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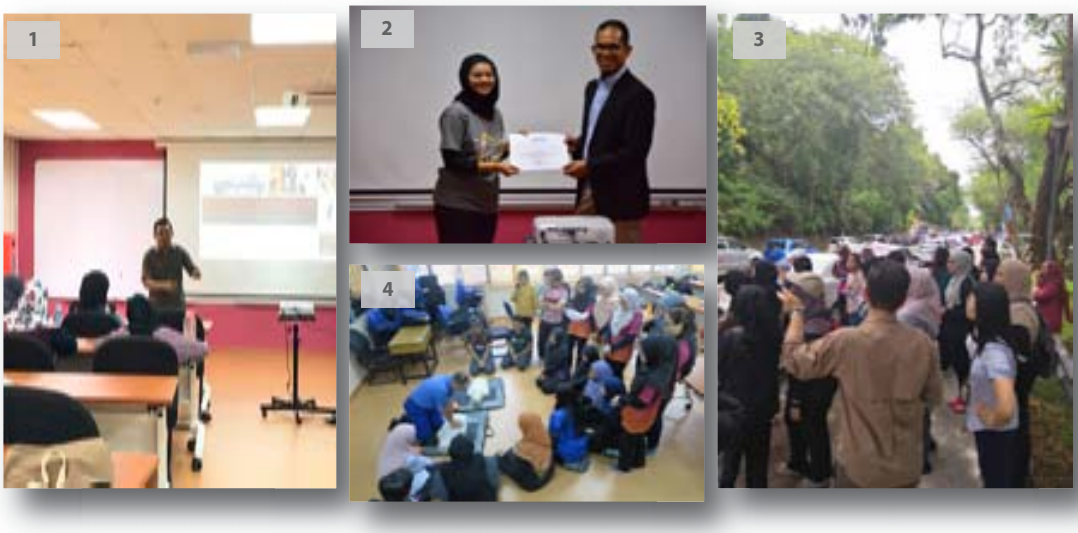

From left clockwise: (1) Mr. Syed Azwan Syed Ali of the Malaysian Press Institute delivered a module on Disaster Risk Communication; (2) Students received a participation certificate from Mr. Norazam Ab. Samah, Vice President of MERCY Malaysia; (3) Dr. Lim Choun Sian of SEADPRI-UKM gave a briefing on landslide features during the field visit around the UKM campus; (4) the Civil Defense Force of Malaysia delivered "First Aid" modules. *Photo by SEADPRI-UKM.*

SEADPRI-UKM kini menawarkan kursus CITRA bagi pelajar Sarjana Muda UKM, yang bertajuk "LMJS1512 Pengurangan Risiko Bencana ke Arah Membina Daya Ketahanan Komuniti". Kursus dua unit ini telah direka dengan konsep kelas interaktif dan bersifat *hands-on*, dan akan menekankan aspek asas dalam konsep pengurangan risiko bencana (DRR); dan pelajar juga akan terlibat dalam lawatan ke beberapa tapak di sekitar kawasan kampus UKM di Bangi.

MERCY Malaysia, Pasukan Pertahanan Awam Malaysia (APM) dan Malaysian Press Institute (MPI) turut terlibat di dalam menyampaikan modul latihan dalam kursus ini. Bagi perancangan masa depan yang lebih gemilang, SEADPRI-UKM berusaha meningkatkan penglibatan lebih banyak agensi dan pihak berkepentingan yang berkaitan dengan DRR bagi menyampaikan modul masing-masing.

Kelas ini terdiri daripada 28 orang mahasiswa dari pelbagai fakulti di UKM. Semua penyelidik SEADPRI-UKM, termasuk penyelidik muda dan kakitangan, terlibat sebagai pensyarah dan ahli sekretariat kursus, dan ianya juga merupakan sebahagian daripada khidmat kepada komuniti. Kursus ini telah mula ditawarkan pada Semester II 2018/2019 pada 27 Februari 2019, dan akan ditawarkan bagi setiap semester kehadapan.

SEADPRI-UKM is now offering a CITRA course for UKM undergraduates, entitled "LMJS1512 Disaster Risk Reduction in Building Community Resilience". The 2-unit course has been designed with the concept of interactive and hands-on classes, and will provide a fundamental basis in disaster risk reduction (DRR) concepts; and the students will also be involved in several site visits around the UKM campus in Bangi.

MERCY Malaysia, the Civil Defence Force of Malaysia (APM) and Malaysian Press Institute (MPI) are also involved in delivering modules in this course. Future plans are exciting, and will see the involvement of more agencies and stakeholders related to DRR delivering their modules.

Currently, the class consists of 28 undergraduates from various faculties in UKM. All SEADPRI researchers, including young researchers and staff, are involved as lecturers and members of the course secretariat, as part of their community service. This course, which commenced in Semester II 2018/2019 on 27 February 2019, will be offered every semester going forward.

ASSOC. PROF. DR. SARAH AZIZ ABDUL GHANI AZIZ
Pengerusi SEADPRI-UKM | *Chair of SEADPRI-UKM*

Buletin SEADPRI, Vol. 18, June 2019, ISSN 2180-1142

Buletin SEADPRI

Buletin SEADPRI is published biennially by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM) through Penerbit LESTARI. It contains short communications, case studies and original research on science, technology, innovation, impact, vulnerability and governance related to disaster risk reduction. The scope includes climatic hazards, geological hazards and technological hazards.

About SEADPRI–UKM

Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM) has been in operation since June 2008. Based at the Institute for Environment and Development (LESTARI), the Centre addresses crucial challenges on disaster risk reduction in Malaysia and the region. The research focus is on climatic hazards, geological hazards and technological hazards, with emphasis on capacity building, mainly through post-graduate programmes and specialised training. Transdisciplinary research conducted by the Centre is action-oriented, bridges the science-governance interface and provides pathways for disaster prevention .

In 2016, SEADPRI-UKM was acknowledged by the Integrated Research on Disaster Risk Programme (IRDR), jointly sponsored by International Science Council (ISC) and the United Nations Office for Disaster Risk Reduction (UNDRR), as an IRDR International Centre of Excellence (ICoE) for Disaster Risk and Climate Extremes (ICoE-SEADPRI-UKM). Globally, SEADPRI-UKM now sits with a group of 16 institutions with such recognition, representing various regions. The focus of ICoE-SEADPRI-UKM is to strengthen local inputs for addressing regional disaster risks in conjunction with national and international partners. A major flagship is the Asian Network on Climate Science and Technology (ANCST), coordinated by SEADPRI-UKM and funded by the Cambridge Malaysian Education and Development Trust, to link disaster risk reduction and climate change for building resilience in the region.

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Buletin SEADPRI, Vol. 18, June 2019, ISSN 2180-1142

Article

Landslides at Tambon Nam Phai, Thailand

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Abstract: Tambon Nam Phai is one of the areas in Thailand at risk of landslides and has been impacted by incidences in the past. Field investigations at Tambon Nam Phai revealed several causal factors: (i) the area is located in high mountain slopes with extremely braided streams; (ii) fault zones in the area contribute to cracks in the rocks leading to a high rate of weathering, (iii) prolonged heavy rainfall makes soil unstable, and (iv) increased forest encroachment on slopes. This paper highlights the current practice for landslide prediction and management in Thailand and makes recommendations to move forward to be better prepared for extreme climatic events.

