UNIVERSITI SAINS MALAYSIA

RU GRANT
FINAL REPORT CHECKLIST

Please use this checklist to self-assess your report before submitting to RCMO.
Checklist should accompany the report.

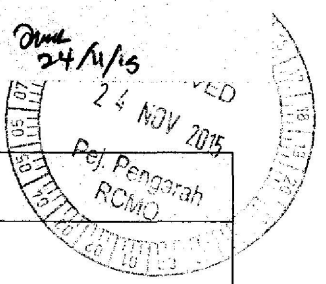
NO.	ITEM	PLEASE CHECK (✓)		
		PI	JKPTJ	RCMO
1	Completed Final Report Form	✓		✓
2	Project Financial Account Statement (e-Statement)	✓		✓
3	Asset/Inventory Return Form *(Borang Penyerahan Aset/Inventori)*	✓		✓
4	A copy of the publications/proceedings listed in Section D(ii) (Research Output)	✓		✓
5	Comprehensive Technical Report	✓		✓
6	Other supporting documents, if any	✓		
7	Project Leader's Signature	✓		✓
8	Endorsement of PTJ's Evaluation Committee	✓		✓
9	Endorsement of Dean/ Director of PTJ's	✓		✓

Project Code : U0892
(for RCMO use only)

UNIVERSITI SAINS MALAYSIA

RU GRANT FINAL REPO

Pn. Adlie
Untuk semakan dan tindakan lanjut. TF. 24/11/15



Please email a softcopy of this report to rcmo@usm.my

A	**PROJECT DETAILS**
i	**Title of Research:** **e-PARTICIPATORY COMMUNITY BASED APPROACH ON LANDSLIDE PREPAREDNESS AND MITIGATION**
ii	**Account Number: 1001/PKOMP/816198**
iii	**Name of Research Leader: ASSOC. PROF. DR CHAN HUAH YONG**
iv	**Name of Co-Researcher:** **1. Prof. Dr Habibah Lateh** **2. Dr Jamilah Hj Ahmad** **3. Dato' Dr Razha Abdul Rashid** **4.Dr Tay Lea Tien** **5.Dr Anton Abdulbasah Kamil** **6.Dr Izham Mohamed Yusoff** **7.Dr Zarina Md Nor**
v	**Duration of this research:** **a) Start Date : 1 April 2012** **b) Completion Date : 31 March 2015** **c) Duration : 3 years** **d) Revised Date (*if any*) : 31 March till 30 September 2015**
B	**ABSTRACT OF RESEARCH**
	(An abstract of between 100 and 200 words must be prepared in Bahasa Malaysia and in English. This abstract will be included in the Report of the Research and Innovation Section at a later date as a means of presenting the project findings of the researcher/s to the University and the community at large) *Ilmu pengetahuan merupakan indikator penting dalam menentukan keberkesanan susun atur strategi bagi menangani kejadian tanah runtuh. Pengetahuan untuk mengenal pasti tanda-tanda awal tanah runtuh adalah perlu bagi mereka yang tinggal terutamanya di kawasan-kawasan berisiko tinggi. Pelajar-pelajar USM yang tinggal di sepanjang kawasan cerun menjadi fokus kajian ini. Hasil kajian menyokong hipotesis alternatif yang*

dinyatakan dalam kajian. Pengetahuan didapati bertambah baik setelah penggunaan portal e-penyertaan dimana secara langsung memberi kesan positif terhadap kesediaan dan sikap di kalangan pelajar. Kesediaan untuk mengamal ilmu yang diperolehi mengatasi skor sikap dan pengetahuan oleh pelajar selepas penggunaan portal e-penyertaan di mana 40% daripada pelajar sangat bersetuju melaporkan sebarang tanda-tanda amaran awal yang dikenalpasti sebelum berlakunya kejadian tanah runtuh. Juga, pelajar lelaki menggambarkan perubahan positif dalam sikap berbanding dengan wanita yang tidak menunjukkan sbarang perubahan. Pelajar-pelajar yang "sangat tidak bersetuju 'atau' tidak bersetuju 'sebelum penggunaan portal e-penyertaan telah mengubah tanggapan mereka terhadap sama ada' bersetuju 'atau' sangat bersetuju. Ini menunjukkan bahawa penggunaan portal memudahkan sokongan usaha sama dengan penggunaan alat-alat seperti platform e-penyertaan yang membolehkan mereka untuk berinteraksi dengan persekitarannya.

Knowledge is an important indicator in an effective landslide mitigation strategy. Knowledge has to be acquired by people living in high risk areas for landslide occurrence such that they will be able to identify early signs of landslides. The students of USM communities living along the slope area are the focus of this study. The result supports the alternative hypotheses stated in the study. Knowledge has improved with the intervention which affects positively the willingness to practice along with right attitude among students. Willingness to practice outscored the attitude and knowledge acquired by students after the intervention where 40% of the students strongly agreed to report any early warning signs encountered before landslide strikes. Also, male students portrayed positive changes in attitude as compared to female who showed none. Those who were "strongly disagreed' or 'disagreed' prior to intervention has changed their notion towards either 'agreed' or 'strongly agreed'. This shows that the intervention facilitates support for collaborative effort with tools such as the e-participatory platform and enables them to interact with its environment.

C BUDGET & EXPENDITURE

i

Total Approved Budget : RM 250, 000

Yearly Budget Distributed

Year 1 : RM **88,220.00**
Year 2 : RM **86,555.00**
Year 3 : RM **75,225.00**

Total Expenditure : RM 176,793.60

Balance : RM 71,806.40

Percentage of Amount Spent (%) : 70.72

 # Please attach final account statement (eStatement) to indicate the project expenditure

ii **Equipment Purchased Under Vot 35000**

No.	Name of Equipment	Amount (RM)	Location	Status
1	Laptop	RM2800	School of Computer Sciences	
2	Nikon	RM3500	School of Computer Sciences	

 # Please attach the Asset/Inventory Return Form (Borang Penyerahan Aset/Inventori) – Appendix 1

D RESEARCH ACHIEVEMENTS

i Project Objectives *(as stated/approved in the project proposal)*

No.	Project Objectives	Achievement
1	To formulate a collective interactive intelligent model for landslide disaster mitigation	100%
2	To develop a proactive communication methods using IT tools that enable community participation to increase awareness	100%
3	To alert community using landslide multimedia information archive with GIS (pre, during and post) landslide occurrences	100%

ii Research Output

a) Publications in ISI Web of Science/Scopus

No.	Publication (authors,title,journal,year,volume,pages,etc.)	Status of Publication (published/accepted/ under review)

b) Publications in Other Journals

No.	Publication (authors,title,journal,year,volume,pages,etc.)	Status of Publication (published/accepted/ under review)
1	Avani, Nazi, Habibah Lateh, and Ghassem Habibi Bibalani. "Root distribution of Acacia mangium Willd. and Macaranga tanarius L. of rainforest." *Bangladesh Journal of Botany* 43.2 (2015): 141-145.	Published
2	AHMAD, JAMILAH, and HABIBAH LATEH. "The Best Communication Tools in Delivering Landslide Information to Orang Asli: A Case Study in Gerik Perak, Malaysia."	Published
3	Jamilah Hj Ahmad, Habibah Lateh, Teaching Orang Asli Perspectives: An Investigation of Teachers' Perception on Landslide Hazard, Journal of Education and Human Development (ISSN:2334-296X (Print), 2334-2978(Online)Vol. 3, No. 3, pp. 157-166, 2014	Published

c) Other Publications
(book,chapters in book,monograph,magazine,etc.)

No.	Publication (authors,title,journal,year,volume,pages,etc.)	Status of Publication (published/accepted/ under review)

d) Conference Proceeding

No.	Conference (conference name,date,place)	Title of Abstract/Article	Level (International/National)
1	AICCE'12 & GIZ' 12 28th August 2012	Landslide Prediction Using Numerical Analysis	National
2	AICCE '12&GIZ '12 28th August 2012	Sensor ML-NT: Innovative Geographical Sensor Description Collection for Mobile Devices Handling Environmental Issues	National
3	Fortechenvi 2013 Czech Republic of Life Science Prague, 26-30th May 2013 Brno, Czech Republic	Investigation of Root Area Ratio of Macaranga tanarius (L.)Mull. Arg. (parasol leaf tree) in Rainforest, Penang, Malaysia.	International
4	ACIS 2015 The Fourth Asian Conference on Information System, 15-17th Oct 2015, Penang, Malaysia	The Effect of Intervention on Landslide Knowledge among Students in Higher Institution, Malaysia: A Case Study	International

 # Please attach a full copy of the publication/proceeding listed above

iii **Other Research Ouput/Impact From This Project**
(patent, products, awards, copyright, external grant, networking, etc.)

Web portal: e-participatory.cs.usm.my

E HUMAN CAPITAL DEVELOPMENT

a) Graduated Human Capital

Student	Nationality (No.)		Name
	National	International	
PhD			1. 2.
MSc			1. 2.
Undergraduate			1. 2.

b) On-going Human Capital

Student	Nationality (No.)		Name
	National	International	
PhD		1	Nazi Avani
MSc	1	1	Wen Yin Ting,Nazi Tabatabaei Yazdi
Undergraduate		2	Wen Yin Ting, Toh Wei Chun (FYProject)

c) **Others Human Capital**

Student	Nationality (No.)		Name
	National	International	
Post Doctoral Fellow			1. 2.
Research Officer	1		1. Jainambu
Research Assistant			1. 2.
Others (.....)			1. 2.

F COMPREHENSIVE TECHNICAL REPORT

Applicants are required to prepare a comprehensive technical report explaining the project. The following format should be used (this report must be attached separately):

- Introduction
- Objectives
- Methods
- Results
- Discussion
- Conclusion and Suggestion
- Acknowledgements
- References

G PROBLEMS/CONSTRAINTS/CHALLENGES IF ANY

(Please provide issues arising from the project and how they were resolved)

There were some technical problems encountered in the proactive communication tool which need to be adrressed and evaluated. Further enhancement may be required.

H RECOMMENDATION

(Please provide recommendations that can be used to improve the delivery of information, grant management, guidelines and policy, etc.)

NIL

Project Leader's Signature:

PROF. MADYA CHAN HUAH YONG
Pusat Pengajian Sains Komputer
Universiti Sains Malaysia
11800 Pulau Pinang, Malaysia

.....

Name : CHAN HUAH YONG

Date : 11/11/2015

I	COMMENTS, IF ANY/ENDORSEMENT BY PTJ'S RESEARCH COMMITTEE

This multi-disciplinary research has been completed. A set of new knowledge on landslide management, from the ICT perspective, has been gathered. A number of research students had also been trained with the help of this grant. There is about 80% un-utilized budget allocation at the end of this project.

PROFESOR AZMAN SAMSUDIN
Timbalan Dekan
Penyelidikan
Pusat Pengajian Sains Komputer
Universiti Sains Malaysia
11800 USM Pulau Pinang, Malaysia

.....
Signature and Stamp of Chairperson of PTJ's Evaluation Committee

Name : AZMAN BIN SAMSUDIN

Date : 18 Nov 2015.

PROFESOR AHAMAD TAJUDIN KHADER
Dekan
Pusat Pengajian Sains Komputer
Universiti Sains Malaysia
11800 USM, Pulau Pinang, Malaysia

.....
Signature and Stamp of Dean/ Director of PTJ

Name :

Date : 23/11/15

UNIVERSITI SAINS MALAYSIA

JABATAN BENDAHARI

PENYATA PERBELANJAAN SEHINGGA 11 NOVEMBER 2015

Projek : E-PARTICIPATORY COMMUNITY BASED APPROACH ON LANDSLIDE PREPAREDNESS AND MITIGATION
TEMPOH : 15 DISEMBER 2011 HINGGA 14 NOVEMBER 2014 (DILANJUTKAN SEHINGGA 31 MAC 2015) (LANJUTAN SEHINGGA 30 SEPTEMBER 2015)
KETUA PROJEK : PROFESOR MADYA DR. CHAN HUAH YONG
PENYELIDIK BERSAMA: DR JAMILAH AHMAD
PUSAT PENGAJIAN SAINS KOMPUTER

No. Akaun : 1001.PJJAUH.816198.

Vot	Nama Vot	Peruntukan Projek	Perbelanjaan Terkumpul Sehingga Thn Lalu	Baki Peruntukan Tahun Lalu	Peruntukan Thn Semasa	Jumlah Peruntukan Thn Semasa	Tanggungan Semasa	Bayaran Thn Semasa	Jum Belanja Thn Semasa	Baki Projek
111	GAJI	113,402.04	103,953.00	-27,153.00	36,602.04	9,449.04	0.00	9,449.04	9,449.04	0.00
111	GAJI	38,400.00	0.00	0.00	38,400.00	38,400.00	0.00	18,898.08	18,898.08	19,501.92
221	PERJALANAN DAN SARA HIDUP	23,697.96	0.00	0.00	23,697.96	23,697.96	0.00	0.00	0.00	23,697.96
221	PERJALANAN DAN SARA HIDUP	0.00	0.00	40,200.00	-40,200.00	0.00	0.00	0.00	0.00	0.00
223	PERHUBUNGAN DAN UTILITI	3,000.00	0.00	0.00	3,000.00	3,000.00	0.00	0.00	0.00	3,000.00
223	PERHUBUNGAN DAN UTILITI	0.00	0.00	2,000.00	-2,000.00	0.00	0.00	0.00	0.00	0.00
224	SEWAAN	12,552.00	0.00	0.00	12,552.00	12,552.00	0.00	0.00	0.00	12,552.00
224	SEWAAN	0.00	0.00	10,000.00	-10,000.00	0.00	0.00	0.00	0.00	0.00
227	BEKALAN DAN BAHAN LAIN	10,842.25	0.00	0.00	10,842.25	10,842.25	0.00	15,985.00	15,985.00	-5,142.75
227	BEKALAN DAN BAHAN LAIN	2,557.75	2,557.75	8,042.25	-8,042.25	0.00	0.00	0.00	0.00	0.00
228	PENYELENGGARAN & PEMBAIKAN KECIL	0.00	0.00	700.00	-700.00	0.00	0.00	0.00	0.00	0.00
228	PENYELENGGARAN & PEMBAIKAN KECIL	700.00	0.00	0.00	700.00	700.00	0.00	0.00	0.00	700.00
229	PERKHIDMATAN IKTISAS & HOSPITALITI	21,798.89	0.00	0.00	21,798.89	21,798.89	700.00	175.00	875.00	20,923.89
229	PERKHIDMATAN IKTISAS & HOSPITALITI	17,601.11	17,601.11	13,873.89	-13,873.89	0.00	0.00	0.00	0.00	0.00
335	HARTA MODAL	5,448.00	2,780.00	220.00	2,448.00	2,668.00	0.00	2,668.00	2,668.00	0.00
441	BIASISWA DAN GERAN PELAJARAN	0.00	0.00	0.00	0.00	0.00	700.00	2,726.62	3,426.62	-3,426.62

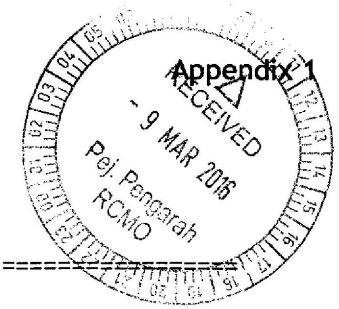
Penyata ini adalah cetakan komputer tiada tandatangan diperlukan
Penyata ini adalah dianggap tepat jika tiada maklumbalas dalam tempoh masa 14 hari dari tarikh penyata

Vot	Nama Vot	Peruntukan Projek	Perbelanjaan Terkumpul Sehingga Thn Lalu	Baki Peruntukan Tahun Lalu	Peruntukan Thn Semasa	Jumlah Peruntukan Thn Semasa	Tanggungan Semasa	Bayaran Thn Semasa	Jum Belanja Thn Semasa	Baki Projek
	Jumlah	250,000.00	126,891.86	47,883.14	75,225.00	123,108.14	1,400.00	49,901.74	51,301.74	71,806.40

Penyata ini adalah cetakan komputer tiada tandatangan diperlukan

Penyata ini adalah dianggap tepat jika tiada maklumbalas dalam tempoh masa 14 hari dari tarikh penyata

Appendix 1



UNIVERSITI SAINS MALAYSIA

BORANG PENYERAHAN ASET / INVENTORI

==========

A. BUTIR PENYELIDIK

1. NAMA PENYELIDIK : CHAN HUAH YONG
2. NO STAF : AA54123
3. PTJ : SCHOOL OF COMPUTER SCIENCES
4. KOD PROJEK : 1001/PKOMP/816198
5. TARIKH TAMAT PENYELIDIKAN : 30 SEMPTEMBER 2015

B. MAKLUMAT ASET / INVENTORI

BIL	KETERANGAN ASET	NO HARTA	NO. SIRI	HARGA (RM)
1	**Laptop TOSHIBA Satellite Pro L840**	-	**8C033626C**	**2800**
2	**Camera NIKON D3100**	-	**8574106**	~~**3500**~~

C. PERAKUAN PENYERAHAN

Saya dengan ini menyerahkan aset/ inventori seperti butiran B di atas kepada pihak Universiti:

PROF. MADYA CHAN HUAH YONG
Pusat Pengajian Sains Komputer
Universiti Sains Malaysia
11800 Pulau Pinang, Malaysia

(CHAN HUAH YONG) Tarikh: 11/11/2015

D. PERAKUAN PENERIMAAN

Saya telah memeriksa dan menyemak setiap alatan dan didapati :

☑ Lengkap
☐ Rosak
☐ Hilang : Nyatakan.....
☑ Lain-lain : Nyatakan ..... Aset dipinjam kembali oleh penyelidik

Diperakukan Oleh :

.....

Tandatangan
Pegawai Aset PTJ

MAHADI YUSOF
Pegawai Aset
Pusat Pengajian Sains Komputer
Universiti Sains Malaysia
11800 USM Pulau Pinang, Malaysia

Nama
Tarikh : 7/3/2016

Pn. Adzie
Utk rekod fail.
TK.

***Nota :** Sesalinan borang yang telah lengkap perlulah dikemukakan kepada Unit Pengurusan Harta, Jabatan Bendahari dan Pejabat RCMO untuk tujuan rekod.

9/3

Introduction

The occurrence of landslides hazards in Malaysia has been increasing at an alarming rate not only due to natural causes but also man-made causes. Landslides are defined as a massive mass of soil and rock debris that move downhill because of the action of gravity. It is important to note that landslides hazard can be prevented. The effect of most hazards including landslides can be reduced through community preparedness, timely warnings, and effective response. Community preparedness that involves education on landslide mitigation is crucial in minimizing the effect of hazards. Therefore, landslide hazard identification is an important determinant in order to avoid injuries, casualties and loss of properties in landslide prone areas. It is the development in disaster management that intrigued research interest in landslide study and on landslide education and mitigation areas. In Malaysia, this kind of research is still in its infancy in regards to landslide hazards.

It is important to study the level of preparedness among students in higher institution in dealing with landslide issues. They are the most ignorant and vulnerable group of public that can be easily nurtured for good cause. As profoundly mentioned by Norris (2008) [1], it is crucial to transform at-risk communities to disaster resilient communities but the community needs to be organized prior to mobilizing them to disaster mitigation strategy. Hence it is important that the community have the capacity to cope with the impact of a disaster and are involved in the development of disaster management activities from the beginning.

Community participation can also make them more confident in their capabilities to act in the event of a disaster (Newport & Jawahar, 2003)[2]. In this spirit, the level of knowledge on landslides among students was measured. This is the generation of students that will be faced with greater challenges in dealing with landslide disaster. It is pertinent to educate them on the mitigation of landslides hazards using an interactive e-portal as they are living in landslide prone areas. As noted by Claire Fagin (1987)[3], knowledge will bring the opportunity to make a difference. According to Norris (2002) [4] preparedness is mediated by specific knowledge, skills and the likelihood of taking appropriate actions when disaster strikes. These behaviour promoting factors are classified as the cognitive and psychomotor domain in Bloom's taxonomy of learning where it is crucial to start from the simplest behaviour to the most complex ones as in requiring immediate response to disaster. Therefore, salient but trivial components such as awareness, knowledge and preparedness influence the mode of response to landslide hazard and risk faced by the community (Roubhan, 2008[5]; Abhinav Sinha et. al, 2008[6]) in particular for those living in high risk areas. It is important to acquire adequate knowledge and practice about disaster mitigation strategy by attending disaster related education where the knowledge level increases and people's attitude towards disaster management improves (Adem Ocal, 2011[7]). Research on landslide awareness among secondary students in Malaysia finds that their awareness level is moderate (Habibah Lateh &Vijaya Govindasamy, 2012)[8].

Further, as technology becomes more embedded in our daily lives, the incorporation of communication technology in this research is timely as technology can be used to achieve

positive community outcomes like increasing access to local information, promoting civic engagement, and creating avenues for collaboration and communication (Jenkins and Thorburn, 2003[9]). Because achieving positive community outcome is fundamental, this research aims to study the effect of intervention (via e-portal method) towards the level of knowledge, attitude and willingness to practice landslide mitigation among students.

Objectives

To formulate a collective interactive intelligent model for landslide disaster mitigation
To develop a proactive communication methods using IT tools that enable community participation to increase awareness
To alert community using landslide multimedia information archive with GIS (pre, during and post) landslide occurrences

Methods

Quantitative method and focus group method were employed.
Location: RPS Kampung Orang Asli Sg Banun and USM
Date: May 2013 till March 2015

Steps to transform at-risk communities to disaster resilient communities	**Finding**
Site entry and rapport building - process whereby the facilitator establishes rapport and constructive relationship with the people. Mutual respect and trust are the key elements that characterize effective integration	25th May 2013 Dato' Dr Razha, an anthropologist is the key personnel who has an established rapport with the aborigines has been appointed as the facilitator.
Community situational analysis - the process of gathering all relevant data about the community such as physical characteristics, demographic features, economic and socio-political aspects of the community	Physical charactericistic: Clan- Jahai (semang and negritos), they mobilize themselves to places where they can hunt for food. Demographic features: No. of villages – 7 No. of families – 126 No of people – 610 Average in a family – 5 Economic and sosio – political aspects of the community – hunters
Identification of priority sector – the process of identifying the target groups or sector of the project or the most in need/most at risk.	Target group- those families living on the slope area, the aborigines, the Jahai, spread area of the 7 villages: 0.5km to 4km away from the east-west highway.
Identification of natural leaders or "progressive members" – the process of selecting natural leader or "progressive	7 has been identified : • ChenelengPilloi (Penghulu of KpgSgBainun)

members" of the identified priority group(s) or tapping existing structure/organization in the community. The core group serves as catalyst or prime mover in the formation of the group	• AnalehGagap: KpgKabel • Ali Bah PintudanEnjut : KpgSg. Raba • AndakLembut: Kpg Desa PermaidanKpgPangkalan • Alias
Feedback/validation of results of community situation analysis - the purpose is to inform the people about the whole situation of the community and to fill in the gaps	Oktober 2013- formulation of questionnaire took place with reference to Bloom Taxanomy by Dato Razha, Dr Zarina and Jai. Since Dato Razha himself is an anthropology and has been key informant for the whole situation analysis, his expert opinion is engaged to validate the questionnaire. As for the reliability, the analysis was excluded since mostly were"Yes" or "No" type of questions. (appendix 1) 18thDecember 2014 visited the community for the second time to gauge feedback. Spoke to the En Samsudin, the student welfare officer of RPS SK SgBanun. We were informed that the best manner to get to the community is through their children who are studying in the school. And the best time to hold any activity would be before the Kuam monetary assistance be given out which is normally around May each year.
Further analysis of priority problem/need/aspiration – the process whereby the community discuss and analyze their problem and transform it into community goals or aspirations	Baseline studies were conducted on 55 form 1 and 2 children from the school to generally gauge their understanding on landslide. These children can read and write with little knowledge on landslide. About 60% have heard about the landslide either from the Tokbatin or teacher. 100% knows how to identify the pictures for the landslide. Very few knows how landslide happens and what need to be done when it occurs.
Planning of the solution/action - the process whereby the community plan how to solve their problems	These 55 children will be exposed to a portal on landslide, 1 or 2 teachers has been identified to coach these children on how to maneuver through the portal and bring back the knowledge to their families.
Organization of the group – the role and responsibility of each member vis-à-vis the community activities and tasks are identified and agreed upon. Skills improvement is provided to the Community organization and	JabatanKemajuan Orang Asli (JAKOA) - En Samsudin will be the liason for the orang asli community via village head, TokBatin Head of village- Tokbatin will be the person to convince the community.

they are encouraged to forge links with other institutions.	Teacher/s - Cikgu Ismail and CikguIzral will be engaged to coach these children. Students will be sharing their knowledge with their families and friends. Selected parents who are keen will be enganged to communicate and educate TokBatin Eventually TokBatin ,ChenelengPilloi, will hold the responsibility to sustain the e-participatory engagement among his community.
The process and requisites for disaster risk reduction:	Focus group, interviews, and training and quatitative analysis
Initiating the process - linkage and building rapport with community	TokBatin: • ChenelengPilloi (Penghulu of KpgSgBainun) • AnalehGagap: KpgKabel • Ali Bah PintudanEnjut : KpgSg. Raba • AndakLembut: Kpg Desa PermaidanKpgPangkalan Jabatan Kemajuan Orang Asli (JAKOA) - En Samsudin RPS SK Banun- the Headmaster Cikgu Amri
Community Profiling - initial understanding of disaster situation and orientation on CBDM and CBDMit	RPS SK Banun and 89 students living in the slope area in USM were chosen for comparison.
Community Risk Assessment – participatory assessment of hazards, vulnerabilities, capacities and people's perception of risks	Overview of the visit to RPS SgBanun Arrived at RPS SK Banun at about 10.30am on a Wednesday morning of 9th April 2014. Briefed the headmaster, CikguAmri on the activity for the day. Respondents were selected randomly from a total of 75 form 1 and form 2 students by Cikgu Ismail who has been the informant for the project ; 20 students (2 from form 2 and 18 from form 1) and 12 teachers . The survey was held in a manner of focus groups in two different slots. Each slot approximately took about 20mins of video presentation followed by 40mins interview. The survey began with administration of questionnaires to gauge their general understanding on landslide. The respondents were then equally divided into 2 groups and placed separately in different rooms. One of the groups is then presented with a video on landslide for about 20mins and later a

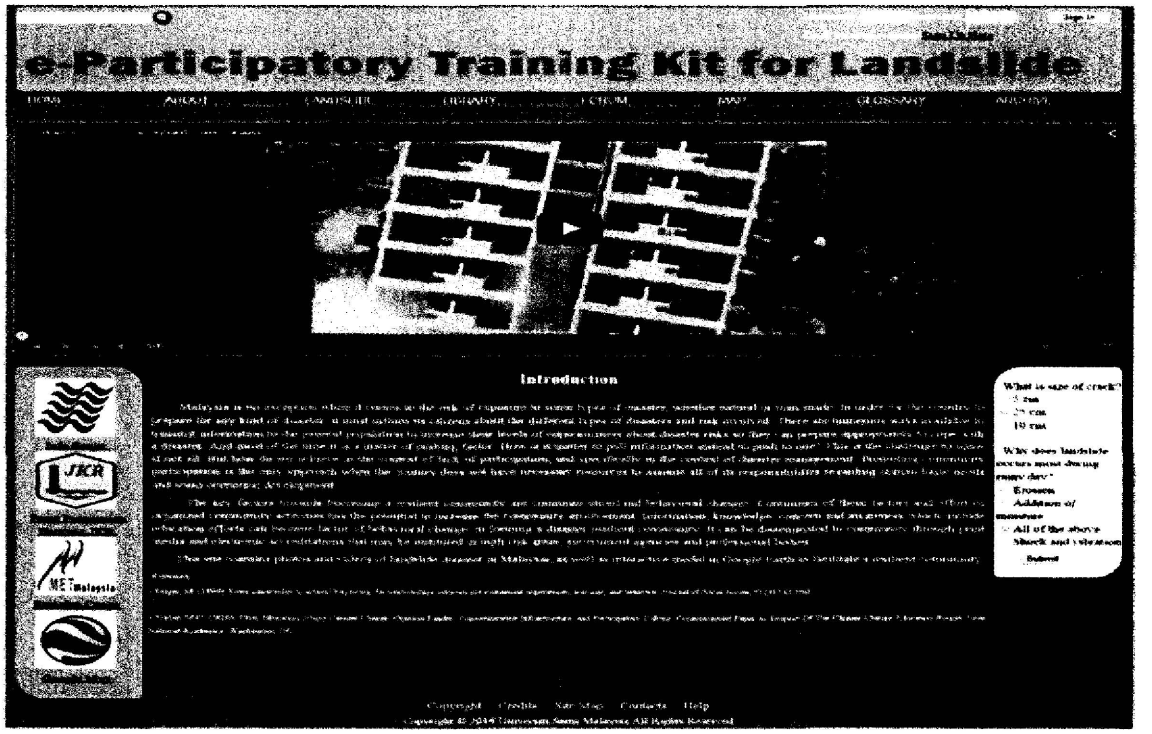
	group interview were conducted to further gauge their views and comments. The same were administered to the other group of respondents with an exclusion of the video presentation. There were total of 4 groups altogether that went through the process (student- 10:10, teachers- 6:6) The survey ended approximately at 3.00pm on the 9th April. At 5.pm further discussion were held among Dr Jamilah's team to conclude the findings. More kampung orang asli were visited the next day to get some insight of actual living conditions of the aborigines.
Formulation of Initial Disaster Risk Reduction Plan - identification of appropriate mitigation and preparedness measures including public awareness, training and education	A pilot study was conducted prior to the distribution of the questionnaire.A sample of 30 students was given the questionnaire during the pilot study. Upon the completion of the pilot study necessary amendment was made to validate the questionnaire with cronbach's alpha value of 0.797. The currently used epistemetric method may be considered as a "set of rules" by which the numbers (scores) or measurements are produced by using Likert scale - and thus to indicate level of agreement from 1 'Strongly disagree' to 5 'Strongly agreed' about the correctness to each statement of attitude, willingness to practice and knowledge. The pre-intervention questionnaire was distributed to 89 students living in the slope area in USM. The nature of questions in the questionnaire were tailored to ease the understandingon landslide as well as to capture the level of actual knowledge and the impact of intervention on their attitude and willingness to practiceamong studentsin the pre-intervention setting. This was the first phase of data collection. The second phase of this research was the intervention method. The studentswere given the exposure on how to navigate through the landslide portal. The portal has been incorporated with a forum platform to help the students to stay connected. It also linked to

	relevant departments whom are responsible to curb landslide and other disasters. Theywereasked to maneuver through the portal and gauge as much benefit as possible within the allocated time frame of 3 weeks from 21st January till 12 February 2015. They were also asked to use the interactive e-portal to discuss among themselves on the topic displayed in the module for preparedness and mitigation of landslide.
Formation of Community Disaster Response Organization - community organizing and mobilization, capability building in CBDMit and preparedness	The youth who took part in this study is hoped to form a disaster response community. And it is possible to create environmental scouts with these orang asli children if right tool and program is provided for them.
Implementation of short-, medium-, and long-term risk reduction measures, activities, projects and programs - implementation strategies and mechanisms; organizational/institutional strengthening	Short-term: learning landslide disaster preparedness and mitigation through portal Medium-term: e-participation among school students to prepare and mitigate landslide disaster Long-term: To form an e-participatory community among the aborigines.
Monitoring and Evaluation continuous improvement of disaster risk reduction plan, documentation and dissemination of good practices for replication	Requires tools and ongoing program to create a disaster resilient community

