood, earthquake, strong storm, strong fire), which often cause heavy damages to houses and people. Additionally, the above-mentioned variables are composed into a disaster preparedness index as follows. If an answer is given for all seven items, the sum of the seven values is derived to create an

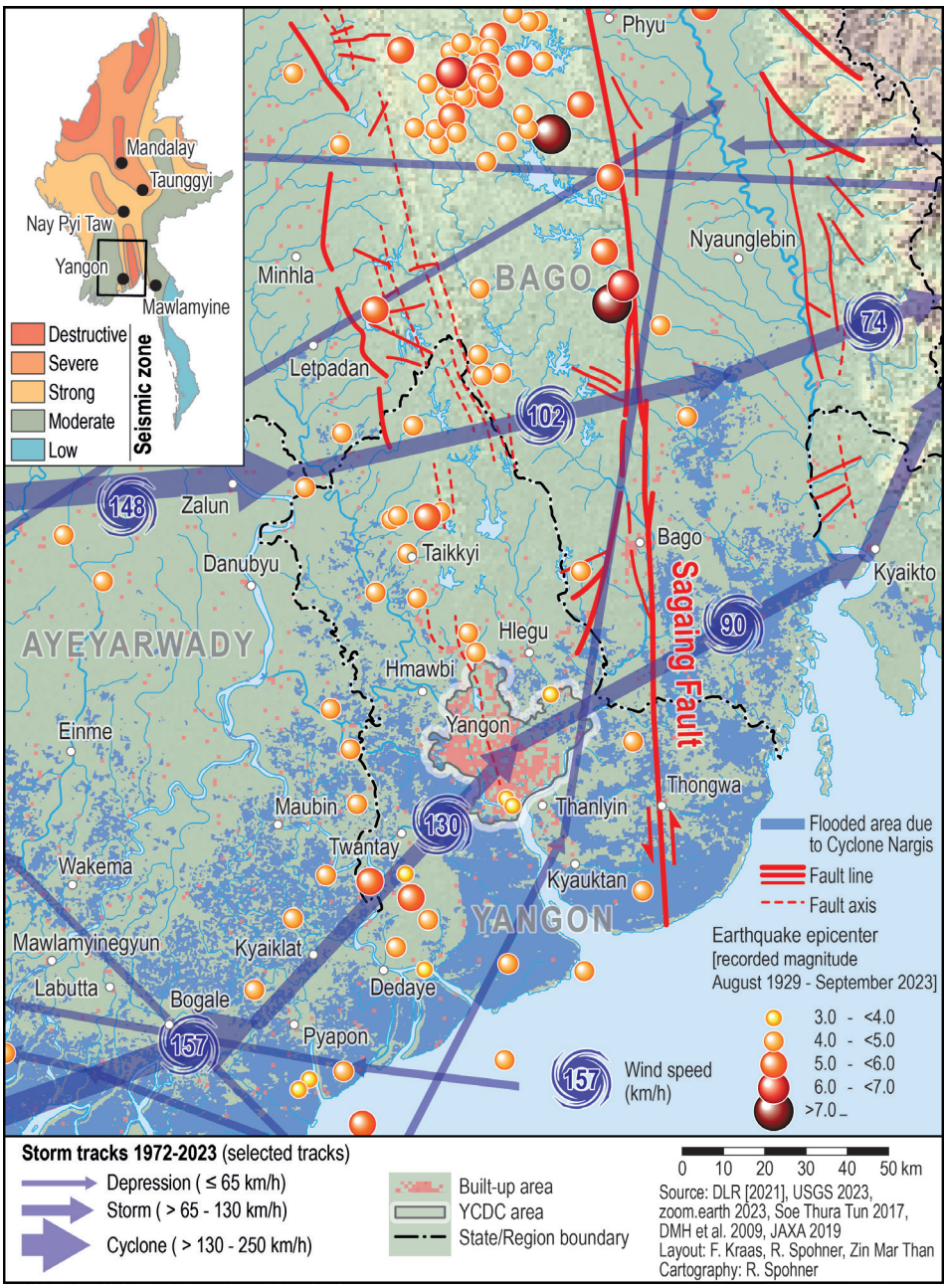

Fig. 3: Storm track, flood and earthquake situation in the Yangon area

index ranging between 0 and 7. Assuming that all seven items contribute equally to preparedness, the result expresses the intensity of being prepared (0 = not prepared at all, …, 4 = prepared regarding four items, …, 7 = fully prepared).

The two following variables were used to assess disaster experiences in the research: 1. Disaster experience in general (general information on whether the respondent has experienced a disaster or not), and 2. Effects of the previous Cyclone Nargis for the respondent (information about whether the respondent was affected by Cyclone Nargis in 2008 or not).

