Onodera S, Saito M, Sawano M, Hosono T, Taniguchi M, Shimada J, Umezawa Y, Lubis R.F, Buapeng S, Delinom R, 2009. Effects of Intensive Urbanization on the Intrusion of Shallow Groundwater into Deep Groundwater: Examples from Bangkok and Jakarta. Science of The total Environment 407, 3209-3217

Sudaryanto, Suherman, D., 2008. Degradasi Kualitas Airtanah Berdasarkan Kandungan Nitrat di Cekungan Jakarta, Jurnal RISET Geologi dan Pertambangan, Vol. 18/2, Bandung, Indonesia

Tio Tek Hong, 2006. Keadaan Jakarta Tempo Doeloe: Sebuah Kenangan 1882-1959, Masup Press, Jakarta, 129 Hal.

Umezawa Yu, Hosono T, Onodera S, Siringan F, Buapeng S, Delinom R, Yoshimizu C, Tayasu I, nagata T, Taniguchi M, 2009. Erratum to Source of Nitrate and Ammonium Contamination in Groundwater under Developing Asian Megacities . Science of The Total Environment, 407,3129-3231

BAB 3
ESTABLISHMENT OF AN EFFECTIVE PEOPLE-CENTERED TSUNAMI EARLY WARNING BY UNDERSTANDING PEOPLE´S BEHAVIOR AND NEEDS: Case Study of Padang, West Sumatra

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Abstract

Tsunami potential in Padang region has been recognized by the international scientific community. Borrero et al. suggested that Padang was one of the most plausible areas where a major tsunami could occur in the near future. Due to its highly concentrated settlement and economic activities in the coastal areas, the city of Padang builds up high tsunami risk. About 40% of the total population are living in the low-lying coastal areas and most of them would have to be evacuated to safe areas in case of major tsunamis. The city has already put a lot of efforts in establishment of an institutionalized local early warning system and disaster management. Within this process, on the one hand it is very crucial to build awareness of the people, who are living and conducting activities in the endangered areas, of the existing tsunami risk, local tsunami early warning as well as the appropriate actions they have to do in case of tsunami. On the other hand, the involved actors need to understand the baseline situation of the people, how they behave towards the existing risk and emergency situation as well as their needs to enhance response capability. The study found out that people have dynamic exposure to tsunamis due to their varying activity pattern and the spatial setting of the city. It also identified several factors related with perception on risk which influence reaction to tsunami early warnings. The need of a clear and standardized risk communication that considers peoples concern and existing informal arrangements at the household level is important. Moreover, it is also suggested that awareness without sufficient infrastructures to conduct evacuation would be senseless. With the most plausible tsunami hazard scenario agreed for the city of Padang, the current transportation infrastructure is far from sufficient for a mass evacuation to the higher ground / horizontal evacuation. Provision of such infrastructure takes a long process and not easily implemented. Therefore, informal efforts at the community level have to be supported and linked to the formal planning activities. This paper is showing some description of the challenges and

lessons learned at the household and community level in the process of establishment of tsunami early warning in the city of Padang.

Keywords : tsunami, early warning, disaster management, risk perception, awareness, response, evacuation

Abstrak

Potensi bahaya tsunami di Kota Padang telah banyak dikaji oleh komunitas peneliti Internasional. Diantaranya adalah Borero dkk., yang menyatakan bahwa kota Padang merupakan wilayah yang sangat diyakini akan terlanda oleh gelombang tsunami besar yang dapat terjadi dalam waktu dekat ini. Potensi risiko bencana tsunami di Kota Padang terutama disebabkan oleh banyaknya tempat tinggal masyarakat dan aktivitas perekonomian yang berada disekitar pesisir pantai. Diperkirakan sekitar 40 % warga bertempat tinggal di wilayah dataran rendah di sekitar pantai, jika gelombang tsunami besar terjadi maka mereka merupakan komunitas yang harus diselamatkan ketempat yang aman. Pemerintah kota sudah melakukan upaya pengembangan sistem peringatan dini lokal dan pengelolaan risiko bencana. Dalam proses ini, disatu sisi persoalan yang harus diatasi segera adalah peningkatan kesadaran masyarakat yang bertempat tinggal dan beraktivitas di daerah berbahaya, yang berisiko bahaya tsunami, untuk ini maka pengembangan sistem peringatan dini lokal serta aktivitas pendukung lainnya merupakan kegiatan yang harus dilakukan guna mengantisipasi bahaya tsunami. Namun disisi lainnya, pelaku-pelaku yang telibat juga perlu memahami permasalahan mendasar yang ada pada masyarakat, bagaimana presepsi mereka terhadap risiko yang sedang mengancam dan dalam keadaan situasi darurat serta kebutuhan untuk meningkatkan kemampuan tanggap mereka. Kajian ini membuktikan bahwa masyarakat tersebut terekspose secara dinamis oleh bahaya tsunami yang paling menonjol adalah akibat berbagai pola aktivitas mereka serta kondisi kota secara spasial. Disamping itu teridentifikasi pula sejumlah faktor yang berkaitan dengan presepsi masyarakat terhadap risiko bencana yang juga berpengaruh terhadap respon mereka terhadap peringatan dini tsunami. Kebutuhan komunikasi risiko yang jelas dan standar dengan mempertimbangkan keinginan masyarakat dan kebiasaan-kebiasaan yang kerap mereka lakukan dalam rumah tangga yang sifatnya tidak formal merupakan hal yang penting. Lebih lanjut, kajian ini juga membuktikan bahwa peningkatan kesadaran tanpa dilengkapi dengan infrastruktur evakuasi yang memadai tentu akan menjadi sia-sia. Dengan menggunakan skenario bahaya tsunami yang paling mungkin terjadi untuk kota Padang, sarana transportasi yang