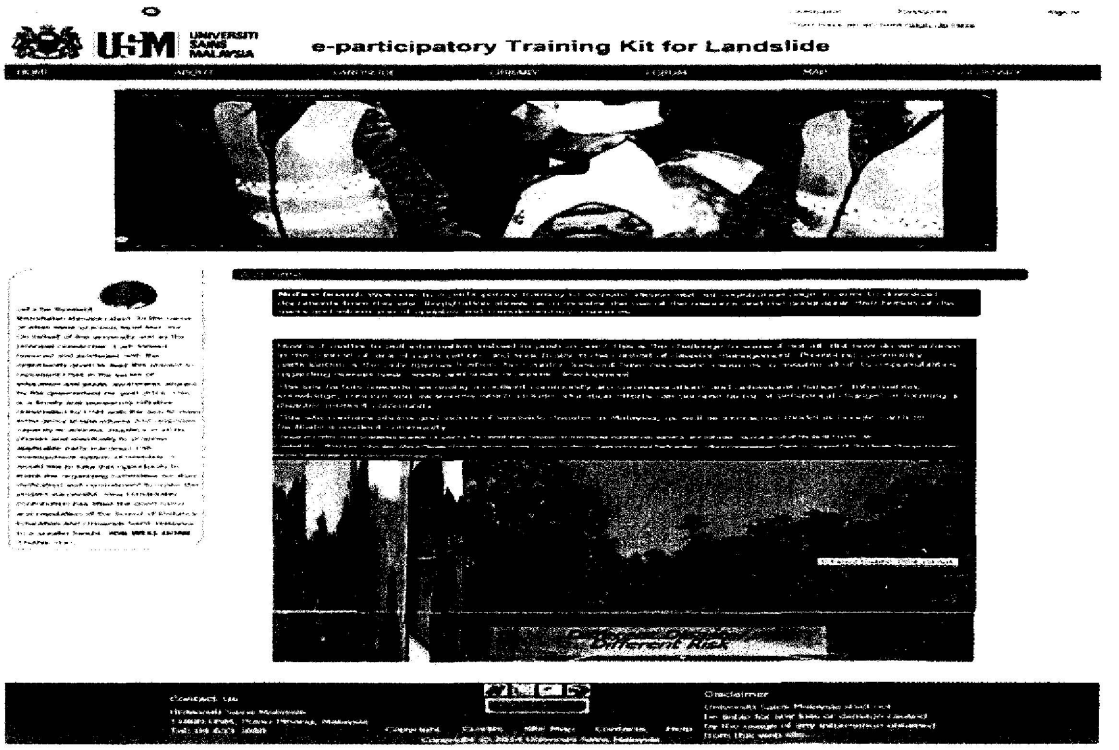
Results

The Homepage has been improved based upon feedbacks received during training, on the feasibility and content through 4 different versions;

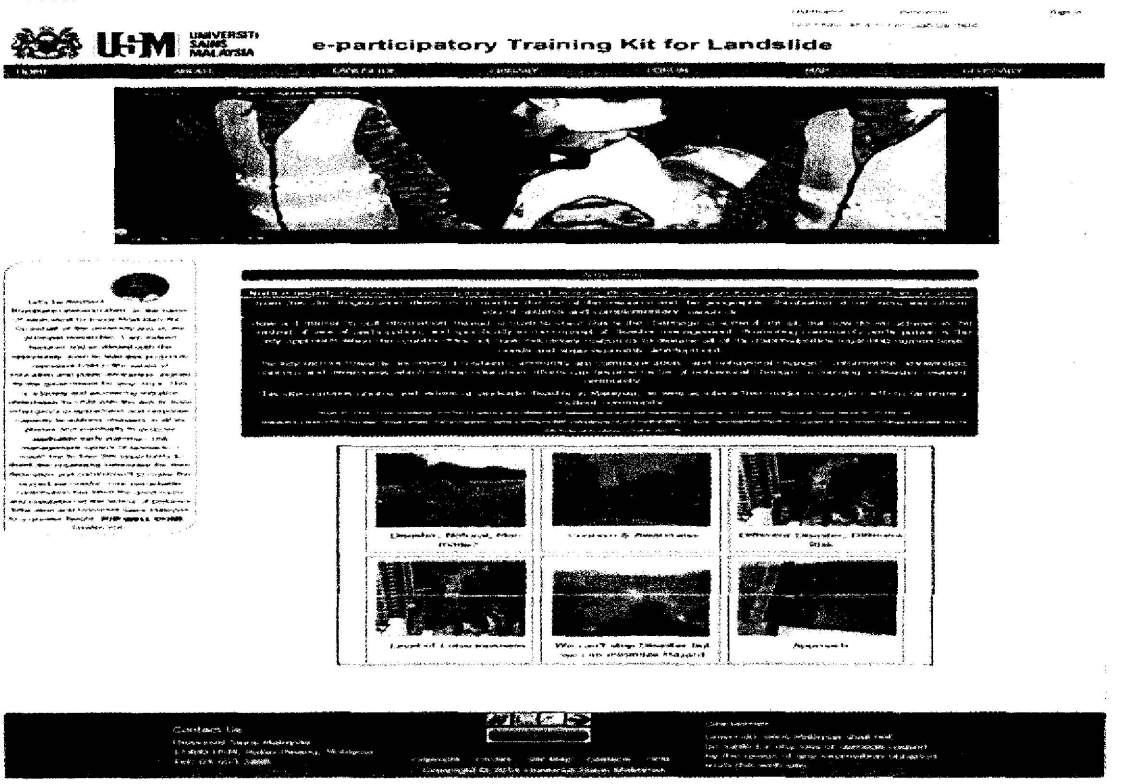
Version 1



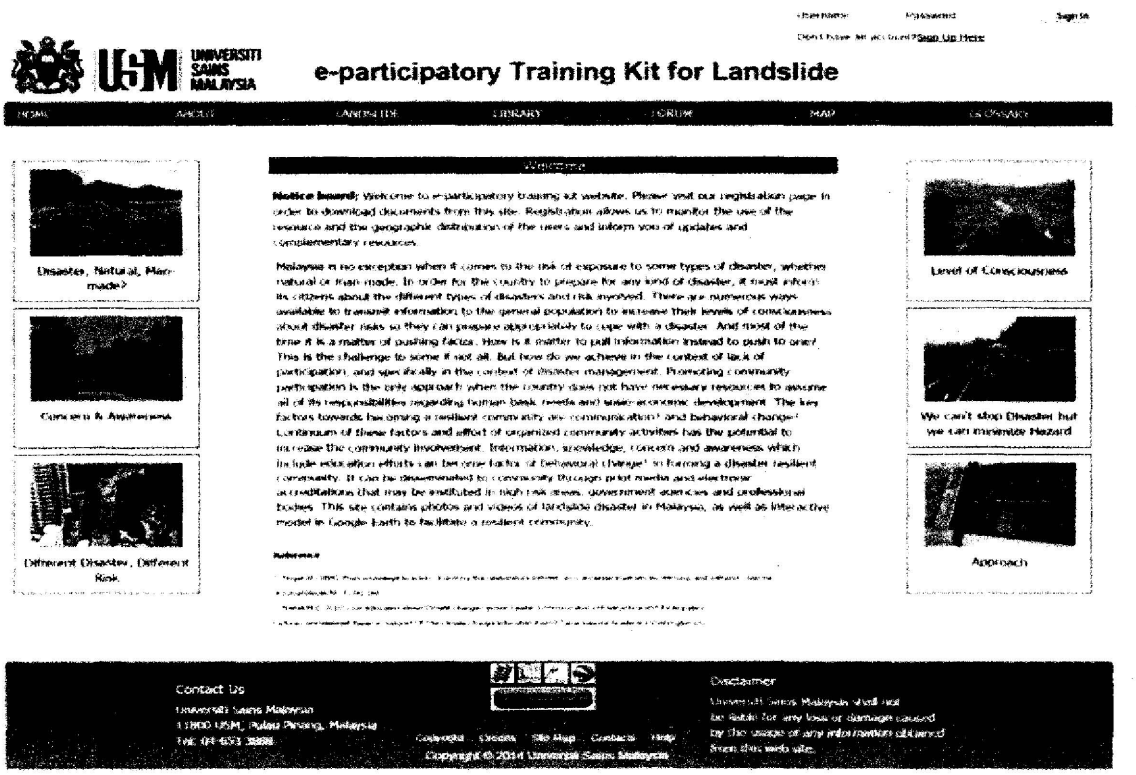
Version 2



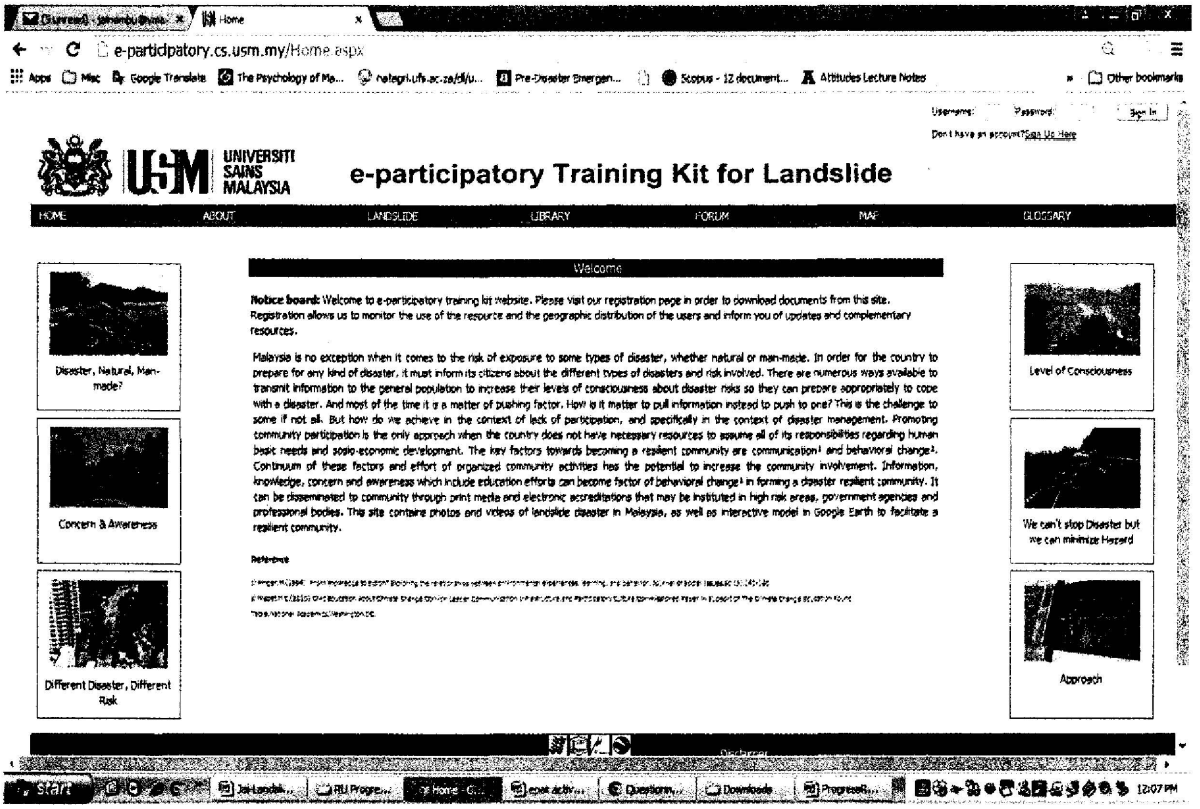
Version 3

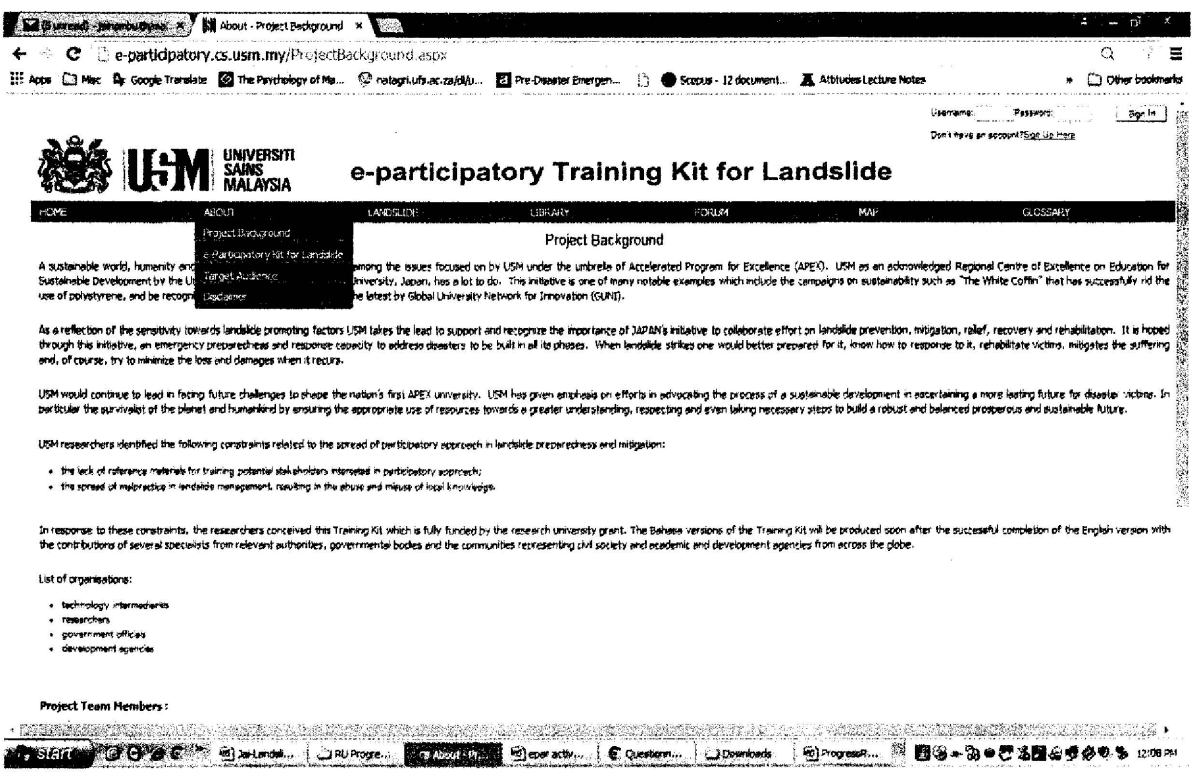


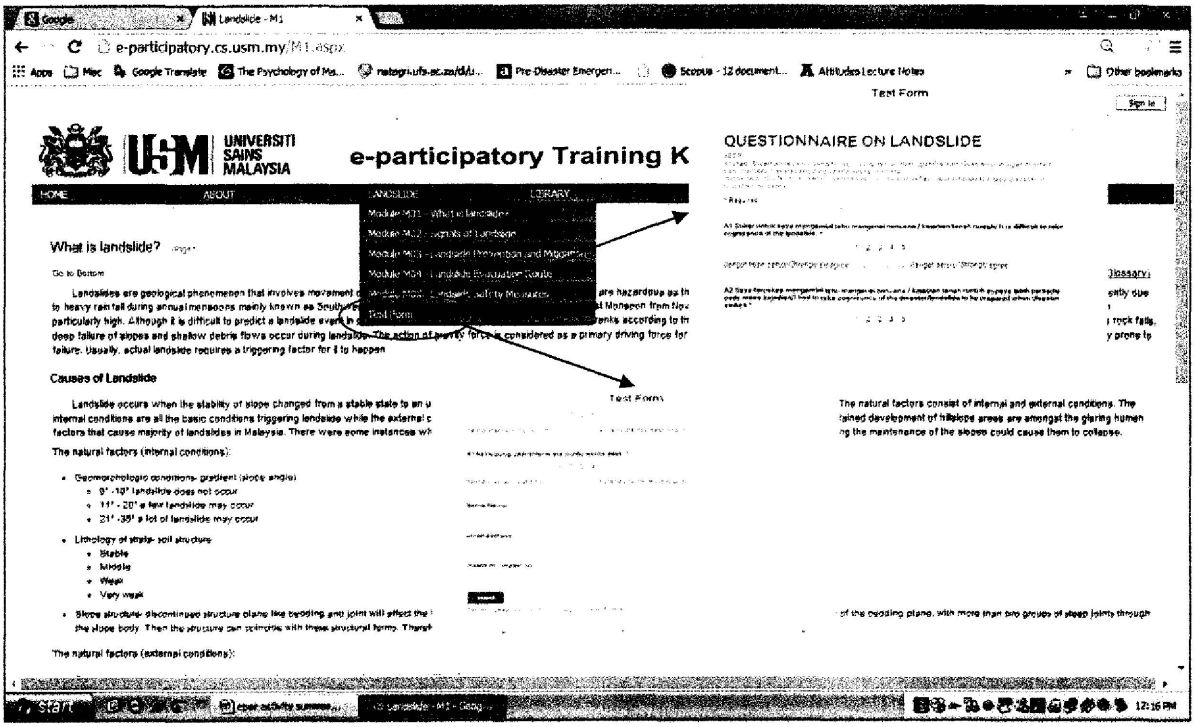
Version 4



Print Screen of Version 4(Final)



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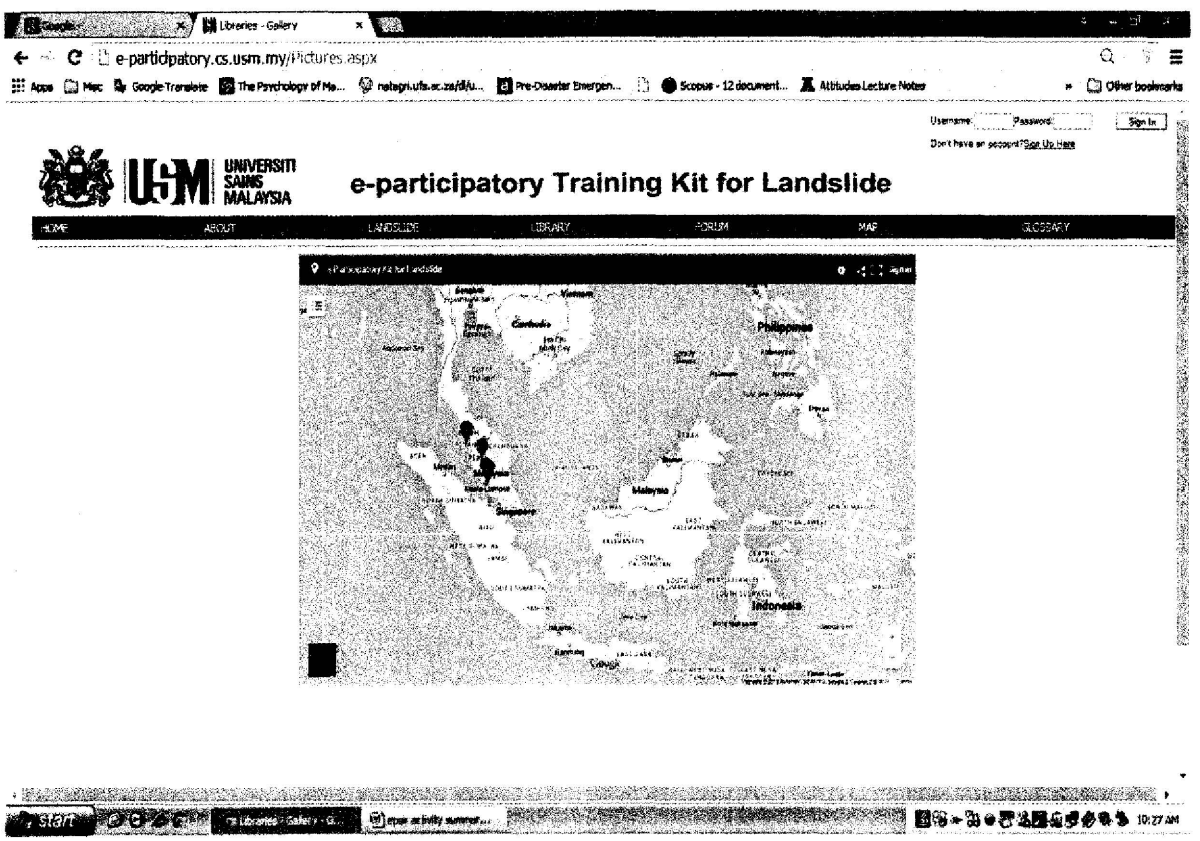
UNIVERSITI SAINS MALAYSIA
e-participatory Training K
HOME
ABOUT
LANDSLIDE
LIBRARY
Module M01 - What is landslide?
Module M02 - Causes of Landslide
Module M03 - Landslide Prevention and Mitigation
Module M04 - Landslide Evaluation Toolkit
Module M05 - Landslide Safety Measures
Test Form
What is landslide?
Causes of Landslide
The natural factors (internal conditions):
The natural factors (external conditions):
Test Form
QUESTIONNAIRE ON LANDSLIDE
Glossary:
The natural factors consist of internal and external conditions. The
ng the maintenance of the slopes could cause them to collapse.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e-participatory Training Kit for Landslide
HOME
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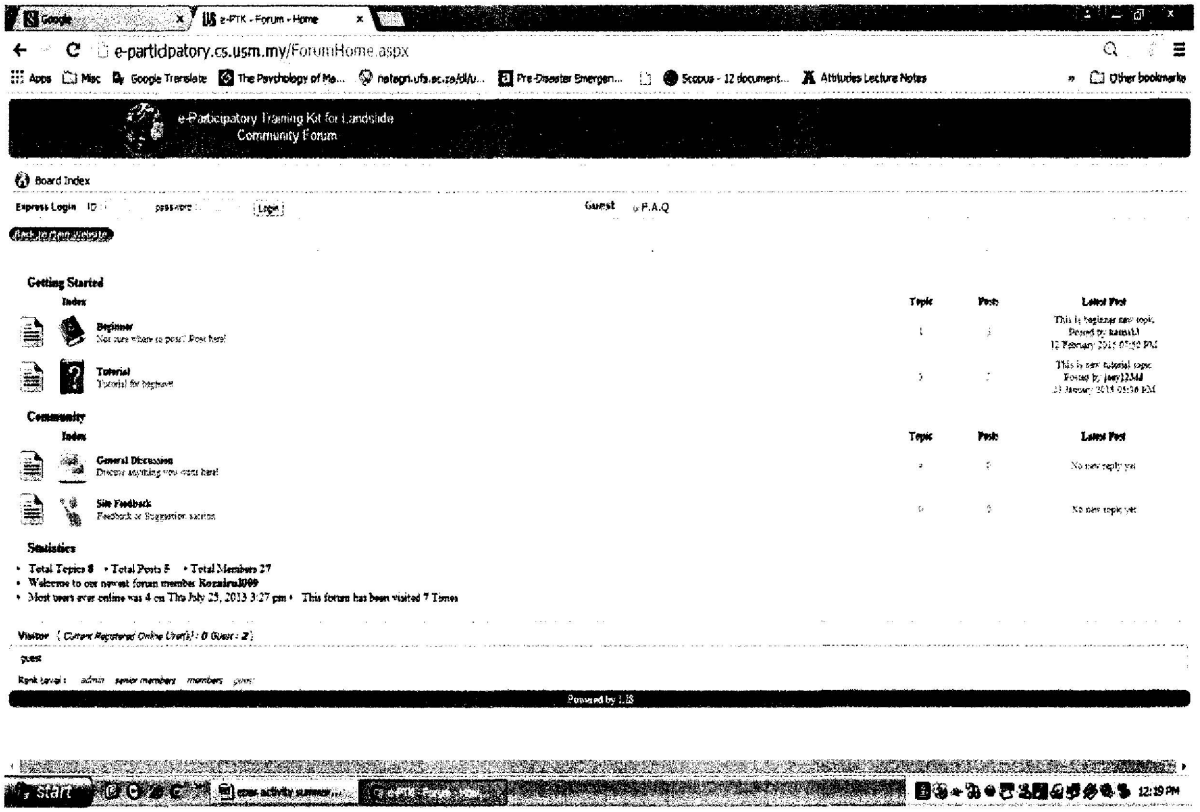
GLOSSARY
Vietnam
Cambodia
Philippines
Malaysia
Singapore
Indonesia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e-Participatory Training Kit for Landslide
Community Forum
Board Index
Express Login
Guest
F.A.Q
Getting Started
Index
Topic
Post
Latest Post
Beginner
Tutorial
Community
General Discussion
Site Feedback
Statistics
Total Topics 8 • Total Posts 5 • Total Members 27
Welcome to our newest forum member, Rozaimal009
Most users ever online was 4 on Thu July 25, 2013 3:27 pm • This forum has been visited 7 Times
Visitor (Current Registered Online User(s) : 0 Guest : 2)
guest
Powered by 1.18
start
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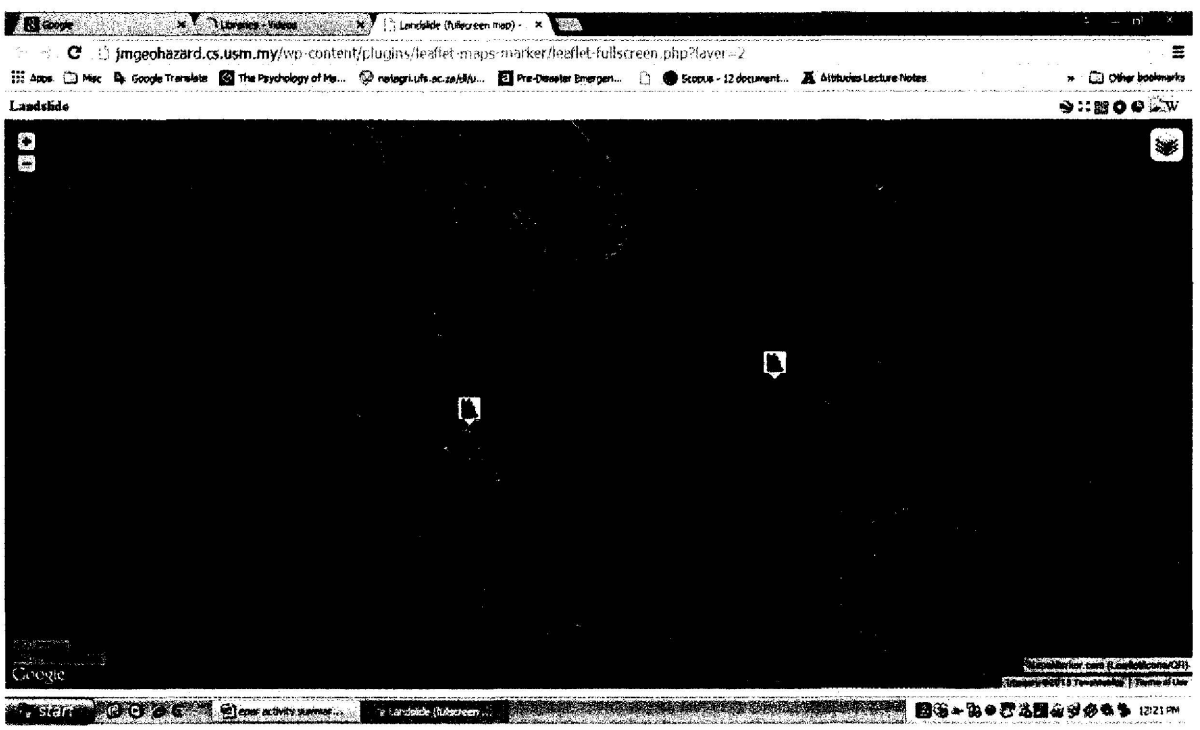
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Discussion

Upon completion of this research the findings support the objective stated in the previous section. The premise of this research is that, as consequence of learning occurs through e-participation, in this case, the students will later be able to practice and be willing to take some responsibility to curb landslide. This requires the students to acquire the necessary knowledge, skills and attitudes, retain the learned material until a later time when it will be retrieved and used to make decision, select and execute actions.

As such, the e-participatory platform facilitates support for collaborative effort with tools enabling joint fact finding, a deliberative process where public and experts work together to determine the following: what they do not know; what they need to know in order to make an informed decision; and how they are going to learn together. This process is similar to participatory communication because both involve the combination of expert and public knowledge and information. This duality has mooted the retention of learned materials to reach the real environment which remains an important challenge.

Questions asked to ascertain the agreed response on attitude were designed in negative statements such as *,'It is difficult to take cognizance of the landslide', 'I had to take cognizance of the disaster/landslide to be prepared when disaster strikes',' I am not ready to take cognizance of the disaster/landslide' and so forth.* The students' attitudes towards landslide were tested based on these questions. They understood and more importantly intrigued to stay on and participate through the final phase of intervention. In addition, these statements became especially useful in obtaining valuable information from these students. It helped to have a better understanding on situations on what information was most useful to provide insight on the students being studied.

In term of the most effective communication tool to deliver landslides information to Orang Asli, newspaper and television are the best tools to serve this purpose. This is due to the reason that newspaper and television are more attractive, enjoyable and flexible compared to the other communication tools.

Conclusion and Suggestion

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The finding revealed clear evidence on the part of portal intervention on landslide knowledge among students. The intervention as such, improved knowledge on landslides along with the attitude and willingness to practice among students. However, attitude and willingness to practice differ among female and male students. This could be due to their social background, experience to disaster, or even the locality they live in. Though the intervention affects the attitude and practice of landslides among students in a positive way, it is important to determine evidence that the acquired knowledge has been put into practice. Since this research only focuses on the intervention of e-participatory portal with no actual events taking place, it is difficult to quantify the changes observed in attitude and practice. Based on the result, it is recommended that evaluation about behaviour changes in students be conducted through routine online observation to determine habits in the manner of practice. More data need to be accumulated, and there is definite need to focus primarily on the transformation of students to become more resilient rather being reactive.

