

PEOPLE'S RISK PERCEPTION OF TSUNAMI HAZARD IN A DEVELOPING DISTRICT OF BALOCHISTAN, PAKISTAN: THE CASE OF GWADAR

AMANULLAH MENGAL^{1*}, MUHAMMAD ASHRAF^{**}, KATSUICHIRO GODA^{***},
GHULAM MURTAZA^{****} AND HASHIM DURRANI^{*****}

* Department of Disaster Management and Development Studies, University of Balochistan, Quetta, Pakistan.

** Assistant Professor, Department of Disaster Management and Development Studies, University of Balochistan, Quetta, Pakistan.

*** Associate Professor & Canada Research Chair in Multi-Hazard Risk Assessment, Department of Earth Sciences, Western University, Canada.

**** Assistant Professor, Department of Disaster Management and Development Studies, University of Balochistan, Quetta, Pakistan.

***** Department of Disaster Management and Development Studies, University of Balochistan, Quetta, Pakistan.

Corresponding author: Amanullah Mengal

E-mail: aman_437@hotmail.com

ABSTRACT

Studies have previously documented that the proximity of hazards can affect the perception of risk among people associated with potential hazards. It is important to understand this relationship between coastal communities at risk of tsunamis, because when starting to plan and incorporating preparation and management strategies against such events, hazards should be recognized. This research consequently seeks to help Baluchistan, Pakistan's local authorities, by conducting a survey to local residents in Gwadar and by examining different public perceptions of tsunami in District Gwadar. This is the first risk perception study of this kind that is conducted in this attractive socio-cultural and local environment. The study, that mostly took place from March to May 2018, resulted in 264 responses from 13 districts Gwadar union councils. It also has pointed out that direct catastrophe exposure does not openly affect perception. In addition, the majority of respondents consider "earthquake" as a catastrophe driver. This could be attributed, in part, to previous geographical experiences in its past. Overall, the analysis specifically indicates that people in the Gwadar district are worried about disasters. Most of the survey respondents agree that disasters have a huge effect on the population of the region. These parameters will contribute to a rise in public fear of the effect of disasters on them individually; the study points out that several respondents conclude that the most serious impact of a tsunami catastrophe in the district is death and degree of harm. Furthermore, the results of the study have provided many confirmations on knowledge of potential hazards and catastrophic events through schooling, training, volunteer work and community access to key information services.

KEYWORDS: Risk perception, Gwadar, Tsunami hazard, Disasters, Risk management.

1. INTRODUCTION

Shoreline areas across the world are devastated by natural disasters, causing many deaths and incalculable economic damages. Over then 750,000 deaths occurred in the last couple of decades only due to an earthquake or tsunami and monetary losses of up to \$787 trillion Lindell and Perry, (2012). In addition, 13 percent of the urban area is projected to live 10 meters or below over sea level, a figure that is projected to continue to increase in the upcoming decades (Johnsten et al, 2005). Before the 2004 disaster, the Makran subduction zone was previously the center of many tsunamis and had created the worst tsunami in the Indian Ocean region, i.e. the 1945 Makran tsunami with a casualty count of approximately 4,000 people (Heck 1947). This region stretches from the Hormoz Strait in Iran east to Karachi in Pakistan, with a total length of 900 km. This subduction zone (Farhoudi and Karig 1977) is formed between the Arabian plate and the Eurasian plate. The geological field research by Page (1979) reveals, with a return period of 125 to 250 years, that the area has had huge earthquakes as strong as the 1945 event. Although some past hazard evaluations have been conducted, such as Shafiq et al. (2013), there is a lack of thorough and systematic research in the latest literature focused on evaluating people's awareness of the hazards as the area is more vulnerable to a number of disasters.

In order to predict the precautionary behaviour by Grothman and Ruesswig (2006) on individual risk responses, including risk perceptions, a social-psychological model was developed. Bird and Dominey- Howes (2008) investigated the general view of threat and risk along Australia's eastern coast to explain the public awareness and misunderstanding of warning alerts. In addition, it is important to analyze the understanding of risk that is affected by the form of catastrophe, such as flooding or landslides, and the victim characteristics Ho *et al.* (2008). From the other side, a comparison of risk perceptions on both victims and for people was the basis on which people who were less likely to respond to the consequences of the mitigation events, such as flooding and landslides Lin et al, (2008). Furthermore, numerous research has been led to evaluate perceptions of alertness for disasters Hammad *et al*, (2011). In Japan, for example, the perception amongst inhabitants was carried out to evaluate the recognition of flood risk by Motoyoshi, (2006). Entirely, the understanding of disaster preparedness is critical and can help to determine the efficacy of preparation programmes and analyze how expectations can differ as emerging disasters O'Sullivan et al, (2008). The 1945 Makran earthquake of *Mw* 8.1 Pararas-Carayannis, (2001) is one of the known damaging events in the recent history that are capable of generating devastating shaking and tsunami disasters, and thus this event serves as a basis for further assessment of risk perception of tsunami