Keywords: Landslide, slope monitoring, community participation, Thailand.

INTRODUCTION

Tambon Nam Phai, Amphoe Nam Phad is located in Uttaradit, a northern province of Thailand. The topography is mostly high mountain ranges and flat valleys. The villages in the area were severely affected by a landslide that occurred in September 2011, which killed 6 people and left one person missing. A total of 109 houses were fully and partly damaged and about 6,720km^2 of farmland were destroyed. The cost of damage caused by these landslides is estimated at more than 50 million baht or about USD1.6 million.

HAZARD FACTORS

Physical conditions such as geology, topography and climate conditions are among the main factors that contribute to landslide hazards in the area (Tatong 2019). In terms of geology, Uttaradit Province is located near the suture zone between the Sibumasu micro-continent plate and Indochina plate. This has created a topography of steep slopes in antiform and synform of sedimentary rocks in Tambon Nam Phai. The presence of numerous fault lines contributes to the high-rate of weathering due to the presence of fractured rocks. The area is also located on the rain shadow side that receives prolonged heavy rainfall almost all year round. High amounts of rainfall and steep slopes are identified as the significant factors that contribute to landslides. Another major factor is anthropogenic influence including forest encroachment. Deforestation in mountain areas contributes to slope disruption where the boundary between surficial soil and basement rock are weakened, expediting slides along such surfaces (Jotisankasa & Vathananukij, 2008).

COMMUNITY INVOLVEMENT

The Department of Mineral Resources (DMR) has installed rainwater volume and soil moisture monitoring instruments in the area. Their investigation revealed that surficial soil slide will mostly occur when the daily rainfall exceeds 100mm especially for steep slopes with an angle of more than 30°. This information is used to provide primary early warning for evacuation to safer zones. The early warning mechanism involves local residents forming a group to monitor landslides by measuring the rainwater volume, observing signs of landslides and planning landslide warning in their area. A landslide hazard map has been produced by the DMR for Tambon Nam Phai where high risk areas and safe zones are delineated based on geological features, slopes and type of surficial vegetation. The map shows three levels of landslide hazard, namely of low, moderate and high risk.

SOLUTION PATHWAYS

Prediction of landslide occurrence through rainfall and soil moisture monitoring, taking into account weather forecast from the Thailand - Meteorological Department, may be sufficient for landslide emergency planning and evacuation action. Nevertheless, plans to develop in hazardous areas should be avoided where possible. More effort is needed to restore vegetation in the area. Illegal forest encroachment has been a serious issue in Thailand and a triggering factor for the landslides. Public awareness and implementation of a more rigorous policy is therefore necessary. Development of landslide modeling using statistical analysis based on historical landslide inventory is also important to gain deeper understanding and better prediction of landslides in the future. Such assessments will strengthen real-time warning and improve timely evacuation measures to reduce damages and losses. Currently, the DMR has been monitoring landslides in hazardous areas with the cooperation of four government agencies, i.e. the Thai Meteorological Department, the Department of Disaster Prevention and Mitigation, the National Disaster Warning Center and the Department of Water Resources, as well as public participation and engagement of the locals. Communication skills is key to tap into the knowledge from these different groups towards improving the management of landslide hazards before and after an incident. There is also a need to integrate disaster-warning systems, which are currently overseen by the ministries of Science and Technology, and Information and Communication, as well as the Meteorological Department, to ensure the effectiveness of early warning (Fredrickson, 2011).

CONCLUDING REMARKS

There is an need to improve and seek new methods to precisely predict landslide occurrences in Thailand. Engineering solutions also need to be explored to mitigate the risks, reduce damage from landslides and to restore slopes. Enhanced knowledge and understanding of the fundamentals of hazards is important to find effective solutions under extreme climate events.

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Article

Flood Risk Mitigation of Households in Khyber Pakhtunkhwa Province, Pakistan

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Abstract: The impact of floods have become more severe over the past two decades in Pakistan. The adaptive capacity, flood mitigation measures in rural households and associated constraints were investigated in the two districts of the Khyber Pakhtunkhwa Province in Pakistan. The findings revealed that households in both districts mostly implemented measures that require less technical knowledge, which is suitable for the short-term but less adapted for long-term risks. Further work is required to address the need for advanced flood mitigation measures for vulnerable communities in rural households.

Keywords: Flood risk mitigation, household flood mitigation, vulnerable communities, Pakistan.

INTRODUCTION

Pakistan is one of the countries most affected by natural hazards, including floods over the last two decades. The worst flood in the country's history was experienced in 2010. The disaster affected 24 million people, damaged more than 2 million hectares of standing crops and caused economic losses of about USD10 billion. In Pakistan, floods are mainly associated with either the rainfall cycle during monsoon season in the lower catchment of the Indus River Basin, or the melting of glaciers in mountain regions upstream of the Indus River. A study was conducted to understand the local adaptive capacity, types of flood mitigation measures and constraints on the implementation of flood mitigation strategies in households. Correlation and probit model methods were used to evaluate flood-affected households. The focus was on two districts of the Khyber Pakhtunkhwa Province that are the most vulnerable areas in the country, which were severely affected by floods in 2010.

CLIMATIC CONDITIONS

The study was conducted in the rural areas of Khyber Pakhtunkhwa (KP) Province (Figure 1). It was selected as the study area because it is plagued by natural disasters such as floods from the Indus River, and earthquakes from the tectonic setting (GOP, 2018). The yearly floods during the monsoon season bring unprecedented damage to property and human lives. The KP Province has experienced several devastating floods in the last two decades. Out of the 22 recorded floods from 1950 to 2014, year 2010 was the most disastrous, affecting millions of households and their livelihoods in the province. In the northern side of the province, avalanches occur, primarily during the winter season while drought occurs during the summer in the southern part of the province. The climate of the KP Province is peculiar due to its large area where it experiences all climate conditions in Pakistan. Rainfall also varies enormously in the province. A majority of the area is usually dry while the eastern side of the province is the wettest especially during the month of June to mid-September.

MITIGATION STRATEGIES FOR FLOOD HAZARDS

Effective flood warnings could be a lifesaving option for households and communities living at the river edges (Qasim et al. 2015). With early warning, people may have enough time to take precautions to protect themselves and their livelihoods from flood risks. However, most of the households reported the poor performance of early warning system due to lack of infrastructure and outdated information dissemination system. Households also reported that they were never trained or provided sufficient information about house building codes, infrastructure building practices, and adequate spatial planning by the related departments. Furthermore, inadequate resources including emergency funds and relief stock are identified as other constraints faced by the respondents in the study area.

Communities have adopted various measures to mitigate the adverse impacts of floods at the household level to overcome these shortcomings. The most implemented mitigation strategies adopted by households include elevated ground floor (EGF), foundation strengthening (FS), construction of house with reinforced material (CHRM), precautionary savings (PS), deployment of sand bags (DSB) and preparing a place for storage of food items on the second floor (FSP2F) as effective risk mitigation tools. Other least adopted measures include building dikes in front of their homes (BDH), cleaning canals which surround the houses (CCSH), constructing houses with a second floor (CH2F), sump pump in the basement (SP), valve in the sewer system (VSS), lifesaving small boats (LSB), and buying food stock (BFS). The findings revealed that households implemented only well-known measures that require less technical knowledge. For example, implementation of technical and long-term measures such as BDH, LSB and developing storage and alternative living spaces are very rare in the two districts of KP Province that were surveyed.