Hence this research also found that newspapers and television are the most effective communication tools to deliver landslides information to Orang Asli. This is based on their

experience in getting landslides information through a variety of communication tools like newspaper, television, radio and books. Newspapers and television are also accessible to them and they also believe that the information disseminated through these tools are reliable can be trusted. However, it is also important to note that there are also Orang Asli communities in Malaysia who still do not have access to newspapers and television due to their remote locations in the forest and rural areas. For these communities, a study needs to be carried out to find the most effective way to communicate landslides information to them

Acknowledgements

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RESEARCH OUTPUT

Bangladesh J. Bot. 43(2): 141-145, 2014 (September)

ROOT DISTRIBUTION OF *ACACIA MANGIUM* WILLD. AND *MACARANGA TANARIUS* L. OF RAINFOREST

NAZI AVANI*, HABIBAH LATEH AND GHASSEM HABIBI BIBALANI[1]

School of Distance Education, Universiti Sains Malaysia, P. Pinang

Key words: Root distribution, Fine roots, *Acacia mangium*, *Macaranga tanarius*, Rainforest

Abstract

The number of roots and root area ratio (RAR) decreased with depth in *Acacia mangium* and *Macaranga tanarius* and the maximum value of RAR and root number were observed in the first layer of soil. This process was regular in *Acacia mangium* Willd., but the RAR value showed great variability in *Macaranga tanarius* L. as the RAR decreased with depth until the second layer (20 cm) and increased again. About 35% of all roots in *A. mangium*, and about 50% of all roots in *M. tanarius* are located in the first layer. About 87% of all roots were in the fine root diameter class (d < 2 mm) in *M. tanarius* species. However 90% of all roots were in the fine root diameter class in *A. magnium* species. Fine roots contribution to soil reinforcement due to concentration on upper levels, prevent surface erosion and shallow landslide. These results will be useful for slope stability projects.

Introduction

Root area ratio (RAR) or index of root area is an amount of rotting mass in a soil. (Bischetti *et al.* 2005). Compared to tensile strength, the root area ratio was significantly more important in soil shear resistance. Docker and Hubble (2008) mentioned that there is a correlation between the amount of RAR and increased shear resistance. The root area index is defined by measuring the number of roots in different diameter classes in cross-sectional area of soil exposed on a vertical face of soil (De Baets *et al.* 2008).

Root distribution of three hardwood species in northern of Iran was compared by Abdi *et al.* (2010a). The number of roots and root area ratio (RAR) decreased with depth, but the number of roots showed the regular pattern of decrease with depth compared to RAR. This is because of the presence of large roots, that RAR values are very sensitive to this factor. Also, the results showed that in larger trees, anchorage occur by increasing in the growth of root diameters but not by increasing in the number of roots. Also in other research, the effect of two species on slope stability was investigated by Ji *et al.* (2012). There was a significant difference in mean RAR between the two species and the amount of RAR is higher in *Robinia pseudoacacia*, which were much bigger than *Platycladus orientalis*. For both the species maximum RAR values were located in the first 30 cm layer, and showed a decrease in the RAR values with depth.

The aim of this study is to compare the characteristic of the root system or root distribution in two species of tropical forests which is important for selecting species for erosion control and slope stability.

Material and Methods

The study area is located along east-west highway in Malaysia, which is one of the major roads in the northern part of Malaysia between N 05° 27′ 32.0″ E 101° 07′ 42.3″ and N 5° 42′ 11.15″ E 101° 49′ 54.74″. This highway links Gerik in Perak and Jeli in Kelantan with the length

*Author for correspondence: <avani.nazi@yahoo.com>. [1]Department of Forestry, Shabestar Branch, Islamic Azad University, Shabestar City, East Azerbaijan, Iran.

of 119 km. The climate is humid and an annual mean precipitation is about 1957.5 mm. The altitude is 283 meters above the sea. The type of soil is sandy, clay and loam and the lithology consist of Schist, phyllite, slate and limestone.

Macaranga tanarius L. is one of the species of Euphorbiaceae which occurs in disturbed rainforest areas. This pioneer species can tolerate in a wide range of soil type including clay, loam and sand. *Macaranga tanarius* is cultivated for ornament and reforestation projects in the tropical regions around the world. It is native to Malaysia and the average annual rainfall between 100 and 200 cm, and the average temperature between 10 and 20 degrees in January to over 20 degrees in July is suitable for its growing.

Acacia mangium Willd. fix nitrogen in the soil, which is useful for other plants, therefore cultivated in mixed cultures and for agroforestry projects (Jeyanny *et al.* 2011). Due to intensive rooting system of *A. mangium*, especially in poor soils (Kadir *et al.* 1998) this species cultivated in disturbed tropical regions.

The root distribution in the soil was analyzed by counting roots directly using a profile trench (Preti and Giadrossich 2009). At first, four trees of each species were selected. Then, under each species sample, one trench with 50 cm of length and depth with a distance about 25 cm from the stem was dug. In consequence, roots were counted in the separate 10 cm of soil layers. The average diameter (breast height) in Macaranga species was about 13 cm and that in *Acacia* species was 27 cm. The soil conditions were the same under the samples, but there was shallow bedrock under *Acacia* trees.

After that, a profile wall of trenches which close to tree stem were marked in every 10 cm thickness, then the number of roots was counted and divided in different root diameter classes i.e., 0 - 1, 1 - 2, 2 -5 , 5 - 10 and >10 mm (as the average root diameter in the root length). According to Ji *et al.* (2012) and Genet *et al.* (2008) roots belong in the first two ranges will classify as fine roots and the other second root diameter ranges consider as thin roots. Then the RAR percentage was calculated in each depth. The occupied area of roots in each layer was calculated by the following equation:

$$\text{Root area} = \sum_{i=1}^{n} \frac{\pi}{4} di^2$$

D_i, is the diameter of roots in each layer and root area is the area that occupied by roots in soil. Then the root area ratio (RAR) was calculated by the following equation:

$$\text{RAR} = \sum_{i=1}^{n} \frac{Ari}{A}$$

In this equation A_{ri} is the area that occupied by roots in each layer and A is the area of soil in each layer (Comino and Marengo 2010).

Statistical software of SPSS 20 was used to analyze data. RAR values from the two species were compared using paired-samples T tests. For assessing the best model between RAR and soil depth, various functions were tested, and the function that show not only the highest R^2 but also the lowest standard error was chosen as the best model. Spearman correlation was used to correlate the relation between RAR and soil depth.

Results and Discussion

The number of roots at each depth class showed a more systemic trend when compared with RAR values (Tables 1-4). The function between the number of roots and depth showed that

number of roots decreased with depth following a power law for *M. tanarius* (R^2 = 0.818, SE of estimate = 0.361), and following exponential for *A. mangium* (R^2 = 0.378, SE of estimate = 0.592). The amount of RAR values declined with depth following exponential for *A. mangium* (R^2 = 0.536, SE of estimate = 0.975), and for *M. tanarius* following by S (R^2 =0.138, SE of estimate = 1.141).

T tests result showed that there is not a significant difference in the percentage of RAR ($F = 0.283$, $p > 0.05$) and root numbers ($F = 0.040$, $p > 0.05$) between two species.

Table 1. Distribution of number of roots at different soil depth in *Macaranga tanarius*.

Soil depth (cm)	Number of roots at different root diameter classes				
	0-1 (mm)	1-2 (mm)	2-5 (mm)	5-10 (mm)	>10 (mm)
10	185	64	10	6	3
20	81	24	4	1	0
30	39	19	15	0	0
40	26	9	11	1	0
50	14	9	6	7	0

Table 2. Distribution number of roots in soil depth in *Acacia mangium*.

Soil depth (cm)	Number of roots at different root diameter classes				
	0-1 (mm)	1-2 (mm)	2-5 (mm)	5-10 (mm)	>10 (mm)
10	145	57	29	3	3
20	95	44	9	1	1
30	85	25	7	0	0
40	71	17	1	0	0
50	57	11	5	0	0

Table 3 shows the percentage of RAR in each diameter class in two species. As recognized with the table about 72% of all roots in *A. mangium* are located in the diameter root classes with less than 10 mm and this amount is about 85% for *M. tanarius*.

Table 3. Percentage of different root classes to RAR values.

Species	% of RAR at different root diameter				
	0-1 mm	1-2 mm	2-5 mm	5-10 mm	>10 mm
A. mangium	6.32	18.24	34.91	12.57	27.94
M. tanarius	4.05	13.19	26.44	42.23	14.08

By comparing RAR values in fine roots ($d < 2$ mm) and thin roots ($2 < d < 10$ mm), in *A. mangium*, fine roots and thin roots decline with depth regularly, but there is an exception in the root diameter classes of 2 - 5 mm in the 50 cm soil depth (Table 4).

The highest RAR value was in the 2 - 5 mm root diameter class and the lowest RAR value were in the first layer in *A. mangium* (34.91, 6.32%, respectively) (Table 3).

There was a wide variety in the RAR distribution in the root diameter classes of 2 - 5 and 5 - 10 mm in *M. tanarius*. As in the diameter class of 2 - 5 mm, the amount of RAR decreased until

the second layer, then increased again until the last layer. This process repeated in the root diameter classes of 5 - 10 mm, at the first the amount of RAR decreased until 30 cm soil depth and then again increased. The largest value of RAR was in the 5 - 10 mm root diameter classes and the lowest was in the first layer (42.23, 4.05 respectively) (Tables 5 and 3).

Table 4. Contribution RAR values in per cent in different size classes at each depth (n = 4 replications) in *A. mangium.*

Soil depth (cm)	Root diameter (mm)				
	0-1 (mm)	1-2 (mm)	2-5 (mm)	5-10 (mm)	>10 (mm)
	% RAR values				
10	2.02	7.16	19.85	9.43	16.76
20	1.32	5.53	6.16	3.14	11.17
30	1.18	3.14	4.79	0	0
40	0.99	1.57	0.68	0	0
50	0.79	0.82	3.42	0	0

Table 5. Contribution RAR values in per cent in different size classes at each depth (n = 4 replications) in *M. tanneries,*

Soil depth (cm)	Root diameter				
	0-1 (mm)	1-2 (mm)	2-5 (mm)	5-10 (mm)	>10 (mm)
	% RAR Values				
10	2.17	6.75	5.75	15.84	14.08
20	0.95	2.53	2.30	2.64	0
30	0.45	2.01	8.62	0	0
40	0.31	0.95	6.32	5.28	0
50	0.16	0.95	3.45	18.48	0

The results indicated that more than 75% of all roots are smaller than 10 mm in diameter. Also Abdi *et al.* (2010b) mentioned that about 60% of the roots are smaller than 10 mm of root diameter. Some authors (De Baets *et al.* 2008, Abdi *et al.* 2010a, Chiaradia *et al.* 2012) considered these roots in soil reinforcement, but the other authors such as Styczen and Morgan (1995) indicated that roots 1 - 20 mm in diameter have the most important role in soil reinforcement.

The root area ratio is an important key for understanding about soil reinforcement by roots as an important factor in soil bioengineering. Therefore, for upgrading the knowledge about the effect of vegetation on slope stability, root area ratio data are useful for this kind of studies.

Acknowledgement

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(Manuscript received on 18 June, 2013; revised on 27 February, 2014)

Effect of *Acacia mangium* root properties on shallow landslide and slope stability

Habibah Lateh
School of Distance Education, Universiti Sains Malaysia, P.Pinang
E- mail: habibah@usm.my

Nazi Avani, Ghasem Habibi Bibalani
School of Distance Education, Universiti Sains Malaysia, P.Pinang
Shabestar Branch, Islamic Azad University, Shabestar City, East Azerbayjan, Iran
E- mail: Avani.nazi@yahoo.com ; Habibibibalani@gmail.com

Abstract

The aim of this paper is to study the influence of *Acacia mangium* on slope stability in forest area with some landslide failure. There are a lot of shallow landslides on the East-West highway in Penang, Malaysia. In this study, root distribution of four samples of *Acacia mangium* was studied in rainforest, Perak, Malaysia, with the purpose to raise our knowledge on RAR (the proportion between the area occupied by roots in a slice area of roots) relevant to depth. Trenching method was used to investigate RAR, and then in each 10 cm layer the number of roots in each root diameter classes was counted. Results indicate that the root area ratio (RAR) decrease with depth, and the highest amount of RAR is located in the first layer. Also, about 35% of roots located in the first 10 cm layer and about 90% of all roots were in the fine diameter root class ($d < 2\,mm$). There is a significant difference between RAR and depth in 0.05 levels. The number of fine roots ($d < 2mm$) is more than the number of thin roots ($2 < d < 10mm$), but the amount of RAR is more in the thin roots. Therefore RAR is more affected by thin roots rather than fine roots. The results develop the knowledge about bioengineering characteristic of root systems of tropical species.

Keywords: RAR (Root Area Ratio), slope stability, shallow landslide, *Acacia mangium*, Perak

I. Introduction

Shallow landslides and slope failure are serious problems around the world, including in Malaysia, where bare soils are assailable to failure through intensive rainstorms [1]. The occurrence of shallow landslide in Malaysia is partly because of non-seasonal and high rainfall. For example in the East-West Highway, which is one of the major road in the northern part of Peninsular Malaysia there are some shallow landslide "Fig. 1". Recently, for preventing natural and man-made hazards, eco-engineering strategies have been defined to manage a site [2].

Plants protect the surface from rain plash and their roots help to bind the soil [3]. When an area of a slope is cleared of vegetation, there is a gradual decline in soil strength due to root decay over time and the loss of evapotranspiration effects [4]. Intrinsically, defined type of plants is better suited than others for specific stabilization objectives [2]. Along a potential slip surface, vegetation (trees) depending on their location, can however prevent or promote slope stability.

Root systems have two principal functions: procuration based resources from the soil and the provision of stability to maintain the plant upright structure. For these functions both fine and coarse roots contribute in their own way. For this purpose, fine roots absorb based resources from the soil and resources are transported to the shoots by coarse roots. Mainly, coarse roots provided stability. The differentiation in coarse, fine roots and woody roots is mainly based on their diameter [5]. "Ref. [6]" stated that "a large number of small roots will contribute more to soil reinforcement as compared to a small number of thick roots".

The roots are strong in tension, while soils, on the other hand, are weak in tension, and strong in compression. Soil reinforcement is a combined effect of soil and roots. When shearing the soil, because of shear stresses that develop in the soil, roots mobilize their tensile strength in the soil matrix and then shear stresses are transferred to the tensile resistance of the roots or via root along [6].

It has been defined that there is a near connection of root system resistance instant with the root number, in addition to the changes in diameter and root angle [7]. Roots can extend between 10-20% before breaking whereas soil can stretch less than 2% before breaking [8]. It is commonly accepted that roots are strong in tension but fragile in compression [1][6]. Conversely, soil is strong in compression but fragile in tension [1][6][9], provided that actually a key reinforcement to landslide prone in slopes. Thus the existence of roots in the soil creates a reinforced matrix in which stress is moved to the roots through the loading of the soil in a way that is parallel to the reinforcement of concrete structures by steel and fiberglass [1][10].

Many research showed that the higher tensile strength is produced by the finer roots [6][11]. Therefore, a large number of fine roots would fix the soil more efficiently

than a small number of coarse roots. During slope failure, fine roots tend to break but stay in their position in the soil particles, whereas coarse roots tend to slip out of the soil [12]. Root density and tensile strength are the most important keys for analyzing root-soil assessment, and also for soil erosion control projects [1].

Soil shear strength increases linearly with increasing soil mass. Plant roots play an important role in stabilization of slopes and erosion control [12].

Root Area Ratio (RAR) has been used as an indicator of root density by several authors [1][13][6][7]. "Ref.[14]" mentioned that reinforcement may be resulting from an upsurge in the Root Area Ratio at the shear plane.

Root Area Ratio has been reported by a lot of authors as a part of slope stability in their research. "Ref. [15]" Investigate root distribution and root area ratio on some of species in Southern Alps, France. The results showed that the number of roots decreased with depth and in the upper 200 mm of soil surface the largest part of root system biomass was observed. Also RAR values decreased with depth regarding rooting depth, as for shrubby plant (*Genista cinerea*) the amount of RAR in the soil surface was 0.053% and at 60 cm soil depth, it declined to 0%, while RAR for *Pinus nigra* reached 0.015% at the soil surface and 0% at a depth of 40 cm. "Ref [16]" showed that the amount of RAR declined with depth in some of forest species in the Italian Alps.

"Ref. [17]" investigated RAR values in different two species on slopes on semiarid Plateau of China. The results showed that the value of RAR in *Robinia pseudoacacia* stands was higher than the amount of RAR in *Platycladus orientalis* stands, and also the amount of RAR decreased with soil depth and the distance from tree stem.

In the present study, the effect of the other root properties such as root architecture not considered as it was not the study objective.

One of the limiting factors in the use of technology of environmental engineering is lack of knowledge about the characteristic of the root systems. Upgrading the knowledge about root systems such as root distribution which is the important key in soil reinforcement, can be useful for selecting plants in soil erosion control projects.

The main purpose of this research is to study the effect of *Acacia mangium* on slope stability, and also investigate the root area ratio as a function of root reinforcement on shallow landslide and slope stability in one of the important highways in Malaysia.

II. Material and Methods

A. Study area

The study area is located on the East-West Highway. This is one of the major roads in the northern part of Peninsular Malaysia between N 05° 27′ 32.0″ E 101° 07′ 42.3″ to N 5° 42′ 11.15″ E 101° 49′ 54.74″. The length of the highway is about 119 km and links two districts namely Gerik in Perak and Jeli in Kelantan. The climate of the study area is humid and an annual mean precipitation is about 1957.5 mm. The altitude is 283 meter above the sea. The type of soil is sandy, clay and loam and the lithology consist of Schist, phyllite, slate and limestone.

Acacia mangium is a fast growing species [18][19][20] with annual wood production by 17-20 m^3 ha^{-1} $year^{-1}$ during a period of 10-12 years [19]. This species is used in Agroforestry project because it is from Fabaceae family and it is able to fix nitrogen in the soil, and the other plants can profit of the nitrogen fixation [21]. Due to *Acacia mangium* tolerate different kind of soils and also can grow on a low fertility soils, it cultivate in mixed cultures. *Acacia mangium* produce and develop intensive rooting systems, especially in low fertility soils [22] and help to improve despicable tropical sites [20].

B. Sampling method, collecting and analyzing the data

Root area ratio or index of root area is an amount of rotting mass in a soil [16]. Root area index is defined by measuring the number of roots in different diameter classes in cross-sectional area of soil exposed on a vertical face of soil [6].

In this study, trenching method was used to analyze root distribution. Four trees with the average 27 cm in Diameter Breast Height (DBH), and also the distance between samples was about 3 meter was selected. The soil condition in the samples was the same, then at each tree, one trench was dug at a distance of 25 cm from the stem and the profiles were 50 cm long×50 cm depth [17] "Fig. 2".

Then, on the vertical profile walls, layers of 10 cm thick were separated, and roots to be counted in different root diameter classes by digital caliper [23], i.e., 0-1, 1-2, 2-5, 5-10 mm and >10 mm. The two first gropes will classify as fine roots, and the two second ranges being presented thin roots. After that the amount of RAR distribution with soil depth for all the root diameter classes was considered.

The RAR is the sum of roots area in the profile wall, Ai divided by a ratio of soil area, A_w [24].

$$\frac{Ai}{Aw} = \frac{\sum ni\ ai}{Aw} \qquad (1)$$

Where ni is the number of roots in size-class i and ai is the average roots area in the class i (mid-point diameter of each size-class should be calculated).

Area of roots was calculated by:

$$\text{Root Area} = \sum_{i=1}^{n} \left(\frac{\pi}{4}.d_i^2\right) \qquad (2)$$

Where di is the diameter of the ith root in millimeters [1].

ANOVA was used for analyzing the RAR values between soil depth and root diameter classes, also curve estimation was used to investigate existence mathematical function between RAR and soil depth. The software SPSS 20 was used for analyzing the data.

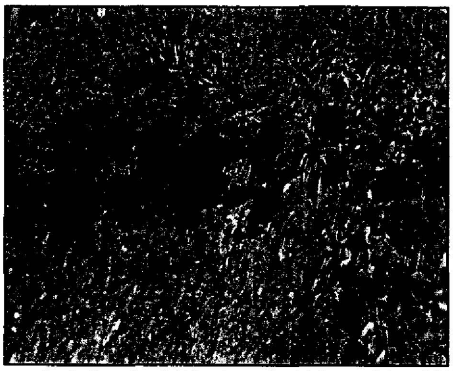

Figure 1: shallow landslide along the highway (Dec. 2012)

Figure 2: sample of trenching profile

III. Results

The amount of RAR shows variability with depth. Totally RAR values decrease with depth. Generally the maximum RAR values are located in the first layers. The minimum and maximum RAR values are 0.68% and 19.85% in the root diameter 2-5 mm "Table 1". Some mathematical functions to be used for analyzing the function between RAR and soil depth, where not only the highest R square ($p < 0.05$), but also a low standard error of estimation, then exponential is accepted "Table 2; Fig.7". Also for investigating the correlation between RAR and soil depth, Spearman correlation was used. The result shows that there is a significant correlation between RAR and soil depth ($F = 3.790; P < 0.05; ANOVA$).

The results indicated that the number of roots decline with depth regarding to the root diameter classes "Fig. 3". The RAR values show a great difference in soil depth and roots with diameter 2-5 mm were generally responsible for the highest amount of contribution to RAR values "Table 1; Fig. 4".

The RAR value in fine roots ($d < 2\ mm$) and thin roots ($2 < d < 10\ mm$) decline with depth regularly, but in the diameter 2-5 mm, the RAR values decline on to the 40 cm and after that increase again. Regarding to the root diameter classes, the highest RAR value was in the diameter class of 2-5 mm and the lowest RAR values belong to the size class of 0-1 mm (34.91%, 6. 32% respectively).

The results indicate that the number of fine roots is more than the number of thin roots, but the amount of RAR is much more in the thin roots rather than fine roots.

The overall trend between RAR percentage and soil depth was shown in the "Fig. 6". One way ANOVA was used to analyze relationship between RAR and soil depth. The results show that there is significant difference between RAR and soil depth. Multiply comparisons were done by Tukey, and the results show that the significant differences are between the first layer (10 cm) and the 40 cm and the last layer, and there are not significant differences between the other layers.

Table 1: contribution RAR values in percent in different size classes at each depth (n= 4 replication)

Depth (cm)	Root Diameter classes (mm)				
	0-1	1-2	2-5	5-10	>10
10	2.02	7.16	19.85	9.43	16.76
20	1.32	5.53	6.16	3.14	11.17
30	1.18	3.14	4.79	0	0
40	0.99	1.57	0.68	0	0
50	0.79	0.82	3.42	0	0

Table 2: Model summary for mathematical functions between RAR and soil depth

Model	R square	Adjusted R square	Std. error of the estimation
Logarithmic	0.467	0.446	5.272
Inverse	0.492	0.464	5.190
Quadratic	0.509	0.444	5.282
Cubic	0.502	0.409	5.447
Compound	0.536	0.510	0.975
Power	0.557	0.532	0.953
S	0.506	0.497	1.006
Growth	0.536	0.510	0.975
Exponential	0.536	0.510	0.975

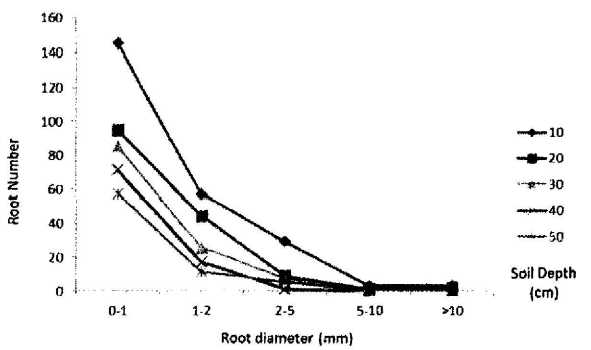

Figure 3: the number of roots with depth

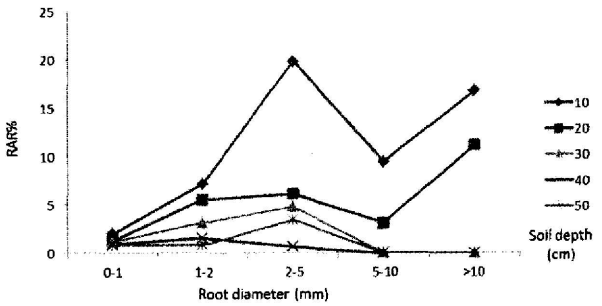

Figure 4: The distribution of RAR% in root classes and soil depth

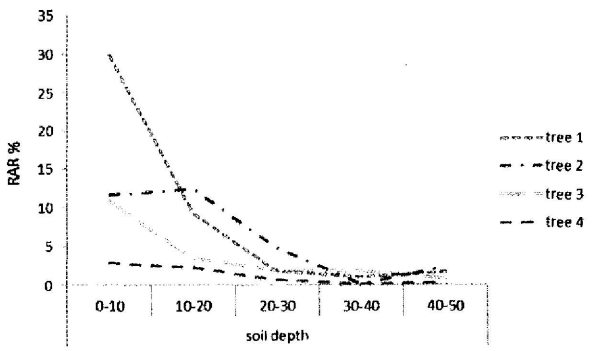

Figure 5: The distribution of RAR value in soil depth regarding to the samples

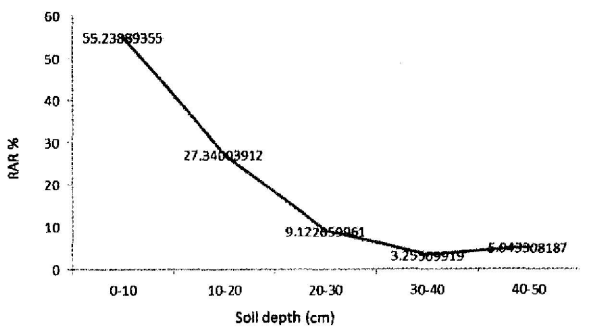

Figure 6: decline RAR % in soil depth

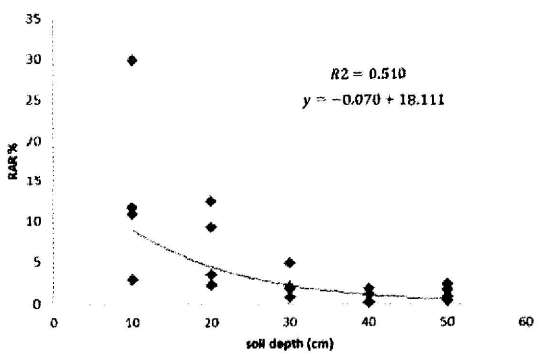

Figure 7: Exponential regression curve of RAR% vs. soil depth

IV. Discussion and Conclusion

Soil reinforcement due to the roots is influenced by numerous variables, including root systems such as root distribution with depth, root distribution over different root diameter classes and root tensile strength [6][15][14][25][7]. Root reinforcement is a function of root strength and root distribution within the soil and directly effect on slope stability. In comparing to tensile strength, the root area ratio was significantly more important in soil shear resistance.

The amount of RAR values are powerfully influenced by both local soil and climate characteristics and genetic [16]. The amount of RAR decline with depth in this study as the other author mentioned [1][6][16][17]. In the present study, there is a significant difference between RAR and soil depth in agreement the other researchers [15]. Because of decrease in aeration and nutrients with depth, and also the presence of bedrock in the lower layers, the amount of RAR values decline with depth [16]. The maximum RAR values were located in the first 10 cm layer, and an exponential function there is between RAR and soil depth. "Ref. [26]" mention that, Roots, in fact, tend to grow near the surface because of the richness of nutrients, water and gases. Nonetheless, plant roots can run very long in depth (meters below soil surface) if the above factors are limited in shallower layers, but their density dramatically decreases with depth.

The results also show that the number of roots decline with depth. The number of fine roots ($d < 2\ mm$) is higher than the number of thin roots ($2 < d < 10\ mm$), but the RAR value is more in the thin roots. Then root diameter rather than root number has much more influence on root area ratio [17].

About 90% of roots, in this study, belong to fine roots ($d < 2\ mm$). "Ref. [27]" mentioned the positive correlation between fine roots and soil reinforcement. There is a negative correlation between root tensile strength and root diameter which the highest tensile strength cause by fine roots [16][12], and tensile strength is one of the important key in soil reinforcement by root.

During slope defeat, the vegetation roots anchor the sliding bulk to prevent further movement. Then the presence of roots grips the soil against the sliding and shallow landslide. One of the parameter that shows how roots can grip the soil is root area ratio. In this study the maximum RAR values was 34% and the minimum RAR value was about 6% , while the maximum RAR value in "Ref [1]" was 6.64% and "Ref. [16]" got the maximum RAR of 0.35%. Also, "Ref [24]" mentioned that soil shear strength increases linearly with increasing root mass, and root reinforcement is a function of root distribution within the soil. RAR should be in the highest amount in the slip surface for slope stabilization [12].

Due to the number of shallow landslide that occurred in this area, there should be researches like this in the area for analyzing the capability of existence trees and vegetation in

the site for preventing shallow landslide and can be useful when selecting plant species for erosion control.

Acknowledgment

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Habibah Lateh

Associate Professor Dr. Habibah Hj Lateh is currently the Dean of School of Distance Education, Universiti Sains Malaysia. She graduated with honours from Universiti Sains Malaysia in 1984, obtained her masters from Western Michigan University, USA in 1986 and later earned her Ph.D in Geomorphology/Landslide from University of Bristol, United Kingdom under supervision of Prof M.G. Anderson. She was awarded the scholarship under ASTS from USM in 1984 and Commonwealth Academic Staff Fellowship, by The Commonwealth Scholarship Commission (The ACU-Association of Commonwealth Universities) and ASHES in 1993.

Dr. Habibah owns vast local and international experience in landslide research covering from site investigations, modeling, monitoring and human aspects on landslide. She has vast field experience in landslides research, soil erosion and slope stabilization study in Malaysia. Apart from landslide study, her research interest also includes Geographical Education, ICT in Distance Learning, Soil Erosion and Disaster Management. She had secured several national and international grants such as from Finland and Japan and project leader for many projects on landslide research. Additionally she had been working with researchers from different countries such as from National Institute of Earth Science and Disaster Prevention (NIED), Japan, VTT Technical Research Center of Finland, Espoo, University of Rajshahi, Bangladesh, International Centre for Integrated Mountain Development (ICIMOD), Nepal and Iran. Her great efforts and contribution in landslide and geographical related areas received recognition from various organizations locally and internationally. Currently, she is working with researchers from Tokyo University, Chiba university, National Institute of Earth Science and Disaster Prevention (NIED), International Centre for Water Hazard and Risk Management (ICHARM), Vision Tech Inc.(VTI), Kyoto University, Ibaraki University, Kyushu University, Multimedia University and Universiti Tenaga Nasional to study landslides sponsored by JST and JICA under Science And Technology Research Partnership For Sustainable Development Program.