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hazard. To date, there has been little investigation effort focused on people's risk perception of a tsunami hazard in District Gwadar to help emergency managers and planners to cope up or take adaptive measures or strategies from such hazards. The specific contribution of this study is that it is the first attempt of its kind to evaluate the existing risk perception level and its allied impacts of hazard in of District Gwadar.

In addition, the purpose of this study is to recognize and evaluate people's perception in Gwadar district, being vulnerable to tsunami hazards and susceptibility to all types of disasters. Furthermore, this study will facilitate the development of viable policies and emergency management plans to reduce the adversarial effects of disasters for the study area. This article describes therefore a short overview and follows up with a presentation and review of the survey findings on relevant work and methodology which supports the study. Moreover, the paper also makes available policy recommendations for future research directions.

2. RISK PERCEPTION ASSESSMENTS

There have been two major approaches to risk perception, a practical method and a cognitive method (Renn, 2009). The realistic risk method could be defined as aimed at 'bringing perception as near as probable to the objective risk of an event.' It means that we should accept and consider an outside factual environment of threats (Rosa, 1998; Rosa, 2008). Identifying the people's awareness of threat is critical for enhancing risk communication and for implementing successful preventive measures Ho et al. (2008). Risk could be described as "a mixture of the likelihood of an occurrence and its dire effects" UNISDR, (2009). Risk perception, on the other hand, can be described as "people's views, behaviors, decisions and feelings, as well as the larger social or cultural principles and provisions that people follow against hazards and their advantages" (Pidgeon et al. 1992). Several researchers have studied a wide variety of hazardous events, including environmental and natural disasters, and some findings have shown that risk assessment can be used whether to minimize risk or to improve behaviour Ho *et al*, (2008); Martin *et al*, (2009).

Numerous surveys have been undertaken to evaluate expectations of preparedness Hammad et al. (2011). Similarly, in Japan, perception amongst inhabitants was analyzed in order to identify the acceptability of flood risks Motoyoshi (2006). The findings of this analysis showed that emergency preparedness strategies can be activated as cooperative initiatives within local areas. In Iceland, the first public awareness analysis of the natural hazard of floods showed that several people did not realize

living in the flood-prone region Pagneux et al. (2011). These findings proposed a crisis readiness curriculum or to recognize vulnerabilities and failure of disaster management Armas (2006); O'Sullivan et al (2008). Perception of disaster response is essential on a permanent basis, and may help to determine the efficacy of preparation programmes and to assess how expectations can differ as new incidents O'Sullivan et al. (2008).

The research in Nagoya City, Japan, recognized four objectives for evaluating factors that decide people's readiness for catastrophic events: I the connection among awareness and preparedness; (ii) the relation between risk knowledge and readiness; (iii) the connection between the level of damage from some kind of subsequent threat and the amount of risk from a previous hazard. The study explored the lack of communication between relevant expectations and preparedness to boost people's preparedness for floods Takao (2006) and noted that disaster preparedness was favorably correlated with the risk perception Miceli et al. (2008).

The analysis showed that even the important factor in determining behaviors to readiness was people's willing to work further about these kind of disasters as Takao. (2006). In addition, Nordenstedt and Ivanisevic (2010) pointed out that improved information regarding risk management will, as a result, improve the efficiency and influence of decisions across society. Decision-makers should also take public opinion into account and aid in the sharing of information also with population, which increases the trust and acceptance of information and thereby tends to minimise the risks of disasters Renn (2004).

While the correlation between perceived risk and hazardous exposure to natural disasters (primarily weather incidents) has raised interest in studying, no studies have been found to date to examine this association with tsunami-prone coastal communities. In general, the tsunami hazard zone could be easier to define relative to other threats affecting lakes and rivers, but this is something that was not previously discussed Arias et al. (2017). This would be the key gap that we hope to resolve in this report. The findings of this study could lead to a deeper understanding of people's interpretation of the risk of a tsunami threat in the Gwadar district.