KEY FINDINGS

Constraints such as lack of financial means (33%), weak land use planning (31%), and ineffective early flood warning system (27%) were found to be key obstacles in flood mitigation at the household level. Financial limitations at the household level may also be observed through daily average per capita of household income (approximately $1 a day), which is quite below the poverty limit set by the Government of Pakistan ($2 a day). Furthermore, access and use of formal credit facilities at the local level (especially due to high-interest rate) is also a big challenge. Lack of land management and planning is another major constraint to adapting to flood risks. Sufficient financial arrangements will enable vulnerable communities to adopt advanced flood mitigation measures. Pathways to solutions include the following:-

- There is a need for a focused study on how to overcome constraints in the areas through improvements in the current institutional setup and access to weather forecasting and early warning systems;
- The adaptive capacity of local households has to be enhanced by providing more access to financial means and diversified sources of income to safeguard livelihood sources in case of floods;

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- Common mitigation strategies within communities need to be developed and implemented at the local level to reduce cost. This could be done in partnership with the government, private sector and community by developing strong linkages among different stakeholders;
- Furthermore, research needs to be done on low cost and advanced mitigation options for households and communities living near river areas in order to make them less vulnerable and more resilient.

CONCLUDING REMARKS

Households in the Khyber Pakhtunkhwa Province may become more capable in dealing with the impact of disasters due to floods if constraints at the local level are addressed. Urgent action is required to make these flood-vulnerable communities more resilient, and improve their wellbeing.

The strategy in the proposed project may be incorporated as part of relevant policies to address flood challenges in the area, and can be employed by the other regions in Pakistan. Findings from the study could also contribute to the national adaptation policy.

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Figure 1: *Location of the two districts (red color) investigated in the Khyber Pakhtunkhwa Province, which are the most vulnerable area in Pakistan.*

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Article

Flash Floods and Mitigation in Lao Cai Province, Vietnam

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Abstract: Mountainous topography with steep slopes and high rate of precipitation renders Lao Cai Province in Vietnam at risk to flash floods and landslide hazards. The Province had experienced severe disaster events in the past from flash floods and landslides due to storm events resulting in the loss of lives and property damage. This paper briefly highlights existing implementation of mitigation and prevention plans for flash floods and landslide disasters in the area. Based on the perfomance from previous events, several recommendations are proposed to improve the existing strategies at Lao Cai Province.

Keywords: Flash floods, landslides, hazards in high elevation area.

INTRODUCTION

Lao Cai is a mountainous area in the Northwest of Vietnam. It has a complex terrain and is greatly influenced by two high mountain ranges running parallel to each other, namely Hoang Lien Son on the west and Voi Mountain on the east. The absolute elevation varies greatly, from 53 m to 3143 m with extremely rough terrain. This province lies within tropical climate conditions, under the influence of monsoons with the average annual precipitation ranging from 1400mm to 2800mm. The maximum daily precipitation can reach over 240mm. Lao Cai has a dense network of rivers and streams; about 107 large and small streams with densities of 0.9-1.7km/ km².

In the mountainous areas, flash floods have high-flow velocity and amplitude. It takes shorter time to reach the peak of flow and fall back to base level. The flow also contains a high level of sediments that can result in severe damages downstream. During big storm events, areas with slope gradients of 20° to 30° and low vegetation cover will experience runoff and overland flow of rivers and streams. In the Lao Cai Province, greater amount of flow to rivers and streams in a short time lead to higher potential forces resulting in flash floods and landslides.

The two main river systems are the Red River and Chay River, which include many tributaries flowing in high elevation over steep areas with a large range of annual total discharge. Hydropower plants are arranged in a terrace-like fashion to prevent the flow of water. Hence, the water level fluctuates and is under the influence of the operation of the hydropower plants. Natural conditions as well as human influence associated with the rapid progress of urbanization, infrastructure construction and mineral resources exploitation have made Lao Cai Province sensitive to flash floods and landslides. The Lao Cai Province has had limited investigation related to future climate conditions, risk assessment as well as vulnerability assessment to delineate vulnerable communities and sectors (Nguyen 2015).

HISTORICAL EVENTS

In August 2016, two consecutive flash floods and landslides resulted in severe damage to the Province. The impact of the second storm (Nida) left 5 people dead, 7 missing and 9 injured. During the storm, 969 houses were seriously damaged and thousands of hectares of crops were destroyed within 4 days (2-5 August 2016). Two weeks after that, the third storm (Dian) caused floods and landslides which led to the deaths of 7 people, 1 missing person, and 364 damaged houses. More than 2000 cattle were also wiped out by the water flow. Meanwhile, floods associated with landslides on September 2013 in Can Ho A village, Khoang commune, Sa Pa district dragged tens of thousands of rock debris, which killed 11 people, wounded 17 people and caused great damage to property. Heavy rains in 2018 resulted in a single flash flood event that caused houses to collapse, and traffic was paralyzed, causing damages estimated at USD 7 million (VnExpress, 2018).

EXISTING MITIGATION AND PROPOSED IMPROVEMENTS

Mitigation of the impacts of flash floods involves structural and non-structural approaches. Structural methods include planting and protecting headwater forest; constructing reservoir to regulate water in areas having high frequencies of flash floods; clearing the flood drainage systems and gutters; building dikes and retaining walls; dividing floods into small flows; constructing additional emergency spillways in reservoirs; and expanding the flood drainage of road systems. Non-structural methods include establishing flash flood distribution maps; planning for land use restrictions in areas with high risk of flash floods; combining agroforestry measurements to reduce erosion and enhance soil quality; evacuating people from high risk areas; installing automatic rain gauges for early warning.

To mitigate the impact of flash floods, Lao Cai Province had put in place a warning system based on data collection from meteorology and hydrology stations. Currently, Lao Cai Province has installed 10 meteorological and hydrological monitoring stations and 22 rain gauges, as well as weather radar. However, requirement for early warning and forecasting purposes is yet to be fulfilled due to scarcity of the stations, degraded infrastructure, and old technology. Areas with high frequencies of flash floods are riparian zones and streams that are associated with land cultivation and water sources for industrial and domestic use. These areas are often found in remote areas where delivering early warning to the locals becomes a challenge. Relocation of the locals residing from areas of high risk to flash floods and landslides areas is yet to be accomplished due to their attachment to the cultivated land.

Several recommendations can be made to improve the mitigation efforts from flash floods impacts in Lao Cai Province. These include constructing flood distribution maps and placing warning signs in areas with high frequency of flash floods. Promoting the restoration and protection of headwater forests has brought positive performance and needs to be continued.

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The Lao Cai Province has planted 8.450ha of forest in 2017, accounting for 118.2% of the plan, including 520.3ha of protection forest. Flood drainage clearance should also be promptly executed and properly planned before the onset of rainy seasons and after heavy storm events. Public awareness of the danger of flash floods should also be reinforced via local media channels such as the radio and television. This will ensure public access to information and improve their preparedness to flash floods.