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Nazi Avani

Nazi Avani received her B.Sc. in Forestry in 2002 in Mazandaran University, Iran. She got M.Sc. in Forestry in Mazandaran University in 2004 with the best grades. Currently she is PhD student in Landslide in University Sains Malaysia and working about slope stability and the effect of vegetation on slope stability and shallow landslide. She presents some papers in international conference in India, Dubai, Ardebil, Tehran, and also publish paper in journal.

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Ghassem Habibi Bibalani

Dr. Ghassem Habibi Bibalani starts his professional career in 2001 as Assistant Professor, Department of Shabestar, Islamic Azad University, Iran. Dr. Ghassem Habibi Bibalani received his B.Sc. in Forestry in 1995 at Department of Chalous, Islamic Azad University, Iran. He got M.Sc. in Forestry in 1998 from Department of Science and Research, Islamic Azad University, Iran. Dr. Ghassem Habibi Bibalani obtained Ph.D. from Department of Science and Research, Islamic Azad University, Iran in 2001 in Forestry.

Dr. Ghassem Habibi Bibalani's current research interests are Forestry, Bioengineering of Soil, Forest Engineering, landslide Protection, Soil Erosion Control.

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The Best Communication Tools in Delivering Landslide Information to Orang Asli: A Case Study in Gerik Perak, Malaysia

JAMILAH AHMAD
Associate Professor Dean, School of Communication, Universiti Sains Malaysia.
Address: School of Communication, Universiti Sains Malaysia, 11800 Pulau Pinang.
Email: jahmad@usm.my
Tel: +604-653 3603
Fax: +604 657 7736

HABIBAH LATEH
Associate Professor at School of Distance Education,
Universiti Sains Malaysia, 11800 Pulau Pinang.

Abstract

Orang Asli are among those who are directly affected by landslides. This is due to their way of life practiced since generations where they prefer to live in jungle and highland areas. Landslide tragedies at Post Dipang Orang Asli Settlement and Sungai Ruil Orang Asli Settlement did not only destroyed their settlements but also claimed many lives. Efforts have been made to provide landslides information and awareness to Orang Asli through variety of communication tools. But, is the information conveyed to them effective? In order to answer this question, this study examined the most effective communication tools that can be used to deliver landslide information to Orang Asli. Such knowledge is necessary to ensure that the information reaches the intended audience. The findings of this study demonstrate that the mass media particularly newspapers and television are the most effective communication tools that can be used to disseminate landslide information to Orang Asli.

Key Word: *Landslide, Information, Awareness, Orang Asli, Communication Tools, Malaysia.*

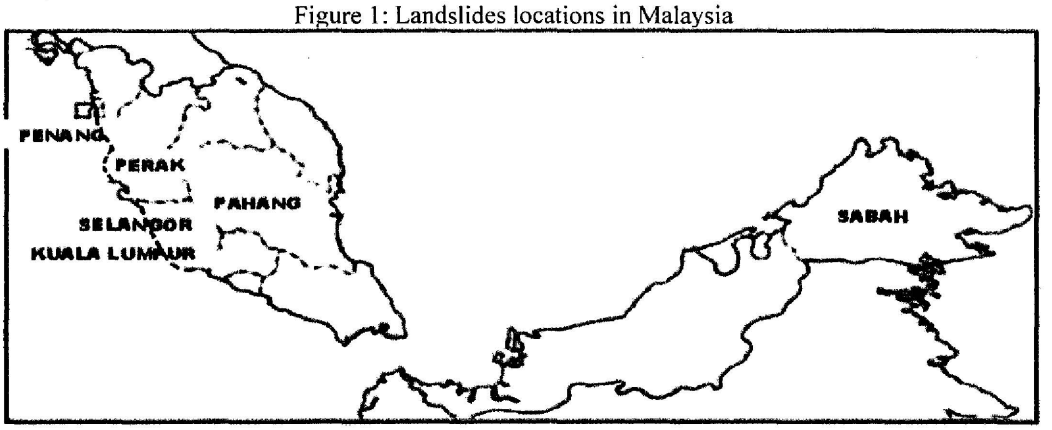
Introduction

Landslides are one of the major natural disasters that occur in Malaysia. Landslides cause enormous property damages in term of both direct and indirect costs and have impacted the country in terms of injuries, deaths, disruption and destruction of services, public inconvenience and economic as well as financial losses (Dai et al., 2002; Ibrahim et al., 2011). Landslides are localised events, dissimilar to earthquakes and floods. In Malaysia, landslides have occurred in several locations such as at Paya Terubong, Penang, Highland Towers, Kuala Lumpur, Pos Dipang, Perak, Sandakan, Sabah, Genting Sempah, Pahang, and Bukit Antarabangsa, Selangor (Habibah and Jamilah, 2011; Ibrahim et al., 2011; Utusan Malaysia, 2011).

Landslides are considered as the Geo-hazards process that causes fatalities and property losses. The frequency of landslides occurrences increase each year and this is caused by several factors such as (1) developments on hilly/highland areas; (2) lack of experience and technical weakness in slope engineering; (3) lack of awareness and negligence; (4) climate change; and (5) lack of monitoring and enforcement of policies, guidelines and acts. Although landslides usually happen at hilly areas, mountainous or hillside areas, the disasters can also occur at flat areas. At flat areas, landslides may occur on cuts and embankment slopes (construction of highways and buildings), river bank, landslides spread type,

collapse/subsidence/sinkhole and various types associated with quarrying and mining exposure (Rodeano et al., 2013).

Figure 1: Landslides locations in Malaysia



According to the National Slope Master Plan (2009), landslides are massive mass of soil and rock debris that move downhill because of the action of gravity. The sheer mass of material involved and the speed at which they occur make them potentially disastrous as a consequence because of the massive damage they can cause to properties and lives. In Malaysia, landslides are among the deadly hazards that occur frequently during the rainy seasons (Habibah and Jamilah, 2011). There are two rainy seasons in Malaysia; (1) from April to October (the south-west monsoons); (2) and from October to February (the north-east monsoons). The average annual rainfall in Malaysia is more than 250 cm (Mohan, 2012).

Common occurrences of landslides in Malaysia are found in the form of slope failures at man-made slopes, particularly cut and fill slopes along highways, residential and urban areas. Besides, there have also been instances of large scale failures in natural terrains, such as rock falls at limestone hills, debris flows along valleys and slow-movement landslides in the mountain regions (Ibrahim et al., 2011). In addition, Habibah and Jamilah (2011) stated that, landslides are regarded as a conflict between men and nature and the disasters normally occur at mountainous landscapes, along coastlines as well as at river valleys.

Landslides trigger public interest especially it causes fatalities and major damages to infrastructures. Malaysians who are often affected by landslides can be categorised into three groups, namely the elite, the middle class and indigenous people. These groups are not only different in terms of their thinking and lifestyles but also experience during the landslides situation in different circumstances. Though, in this research, the researcher only focuses on the indigenous people or Orang Asli.

'Orang Asli' is a Malay term which means 'original peoples' or 'first peoples' (Tarmiji et al., 2013). They are affected by landslides due to their way of life. Orang Asli community is more comfortable living in the jungle and highland areas and also at the hillsides where they can easily find food and generate income. By choosing to live in these areas, it opens themselves to risks especially during landslides. It is difficult to deliver landslides information to Orang Asli because their way of lives, thinking and their level of education that are different compared to those in the elite and middle class groups.

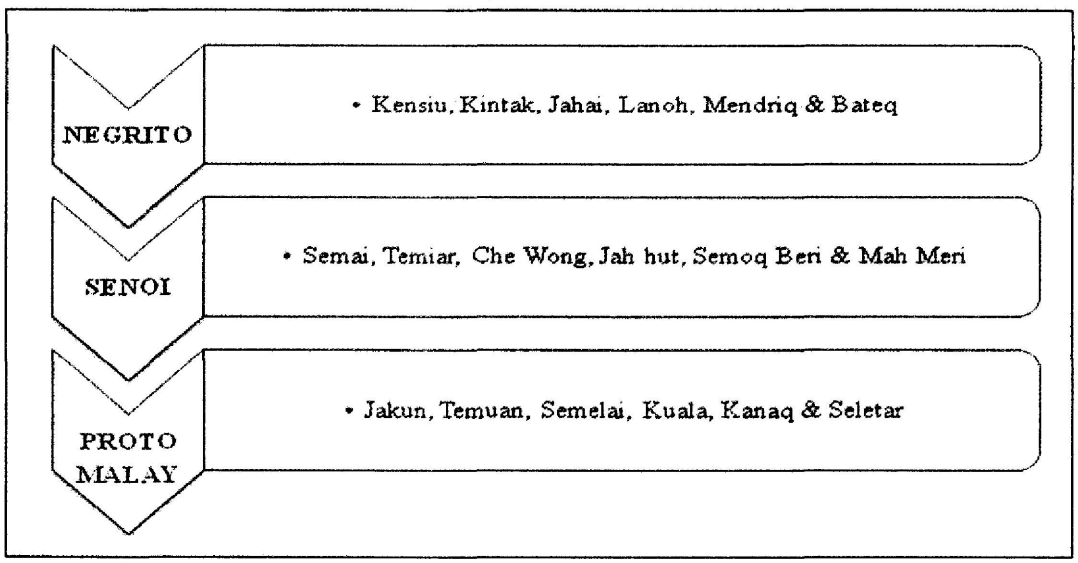
Therefore, in delivering information to Orang Asli, it is important to understand what they know, what they need and what they prefer to ensure that the messages are successfully delivered. This is important as it can prepare them to face landslides accordingly. With regard to this study, it was conducted with aim to examine the knowledge level of Orang Asli about landslides and to investigate the communication tools that they prefer in obtaining landslides information. It is essential to know the most effective communication tools that can be used to deliver landslides information to Orang Asli.

Literature Review

Orang Asli in Malaysia

Orang Asli are the indigenous minority people of peninsular Malaysia and they are separated into three main tribal groups that are Negrito, Senoi and Proto Malay. Negrito is also called as Semang while Proto Malay is also known as Aboriginal Malay. Orang Asli is not a homogeneous race, meaning that they have diverse cultures, traditions and ways of lives, beliefs and languages. There 18 ethnic subgroups of Orang Asli. This is shown in Figure 2 below.

Figure 2: 18 ethnic subgroups of Orang Asli in Penisular Malaysia

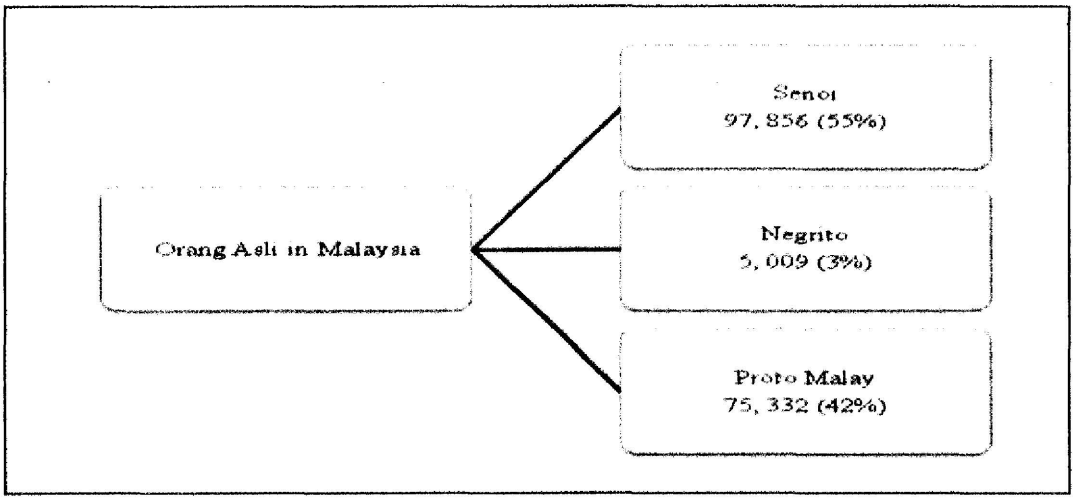


Negrito is divided into six ethnic subgroups namely Kensiu, Kintak, Jahai, Lanoh, Mendriq and Bateq. Senoi is divided into six ethic subgroups namely Semai, Temiar, Che Wong, Jah hut, Semoq Beri and Mah Meri. Proto Malay is also divided into six ethnic subgroups that are Jakun, Temuan, Semelai, Kuala, Kanaq and Seletar. All of these subgroups depend on their ethnicities and the locations (Tarmiji et al., 2013; Kamarulzaman and Osman, 2008). Senoi is the largest ethnic subgroups constituting of about 97,856 of the total population, followed by Proto Malay and the Negrito at 75,332 and 5,009 respectively (Ministry of Rural and Regional Development of Malaysia, 2012).

Proto Malay is concentrated in Negeri Sembilan, Selangor, Johor and Pahang and their cultures have some similarities with the Malay cultures (Abu Bakar Sedek et al., 2002). According to Endom et al. (2013), Negrito is mainly concentrated in Kedah, Perak, Kelantan and Pahang and they have physical features which strongly resemble the African pygmies rather than any of the other main South East Asian ethnic groups. According to Mohd Mizan (2004), Senoi is concentrated in Selangor, Perak, Kelantan, Pahang and Terengganu and they are highly skilled in producing women's jewellery such as bracelets, earrings and necklaces, using seeds from Karyel Trees.

According to the data released by the Ministry of Rural and Regional Development of Malaysia (2012) there were about 178,197 Orang Asli in Malaysia, living in 852 villages and represents just 0.6 % of the total national population. The largest Orang Asli population is in the state of Pahang with 67,506 followed by Perak, 53,299, Selangor, 17,587, Kelantan, 13,457, Johor, 13,139, N. Sembilan, 10,531, Melaka, 1,515, Terengganu, 893, and Kedah, 270.

Figure 3: Statistics of Orang Asli in Malaysia according to the three main tribal groups



According to the Department of Orang Asli Affairs of Malaysia (2008), Orang Asli community is thinly scattered throughout the peninsula. This is because majority of the Malay population grow on the coastal plains and major river valleys. This causes Orang Asli to be pushed back into the interior montane forests. Traditionally, the indigenous people are hunter-gatherers, fishermen, arboriculture cultivators and many of them are still depending on the forests for livelihood in varying degrees and this affects every facet of their lives (Abu Bakar Sedek et al., 2002).

According to Tarmiji et al. (2013), lifestyles and means of survival of Orang Asli vary from one group to another. For example, fishing is the main occupation for Orang Kuala, Orang Seletar and Mahmeri. But for Temuan, Jakun and Semai, they love to practise permanent agriculture and manage their own rubber, oil palm or cocoa farms. Whereas, for Orang Asli who live close to or within forested areas such as Semai, Temiar, Che Wong, Jahut, Semelai and Semoq Beri, their primary occupations are hunting, gathering and swiddening (hill rice cultivation). They also trade petai, durian, rattan and resins to earn cash incomes. As for Negrito, they are still semi-nomadic and depend on the seasonal bounties of the forest, and a fair number of them are to be found in urban areas surviving on their wage or salary jobs.

The community of Orang Asli in Malaysia is under the supervision of the Ministry of Rural and Regional Development and managed by the Department of Orang Asli Affairs (JAKOA). The primary goal of JAKOA is to protect the rights of Orang Asli and their way of life from rapid development and exploitation of external parties as well as to provide facilities and assistance in education, health and socio-economic development. In general, the department is responsible for developing indigenous people with the aims of eradicating poverty, reducing income disparities and improving the quality of education and health. Other than that, the department is also responsible to improve the ability, confidence, perseverance, skills and discipline images and resilience among Orang Asli and eliminate the Malaysians negative perception towards this community (JAKOA, 2013).

Landslides and Orang Asli in Malaysia

In Malaysia, there were two tragic landslides incidences that directly involved Orang Asli. These tragedies were the Pos Dipang tragedy at Kampar, Perak and the Sg. Riul tragedy at Cameron Highland, Pahang. Both incidences have left a black mark on the country's history after the much coveted Highland Tower tragedy.

Table 1: Occurrence of landslides involving Orang Asli in Malaysia

Location	Year	Injury	Fatalities	Missing
Post Dipang Orang Asli Settlement, Kampar, Perak.	1996	-	39	5
Sungai Ruil Orang Asli Settlement, Cameron Highland, Pahang.	2011	2	7	-

Pos Dipang Tragedy

Pos Dipang was among the largest Orang Asli settlements in Perak with about 1,500 people. It is located on a site about 200 metres above sea level (Bernama, 1996). According to New Straits Times (2013), the mudslide incident near the Post Dipang Orang Asli settlement occurred abruptly at about 6pm on 29 August 1996 and took away 44 lives. As reported by Utusan Malaysia (2011), only 39 dead bodies were found and another 5 bodies are still missing until today. According to Mohd Yusop (1996), the disaster was triggered by heavy rain that sent a torrent of water and mud down on to the houses and out of 100 houses in the settlement, 30 were destroyed and 20 were damaged.

According to the New Straits Times (2013) report, the raging water of Sungai Dipang almost wiped out the entire village and its residents. The unexpected gush of water from Sungai Dipang swept away nearly 60 homes from the village that were located along the river bank. The search operation lasted three weeks and most of the dead bodies were found, buried under sand and debris at Kampung Sahom which is located downstream of Pos Dipang. Bernama (1996) also reported that, most of the victims were found 3 km away from the scene, at Sahom Village, close to the North-South Highway. According to the rescue team, most of the dead bodies were found buried approximately 0.9-1.2 meters in the mud, and there are also dead bodies found under a pile of wood logs and river rock (Bernama, 1996).

Overall, about 800 residents in the Pos Dipang Orang Asli Settlement were affected by the tragedy and it is considered as the worst landslides incident in the country after the Genting Highlands slip road on June 30, 1995 in which 22 people died and 23 others were injured (Bernama, 1996). According to Utusan Malaysia (2011), Pos Dipang tragedy recorded the highest number of victims of mud flood and the incident was believed to be closely related to rampant logging activities performed in the area.

However, for the Orang Asli community involved, they believed the bad disaster that destroyed their settlement was the sign of the wrath of God. Following the mudslide tragedy at Pos Dipang, a new Orang Asli settlement was set up not far from the scene, with a leader (Tok Batin) to help unite the residents in the area. The Pos Dipang tragedy serves as a harsh reminder to everyone not to sacrifice others' safety for own greed. The incident also indicates the needs for JAKOA and other related agencies to work together towards ensuring the rights and wellbeing of the Orang Asli community (Utusan Malaysia, 2011).

Sg. Ruil Tragedy

As reported by Jaafar (2012), landslides incident at Sg. Ruil, Brincang, Cameron Highland, Pahang occurred on August 7, 2011 at 5.50 p.m. The incident destroyed six houses. The houses were buried by

debris or mud. The incident claimed seven lives and injured two others. According to Cameron Highlands OCPD, DSP Wan Zahari (2011), two hundred and forty-eight personnel from the various agencies including the police, Fire and Rescue Department, the SMART team and Rela were involved in the rescue operations at the scene of the incident (Bernama Media, 2011; Jaafar, 2012).

The landslides incident at Sg. Ruil occurred due to landslides debris flow. The total area of the village involved was around 40 hectares whilst the catchment area of the village was around 80 hectares. The Sg. Ruil Orang Asli settlement located about two kilometres from the Brinchang-Tanah Rata Road, has 45 houses with about 1,300 residents and is considered as the oldest Orang Asli settlement in this area (Bernama, 2011; Bernama Media, 2011; Jaafar, 2012).

According to Mohamed Idris (2011), it was speculated that the clearing and earthworks performed nearby the settlement for housing development likely contributed to the disaster. Consumers Association of Penang (2011) reported that, they have informed the authorities in a letter dated May 26, 2011 relating to earthworks on a large scale for the development of the project after receiving complaints from local residents and tourists who were infuriated with the situation. Unfortunately, despite the complaint and early warning, CAP felt the appropriate action was not taken that caused the landslides incident.

According to Jaafar (2012), there are three factors that caused the landslides tragedy at Sungai Ruil. The first factor was the presence of geological factors weakness (covered by colluviums), weathered material, orientation and location of adversely discontinuities and relict slope failure. The second factor was the appearance of the morphology of hilly terrain, presence of channel order 0 or 'ephemeral drainage' and river bed gradient more than 35 degrees. The third factor was human activity that built water barrier, however the high intensity of rainfall in a short period of time is believed to be a triggering factor.

After the tragedy, Simon (2011) reported that, all the 1,015 Semai villagers affected by the landslide at Kampung Sungai Ruil refused to be relocated. The reason was because they have been staying at the village for the past five generations and believes that no one should force them to leave their ancestral land, and they are prepared to take any risk. The residents also argued that the move to temporarily relocate them was an attempt to evict them and to take over their land to carry out other projects. According to the villagers, instead of relocating them, the authorities should restructure the village or build retention walls to prevent future landslides.

The Variety of Communication Tools in Delivering Information

Communication tools can be divided into 3 types namely print media, electronic media and new media. The examples of print media are newspaper, magazine, book and pamphlet. Television, video and radio are the example of electronic media. Whereas, the examples of new media are websites, blog and social networking sites such as Facebook, Twitter and WeChat.

Print Media

According to Crossley (2010), print media is still regarded highly by many for its impacts compared to other media tools. First, it serves as a keepsake memorabilia, where readers can cut out and keep any section of a magazine or newspaper which is of importance to them. The print media is also convenient in terms of portability. Readers can carry print material wherever they go, increasing the likelihood that they might read the content, as opposed to turning on the television at home or logging on the internet. In addition, the print media also offers a clean design without the distraction of commercials and pop-up advertisements. Finally, it is the most reliable form of media to date. In the case of a broken cable or bad weather, television reception and internet access may be disrupted for days, but such factors would not affect print media.

Piechota (2002) affirmed that e-books and the internet will never be able to replace print media. She feels that although digital technology has already created an impact on the way news are disseminated to the world, print materials would never really fade out. The disadvantage of over-reliance on the online materials is the diminishing number of quality materials. Unlike stories in newspapers and magazines, content which appears on the internet can be easily uploaded or written by anyone. As such, the credibility of the writer is questionable, jeopardizing the quality of the material.

Electronic Media

The most popular electronic media is television. A local study conducted by Shanthi et al. (2009) informed that the majority of young audiences in Malaysian rely on broadcast media like television for knowledge on environmental issues. In particular, they rely on television news. This is due to the high degree of credibility offered by television news, which is further reinforced when media presents opinion polls and rating surveys on a particular issue (Anne Dunn, 2005).

Kibben (1992) also stated that television is one of the most important tools for providing information to the public while Hartley (1999) believes that, the advantage of this media is that it overcomes the confines and control of school education, paving way to a free and relaxed mode of learning. In his book entitled Uses of Television, Hartley wrote that teaching is what television does best. In addition, television is also believed to be an informal but important form of media from which viewers can gain knowledge. Television has successfully decreased the gap between ordinary people and experts within the society by educating the general public on almost every issue, even those considered professional knowledge in earlier days. However, the role of television is most prominent in lifestyle issues, particularly those concerning living skills.

New Media

New media is one of the most used tools especially social networking sites such as Facebook and Twitter. According to Merrill et al. (2011), in less than a decade, social networking sites in many ways seem to have taken over the world. A class of social media technologies, more commonly known as Web 2.0 has become the darling of the business world in the last few years. Social networking sites applications including Facebook, Twitter and MySpace purportedly represent a new era of increased participation, democracy, and creativity (Benkler, 2006; Jenkins, 2006). According to Wisconsin Centre for Education Research (2011), about 250 million people log into Facebook every day and Twitter has 15 million regular users who send 65 million messages each day. Social networking sites have also become enormously popular across demographics of race, age and gender, and have hundreds of millions of users.

As reported by Nur Nasliza Arina and Jamilah (2013), social networking sites like Facebook is very useful in delivering information to the community. The reason is that, it is able to reach a huge audience, make delivery of information easy and effectively, accelerate the process of delivering information, help to highlight and focus on important issues and assist in the process of message repetition (Nur Nasliza Arina and Jamilah, 2013).

Methodology

This research employed a focus group approach in order to get data from the respondents. The respondents were Orang Asli children from ethnic subgroups of Jahai and Temiar and they were Form 1 and 2 students, studying at SK RPS Banun, Gerik Perak, Malaysia. The focus group discussions were conducted at SK RPS Banun and involved a total of 22 student participants. The students were divided into two focus groups to discuss matters related to landslides. There were two main issues that were discussed; (1) general knowledge about landslides; and (2) the best communication tools in delivering landslides information to

Orang Asli. The two focus group discussions were recorded using digital audio recorder and the information provided by the respondents during the discussions was also written down on paper.
Thematic analysis method was adopted to analyse the data that was obtained from the respondents. Thematic analysis is a method used for identifying, analysing and reporting patterns which refer to the 'themes' within data and it also minimally organises and describes data set in (rich) details (Braun and Clarke, 2006). In order to analyse data using thematic analysis, this research followed the six processes in thematic analysis as suggested by Braun and Clarke (2006). The six processes are; (1) familiarising yourself with your data; (2) generating initial codes; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes and (6) producing the report.

Results

Demographic Respondents

Table 2: Number and percentage of respondent

Sex	Number	Percentage (%)
Male	13	59
Female	9	41
Total	22	100

Table 2 above shows that male respondents made up 59% of the total respondents while another 41% of the respondents were females. The total number of the respondents in this research was 22 respondents.

Respondents General Knowledge about Landslides

To understand respondents' general knowledge of landslides, they were asked four questions; what are landslides, what causes landslides, what are landslides warning signs and what to do during landslides. From the responses obtained, it was found that most of the respondents understand what landslides are. Majority of them stated that landslides are natural disasters that occur naturally, while one male respondent answered landslides are natural disasters caused by human activities.

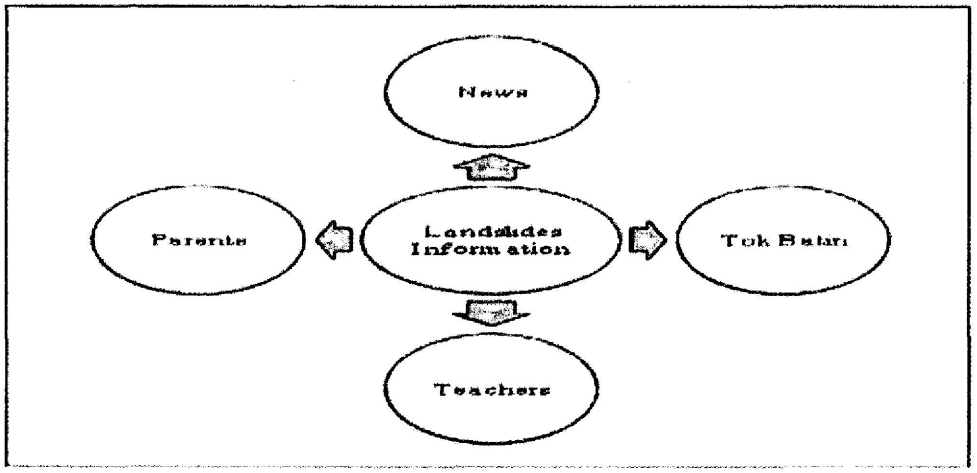
In terms of what causes of landslides, the respondents listed three causes of landslides; flood, heavy rain and strong wind. When asked about landslides warning signs, the respondents said there are two signs normally occur before landslides; fallen rocks and trees tilt or move. When probed on what to do during landslides, all the respondents answered that they will run into the woods or over the hill with their families to save their lives.

The Best Communication Tools in Delivering Landslides Information

To find the most effective communication tool in delivering landslides information to Orang Asli, the respondents were asked five questions; how do you know and get landslides information, what types of printed media that you prefer to get the landslides information, what types of electronic media that you prefer to get landslides information, what types of social media that you prefer to get landslides information and who do you think is responsible in informing and delivering landslides information.

As stated by the respondents, there are four main sources that they usually use to get landslides information. The four main sources are news from television, newspaper and radio, Tok Batin (headman), parents and teachers.

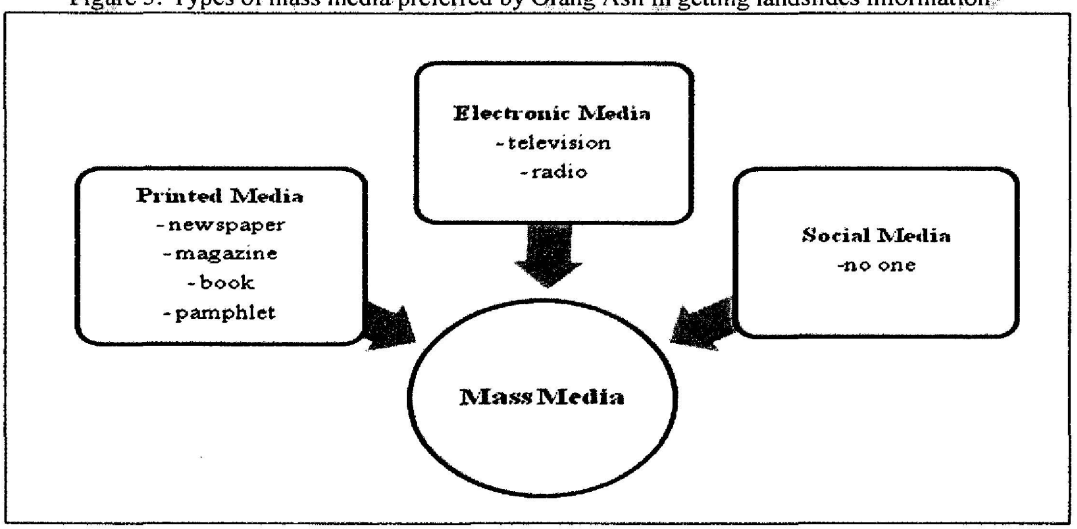
Figure 4: Orang Asli sources in getting landslides information



In terms of the types of print media that they prefer to get landslides information, the respondents indicated that, they prefer newspaper, magazine, book and pamphlet. This is because, they can read the information anytime and anywhere and they can keep the information if necessary. As for the electronic media, they like to watch television and listening the radio to get landslides information. As explained by the respondents, television and radio are more attractive compared to the other communication tools. According to them, television has attractive audio and visual, while the radio has amazing audio that can easily capture their attention.