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3. METHODOLOGY

The Makran Subduction Zone (MSZ) is located off Iran and Pakistan along the coast of Northern Arabian Sea and runs east-west from the Strait of Hormuz in Iran to the Ornach-Nal fault in Pakistan and toward the west of Karachi Mahmood *et al*, (2012). The presence of the MSZ makes Baluchistan's coastal zone are amongst Pakistan's geologically most endangered region and to protect people at high risk, mitigation measures are desperately needed. It is important to note that the first priority should be focused upon assessments of people's risk perception towards tsunami hazard. It is crucial to plan information collection strategies, such as Bird and Dominey-Howes (2008) survey methods, to obtain public ability to insight knowledge in reference to a particular hazard category. Consequently, a questionnaire planned to report the above aims is organized as follows: - Age, gender, literacy, occupation and accountability questions like what to do for managing a tsunami disaster. Similarly, the questions for understanding people's perception and to explore the emotional responses of indigenous people of district Gwadar about the risk of disasters. Similarly, a study by Kakar *et al*. (2015) was undertaken that focuses almost exclusively on Makran tsunami vulnerabilities via the memories of the 1945 disaster by indigenous people. Several of the stories of the people were collected who birthed prior to actually 1945 event. Further evidence came from youth who narrated what their ancestors had communicated them via their indigenous knowledge.

However, numerous appropriate surveys by Bird and Dominey-Howes (2008) influenced the nature of the questionnaire in this research. The questionnaire contained 22 mainly selected questions, all of which were discussed in separate sections. The "other, please explain" choice was available where appropriate to prevent restricting or regulating answers to close - ended questions. The questionnaire was validated between January and February 2018 by 20 pilot respondents. In general, 20-30 minutes have been required and the questionnaire has been updated to correct and explain the final version of the document. Responses were extracted by participants' recognition by direct associations and enumerators Sadavoy *et al* (2004). Many delivery mechanisms for the dissemination of the sample are available, for example, E-mail and Telephone Bird (2009). This form, however, offers benefits, including the cost-effectiveness of immediate face-to - face interactions, time to analyze responses, and significantly higher participation rates.

4. RESULTS

Data was collected through 264 questionnaires. Fig. 2 indicates the geographic variation of participant areas: All information gathered, like statistical analysis, were executed with version 18.0 of the Statistical Package for Social Studies (SPSS).

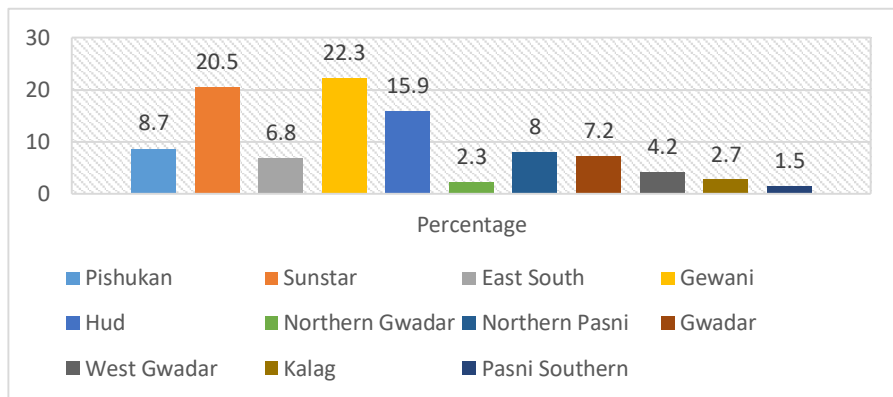


Fig. 1 the geographic variation of participant areas

4.1 Data quality

Information from the questionnaire needed to be tested for consistency earlier being analyzed to explore whether respondent responses were consistent Deng *et al*, (2011). For this purpose, the study questionnaire has undergone by Cronbach's alpha to validate its reliability. As in Hassad study, (2010) Cronbach's alpha (α) scale of 0.6 and higher is suggested to be a satisfactory reliability for exploratory studies. Based on Cronbach's alpha, the average reliability of the elements in this questionnaire was 0.78 for this study, that was appropriate.

4.2 Universal attributes of participants

Table 1 explains the universal attributes of sample respondents and shows that the participants were dispersed in gender, over a range of ages, and were of diverse levels of literacy and occupation. A very low ratio of female respondents was due to the fact that the study area was dominated with Baloch ethnic group, who have very strict cultural norms for females and accessing female respondents was thus a difficult job. Living on the shores, one-fourth of the respondents were engaged in fishing while more than one-fourth of the respondents were students. The economic situation of the respondents was not satisfactory as two-fifths of them were living on just 15,000 monthly incomes.

