

ORIGINAL ARTICLE

Disaster Debris Management during the 2014-2015 Malaysia Flood Incident

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ABSTRACT

Introduction: Flood is a natural disaster cause by heavy rainfall and high tide phenomenon. In the event of flood, substantial amount of wastes tend to be moved away and washed with mud that cause the task of waste recovering extremely challenging. The objective of the study was to assess flood victims participation, duration and major problem arise during post flood waste clean-up activity together with respondent's knowledge and psychological importance in the recovery process. **Methods:** A cross sectional survey using interview and self-administered questionnaire was conducted involving 150 flood victims in Kuala Krai, Kelantan, who were heavily affected by the recent flood. **Results:** Respondents participation in the clean-up process was high (N = 126, 84%). Average 1 to 3 months were taken for the clean-up activity. Majority of the respondents had low and moderate satisfaction on the cleaning service provided by the authority (N = 84, 56%). Major problem arises from the past flood waste clean up activity was the biased waste removal process (N = 124, 83%), victims have to find alternative ways for disposal (N = 108, 72%) and the temporary disposal site were located near to the housing area that creates discomfort (N = 105, 70%). The correlation test obtained significant relationship between knowledge and education level ($X^2 = 0.203$, $p=0.013$). But no significant relationship was obtained between knowledge with gender, age, monthly income, duration of clean-up process, respondents participation and satisfaction. **Conclusion:** Disaster debris management and disposal is critically important to support the victims in their recovery process.

Keywords: Natural disaster, Response, Flood, Waste, Malaysia

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INTRODUCTION

Flood is the main natural disaster in Malaysia affecting almost 4.82 million or 22% of the total population with 29,800 km² or 9% of the area vulnerable to flood. The country has 189 river basins with the main channels flowing directly to the South China Sea and 85 of the river basins are prone to become recurrent flooding. In total, 89 of these river basins are located at the Peninsular Malaysia and the remaining is located at the Malaysian Borneo (1).

The weather along the 4,800 km coastlines surrounded the country is influenced by convective rain and the rainfall distributions is greatly influenced by the topography and the monsoon winds (2). There are two

types of monsoons that influenced the rainfall pattern in the country which is the South West and the North East Monsoons (2). The flood events occur frequently in the two states located at the East Coast of Malaysia (i.e. Kelantan and Terengganu) during the North East monsoon season, in November and December. This flood is known as coastal flooding which is mainly due to heavy rainfall during the monsoon season and close proximity of the area to the sea as well as associated with the elevation (3).

High tide phenomenon had caused the worst flood in the Malaysian history in December 2014 especially in Kelantan (4). The flood is considered as 'tsunami-like disaster' and had caused displacement of 202,000 people and 13 deaths (4). This flood is also known as 'Bah Kuning' or the yellow flood that reflects the high content of mud (5). During the flood strike, the nearest hospital to the disaster area (i.e. Hospital Universiti Sains Malaysia) has received almost 180 flood victims daily with majority of them experiencing general acute problems from the underlying chronic medical

for Social Science (SPSS) version 22.0. Descriptive analysis was used to report mean, standard deviation, range, frequency and percentage of respondent's socio-demographic background, duration of flood waste removal, respondent participation and satisfaction, their knowledge on post flood waste management and psychological importance of the cleaning process to them. One-way ANOVA test was used to determine difference of the knowledge level between respondent by groups. Chi-square bivariate correlation test was performed to observe the correlation between the knowledge with other variables such as gender, education and household income. The correlation between level of knowledge with the duration of waste removal, respondents participation and satisfaction also were measured.

RESULTS

Socio-demographic of respondents

Table I highlights the socio-demographic characteristic of the respondent. Majority of the respondents are female (N = 89, 59.3%), married and are housewives (N= 43, 28.7%). Respondents in the temporary shelter were slightly younger (43.9 ± 16.0 year) than majority of respondents at home (52.4 ± 14.5 years). The highest education level of these respondents are primary level (N = 76, 50.6%). The average monthly income of respondents in the temporary shelter was significantly lower (US\$ 178 ± 126) compared to respondents at home (US\$ 290 ± 287). Majority of the respondents had owned a traditional village house (N = 149, 99.3%) mainly made of wood (N = 93, 62%) before the flood, and owned the house before the flood. Only 39 of the respondents (26%) rented the house. The flood has completely damaged the whole house of 68 (45.3%) respondents. Majority of them currently lives in the temporary shelter provided by the government (N=60) while the rest stay at their relatives.