In this study, the following independent variables regarding socio-demographic factors were used: gender of respondent (male, female), education level of respondent (monastic/primary, middle school, high school, graduated), age of respondent (below 30, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 and older), household size (very small [1-2], small [3-4],

Tab. 1: Socio-demographic characteristics for eight townships of Yangon

	Inner city		Densely urban		Urban fringe			Outer city		
Variables	Pabedan	Latha	North Okkalapa	Insein	Hlaing-tharyar	Shwe-pyithar	Dagon Seikkan	Twantay	Yangon City	Yangon Region
Area (sq.km)	0.7	0.8	26.7	28.2	67.3	66.8	85.4	724.9	794.1	10,277.1
Population	30,382	26,109	289,928	285,500	440,949	284,922	187,891	231,319	5,211,431	7,831,830
Urban pop*(%)	100.0	100.0	100.0	100.0	77.2	84.4	91.1	18.6	90.7	69.1
Gender ratio**	89.2	79.6	90.1	89.8	92.0	87.7	91.5	95.6	87.5	86.8
Age (%)										
0 - < 18	22.8	14.0	34.5	18.5	31.3	26.8	28.1	30.1	27.1	27.3
≥ 18	77.2	86.0	65.5	81.5	68.7	73.2	71.9	69.9	72.9	72.7
Education***										
primary	16.2	12.4	22.2	22.7	36.5	30.9	32.9	59.6	24.3	32.4
middle	24.0	18.9	28.4	26.5	30.4	30.5	26.1	15.9	25.4	23.7
higher	22.5	20.5	24.5	23.3	16.6	20.4	19.1	8.5	21.5	18.1
graduate	33.3	44.3	20.6	22.8	9.9	12.2	13.1	5.4	23.6	18.7
Homeowner (%)	75.2	71.4	60.7	55.6	39.4	55.1	52.5	91.4	54.1	64.5
Household size	5.7	4.7	4.4	4.3	5.5	4.6	3.8	4.4	4.5	4.6

* People living in areas classified as urban (defined by General Administration Department)
** Number of males per 100 females
*** for education level: % of population aged 25 or older
Source: MIMU (2014), MIMU (2019), Republic of the Union of Myanmar (2019)

medium [5-6], big [7-8], very big [9 or more]), migration of household to Yangon in the last 15 years (yes, no), ownership of accommodation (owner, not owner).

The township level was chosen as the spatial dimension. In Myanmar the administrative system is organized into five spatial levels (i.e. national, state/region, district, township, ward/village tract). Overlooking the legal regulations for disaster situations, the townships play the key role in community-based risk management as they act as crucial nodes between communities and national and sub-national levels (see also MDN 2019). Insofar, they are most relevant for disaster risk management and the most influential entities at the local level in terms of preparing for and responding to a disaster.

To analyse interrelations between influencing variables and disaster risk perception and preparedness as well as differences in disaster risk perception and preparedness on the spatial level (townships), a contingency table analysis was used for categorical data. Throughout the text the contingency coefficients are of the type 'corrected contingency coefficient' and named as C. The disaster preparedness index can be regarded as a metric, not normally distributed variable. For analysing differences and relations regarding this index, a kind of non-parametric ANOVA test (based on Kruskal-Wallis-Test as well as Mann-Whitney U-Test) was conducted and boxplots were created. All tests were carried out at the significance level of 5% (0.05) and 1% (0.01) respectively.

The majority of research (e.g. Sjöberg 2000, Botzen et al. 2009, Hajito et al. 2015, Hoffmann & Muttarak 2017, Onuma et al. 2017, Nikkanen et al. 2021) that deals with the influence of socio-demographics and experience on disaster risk perception and preparedness follows a multivariate approach – often based on a kind of multivariate 'regression' analysis. The advantage of such an approach is on the one hand that in reality the interrelationship is a multivariate one. On the other hand, in such an approach, the influence of a factor as a single entity cannot be presented in detail. However, a bivariate analysis seems to be of some considerable value for applied work in disaster risk management. For instance, it might be of interest for decision makers to know whether disaster training/drill activities should be directed to specific gender or age groups, to homeowners in particular or to citizens with a specific educational background. Following this perspective, this study focuses on bivariate analyses. That is, we examine the relations between one disaster risk perception or preparedness variable and one socio-demographic or experiential variable individually.

4 Disaster experiences, disaster risk perception and preparedness of households – in general

The vast majority of the households in Yangon (more than 85%) have experienced disasters. Of these households, 97.1% name cyclones, 21.1% name floods and 13.7% name earthquakes as the disasters they experienced. Other disasters like fires or droughts are named less frequently. Not all of the households that have experienced disasters also experienced Cyclone Nargis in 2008, although about 59% were affected by this event. More than a third of the affected respondents claimed that parts of their houses were destroyed (34.4%), but the complete destruction of houses was also mentioned fairly often (17.3%). Besides these mostly frequently mentioned effects, the interruption of electricity supplies (13.2%) and food shortages (11.3%) were cited by the respondents.

Regarding disaster risk perception, the survey provides the following results. Considerably more than 60% of households are at least afraid of flooding, cyclones and earthquakes, whereby the fear of a cyclone is highest at just over 70% (Fig. 4). This high percentage is related to the experiences people had with Cyclone Nargis. But, in general, feelings do not differ much between the disaster types.

Remarkable differences exist in terms of evaluations of knowledge about proper risk reduction measures for the three hazard types. More than 60% of the respondents think that they know about the proper risk reduction measures to undertake in case of flooding. But only 40% state that they have the relevant knowledge for cyclones and even less (about 30%) for earthquakes.