ada pada saat ini untuk digunakan dalam proses evakuasi masyarakat secara masal ketempat yang lebih tinggi ataupun secara horizontal masih jauh dari mencukupi. Penyediaan sarana untuk kebutuhan evakuasi tersebut membutuhkan waktu yang panjang dan tidak mudah untuk dilakukan. Oleh karena itu upaya informal yang dapat dilakukan di tingkat masyarakat perlu didukung yang kemudian dikaitkan dengan kegiatan perencanaan yang sifatnya lebih formal. Tulisan ini memperlihatkan sejumlah tantangan dan pembelajaran pada tataran rumah tangga maupun masyarakat dalam kaitannya dengan proses pembentukan peringatan dini tsunami di kota Padang.

Kata Kunci : tsunami, peringatan dini, pengelolaan bencana, presepsi risiko, kewaspadaan, repon, evakuasi

Introduction

The city of Padang is located in a zone of extreme high probability to severe earthquakes and potential triggered tsunamis. The tsunami hazard in Padang has been recognized in the international community. Borrero et al. (2006) suggested that Padang was one of the most plausible areas where a major tsunami could occur in the near future. Also, the strong earthquake event in September 2009 did not yet release the Sunda-megathrust strain-energy budget and significantly relax the accumulated stress in the Mentawai segment, meaning that the threat of tsunamigenic earthquake in the area remains (McCloskey et al., 2010). The coastal areas of Padang build a back-bone of the socio-economic activities of the city. It is clear the current urban setting and development contribute to high exposure to tsunamis (Figure 3.1). Padang city covers 694.96 km^2 of which

Figure 3.1. City of Padang (Source: DLR, 2007)

about 10% is built-area is located mostly along the coast and in the lowland. The coastal areas in the western side of Padang have the varying elevation from -5 to 20 meter above sea level (Hidayati et al., 2006). More than 40% of the city population living in the areas lower than 5 meter above sea level (Hidayati et al., 2006), which makes the city highly exposed to coastal hazards.

The local government and the inhabitants of Padang are aware of tsunami threat the city is facing. The concern on earthquake and tsunami risk reduction has emerged particularly after the experience of province of Nangroe Aceh Darussalam during Indian Ocean Tsunami 2004 and several strong earthquake events afterwards (March 2005, April and September 2007 and September 2009). This has created a window of opportunity to develop and discuss ideas and options of structural as well as non-structural risk reduction measures in the city of Padang. Particularly tsunami early warning and evacuation planning is seen as the prominent solution.

The city has already put a lot of efforts in establishment of an institutionalized local early warning system and disaster management. At the moment, the city already has a tsunami hazard map and early warning system for the city, however, further process of planning and implementation of the whole tsunami risk reduction takes time. Within a predicted short timeframe that Padang city would need to conduct a mass evacuation to safe places, Padang still has a lot to do.

In the international discussion on effective (tsunami) early warning systems, it is emphasized that an early warning system should enable capability of the people to response appropriately once the early warning has been issued. The term "people-centered" early warning suggests that an early warning should reach and be understood by the people they serve and trigger a timely anticipated response. Unfortunately, the element of anticipated response has also been identified as the weakest in its implementation (UN, 2006). The study presented here attempts to reveal and discuss some challenges the people in the "Last-Mile" are facing and highlights the importance of understanding people´s needs and behavior in developing an early warning through a case study in Padang city.