About the types of social media that they prefer to use to get landslides information, all respondents answered that they do not prefer to use social media. This is due to the fact that they are not familiar with any form of social media and they do not know how to use it.

Figure 5: Types of mass media preferred by Orang Asli in getting landslides information



When the respondents were asked about responsible person that should inform and deliver landslides information to them, majority of them answered the mass media and Tok Batin. According to them, landslides information should be disseminated through news on television and newspapers.

Discussion

Based on the findings obtained in this research, it can be concluded that many of the respondents had little understanding about landslides. This can be seen in the three general questions on landslides that have been discussed in the focus group discussions. For instance, the answers given by the respondents about what landslides are during focus group discussions were too brief and shallow. Most of the respondents said that landslides are natural disasters that occur naturally as well as natural disasters caused by human activities. The answers provided are not wrong but they do not describe the in-depth definition of landslides, and it indirectly shows that the respondents had limited knowledge on landslides.

In addition, the respondents' knowledge about the causes of landslides was also limited. This can be seen in the feedbacks given by the respondents. Many of them only listed three causes of landslides, when in fact, there are many other factors that can cause landslides to occur. According to the U.S. Geological Survey (2004), there are three major factors that can cause the landslide; (1) hydrogeological factor; (2) morphological factor; and (3) human factor. The examples of hydrogeological factor include weak or sensitive materials, weathered materials and sheared, jointed, or fissured materials. The examples of morphological factor are tectonic or volcanic uplift, glacial rebound as well as fluvial, wave, or glacial erosion of slope toe or lateral margins. The examples of human factor include excavation of slope or its toe, loading of slope or its crest, drawdown (of reservoirs), deforestation, irrigation and mining.

The respondents' knowledge about landslide warning signs were also limited, and this shows that the responsible parties should play a more significant role in informing landslides information to Orang Asli. It is very important for the respondents to know about the landslide warning signs in order for them to prepare themselves to face landslides and to save themselves from being victims. Based on the feedbacks received from the respondents, they only knew two landslide warning signs at times when there are altogether 11 landslides warning signs as reported by the Ampang Jaya Municipal Council (MPAJ) (2011).

The 11 landslide warning signs are; (1) bulging ground appears at the base of the slope or retaining wall; (2) water breaks through the ground surface in new location near a slope; (3) water appears at the base of slope; (4) fences retaining walls, utility poles or trees tilt or move; (5) cracks appear on the slope; (6) water pipes break; (7) cracks appears on the ground or in the foundation of houses, buildings and other structures; (8) doors or windows stick or jam for the first time; (9) slowly developing widening cracks, appear on the ground or on paved areas such as streets or driveways; (10) land movement and small slides; and (11) outside walls, walks or stairs begin pulling away from the building.

The respondents' knowledge about what to do during landslide is good. The respondents indicated that they will run into the woods or over the hill with family members if landslides happen without thinking about other thing either their homes or other properties. This is accordance to the recommendation provided by the U.S. Geological Survey (2013) that is to immediately run and hide at a safe place if landslides occur. The U.S. Geological Survey (2013) also recommended victims to quickly leave the scene and not to delay to save themselves, not their belongings.

In term of the most effective communication tool to deliver landslides information to Orang Asli, newspaper and television are the best tools to serve this purpose. This is due to the reason that newspaper and television are more attractive, enjoyable and flexible compared to the other communication tools. According to Mitchell and Hansen (2010), print media like newspapers and magazines consist of two main elements, which are words and images. Words function by telling the story, while pictures enable readers to relate to the story and find resemblance to things in the world. Words itself act as a graphic image, where the choice of typeface or font creates a "look" for the text. This may influence readers and the way how they perceive the particular print media. As also explained by Nur Nasliza Arina and Jamilah (2013), print media especially newspapers have a lot of advantages such as it can illustrate the message to look more

formal and serious, can provide a more detailed information to the public and make communication with the public more closely and personally.

Lewis (2008) explained that television is a mean of education. In his study, Lewis found how there are now more ordinary people on television than there were before, and the gap between experts and ordinary people is decreasing. Through its dissemination of knowledge about the ordinary and its depiction of ordinary people, television is able to relate to a larger group of audience. It thus adopts a mode of education that is easily understood and more effective in terms of reaching out to the society.

Bonner (2003) also stated that, the content of television is becoming more focused to ordinary people and their everyday life. He elaborates that this process has caused an expansion and diversification of what kinds of knowledge are received through television, and this then leads to the blurring of boundaries and hierarchies between experts and ordinary people. According to Hartley (1999), television, along with family, school, and the state, can be thought of as an institution that contributes to the "systematic teaching of selfhood".

Besides the fact that newspaper and television are attractive and enjoyable, these tools are also accessible to the respondents. The respondents can watch television at their homes and can read newspapers at any time to find out about news or information related to landslides. Newspapers and television are also the two communication tools that the respondents trust. The respondents know that they can always rely on to these tools to get important information about landslides. They perceive every information published in the newspapers or appear on television news is accurate, important and should be trusted.

The social media was found not to be an effective medium to deliver landslides information to Orang Asli. The respondents do not prefer this tool because they are not familiar with it and do not know how to use it. This is also due to the difficulty to get the internet coverage at their place.

In conclusion, it is important for Orang Asli to increase their knowledge and information about landslides by utilising on appropriate and effective communication tools. By utilising on effective communication tools, landslides information can be delivered to them efficiently, and this will help them to be more prepared to face landslides occurrences. The use of effective communication tools such as newspapers and television can also help to increase the level knowledge of Orang Asli on landslides. This is because the tools are accessible to them and suitable to their level of education and thinking.

Conclusion

This study found that newspapers and television are the most effective communication tools to deliver landslides information to Orang Asli. This is based on their experience in getting landslides information through a variety of communication tools like newspaper, television, radio and books. Newspapers and television are also accessible to them and they also believe that the information disseminated through these tools are reliable can be trusted. However, it is also important to note that there are also Orang Asli communities in Malaysia who still do not have access to newspapers and television due to their remote locations in the forest and rural areas. For these communities, a study needs to be carried out to find the most effective way to communicate landslides information to them.

Acknowledgment

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Teaching Orang Asli Perspectives: An Investigation of Teachers' Perception on Landslide Hazard

Assoc. Prof. Dr Jamilah Hj Ahmad[1] & Assoc. Prof. Dr Habibah Hj Lateh[2]

Abstract

This study investigates the teachers' perception, understanding and strategies to educate *orang asli* students on landslide hazards. This study also aims to unravel effective strategies to provide information regarding landslides to the community especially the *orang asli* community. A survey and focus group interview were conducted to explore the teachers' experiences, understanding and perception towards the landslide issues. The findings revealed that most of the respondents have general knowledge on landslides. They perceived landslide to be dangerous to their safety and could also harm their economic and social development. Majority of the respondents believe that video as an effective learning tool to educate students on landslides. They also believe that television is the best medium to be used to deliver information on landslides to the community.

Keywords: Landslide, Risk Perception, Environmental Education, *Orang asli* and Focus Group Interview

1.0Introduction

Along with rapid development, sophisticated technologies, and population explosion, people and the environment are increasingly suffering from the effects of environmental degradation. In recent years, there have been increased cases of natural disasters such as floods, earthquakes and landslides that affect the lives of many. These disasters also involve recovery cost. It is in fact a problem that exists since a long time ago. In a recent incident that occurred in May 2014, hundreds of people have been killed and more than 2000 were missing as a result of a landslide at a mountainous area of north Afghanistan (Harooni, 2014). Malaysia has also experienced several major traumatic landslides at Pos Dipang, Perak; Paya Terubong, Penang; Highland Towers, and Bukit Antarabangsa, Kuala Lumpur that claimed hundreds of lives. Table 1 below listed the landslide tragedies in Malaysia.

[1] School of Communication, Building D13, Universiti Sains Malaysia, 11 800 Pulau Pinang Malaysia. Email: jahmad@usm.my, Phone: 04-653 3320
[2] School of Distance Education, Jalan Sasaran, Universiti Sains Malaysia, 11 800 Pulau Pinang Malaysia. Email: habibah@usm.my, Phone: 04-6533608

Year	Place/ State	Year	State
1961	Cameron Highland, Pahang	2008	Cameron Highland, Pahang
1993	Pantai Remis, Perak	2008	Kajang, Selangor
1993	Ulu Klang, Selangor	2008	Petaling Jaya, Selangor
1995	Genting Highlands, Pahang	2008	Terubong Jaya, Penang
1996	Gua Tempurung, Perak	2008	Kuala Kubu Baru, Selangor
1996	Pos Dipang, Perak	2008	Jalan Semantan, Kuala Lumpur
1999	Ulu Klang, Selangor	2008	Ulu Klang, Selangor
2002	Ulu Klang, Selangor	2009	Bukit Ceylon, Kuala Lumpur
2003	Bukit Lanjan, Selangor	2011	Ulu Langat, Selangor
2006	Ulu Klang, Selangor	2012	Puncak Setiawangsa, Kuala Lumpur
2007	Kapit, Sarawak	2013	Petaling Jaya, Selangor

Table 1: Landslide tragedies in Malaysia (Khairiah & Habibah, 2012)

Malaysia is geographically outside the Pacific Rim of fire and the country is relatively free from any severe destruction of natural disaster such as earthquake, typhoon and volcanic eruption. However the country is exposed to monsoon floods, landslides and haze problems (Ibrahim & Fakhru'l Razi, 2006). Figure 1 shows the types of natural disaster that occurred in Malaysia. According to Ibrahim and Fakhru'l Razi (2006), besides flooding, Malaysia also needs to deal with landslides. The landslide hazards lead to the damage of roads, building and other infrastructures, block of rivers and a very high cost of recovery each year (Pan, 2012).

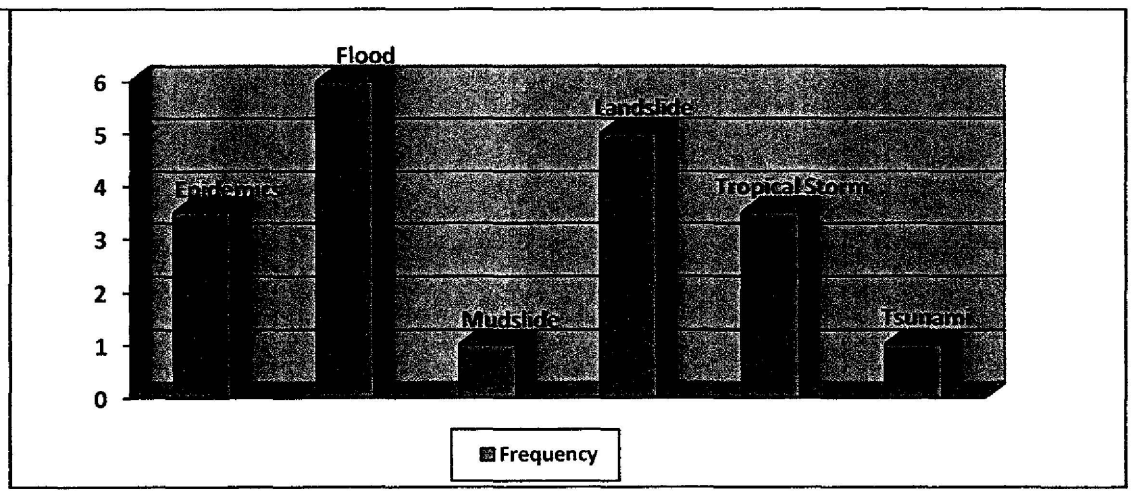

Figure 1: Natural Disaster Types in Malaysia (Ibrahim & Fakhru'l-Razi, 2010)

Natural disasters usually occur due to natural hazards and human activities. However, the causes of landslides are usually related to slope instabilities. The causes of landslides or mass movement are usually due to endogenic and exogenic factors (Costa & Baker, 1981; Alexander, 1992). Figure 2 shows the details of endogenic and exogenic factors that lead to landslide problem

Endogenic Factor

- The steepening of slope.
- The removal of lateral or underlying support.
- Loading of the upper edge of the slope following construction, landfill dumping, land sliding or other factors.
- Changes in slope gradient as a result of faulting, tectonic uplift, or the creation of artificial slopes by grading with construction machinery.

Human activity can be a reason for either internal and external causes, or both active and passive ones over time periods that vary from the immediate (10^{-2} years) to the long-term (10^{3} years) (Alexander, 1992).

An earlier research found that the cause of landslides is due to the lack of awareness and knowledge in the hill destruction (Habibah & Vijaya, 2012). Habibah and Vijaya (2012) also stated that the exploitation of the hill by human being for various purposes without taking any consideration the safety and destruction of flora and fauna. Education is indeed the best way to foster environmental awareness and knowledge among the society (Jamilah, Hasrina, Hamidah, & Juliana, 2011; Jamaluddin, 2001). According to Muhammad Rizal et.al (2010), environmental legislation is another measure that could be used to protect the environment from being polluted and abused.

Teachers play important roles in educating the society about environmental problems and natural disasters including landslides. The younger generation needs to be molded with the right knowledge, attitude and behavior pertaining to landslide issues. Hence, the main focus of this article is to perceive the teacher's perception regarding landslides in order to foster students' awareness regarding the hazard of landslide disaster.

The objectives of this study are as follows:

- To discover teachers' general knowledge, understanding, and attitude towards landslide issues.
- To investigate teachers' perception and awareness in landslide hazard in relation to their experience of teaching.
- To indicate teachers' perception of effective communication strategies to deliver information regarding to landslide.

2.0 Literature Review

2.1Knowledge, Attitude and Practice on the Landslide Issues

Landslide is a natural disaster that can occur beyond our expectation. In the past, it has claimed hundreds of lives and caused losses of millions of Ringgit. Many try to solve environmental problems with different methods, especially environmental education which it is process of environment teaching for people have environmental knowledge and understanding, awareness, attitude, environmental ethics, behaviour and evaluation (Wongchantra, Boujai, Sata, & Neungchalerm, 2008). Public preparedness can be gauged through knowledge, attitude and practice towards landslide issues (Khairiah Salwa & Habibah, 2012).

Awareness, knowledge and attitude are objectives that have become important components in the environmental education (Lavega, 2004). Golob and Hensler (1998) found that behaviours influenced attitudes more strongly than attitudes influenced behaviours.

In order to minimize risk, public preparedness towards disaster is essential as it can prepare them to face and react accordingly when the disaster happens. According to Karnawati & Pramumijoyo (2008), lack of knowledge about landslides is one of the factors that cause huge number of live losses when the disaster occurs. Therefore, environmental disasters knowledge is very important as guidelines.

It is assumed that people who are knowledgeable about the environment and its associated issues are more aware of the environment and its problem and are more motivated to act toward the environment in more responsibly (Zarintaj, Sharifah Zarina, Abdul Samad, & Mahyar, 2013). This is in line with Kollmus and Agyeman (2002) behavioural model which indicates that society should be provided with environmental knowledge to increase awareness and in turn, it will develop more positive behaviour towards the environment (Kollmuss & Agyeman, 2002). Figure 3 describe the relationship between knowledge, attitude and awareness.

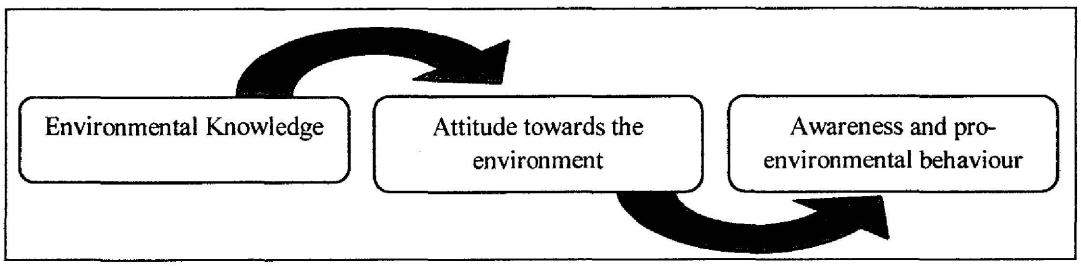

Figure 3: Model of Pro-Environmental Behaviour. Adapted from Kollmuss & Agyeman, 2002

According to Dunlap et. al (2000) factors that related to knowledge, attitude and awareness are age, education and political ideology. Rovira (2000) agreed that environmental consciousness might be influenced by social factors such as social position, age, and level of education.

Education is the key element to reduce natural hazards including landslides and achieving better security in the pursuit of sustainable development (Rouhban & Shaw, 2008). In this regard, teachers should play important roles to nurture the younger generation to be more concerned about the environment. Teachers should also provide good examples to their studentse (Habibah & Govindasamy, 2012). Thus, in regard to this study, it is important to perceive the teachers' and public's perception in order to educate the younger generation on landslides.

2.3Risk Perception

Few researches have attempted to assess public perception on landslide hazards. In order to explore people's current perception and preparedness it is necessary to understand whether they have accessible factual information regarding landslides. The perception of risk involves the process of collecting, selecting and interpreting signals about uncertain impacts of events, activities or technologies (Wachinger & Renn, 2010). If risk perception of people living in risk prone areas is known, effective information strategies on protective measures can be designed by responsible authorities (Pan, 2012; Dai, Lee, & Ngai, 2002).

Lindell and Perry (1994) argued that understanding public perception on natural hazards is necessary in order to impact hazard preparedness. Residents of at risk areas often have inaccurate beliefs about the hazard agent and its impacts, are unaware of available adjustments, and may have erroneous beliefs about the effectiveness of the adjustments of which they are aware. Hence, in assessing people's current levels of risk perceptions and preparedness, it is very important to understand whether they have accessible information (Lindell, 1994).

Some research findings suggest that public perception, awareness and preparedness for a natural disaster is associated with a wide range of socio-demographic characteristics which may play a different role depending on the social and environmental context (Rodeano, Tajul, Mustapa, & Suriani, 2011).

Research conducted by Rodeano, Tajul, Mustapa & Suriani (2011) compiled the socio-demographic characteristics which consist of age, marital status, presence of children living at home, income, education, home ownership and length of residence at the same location. Habibah and Govindasamy (2012) found that student's perceptions of natural disasters are influenced by their age, developmental abilities and experiences.

In short, from the public's perception, the responsible authorities could consider the right strategies to prevent natural hazards including landslides. It is essential to constitute the synergy of government, universities, local administrations, non-governmental organizations, private sector, general public and media with the aim of increasing awareness, knowledge and preparedness about natural disasters (Unaldi, 2008).

2.3The roles of Teachers to Educate the Students on Environmental Disaster Including Landslides

Environmental issues including pollution, global climate change, and depletion of the world's natural resources, environmental issues threaten individuals, communities, and other living organisms on the planet (Bruni, Chance, & Schultz, 2012). Most of the environmental problems are caused by human beings who lack environmental knowledge and awareness. In this instance, teaching of environmental ethics is important as it can help to raise environmental knowledge and awareness especially among students (Wongchantra, Boujai, Sata, & Neungchalerm, 2008). Education is regarded as the best way to help the students to understand the environmental hazards including landslides. Environmental education is characterised as a process that prepares citizens to prevent and solve environmental problems (Day & Monroe, 2000).

Students need to be exposed to knowledge and awareness about landslides as well as other natural disasters. This requires educators to play an important role in providing knowledge and information to students (Aini, Fakhru'l-Razi, Laily, & Jariah, 2003). It was proved that teacher's attitude, knowledge and behavior towards the environment affect the students' attitude in order to assess their preparedness in guiding and sharing the young generation to adopt a sustainable lifestyle (Summers, 2000; Aini, Fakhru'l-Razi, Laily, & Jariah, 2003).

According to Kato, Nishida and Numaguchi (2014), there are five effective ways to enhance students' abilities in dealing with natural disasters. These include by giving students realistic simulation experiences, repeated drills, a variety of experiences, experience listening to emergency broadcasts and related instructions and use of visual materials.

Relationship between teacher and students is essential to develop trust and a sense of belonging for *Orang Asli* students and therefore consequent engagement in their education (Burgess & Berwick, 2009). In this regard, teachers are considered as the most influential in educating students to preserve the environment (Norizan, 2010).

Teachers need to equip themselves with relevant knowledge, good attitude and lifestyle in order to ensure successful implementation of landslide or environmental education to students. In an earlier study conducted by Habibah and Govindasamy (2012), it was revealed that more than 20 percent of teachers were lacked of landslides knowledge and below 50 percents of the teachers had average knowledge of the issue. There are various ways that can be used to equip teachers with necessary knowledge and skills including through in service –training programmes to give emphasis on environmental aspects; encourage involvement of teachers in environmental related activities or co-curriculum at the school; establish linkage between the school and corporations or organizations with environmental interest; and organize talks, seminars and visits (Aini, Fakhru'l-Razi, Laily, & Jariah, 2003).

At present, there is no specific subject in the school curriculum about risk mitigation and disaster preparedness. But students are able to learn about the environment in History, Geography and Science subjects (Habibah & Govindasamy, 2012). Most of these subjects however emphasise only on the development of knowledge aspects related to the definition and the cause of natural disasters such as landslides, soil erosion, earthquake and volcanic eruption (Karnawati & Pramumijoyo, 2008).

Thus, teachers should find out other alternatives to educate students on the importance of preserving and conserving the environment and natural disasters.

Karnawati and Pramumijoyo (2004) suggested that educational institution should provide an attractive method for teaching and learning of geohazard mitigation and preparedness. Practical exercises for emergency responses need to be adapted in the existing curriculum. Knowledge of geohazard can also be integrated in the Geography, Sciences, Language or Religion syllabuses (Karnawati & Pramumijoyo, 2008). Global Precipitation Measurement Mission suggested that teachers should engage students with hands on project such as landslide mini lab experiment and expose them with short video of landslide real tragedy. From these activities, students will have the opportunity to learn and monitor the causes of landslide hazard. It is also important to note that, in teaching orang asli students, teacher's relationship with students is important. According to Alberta Education, they are several effective approaches that can be implemented to attract the attention of aboriginal students in any issues especially natural disasters such as using variety of approaches and learning materials. The effective approaches can be used for the same purpose which is to educate students of orang asli about landslide and other environmental problems.

3.0Methodology

This study was conducted using qualitative approach. Data was obtained through focus group interviews which were conducted in April 2014 at Sekolah Kebangsaan RPS Banun in Gerik, Perak. The school was one of the *orang asli* public schools in the country and some of its students have experienced landslide tragedy before.

Twelve teachers participated in this study; seven males and five females. The researcher sent an invitation letter to the school and requested the Principal to nominate suitable teachers to become research participants. Data was collected in three parts. In the first part, each participant was given a set of semi-structured questionnaire to perceive their general knowledge about landslide. In the second part, they were exposed to a landslide video. The eight minutes length video aims to give information on landslide. In the last part, the participants were divided into two groups that consisted of seven and eight members respectively. Each group was provided with a set of questions to be discussed among members.

The main questions to be answered in each group were; 'List down some of the natural disasters that have occurred in Malaysia?', 'How often do you get involved in activities that related to the environment?', 'What is your role as a teacher in addressing environmental issues such as landslide to the students?', 'According to the video, how do you find the video in terms of content and presentation?', 'In your opinion, is the video effective in order to educate students on landslides?', 'Who do you think the right person to play the role in delivering information regarding environmental problems like landslide to the society?' The main goal of the focus group interview was to discover the teachers' perception on the most suitable strategy to educate students about landslides. The interviews were audio recorded and transcribed verbatim.

4.0 Results and Discussion

The findings of this study are discussed based on the research objectives.

4.1 To discover Teachers General Knowledge, Understanding, and Attitude or Practice Towards Landslides Issues

The findings of this study reveal that majority of the respondents agreed that floods, landslides, and tsunami are among the natural disasters that occur in Malaysia. The respondents' knowledge on landslides was tested based on the landslides signs. The focus group interview session proved that all the participating teachers have general knowledge about landslides. They understand the nature of landslide hazards and how it occurs. However, majority of them only know basic signs of landslides and only two out of 12 respondents answered all the 10 landslide signs correctly.

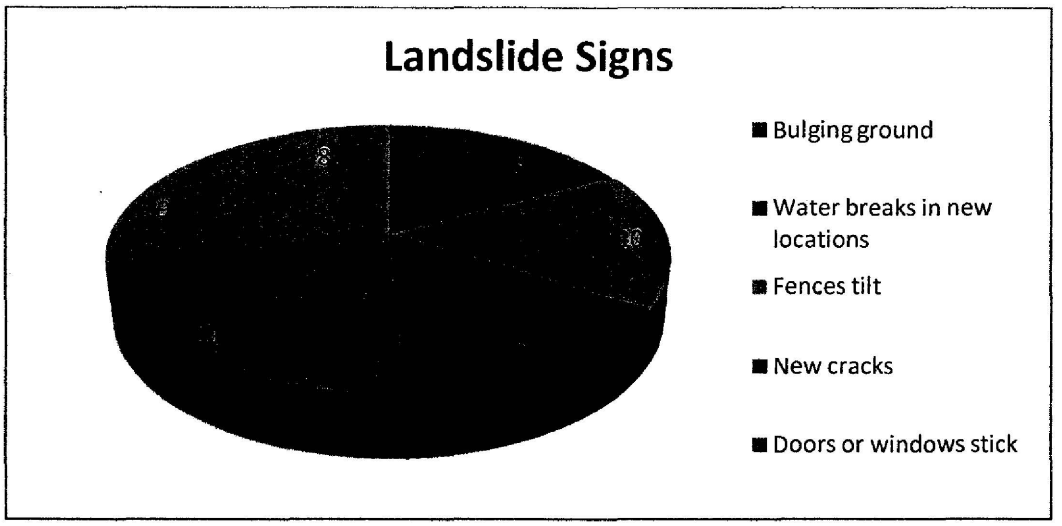

Figure 2: Landslide Signs

The discussion also highlighted respondents' knowledge on landslide cases that have happened in Malaysia. Majority of the respondents are aware of the Highland Tower, Pos Dipang and Bukit Antarabangsa tragedy that occurred in 1993, 1996 and 2008. But, they are unsure if the other locations such as Ulu Langat, Petaling Jaya, Pulau pinang are prone to landslide.

The findings also reveal that, most of the teachers are showing positive attitude towards landslide issues. They are keen to know more about landslide and how to prevent it from happening. Besides, most of the teachers are frequently involved in activities that relate to environmental preservation such as recycling, trees planting, and organizing environmental campaign. All of them also agree to take action by informing the responsible authorities if they witness any landslide occurrence. From this study, it can be concluded that the participating teachers are practicing good attitude towards the environment.

4.2 To Investigate Teachers' Perception and Awareness in Landslides Hazards in Relation to Experienceof Teaching

It is important to understand teachers' perception on landslides issues. The findings indicate that all the teachers believe that landslides are hazardous natural disaster that could harm lives and properties. Most of them do not agree with the statements that landslides in Malaysia are not critical and there is no need to control development on hill slopes. They think that mass media are useful tools that provide information regarding landslides. Five respondents (R11, R9, R7, R5, and R3) indicated that, besides mass media, they also get information about landslides from non-government organisations (NGO). Four other respondents stated that landslides awareness campaigns are essential as they can learn more through these events. Most of the respondents said that they prefer newspaper (printed media), television (electronic media) and Facebook (social media), as media tools to get information about landslides.

This study found that none of the teachers has landslides experience. Though, they are aware that landslide could happen to anybody regardless of their social status, especially those who stay at landslide prone areas. This study also found that some of the participating teachers are not aware of specific factors that contribute to landslides occurrence. Among the factors that can cause landslides include river erosion, ocean waves, vibration from traffic and machinery and earthworks which altering the shape of the slopes. Human activities such as construction, agriculture and logging may also cause landslides. Most of the teachers agree that landslides are caused by natural phenomena such as heavy raining, and human activities especially hill slope developments. It is important for the teachers to seek the most effective strategy to educate the students on landslides and safety.

4.3 To Indicate the Most Effective Strategies to Deliver Information Regarding Landslides to the Students

The findings of this study show that most of the respondents prefer using video as their teaching material. Video is a useful tool that can be used to disseminate landslides information. They believe that video is a more effective teaching and learning tool compared to other tools such as flyers or posters. The teachers added, video is more suitable especially for orang asli students because some of them are illiterate, so it provides a good platform for them to learn.

During the focus group session, the teachers brainstormed some ideas to improve the video so that it suits for educational purposes. Many of them suggested that the video include elements like footages of landslide incidents, its impacts, and how it can occur to provide easy understanding for students.

Most of the teachers also believe that animation is an effective way to capture students' attention. According to the fourth respondent (R4), the video must be attractive and provide detailed information. We should add on some graphic animation to show how landslides occur. It is also important to make the video more interesting and not to depend much on still images. However, two respondents (R2 and R5) disagree with the idea to convert the video into animation. In their opinion, animation is not suitable because landslides tragedy is something serious. They suggested that, the video must provide serious and traumatic sound to indicate that landslides are tragic, and everybody should be aware of the consequences of such hazards. All the teachers agree to discuss about the landslides issue with their students if they are provided with the educational video.

All respondents believe that both public and private sectors should be responsible for slope safety and they should take their roles seriously. The findings of this study indicate that most of the teachers are not aware of the responsible authorities to be referred to in case if they encounter landslides events.

Some of the teachers think that it is beneficial to use television as a medium to publicise and educate the public on landslides. However, younger teachers have different perspective as they find that social media such as *Facebook, Twitter, Instagram, Wechat, Whatsapp* are more important in dessiminating messages to the public. Though, they believe that in the society of *Orang asli*, television and word of mouth are the most effective ways to spread the news.

In conclusion, this study shows that most of the teachers of *Sekolah Kebangsaan RPS Banun* possess general knowledge about landslides and are aware of other environmental issues in Malaysia. They also believe that landslides are natural disasters that can harm lives and properties. Most of them think that video is a useful learning tool for students in schools. They also think that television is an effective tool to reach the mass.