Differences between the state of disaster preparedness in relation to specific items are also remarkable (Fig. 5). Only 58.9% knew the location of fire extinguisher and 65.9% checked their facilities. For 'fire

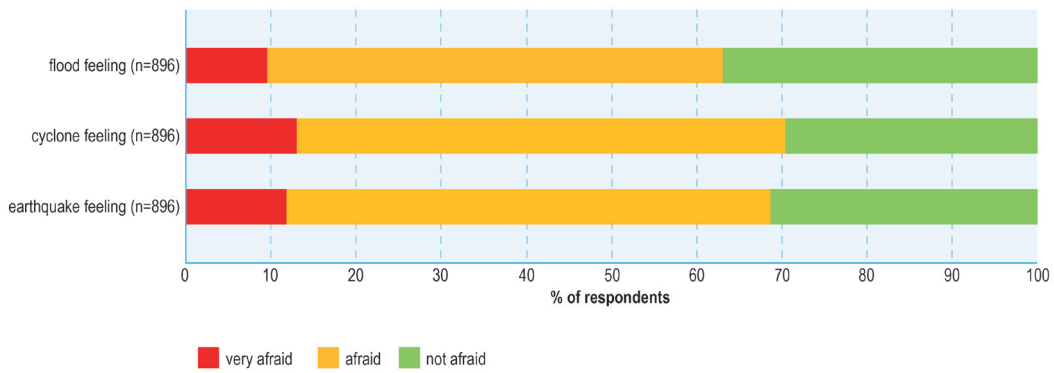

Fig. 4: Feelings related to the disaster types flood, cyclone and earthquake

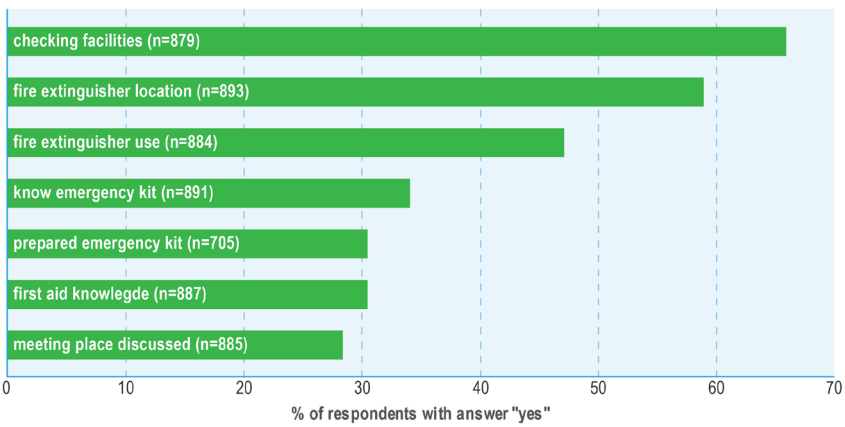

Fig. 5: Respondents with positive answers regarding their disaster preparedness in relation to specific items

extinguisher use' the percentage is still 47.1%. For the other four items, only about 30% of the respondents answered 'yes'. Thus in general, the disaster preparedness of households is not particularly advanced and requires upgrading.

5 Spatial variations in the disaster risk perception and preparedness of households

5.1 Spatial variations in disaster risk perception

There are substantial spatial variations in disaster risk perception. To some extent, a pattern is apparent (Tab. 2). The table shows the percentages of the respondents who are not afraid of the disasters (flood, cyclone, earthquakes) and who know about proper risk reduction measures. Additionally, contingency table analyses were carried out. For all the disaster risk perception variables, the contingency coefficients are highly significant (sig. <0.01). Regarding the feeling variables the C-coefficients are in the range between 0.3 and 0.4, for the variables on knowing about proper measures C is between 0.4 and 0.5 revealing not very strong, but notable differences between the townships. The column 'sig.' shows the significance of the deviation from the theoretically expected value (under the assumption of equal distribution) regarding the answers 'not afraid' and 'knowing about proper risk reduction measures' respectively. In particular in the townships at the urban fringe (Hlaingtharyar, Twantay, Shwepyithar), a disproportionally small number of people are not afraid of disasters and very few people in these townships (except Shwepyithar) state that they know about risk reduction measures. In contrast, in the inner-city townships (Latha, Pabedan) many people are not particularly afraid, and in Pabedan and Insein they more often think that they are aware of the proper measures with which to meet disasters.

5.2 Spatial variation in disaster preparedness

There are remarkable variations between the townships in terms of the seven variables measuring aspects of disaster preparedness. Contingency table analyses revealed that for six of the seven variables (except meeting place), the townships differ very significantly (sig. <0.01), while a significant difference (sig. <0.05) exists for meeting place. The height of the C-coefficients (except agreed meeting place) with at least > 0.3 (in most cases > 0.4) underline, that the differences are not very high, but quite remarkable. Table 3 shows the percentages of responding households that answered the related questions affirmatively and the significance level of the adjusted residuals of the contingency analysis. By far the most problematic township regarding disaster preparedness of the households is Twantay, although Hlaingtharyar also often has quite low values. The percentages for Twantay are the lowest for all seven aspects (underlined in the table). On the other hand, the maximum percentages of the seven aspects (bold in the table) are not concentrated in just