Objective of the Study

The study presented in this paper was part of the joint research project called the "Last-Mile – Evacuation" [1], which was conducted in Padang in the period of 2007-

[1] "*Last-Mile Evacuation*" was a joint research project funded by German Ministry of Education and Research (BMBF). The researcher was involved in one of the working packages in the project, where this study was embedded in.

2010. It aims at identification and description of factors related with the response capability of the people in the "Last-Mile" that lead to ineffectiveness of tsunami early warning in the city of Padang.

It focuses on the following research questions:

- How are the population distribution and its dynamic in the potential tsunami affected areas?
- How are tsunami risk, early warning and evacuation measures perceived by the people?
- How does this perception influence people´s reactions to an early warning, what are other considerations of the people in conducting evacuation?
- How do the people estimate the evacuation capability with regard to the existing infrastructure, how do they cope with the situation?

Methodology

The study is a combination of qualitative and quantitative approach. The combination allows derivation of a better picture to understand the existing complex problem and situation in the study area.

Data Source

Aside from locally available statistical data during the research period (Population Census 2000 and Kecamatan Dalam Angka 2006), the main data used were obtained from two sets of household surveys. The first survey was conducted in 2008 (UNU-EHS/Unand Household Survey 2008) with a sample size of about 900 households selected purposively to represent different physical and socioeconomic characteristics of the city, which was used to analyze early warning experiences, daily activity pattern, risk perception and evacuation behavior. The latter one was conducted in 2009 (UNU-EHS/GTZ/KOGAMI Household Survey) with a sample size of 800 households selected randomly in pilot areas of a community preparedness activities comprised variables once again on risk perception, evacuation behavior, and furthermore on perception on evacuation infrastructure and facilities.

Complementary, qualitative data were obtained during field observation in 2008 and 2009 by means of: one focus group discussion with disaster management actors, 2 group discussions with coastal communities, semi-structured interviews with 6 purposively selected households with different intended evacuation behaviors, as

well as non-structured conversations or interviews with various informants at the community level.

Other additional data were obtained from the research partners in the scope of "Last-Mile – Evacuation" Project, such as empirical results of remote sensing analysis of the city as well as evacuation modeling results taking into account the population distribution estimation which is presented in this study.

Data Analysis

The population assessment was done using a combination of the data extracted from remote sensing and conventional socio-economic data of census and household surveys. The knowledge on building use was combined with the daily activity pattern of various population groups to derive time-dependent distribution of different vulnerable population groups (See more in Setiadi et al., 2010).

With regard to risk perception and evacuation behaviour of the people as well as evaluation of evacuation facilities, descriptive and multivariate statistical analysis was conducted. Commonly used methods to analyse the ordinal and nominal variables such as cross-tabulation analysis and multinomial logistical regression analysis were employed.

Qualitative analysis of the qualitative data enriches the quantitative findings and is used to reveal issues which cannot be captured by means of household surveys.

Empirical Results

Dynamic Exposure

As previously mentioned, Padang is a historically important coastal city, and consequently the activities in the coastal areas build the backbone of the city. From group discussion with a coastal community it was found out that the people have been living close to the coast due to various reasons, mostly because they and their family have been living there for generations and because they want to live close to their source of income (fishermen or small traders). However, the population density of the coastal areas does not only count for settlement areas, but also due to activities in public facilities as well as economic activities located there during the working hours. Aside from a small proportion of fishery activities at the coast of Padang, most of the activities in the coastal zone are related with the trading activities in the heart of the city. Moreover, the exposure of different population groups differs as their daily activity patterns vary.

The population assessment allows a time-dependent quantification of affected people and their vulnerability status. Here, the female population, children and elderly were categorized as more vulnerable due to their limited physical capability to conduct evacuation. It becomes obvious, that the morning time reveals the highest number of people in the endangered zones – about 181.000 with 118.000 of them (65%) being part of the highly vulnerable group. Although main concentration of the people in the morning time is located in the city center and along the main roads, variation of different population groups by building use could be identified. The proportion of highly vulnerable group is higher in the residential areas and schools, while higher proportion of the less vulnerable group (male population) is in the workplaces and public centres (Setiadi & Birkmann, 2010) (See Figure 3.2).