Acknowledgements

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Landslide Prediction Using Numerical Analysis

[1] Swee Peng KOAY [#],[2]Habibah LATEH, [3]Naoki SAKAI, [3]Toshikazu MOROHOSHI, [3]Teruki FUKUZONO

1. Resercher, Universiti Sains Malaysia, Malaysia, spkoay@cs.usm.my
2. Associate Professor, Universiti Sains Malaysia, Malaysia
3. Researcher, NIED, Japan
(#:corresponding author)

Setting site monitoring system, with the extensometer, soil moisture probe, inclinometer and water gauge can monitor the movement of the soil in the slope. However, site monitoring system, to predict the failure of the slope, is very costly. Our study on the numerical analysis approach to predict slope failure, by calculating mechanism of resisting and driving forces in the slope, will reduce the site monitoring cost. If the factor of safety (F), where the resisting forces versus driving forces, is equal or greater than 1, the slope can be considered stable. The result of this numerical analysis on the slopes failure prediction also provides the risk boundary information which will assist the authority on making decision from time to time. In the study, we would like to propose the method of smooth information dissemination, which gives early alert information to the surroundings. Moreover, our study will also apply soil mechanical assumption on the existing slope stability equation.

Key word: Factor of Safety (F) Value, Cohesion Force and Information Dissemination

1. INTRODUCTION

In Malaysia, more landslides casualties happened recently. Besides landslide at Gua Tempurung in 2004 affecting blockage of the north-south highway, the collapse of the apartment Highland Towers in 1993, bungalow in 2002 and 2008 at Ampang were major tragedies that claimed many lives. Other incidents include the collapse of the hillside housing development in Gombak (2004), the highway rockslide at Bukit Lanjan in Selangor (2003) and the house-sized boulder rockslide at the highly populated Majestic Heights in Paya Terubong in 2003. Landslide happened along Jalan Tun Sardon in 2008 Penang caused the economical loss as the road is main access between Georgetown(Northeast of Penang) to Balik Pulau(Southwest of Penang). Recently, on 21st. May 2011, landslide happened in Hulu Langat, Selangor claimed 16 lives, 7th. August 2011, Kampung Sungai Ruil, Cameron Highlands landslide killed 7 people and 18th. February 2012, landslide buried woman and girl in Lahad Datu, Sabah.

Thus, it is very clear that landslides and other ground failures impose many direct and indirect costs to society. Direct costs include lost of life, the actual damage sustained by buildings and property, ranging from the expense of cleanup and repair to replacement. Indirect costs are harder to measure and include business disruption, loss of tax revenues, reduced property values, loss of productivity, losses in tourism, and losses from litigation. Much of the economic loss is borne by Federal, State, and local agencies that are responsible for disaster assistance and highway maintenance and repair.

Here, we study the mechanism of the slope stability and formulate the landslide prediction system which will certainly give a much better insight into disaster mitigation involving landslides in Malaysia, by several mathematical assumptions. Moreover, with better knowledge and consideration on the roles of rainfall, ground conditions, roots, vegetation and proper housing developments management in hill slopes, some landslide casualties can be prevented.

2. LANDSLIDE PREDICTION EQUATION

In Malaysia, heavy rainfall is one of the main causes of landslide. In our study, we study the stability of the slope by consideration of the sliding and the pulling force as below,
which factor of safety F can be represented as

$$F = \frac{\tau_r}{\tau} = \frac{\frac{c}{\cos\theta} + \{\gamma s \cdot H - (\gamma s - \gamma b) \cdot H1\} \cdot \cos\theta \cdot \tan\Phi}{\{\gamma s \cdot H + (\gamma t - \gamma s) \cdot H1\} \cdot \sin\theta} \quad (1)$$

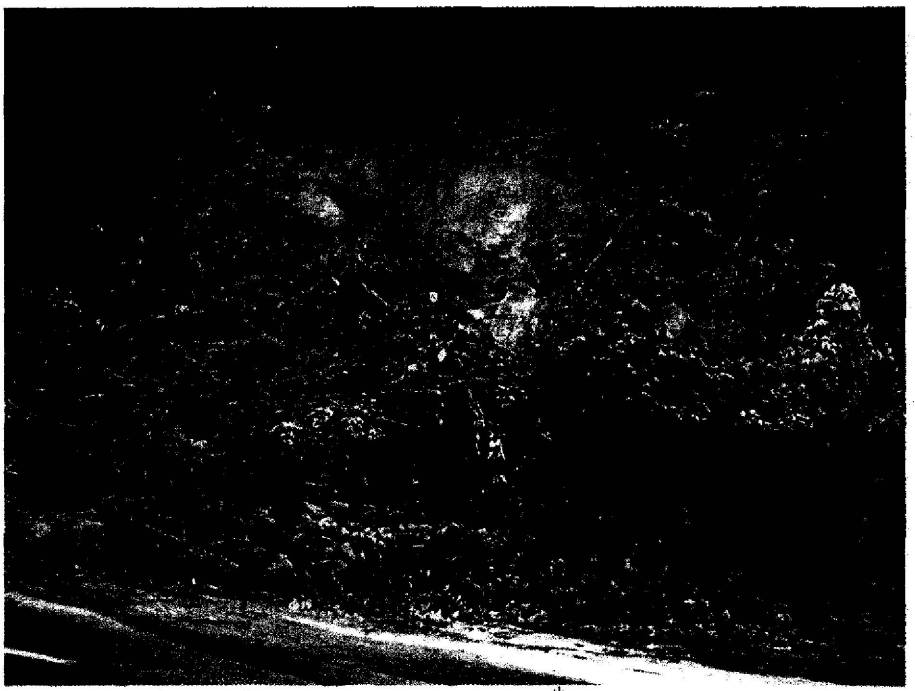


Fig. 1: Landslides along Jalan Tun Sardon , on 5th. September, 2008, in Penang

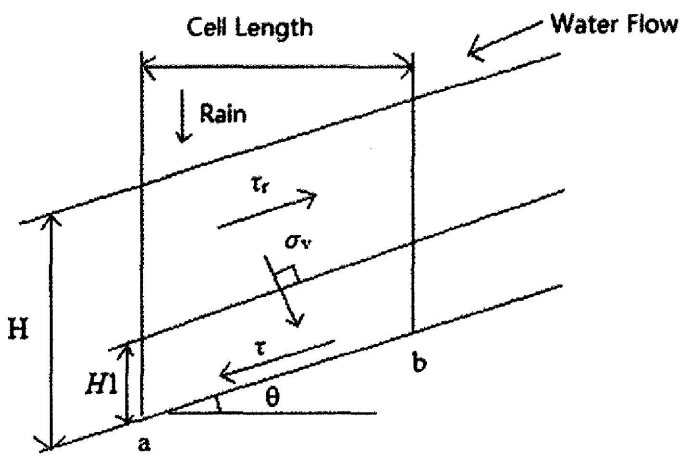


Fig.2: The stability of the slope

where H is soil height(m) , H1 is underground water table(m), θ is slope degree(°), τr is resistance force of the slope, τ is sliding force, c = cohesion force (soil sticky force) (g/cm²), Φ = internal friction angle(°), γ_s = soil unit weight(g/cm³), γ_t = saturated soil unit weight(g/cm³) and γ_b= soil unit weight in water(g/cm³) .

Here, by the equation, if this factor of safety F value is greater than 1, the slope is considered stable. We consider the flow of water in the slope

as the below hydrological equation :

$$\lambda \cdot \frac{\partial h}{\partial t} + \frac{\partial qx}{\partial x} + \frac{\partial qy}{\partial y} = qz \quad (2)$$

$$qx = h \cdot K \cdot Ix \quad (3)$$

$$qy = h \cdot K \cdot Iy \quad (4)$$

where h = water table(m), K = saturated hydraulic conductivity(m/h), I_i =hydraulic gradient in i direction, λ = effective porosity / valid porosity, q_i = the flow of water in i direction(m^2/h).

According to W. D. Kemper and R.C. Rosenau (1984), water content affects cohesion force c time by time, and the estimate of cohesion force Fs due to surface tension in soil is as below

$$Fs = 2\sigma \sum_{i=1}^{n} \frac{\rho_i}{\bar{r}_i} \quad (5)$$

Hence, we can set an assumption on cohesion force c value in Equation 1, as variable depending on time t, and the cohesion force can be represented as below, when water table in the soil is as high as H1, with the assumption by Fujiya KOMAMURA (1988),

$$\textbf{Assumption:} c = c_a \frac{(H-H1)}{H} + \frac{H1}{H} 2\sigma \sum_{i=1}^{n} \frac{\rho i}{\bar{r}_i} \quad (A1)$$

where ca is the initial cohesion force value and σ is the surface tension of the air-water interface in N/m. $\bar{r}_i$ is $((r_i+r_{i+1}))/2$, where r_i is a pore of radius in meters, and ρ_i is the fraction of the soil volume emptied of water between $(r_i + r_{i+1})$.

When the water table H1 is going up, the water content in soil becomes higher and the cohesion force will decrease as the curve which is shown in Graph 1. Here, we assume that the soil cohesion force from the bottom to H1 becomes 2, when the water table reaches H1 and the water content is more than 25%, as

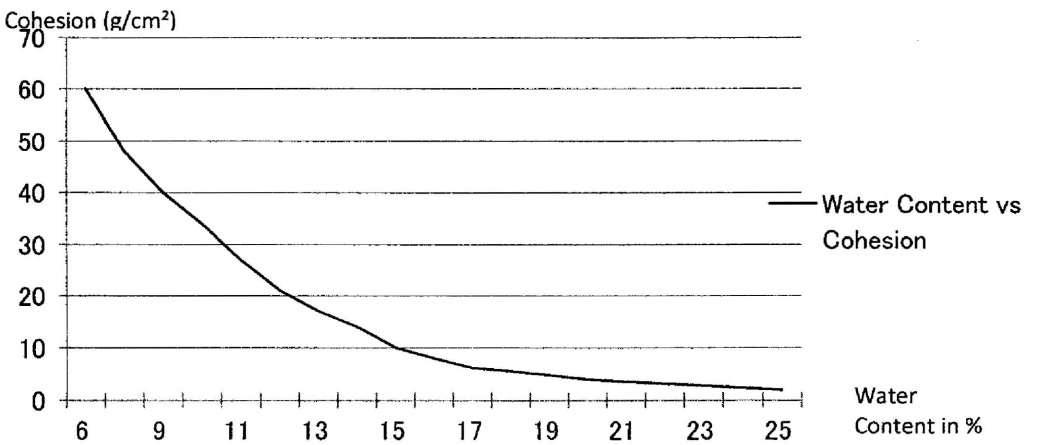
Assumption: Soil cohesion force in H1 will drop to 2 when water table reaches H1 (A2)

From Equation (1), (2), (3), (4) and Assumptions, the factor of safety F value can be obtained by running the simulation on time t.

3. LANDSLIDE PREDICION CALCULATION

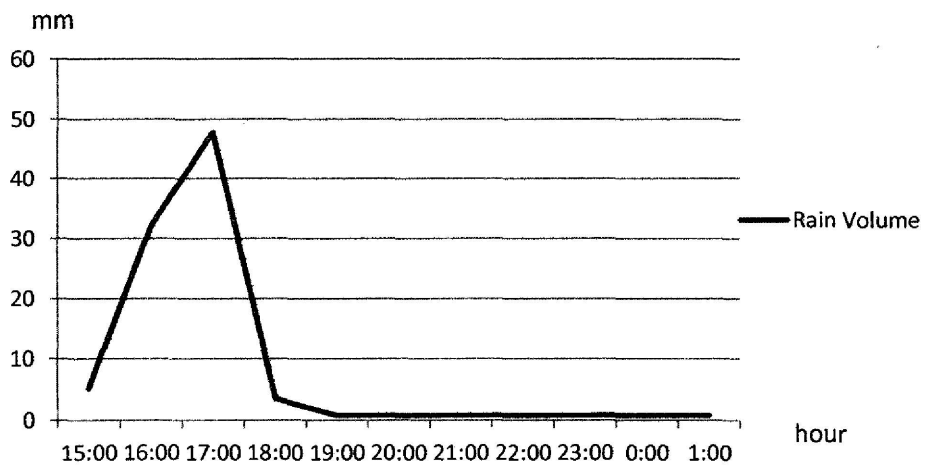
Here, we show how the landslides happened in Kampung Sungai Ruil, Cameron Highlands, at 17:50 on 7th. August 2011, with the above assumptions and calculation of the factor of safety. From the data, which are obtained from Malaysian Meteorological Department (MMD), the heavy rain, with 32.2mm/h, started from 16:00 to 17:00 and became heavier to 47.8mm/h from 17:00 to 18:00.

Graph 2, which was the recorded rain data in Cameron Highlands by MMD, shows it started to rain at 15:00 with a small shower(5.2mm/h) but from 16:00, it began to rain heavily for 2 hours. This sudden downpour caused the rise of water table in the slope, as shown in Graph 3. The rise of water table in the soil weakened



Graph 1 : Water Content versus Cohesion Force

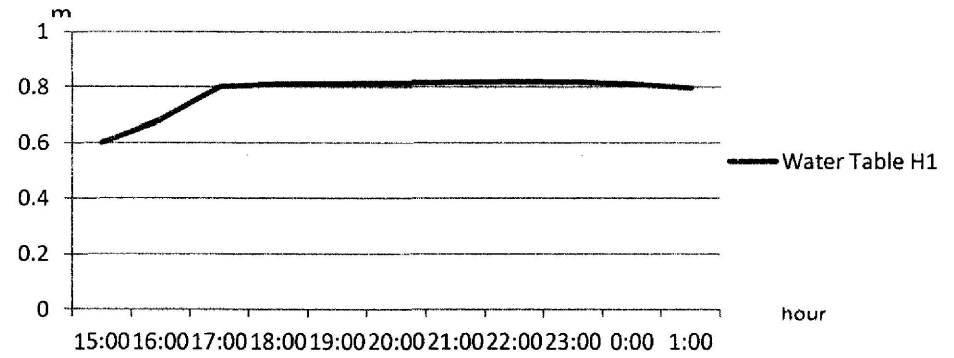
Fig. 3: Landslides in Kampung Sungai Ruil, Cameron Highlands (source: STAR)



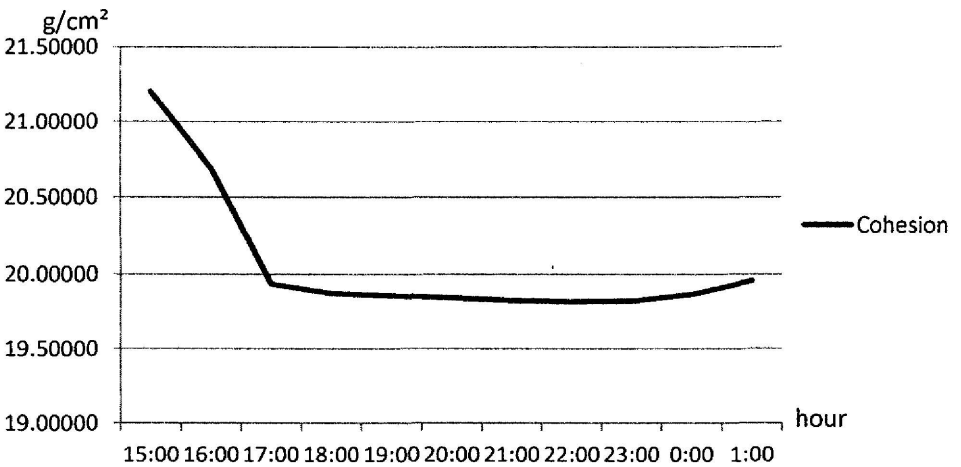
Graph 2: Rain Fall in Cameron Highlands on 7th. August, 2011(source: MMD)

cohesion force in the soil and affected the soil structure in the slope, as shown in Equation 1. Factor of Safety F value drops below to 1 due to decreasing of the cohesion force c value and rising of water table H1.

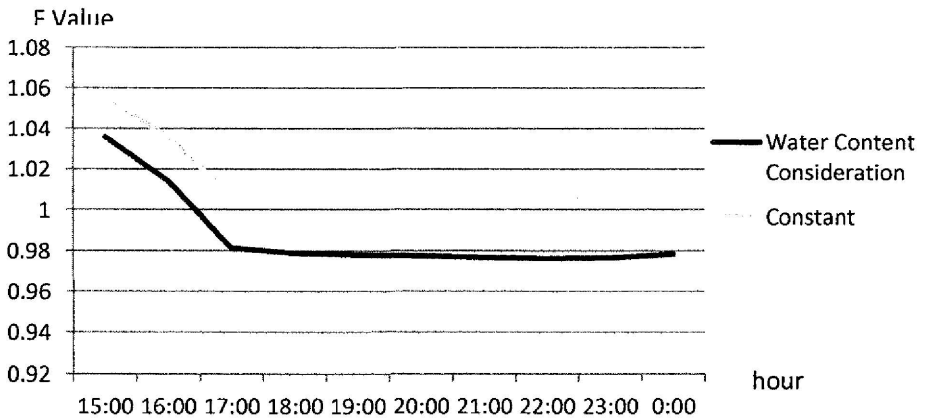
From the Graph 2 rain data, with the assumptions, the simulation showed the occurrence of landslides, as in Graph 4 and Graph 5. Graph 4 shows that the cohesion force value decreases when the level of water table H1 goes up. And, the F value slips down accordingly, as in Graph 5. Casualties and houses were buried beneath the landslide. Graph 5 also shows that without the consideration of assumptions (where cohesion force c is constant), factor of safety F value (light blue) remains more than 1 and does not indicate any risk of landslide happening.



Graph 3 : Water Table H1 in Kampung Sungai Ruil, Cameron Highlands on 7th. August, 2011



Graph 4 : Soil cohesion force c in Kampung Sungai Ruil, Cameron Highlands on 7th. August, 2011



Graph 5: Factor of safety F in Kampung Sungai Ruil, Cameron Highlands on 7th. August, 2011

4. EARLY WARNING SYSTEM

In our further study on landslide, the dynamical landslide prediction will be enhanced by linking rain gauge automatically. Rain data will be collected from monitoring site and sent to the server via internet. After processing rain data in the server, the data will be sent to the workstation where the landslide prediction system calculates the stability of the slope with the surveyed soil property.

The calculated result will be disseminated to the government agencies(Command and Control Centre) and local authorities. The officers study the climate data and GIS data from satellite, and analyze the calculated result in Command and Control Centre before making decision on when to issue early warning for evacuation from the risk area. The study on information delivery method and providing the past data and history to alert the public on the risk management will also be conducted in future.

The study on vegetation practice to strengthen soil structure in the slope to prevent the occurrence of tragedy, will also be one of our studies in the future.

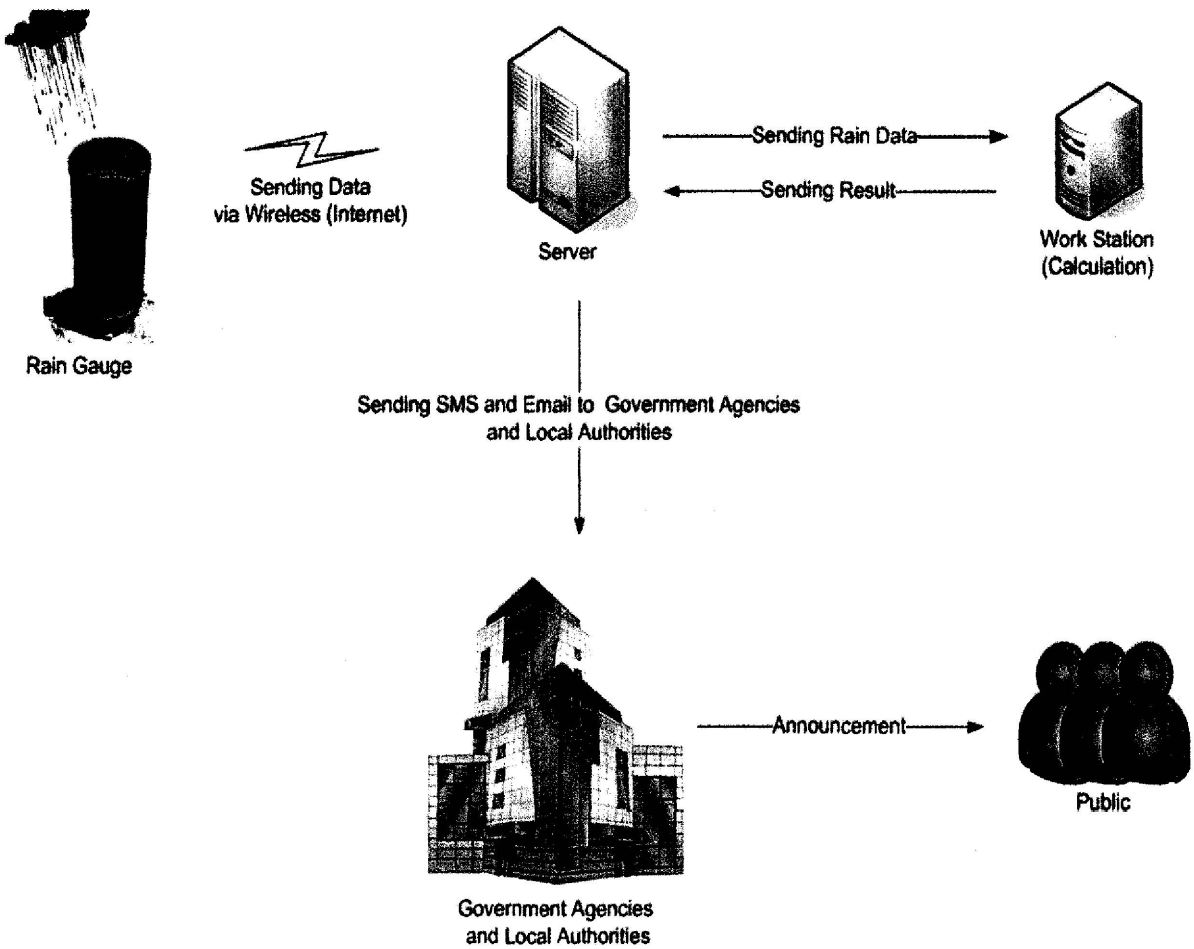


Fig. 4: Landslides Prediction Information Delivery System

5. CONCLUSIONS

We managed to reproduce the possibility of landslide happening in Kampung Sungai Ruil, Cameron Highlands with landslide prediction system. This simulation also shows that the differences of the results between with and without the consideration of water content affected cohesion force in soil, as in Graph 5. The assumptions that we proposed in this study can be taken into consideration while calculating soil cohesion force.

Although the factor of safety F value is only simulated through computing machines, it can be one of the key references for making decision on alerting the public, besides images from satellite, data from radar and installed devices in monitoring sites. Setting more monitoring system and rain gauges in the risk area will help to reduce casualty.

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SensorML-NT: Innovative Geographical Sensor Description Collection for Mobile Devices Handling Environmental Issues

Nazi Tabatabaei Yazdi[1], Chan Huah Yong[2,]

1. **PhD Student, School of Computer Science, Universiti Sains Malaysia, ntyazdi@ieee.org**
2. **Associate Professor, School of Computer Science, Universiti Sains Malaysia, hychan@cs.usm.my**

(1:corresponding author)

Abstract

Natural hazard cannot be eliminated from the earth and some may lead to disasters. Additionally, the numbers of unnatural disasters are increasing. This paper addresses handling the environmental issues using mobile devices. Today's mobile devices are pervasive and equipped with growing sets of powerful embedded sensors. Due to the application nature of these devices, they have built an unsought large scale sensor network worldwide. Whereby, the intelligence of human users controlling mobile devices and its sensors will give the collected data more value. However, due to the limitations of mobile devices, the need for central services is required. The scope of this paper is to use the mobile devices as sensing nodes. This framework can change many sectors of environmental issues, collecting, monitoring, processing and storing the information. This paper proposed the SensorML-NT (Sensor Model Language-Network Translator), using the Open Geospatial Consortium (OGC) standards (SensorML and Open GeoSMS). The proposed system enables mobile owners to describe their mobile devices with SensorML specification format, in a fast, efficient and automated manner. This specification features a transparent plug and play automated sensor description for mobile devices. According to the implementation, established in a formulated architectural framework, this approach has been evaluated for solving the mobile device comprehension to geospatial data via Cloud services. The final created SensorML schema is later validated using VisAnalysis and Systems Technology (VAST) SensorML validator web service by giving the URL of our data stream on "Sensor.Network".

Keywords: GIS, OGC, SensorML, Mobile sensing, GeoSMS, voluntary data.

1. Introduction

Natural or man-made hazard and disasters happen frequently each year (i.e. flood, tsunami, earthquake, etc,). For predicting and analyzing these cases, there is a need for huge amount of data and information about different aspects of locations over long periods of time. Therefore, there is a need for finding new ways of collecting data and handling them in a standardized and understandable manner.

Nowadays, individuals frequently own a collection of mobile devices. With the growing numbers of powerful embedded sensors available in them, they can observe and collect data [1]. Oppose to basic sensor networks, because of the intelligent human users, the collected data would be more valuable. The mobile devices could be used in situations where basic sensors could not be employed (e.g., tunnels, shopping malls, etc.) or cannot be predicted, such as natural disasters (earthquake, floods, etc.) Therefore, with the help of voluntary data captured by mobile phones a richer database could be achieved [2].

The main objective of this work is to find a better solution for handling environment issues, by collecting the numerous amounts of geospatial environmental data from around the globe, accommodating the available mobile devices as sensing nodes as opposed to systems where they are using basic sensor networks.

1.1 Geographic Information System (GIS)

Many environmental problems and habitat-monitoring tasks, disaster managements and etc., require near real-time field mapping and precise positional information [3]. To allow applying general principles to specific conditions of each location or tracking what is happening at any place, it is essential to have access to details of the immediate surroundings and require information of specific places on the earth surface; The information are called geographical information or spatial data.

On the other hand, Geographic information system (GIS) is used generically for any computer-based capability for manipulating geographical data. A GIS includes hardware and software and also the spatial data.

The increase integrations and combinations of the geographical data, increase mutual understanding among users, and eliminate technical problems for exchanging data between different systems. However the Geographical information and its systems must be standardized, so the data can be useable and understandable. The standard will provide definition of data structures, data content, and rules [4].

1.2 Geospatial standards

"The Open Geospatial Consortium (OGC)" is an international industry consortium of 413 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards. OGC Standards support interoperable solutions that "geo-enable" the Web, wireless and location-based services and mainstream IT. The standards empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications.

OGC and OpenGIS are registered trademarks of the Open Geospatial Consortium (OGC). OGC is the brand name associated with the standards and documents produced by the OGC. OGC standards are developed in a unique consensus process supported by the OGC's industry, government and academic members to enable geo processing technologies to interoperate, or "plug and play" "[5].

The OGC also has close relationship with ISO/TC 211(Geographical Information/ Geomatric). As The OGC Abstract specifications is progressively being replaced by ISO 19100 volumes series. Further, the Web Map Service and Simple Features are ISO standards; where GML will also soon be approved as another ISO standard. OGC also works with other international standards including W3C and OASIS.

2. Related work

Increasingly popular worldwide, Location Based Services (LBS) applications cover a wide spectrum of wireless users, for fleet management in location identification, for cases such as emergency, or travel aids. Current methods of GeoLocation would be classified into: GPS-based, cellular network based, or a combination of both aka AGPS (AssistedGPS) [6, 7].

Mok et al., research, developed with ESRI's GIS Active X - Map Objects, sends a request to the service gateway for the mobile device's location [6]. The position of the mobile device is send via internet, for the mobile device equipped with JAVA SIM card. Finally, relevant information would be sent to the mobile device by SMS message.

Licoppe et al., methodology, experiments an empirical apparatus for collecting and aggregating data, using mobile phone; concerning the locations of users and their communications [8]. Hester et al., as part of Mission 4636, after a 7.0 magnitude earthquake struck Haiti on 12 January 2010, conducted Crowd sourced Translation [9]. Crowd sourcing, filter, verify, translate, and geo-tag, all the incoming SMS reports, by distributed entity.

Numerous works has been carried out, related to the field of OGC SWE (sensor web enablement). As a representative in this area, Asian Institute of Technology develops an infrastructure for Sensor Asia, called Sensor Service Grid (SSG), which integrates fieldserver and Web GIS to realize easy and low cost installation and operation for the ubiquitous field sensor network. Honda et al., outlines the problem, where it requires the need of highly skilled engineers to set up a sensor network [10]. By introducing a SSG, which is designed is to run of two parts, the SOS Station and the SSG centre service, it supports sensor 'Plug and Play'. However the designed architecture of the

SOS Station is quite complicated; itself consist of fieldserver combined with a small Linux Box which gives a high capability of storing sensor data and provides data connectivity. Note that, the sensors are connected via feeders designed for that particular sensor; where the data can be obtained in SensorML Observation and Measurement (O&G) encodings.

3. Design and implementation

In this section, the standards selected for the purposed architecture and the methods to overcome the existing problems, creating a more scalable and transparent web service will be presented in detail.

3.1 Proposed communication method

Worldwide humanitarian crisis would be facilitated with effective responses sharing information, with the use of distributed, SMS-based systems [9]. Previous authors have tried to overcome existing information sharing challenges, with the use of SMS-based systems; also geo-locating the devices. However, there are no exact attempts on how it can use the mobile devices as sensing nodes.

The selected standard is OGC Open GeoSMS Specification [7]. Open GeoSMS specification is to facilitate the communication among different Location Based Service (LBS) devices or applications; designed to be used by Short Message System (SMS) applications on mobile phones or on Personal Navigation Devices (PND) capable of handling SMS.

Due to the use of SMS this standard is practical and a convenient way, which will save money, time, and human resource. It simplifies the communication problem, without causing too much effort or cost, since there is no need to change the infrastructure or existing systems. More importantly, the coverage of cellular networks is higher than it is for Wi-Fi availability. This fact will insure a higher connection probability of the mobile devices to the GIS services opposed to normal internet connection. Noting that, all mobile devices are not equipped with Wi-Fi.

Furthermore, the user only needs to send a text which follows the Open GeoSMS standard format, and then it is ready to be used. Therefore, two different types of devices from different companies running different systems, can communicate using the Open GeoSMS specification. Table 1 illustrates the format structure and definition of the OGC Open GeoSMS message.

Table 1: Open GeoSMS format Structure.

Field	**Prefix (Mandatory)**		**Latitude (Mandatory)**	**Longitude (Mandatory)**	**Format Type (Mandatory)**	**Payload (Optional)**
Item	GeoSMS	Version Number	Latitude under NMEA0183[2]	Longitude under NMEA0183	format initial name	extra data for special purpose

3.2 Proposed method of using mobile devices as sensor

While Sensor networks coordinate monitoring of particular phenomena by linking spatially distributed sensors, Sensor Webs are distinct; its loosely couple web services, enabling distribute discovery, exchange and processing the sensing nodes that are interpolated using standardized interfaces. To include interaction beyond sensor-to-sensor exchanges, (such as, sensor-to-forecast model exchange) and making observation available, the role of GIS Web applications comes into play [11, 12].