Tab. 2: Disaster risk perception variables and township variability

	Feeling of disaster: not afraid						**Knowing about proper risk reduction measures**					
	Flood (n = 874)		Cyclone (n = 878)		Earthquake (n = 873)		Flood (n = 680)		Cyclone (n = 643)		Earthquake (n = 610)	
Township	(%)	sig.	(%)	sig.	(%)	sig.	(%)	sig.	(%)	sig.	(%)	sig.
Twantay	31.48		<u>17.43</u>	--	27.78		<u>30.65</u>	--	<u>11.67</u>	--	<u>8.06</u>	--
Hlaingtharyar	<u>22.32</u>	--	20.35	-	26.79		44.57	--	25.84	--	18.82	-
Shwepyithar	33.02		20.95	-	25.71		70.93		47.44		32.39	
Dagon Seikkan	30.91		22.02		<u>24.07</u>		64.77		29.41	--	18.75	-
North Okkalapa	35.19		32.73		31.48		71.29		40.63		20.45	-
Insein	37.27		29.09		30.91		**80.52**	++	68.12	++	51.61	++
Pabedan	50.89	++	45.61	++	38.60		73.03	+	**68.67**	++	**60.00**	++
Latha	**54.63**	++	**48.15**	++	**45.37**	++	58.82		44.58		35.37	
Total sample	36.96		29.61		31.39		62.79		42.30		30.49	

bold = maximum underlined = minimum
++ = very disproportionally high (sig. <0.01) + = disproportionally high (sig. <0.05)
-- = very disproportionally low (sig. <0.01) - = disproportionally low (sig. <0.05)
Source: Own survey 2019

Tab. 3: Disaster preparedness variables and township variability

	Normal disaster measures						Severe disaster measures							
	First aid knowledge (n = 887)		Fire extinguisher availability (n =893)		Fire extinguisher use (n =884)		Knowledge of kit (n =891)		Preparedness of kit (n =705)		Checking of facilities (n =879)		Agreed meeting place (n =885)	
Township	yes %	sig.	yes %	sig.	yes %	sig.	yes %	sig.	yes %	sig.	yes %	sig.	yes %	sig.
Twantay	14.68	--	20.91	--	16.51	--	4.50	--	1.59	--	38,53	--	18.18	-
Hlaingtharyar	21.24	-	50.00	-	36.45	-	17.50	--	23.08		45.13	--	25.66	
Shwepyithar	**46.36**	++	42.73	--	40.91		37.30		29.36		61.17		29.63	
Dagon Seikkan	27.52		51.82		43.52		36.20		46.74	++	74.31	+	**41.82**	++
North Okkalapa	34.55		73.64	++	47.27		**49.10**	++	**53.64**	++	76.36	+	25.93	
Insein	45.37	++	49.09	--	48.18		47.30	++	38.78		74.29		31.19	
Pabedan	31.03		**91.53**	++	**75.42**	++	44.10	+	20.19	-	**81.20**	++	30.43	
Latha	23.21		88.50	++	65.18	++	36.30		13.33	--	75.22	+	24.11	
Total sample	30.44		58.90		47.06		34.01		30.50		65.87		28.36	

bold = maximum underlined = minimum
++ = very disproportionally high (sig. <0.01) + = disproportionally high (sig. <0.05)
-- = very disproportionally low (sig. <0.01) - = disproportionally low (sig. <0.05)
Source: Own survey 2019

one township but reflect the variations between the townships. Quite high disaster preparedness regarding the fire extinguisher variables can be reported from the central city townships (Pabedan, Latha), as is also the case for checking of facilities. In contrast, disaster preparedness regarding emergency kit is quite low in these areas. In terms of the emergency kit variables, North Okkalapa stands out positively while comparatively good knowledge of first aid can be found in Shwepyithar and in Insein.

The analysis of the disaster preparedness index produced additional results. It shows quite remarkable differences between the townships regarding the extent to which households are prepared. According to the Kruskal-Wallis-Test, overall the eight townships are significantly different (sig. <0.01). The pairwise comparison test based on Mann-Whitney U-Tests (Tab. 4) together with an analysis of the boxplot diagram (Fig. 6) reveals a more detailed picture of these differences. The disaster prepared-

Tab. 4: Pairwise comparison of townships related to disaster preparedness index

	Township							
Township	Twantay	Hlaingtharyar	Shwepyithar	Dagon Seikkan	Latha	Insein	North Okkalapa	Pabedan
Twantay (n = 61)		**	**	**	**	**	**	**
Hlaingtharyar (n = 36)						*	**	**
Shwepyithar (n = 100)							**	**
Dagon Seikkan (n = 90)								*
Latha (n = 87)								*
Insein (n = 91)								
North Okkalapa (n = 108)								
Pabedan (n = 98)								

* = significantly different (sig. <0.05) ** = highly significantly different (sig. <0.01)
Sample size (all townships together): n = 671
Source: Own survey 2019