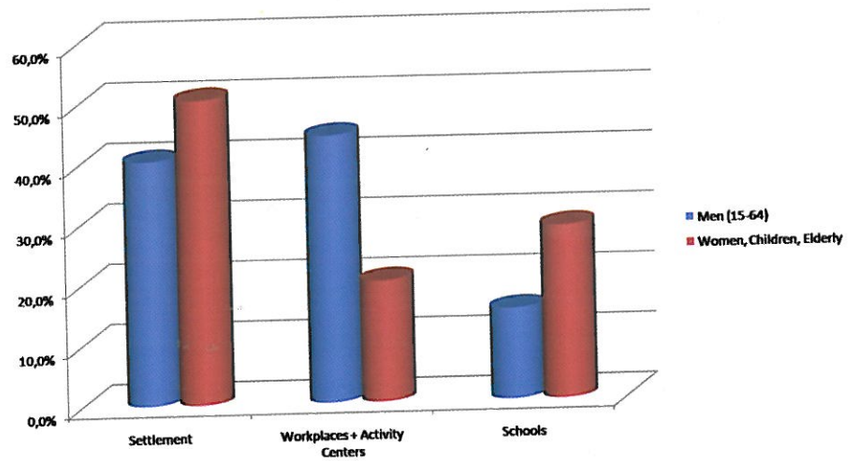

Figure 3.2. Distribution of population groups by building use (Source: own figure)

Risk Perception and Evacuation Behavior

The findings from the household questionnaires conducted in 2008 showed that during the last earthquake events in Padang, especially in September 2007, 26 % of people did not receive any tsunami early warning, 51.3% received formal warning through television (TV) and radio and the rest (22.2%) were only informally notified. There was varying effectiveness of warning dissemination through different media in proportion to availability of the respective media in the households. This may be explained by the utilization of these media during the time of the event. It indicates that some households have to take uninformed decisions because of receiving different warning messages from different media. Results show that especially the

informal notification and the interpretation of the warning information was difficult. There were only a small proportion of people evacuating after receiving the warning during the last experience (34%) (See Figure 3.3), however, the intention for evacuating in case of future tsunami early warning showed higher rates (75%) (Birkmann et al., 2008b, Taubenböck et al., 2009).

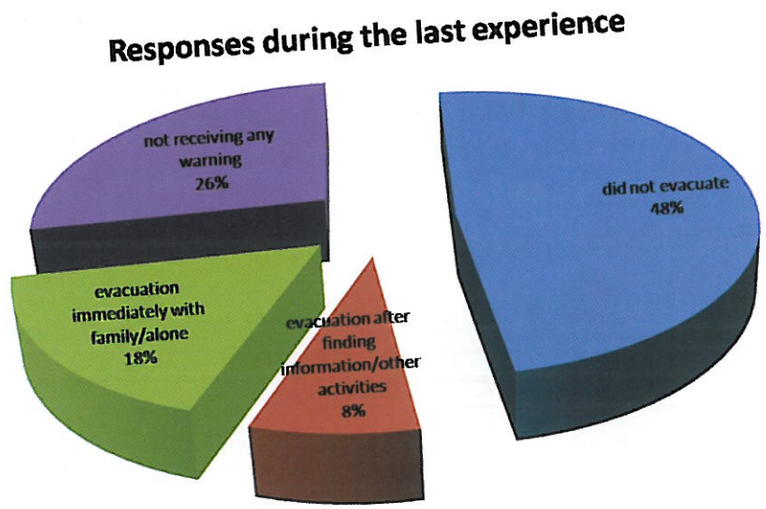

Figure 3.3. Reaction to tsunami early warning in the previous events (Source: own figure)

With regard to the evacuation readiness, a set of variables on tsunami knowledge and perception were found to have significant influence on intention of people to evacuate by means of correlation and multinomial logistic regression analysis (Setiadi & Birkmann, 2010). The variables were summarized in two indices: 1) the evacuation awareness index, which comprises basic knowledge of tsunami, perception of tsunami hazard, perception of vulnerability and preparedness, perception of own capability to conduct evacuation, and 2) the evacuation knowledge index, consisting of knowledge of existing evacuation facilities, early warning and participation in the evacuation drill. On average, the evacuation awareness of the population is higher than specific knowledge on evacuation. The level of evacuation awareness was proven to significantly correlate with the intention to evacuate or not (Kendall Tau-B coefficient 0.224). The parameters and correlation with the intended behaviour is also confirmed by the subsequent

household survey in 2009. Additionally, socio-economic profile of the households such as existence of elderly members and concern on income also played a role in intention to evacuation.

