



# International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction

To promote the availability and application of research, science and technology to support implementation of Sendai Framework for Disaster Risk Reduction 2015-2030

16<sup>th</sup> - 18<sup>th</sup> March 2020,  
Cinnamon Grand, Colombo, Sri Lanka

Symposium Book of Abstracts and Proceedings

Organised by:



Ministry of Defense  
Sri Lanka



Disaster Management Centre  
Sri Lanka

University of  
HUDDERSFIELD



University of Moratuwa  
Sri Lanka



Asian Disaster  
Preparedness Center



World Vision



# International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction

*To promote the availability and application of research,  
science and technology to support implementation of  
Sendai Framework for Disaster Risk Reduction 2015-2030*

## Symposium Book of Abstracts and Proceedings

Edited by: Professor Dilanthi Amaratunga  
Professor Richard Haigh  
Dr Nuwan Dias  
Major General (Rtd.) Sudantha Ranasinghe  
Mr Sunil Jayaweera  
Dr Chandana Siriwardana

March 2020

Professor Dilanthi Amaratunga, Professor Richard Haigh, Dr. Nuwan Dias, Dr. Chandana Siriwardana, Major General (Rtd.) Sudantha Ranasinghe and Mr. Sunil Jayaweera

(edited by)

International Symposium on  
Multi-Hazard Early Warning and Disaster Risk Reduction

*To promote the availability and application of research, science and technology to support implementation of Sendai Framework for Disaster Risk Reduction 2015-2030*

## **Book of Abstracts**

ISBN (978-1-86218-173-1)

© 2020 University of Huddersfield, UK

All rights reserved. No part of this publication may be reproduced, stored and transmitted in any form, or by any means without prior written permission from the editors.

The views expressed in the papers are of the individual authors. The editors are not liable to anyone for any loss or damage caused by any error or omission in the papers, whether such error or omission is the result of negligence or any other cause. All and such liability is disclaimed.

The reader should verify the applicability of the information to particular situations and check the references prior to any reliance thereupon. Since the information contained in the book is multidisciplinary, international and professional in nature, the reader is urged to consult with an appropriate licensed professional prior to taking any action or making any interpretation that is within the realm of a licensed professional practice.

Copies may be ordered by contacting:

Mr Sunil Jayaweera,  
Director (Preparedness Planning)  
Disaster Management Centre,  
120/2, Vidya Mawtatha,  
Colombo,  
Sri Lanka

Email: jayaweera\_s@yahoo.com

## Table of Contents

Message from the Secretary	iv
Message from the Director General	v
Preface	vi
About the Editors	ix
Acknowledgements	xiii
Conference Organisation	xiv
International Journal of Disaster Resilience in the Built Environment	lxii
Key note speakers	lxiv
National launches	lxxvi
Special Plenary	lxxxiv
Thematic Sessions	xcvii
Associated projects	cxiii
National Level Art Competition	cxxx
International symposium publications	cxxxiii
Colombo 2020 DRR declaration	cxxxiv
Book of Abstracts	1
Index	156



## Message from the Secretary



### **Kamal Gunaratne WWV RWP RSP USP ndc psc MPhil**

Major General (Rtd)

*Secretary, Ministry of Defence*

I am pleased and honoured to welcome all participants to this International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction in Colombo, Sri Lanka. This symposium is an excellent platform and an opportunity for professionals of various backgrounds and nationalities involved in disaster risk reduction activities to meet and exchange experience, knowledge and ideas related to this important field.

Disasters arising from natural hazards have a high potential to cause large scale damages and thereby negatively affect the country's livelihood and the economy. The Government of Sri Lanka, with a new vision for the future by His Excellency President Gotabaya Rajapaksa, is currently observing measures to improve the National Strategy on Disaster Risk Reduction. A collaborative interaction between policymakers, administrators and academia in symposiums of this nature, plays an important role in meeting with such national endeavours.

I am pleased to give this welcome message for the International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction and I am confident that this symposium will create a platform for local and international participants to share their experiences, as well as exchange novel know-how and latest developments in the field of disaster risk reduction and mitigation.