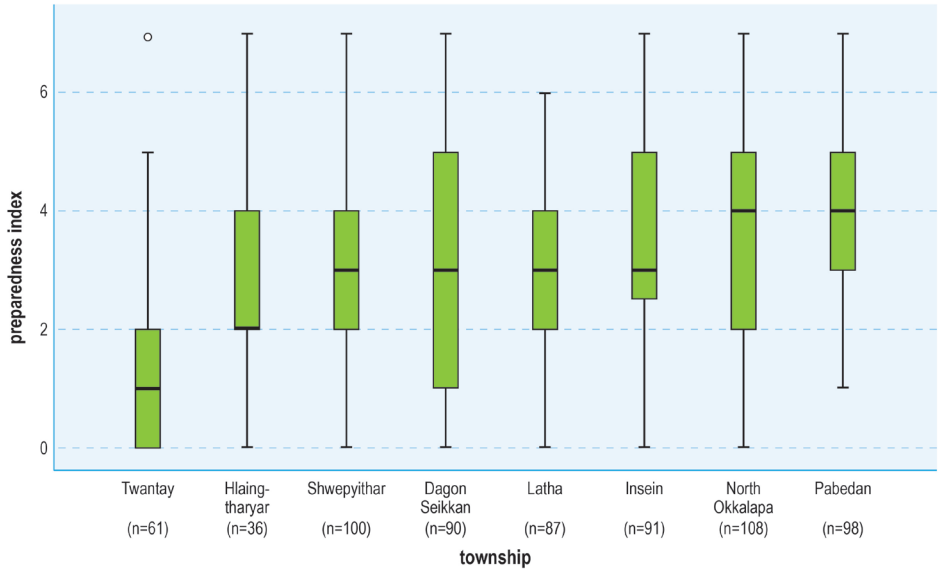

Fig. 6. Township variability for the disaster preparedness index. Sample size (all townships together): n = 671; ○ = outlier. Source: Own survey 2019

ness situation of the households in Twantay is exceptionally poor and the township is significantly different to all other seven townships (Tab. 4). In Twantay, 75% of the respondents indicated that they have made preparations involving a maximum of two of the items investigated and at least 50% of the households name only one item or even none at all (Fig. 6). Thus, the vast majority of the households is extremely badly prepared for disasters. This result lets assume that there is a high discrepancy in disaster preparedness between urban and rural areas, since the situation in the highly urbanised township of Pabedan is something of a contrast to Twantay (Fig. 6). Here 50% of the households are prepared with at least four items, and five items or more are named by at least 25%. Pabedan Township differs significantly from most of the other townships (Tab. 4), except for Insein and North Okkalapa. These townships are more similar to Pabedan with, for instance, 25% of the households prepared with at least five items. These three townships do not differ significantly from one another, but they often differ significantly from the other townships – this is in particularly pronounced for Pabedan (Tab. 4). A common characteristic of the rest of the townships (Hlaingtharyar, Shwepyithar, Dagon Seikkan and Latha) is that they do not differ significantly from each other. Additionally (except for Dagon Seikkan), at least 25% of the households are prepared with at least four of the items and only 25% name not more than two items. In these townships the height of the box (Fig. 6) is quite small, which means that the 'middle' 50% of the households name two to four items. Here Dagon Seikkan is an exception with the middle 50% varying between one and five items.

6 Former experiences as influencing factors for disaster risk perception and preparedness

Experiences with disasters (in general or Cyclone Nargis) significantly influence the perception of disasters (Tab. 5). The contingency coefficients demonstrate that previous disaster experiences show significant interrelations with the cyclone issues (feelings and evaluations of having proper risk reduction measures). The disaster risk perception variables for cyclones differ significantly with the general disaster experience. This is not the case for floods and earthquakes. This contrasts with the specific Nargis-related variable. All the above-mentioned significant relations are structured as follows (interpretation of the residuals of the contingency table analysis): after having had experience of or been affected by Nargis, respondents disproportionally often feel afraid or very much afraid and disproportionally many respondents state that they do not know about proper risk reduction measures (for cyclones). This initially appears surprising, but bearing in mind the devastating experiences people went through with Nargis, it is quite understandable

Tab. 5: Contingency coefficients C: Experiences with disasters and disaster risk perception

	Feeling of fear						Proper reduction measures					
	Flood		Cyclone		Earthquake		Flood		Cyclone		Earthquake	
Disaster experience	C	sig	C	sig	C	sig	C	sig	C	sig	C	sig
General	0.0779		0.1230	*	0.0992		0.0634		0.1254	*	0.0619	
	n=872		*n=876*		*n=872*		*n=679*		*n=641*		*n=609*	
Through Nargis	0.1362	*	0.1829	**	0.1838	**	0.0331		0.1250	*	0.1130	
	n=850		*n=854*		*n=849*		*n=665*		*n=627*		*n=596*	

* = significant (sig. <0.05)
** = highly significant (sig. <0.01)
Source: Own survey 2019

that people cannot conceive of proper risk reduction measures in relation to such a cyclone. Additionally, it has to be pointed out that even if the C-coefficients are significant they are quite low, which means that the relations do exist but that the involved experience variables do not influence very strongly.

In some cases the two experience variables have quite a significant influence on disaster preparedness, in some cases such a relation does not exist, and the significant relations vary to some extent (Tab. 6). Experiences with disaster in general as well as in connection to Nargis have no influence on checking facilities, which is interesting because it indicates that experience of a disaster is irrelevant to attitudes linked to checking facilities, this is rather a normal activity. On the other hand, disaster experiences (in general) lead to knowledge of what an emergency kit is and the preparing of such a kit. Discussion to fix a meeting place is significantly often held in households with general experience of a disaster. Experiences of Nargis significantly influence disaster preparedness regarding an emergency kit and the variables related to knowledge about using a fire extinguisher. If significant relations exist, they reveal that people with experience are better prepared except for the fire extinguisher variables (interpretation of the residuals). Here people who lack experience know more about this equipment. This surprising result might have its origin in the fact that many people who experienced Nargis are migrants living in poor conditions who cannot afford to have an extinguisher in their households and are thus unfamiliar with it. As in the above discussed relationship between experience and perception, also here it has to be pointed out that even if the C-coefficients are significant they are quite low, which means that the relations do exist but that the involved experience variables do not influence very strongly.