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Table 1: Universal attributes of respondent residents

Characteri stic	Class	Percenta ge	Characteri stic	Class	Percenta ge
Age	Below 18	5.3	Occupatio n	Student	28
	18-30	44.3		Teacher	12.5
	31-50	39.8		Fisherman	25.4
	50 and Above	10.6		Governme nt employee	6.8
Gender	Male	78.8	Monthly Income in Pakistani Rupees*	Businessm an	12.1
	Female	21.2		Labor	15.2
Level of Education	Primary	18.6		Less than 15,000	40.2
	Matriculati on	12.1		15,000-29,999	29.6
	Intermedia te	35.2		30,000-39,999	20.5
	University Degree	16.3		40,000-49,999	9.1
	Advanced Diploma	3.8	50,000 and more	0.6	
	Uneducate d	13.3			

***1 US Dollar = ??? Pakistani Rupees as per 30 December, 2019 exchange rates**

4.3 Information and perception of disasters

Table 2 offers a description of the answers of the identified catastrophe drivers to questions relevant to their expertise. It was observed that the majority (almost three-quarters) of the respondents had the knowledge of causes of Tsunami being earthquake.

Table 2 Description of the answers related to the hazard information

What do you believe could produce a tsunami from below?	Response (Yes) Percentage
Earthquake	73.9
Volcanic eruption (above sea level)	1.5
Volcanic eruption (below sea level)	8.0
Landslide above sea level	1.5
Landslide below sea level	12.5
Meteorite or asteroid strike into the sea	0.8
Others	1.9
Do you think that disasters will impact the area you live in?	57.6

4.3.1 Risk perception and apprehension

The interviewees were investigated to assess the degree about which they consider the possibility of a tsunami in Gwadar and if they are indeed worried about the tsunami Table 2. 57 % of respondents either agree or agree entirely that disaster-induced threats are for residents in District Gwadar. Almost 2/3 (20.83 percent) think disasters may affect their area, and 58 percent believe that disasters of any sort may affect their society. The meaning of chi-square data (48.74) reveals a correlation seen between fear of disasters and the locality of the respondents (Table 3).

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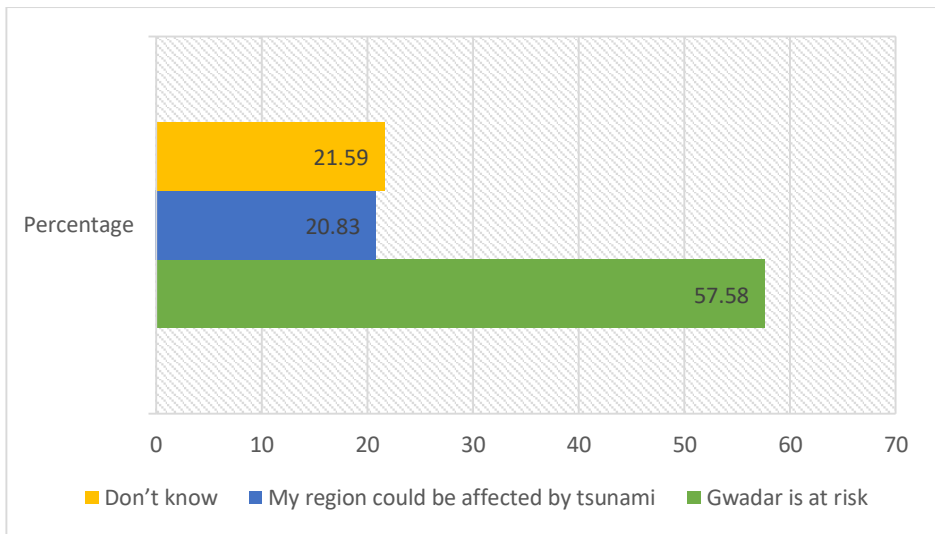


Fig 2. People’s risk perception about tsunami in District Gwadar.

Table 3 Cross tabulation between regions and the fear of tsunami

Union council	Do you believe that a tsunami will impact the area where you currently reside?			Total
	Yes	No	Don't know	
Pishukan	10	10	3	23
Sunstar	36	4	14	54
East south	6	8	4	18
Gewani	34	12	13	59
Hud	29	8	5	42
Northern Gwader	4	1	1	6
Northern pasni Gwader	12	0	9	21
West Gwader	5	10	4	19
Kalag	7	1	3	11
Pasni Southren	6	1	0	7
	3	0	1	4
Chi-square	48.74***			

Note: *** shows the Chi-square is significant at 1%.