CONCLUDING REMARKS

Mitigation of the impacts of flash floods in the Lao Cai Province involves structural and non-structural approaches. Early warning systems based on using meteorological and hydrological monitoring stations, as well as rain gauges and weather radar, are found to be - insufficient due to its scarcity, degraded infrastructure and old technology. More needs to be done, including formulation of flood distribution maps, promoting forest restoration and protection, improvement of awareness, and access to information to enhance the preparedness of communities to disasters.

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The Second National Conference aims to strengthen science, technology and innovation on disaster risk reduction in Malaysia, convened by the National Disaster Management Agency (NADMA Malaysia), Academy of Sciences Malaysia (ASM) and Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), with support from key partners. This is a follow-up from the inaugural National Conference on Science, Technology and Innovation for Disaster Risk Reduction was successfully held on 5-6 October 2017 at Puri Pujangga UKM Bangi, under the aegis of NADMA Malaysia. The aim of the Conference is to provide an insight into the state of disaster risk reduction (DRR) in Malaysia, in relation to climate change and sustainable development. This Conference also serves as the national platform for exchange of good practices in DRR among researchers and practitioners. In Malaysia, the National Disaster Management Agency (NADMA Malaysia) is Focal Point for the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030.

The Conference will cover themes on disaster risk reduction based on similarity of issues and challenges to be addressed. The themes are as follows:

- Geological Hazards - Landslides and Earthquakes;
- Hydro-meteorological Hazards – Extreme Flooding and Weather;
- Health and Emerging Hazards;
- Critical Infrastructure and DRR; and
- DRR Governance, Risk Management and Insurance.

Universities, research institutes and civil society organisations are invited to contribute papers in the form of poster presentations for the Conference themes. The Conference will highlight DRR innovation in Malaysia. The contributions should focus on products of DRR innovation such as models, approaches and methods, among others. The innovation must be at the stage of pilot testing or already implemented, after being peer-reviewed.

Interested parties are requested to submit an abstract (200-300 words) of their proposed contribution to the Secretariat, latest by **30 June 2019**. The organisers will inform selected parties of their acceptance by **15 July 2019**. Abstracts for poster presentations can be submitted to the Secretariat via conference website [www.ukm.my/sti4drr]. Kindly note that the manuscript must be written in English. The submission of full manuscripts is encouraged, to be considered for publication in an indexed journal. The deadline for full manuscripts is **1 November 2019**.

You are invited to register and keep abreast of developments at http://www.ukm.my/sti4drr.

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Article

Assessing Climate Change Impacts on Floods in Vu Gia–Thu Bon River Basin, Vietnam

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Abstract: The Vu Gia-Thu Bon River Basin consists of areas that are at risk to the hazards of flash floods during the annual monsoon season. Under the influence of climate change, changes in extreme rainfall is expected to further exacerbate flood hazards in the area. This study conducted flood modeling and mapping using MIKE-NAM and MIKE-11 model considering RCP 4.5 and RCP 8.5 (Representative Concentration Pathways) climate change scenarios to forecast the magnitude and extent of flood inundation in the Basin. Results from the models indicate that in the period of year 2020s, 2050s and 2080s, the average annual precipitation in the area under RCP 4.5 scenario will increase by 16.3%, 21% and 11.7% respectively. While under the RCP 8.5 scenario, the average annual precipitation will increase by 19.5%, 13.1% and 15.9% respectively. For return period of 20 years, the inundation area will expand by 27.5% and 20.7% under the RCP 4.5 and RCP 8.5 respectively, while for return period of 100 years, it will increase by 37.1% and 25.6%. The flood peak in the Basin was found to increase twice as much compared to the historical level.

Keywords: Floods, Vu Gia-Thu Bon River Basin, climate change impacts.

INTRODUCTION

Every year, floods threaten human life and socio-economic development in the Vu Gia-Thu Bon Basin. In recent years, consecutive occurrence of floods had resulted in loss of lives, damages costing hundreds of millions in USD to the economy, and evacuation of several thousands of residents from landslide and inundated areas. Ecosystems surrounding river mouths were also seriously affected. With climate change, the Basin is expected to experience an increase of extreme rainfall events in the intensity and duration that lead to higher flood peaks and water levels in rivers. Spatial expansion of flood zones in the Basin further exacerbate flood damage downstream, where urban areas and coastal cities are located.

The Vu Gia-Thu Bon River is one of the biggest and most complicated river systems in Central Vietnam (Figure 1). The river originates from Kon Tum Province flowing through Quang Nam Province and the city of Da Nang before draining to the East Sea of Vietnam at the Dai and Han river mouths. The Vu Gia-Thu Bon Basin covers an area of 10,350km² extending from 14°90´ to 16°20´N and from 107°20´ to 108°70´E, embracing the Quang Nam Province and Da Nang city, which are considered key economic areas in central Vietnam receiving large investments and socio-economic development from the Government of Vietnam.

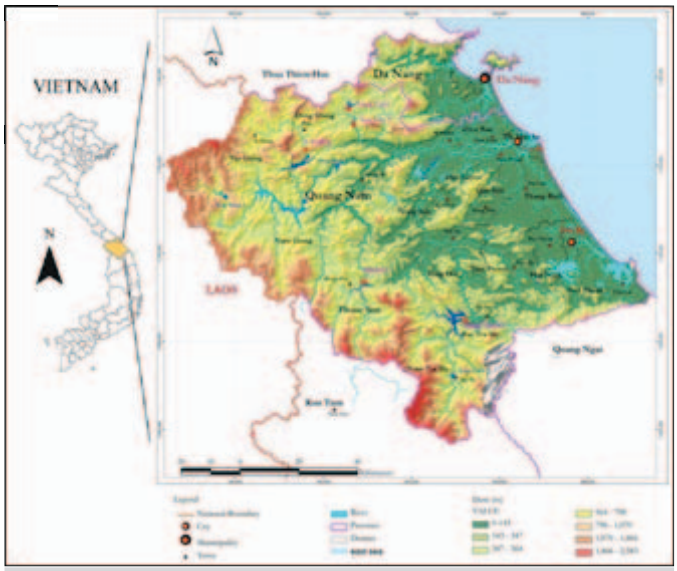

Figure 1: *Location and topographic map of the Vu Gia-Thu Bon River Basin.*

STUDY AREA

The Vu Gia-Thu Bon River Basin consists of a complex terrain with mountains and hills accounting for over 60% of the area (Figure 2). The basin lies at 552m elevation and has an average slope of 25°. The river and stream network is complex and typical of mountainous areas. The basin is located within the region that receives the highest total rainfall in the country. Rainy seasons are from September to December with the rest being dry season. The average annual rainfall in the upland area of approximately 3000-4000mm is much higher than that of the coastal areas (approximately 2000mm/year). The maximum monthly rainfall is concentrated in the rainy season (from September to December) with 60%-76% (compared with 75%-76% in coastal areas). The high rainfall is often the result of storms and typhoons.

Floods in the area are often a result of tropical monsoons, where the phenomena of storm, typhoon and tropical low pressure results in torrential rains in the basin.