Additionally, SensorML is one of the mechanisms for describing sensor resources on the web. Furthermore, completely distributed workflow descriptions on the web are facilitates by SensorML. However some existing challenges still remain on how to fully capture the requirements as relating to open and distributed environments using SensorML which some extensions are required [13].

For using mobile devices as sensing nodes, this work has employed Open SensorML specification. This specification is the predominated standardized mechanism of describing sensor resources for sensor web enablement [14].

3.3 Contributions

After selecting the OGC Open GeoSMS Specification for the communication standard of our mobile device, to enable the GIS services to use the mobile devices as sensors, the exigencies role of a translation method is visible. Packages of Open GeoSMS must be sent to the translator web service so it can be GIS services.

The contribution of this research paper was introducing SensorML-NT (Sensor Model language-network translator). SensorML-NT is a translating web service, located between the GIS service and the mobile devices; after receiving the GeoSMS packet, the data will be pulled out and inserted in the Open SensorML schema in a relevant manner, ready to be used by the GIS services. The process is pictorially shown in Figure 1.

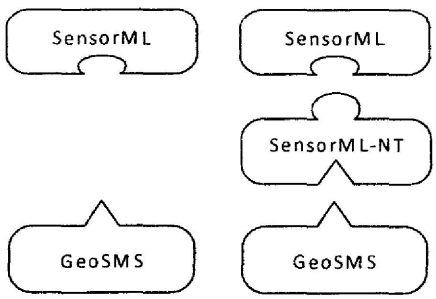

Fig. 1: SensorML-NT.

4. Validation

To evaluate the system and validate the created SensorML description, VisAnalysis and Systems Technology (VAST) SensorML validator web service is used. VAST SensorML validator is an open source project available, which we have been running on a Tomcat server; by giving the URL of the SensorML description produced by the use of SensorML-NT, it could be verified. This web service is shown in Figure 2.

5. Conclusion

One of the problems of handling environmental issues is that the installation of sensors, collection of the data also eliminating the lack of standardization of the collected information, requires professional engineers. This paper has introducing SensorML-NT, inspired by combining two of the available OGC specifications, SensorML and GeoSMS. SensorML-NT is an innovative way of communicating and describing mobile devices as sensing nodes, in a transparent, Plug and Play, Automated, sensor description service. It allows mobile devices to easily describe themselves as sensing nodes from anywhere – anytime, in a pervasive manner so they can be used in handling environmental issues by OpenGIS.

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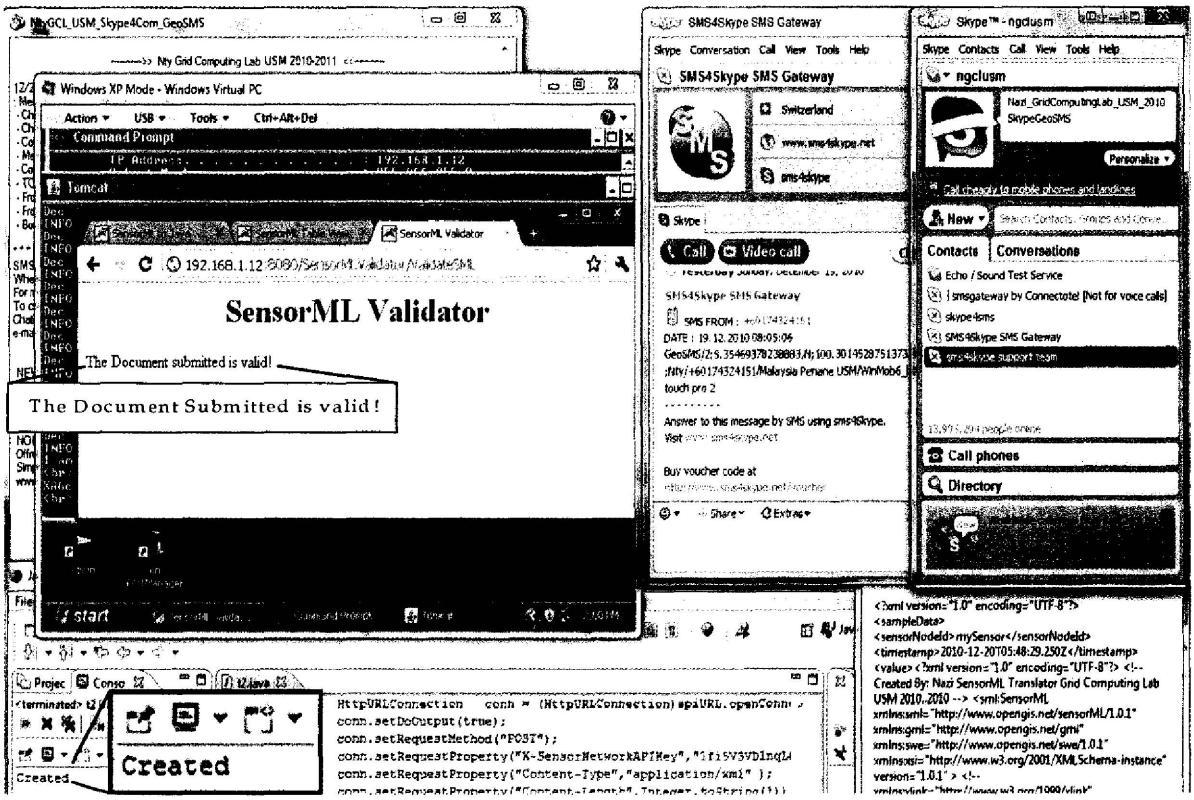

Fig. 2: A scenario of SensorML-NT is successfully created and validated.

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Investigation of Root Area Ratio of *Macaranga tanarius* (L.) Müll. Arg. (parasol leaf tree) in rainforest, Penang, Malaysia

Nazi Avani[1], Habibah Lateh[1], Ghasem Habibi Bibalani[2]

[1] School of Distance Education, Universiti Sains Malaysia, P.Pinang

avani.nazi@yahoo.com ; habibah@usm.my

[2] Shabestar Branch, Islamic Azad University, Shabestar City, East Azerbayjan, Iran

habibibibalani@gmail.com

Abstract

Plants can substantially improve slope stability and prevent soil slippage on two ways, through hydrological mechanisms lowering pore water pressure and through mechanical reinforcement of soil by roots. Root Area Ratio (RAR) with depth, root distribution over different root diameter classes and root tensile strength are the most important parameters in root reinforcement and slope stability. In this study, four trees of Macaranga tanarius (L.) Müll. Arg. (Parasol leaf tree were) were randomly chosen from in the rainforest, Pinang, Malaysia for root distribution analysis. For analyzing root distribution profile trenching method was used. The result shows that the amount of Root Area Ratio (RAR) is 1672.83 mm^2 m^{-2}.

Keywords: Root Area Ratio (RAR), *Macaranga tanarius*, slope stability, Pinang

Introduction

Plants can substantially improve slope stability and prevent soil slippage on two ways, through hydrological mechanisms lowering pore water pressure (Gyssels *et al.*, 2005) and through mechanical reinforcement of soil by roots (Nilaweera and Nutalaya, 1999; Burylo *et al.*, 2011). The most important parameters of the root system governing soil fixation are root density, depth and tensile strength (Genet *et al.*, 2008). The anchorage of roots and the improvement of slope stability depend on the properties of root systems such as the root distribution and tensile strength (Nicoll and Ray, 1996; stokes and Guitard, 1997; Li *et al.*, 2007; Sun *et al.*, 2008), root number, root diameter or rooting depth (Wu *et al.*, 1979), root system architecture (Duputy *et al.*, 2005) and pullout resistance (Nilaweera and Nutalaya, 1999).

It has been reported that there is a close relationship of root system resistance moment with the root number, as well as the changes in root angle and diameter (Sun et al., 2008). Root Area Ratio (RAR) has been used as an indicator of root density by many authors (De Baets *et al.*, 2008; Sun *et al.*, 2008; Abdi *et al.*, 2010a; Abdi *et al.*, 2010b; Comino and Marengo, 2010; Burylo *et al.*, 2011). Authors have reported previously that reinforcement may be derived from an increase in the Root Area Ration (RAR) at the shear plane (Loades *et al.*, 2010). The effect of tree roots on the stability of a slope can be considered in terms of their strength and distribution within the soil. These two factors control the main stabilization mechanisms such as soil reinforcement, soil arching and buttressing and root anchoring (Nilaweera and Nutalaya, 1999).

RAR is influenced by type of species (size, order) and site characterization such as soil type, land use management, climate, associated vegetation societies, spatial variability of vegetation properties (density, age), etc. (Genet *et al.*, 2008; Abdi *et al.*, 2010b).

The aim of this study is to obtain the information about *Macaranga* roots distribution in the rainforest as a native tree in Malaysia.

Materials and Methods

Site details

Major forest types in Malaysia are lowland dipterocarp forest, hill dipterocarp forest, upper hill dipterocarp forest, oak-laurel forest, montane ericaceous forest, peat swamp forest and mangrove forest. In addition, there also smaller areas of freshwater swamp forest, heath forest, forest on limestone and forest on quartz ridges.

The forests in Malaysia are mostly dominated by trees from the Dipterocarpaceae family, hence the term 'dipterocarp forests'. The dipterocarp forest occurs on dry land just above sea level to an altitude of about 900 meters.

Dipterocarpaceae are a family of 17 genera and approximately 500 species of mainly tropical lowland rainforest trees. The family name, from the type genus Dipterocarpus, is derived from the Greek (DI = two, pteron = wing and karpos = fruit) and refers to the two-winged fruit. The largest genera are *Shorea* (196 species), *Hopea* (104 species), *Dipterocarpus* (70 species), and *Vatica* (65 species). Many are large forest emergent species, typically reaching heights of 40–70 m tall, or more than.

Macaranga (mahang) is a genus which is widely distributed in Malaysia. The populations are generally found in village-thickets, wastelands, at the edge of forest reserves or in swampy forests. In Malaysia alone, there are 27 species of Macaranga from the total of 280 species worldwide. *Macaranga* genus is fast growing, soft-wooded, evergreen trees reaching a height of 20 m (Zakaria *et al.*, 2008).

Macaranga tanariusis , native to Malaysia, cultivated for a variety of uses. This small tree grows as an ornamental tree in landscaping and for reforestation projects in warm tropical regions of the world. The following uses for *M. tanarius* are listed by World Agroforestry Centre (2002). Average annual rainfalls in the areas that Macaranga grows varies from 40-over 80 in (100-over 200 cm) with average temperatures ranging from 50-over 68 F (10-over 20 C) in January to over 86 F (over 30 C) in July (Hammond 1986). In these regions, *M. tanarius* grows up to an elevation of 1,500 m (4,921 ft) and is common in secondary forests, especially in logging areas and also is found in thickets, brushwood, village groves, and beach vegetation (World Agroforestry Centre 2002). *M. tanarius* grows in a variety of soil types including clay, loam, and sand and is usually found in the lowlands (World Agroforestry Centre 2002).

Four trees were randomly chosen for the Root Area Ratio (RAR) and their diameters at breast height (DBH) were measured and recorded. The average DBH in our samples is 13 cm.

Root measurements

Root Area Ratio (RAR) has been used as an indicator of root density by many authors (De Baets *et al.*, 2008; Sun *et al.*, 2008; Abdi *et al.*, 2010a; Abdi *et al.*, 2010b; Comino and Marengo, 2010; Burylo *et al.*, 2011). Authors have reported previously that reinforcement may be derived from an increase in the Root Area Ration (RAR) at the shear plane (Loades *et al.*, 2010). RAR is defined as the fraction of the soil cross-sectional area occupies by roots per unit area (Gray and Leiser 1982; Abdi et al., 2010a; Comino and Marengo, 2010).

Root Area Ratio (RAR) investigated using a vertical trench profile wall method (Bischetti *et al.*, 2009; Bischetti *et al.*, 2005; Abdi *et al.*, 2010a; Abdi *et al.*, 2010b; Ji *et al.*, 2012; Schwarz *et al.*, 2012). RAR values were assessed by recording the size and location of all roots intersected by vertical profile walls (Abdi *et al.*, 2010b). At each tree, one trench was dug at a distance of 25 cm from the stem and The profiles were 50 cm long×50 cm depth (Ji *et al.*, 2012) (figure 1).

Layers 10 cm thick were marked on the vertical profile walls by counting roots and measuring the mean root diameter (Abdi *et al.*, 2010a; Abdi *et al.*, 2010b; Bischetti *et al.*, 2005; Comino and Marengo, 2010; Comino *et al.*, 2010; Hudek *et al.*, 2010; Ji *et al.*, 2012). Root numbers were then counted and separated into different diameter classes i.e., 0-1, 1-2 mm, 2-5 mm, 5-10 mm and >10 mm (Genet *et al.*, 2008; Ji *et al.*, 2012). Roots belonging to the tow first range will classify as fine roots, the others being denoted thin roots (Ji *et al.*, 2012).

Based on the diameters of roots, the area that was occupied by roots in each layer determined using the following equation:

$$\sum_{i=1}^{i} \left(\frac{\pi}{4} \cdot d_i^2\right),$$

Where d_i is the diameter of the *ith* root in millimeters (Abdi *et al.*, 2010b).

Figure 1a: location of roots in hole

Figure 1b: sample of *Macaranga* roots

Result

Root measurements

With that formula, the total RAR analyzed in four treatments and show in the tables 1 to 3. The result shows that the amount of Root Area Ratio (RAR) is 1672.83 mm2 m-2.

Table 1: The number of roots in four treatments

Depth	Root diameter (mm)				
	0-1	1-2	2-5	5-10	>10
1-10	185	64	10	6	3
10-20	81	24	4	1	0
20-30	39	19	15	0	0
30-40	26	9	11	2	0
40-50	14	9	6	7	0

Table 2: RAR in four treatments

Depth	RAR				
	0-1	1-2	2-5	5-10	>10
1-10	36.30625	113.04	96.1625	264.9375	235.5
10-20	15.89625	42.39	38.465	44.15625	0
20-30	7.65375	33.55875	144.2438	0	0
30-40	5.1025	15.89625	105.7788	88.3125	0
40-50	2.7475	15.89625	57.6975	309.0938	0

Table 3: Total RAR in four treatments in diameter classes

0-1	1-2	2-5	5-10	>10
62.70625	220.7813	442.3475	706.5	235.5

Conclusion

Many authors (De Bates *et al.*, 2008; Sun *et al.*, 2008; Abdi *et al.*, 2010a; Abdi *et al.*, 2010b; Comino and Marengo, 2010; Burylo *et al.*, 2011), have used RAR as an indicator of root density. This author concluded that the amount of RAR is high in the up layers, but as we can see in this article there is some Inconsistency, for example the amount of RAR in the root diameter of 2-5 mm, in the depth of 20-30 m is most and also in the root diameter of 5-10mm, in the depth of 40-50 the amount of RAR is the most. As Chiaradia (2012) mention that, Roots, in fact, tend to grow near the surface because of the richness of nutrients, water and gases. Nonetheless, plant roots can run very long in depth (meters below soil surface) if the above factors are limited in shallower layers, but their density dramatically decreases with depth. In this study the total RAR value is 1672.83 mm^2 m^{-2}. When RAR, and root density in general, are used to estimate the root contribution to stability, then the use of average values should be avoided because they can lead to a dramatic overestimation of the additional cohesion at the sliding surface (Bischetti *et al.*, 2009).

RAR is an important factor to obtain soil shear strength due to presence of roots, then obtain information about the number of roots that occupied the soil can be very useful. In this study, we gather the number of roots in different soil depth of understanding about the area that occupied by the roots. Di Iorio *et al.* (2005) stated that the larger cross-sectional area of the roots can only be due to the greater mechanical stresses (cited in Abdi *et al.*, 2010a), then this may imply that in this area *Macaranga* species is under tension. Although for the best conclusion we need another information such as tensile strength. Sokes *et al.*, (2008), mention desirable plant characteristics for vegetation of a slope stability problem, that in our studied species we can find these

characteristics: ready propagation from cuttings and root suckers, because in the study area we can see coppice shoots and also a low canopy is the other ideal that we can see in the species. However, on the other hand we can choose *Macaranga tanarius* as a suitable species on slope stability.

Also, the other parameters such as species, soil type and site conditions have an effect on root systems (stokes et al., 2008), that in the other research we consider these parameters on RAR.

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The Effect of Intervention on Landslide Knowledge among Students in Higher Institution, Malaysia: A Case Study

CHAN Huah Yong[¥] Habibah LATEH[*]
Mohd.Razha ABD RASHID* Anton ABDULBASAH[*] Jainambu M D MOHD SULTAN[¥]

[¥]School of Computer Sciences, USM, Penang, Malaysia,
*School of Distance Education

Abstract

Knowledge is an important indicator in an effective landslide mitigation strategy. Knowledge has to be acquired by people living in high risk areas for landslide occurrence such that they will be able to identify early signs of landslides. The students of USM communities living along the slope area are the focus of this study. The result supports the alternative hypotheses stated in the study. Knowledge has improved with the intervention which affects positively the willingness to practice along with right attitude among students. Willingness to practice outscored the attitude and knowledge acquired by students after the intervention where 40% of the students strongly agreed to report any early warning signs encountered before landslide strikes. Also, male students portrayed positive changes in attitude as compared to female who showed none. Those who were "strongly disagreed' or 'disagreed' prior to intervention has changed their notion towards either 'agreed' or 'strongly agreed'. This shows that the intervention facilitates support for collaborative effort with tools such as the e-participatory platform and enables them to interact with its environment.

Keywords: *landslide education; landslide hazard; knowledge, attitude, practice*

1 Introduction

The occurrence of landslides hazards in Malaysia has been increasing at an alarming rate not only due to natural causes but also man-made causes. Landslides are defined as a massive mass of soil and rock debris that move downhill because of the action of gravity. It is important to note that landslides hazard can be prevented. The effect of most hazards including landslides can be reduced through community preparedness, timely warnings, and effective response. Community preparedness that involves education on landslide mitigation is crucial in minimizing the effect of hazards. Therefore, landslide hazard identification is an important determinant in order to avoid injuries, casualties and loss of properties in landslide prone areas. It is the development in disaster management that intrigued research interest in landslide study and on landslide education and mitigation areas. In Malaysia, this kind of research is still in its infancy in regards to landslide hazards.

1.1 Related Studies

It is important to study the level of preparedness among students in higher institution in dealing with landslide issues. They are the most ignorant and vulnerable group of public that can be easily nurtured for good cause. As profoundly mentioned by Norris (2008) [1], it is crucial to transform at-risk communities to disaster resilient communities but the community needs to be organized prior to mobilizing them to disaster mitigation strategy. Hence it is important that the community have the capacity to cope with the impact of a disaster and are involved in the development of disaster management activities from the beginning.

Community participation can also make them more confident in their capabilities to act in the event of a disaster (Newport & Jawahar,

2003)[2]. In this spirit, the level of knowledge on landslides among students was measured. This is the generation of students that will be faced with greater challenges in dealing with landslide disaster. It is pertinent to educate them on the mitigation of landslides hazards using an interactive e-portal as they are living in landslide prone areas. As noted by Claire Fagin (1987)[3], knowledge will bring the opportunity to make a difference. According to Norris (2002) [4] preparedness is mediated by specific knowledge, skills and the likelihood of taking appropriate actions when disaster strikes. These behaviour promoting factors are classified as the cognitive and psychomotor domain in Bloom's taxonomy of learning where it is crucial to start from the simplest behaviour to the most complex ones as in requiring immediate response to disaster. Therefore, salient but trivial components such as awareness, knowledge and preparedness influence the mode of response to landslide hazard and risk faced by the community (Roubhan, 2008[5]; Abhinav Sinha et. al, 2008[6]) in particular for those living in high risk areas. It is important to acquire adequate knowledge and practice about disaster mitigation strategy by attending disaster related education where the knowledge level increases and people's attitude towards disaster management improves (Adem Ocal, 2011[7]). Research on landslide awareness among secondary students in Malaysia finds that their awareness level is moderate (Habibah Lateh &Vijaya Govindasamy, 2012)[8].

Further, as technology becomes more embedded in our daily lives, the incorporation of communication technology in this research is timely as technology can be used to achieve positive community outcomes like increasing access to local information, promoting civic engagement, and creating avenues for collaboration and communication (Jenkins and Thorburn, 2003[9]). Because achieving positive community outcome is fundamental, this research aims to study the effect of intervention (via e-portal method) towards the level of knowledge, attitude and willingness to practice landslide mitigation among students.

1.2 Objective

This research has 3 objectives that ought to be achieved. The first objective is to identify the level of knowledge on landslide among students. The second objective is to identify the effect of intervention on attitude and willingness to practice landslide mitigation among students and the third one is to gauge the difference of the effect of intervention among gender. In order to fulfil these objectives, three hypotheses tested were:

H_{A1}: The knowledge on landslides improved the attitude and willingness to practice among students

H_{A2}: The intervention affects the attitude and practice of landslides among students

H_{A3}: Knowledge, attitude and willingness to practice landslide mitigation differ among female and male students

2 Methodology

Data for this study was collected using a questionnaire. It was a self-administered questionnaire but with some help to the students having troubles understanding the questions. A pilot study was conducted prior to the distribution of the questionnaire. A sample of 30 students was given the questionnaire during the pilot study. Upon the completion of the pilot study necessary amendment was made to validate the questionnaire with cronbach's alpha value of 0.797. The currently used epistemetric method may be considered as a "set of rules" by which the numbers (scores) or measurements are produced by using Likert scale - and thus to indicate level of agreement from 1 'Strongly disagreed' to 5 'Strongly agreed' about the correctness to each statement of attitude, willingness to practice and knowledge. The pre-intervention questionnaire was distributed to 89 students living in the slope area in USM. The nature of questions in the questionnaire

were tailored to ease the understanding on landslide as well as to capture the level of knowledge and the impact of intervention on their attitude and willingness to practice landslide mitigation among students in the pre-intervention setting. This was the first phase of data collection.

The second phase of this research was the intervention method. The students were given the exposure on how to navigate through the landslide portal. The portal has been incorporated with a forum platform to help the students to stay connected. It also linked to relevant departments whom are responsible to curb landslide and other disasters. They were asked to manoeuvre through the portal and gauge as much benefit as possible within the allocated time frame of 3 weeks from 21st January till 12th February 2015. They were also asked to use the interactive e-portal to discuss among themselves on the topic displayed in the module for preparedness and mitigation of landslide.

In the final phase of data collection, a post-intervention questionnaire was uploaded on the e-portal which required all the students involved in the first and second phase to complete. The data was later tested in order to accept or reject the hypotheses using statistical analysis IBM version 21.

3 Result and Discussion

Upon completion of this study the result supports the alternative hypotheses stated in the previous section. The premise of this study is that, as consequence of learning occurs through e-participation, in this case, the students will later be able to practice and be willing to take some responsibility to curb landslide. This requires the students to acquire the necessary knowledge, skills and attitudes, retain the learned material until a later time when it will be retrieved and used to make decision, select and execute actions.

As such, the e-participatory platform facilitates support for collaborative effort with tools enabling joint fact finding, a deliberative process where public and experts work together to determine the following: what they do not know; what they need to know in order to make an informed decision; and how they are going to learn together. This process is similar to participatory communication because both involve the combination of expert and public knowledge and information. This duality has mooted the retention of learned materials to reach the real environment which remains an important challenge.

Questions asked to ascertain the agreed response on attitude were designed in negative statements such as *,'It is difficult to take cognizance of the landslide', 'I had to take cognizance of the disaster/landslide to be prepared when disaster strikes',' I am not ready to take cognizance of the disaster/landslide' and so forth.* The students' attitudes towards landslide were tested based on these questions. They understood and more importantly intrigued to stay on and participate through the final phase of intervention. In addition, these statements became especially useful in obtaining valuable information from these students. It helped to have a better understanding on situations on what information was most useful to provide insight on the students being studied.

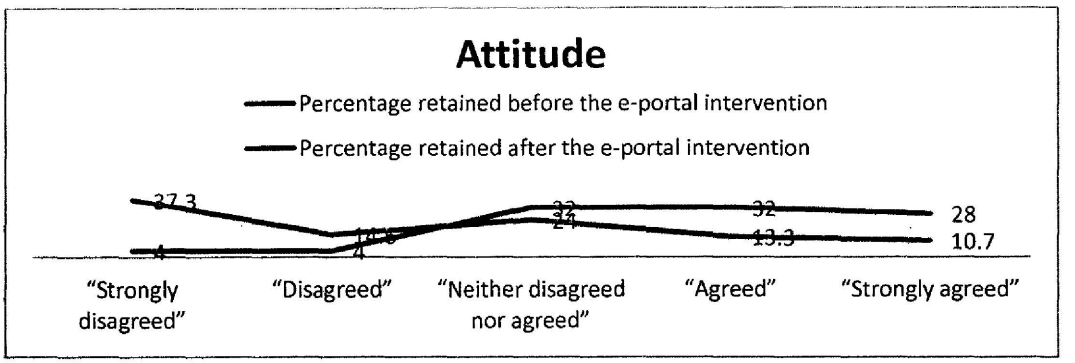


Figure 1: Percentage retained for each responses after the intervention on attitude

As such respondents would be motivated to know more during the intervention whereby their responds would act as reinforcement for them. It is evident that those who were "strongly disagreed' or 'disagreed' prior to the intervention has later changed their notion towards either 'agreed' or 'strongly agreed'(Figure I). This shows that the intervention improved the attitude in a positive way. It has been a practical choice and the appropriate method to gather pertinent details. Therefore, the growing need to belong and to work in groups requires the support of group processes such as e-participation and prompt notification as well as effective communication within the virtual environmental network.

The knowledge of people greatly affects the safety, effectiveness, satisfaction with which the goals of an individual is formulated and attained. Knowledge allows an individual to conceptualize goals in orderly manner, to anticipate and perceive events, and to response in accordance with the changing needs, purposes and desires. It depends on the data received through senses and knowledge possessed that would require to interpret them.

In relation to landslide education and mitigation, this platform can be supplemented by providing the students with landslide scenarios that describe the potential challenges, opportunities and threats faced by a community from the disaster. These students can form a community for a development program with a specific focus on integrating problem solving activities to deal with existing problems. The scenarios presented should facilitate the necessity of attempts to contain risk to save lives. Contrary to the phrase," Seeing is believing', it is knowledge that structure an individual's behaviour and perception. An individual's behaviour and attitude depend both on the knowledge that has been acquired through learning and practice. As it is, a powerful sense of possibility has to be established to produce a useful work. Therefore knowledge as 'a capacity to act' has improved with the intervention which affects positively the willingness to practice along with right attitude among students. Through this platform students are able to perceive the risk of landslide or disaster and interact with its environment.

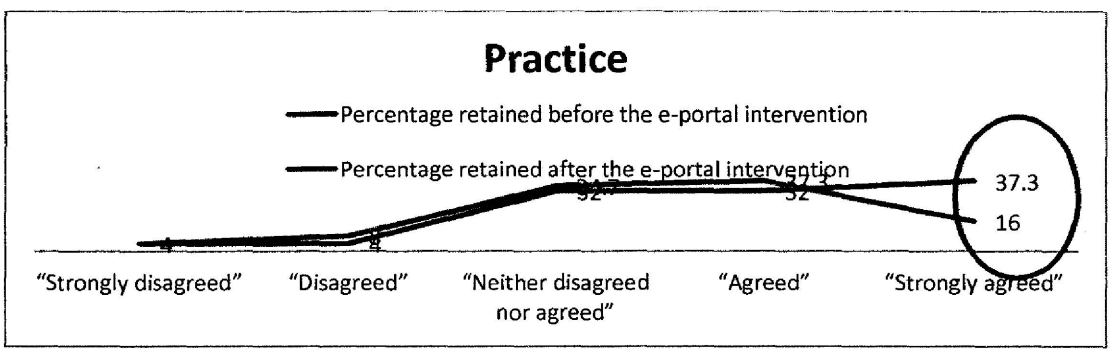


Figure II Percentage retained for each responses after the intervention to practice

The ever compelling desire for ubiquitous technology triggered the focus for this study to include, namely the youth, to be directly involved in the decision making process through e-participation. The tool as the e-participatory portal which enables them to stay connected with the community as a whole also linked to departments playing the key roles in mitigating landslide. The finding shows that students are willing to practice the knowledge acquired when provided with right tool. This provides the edge to students to be part of the team to curb landslide by reporting early signs (Figure II). Social networking sites have become enormously popular across demographics of race, age, and gender, and have hundreds of millions of users. It is able to reach a huge audience by making delivery of information easy and effectively. This study employed a web portal as the communication tool in delivering landslide information to and from the students.

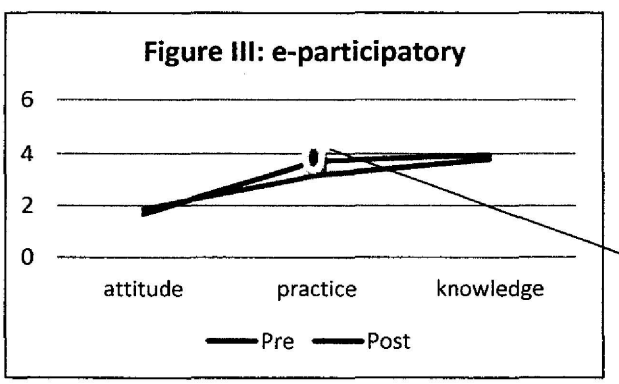
Students were asked to respond based on a series of attributes on a 5-point scale. At a glance, attitude, willingness to practice and knowledge has marginally improved after the e-participation. But the higher SD for attitude and willingness to practice could also indicate that the responses were polarized, where most had no attitude or willingness to practice issues but a smaller, yet important segment of these students had problem with these issues (Table I) prior to intervention.

Table I Attitude, practice and knowledge before and after portal intervention

test used	e-participatory	mean	std. dev
attitude	pre	1.87	1.07
	post	1.68	.68
practice	pre	3.16	1.02
	post	3.71	0.85
knowledge	pre	3.78	.97
	post	3.95	0.90

Critics argue that the benefit of incorporating self-assessment responding are biased against various group of people, such as women. This study postulates the fact that male and female students that were exposed to the same amount of knowledge about the preparedness and mitigation of landslide would portray attitude and willingness to practice differently. It is found that willingness to practice outscored the attitude and knowledge acquired by students after the intervention (Figure III). About 40% of the students strongly agreed to report any early warning signs encountered before landslide strikes. Also, male students portrayed positive changes in attitude as compared to female who showed none.