Duration of flood waste removal, respondent participation and satisfaction

Table II highlights the duration of flood waste removal, respondent participation and satisfaction in the process. On average, 1 to 3 months were taken by many victims to clean their house (N = 31, 38.8%) while some of them (N = 23) took less than a month (1 to 4 weeks). The authority took 1 to 3 months to remove the flood debris from the local street and public areas after the flood water went down.

Majority of respondents in this study participated in the cleaning process (N = 126, 84%). Only 16% of the respondents mainly in the temporary shelters were not involved in the process at all (N = 20).

Half of the flood victims surveyed had low and moderate satisfaction rates on the cleaning service provided by the authority (N = 84, 56%). They have reported the waste

Table I: The socio-demographic background of the respondents (N = 150)

Variables		Temporary shelter n (%) ^(n = 70)	Homes n (%) ^(n = 80)
Age ^a	mean \pm standard deviation (SD)	43.9 ± 16.0	52.4 ± 14.5
Gender ^b	Male	21 (34.4)	40 (65.6)
	Female	49 (55.1)	40 (44.9)
Married	Married	67	78
	Primary education or less	41	35
	Lower secondary education	6	10
Education	Higher secondary education	23	35
	Monthly income ^a	mean \pm SD (US\$)	178 ± 126
Occupation	Self-employed	21 (30)	17 (21.3)
	Pensioner	2 (2.9)	12 (15)
	Housewife	30 (42.9)	13 (16.3)
	Labour	8 (10.6)	20 (25)
	Unemployed	7 (10)	9 (11.3)
	Others	4 (5.7)	13 (16.3)
Types of house	Traditional house	70 (100)	79 (98.8)
	Attached house	0 (0.0)	1 (1.3)
House materials	wood	61 (87.1)	32 (40.0)
	cement	0 (0.0)	36 (45.0)
	wood and cement	9 (12.9)	12 (15.0)
Ownership	Renting	30 (42.9)	9 (11.3)
	Own	40 (57.1)	71 (88.8)
Level of damaged	The whole house	60 (85.7)	8 (10.0)
	Half of the house	4 (5.7)	13 (16.3)
	A part of the house	5 (7.2)	42 (52.6)
	Not affected at all	1 (1.4)	17 (21.3)

^aSignificant difference at $p < 0.05$ for t-test, ^bSignificant difference at $p < 0.05$ for Two-Way ANOVA

removal was not a fair process (N = 124, 83%) and they have to find alternative ways for waste disposal (N = 108, 72%). Low satisfactory was recorded among 30% (N = 45) respondents (18 in temporary shelter and 27 at home). Respondents also highlights about the unsuitable location of the temporary disposal site (N = 105, 70%) where it was located near to their house. This resulted in discomfort, scavenger problem and smells. The temporary disposal site was left open without proper closure management.

Respondents knowledge post flood waste management

The overall respondents' involvement in the cleaning process was good but there were less involvement of respondents in the temporary shelters (N = 22, 31.4%). There appears to be insufficient transfer of information (N = 130, 87%) and therefore respondents were ill informed of the function of waste disposal facilities such as kerbside (N = 95, 63%), temporary disposal sites (N = 90, 60%) and skip bin (N = 98, 65%) and the role of the authorities in the cleanup activity. They also did not

Table II: The duration of flood waste removal, respondent participation and satisfaction in the process