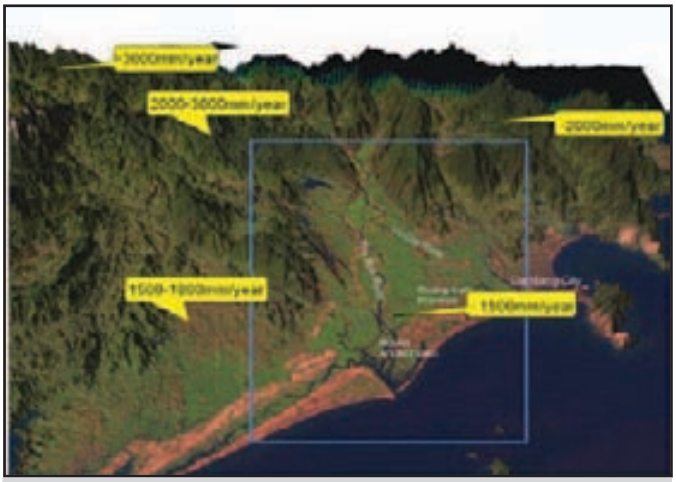

Figure 2: *Terrain and rainfall distribution of Vu Gia-Thu Bon River Basin.*

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The geomorphologic features of relatively narrow, short and steep channels make the basin prone to floods that can happen after 2-8 hours of heavy rainfall. The flood intensity is often high and unstable. The flood is usually high in amplitude, with a depth of about 2-3m for normal floods, and 4-5m for high floods over short durations of 1 to 3 days.

ASSESSMENT APPROACH

The impacts and losses due to floods in the Vu Gia–Thu Bon River Basin can be mitigated with appropriate information. It is necessary to keep track of changes in flood characteristics in the area in order to come up with suitable mitigation measures. One of the most effective solutions is through flood modeling and mapping to forecast and simulate the scope and extent of flood inundation. Outputs from flood modeling and mapping will be useful for flood preparedness by facilitating early planning and emergency response. There have been various studies on flood inundation conducted for Vu Gia-Thu Bon River Basin. Flood modeling and mapping measures have been performed to provide flood risk maps for the area. However, previous works were based mostly on historical floods and the related flood frequencies. It has now become necessary to consider the impacts of climate change with more extreme rainfall events that will bring significant changes towards flood peaks and volumes. Due to short flood rise from the river, it is crucial to provide timely information for early warning systems, especially for the purpose of evacuation planning. Upgrading and installation of more flood monitoring stations is also necessary. New flood maps should also provide information on safe roads for rescue and disaster relief teams to get to the flood inundated areas.

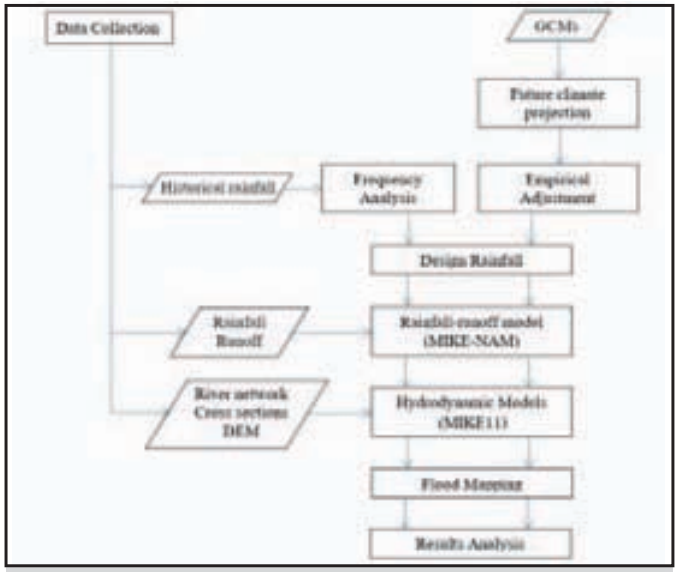

Figure 3: *Methodology of the study.*

In this study, GCMs linear bias correction was carried out to project future climate data under two climate change scenarios; RCP 4.5 and RCP 8.5 which stand for Representative Concentration Pathways for greenhouse gas trajectory adopted by the IPCC (IPCC, 2014). Extreme rainfall condition is considered using empirical adjustment method for the daily rainfall data (Figure 3). The MIKE-NAM model was then employed to analyse the rainfall-runoff process, while the MIKE11 model was used to simulate flood in the river and floodplain. Output from the hydrodynamic model was then used to create the flood maps. Flood characteristics such as inundation area, flood depth and flow - discharge were analyzed and compared between the 2 datasets, namely historical data and forecasted data.

KEY FINDINGS

This study highlights the results on projected rainfall under the impact of climate change for Vu Gia -Thu Bon River Basin over three scenarios (Figure 4). Results indicate that in the period of 2020s, 2050s and 2080s, the average annual precipitation in the area under RCP 4.5 scenario will increase by 16.3%, 21% and 11.7% respectively. While under the RCP 8.5 scenario, the average annual precipitation will increase by 19.5%, 13.1% and 15.9% respectively. As a consequence of changing rainfall trends under the impact of climate change, flood events will also change by expanding in its extent and magnitude. For return period of 20 years, inundation area will expand by 27.5% and 20.7% under the climate change scenarios of RCP 4.5 and RCP 8.5 respectively, while for return period of 100 years, it increases by 37.1% and 25.6% respectively. It was observed that when the rainfall is added into the floodplain model for simulation, inundation area expanded even more. Under the impact of climate change, flood peaks in general will increase by about 1.5 times compared to historical floods. Once floodplain is taken into account in calculation with rainfall in the model, the flood peak increases around 2 times compared to historical floods, while the flood duration change is insignificant. The findings could be useful for areas with very limited information on future climate conditions (Nguyen et al., 2015).

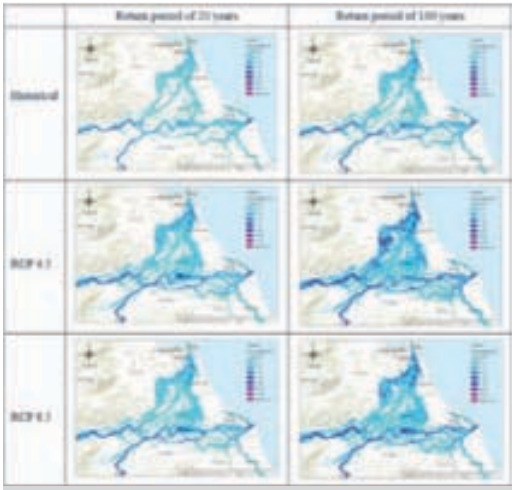

Figure 3: Changes in flood areas under extreme rainfall events caused by climate change.

CONCLUDING REMARKS

This study used a system of models and calculation methods to simulate floods for the Vu Gia-Thu Bon River Basin. The approach contributes to seeking solutions. Forecasts and simulations enable delineation and extent of floods, and could be applied more widely with adequate verification. The application of this methodology in other study areas requires some adjustment to suit the local context and geography to ensure robust results.