I convey my best wishes for the International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction and trust this will be a wonderful thought-provoking experience to all participants. I express my sincere thanks to all the guests, keynote speakers, authors, financial sponsors and members of the organising committee who supported in making this very significant event a success.

## Message from the Director General



### **Sudantha Ranasinghe RWP RSP MSc ndu psc**

Major General (Rtd)

*Director General, Ministry of Defence*

It is my greatest pleasure and privilege to welcome you to this International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction. The purpose of this symposium is to promote the availability and application of research, science and technology to support the implementation of the Sendai Framework for Disaster Risk Reduction 2015 -2030. In an area such as disaster risk reduction, it is vital that academia, industry practitioners and government agencies all work together to achieve the goals and target.

In 2015, both the UN Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction were introduced. Target G, which looks at increasing the availability of and access to multi-hazard early warning (MHEW) systems and disaster risk information to people, has been identified of special importance to Sri Lanka. The wider development of new technologies enables the development of novel, technology-based MHEW. The adaptation of these systems successfully into countries more prone to natural hazards can be very helpful in disaster risk reduction.

It is my belief that this symposium will bring professionals of various disaster management backgrounds together in an environment that will allow them to address the existing and emerging gaps in the disaster risk reduction and multi-hazard early warning, and to develop potential solutions that can address these challenges .

I convey my sincere thanks to the symposium guests, keynote speakers, authors, financial sponsors and members of the organising committee for their dedication in making this event a success, and hope that you have a fruitful time in Colombo, Sri Lanka.

## Preface

This International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction provides an important opportunity to reflect upon our progress to date in tackling disaster risk, but also to consider some of the challenges and opportunities that lay ahead of us.

It is now almost 5 years since the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) was signed and became the first major agreement of the post-2015 development agenda. It provided Member States with concrete actions to protect development gains from the risk of disaster.

The Sendai Framework works hand in hand with the other 2030 Agenda agreements, including The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals. It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDDR), and advocates for: The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

It recognises that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. This symposium reinforces this approach and provides an opportunity to bring these stakeholders together, including to explore ways to promote the availability and application research, science and technology to support implementation of Sendai Framework for Disaster Risk Reduction 2015-2030.

A particular focus of this event is Multi-Hazard Early Warning. During the negotiations for the Sendai Framework, countries and partners highlighted the need to:

1. Continue to invest in, develop, maintain and strengthen people-centred, end-to-end early warning systems;
2. Promote the application of simple and low cost early warning equipment and facilities;
3. Broaden the dissemination channels for early warning information to facilitate early action.

Countries also called for the further development of and investment in effective, nationally compatible, regional multi-hazard early warning mechanisms. To address these needs, global Target (g) of the Sendai Framework was adopted, namely to “substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030”.

In 2004, the host country for this Symposium, Sri Lanka, experienced the devastating effects when there are inadequate early warning systems. The lack of a tsunami early warning system and poor preparedness of communities resulted in the death of over 30,000 people in Sri Lanka, and the displacement of many more. Sri Lanka was not alone in these failings, as the Indian Ocean did not have the type of tsunami early warning system that had been operating in the Pacific since the 1960s. As a result, communities along the surrounding coasts of the Indian Ocean were severely affected, and the tsunamis killed an estimated 227,898 people in 14 countries. The direct results caused major disruptions to living conditions and commerce, particularly in Indonesia, Sri Lanka, India, and Thailand.

Following the disaster, the Intergovernmental Oceanographic Commission (IOC) of UNESCO was given the mandate to develop and implement the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). The Intergovernmental Coordination Group (ICG) for the IOTWMS was established as a primary subsidiary body of the IOC by its July 2005 Assembly (Resolution XXIII-12). Further mandates were given to UNESCO/IOC by the UN General Assembly through Resolutions 61/132 and 62/91.

After 8 years of international collaboration and development, facilitated and coordinated by UNESCO/IOC, the IOTWMS became fully operational on 31 March 2013 with Tsunami Service Providers (TSPs) established by Australia, India and Indonesia.