Regarding the disaster preparedness index (see explanation in chapter 3), a significant difference is apparent for the experience variable (general) (sig. <0.05, Mann-Whitney U-Test). The frequency diagram in Figure 7 shows that households with no experience predominantly know of up to four measures with a peak at two and three, and only a few know of more than four measures. On the other hand, for households with experience the peak is at three and four measures and a remarkable percentage of households have more than four measures in hand. All in all, people with disaster experiences know and use comparatively more disaster measures than people who do not have previous disaster experiences. Regarding experiences with Nargis, the Mann-Whitney U-Test does not show significant differences.

Tab. 6: Contingency coefficients C: Experiences with disaster and disaster preparedness

	Normal disaster measures						Severe disaster measures							
	First aid knowledge		Fire extinguisher availability		Fire extinguisher use		Knowledge of kit		Preparedness of kit		Checking of facilities		Agreeing on meeting place	
Experiences	C	sig	C	sig	C	sig	C	sig	C	sig	C	Sig	C	sig
General	0.1106	*	0.0447		0.0805		0.1673	**	0.1550	**	0.0441		0.0955	*
	n=885		*n=741*		*n=883*		*n=889*		*n=705*		*n=877*		*n=883*	
Through Nargis	0.0412		0.1529	*	0.2041	**	0.0191		0.1407	**	0.0353		0.0260	
	n=864		*n=869*		*n=860*		*n=867*		*n=685*		*n=856*		*n=862*	

* = significant (sig. <0.05) ** = highly significant (sig. <0.01)
Source: Own survey 2019

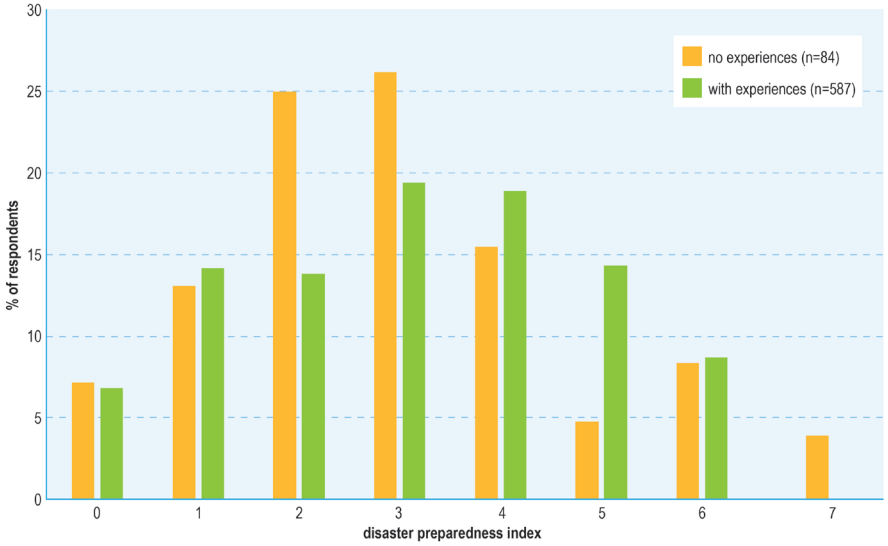

Fig. 7: Frequencies: experiences with disasters (in general) and disaster preparedness index
Sample size (all respondents): n = 671. Own survey 2019.

7 Influences of socio-demographic aspects on the disaster risk perception and preparedness of households and individuals

7.1 The influence of socio-demographic aspects on disaster risk perception

Interestingly, gender is highly significantly and quite strongly related to feelings about disasters (C ≈ 0.4), in that women feel disproportionally often afraid or very afraid. Regarding proper risk reduction measures, gender is only significantly related to measures for cyclones (Tab. 7). This contrasts with relations concerning education. The coefficients with the variables of proper risk reduction measures are highly significant and not too low (C ≈ 0.3). For all three disaster types, respondents with graduate-level education disproportionally often stated that they know about proper risk reduction measures. Respondents with primary-school-level education state the opposite. The migration status of respondents significantly influences feelings of being afraid of floods and cyclones, but not of earthquakes. People who have migrated are disproportionally often afraid of flood and cyclones, which makes sense because often such a disaster was the reason they migrated to Yangon and they often now live in areas affected by floods. But the C-coefficients are fairly low, which means that the influence of migration is not remarkably high. Regarding proper risk reduction measures, a significant relation is found for earthquakes, whereby people who have migrated disproportionally often think that they lack proper risk reduction measures for earthquakes. The only significant influence of 'age' on the evaluation of proper risk reduction measures is for earthquakes.

The socio-demographic aspects 'household size' and 'ownership' show no significant relationship to the disaster risk perception variables. In contrast to this, household/family size is an influencing factor in Fernandez' study (Fernandez et al. 2018), at least regarding cyclone and earthquake risk perception. There may be manifold reasons for this discrepancy. For instance, disaster risk perception variables are somewhat differently measured in the surveys. Differences also exist in the definitions of socio-demographic variables (e.g. household size as a continuous variable in Fernandez et al. (2018), five household size classes here).