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Buletin SEADPRI, Vol. 18, June 2019, ISSN 2180-1142

Article

Case Study of Building Coastal Community Resilience in Vietnam

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Abstract: Low-income communities living in coastal regions of Vietnam are negatively impacted by frequent natural disasters. Coastal mangrove forests are serving as a vital buffer against storms, sea surges and salt-water intrusion, highlighting the importance of ecosystem-based disaster risk reduction. The involvement of coastal communities in restoration initiatives promote disaster resilience.

Keywords: Coastal hazards, community resilience, Thanh Hoa Province, Vietnam.

INTRODUCTION

Communities in the Thanh Hoa Province, Vietnam are often exposed to coastal hazards. Between 1990 to 2012, the coastal region suffered annual average disaster losses of 457 lives and 1.3% of GDP (CARE, 2014). In 2005, tidal waves and upstream floods from Typhoon Damrey damaged about 100 houses. The event also caused inundation of more than 500 hectares of paddy fields and shrimp farms as well as degradation of soil by saltwater. Low-income communities are negatively impacted by frequent natural disasters. Coastal ecosystems such as coastal mangrove forests are assets that provide a vital buffer against storms, sea surges and salt-water intrusion.

APPROACH

Ecosystem-based disaster risk reduction (Eco-DRR) involves sustainable management and restoration of ecosystems to reduce disaster risk and promote resilient development. Eco-DRR also reduces physical exposure to many hazards and increases socio-economic resilience of communities. CARE International applied the Eco-DRR concept to build coastal resilience of vulnerable communities in the Thanh Hoa Province of Vietnam. The project was implemented from 2006 to 2014. The focus was on the Da Loc and Nga Thuy Communes, to help in coping with disasters, promoting sustainable livelihood development and supporting the poor. The aim was to restore existing systems and establish new institutions for community-based management of mangrove forests, whilst building capacity for disaster risk reduction and stimulating resilient livelihood strategies. A critical component was to enhance understanding and promote local support for the integrated approach.

KEY FINDINGS

The project was successful in advancing the community-based ecosystem approach and enhancing livelihood strategies for sustainable coastal community development. Since 2007, more than 277 and 181 hectares of mangrove forest have been planted in the Da Loc and Nga Thuy Communes, respectively. This was done exclusively by local villagers, who were involved in planting, maintaining, and protecting the young forests. About 700 local people contributed their labor and assets to mangrove planting. More than 90% of the young mangrove trees survived, making the mangrove forest planting very successful compared to earlier projects in the same area (CARE, reported, 2014).

The use of local labor and local expertise was also more cost effective and promoted strong community buy-in for forest protection. Local community mobilisation and engagement was also supported by local officials. People realised that if they protected the mangroves, they would be protecting their future livelihoods by reducing exposure to natural disasters. The Eco-DRR concept played a crucial role for sustainable development by reducing the impacts of natural disasters in these two coastal communities.

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Buletin SEADPRI, Vol. 18, June 2019, ISSN 2180-1142

Climatic Hazards Programme

SEADPRI Forum 2019 @ ASM: Strengthening Ties

Joy Jacqueline Pereira

SEADPRI-Universiti Kebangsaan Malaysia

Photo by SEADPRI-UKM

Participants of the SEADPRI Forum 2019 hosted by the Academy of Sciences Malaysia.

Since its inaugural debut a decade ago in 2009, the annual flagship SEADPRI Forum was held for the first time away from UKM Bangi, hosted by the Academy of Sciences Malaysia (ASM). The ASM is a statutory body under the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) Malaysia, and strives to be the "Thought Leader" in the national science, technology and innovation arena. The mandate of ASM is to address the needs of the nation by providing the best scientific advice and advocacy that is independent, credible, relevant and timely.

The topic of disaster risk reduction and climate change is central to ASM as reflected by establishment of the ASM Disaster Risk Reduction Research Alliance Committee (DRR Research Alliance) to support the scientific community in Malaysia in 2017. The alliance serves as a platform to bring together key researchers and other stakeholders who are working in silo to connect, communicate and collaborate on issues related to disasters and their drivers such as climate change. Under the aegis of National Disaster Management Agency (NADMA), ASM and SEADPRI-UKM, the inaugural National Conference on Science, Technology and Innovation for DRR was convened in 2017 for this purpose. The 2nd National Conference on Science, Technology and Innovation for DRR, to be held in Kuala Lumpur from 14-15 October 2019, will further this aspiration. The hosting of the SEADPRI Forum 2019 @ ASM marks a culmination of the collaboration between ASM and SEADPRI-UKM in building disaster and climate resilience of the country.

The Forum on "IPCC Special Report on 1.5°C: Implications for Southeast Asia" held on 25 April 2019 (Thursday) at MATRADE - Tower, Kuala Lumpur, was led by Prof. Mark Howden from the Australian National University and Vice Chair of Working Group II of the Intergovernmental Panel on Climate Change (IPCC). Prof. Howden commenced by presenting key findings of the IPCC Special Report on 1.5°C. According to the report, humans have contributed approximately 1°C of global warming since pre-industrial times and the consequences are already apparent worldwide for people, nature and livelihoods. At the current rate, it is projected that warming would reach 1.5°C between 2030 and 2052. There are pathways to limit global warming to 1.5°C and this is much better for tropical Southeast Asia, which is projected to experience the largest impacts on economic growth. Compared to a warming of 2°C, limiting warming to 1.5°C is expected to contribute to less extreme weather where people live, including extreme heat and rainfall. By limiting warming to 1.5°C, global mean sea level rise will be around 10 cm lower in 2100 but may continue to rise for centuries but 10 million fewer people will be exposed to risk of rising seas. In addition to other projected impacts, it is expected that up to several hundred million fewer people will be exposed to climate related risk and susceptible to poverty by 2050.

There are many challenges ahead for Malaysia and the region. Climate change mitigation is critical and should be given adequate emphasis for limiting global warming to 1.5°C. In addition, the country should also prepare disaster resilience plans for the short-term and climate change adaptation plans to address long-term risks. In this context, the ASM DRR Research Alliance and SEADPRI-UKM have much to contribute, to ensure that the country is prepared for a 1.5°C world.

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Geological Hazards Programme

SEADPRI Shares Research Experience at GADRI Meeting

Lim Choun Sian

SEADPRI-Universiti Kebangsaan Malaysia

SEADPRI-UKM was represented by Dr. Lim Choun Sian at the 4th Global Summit of Research Institutes for Disaster Risk Reduction, organised by GADRI at Kyoto University, Japan. *Photo by GADRI*

The Fourth Global Summit of Research Institutes for Disaster Risk Reduction, organised by the Global Alliance of Disaster Research Institutes (GADRI) Kyoto University, was held at the Uji Campus in the Kyoto University, Japan from 13 to 15 March 2019. GADRI is a forum for sharing knowledge and promoting collaboration on topics related to disaster risk reduction and resilience to disasters; it is a network of networks guided by organizational values for disaster risk reduction hosted at the Disaster Prevention Research Institute (DPRI) of Kyoto University.