Variables		Temporary shelter n (%)	Home n (%)	Total n
Duration to remove flood waste from the house by respondents	< 1 week	1 (1.4)	8 (10.1)	9
	1-4 weeks	13 (18.6)	23(26.4)	36
	1-3 months	17 (24.3)	31(38.8)	48
	Still recovering	17 (24.3)	20(25.0)	37
	Not applicable	22 (31.4)	0(0.0)	22
Duration of local authority to remove flood waste from local street	< 1 week	1 (1.4)	7(8.8)	8
	1 - 4 weeks	8 (11.4)	18(22.6)	26
	1 -3 months	44 (62.9)	50(62.5)	94
	Still in the process	17 (24.3)	5(6.3)	22
Satisfaction of the authorities services in removing flood waste	Low satisfaction	18 (25.7)	27 (34)	45
	Moderate satisfaction	24 (34.3)	15 (18.8)	39
	High satisfaction	28 (40)	38 (47.5)	66
Related to satisfaction	Removal of flood waste is not a fair process	57 (81.4)	67 (83.8)	124
	Respondents have to dispose in alternative ways	49 (70.0)	59 (73.8)	108
	The location of temporary disposal site is not suitable	44 (62.9)	61 (76.3)	105
	Respondents participation in the cleanup process	17 (24.3)	55 (68.8)	72
Respondents participation in the cleanup process	Heavily participated	17 (24.3)	55 (68.8)	72
	Moderate participation	18 (25.7)	15 (18.8)	33
	Little participation	15 (21.4)	6 (7.5)	21
	Not participate at all	20 (28.6)	4 (5.0)	24

know the location of flood waste disposal sites (N = 96, 64%) (Fig. 2).

Psychological importance of the flood and cleaning process to respondents

Respondents in both groups claimed that the removal of flood waste from their house is an important step of their recovery after the disaster (Fig. 3). Since the removal of post flood waste was a slow process (N = 103, 69%), they

have the perception of longer recovery time (N = 110, 73%). Physically participating in the cleaning process assist only small numbers of respondents recovery at home (N = 44, 55%) and in temporary shelter (N = 19, 27%). Respondents in this study did not feel empower by the cleaning activity. However, the benefit of the flood incident is they feel a close relationship with their neighbors (N = 147, 98%). They also addressed the involvement of volunteers in assisting them during the cleaning process even though not all respondents highlighted this (N = 74, 49%). Respondents with homes felt that they could participate more in the cleaning process (N = 41, 51.3%) but not to those in the temporary shelter (N = 28, 40%). Both respondent groups indicated community training is good to increase their preparedness and to minimize the impact to them (N = 129, 86%).

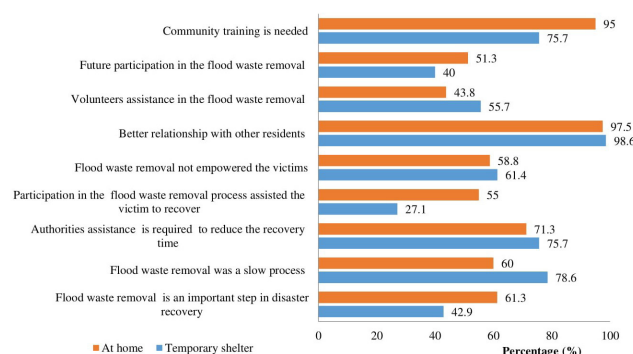


Figure 3: The psychological elements of the flood and cleaning process that importance to respondents

The statistical analysis ANOVA shows no significant difference of knowledge level between respondent by groups (F = 1.071, p = 0.302). Significant correlation was observed between knowledge and education level ($\chi^2 = 0.203, p=0.013$). But no significant relationship between knowledge with gender ($\chi^2 = 0.090, p=0.272$), age ($\chi^2 = -0.0124, p=0.132$) and household income ($\chi^2 = 0.094, p=0.253$). The level of knowledge also did not correlate with the duration of waste removal ($\chi^2 = -0.137, p = 0.095$), respondents participation in the cleaning process ($\chi^2 = 0.074, p = 0.371$) and satisfaction of the clean up service ($\chi^2 = 0.045, p = 0.587$).

Less participation of respondents in the cleanup process in this study was significantly correlated with the group of respondents (i.e. temporary shelter and at home) ($\chi^2= 0.473, p < 0.001$) and gender ($\chi^2 = -0.193, p = 0.018$). Respondents age in this study did not correlate with the level of participation ($\chi^2= 0.079, p = 0.335$).