7.2 The influence of socio-demographic aspects on disaster preparedness

The first interesting result is that age, household size and ownership have no significant influence on any of the disaster preparedness variables (Tab. 8). On the other hand, education level is the only socio-demographic aspect which significantly influences very many disaster preparedness variables (with the exception of preparedness of an emergency kit and establishing a meeting place). In most cases the related C-coefficients show with values of above 0.3 that education influences preparedness to at least some

Tab. 7: Contingency coefficients C: socio-demographic aspects and disaster risk perception

	Feeling of fear						Proper reduction measures					
	Flood		Cyclone		Earthquake		Flood		Cyclone		Earthquake	
Variable	C	sig	C	sig	C	sig	C	sig	C	sig	C	sig
Gender	0.4552	**	0.4240	**	0.3972	**	0.0638		0.1121	*	0.0908	
	n=873		*n=877*		*n=872*		*n=679*		*n=642*		*n=609*	
Education	0.1338		0.1630	*	0.1234		0.3590	**	0.3234	**	0.2726	**
	n=853		*n=857*		*n=853*		*n=671*		*n=634*		*n=600*	
Age	0.1306		0.1448		0.1419		0.0874		0.1388		0.2075	**
	n=874		*n=878*		*n=873*		*n=680*		*n=643*		*n=610*	
Household size	0.1136		0.1094		0.0818		0.0727		0.1141		0.1340	
	n=870		*n=874*		*n=869*		*n=678*		*n=642*		*n=609*	
Migration	0.1507	**	0.1326		0.0438		0.0505		0.0924		0.1295	*
	n=868		*n=872*	*	*n=867*		*n=674*		*n=637*		*n=604*	
Ownership	0.0297		0.0180		0.0145		0.0631		0.0457		0.0766	
	n=869		*n=873*		*n=868*		*n=677*		*n=640*		*n=607*	

* = significant (sig. <0.05) ** = highly significant (sig. <0.01)

Source: Own survey 2019

Tab. 8: Contingency coefficients C: socio-demographic aspects and disaster preparedness

	Normal disaster measures						Severe disaster measures							
	First aid knowledge		Fire extinguisher availability		Fire extinguisher use		Knowledge of kit		Preparedness of kit		Checking of facilities		Agreeing on meeting place	
Variable	C	sig	C	sig	C	sig	C	sig	C	sig	C	sig	C	sig
Gender	0.0455		0.2240	**	0.4226	**	0.0551		0.1773	**	0.0154		0.0303	
	n=886		*n=892*		*n=883*		*n=890*		*n=704*		*n=878*		*n=884*	
Education	0.3637	**	0.3004	**	0.4280	**	0.3005	**	0.1068		0.2652	**	0.1304	
	n=886		*n=872*		*n=864*		*n=870*		*n=691*		*n=859*		*n=864*	
Age	0.1299		0.1492		0.0841		0.0734		0.0952		0.1119		0.1154	
	n=887		*n=892*		*n=884*		*n=891*		*n=705*		*n=879*		*n=885*	
Household size	0.1270		0.0596		0.0639		0.0847		0.0936		0.0919		0.0926	
	n=883		*n=889*		*n=880*		*n=887*		*n=701*		*n=875*		*n=881*	
Migration	0.0374		0.0459		0.0832		0.1171	*	0.1335	**	0.1000	*	0.0841	
	n=881		*n=887*		*n=878*		*n=885*		*n=699*		*n=873*		*n=879*	
Ownership	0.0501		0.0030		0.0752		0.0037		0.0239		0.0429		0.0529	
	n=882		*n=888*		*n=879*		*n=886*		*n=700*		*n=875*		*n=880*	

* = significant (sig. <0.05) ** = highly significant (sig. <0.01)

Source: Own survey 2019

extent. Respondents with a graduate level of education disproportionally often answer the questions affirmatively, this is disproportionally rare among people with a low educational level (monastic/primary). Another interesting result is that none of the socio-demographic aspects have a significant impact on whether the households have discussed a meeting place with family members.

The factors 'gender' and 'migration' are located between these two extreme situations. Gender is related highly significantly to the variables concerning fire extinguishers and prepared emergency kits. Thereby the relation regarding fire extinguisher use is quite strong (C = 0.4226). In all significant relations females disproportionally often answered the questions positively. On the other hand, migration is the only factor which influences most of the disaster preparedness activities related to severe disasters. If people have migrated within the last 15 years, they know of and have prepared an emergency kit disproportionally less often; the same is true for checking facilities (interpretation of the residuals). But the related C-coefficients are quite low showing that migration does not influence very strongly.

From the perspective of the disaster preparedness index, additional results can be derived. The Kruskal-Wallis-Test and Mann-Whitney-Test of the socio-demographic variables show that only education (sig. <0.01) and migration (sig. <0.05) affect the index significantly. People with a higher educational level know about more measures. Three-quarters of those who are only educated up to primary-school level, know only three or less measures; in contrast three-quarters of those with graduate-level education know of three or more measures. Regarding migration status, a similar difference is apparent: almost half of respondents who have migrated in the last 15 years know of only two or less measures, whereas only about a third of respondents without migration experience name two or less measures.

8 Conclusion and recommendations

Although quite a high proportion of respondents are afraid of a disaster, less respondents state that they know about proper disaster risk reduction measures. Furthermore, the percentage of households that are prepared, e.g. know about and use measures, is not very high.