An end-to-end tsunami warning system begins with the upstream rapid detection of a tsunami wave, including detection, verification, threat evaluation, and forecasting. It ends with a well-prepared community that is capable of responding appropriately to a warning, including delivery of public safety messages, risk assessment and management, initiating national countermeasures, and preparing and implementing standardised reactions.

Recent studies and practical experiences from the Indian Ocean region suggest that more attention needs to be paid to the cognitive and normative challenges in positioning the tsunami early warning systems and preparedness in the wider context of social change in the coastal societies and communities at risk, and for critical reflection of 'on-the-ground' experiences and lessons learnt. Although the IOTWMS has been largely successful in promoting regional cooperation to develop the technical hazard detection infrastructure, progress at the national and sub-national level has been far more variable. A review of national reports, recent earthquake and tsunami threat responses, and practice evacuation exercises suggests uneven progress across the region, with some high-risk, low-capacity countries falling behind.

As illustrated by recent events in Indonesia, it is also vital to address the challenge of cascading hazards that pose a tsunami risk, and the importance of linking tsunami early warning to a multi-hazard environment. Moving towards a multi-hazard environment is complex and poses many challenges but can bring significant benefits in terms of efficiencies and also in recognising the links between hazards, such as cascading threats.

We very much hope that this International Symposium will provide an important platform to address these and other challenges in addressing disaster risk, as well as supporting implementation of the Sendai Framework for Disaster Risk Reduction. The format of the event is designed to promote a serious dialogue between scientists and policy makers in Sri Lanka, but also in linking to wider regional and international efforts. In promoting this, we have a series of distinguished keynote speakers from Sri Lanka and the Indian Ocean region.

We would also like to take this opportunity to thank our co-organisers for enabling this event to take place, including the Ministry of Defence and Disaster Management Centre, Sri Lanka, partner universities, partner UN agencies, JICA, ADPC and other partner agencies. Without their support this event would not have been possible.

We very much hope you enjoy the conference.

Professor Dilanthi Amaratunga & Professor Richard Haigh  
Major General (Rtd) Sudantha Ranasinghe & Sunil Jayaweera

*Conference Chairs,  
International symposium on  
Multi-Hazard Early Warning and Disaster Risk Reduction*

## About the Editors



**Dilanthi Amaratunga** is the Professor of Disaster Risk Reduction (DRR) at the University of Huddersfield, UK, where she is the founding Director of its Global Disaster Resilience Centre (GDRC), a global leader in interdisciplinary research to improve the resilience of nations and communities. Since its inception, it has expanded to become one of the UK's leading research groups on disaster resilience. She has a BSc First Class Hons degree from Sri Lanka and a PhD from the UK. With 30 years of experience in the sector and as an

international leader in DRR with specific emphasis on early warning systems, she has over 400 publications under her name. Her research has been cited in key United Nations publications such as the UN Global Assessment Report. She is the Joint Editor in Chief of the SCOPUS indexed International Journal of Disaster Resilience, Emerald Publishing. She is a member of European Science & Technology Advisory Group (E-STAG), of the UNDRR, one of two members who represent the UK. The principal goal of the ESTAG is to provide scientific support to 56 European and Central Asian countries for the implementation of DRR related frameworks or policies in the European Union. She won the 2019 Prestigious Newton Prize which recognises her work internationally, for helping to protect coastal communities from the devastation caused by coastal hazards through effective early warning systems. In 2018, she received the "His Excellency the President of Sri Lanka Award" from the President of Sri Lanka, for the contribution to Disaster Resilience in Sri Lanka. She was also the winner of the UALL International Award for 2018 for her CADRE project for its innovative partnership that created change in an international context. She has supervised to successful completion over 55 PhD researchers. The key contributions she has made have been in providing leadership within the international research community and peer respected research. Further details on her activities can be viewed at: [www.dilanthiamaratunga.net](http://www.dilanthiamaratunga.net)



**Richard Haigh** is Professor of Disaster Resilience and Co-Director of the Global Disaster Resilience Centre at the University of Huddersfield, UK. His research interests are in field of disaster resilience in the built environment, with a focus on disaster risk governance and accountability, multi-hazard early warning and the last mile, convergence of disaster risk reduction and climate change adaption, and post-conflict reconstruction. He is the Co-Founding Editor-In-Chief of the Scopus indexed International Journal of Disaster Resilience in the Built Environment, Founder and Co-