The Fourth Global Summit under the theme of "Increasing the Effectiveness and Relevance of Our Institutes" explored 4 main agenda: GADRI Contributions to the 2016 Science & Technology Roadmap and Sendai Framework; The Tokyo Statement 2017 and the SFDRR Agenda 2030 - Nation's Synthesis; Related research for SDGs and climate change and adaptation; and research funding for DRR, the sources and target areas. In this meeting, SEADPRI-UKM presented two subjects, namely Bridging Science and Policy for Disaster Risk Reduction and Strengthening Governance Measures to Better-Address Existing and Emerging Geological Hazards and Disaster Events in Malaysia. It showcased the completed and ongoing projects where integrated and multi-hazard approach research for resilient cities, as well as, examples of how science-policy can reduce disaster risk.

The take-home message or resolution of the summit reiterated that GADRI will support the Sendai Framework, advocate evidence-based technical reporting, effective interface between technical information and policy making, and proactive implementation of policy to reduce disaster losses.

GADRI members will take action to prioritise reviews of hazard at country and regional levels, and to compile success examples. The summit also acknowledged the need for improved communication and interaction among technical experts, policy makers, implementers and other stakeholders; and effective education programmes on DRR for stakeholders i.e. government and community leaders, media and public.

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Technological Hazards Programme

The Toxic Effects of the Sungai Kim Kim Disaster

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SEADPRI-Universiti Kebangsaan Malaysia

Clean-up of toxic waste has commenced at Sungai Kim Kim in Pasir Gudang, Johor. *(Source: Graphic from Malay Mail)*

An air pollution disaster caused by toxic chemical fumes occurred on March 7 following illegal waste dumping into Sungai Kim Kim in Pasir Gudang, Johor. Investigations by the Department of Environment (DOE) found that the toxic chemical wastes were dumped under a bridge connecting Taman Pasir Putih and Taman Kota Masai. Chemical poisoning incidents were initially reported at SK Taman Pasir Putih and SMK Pasir Putih, which are located half a kilometre away from the river.

The initial river cleaning operation was halted when scheduled wastes were detected; the subsequent cleaning process was believed to have caused the chemicals to react, which resulted in a second wave of poisoning at the same schools on March 11. These were followed by third (March 12) and fourth (13 March) waves of poisoning as the volatile organic chemicals continued to evaporate following the rapid spillage cleaning procedures that facilitated volatilization.

Heavy rainfall had dispersed the spilled waste further downstream, and warm temperatures enhanced the volatilization process; and this evolved into an air pollution disaster due to the high volatility characteristics of the water pollutants.

By 14th March 2019, a total of 111 schools in the area of Pasir Gudang had been forced to close. Children were more vulnerable to the toxic chemical fumes than adults due to their immature respiratory systems.

According to the National Disaster Management Agency (NADMA), five main chemicals were detected from Sungai Kim Kim i.e. methane at 0.96 ppm [no information on IDLH (Immediately Dangerous to Life or Health) or PEL (Permissible Exposure Limit)], hydrogen chloride at 1.63 ppm (with PEL-ceiling: 5ppm), acrylonitrile at 7.33 ppm [PEL-time weighted average (TWA): 2ppm], acrolein at 5.29 ppm (IDLH: 2 ppm) and benzene at 1.87 ppm (PEL-TWA: 0.5 ppm).

It was determined that these highly volatile and carcinogenic chemical compounds were at alarming threshold levels, especially acrylonitrile, acrolein and benzene. This resulted in teachers and pupils from the two schools suffering from shortness of breath, dizziness and vomiting. These chemical wastes are also toxic to the aquatic life with long-lasting effects. Acrylonitrile is a colourless man-made liquid chemical with a pungent onion or garlic-like odour - (odour threshold: 21 ppm), and is used mostly to make plastic, acrylic fibers and synthetic rubber. It is neurotoxic, and can quickly break down in the air and cause symptoms like headache, nausea and disorientation in humans. Once it enters the human body, via oral administration or when it enters the airway, it breaks down into cyanide, which is a potentially deadly chemical. It is a suspected carcinogen and animal teratogen.

Acrolein, on the other hand, is a clear or yellowish liquid with a acrid, pungent odour (odour threshold: 0.25 ppm). It can be rapidly deactivated by binding to materials in soil. It is commonly utilized as a pesticide to control underwater plants, algae and slime growth, and used in developing chemical weapons. It is also found in cigarette smoke, exhaust fumes and coal-fired power plants. If released into water, acrolein may biodegrade under aerobic conditions, volatilize or undergo reversible hydration to beta-hydroxypropionaldehyde. Acrolein was detected at 5.29 ppm, which is about >2 orders of magnitude higher than the IDLH level. The extremely high levels of acrolein may target organs like lungs, eyes, skin and mucous membranes, cause severe irritation of the respiratory tract resulting in sore throat, coughing, shortness of breath and delayed lung edema. Inhalation may be fatal resulting in spasms, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.

Benzene is an aromatic compound confirmed to be carcinogenic to humans, where it causes hematotoxicity, immunotoxicity and leukemia through multiple toxic metabolite mechanisms. It is a colourless liquid with a sweet odour, and often used in chemical manufacturing plants to produce other organic chemical substances, such as styrene, cumene and cyclohexane as well as rubber, lubricants, dyes, detergents, drugs and pesticides. It can persist in water and soil, but breaks down in air within days. It is also neurotoxic to humans, causing drowsiness, dizziness, rapid heart rate, headache, tremors, confusion and unconsciousness.

Although acute health effects as a result of inhaling toxic chemical fumes may pass after emergency first aid or hospital treatment procedures, we are yet uncertain of the chronic effects, such as cancer, which may occur within months or years after exposure to these toxic chemical wastes.

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Activities

Malaysia Advances in Reporting to the Sendai Framework

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[1]*SEADPRI-Universiti Kebangsaan Malaysia*

[2] *National Disaster Management Agency (NADMA), Prime Minister's Department*

Participants of the workshop at Puri Pujangga, UKM Bangi. *Photo by SEADPRI-UKM*

A national workshop on the Sendai Framework Monitoring (SFM) was successfully held on 19 February 2019 at Puri Pujangga Hotel, UKM Bangi. The workshop was organised by the National Disaster Management Agency (NADMA), Prime Minister's Department, with technical support from SEADPRI-UKM. It was inaugurated by Mr. Mohamed Zahari Razali, Deputy Director General (Post-Disaster Management Sector) of NADMA. Participants comprised representatives from the key federal government agencies who are involved directly in disaster management in the country. The discussion focused on the data availability across the relevant ministries, ranging from 2005 until 2015, with the deadline for the data - input into the SFM system set for 31 March 2019. The workshop emphasized the participation of all stakeholders in the reporting system to the national focal point on disaster risk reduction. The baseline data for SFM is also crucial to the Economic Planning Unit (EPU) in presenting the budget to the various ministries in the future, especially on the DRR-relevant component. Also highlighted was the need to synergise with the ongoing national efforts on Sustainable Development Goals (SDGs) anchored by the EPU, and the Paris Agreement on Climate Change anchored by the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC).