Moreover, the extent to which the respondents are aware or prepared varies quite remarkably between the townships in Yangon. Low percentages are found in townships in the urban fringe, where Twantay stands out particularly, as the vast majority of respondents in this township state that they have no knowledge of risk reduction measures and the figures indicating disaster preparedness are here lower for all items than in other townships.

Past experiences with disasters influence the disaster risk perceptions of the Yangon citizens and their disaster preparedness as well. Having experience of disasters enhances people's awareness of them and they are often better prepared. This is in line with research results of, for instance, Kim (2022) and Ng (2023) as well as Bronfman (2020), which found that past experiences influence preparedness quite remarkably. But in contrast to these studies (where preparedness and perception are measured by one index each, composed of a set of items) the results of this study show, that this relationship is not valid for all the disaster risk perception and preparedness items. While for some items a significant relationship can be found (e.g. experience of Cyclone Nargis and preparedness of emergency kit, general disaster experience and emergency kit items), for others an influence cannot be verified (e.g. general/Cyclone Nargis experience and knowledge of proper risk reduction measures for floods, general/Nargis experience and checking of facilities). If people were affected by Nargis, they very much fear hazards, no matter whether in relation to flooding, a cyclone or an earthquake.

Socio-demographic factors are relevant but not all of them influence. Often they influence only some of the variables measuring aspects of perception and preparedness. Additionally the influence is often not very strong. This is in line with other studies which show varied results in terms of which factors have an influence and how much. The studies of Qasim et al. (2015), Hoffmann & Muttarak (2017), Fernandez et al. (2018), Kim & Kim (2022), Tohan et al. (2023) or Ng (2023) might be named here as examples for regions in Asia. But this is also verified by studies from other world regions (e.g. Kellens et al. (2011), Nikkanen et al. (2021) for Europe, Castañeda et al. (2020) for Chile). In this study, education shows a particular influence on disaster preparedness. More highly educated people are better prepared than people with lower educational levels. Gender and migration status influence risk perception and disaster preparedness items. In contrast, no significant relations can be found for age, household size or home ownership, neither for perception nor for preparedness items.

Turning now to interpretations that focus on differences spatially or between groups with different experiences and socio-demographic groups, e.g. people with disaster risk experiences or more highly educated people are better prepared. The main results from such a perspective are:

- Spatial variation is a dimension which very much influences disaster risk perception and preparedness. Quite remarkable differences exist between the spatial units (townships) in Yangon regarding risk perception and preparedness. In particular, people at the fringe of the city have less sense of risk perception and disaster preparedness. But the disaster risk perception does not decrease linearly with growing distance from the centre, it is rather more specifically structured. For example, the highest values of disaster preparedness variables vary between townships within the Yangon City area, but the fringe township Twantay is always at the lower end regarding the preparedness variables.
- Past experience with disasters often leads to people being more aware and better prepared. But this pattern is not always valid. Here, the results regarding the fire extinguisher items are prob-

ably most striking: people with no experience of Cyclone Nargis disproportionally often know about these items. This can be explained by the fact that many people with experience of Nargis are migrants living in poor conditions who cannot afford to have an extinguisher in their households and are thus unfamiliar with such equipment.
- For some socio-demographic factors no differences can be found between the categories. This is true for age, household size and home ownership. On the other hand, remarkable differences in the intensity of disaster risk perception and preparedness can be found regarding education levels. There are also differences related to gender status and migration status, at least for some of the disaster risk perception and preparedness items.

From the perspective of disaster management these results lead to the following reflections:
- The intensities of disaster risk perception, awareness and preparedness have to be increased for Yangon in general.
- Ideally the intensity of disaster risk perception, awareness and preparedness should not differ significantly regarding former experiences and socio-demographic characteristics.

It is therefore necessary to ensure a high and equal level of disaster risk perception, awareness and preparedness. The question then is: how can this be achieved? Improving knowledge regarding disasters and encouraging people to be better prepared is probably most urgent. Two measures should be mentioned here. First, the topic 'coping with disasters and preparing for hazards' has to be fully integrated into the school curriculum. This would help children to be aware of the issues and trained to deal with them, which would also affect the adults in the households because the children would talk about the topic at home. Such an approach would lead to the general early sensitizing of the population. The elaboration of a new school curriculum, which has already been initiated in Myanmar, considers the integration of hazard-related themes. Secondly, training courses – appropriately customized and targeted for each spatial area (e.g. township) and the different groups which are 'lagging behind' – are an important measure. Such courses are fully in line with the concept of community-based risk management. Flyers, with information about types of hazards, disaster risk prevention and measures to reduce the effects of disasters, are additional measures.

Regarding disaster preparedness measures, it is, however, important to consider that households might not be able to afford all tools (e.g. fire extinguisher, emergency kit). Here the administration should think about donating such equipment for the use of low-income households, after these households have been trained in their use.

The results show that examining socio-demographic characteristics, experience of disasters, local variations and how they in various ways influence disaster risk perceptions and disaster preparedness can help in disaster risk management by providing detailed insights as a basis for customized and targeted measures to improve disaster risk preparedness. However, as this study also shows, relations can vary from area to area, so that such an investigation should be carried out every time that planned measures are introduced.

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