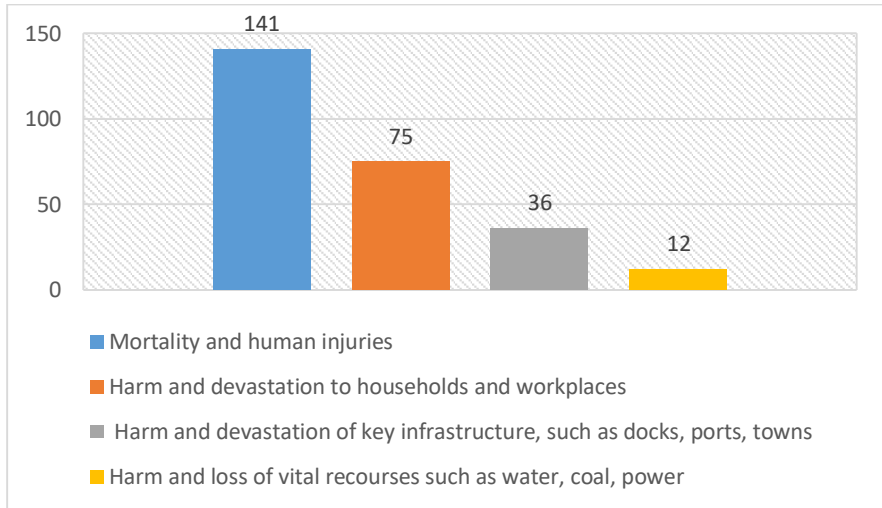


Fig 3 Respondent's different opinions regarding tsunami hazard

Around 21 % of respondents consider that the peak run-up intensity of greater than 10 m could become the tsunami affecting Gwadar, and 93% assume that another tsunami could impact Gwadar district. Conversely, the findings of the experiments from Heiderzadech and Satake, (2017) showed that such tsunami prediction can be replicated only by a submarine dip of 15 km (length) per 15 km (width), 600 m (surface area), a volume of 40 km³ per volume at 63.0 ° E and 24.8 ° N. This integrated earthquake-landslide source represents all measurements accessible, including far-flung tsunami sources, in Karachi (Pakistan) and Mumbai, India, with relatively close-field 10–12 m run-up, maritime pre-seismic displacement data at Pasni and Ormara (uplift 1-3 m) and seismic magnitude (M 8.0–8.3).

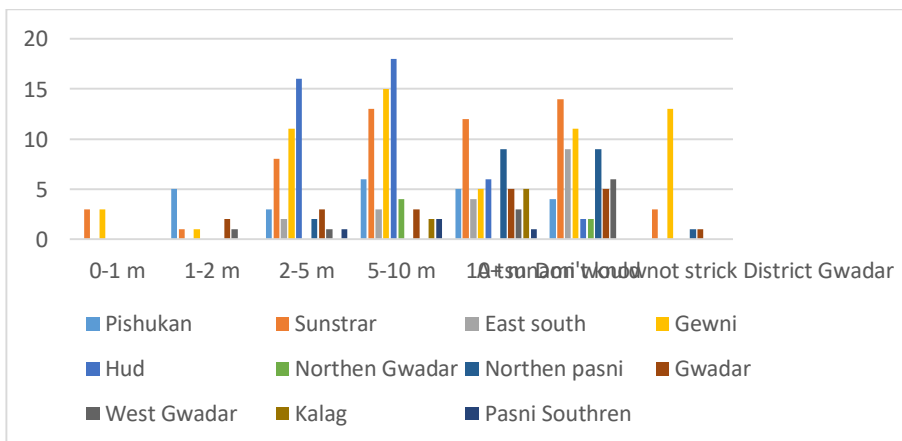


Fig 4. People's perception about possible tsunami run-up height.

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4.4 Media Accessibility

The study contained questions about how respondents would obtain disaster information. These debate respondents (264 respondents) were enquired to show the media strategies they use to access disaster data. As seen in Figure 5, many (171), followed by newspaper (26) the internet (20), and radio (3), receive information on disasters on their cell phones as their first choice. With respect to disaster risk, both participants were asked to select the two best approaches for seeking advice on protective measure.