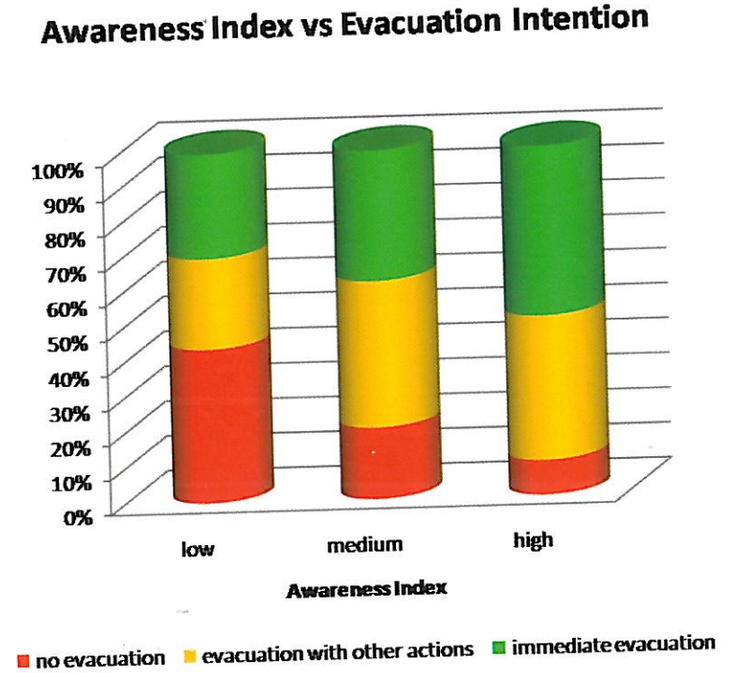

Figure 3.4. Correlation of intended evacuation with awareness index (Source: own figure)

According to semi-structured interviews with selected households and various informants at the community level, there are also some issues that influence the evacuation behaviour of the people related with risk communication and perception as well as considerations in family evacuation (Some selected quotations are presented in this paper to provide a better sense on people´s perceptions).

It was found out that some people associated natural events like earthquake and tsunamis with their belief and life priorities, which meets various information that they received through the media. This complex constellation leads to different behaviors.

"we heard a lot about tsunami from the media, but it is also like this in Padang, people just react or take action if there is an event, not much preparation before the event .If you would ask people in the coastal areas, they would think more about their daily life, what they are going to eat tomorrow – compared to worry about tsunamis. Why don't people like to talk about natural disasters? We think it is in God´s hands, what is determined to happen will just happen" (HH2, Nov 2008)

"I believe that earthquake and tsunami would happen in Padang. It is not that I do not trust God, but it is the scientific findings. I just try not to worry and make my family worried. (HH3, Nov 2008)

"Socialization for the people is needed but we cannot know when tsunami would happen, so we have to surrender to God. I think sometimes information from BMG or rumors on tsunami only make the people worried. I heard that Padang city would be submerged, but I don't believe it. If there is a warning, I would stay in alert but I don't want to believe 100%" (HH5, Nov 2008)

"many people think: if we do good deeds, we will be protected. If we runaway, it means we are afraid / not faithful– this makes people ashamed to evacuate themselves immediately. This is why we now try to cooperate with Ulama network to build awareness of the people but it is not easy" (PR09, March 2009)

With regard to communication of tsunami risk and early warning, a need to disseminate clear and understandable information for the people was expressed. More intensive and continuous socialization activities on evacuation routes and places would be needed for communities living and conducting activities in the potentially affected areas.

"please show us where to go to evacuate, there are already some maps, but they are not clear, not all people understand what the government announced about evacuation. Also conduct more socialization and provide more evacuation signs." (HH2, Nov 2008)

"I came to an exhibition about earthquake and tsunami from the city government. Every year during the celebration of the city they distributed leaflets about preparedness for tsunamis. But nowadays people / government felt content with the previous socializations and became calmer." (HH3, Nov 2008)

"A clear evacuation instruction and information is one of the discussion drivers in the community. In panic situation, people really need clear information" (KR, May 2009)

Moreover, some aspects on evacuation intention at the household level as well as particular behaviors of the coastal community could be identified.