DISCUSSION

This study had addressed the duration of flood waste removal, the participation level of flood victims in the post flood waste clean-up process and their satisfaction level. Our findings reported the authority took 1 to 3

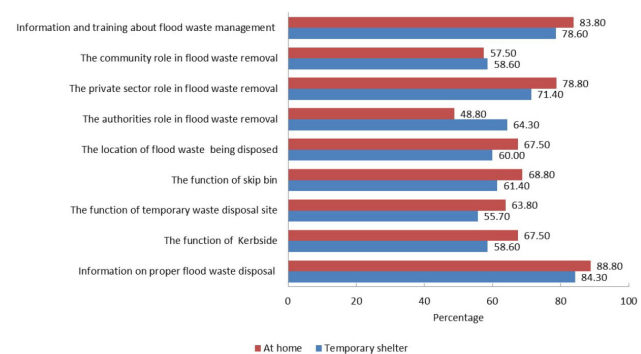


Figure 2: The respondents knowledge about post flood waste management

months to remove the flood debris from the local street and public areas after the flood water went down. Long duration of cleanup process was possibly related to huge amount of waste generated in the study area. According to Agamuthu et al., (15) the highest amount of flood waste generated during this incident was recorded in Kuala Krai with the total amount of 29,851 tonnes which is equivalent to the daily waste generation rate in Malaysia. The highest waste generation rate kilogram (kg) per capita was recorded in Kuala Krai (532.8 kg / cap) followed by Tanah Merah (419.4 kg / cap), Tumpat (372.1 kg / cap), Gua Musang (374.9 kg / cap) and Kota Bharu (3.9 kg / cap) (15).

The most abundant waste generated in this area was construction and demolition wastes category, mainly from wood (44%) and concrete (29%). Other type of flood waste reported in the study area were concrete, metal, hazardous waste, electrical appliance, non-organic waste, coloured glass, sand/dirt, green waste, aluminium can, plastic and food waste (15). This is consistent with our findings in Table II where majority of the respondents owned a traditional house made of wood and cement. A house made of wood and combination with cement is common in the country especially in most of the rural areas. High volume of water created during the flood in the study area had caused destruction to the house and other infrastructures which eventually generates huge amount of waste in Kuala Krai. The highest flood water level recorded in Kuala Krai was 34.17 m, exceeding the danger limit of 25 meter (m) set by the Malaysian Department of Irrigation and Drainage (15).

Hazardous materials can pollute the flood water and it can be harmful to the community and also to the emergency personnel or the environment. Keeping minor stocks of hazardous materials on location and avoiding expensive and complicated clean-up could help in minimizing the risk at post flood. This kind of information is very helpful and could create a better waste management in the affected area. It also encourage proper management of flood debris and prompt cleanup that will empowers residents to move forward with their lives while reducing potential public health and environmental disputes that can be intensified the longer the waste is not managed (16). Building structures also should be handled carefully to minimize the exposures to hazardous materials such as asbestos that potentially present in the impaired structure or debris (17). Flood debris is challenging to manage because of its heterogeneity (15). The heterogeneity of flood waste caused recovery and recycling more difficult. Appropriate waste treatment was unable to be applied as the waste contains mixture of recyclable and non-recyclable items and it can produce negative effect on human health and greater risk to the environment.

The communities in this study have not been informed on how to manage their waste during the pre and

post flood. There was no waste management program conducted by the local authority prior to the disaster, not only in Kuala Krai but also to other places. To some extent this information is very important especially for a quick cleanup process by the waste handling operator. Furthermore, the early warning systems and waste management training were aimed to raise community vigilance to deal with the floods. Human resources in the form of understanding, skills and local cooperation in response to these events are particularly useful in reducing the economic losses (18 - 19).

This is supported by several studies which has proven that people who are not aware how flood would affect them were usually unprepared and suffered losses and commotion in their routine life compared to those who lives in the floodplain, they are more aware of the flood and river behaviour (20). These group of people usually have experienced evacuation and are better prepared and experienced less impact psychologically (20 – 21). To some extent, this has shown that knowledge, attitude and perception are essential to help them manage and response to flood disaster. Ideally, those who are alert of the hazards and concerned ought to feel motivated and become better prepared. However, many research shows that an accurate risk perception usually fails to generate adequate preparedness (22-26).