Chair of the Co-Chair of the International Conference on Building Resilience series. Richard has secured twenty-three research grants since 2005, delivered over 60 invited speeches and keynote presentations for audiences in over twenty countries across the World. He has published an edited book with Wiley Blackwell, seven book chapters in three edited books, and over forty peer reviewed journal articles, the majority in ISI or SCOPUS indexed journals. In 2019, his work to protect coastal communities from the devastation caused by coastal hazards such as flooding and tsunamis won the prestigious Newton Prize for Indonesia, part of an annual fund awarded for the best research or innovation that promotes the economic development and social welfare of Newton Fund partner countries. For further information, see <https://pure.hud.ac.uk/en/persons/richard-haigh>.



**Dr Nuwan Dias** is a Research Fellow in Disaster Resilience at the Global Disaster Resilience Centre, University of Huddersfield, UK. Nuwan has over 11 years of experience in engaging in various international research activities in Urban Planning, Urban Design, Disaster Risk Reduction, Climate Change Adaptation and Disaster Resilience Education. Currently, Nuwan is working on research impact activities in relation to the UOA13 (Architecture, Built Environment and Planning) of the UK's Research Excellence Framework

(REF). Nuwan has published his research work in international high-quality journals and in international conferences. Nuwan obtained his PhD from the University of Huddersfield, UK for Developing a sustainable novel urban design process framework embedding bottom-up and top-down urban design approaches. He obtained his MSc from the University of Salford in Urban Design, UK and his undergraduate degree from the University of Moratuwa, Sri Lanka in Town and Country Planning.



**Major General (Rtd) Sudantha Ranasinghe** is the Director General of Sri Lanka Disaster Management Centre. He holds a Master of Science in War Studies from National Defence University Islamabad, Pakistan, is a graduate of the National Defence University of China on Military and Political Strategy and also a graduate of National Defence University Pakistan on Science of War Studies. He also holds a Diploma in Personal Management. Prior to being appointed as the Director

General of the Disaster Management Centre, he has held the following posts:



Coordinating Officer (Principle Staff Officer) to the Competent Authority, Rehabilitation and Resettlement of North and East of Sri Lanka; Commissioner General Rehabilitation responsible for the rehabilitation of all 12000 Ex Combatants after the Humanitarian Operation; Member of the Sri Lankan Delegation who represented the Government of Sri Lanka at Geneva on the motion brought in by CRC (Convention of Rights of Children) in early 2010; Member of the Sri Lankan Delegation who represented the Government of Sri Lanka at Geneva on the motion brought in by CEDAW (Convention on the Elimination of all forms of Discrimination Against Women) in 2010; Advisor on Ex-Combatant Rehabilitation and Reintegration to National Reconciliation Unit, Office of Reconciliation; Reintegration advisor to Organization of Emotional Intelligence and Strength of Life Skills – Sri Lanka; and the President National Rifle Association (2016 - 2017).



**Dr. Chandana Siriwardana** is a senior lecturer attached to the Department of Civil Engineering, University of Moratuwa, Sri Lanka. He obtained his Bachelors' Degree in Civil Engineering from University of Moratuwa, followed by his Master's degree on Coastal Engineering from University of Tokyo, Japan with Monbukagakusho Scholarship. He obtained his PhD in Civil Engineering, with Project Management Specialization from University of Calgary, Canada. After returning back to Sri Lanka, Dr. Siriwardana collaborated with late Professor Samantha Hettiarachchi, at University of Moratuwa,