> *"I have considered to move my children to other school close to my husband´s office so that it is easier to evacuate together during the working hours"* (HH2, Nov 2008)
>
> *"we have prepared our family to evacuate if there is tsunami, if possible using the car, if not walk on foot. We will go to high buildings which are strong for vertical evacuation. We already have info on safe zone in Padang. We need better evacuation planning, I would pick up my children from school, but my older child has been instructed to go by himself to Gunung Pangilun (safe area), also my wife if we are in different locations during the event."* (HH3, Nov 2008)
>
> *"I was observing the beach as people were evacuating during the last earthquake. I know the indications of tsunami from the television and books. If the water retrieves it means tsunami would occur, otherwise not. I will evacuate if there are tsunami indications and the earthquake is very strong" (HH4, Nov 2008)*
>
> *"we cannot avoid/forbid people to evacuate using their vehicles, we might recommend them to run (on foot) or use bike, but we have to consider the worst-case scenario and give more safety factor for uncertainty. The current SOP has not been tested and proven as effective yet" (BE09, March 2009)*
>
> *"one of the cultural values in the community is to pay respect to the community leaders. Many testimonies from the people mentioned that they evacuated if the leaders evacuated" (KR09, May 2009)*

Evacuation Infrastructure and Facilities

The most-plausible tsunamigenic earthquake agreed by the scientific community for Padang implies a very short estimated tsunami arrival time (around 20-30 minutes). This will confront the concentration of the population in the coastal areas. An evacuation modeling analysis showed that the current road network is far than sufficient to conduct mass evacuation to higher ground (TU Berlin - Last-Mile, 2010), which is among others due to lack of transportation access perpendicular to the coastline as well as bridges crossing rivers and channels to access the safe areas. In

the household survey 2008 and the focus group discussion with the disaster management actors, traffic jam was mentioned as one of the biggest difficulties of evacuation in the last experiences. The household survey conducted in 2009 indicated that the same issue was also perceived at the community level, where the majority of the respondents evaluated the current infrastructure and facilities as not sufficient or not sufficient at all (Figure 3.5). This is further emphasized by the actors at the community level that awareness and SOP at the community level without sufficient infrastructures and facilities are senseless (Personal communications in March 2009).

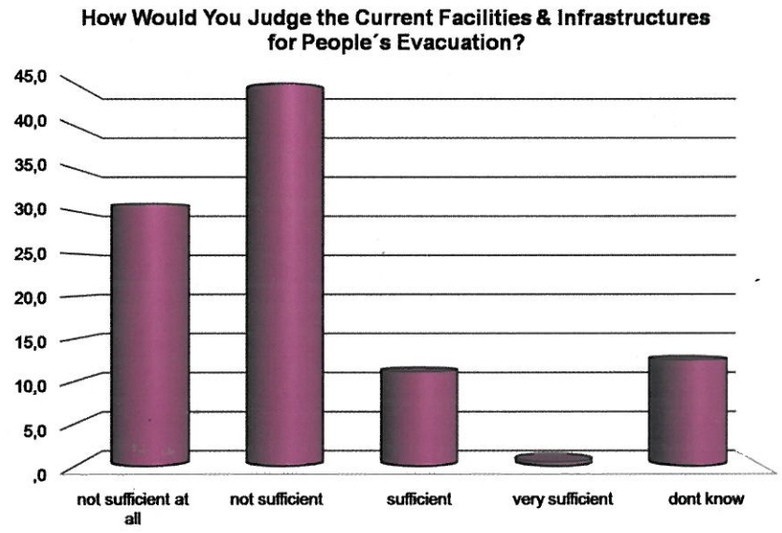

Figure 3.5. People´s perception of existing evacuation infrastructure and facilities

There have been some efforts of the local government to integrate the infrastructure needs in the longer-term planning, e.g. through newly revised urban planning (RTRW), and plan to build multi-storey flats close to the coast for vertical evacuation buildings. However, these efforts take time and there are a lot of players as well as institutional issues that come into the picture. Meanwhile, some informal arrangements on evacuation routes and provision of facilities at neighborhood levels were identifiable, especially in areas where community-based activities conducted by NGOs, such as KOGAMI and Red Cross were taking place. People opened more access to the safer areas on their own initiatives and at their own expenses, e.g. opening pathways perpendicular to coastline which were blocked by the bushes

(Interview with SIBAT Lubuk Buaya, 2009) (Figure 3.6), widening the streets by releasing a part of their land agreed among themselves, making agreement between communities in the endangered and in the potential evacuation place (Interview with KOGAMI, 2009).