On the other hand, as the normal practice in the country, the residence in the village will manage and dispose their own solid waste using various methods including burning and dumping on the ground. The local authority is not responsible for the waste unless the waste collection service was requested by the villagers. Due to this, the post flood waste cleaning process for those who reside the village was not efficiently implemented and take a while for the authority to collect the waste from their housing area. On the contrary, solid waste management in urban areas is more structured and systematically managed by the local authority and due to this, more efficient clean-up process was observed.

Significant correlation was observed between knowledge and education level but no significant relationship between knowledge with gender and household income. The level of knowledge also did not correlate with the duration of waste removal, respondents participation in the cleaning process and satisfaction of the clean up service. This result was not consistent with previous studies where some relationships were obtained between socio-demographic variables such as sex, age, education with environmental behavior (27-28). A study by Agwu (29) also found correlation between respondents' knowledge and waste management practices. Public awareness and knowledge is directly connected to the way people identify disaster risk and response to it (30). However, most of the victims are not very much concerned with the natural hazards, and cause them to become less prepared (26, 31). This had caused them to suffer from

cognitive emotional and behavioural shortfalls, for example fear, anxiety, hopelessness, helplessness and depression (32). According to Assanangkornchai et al. (33), 40% of the flood victims in Thailand was reported with probable mental health problem.

Recent study among the flood victims in Kuala Krai also determined 29% of 150 flood victims experienced mild to moderate depression with 2% of them in severe depression (5). Fourteen respondents (9.33%) had severe level of general anxiety disorders and 28% of the respondents were suspected to have post-traumatic stress disorders. The time of receiving information about flood is the most significant factor predicting depression, general anxiety disorders and post-traumatic stress disorders. This possibly explains why respondents in this study did not feel empowered by the cleaning activity (43 at temporary shelter and 47 at homes). Less participation of respondents in the cleanup process in this study was significantly correlated with the group of respondents (i.e. temporary shelter and at home). This is because all of the respondents in the temporary shelter have completely lost their home in the flood, and cause them to pay little effort to participate in the cleaning process. Less participation in this study also was significantly correlated with gender since most of respondents in this study especially in the temporary shelter are woman. However, this finding is opposite to what has been found in Van Liere and Dunlap, where gender did not influence the environmental concerns and attitudes as shown by other socio-demographic variables (34). This is because the spontaneous participation of the community in all phases is important to ensure the effectiveness and the efficiency of the results of the mitigation measures.

Overall, this study has filled in the research gap about the post flood waste management and its impact to the victim's psychology and recovery in Malaysia. Limited research has been done to illustrate the impact of post flood waste to the victims perception psychology and recovery. This study had addressed the participation level of flood victims in the post flood waste clean-up process and the duration of the clean-up process from the recent flood disaster in Kelantan.

Problems that arise during the clean-up process were recorded and the importance of the clean-up process to the flood victim's recovery was assessed. The findings of this study serve as a baseline data to elaborate the significant of post-flood waste management program structured and contribute significantly to the recovery of the victims. This finding also creates awareness about the role of the authority to help the community whom affected by disaster in their recovery. This study can also initiate education and urban strategic plans by the authorities and policymakers in future especially in dealing with disaster effectively. An effort to convey the information about post flood waste management at all levels of the society is vital. The effort will be able to

prepare the people towards a resilience community.

Limited number of respondents involved in this study can be considered as the limitation that possibly influences the results. However, the results manage to illustrate the impacts of the post flood waste management system in this area. This assessment suggest for continuous measurement to be done as it is crucial to ensure appropriate flood waste management system being implemented and as a preparedness measure.

CONCLUSION

In the present study, a survey has been conducted among flood victims to determine the involvement and waste removal process after the incident of flooding. The overall assessment found, the victims and the responsible authorities took 1 to 3 months to remove the flood debris from the local street and residential area. Respondents' involvement in the cleaning process was good but less involvement of respondents in the temporary shelters. It appears to be insufficient transfer of information between the authorities with the flood victims. Respondents indicate the removal of flood waste from their house is an important step of their recovery after the disaster. Since the removal of post flood waste was a slow process, they have the perception of longer recovery time. The necessity of articulated community training to communicate the risk and the response of it is important and was heavily wanted by most of the respondents in this study for them to be a resilient community to the future disaster.