The obvious trend of this group would make a considerable impact of many aspects of modern life, to save time, money and lives. It is important to note that the inclination to behave in this manner can be further nurtured with more participation in real situations. Due to the emergence of real time information, the platform aids as an apt mediator for a particular purpose focused more on the environment.



e-participatory	Pre	Post
attitude	1.87	1.68
practice	3.16	3.71
knowledge	3.78	3.95

40% strongly agreed to report early warning signs through the portal

4 Conclusion

The finding of this study revealed clear evidence of the intervention on landslide knowledge among students. The intervention as such, improved knowledge on landslides along with the attitude and willingness to practice among students. However, attitude and willingness to practice differ among female and male students. This could be due to their social background, experience to disaster, or even the locality they live in. Though the intervention affects the attitude and practice of landslides among students in a positive way, it is important to determine evidence that the acquired knowledge has been put into practice. Since this study only focuses on the intervention of e-participatory portal with no actual events taking place, it is difficult to quantify the changes observed in attitude and practice. Based on the results of this study, it is recommended that evaluation about behaviour changes in students be conducted through routine online observation to determine habits in the manner of practice. More data need to be accumulated, and there is definite need to focus primarily on the transformation of students to become more resilient rather being reactive.

Acknowledgment

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JICA Training: CBDRM

Course titled:
"Community Based Disaster Reduction Management"

Attended by Jainambu M. Sultan (USM) &
Chua, Kok Hua (UNITEN)

From 6th January – 14 February 2014
At Kansai JICA International Center, Kobe. Japan

Organised by
(i) Kobe International Center for Communication
& Corporation KIC
(ii) Kobe City Fire Bureau

Sponsored by Japan International Corporation Agency JICA

Presentation contents

- The course detail
- The great Hanshin Awaji earthquake 1995
- Disaster management in Japan
- Disaster management education in Japan
- Community based disaster reduction management
- Iza kaeru Caravan
- Disaster administration and mitigation
- Great East Japan Earthquake & Tsunami
- The storytellers sharing session
- Lessons learned from this course
- Gap analysis
- What we can do
- Sample

Program title: Community Based Disaster Reduction management CBDRM

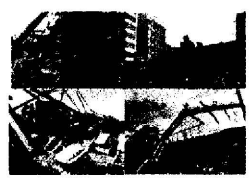
Program objective	To understand the significant of disaster risk management of natural disasters and needs for self help and mutual help and acquire the concrete method for the promotion of community based disaster risk management in each country through the activities of self help organization of residents for disaster risk management such as *Bosai Fukushi Komyunithi* or BOKOMI or Disaster safe welfare community.
Approaches:	Lectures, workshops, observations, museums , research institutes, via 5 modules &country presentations
Module 1	To understand the significant of disaster prevention
Module 2	To understand the concepts of community based disaster prevention and the needs of self help and mutual help
Module 3	To understand how to operate drills and the activities of community organization
Module 4	To understand disaster prevention education and the concrete method for its dissemination and enlightenment
Module 5	To make an action plan considering the promotion of community based disaster prevention in each country

Introduction

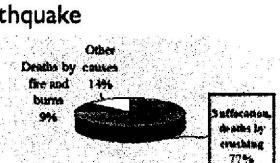
1995, Jan 17, 5.46 am, earthquake (*The great Hanshin-Awaji Earthquake*) measuring 7 scale in Japanese or 7.3 (international scale).

- 6434 (+3 missig) fatalities, 14678 injured (crushed or burned)
- 122,566 buildings either collapsed or partially collapsed
- Paralyse Kobe City, highways, utilities, etc

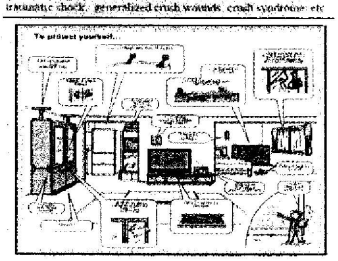




The causes of death in Great Hanshin Awaji Earthquake



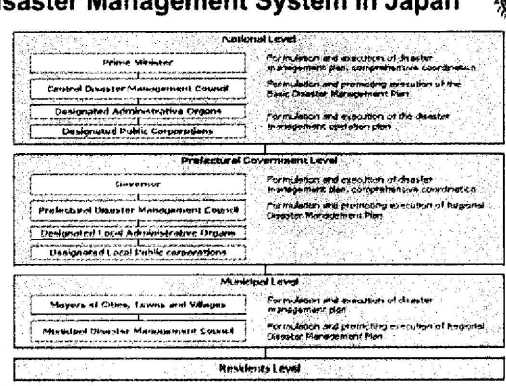
"Other causes" include head and neck injuries, visceral injuries, traumatic shock, generalized crush wounds, crush syndrome, etc.



- Amending 1981 building code: promotion of seismic retrofitting of building 1995. eg reinforcing household furniture
- Those that survived were rescued by community (77.5%!!!) and the rest by fire fighters.

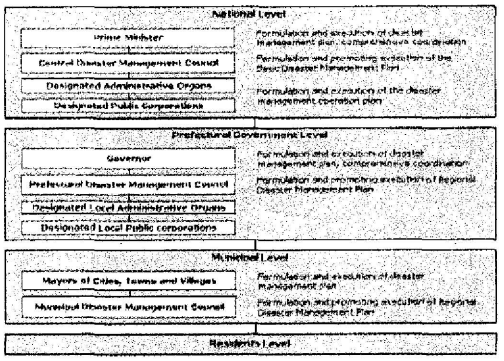
The experiences and lessons learned form the basic of this training course.

Disaster Management System in Japan



Reference: lecture by Natori Kiyoshi of Asian Disaster Reduction Center ADRC, Kobe " Disaster management policy in Japan , 9th January 2014

Disaster Management System in Japan



Reference: taken from lecture by Natori Kiyoshi of Asian Disaster Reduction Center ADRC, Kobe " Disaster management policy in Japan , 9th January 2014

List of "Designated Public Corporation" of national level

Category	Designated Public Cooperation
Economy	Bank of Japan
Search and Rescue	Japan Red Cross
Broadcasting	NHK (Japan Broadcasting Co.)
Expressway	West Japan Expressway Co. etc.
International Airport	Kansai International Airport Co. etc.
Railways	West Japan Railways Co. etc.
Telecommunication	West Nippon Telephone and Telegram etc.
Postal Service	Japan Post Co.
Gas	Osaka Gas Co. etc.
Transportation	Nippon Transportation Co.
Electricity	Kansai Electronic Power Co. etc.
Mobile Phone	NTT Docomo, KDDI

Each of these public corporations play their roles in disaster management especially in disaster preparedness, emergency response and recovery

Budget for Disaster Reduction (FY2011)

UNIT: Million Japanese Yen	Scientific Research on DRR	Disaster Preparedness	River Dike, Sabo Work etc	Disaster Recovery	TOTAL
Cabinet Office	7	3,801		606	4,417
Police Agency		3,464			3,464
Ministry of Internal Affairs and Telecommunications	498	50			548
Fire and Disaster Management Agency	489	10,439			10,928
Ministry of Justice		14,031			14,031
Ministry of Foreign Affairs		268			268
Ministry of Finance		9,286		78,348	87,634
Ministry of Education, Science and Sports	4,877	8,606		882	13,485
Agency for Cultural Affairs		89			89
Ministry of Welfare, Health and Labour		14,821		720	15,541
Ministry of Agriculture, Forestry and Fishery		3,179	96,145	126,147	225,468
Ministry of Economy, Trade and Industry		3,586	1,443		5,871
Ministry of Land, Infrastructure and Transportation	1,457	44,210	527,208	44,958	668,038
Meteorological Agency	3,408	21,957			25,065
Coast Guard Agency	118	22,002			22,118
Ministry of Environment			14	200	214
Ministry of Defence		3,113		118	3,231
TOTAL	8,099	308,686	624,650	254,700	1,146,226

Each ministry has its own budget on disaster reduction program. Disaster preparedness is allocated 18% of total budget.

The evolution of disaster management policy in Japan

1945 – Typhoo Makurazaki 1946 – nankai Earthquake 1947 – Typhoon Catherine 1948 – Fukui Earthquake	Disaster Relief Act (1947) Flood control Act (1948) Building standard law (1950)
1959 – Typhoon Ise won	Soil conservation and flood control Urgent measures Act (1960) Disaster Countermeasures Basic Act (1961) Act on special Financial Support to deal with Extremely Severe Disasters
1961 heavy snowfalls 1964 Nigata Earthquake	Act on Earthquake Insurance (1965)
1973 – Mt. Sakurajima Eruptions Mt. Asama Eruptions	Act on Special measures on active volcanoes (1973)
1995 Great Hanshin Awaji Earthquake	Act on special measures for earthquake disaster countermeasures Act on promotion of the earthquake proof retrofit of buildings Amendment of disaster countermeasures basic Act Amendment of Act on Special measures for large scale earthquake
2011 Great East Japan Earthquake	Basic Disaster Management plan updated (2011) Disaster Countermeasures Basic Act (2012)
	Learned from the disasters – improve on the Acts.

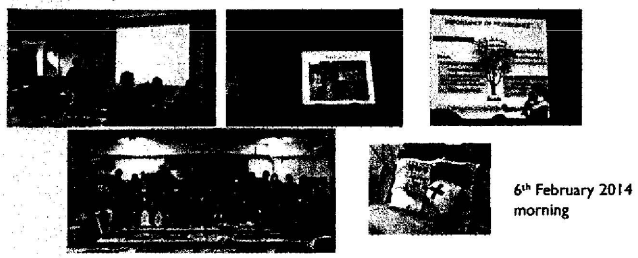
Disaster education in Japan

- Each school has its own teacher that specialize in disaster management.
- It focuses on self help, mutual help, volunteerism and compassion for your classmates that affected by disaster.
- Children can be a helper during the disaster if they are well trained.
- Community leaders and school teachers conduct disaster drill together with the help of fire fighters.
- Victims are given counseling through out their school life.
- Most school have disaster drills in various forms: field drill, evacuation run, town-watching etc.

Ex 1: Disaster education drill at Uozaki Elementary School, 11th January 2014 morning

Ex 1: Disaster education drill at Hanatani Elementary school, 19th January 2014 morning

In Maiko high School – the only school in Hyogo Prefecture that offer disaster management subjects such as *disaster and human beings, environment and science, social environment and disaster reduction, natural environmental and disaster reduction, computer study on disaster reduction, activities in disaster reduction etc.* The approach includes guest teachers, activity at primary school, volunteer activity, international exchange, and participation in workshops and seminars .



6th February 2014 morning

In Kobe Gakuin University, there is interdiscipline course on disaster management .The course is conducted by lecturers and local administrative body via lectures and fieldwork.The syllabus includes *natural disasters, education for disaster prevention, public administration for disaster prevention, basic theory of disaster analysis, volunteer activities in natural disasters, practice of basic life support, risk management, paramedic training, create teaching materials and open class at community and local schools.*

21st January 2014

Some of the activities by the university students

One of the lessons learned from great Hanshin Awaji Earthquake is that

- Human lives are saved through relations among people in the nick of time.
- The power to prevent disasters differs depending on the strength of the solidarity of the local community.
- The strength of each of the local organizations is important for protecting of the local community.

Bosai Fukushi Komyunithi, BOKOMI was established in Kobe after the 1995 earthquake.

History of BOKOMI

Prior 1995 – there are community based organizations formed by residents association, PTA, women association for disaster management, first aid and resident's welfare.

During earthquake:

- Actions taken by council for the voluntary disaster management promotion:
  Rescuing people from collapsed houses and firefighting using bucket brigades in collaboration with neighborhood residents. However, systematic firefighting or emergency care/rescue efforts were not possible.
- Activities of Council for Community Welfare Development:
  Acting as facilitators at evacuation shelters, preparing meals outdoors, and collecting/distributing relief supplies at evacuation shelters such as elementary schools and community welfare centers.

There is a need to reinforce this community based disaster reduction activities via community organization

The birth of BOKOMI

The approach: to get the community leaders to lead and train the community on disaster prevention with the guidance of fire department.

- Disaster-Safe Welfare Community" or BOKOMI was established from the "Kobe City Basic Fire Defense Plan" in July, 1995.
- It is defined as "a community that is actively involved in welfare activities/disaster management activities on a constant basis so that a spirit of mutual aid among residents that has been nurtured through community activities (including everyday community welfare activities) can be applied effectively for disaster response activities such as initial firefighting or rescue efforts at the time of a disaster."

Ref: "The birth of story BOKOMI Toshiyuki Onoda, Former manager, Fire prevention Division, Kobe Fire City Bureau, 15th Jan 2014

BOKOMI

- Use existing local clubs/associations eg PTA, resident association, etc to lead this group.
- Since school is used as evacuation center, those stay around the school shall be the members to BOKOMI.
- Funding from residents association and Fire department , NGOs and sponsorship from local business community.

- Roles of Fire Department:
- Distribution of required materials and equipments for disaster management
- Distribution of home disaster management manual
- Training for civil disaster management leaders
- Creation of promotion video of BOKOMI
- Support /guidance for establishment of BOKOMI
- Assigning firefighters to in charge the community – good relations is essential
- Creation of guidebook on BOKOMI
- Promotion of participation from all sector of community: students, community and business owners

Example of activities

Creation of kid hazard map by children
Joint hazard prevention drills
Promotion of involvement of business owner
Holding disaster walk rally
Town watching
Preparation of hazard map for the community/town
Participation in welfare activity eg festivals
Disaster games competition between kampung or group






"When the Great Hanshin earthquake struck, we saw, in every place we looked, people helping each other by bucket brigades and conducting rescue works using materials/equipment they brought from their neighborhoods.

A great deal of power was generated among ordinary residential communities. If residents and businesses work hand in hand to make an effort to build a Disaster-Safe Welfare Community based on a concept that "we will protect our own community by ourselves," autonomous disaster management capacity in each district will become much stronger than the capacity of individual.

With this in mind, Kobe City is promoting the Disaster-Safe Welfare Community project with the help of residents, business owners and government."

Final word from the founder of BOKOMI, Toshiyuki Onoda

Example of drill activities

Transporting of people-in-need or OKU

How to use blanket to make stretcher

How to treat injury person

Smoke house

How to use extinguish fires

How to report a fire?

Water bucket relay

The rides

How to fight fire

Iza! Kaeru Caravan, IKC : a fun disaster education event for kids (2-3 hours)

"IZA! KAERU CARAVAN!" Development Background

1. Development as the 10th anniversary project of the Great Hanshin-Awaji Earthquake
2. Commenced study at the request of Kobe City, Hyogo Prefecture
3. Collected 167 disaster victims' experiences
4. Picked up disaster prevention knowledge and skills, which should be passed on from disaster experiences
5. Developed drills and games to learn this knowledge and skills
6. Hold events to experience the drills and games developed

By Nagata, founder of Iza Kaeru Caravan, 26th January 2014

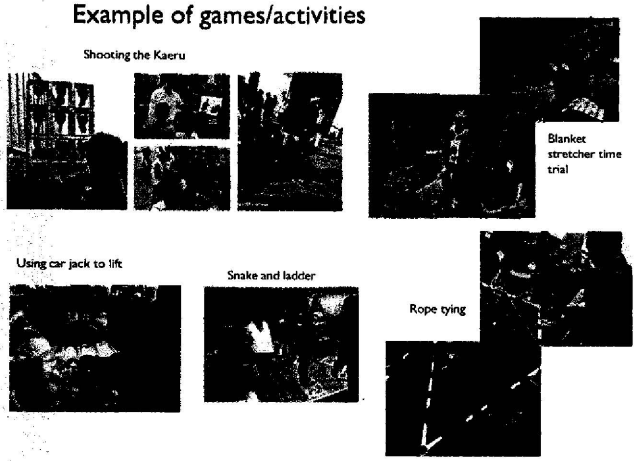
Approaches: educate via fun games

- Involved the government agencies that execute disaster management plan eg Fire Bureau, Kobe City council
- The volunteers are from BOKOMI group, disaster management clubs from schools/colleges/universities, PTA. They are given bandana and name tag.
- Each club/association handles one activity.
- Each kid will get a stamp on a card, once completed, he/she entitled to free gift.
- When they visit one stand, they will get one stamp.
- Activities include exhibition, card games, participatory games,
- To get the attendance/participation – the kids can exchange their unwanted toys at the event. The kids are given "money"/token when they visited the booth and use them to exchange for toys.
- In Japan, parents brought their kids to attend such events.
- Another event is survival camp – kid learn how to survive during the disaster

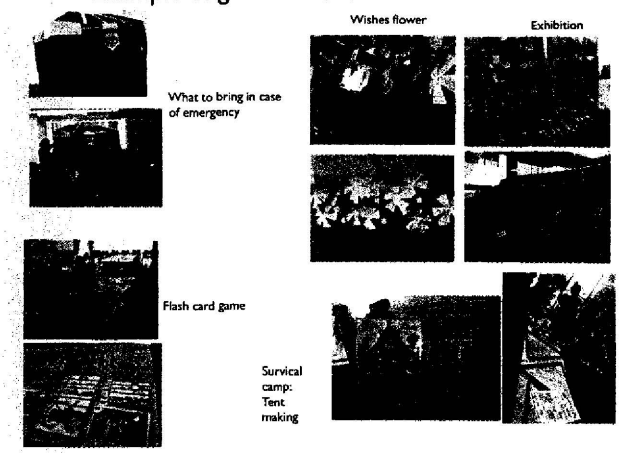
List of games/activities

Name of activities	Objective
Exhibition on disaster	Create awareness and education
Wishing flowers	Part of exhibition participatory activity
Flashcard games	What to do when disaster strike
Filling in the empty talk box	Evacuation ethic
Dark room venture	Pick the right thing to bring during the disaster
What to take? quiz	How to prepare emergency kit
Big size Snake & ladder	What to do in case of disaster
Blanket stretcher run	How to prepare blanket stretcher to carry injured person
Shooting the targets	Fire fighting exercise
Car jacking	Use the carjack to lift/rescue injured person
Disaster and fist aid related quizzes	
More.....	

Example of games/activities



Example of games/activities



Disaster mitigation and management

Disaster management on tsunami:

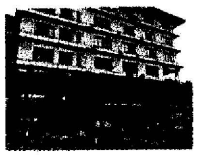
- Preparation of hazard map that involve community's input and "dry run" .
- It is a simple map that easy to follow by kids and adults. There are signage at lamppost etc to inform forecasted depth and direction to evacuation centers.
- Using the public speaker to send out warning. Some town blast out siren 12 noon everyday to check on serviceability.
- When earthquake strikes – all mobile phone will ring simultaneously
- When the evacuation center/school/halls are below forecast inundation depth, it will be retrofit or to build new evacuation tower.

Evacuation towers/centers

Great East Japan Earthquake 2011

- It occurred on 11/3/2011 at 2.46pm, magnitude 9.0.
- Death = 15850, missing 3287, injured 6011 person
- Total damage cost estimated between 16 – 25 trillion yen




Sharing sessions:

At an Island, Kesunnuma Oshima, only one ship survived, Captan Sugawara of "Himawari". From March till September 2011, he collected the ticket fares to donate to the victims on that island.

At another secondary school, the students helped the primary school kids to escape to a higher ground that they were saved (Iwate)

Another school, the leader use class platform as a ladder to escape the fire caused by the tsunami.





Tsunami overflow the seawall and drowned the residents next to it.

The town disaster management center employees died from saving others (lady announcer kept asking the people to evacuate but herself eventually swallowed by the tsunami.

Sad story:

Ogawa primary school: 108 pupils, only left 34 and 11 teachers only 1 survived.





Lessons learned:

- Early warning system and disaster forecasting are important elements in disaster management.
- But it is also important to instill disaster preparedness among the community so that they will know how to response during the disaster.
- Mitigation structures such as seawall can save life from tsunami. But when the residents put their whole trust in the structure, it might cause their life when higher than forecasted tsunami strike. It should be a mean to provide more time for the residents to escape.
- Self help and mutual help during disaster is essential to save one's life. It can be partly via proper disaster preparedness education among community which include school children.

Gap analysis

Items	Japan	Malaysia
Institutional framework and Legislation	Japan has comprehensive legislation on disaster management. Each ministry at central, prefecture and municipality has each own disaster management plan. The Fire bureau manage disaster reduction management in Japan.	Malaysia only have Nota Arahan 20. Pemandu had conducted a lab on disaster management for Malaysia. stakeholders should have
Community based disaster management	Japan has comprehensive disaster preparedness program/activity. The allocated budget is almost 20% of total disaster management allocation. It has establish system in terms of communication (software), and community involvement. In Kobe its community helping the community	We do have Malaysia Volunteer Fire and Rescue Association that play secondary role to Fire and Rescue department. It is more to provide assistance than to train the community leaders. There is no community based disaster program or association.
Mass media	There is very little information on disaster preparedness, more on reporting the impact and recovery .	Malaysia mass media report more on emergency and recovery. There is very little information on disaster preparedness.
Communicati on system	They use siren, signage, and mobile communication (ringing) and messages.	We have siren/loud speaker
Disaster preparedness resources	Japan has comprehensive disaster management resources such as posters, booklets, leaflets, games, guidebooks, CDs, movies, books etc. The hazard maps are informative and easily follows by all age groups.	We have posters on disaster but little on guidebooks, CDs, booklets to be used to educate the public on disaster preparedness.

Gap analysis / Knowledge gained

Items	Japan	Malaysia
Disaster education in schools	Japan introduce disaster education from primary schools (compulsory) till secondary school. Some universities offer a minor degree in disaster management. it trains the students to become volunteer, educators and firemen.	Very little disaster education stress in primary and secondary school students. There is no degree in disaster management in Malaysia.
Public awareness	In Japan there are museum that focus on disasters such as earthquake, landslide and tsunami museum. In one museum in Tokyo, one can experiences the disaster and assess his/her own disaster preparedness through the tour. Government learns from past disaster and improve the system and law continually.	There is no museum dedicated to disaster.
Public participation	Japan has public disaster event that promote disaster preparedness and education via games /exhibition. It involve community, college students, agencies. The participants are children and general public.	We only have fire drills for public and companies.
mindsets	Japan train her citizens to know what to do in case of disaster occur. Citizen sees it is his/her duty to educate themselves.	Malaysian look to authority to teach and guide matters related to disaster management
New areas of interests	Japan researchers look into hardware, software and human-ware in disaster management. The new areas are evacuation route, management of evacuation centers, disaster forecasting, temporary shelters, social and economical impact of forecasted disaster,	Informative hazard maps, management of evacuation centers, public engagement, social and economical cost of disasters.

WHAT WE CAN DO BASED JICA PROJECT:

1	Provision of disaster preparedness materials	Booklets, posters, CDs, teacher guidebook,
2	Execution of disaster preparedness activities	Increase publicity in mass media
3	Establishment of BOKOMI group and activity	Disaster preparedness event and increase awareness and publicity
4	Enhancement of Train the trainers program	Increase manpower
5	Conduct conference/seminar	To share and to create awareness and publish/record the materials
6	Survey on disaster awareness and preparedness	Level of awareness on evacuation center, route, activties

OUTPUT 1: DEVELOPMENT OF DISASTER PREPAREDNESS MATERIALS

- booklets on flood and landslide for primary school kids – in Bahasa, English, Chinese & Tamil. We can use that to engage school kids on disaster preparedness
- Multimedia presentation CDs –
  - (i) storytelling from survivors
  - (ii) animation of disaster education
  - (iii) disaster awareness for public
- Disaster preparedness guidebook for association leaders, BOKOMI leaders, teachers
- Disaster education guide book

OUTPUT 2: DISASTER PREPAREDNESS EVENT

(ala Iza Kaeru Caravan – assisted by BOKOMI members, fire and rescue officers, volunteer group, teachers and college students)

Possible activities:

- Stretcher race – (i) using blanket, (ii) blanket + 2 poles
- Fire target shooting
- Jack up games
- Treating victims
- smoke house
- Water brigades
- Sandbag construction
- Snake & ladder games
- Emergency kits – what to bring
- Cooking and serving meals at evacuation center
- Evacuation center etiquette
- Paper dish

OUTPUT 3: ESTABLISHING BOKOMI STYLE ASSOCIATION

Based on existing resident association, PTA, rukun tetangga, etc, we try to establish the disaster safe and welfare community in housing area.

It needs the blessing from Fire and Rescue Department. It should not overlapping the existing group such as school's bomba kelab but can roped them in as part of BOKOMI member.

Potential project is to establish a volunteer group in colleges to assist in disaster management including preparedness and recovery.

OUTPUT 4: TRAIN THE TRAINERS

- Enhancement of the ToT program that focus on community leaders and secondary school and college students. Currently MERCY Malaysia is provide training more for voluntarily work during disaster recovery.
- Our project should focus more on disaster preparedness training including e-community, EWS, hazard map etc.

OUTPUT 5: CONDUCT CONFERENCE ON COMMUNITY BASED DISASTER MANAGEMENT

- It provides a platform for community based disaster reduction management practitioners to share their experience.
- It include disaster education, volunteerism, community based activity, legislation,
- We can obtain outside expert to share and to train

OUTPUT 6: CONDUCT SURVEY AT SITE

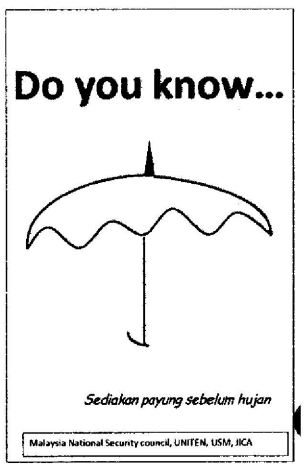
- It allows us to obtain feedback on current disaster management system that include early warning system, evacuation route/centers, "self-help" during flood, and insurance coverage.
- It also provide us an opportunity to introduce the early warning system (if its ready during the site survey).

EXAMPLE : BOOKLET

- Rationale : use it to visit school to share disaster preparedness
- Target audience: primary school kids
- Approach: information and activity booklet.
- Language: bahasa, English, Chinese, Tamil and native language in Sabah & Sarawak
- Still need to create a cartoon characters, colour scheme, pictures and contents
- Need to consult the stakeholders on the proper statement/sentence etc in the booklet.

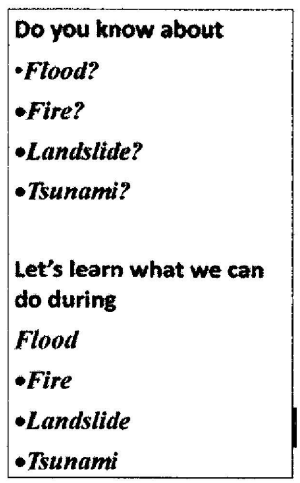
SAMPLE:

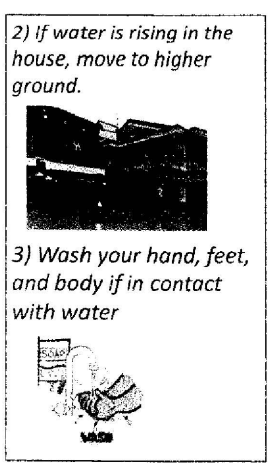
- Front cover:
- *Sediakan payung sebelum hujan*

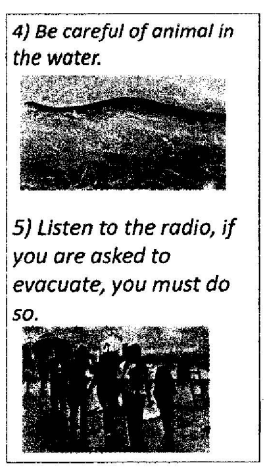


SAMPLE:

- Table of content:
  Flood
  Fire
  Landslide
  Tsunami





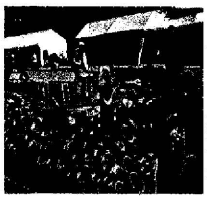


RESOURCES FROM THE JICA TRAINING COURSE

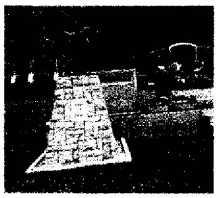
- Importance of disaster prevention esp. preparedness
- Concept of BOKOMI, establishment and implementation in Kobe and Indonesia
- Observation of drills and Iza Kaeru Caravan events
- SEEDs
- Knowledge gained via school visits – university, primary and secondary schools
- Disaster prevention education – concept, syllabus, activities
- Listening to the storytellers
- BOKOMI guidebook and also disaster education guidebook by SEEDS.

Our inspiration...

LEST WE FORGET THE SACRIFICES OF OTHERS.



Hanshin Awaji Earthquake, 1995



74 pupils and 10 teachers died at Ogawa Primary School. March 11 2011

Lady that sacrified to save others. March 11, 2011 East Japan earthquake/tsuna[redacted]

Thank you

Chua Kok Hua
Universiti Tenaga Nasional, UNITEN
ckh@uniten.edu.my

School of Computer Sciences

CAT400 – Undergraduate Major Project Analysis Report

EARLY WARNING SYSTEM WITH TRUSTED INFORMATION SHARING [MIS/ MW13146]

TOH WEI CHUN
107638

Supervisor: [Associate Professor Dr. Chan Huah Yong]
Examiner: [Associate Professor Aman Jantan] [Dr. Ibrahim Venkat]

2013/2014 Academic Session

ABSTRACT

Natural disaster is the combination of natural hazard and human activities, resulted from the lack of appropriate emergency management, which leads to financial, structural, and human losses. In order to prevent natural disaster or man-made disaster, disaster early warning system together with trusted information sharing system has utilized the combination of GeoServer and Google Earth to form a web-based system. It allowed user to easily explore and retrieve information of interest as well as navigate and publish photo on Google Earth. Users can add place marks, text labels, descriptions of disaster on the map to keep track of the geo-hazard issues. Besides, users also can rate the issues published to evaluate reliability of the information according to certain criteria. It will enhance system performance so that user can monitor the trustworthy, genuine and reliable of disaster information. Disaster early warning system can be used for disaster management, mitigation and control by local authorities.

School of Computer Sciences

CAT400 – Undergraduate Major Project

MW13147: EARLY WARNING SYSTEM FOR DISASTER MITIGATION

WEN YIN TING

107639

Supervisor: Associate Professor Dr Chan Huah Yong

Examiner: 1. Associate Professor Dr. Aman Jantan

2. Dr. Ibrahim Venkat

2013/2014 Academic Session

ABSTRACT

The project is basically implementing GIS on to the system but not losing the participation of users. The main objective of the project is to mitigate the disaster and thus reduce the loss. Thus, the system will introduce roles such as disaster reporter, disaster reduction team and disaster investigator. Since the system contains user-generated content, thus a metric is need for the users to determine whether the information sharer can be trust or not.