for EU ERASMUS+ co-funded collaborative research projects namely ASCENT (2016 – 2019) and CABARET (2017 – 2020) lead by University of Huddersfield, UK together with other partner universities from Europe and Asia. Dr. Siriwardana was the co-chair of the 'ASCENT festival', a five-day event held in Colombo, Sri Lanka in 2019, comprised of training programs, panel discussions, field visits with an international conference on 'Capacity Building for Research and Innovation in Disaster Resilience'. Further, Dr. Siriwardana was the Principal Investigator, representing Department of Civil Engineering, University of Moratuwa for the MOBILISE project (2017 – 2019), co-funded by the Global Challenges Research Fund (GCRF) UK. And also the Principal Investigator of the recently launched BRITAE project (Building Resilience in Tropical Agroecosystems) which is co-funded by an EU Erasmus+ programme grant. In addition, Dr. Siriwardana has been working with the Ministry of Health, Sri Lanka, on adapting WHO 'Safe Hospitals' guidelines to the Sri Lankan context. HEARTS-SL is an extension to this initiative, which aimed to develop an evidence based vulnerability assessment for hospitals in Sri Lanka regarding tsunami and storm surge. HEARTS-SL is a collaboration with University College of London (UCL), UK funded by GCRF, UK. Moreover, Dr. Siriwardana collaboratively works with Dialog Axiata, PLC, Sri Lanka and Huddersfield University, UK to investigate the current state of Multi Hazard Early Warning in Sri Lanka with a special focus on the



mobile application DEWN. Dr. Chandana Siriwardana is the Focal Point, representing University of Moratuwa for the implementation of Sendai Framework for Disaster Risk Reduction (SFDRR 2015 – 2030). Recently he was appointed as the Secretary of the Association of Disaster Risk Management Professionals (ADRIIMP) in Sri Lanka. Further, he holds the responsibilities as the research coordinator of Masters' degree of Project Management offered by the Department of Civil Engineering, University of Moratuwa as the senior treasurer of the World University Service (WUS) and the staff adviser to the Nature Team of University of Moratuwa, Sri Lanka.



**Mr Sunil Jayaweera** is the Director, Preparedness Planning of the Disaster Management Centre, Sri Lanka. He has a Master of Science in Town & Country Planning, University of Moratuwa, Sri Lanka.; a Post Graduate Diploma on Applied Sociology ,University of Colombo,Sri Lanka; and a Bachelor of Science (Special) Estate Management and Valuation ,University of Jayawardanapura, Sri Lanka. He has over 30 years of experience in the relevant field including: Senior Scientist ,National Building Research Organization (NBRO) , Sri Lanka, 1990-2002; Consultant Public Communication Water Resource Secretariat , Sri Lanka, 2002 – 2004; and Senior Scientist ,National Building Research Organization (NBRO),Sri Lanka, 2004 -2011. His professional qualifications include: Member of Population Association of Sri Lanka; Co-Operate member of Institute of Town Planning of Sri Lanka; Committee Member of Sri Lanka Women Water Partnership, Sri Lanka; and Expert member in EIA and SIA Studies, Sri Lanka.

## Acknowledgements

As Chairs of the International symposium on Multi-Hazard Early Warning and Disaster Risk Reduction, we are delighted to have the opportunity to hold this conference.

The Conference organising committee met regularly and together we made an array of, hopefully better, key decisions! All involved have provided a willing source of on-going support and guidance that is very much appreciated. Our thanks go to the International Scientific Committee members who made extensive efforts in reviewing papers to tight time scales in ensuring the high quality of the conference.

We thank the keynote speakers for their willingness to stimulate invaluable discussions and debate around the conference theme. We also thank session chairs for agreeing to ensure the conference is as challenging, exciting and rewarding as possible, and the organisers and the judging panel of the Student Arts Competition. Selecting the winners is not an easy task due to the number of high-quality submissions we have received.

We are grateful for the exceptional help and support from a number of people, organisations and bodies in the work for this conference: the Secretary, Ministry of Defence, Sri Lanka; Secretary, Ministry of Education, Sri Lanka; Additional Secretary-Disaster Management Division of the Ministry of Defence; Additional Director General, Directors and all staff of the Disaster Management Centre, Organization Committee, University of Moratuwa, and all paper authors who contributed with their scientific and policy inputs.

We extend our sincere gratitude towards all sponsors and partners of this international conference. Without their support, and event of this extent wouldn't have been possible to plan and hold.

We would like to thank Emerald for agreeing to publish selected papers in the International Journal of Disaster Resilience in the Built Environment, and Springer Nature for agreeing to publish selected papers in a book about multi-hazard early warning and disaster risk reduction.