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REFERENCES

1. D/iya SG, Gasim MB, Toriman ME, Abdullahi MG. Floods in Malaysia: historical reviews, causes, effects and mitigations approach. *Int J Interdiscip Res Inno.* 2014;2(4):59-65.
2. Baharudin Y, Mohd ET, Maimon A, Salmijah S, Chen CY, Heng LY. Impact of climate change on flood risk in the Muar river basin of Malaysia. *Disaster Adv.* 2013;6(10): 11-17.
3. Gasim MB, Ismail BS, Toriman E, Mir SI, Chek TC. A physico-chemical assessment of the Bebar River, Pahang, Malaysia. *Global J Env Res* 2007; 1 (1): 7-11.
4. Su-Lyn B. Kelantan floods like Japan's 2011 Tsunami. *The Malay Mail Online* [newspaper online]. 2015 January 5 [cited 2016 Jan 21]. Available from: <http://www.themalaymailonline.com>.

5. Irniza R, Emilia ZA, Sharifah Norkhadijah SI, Vivien H, Praveena SM, Karmegam K, Yu Bin H, Nik Nurul Aizzah NA, Syukriah M, Suriani I, Zailina H. The association between KAP on disasters with depression, GAD and PTSD among flood victims. *Indian J. Env Prot.* 2016;36(11):888-894.
6. Baharuddin KA, Wahab FA, Ab Rahman NHN, Mohamad NAN, Kamauzaman THT, Noh AYM, Majod MRA. The record-setting flood of 2014 in Kelantan: challenges and recommendations from an emergency medicine perspective and why the medical campus stood dry. *Malay J Med Sci.* 2015;22(2):1-7.
7. Damage due to Malaysia flood close to \$284M. *The Star/Asia News* [serial online]. 2015 [cited 2016 Jan 3]. Available from: <http://newsinfo.inquirer.net/662008/damage-due-to-malaysia-flood-close-to-284m#ixzz4ef4HMsvR>
8. United Nations Environment Programme, UNEP (2012). Managing post disaster debris: the Japan experience. Report of the International Expert Mission to Japan [document on the internet]. *Int Env House*; 2012 [cited 2016 Feb 9] Available from: www.unep.org/pdf/UNEP_Japan_post-tsunami_debris.pdf
9. Alam P, Ahmade K. Impact of solid waste on health and the environment. *International J Sust Dev Green Eco.* 2013;2(1):165-168.
10. Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan (KPKT). Siaran media: Alam Flora kutip sampah 2,000 tan sehari di Kelantan [Internet]. [kpkt.gov.my](http://www.kpkt.gov.my/resources/index/user_1/media_akhbar/2015/SM_alam_flora_kelantan.pdf).2015 [cited 21 Jan 2016]. Available from: http://www.kpkt.gov.my/resources/index/user_1/media_akhbar/2015/SM_alam_flora_kelantan.pdf
11. 98,142.5 Tonnes of waste collected in Kelantan as at Jan 29. *Bernama* [newspaper online].2015 [cited 2016 Jan 21]. Available from: <http://www.bernama.com/bernama/>
12. Floods cost Kelantan RM 200 mil in losses. *The Star Online* [newspaper online]. 2015 [cited 2016 Jan 2]. Available from: <https://www.thestar.com.my/news/nation/2015/01/02/floods-cost-kelantan-rm200mil-in-losses/>
13. Department of Statistic Malaysia Official Portal. Population census 2010 [Internet]. [statistics.gov.my](https://www.statistics.gov.my/).2010. [cited 21 Jan 2016]. Available from: <https://www.statistics.gov.my/>
14. Milton P. Social effects of disaster waste management: A case study of Brisbane suburbs post 2011 January floods. [Thesis]. The University of Queensland Australia; 2014.
15. Agamuthu P, Milow P, Nurul AMN, Nurhawa AR, Fauziah SH. Impact of flood on waste generation and composition in Kelantan. *Malay J Sci.* 2015;34(2): 130-140.
16. The Boulde County Emergency Operation Centre. Hazard mitigation plan [Internet]. 2014 [cited 2016 Jan 24]. Available from: www.boulderoem.com/attachment/8631.
17. Hickenlooper JW, McGowan K. 2013 *Floods – guidance: management and disposal of flood debris.* Giendale, Colorado. Colorado Department of Public Health and Environment; 2013. 10 p.
18. USESCO. Flood Mitigation - A Community-based project. Jakarta. 2004 [cited 2016 Jan 24]. Available from: <http://unesdoc.unesco.org/images/0015/001543/154381E.pdf>
19. Wisner B, Adams J. *Environmental health in emergencies and disasters: a practical guide.* Switzerland. World health organization; 2002.
20. Wisitwong A, McMillan M. 2010 Management of flood victims: Chainat Province, central Thailand. *Nurs Health Sci.* 12(1):4-8. Available from, DOI:10.1111/j.1442-2018.2009.00504.x
21. Baan PJA, Klijn F. Flood risk perception and implications for flood risk management in the Netherlands. *Int J Riv Basin Manag.* 2004;2(2):113-122. Available from, DOI: 10.1080/15715124.2004.9635226
22. Corwin KA, Brand BD, Hubbard M.L, Johnston DM. Household preparedness motivation in lahar hazard zones: assessing the adoption of preparedness behaviors among laypeople and response professionals in communities downstream from Mount Baker and Glacier Peak (USA) volcanoes. *J App Volcano.* 2017; 6 (1): 3-9. Available from, DOI: 10.1186/s13617-017-0055-8
23. Corwin KA. Living in lahar zones: Assessing hazard exposure, risk perception, and preparedness behaviors in communities within the Mount Baker and Glacier Peak volcanic hazard zones [master's thesis]. Boise State University; 2016. 168 p.
24. Sims JH, Baumann DD. (1983). Educational programs and human response to natural hazards. *Env Behav.* 1983;15(2):165-189. Available from, DOI: 10.1177/0013916583152003
25. Paton D, Smith L, Daly M, Johnston D. Risk perception and volcanic hazard mitigation: Individual and social perspectives. *J Volcano Geotherm Res.* 2008;172(3):179-188.
26. Wachinger G, Renn O, Begg C, Kuhlicke C. The risk perception paradox—implications for governance and communication of natural hazards. *Risk Anal.* 2013; 33 (6): 1049-1065. Available from, DOI: 10.1111/j.1539-6924.2012.01942.x.
27. Jones RE, Dunlap RE. The social bases of environmental concern. Have they changed over time? *Rural Soc.* 1992;57(1):134-144. Available from, DOI: 10.1111/j.1549-0831.1992.tb00455.x/abstract
28. Raudsepp M. Some socio-demographic and socio-psychological predictors of environmentalism. *TRAMES.* 2001;5(55/50) (3):355-367. Available from: <http://www.digar.ee/arhiiv/et/download/147141>.
29. Agwu, M.O. Issues and challenges of solid waste management practices in Port-Harcourt