Figure 3.6. People working together to open an evacuation pathway to safer areas (Photo: Setiadi, 2009)

Discussion

The discussion about development of an effective tsunami early warning system in Indonesia has been taking place since the major tsunami experience in December 2004. While the technology of detecting earthquake and potential tsunamis has been advanced, the implementation of a "people-centered" end-to-end early warning system is still facing a lot of challenges. Padang city is an example in Indonesia where a lot of processes and efforts in tsunami early warning and disaster management in general are taking place, both at planning (city) level and at the community level. The existence of local and international NGOs as well as scientific communities also influences the processes and development of local early warning system and tsunami preparedness in Padang. The results of the study here zoomed

in at the community level to identify existing needs and issues, which drives various behaviors of the people and in turn determines the effectiveness of the early warning system being established in the city. Although the identified factors in the previous chapter are partly being realized and sometimes seem to be "common sense", it is necessary to emphasize and address them explicitly as well as continuously, in order to put them in a place with an important priority and to be considered in a systematic manner in the process of developing an early warning system.

Firstly, one has to have a good knowledge on the people at risk. This does not only take into account solely the amount of people in the potentially affected areas, but also to know who are actually exposed, in which term are they exposed (living in the coastal areas, conducting daily activities, having their source of income there) and where exactly the vulnerable ones are located. The knowledge of who are exposed serve as a basis for development of disaster preparedness and response strategy. In the case of Padang, it is indicated that in the settlement areas there are more vulnerable people (female and elderly population) as well as in schools (children) during the daytime, while a higher proportion of male population are in their workplaces. Consequently, evacuation strategy should be made e.g. to provide special assistance in dense settlement areas and schools, to anticipate back wash traffic due to people that want to pick up their more vulnerable family members from their workplaces, etc.

Furthermore, one has to understand the existing norms and values in the community at risk in association with the existing risk prior to the event and issuance of an early warning. Are they aware of the risk? How do they perceive it? What kind of information do they receive? How do they relate it with their life values, concerns, and priorities? In the case of Padang, it was shown that during the previous events of early warning issuance, only a small proportion of people really evacuated. This is not an unexpected situation; in other studies on evacuation behavior – on tsunamis and other natural events like hurricanes – it was found that not all people would comply with the warning or evacuation instruction and that there are many influencing factors (see e.g. Lachman et al., 1961, Baker, 1991, Riad & Norris, 1998, Lindell et al, 2005). Batthi (2001) suggested five phases of early warning chain which are receiving the warning, understanding the content of the warning, internalization of early warning and sources, confirmation of the warning through other sources, and lastly reaction of the warning. Mileti and O´Brien (1992), Sorensen (2000) and Gregg et al. (2007) suggested similar framework and also

mentioned other factors such as characteristics of the individuals and the warning itself. Reflecting on the case of recent tsunami event in Japan where a large proportion of the people did not evacuate due to "cognitive bias" (Parashar et al., 2011, Muhari et al., 2011), that they associated the event with their past experiences with tsunami in lower magnitude and underestimated the event; it shows that risk perception, which has been shaped prior to the event, is crucial. In the case of Padang where the people (in the current generation) have never experienced any major tsunamis and have limited information on the existing tsunami risk, cultural values and norms, belief, as well as information flow through various media and word of mouth would play a significant role. This should be kept in mind in approaching the people, before then trying to define their needs and possible solutions.

Clear information and city-wide socializations should be conducted continuously accompanying establishment of early warning detection and dissemination technology. This has to take place in an institutionalized way, meaning that clear SOPs should be developed by the city taking into consideration local wisdom and existing informal arrangements at the household level. It also includes provision of evacuation infrastructure and facilities such as high buildings for vertical evacuation. As indicated in the previous chapter, processes occurring in parallel both at the planning and community level. Conflicting arrangements at both levels would cause ineffectiveness during the evacuation conduction. Thus, participation of the community in planning processes is crucial. It is proven from the case study of Padang that community with high awareness would also be likely to cooperate and even would engage themselves in the ongoing efforts.

Conclusion

The paper shows importance of assessment at the community level to identify gaps and challenges that have to be taken into account when developing an effective "people-centered" early warning system. It takes not only information on the amount of people in potentially affected areas, which is normally considered in the common risk assessment. More detailed and fine information on the "soft" parameters related with socio-cultural characteristics of the people interlinked with "hard" parameters in terms of availability of structural measures such as early warning technology as well as evacuation infrastructures and facilities.

It was revealed through the empirical study in Padang that already the exposure of the population in the tsunami potentially affected areas has its dynamic, and that

the compliance of a tsunami early warning without understanding the processes taking place and perceptions of the people at the grassroots level cannot be guaranteed. Linking the formal and informal processes is also emphasized.

Being fully aware that the study may not represent all processes taking place in the city of Padang and a lot of development has taken place in the area since the time of the conduction of this study, lessons learned from the processes in Padang derived through this study provide useful insights for other areas (spatially as well as other natural hazards) where an early warning system is being established. The main point remains that early warning should bear in mind and put forward its "people-centered"-ness through understanding the people´s needs and behavior.