Most of all, we want to thank our colleagues who worked very hard for the professional undertaking of the work involved in the tasks that are so often unseen and unrewarded for a conference of this scale. We thank University of Huddersfield team for their unconditional efforts towards the conference, for all their expertise on the development and management of the conference database, and managing the double blind peer review process.

Professor Dilanthi Amaratunga & Professor Richard Haigh  
Major General (Rtd) Sudantha Ranasinghe & Sunil Jayaweera

*Conference Chairs,  
International symposium on  
Multi-Hazard Early Warning and Disaster Risk Reduction*

## Conference Organisation

### *Organised by*

- Disaster Management Centre, Ministry of Defence, Sri Lanka
- Global Disaster Resilience Centre, University of Huddersfield, UK
- Asian Disaster Preparedness Centre, Thailand
- University of Moratuwa Sri Lanka

### *In association with*

- The International Oceanographic Commission of UNESCO (IOC-UNESCO), Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) ICG/IOTWMS WG 1 on Tsunami Risk, Community Awareness and Preparedness
- IOC-UNESCO IOTWMS, WG 1 on Tsunami Risk, Community Awareness and Preparedness
- International Union for Conservation of Nature (IUCN), Sri Lanka
- Department of Meteorology, Sri Lanka
- Association of Disaster Risk Management Professionals in Sri Lanka (ADRIIMP)
- University of Peradeniya, University of Colombo, University of Ruhuna, Sri Lanka
- REGARD (REbuilding After Displacement)
- CABARET (Capacity Building in Asia for Resilience EducaTION) project on fostering regional cooperation for more effective multi-hazard early warning and increased disaster resilience among coastal communities
- Bandung Institute of Technology (ITB), Indonesia
- Regional dialog of Asian Preparedness Partnership (APP)
- The United Nations World Food Programme
- Asian Disaster Preparedness Centre (ADPC), Thailand
- The United Nations Development Programme
- The Japan International Cooperation Agency
- ChildFund Sri Lanka
- International Journal of Disaster Resilience in the Built Environment

*Conference Chairs*

- Professor Dilanthi Amaratunga, Global Disaster Resilience Centre, University of Huddersfield, UK
- Professor Richard Haigh, Global Disaster Resilience Centre, University of Huddersfield, UK
- Major General (Rtd) Sudantha Ranasinghe, Director General, Disaster Management Centre, Sri Lanka
- Mr Sunil Jayaweera, Director Preaprens Planning, Disaster Management Centre, Sri Lanka

*Publication and technical directors*

- Dr Nuwan Dias, Global Disaster Resilience Centre, University of Huddersfield, UK
- Asitha de Silva, Global Disaster Resilience Centre, University of Huddersfield, UK

## Organising Committee

### *University of Huddersfield, UK*

- Prof. Dilanthi Amaratunga
- Prof. Richard Haigh
- Dr Nuwan Dias
- Asitha De Silva
- Malith Senevirathne

### *Disaster Management Centre, Sri Lanka*

- Maj.Gen. (Rtd) Sudantha Ranasinghe
- Mr Sunil Jayaweera
- Mr Sangarappillai Ravi
- Mr Chathura Liyanaarachchi

## Art Competition Organisation Team

### *Disaster Management Centre, Sri Lanka*

- Mr. Sugath Disanayake
- Dr. N.S. Vithanage
- Mr. Shann Pathirana
- Mr. B.A.W.R. Pathmashantha