- City, Nigeria: A behavioral perspective. *Am J Soc Manag Sci.* 2012; 3(2): 83-92. Available from:<https://pdfs.semanticscholar.org/9ee0/ded2c33732158db1c0cec92b67b947a92ea7.pdf>
30. Hernández-Moreno G, Garnica-Peca RJ, Alc6ntara-Ayala I. Landslide community mapping and public awareness in the region of Chichonal volcano, Chiapas, Mexico. In *Landslide Science for a Safer Geoenvironment. Volume 2: methods of landslide studies.* Springer International Publishing. 2014. Available from:<https://www.springerprofessional.de/landslide-community-mapping-and-public-awareness-in-the-region-o/2100422>
31. Wagner K. Mental models of flash floods and landslides. *Risk Anal.* 2007;27 (3): 671-682. Available from, DOI: 10.1111/j.1539-6924.2007.00916.x/abstract
32. Nasir R, Zainah AZ, Khairudin R. Psychological effects on victims of the Johor flood 2006/2007. *Asian Soc Sci.* 2012;8(8):126-136. Available from, DOI: 10.5539/ass.v8n8p126
33. Assanangkornchai S, Tangboonngam SN, Edwards JG. The flooding of Hat Yai: predictors of adverse emotional responses to a natural disaster. *Stress Health.* 2004;20(2): 81-89. Available from, DOI: 10.1002/smi.999
34. Van Liere KD, Dunlap RE. Environmental concern: Does it make a difference how it's measured? *Env Behav.* 1981;13(6):651-676. Available from, DOI:10.1177/0013916581136001