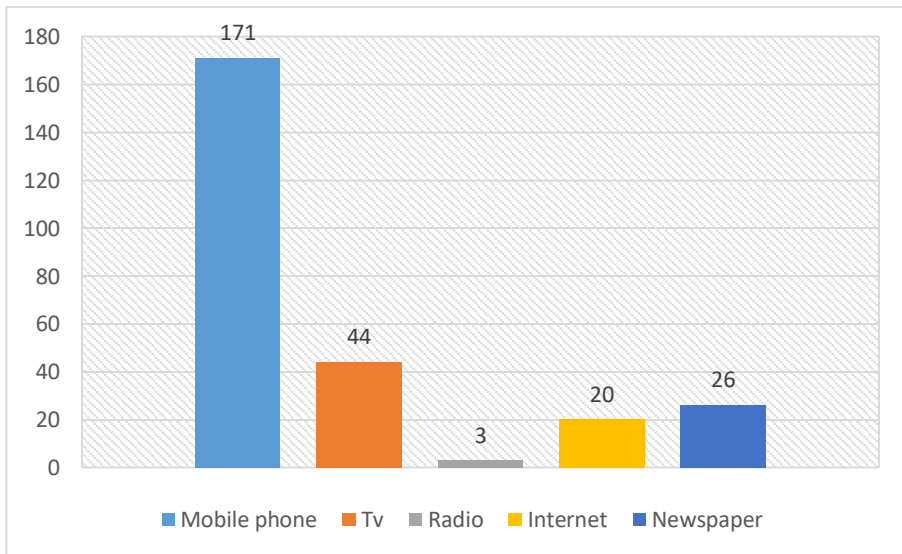


Fig. 5 Frequencies of the media source in receiving disaster details in district Gwadar

Even if there had been a major earthquake along Pakistan 's coastline and a tsunami, fishing villages people would have to move swiftly to evacuate. Countless lives were claimed by Haiderzadeh et al (2008), a tsunami triggered by the earthquake in that area in November 1945. Most deaths were on the coastal rivers and streams of the Indus Delta, where the initial earthquake had barely occurred. Numerous of the Delta communities can even be reached only by boat today and telecom stands minimal. This adds to the difficulty of warning local residents of the possibility of an upcoming tsunami.

The Indian Ocean tsunami of 2004 and the Kashmir earthquake of 2005 led the institutions in Pakistan to develop policy frameworks for disaster management and improve current monitoring systems which can send warnings to its most vulnerable. In March 2010, OXFAM Research Report (2016) issued a selection of basic security protocols for tsunami

alert, SWETWC (Seismic Alert and Early Tsunami Warning Center) in the Pakistan Meteorological Department. The PMD, crisis response organizations and emergency response organizations have been key players in the early warning chain of communications, beginning with SWETWC and ending with affected populations.

The SWETWC, located in Karachi, Pakistan Meteorological Office is trained to warn about tsunamigenic earthquakes based on real-time tracking data from regional and world networks on seismic activities. It will also track data in the Indian Ocean study report OXFAM, (2016) by contacting the Pacific Tsunami Warning Center (PTWC) and Japan Meteorological Agency (JMA). When an alert has been sent, the SWETWC will determine the situation and transmit a response to the District management authorities. Similarly, alerts are issued from domestic and global outlets by the Tropical Cyclone Warning Center of PMD. TCP / IP – mainly an online service-can transmit a tsunami warning alert to an Inmarsat Earth Station. The ground station transmits this signal to a satellite called Inmarsat, which activates the Pasni and Gwadar sirens. Notifications can also be issued by district alarm centers. Similarly, coordination modes include high-intensity sirens attached to mosques (though those are very limited by their number) and special siren towers. When there is an electrical outage, sirens are sounded by police, ambulances and a fire brigades. Early warning agencies are maintained by the DDMA through wireless telecommunication devices contact are commonly used to connect with municipal offices, based on their accessibility.

However, while conducting survey about 36% of the group suggested that they knew there was a tsunami alert system, while 28.8% suggested that there has been no warning system and that 35.2% didn't even know that there was a Tsunami safety mechanism. Of those who said that there is no or do not know a tsunami warning system, 64 percent agree that Gwadar requires a warning system. In order to safeguard populations from hurricane tsunamis, cyclones and tsunamis, and to provide emergency response services with more effective response, EWS and/or upgrade of current systems would also benefit. A prompt notification of threat will warn fishermen back to the shore to evacuate their lives Ocean Studies Board, (2011).