Streamlining the National Platform on DRR to the Sendai Framework

Lim Choun Sian

SEADPRI-Universiti Kebangsaan Malaysia

The National Disaster Management Agency Malaysia (NADMA) revisited the Malaysia National Platform for DRR (myDRR) in line with the Sendai Framework's call on setting up and strengthening the national platform. The myDRR was set up during the Hyogo Framework (2005-2015). A half-day workshop was held to enhance the existing myDRR by streamlining it to the Sendai Framework (2015-2030), and aligning it to the NADMA core business and coverage of stakeholders. This workshop, also held on 19 February 2019 at Puri Pujangga Hotel, UKM Bangi, was attended by NADMA personnel in the administrative and operations sectors. SEADPRI attended as session moderators and rapporteurs. The National Platform for Malaysia, or its proper name, National Platform and Action Plan on Disaster Risk Reduction, has been coined to be known as myDRR. Malaysia had preambled the establishment of a multi-stakeholder National Platform on Disaster Management at the Fourth Session of the Global Platform for Disaster Risk Reduction of United Nations Office for Disaster Risk Reduction (UNISDR) in 2013. The National Platform was established by the end of 2013, and in 2014, a website www.mydrr.org was set up before the Sixth Asian Ministerial Conference on Disaster Risk Reduction.

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Activities

Task–force meeting on the toxic waste disaster at Pasir Gudang, Johor

Tan Ling Ling

SEADPRI-Universiti Kebangsaan Malaysia

SEADPRI-UKM was represented by Dr. Tan Ling Ling at the task-force meeting, organised by MyCAS at University Putra Malaysia, Serdang, Selangor.

On 15th March 2019, SEADPRI-UKM participated in a task-force meeting on the emergency response to the air pollution disaster in Pasir Gudang which occurred on March 7. The meeting was organised by the Clean Air Forum Society of Malaysia (MyCAS) at the JKPP Meeting Room, Faculty of Medicine and Health Sciences, University Putra Malaysia (UPM), Serdang, Selangor. This meeting was held to provide information and updates on the status of the Pasir Gudang air pollution crisis; and to seek expert opinions and help from our community of experts from different backgrounds and experiences regarding the disaster. Participants comprised representatives from local higher education institutions (i.e. UPM, UKM, USM and UMP), medical and healthcare professionals, technical agencies (e.g. International Institute of Risk Management and Crisis Strategies, IIRMACS), local authorities (e.g. local armed forces, etc.), which were involved - in disaster management, stakeholders or professionals from the public sector, private sector and other expert stakeholder groups. Prof. Dr. Jamal Hisham Hashim, visiting professor at the United Nations University-International Institute for Global Health (UNU-IIGH) and director of Provenue Corporation Sdn Bhd, who specializes in health risk and impact assessment, was invited to present on the nature of the toxic waste dumping incident, chronology of events, the implicated victims, chemicals detected and their health effects as well as the lessons learnt. Prof. Dr. Jamal, also sits on the Scientific and Technical Expert Panel (STEP) of the National Disaster Management Agency (NADMA), and chairs the Thematic Working Group of Environmental Health Experts under the National Environmental Health Action Plan (NEHAP). The meeting ended with a generous donation of RM5,000 from MyCAS to help alleviate the air-quality crisis in Pasir Gudang.

Bengkel Penyediaan Infografik ke Arah Udara Bersih

Tan Ling Ling

SEADPRI-Universiti Kebangsaan Malaysia

Susulan daripada insiden pencemaran sisa toksik yang berlaku di Pasir Gudang, Pertubuhan Forum Udara Bersih Malaysia (MyCAS) telah mengambil inisiatif untuk mengadakan bengkel penyediaan infografik ke arah udara bersih pada 28 Mac 2019 di Hotel Armada, Petaling Jaya. Objektif penganjuran bengkel ini adalah untuk menyalurkan maklumat mengenai pencemaran udara dan langkah-langkah yang perlu diambil bagi membantu menjadikan Malaysia ke arah persekitaran yang lebih bersih. Doktor perubatan dari Hospital Universiti Kebangsaan Malaysia (HUKM), Pensyarah Kimia dari Universiti Malaya (UM) dan pakar-pakar teknologi maklumat dan komunikasi (ICT) dari Universiti Teknologi MARA (UiTM) dan syarikat swasta turut dijemput untuk menyertai pasukan infografik ini bagi memberikan maklumat bermanfaat dalam usaha menyediakan maklumat teknikal ringkas mengenai kimia toksik, pencemar-pencemar udara dan kesannya-terhadap kesihatan orang awam dalam bentuk poster, risalah dan infografik. Kandungan infografik dan maklumat yang diperlukan adalah seperti senarai pencemar-pencemar udara lazim iaitu karbon monoksida (CO), zarah 10 mikrometer atau kurang dalam diameter (PM10), zarah 2.5 mikrometer atau kurang dalam diameter (PM2.5), sulfur dioksida (SO_2), nitrogen dioksida (NO_2) dan ozon (O_3); pencemar-pencemar udara berbahaya seperti benzene, hidrogen klorida, toluene, limonene, metana, hidrogen sianida, akrolein dan akrilonitril termasuk bau mereka yang tersendiri; implikasi-implikasi kesihatan selepas pendedahan sama ada dalam jangka pendek atau jangka panjang; cadangan langkah-langkah serta-merta yang perlu diambil sekiranya terbau sesuatu yang mencurigakan untuk melindungi orang awam; dan cadangan tindakan-tindakan masa hadapan yang boleh diambil oleh penduduk sebagai langkah pencegahan pencemaran udara.

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2020 Asia Pacific Science and Technology Conference for Disaster Risk Reduction 16–17 March 2020, Kuala Lumpur, Malaysia

http://www.ukm.my/apstcdrr

Malaysia will host the 2020 Asia Pacific Science and Technology Conference for Disaster Risk Reduction on 16-17 March 2020 in Kuala Lumpur, in partnership with the United Nations Office for Disaster Risk Reduction (UNDRR) Asia Pacific Science Technology and Academia Advisory Group (APSTAAG), whose members play a crucial role in strengthening regional networking and providing advice and insight to boost national science and technology capacities. The 2020 Asia Pacific Science and Technology Conference for Disaster Risk Reduction aims to provide an opportunity to the science, technology, and academia community in Asia and the Pacific to continue the much-needed science-policy dialogue to ensure that implementation of disaster risk reduction (DRR) measures are based on reliable science, technology and innovation. There will be a focus on the application of science, technology and innovation for local and inclusive action to build disaster resilience in the face of growing disaster risks and a changing climate. The application of science and innovation in the development or revision of national and local strategies to meet Target E of the Sendai Framework will also be highlighted. Opportunities will be provided to various organisations and stakeholders, in particular the young scientists, to learn and share on application of science and technology for DRR. The Conference will:

- Review progress on the outcome of the Second Asia Science and Technology Conference, against the revised Science and Technology Global Roadmap;
- Review progress in the commitments made by the science, technology and academia community in the region, in particular, the Voluntary Action Statement made at the AMCDRR 2018 in preparation for the Asia Pacific Ministerial Conference on Disaster Risk Reduction (APMCDRR) 2020 in Australia and other Voluntary Commitments registered;
- Renew the commitments and promote development/revision of science-based national and local DRR strategies;
- Identify future work priorities for the Asia Pacific region; and
- Share good practice in application of science and technology in disaster risk reduction.

Expected outcomes of the Conference will include the final draft of the Asia Pacific Science Technology Status Report 2020; APSTAAG position for the APMCDRR 2020; and the Conference report.

You are invited to register and keep abreast of developments at http://www.ukm.my/apstcdrr.

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ISSN 2180 - 1142