Reference

Baker, E. J., 1991. Hurricane Evacuation Behavior. International Journal of Mass Emergencies and DIsasters , 9/2, 287-310.

Bhatti, A., 2001. Risk perception, culture and communication: A South Asian Experience.

Birkmann, J., Setiadi, N., & Gebert, N., 2008. Socio-economic Vulnerability Assessment at the Local Level in Context of Tsunami Early Warning and Evacuation Planning in the City of Padang, West Sumatra.

Borrero, J. C., Sieh, K., Chlieh, M., & Synolakis, C. E., 2006. Tsunami Inundation Modeling for Western Sumatra. Proceedings of the National Academy of Sciences , 103 (52), 19673-19677.

Gregg, C., Houghton, B., Paton, D., Johnston, D., Swanson, D., & Yanagi, B., 2007. Tsunami Warnings: Understanding in Hawai´i. Natural Hazards , 40, 71-87.

Hidayati, D., Permana, H., Pribadi, K., Ismail, F., Meyers, K., Widayatun, et al., 2006. Assessing and Recognizing Community Preparedness in Natural Disasters in Indonesia. Kajian Kesiapsiagaan Masyarakat Dalam Mengantisipasi Bencana Gempa Bumi dan Tsunami di Indonesia. LIPI-UNESCO/ISDR.

Lachman, R., Tatsuaoka, M., & Bonk, W. J., 1961. Human Behavior during the Tsunami of May 1960. Science , 133 / 3462, 1405-1409.

Lindell, M. K., Lu, J.-C., & Prater, C. S., 2005. Household Decision Making and Evacuation in Response to Hurricane Lili. Natural Hazard Review , 6/4, 171-179.

McCloskey, J., Lange, D., Tilmann, F., Nalbant, S. S., Bell, A. F., Natawidjaja, D. H., et al., 2010. The September 2009 Padang earthquake. Nature Geoscience , 3 (2), 70-71.

Mileti, D. S., & O'Brien, P. W., 1992. Warnings During Disaster: Normalizing Communicated Risk. Social Problems , 39 (1), 40-57.

Muhari, A., Gusman, A. R., Istiyanto, D. C., Triawan, F., Febriani, F., Hastiadi, F. F., et al., 2011. Belajar dari Bencana Jepang 11.03.2011 - Gempa Bumi - Tsunami - Radiasi Nuklir. Institute for Science and Technology Studies (ISTECS).

Parashar, S., Uy, N., Nguyen, H., Fernandez, G., Mulyasari, F., Joerin, J., et al., 2011. Mega Disaster in a Resilient Society - The Great East Japan (Tohoku Kanto) Earthquake and Tsunami of 11th March 2011. Kyoto University.

Riad, J., & Norris, F., 1998. Hurricane Threat and Evacuation Intentions: An Analysis of Risk Perception, Preparedness, Social Influence, and Resources. Disaster Research Center University of Delaware.

Setiadi, N.; Birkmann, J., 2010. Working Package 1000: Socio-Economic Vulnerability Indicators. Final Report for the "Last-Mile - Evacuation" Project, DFG/BMBF Special Program Geotechnologies. United Nations University, Institute for Environment and Human Security (UNU-EHS). German.

Setiadi, N., Taubenböck, H., Raupp, S., & Birkmann, J., 2010. Integrating Socio-Economic Data in Spatial Analysis: An Exposure Analysis Method for Planning Urban Risk Mitigation. In M. Schrenk, V. V. Popovich, D. Engelke, & P. Elisei (Hrsg.).

Sorensen, J. H., 1991. When Shall We Leave? Factors Affecting The Timing Of Evacuation Departures. International Journal Of Mass Emergencies And Disasters , 9 (2), 153 – 165.

Taubenböck, H.; Goseberg, N.; Setiadi, N.; Lämmel, G.; Moder, F.; Oczipka, M.; Klüpfel, H.; Wahl, R.; Schlurmann, T.; Strunz, G.; Birkmann, J.; Nagel, K.; Siegert, F.; Lehmann, F.; Dech, S.; Gress, A.; Klein, R., 2009. Last-Mile preparation for a potential disaster – Interdisciplinary approach towards tsunami early warning and an evacuation information system for the coastal city of Padang, Indonesia. In: Natural Hazards and Earth System Sciences. vol. 9, pp. 1509-1528.

United Nations, 2006. Global Survey of Early Warning Systems. United Nations.