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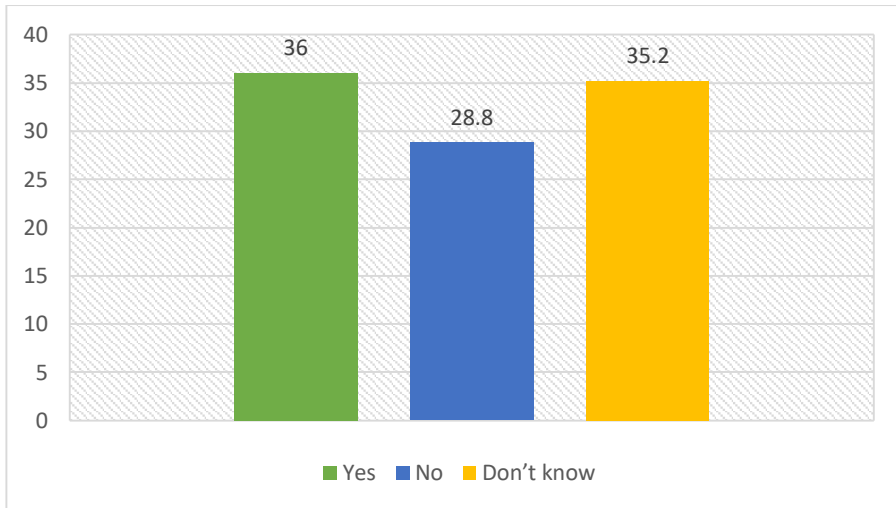


Fig 6. Is there any early warning system exist in Gwadar

4.5 Importance of tsunami risk

Just 17 percent assume that the drought risk in the Gwadar is as severe as the tsunami. Of interest, 79, 73, 75, 76 and 78 percent regard the tsunami to be the same as the earthquake, flood, lightning strike and severe thunderstorms.

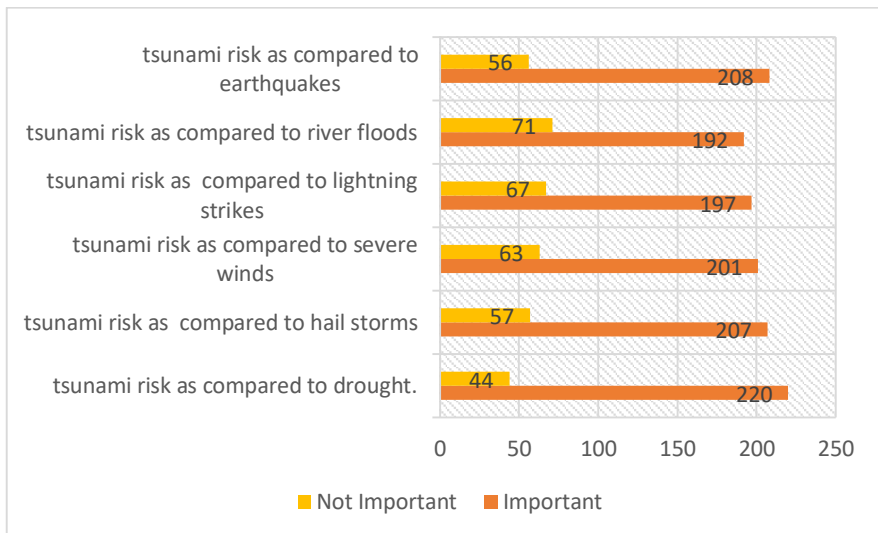


Fig 7. People's perception regarding importance of tsunami over other disasters.

The findings of the survey show that a high majority of respondents are intermediate or postgraduate; this is possible because of their sampling method. As shown in (Table 2), there are diverse rates of agreement on the producers of disasters, which may identify a general lack of consciousness. In addition, most of the participants consider "earthquake" as a catastrophe driver. It might be due, in part, to the early observations within the area through its history. Overall the analysis specifically shows that people in district Gwadar also fears about disasters. The large proportion of the survey participants approve that disasters significantly affect the region. These aspects will contribute to a rise in people 's fear including its effects of natural disasters on them individually; each interviewee were of the view that that death and damage to people has been the most significant result of a tsunami catastrophe in the district. Such information recommends earlier indication from the previous work, such as, "if citizens did not fright floods, they were not worried about floods" Takao, (2006). The findings can be understood as a strong indicator that study participants typically indicate a readiness to deal with disasters.

In addition, considering the lack of participant familiarity with disasters, the research discloses certain understanding of disaster risk, but that still doesn't reflect the readiness of participants to cope with disasters, apart from in the situation of those who would be highly trained. This finding is similar with the research performed by Anderson (2003), who observed that individuals could report background understanding of hazards, however that doesn't necessarily serve as proof that awareness or meaning is necessary to move to planning and management for hazards. The latest findings of the research, however, show very explicitly that many participants assume that they're not really qualified to deal with disasters, but that they would be able to read more about disasters, thus positively impacting their prevention behaviors. Overall, the findings suggest that promoting awareness of the threat of a catastrophe is the most significant factor in rising disaster resilience, a finding that is compatible with other Ghafory-Ashtiany (2009) reports.

The findings of the study also reveal that disasters enable one third of the participants' care about some of the other issues. Climate change, which has close connections with disasters, is one particular topic of discussion (Brickmann and Von Teichman, 2010; Vogel et al, 2007). Most survey respondents following catastrophe discussions in Gwadar have access with the use of cell phones as a device for obtaining information. Likewise, after crises, a significant percentage of people use television as an official source of knowledge. In addition, the study indicates that most participants read newspapers as a supplementary source of knowledge to receive safety

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instructions. It may also be attributed to ease of access and the vast advancements in digital technologies and print media. It is important to remember that the research findings suggest that such sites are not visited by the vast number of internet subscribers. It also may be because of an absence of understanding of the responsibilities and importance of these organizations in crisis scenarios, a lack of expertise and background of the respondents of such websites. However, it is obvious, though, because they simply accept the alerts they get on television from such organizations.

5. DISCUSSIONS AND CONCLUSIONS

The research investigated the understanding of people in District Gwadar of a risk of tsunami. This is the very first major study undertaken in Gwadar, to the knowledge of the authors. The key areas of the research measured the respondents' expertise and identified the resources they used to collect the information they wanted. The findings suggest some understanding of the catastrophe risk, which can be due to factors including the educational level of interviewees. The findings can also be attributed to the large use of cellular phones by survey participants. After all, their expertise is missing in many fields, such as: individual catastrophe experience, disaster generation sensitivity and disaster readiness. Based on the analysis of the study, we think that although the guidelines are like schooling that should be substantially improved. Disaster literacy in schools can improve individual's willingness to deal during crises, and reduce public pressures through catastrophic events and act as a catalyst for accelerated return to daily life after a crisis. Study on education contributing to this suggestion is endorsed by other research outlets. A research has shown that knowledge of catastrophe hazards can increase perceived risks in early school, but public participation is also an important component Shiwaku et al (2007). The understanding of this international issue would boost people's knowledge also on concept of catastrophes. A study has showed that routine disaster education and training was necessary for raising and sustaining information, public consciousness and expertise Chen *et al*, (2006).

Based on the results from this research to conduct public education, conferences, seminars and workshops in collaboration with other fields, in order to educate their workers about the main problems of disaster preparedness faced by citizens in Gwadar should be advocated by competent association such as the Provincial Disaster Management Authority. Volunteering is also an important tool for enhancing municipal

capacity for emergency relief. It is essential, then, that official authorities and organizations raise awareness of the potential of volunteer service, attracting and training, and thereby benefit from eligible volunteers. This would improve their capacity to mitigate catastrophe by reviving populations.

During this analysis the authors are conscious of the shortcomings. A relative lack of data points surrounding the tsunami horrific event in Gwadar District arises from external constraints. With respect to the research itself, a skew in a random sample could be posed by the geographical position of the participants. More than one fourth (22.3%) of the participants were based in the Gewni region, but their findings could not be indicative compared to other areas, such as Northern Gwadar and Northern Pasni, which have reversed much lower responses (2.3% and 1.5%). Eventually, the majority of women respondents, owing to the cultural factors mentioned above, was comparatively limited but it should be noted that it was higher than previously predicted. While the reports could help to increase public understanding of the possibility of disasters in the Gwadar District, further work needs to be done. The analysis can be extended by looking at adaptability in the cultural context. The most significant result, as discussed all across the literary works, is to educate populations for crises by growing the durability of the populations Norris et al. (2008). This study shows that resilience is missing in different fields, including consciousness raising, preparation and information access skills. Other important attributes can also improve the community's resilience in district Gwadar to tackle disasters. We plan to continue this study using the Delphi methodology or concentrated community meetings with disaster management stakeholders to obtain knowledge within their area.

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