### *Ministry of Education*

- Mr. Padmashantha

### *University of Moratuwa, Sri Lanka*

- Dr Chandana Siriwardana

### *Asian Disaster Preparedness Centre (ADPC), Thailand*

- Mr. Sisira Madurapperuma
- Ms. Ganga Samarawickrama
- Dr. Senaka Basnayake

---

## International Scientific Committee

	<b>Name</b>	<b>Institute</b>	<b>Country</b>
<b>01</b>	Prof Dilanthi Amaratunga	Global Disaster Resilience Centre, University of Huddersfield	United Kingdom
<b>02</b>	Prof Richard Haigh	Global Disaster Resilience Centre, University of Huddersfield	United Kingdom
<b>03</b>	Prof Siri Hettige	University of Colombo	Sri Lanka
<b>04</b>	Dr Harkunti Rahayu	The International Oceanographic Commission of UNESCO (IOC- UNESCO), Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) ICG/IOTWMS WG 1 on Tsunami Risk, Community Awareness and Preparedness	Indonesia
<b>05</b>	Prof K D N Weerasinghe	University of Ruhuna	Sri Lanka
<b>06</b>	Prof Champa M Navaratne	University of Ruhuna	Sri Lanka
<b>07</b>	Dr Nishara Fernando	University of Colombo	Sri Lanka
<b>08</b>	Dr Champika Liyanage	University of Central Lancashire	United Kingdom
<b>09</b>	Dr Ignacio Aguirre Ayerbe	Environment Hydraulics Institute IH Cantabria	Spain
<b>10</b>	Ms Maria Merino Gonzalez- Pardo	International Project Manager Environment Hydraulics Institute IH Cantabria	Spain
<b>11</b>	Prof Boyko Rangelov	Professor Mining and Geology University Bulgaria	Bulgaria
<b>12</b>	Dr Ruben Paul Borg	University of Malta	Malta
<b>13</b>	Dr Francesco Romagnoli	Riga Technical University Latvia	Latvia
<b>14</b>	Dr Chandana Siriwardana	University of Moratuwa	Sri Lanka
<b>15</b>	Prof Ranjith Dissanayake	University of Peradeniya	Sri Lanka
<b>16</b>	Dr Chaminda Bandara	University of Peradeniya	Sri Lanka
<b>17</b>	Prof Benedictus Kombaitan	Institute of Technology Bandung	Indonesia
<b>18</b>	Dr Taufika Ophiyandri	University of Andalas	Indonesia
<b>19</b>	Prof Abdul Hakam	University of Andalas	Indonesia

<b>20</b>	Ms Fathimath Shadiya	The Maldives National University	Maldives
<b>21</b>	Dr Shazla Mohamed	The Maldives National University	Maldives
<b>22</b>	Dr Marlon de Era	De La Salle University	Philippines
<b>23</b>	Dr Maria Caridad H Tarroja	De La Salle University	Philippines
<b>24</b>	Dr Crisanto M Lopez	Ateneo De Manila University	Philippines
<b>25</b>	Dr Charlotte Kendra de Gotangco	Ateneo De Manila University	Philippines
<b>26</b>	Dr Zin Mar Lwin	Mandalay Technological University	Myanmar
<b>27</b>	Dr Aung Kyaw	University of Yangon	Myanmar
<b>28</b>	Dr Day Wa Aung	University of Yangon	Myanmar
<b>29</b>	Dr. Nuwan Dias	University of Huddersfield	United Kingdom
<b>30</b>	Dr. Chamindi Malalgoda	University of Huddersfield	United Kingdom
<b>31</b>	Ms. Kinkini Hemachandra	University of Huddersfield	United Kingdom
<b>32</b>	Dr.Chathuranganee Jayakody	University of Huddersfield	United Kingdom
<b>33</b>	Dr Maheshika Sakalasuriya	University of Huddersfield	United Kingdom
<b>34</b>	Dr Senaka Basnayake	Asian Disaster Preparedness Center	Thailand

## **Conference Partners**





## Disaster Management Centre, Sri Lanka

The Sri Lanka Disaster Management Act No. 13 of May 2005 was enacted in the Parliament. This Act has paved the way for Sri Lanka to move towards a new paradigm with a proactive approach in the sphere of disaster management. Under the Disaster Management Act, the National Council for Disaster Management (NCDM) was established. The NCDM has primary responsibility for formulating a National Policy, program and institutional setup for the management of disasters in Sri Lanka. The NCDM is chaired by H.E. the President and includes the Hon Prime Minister, the Opposition Leader, five Members of Parliament, nine Chief Ministers of the Provincial Council, and Ministers of the Ministries relevant to disaster management.

The Disaster Management Centre (DMC) is mandated with the coordination of all aspects of disaster management but was expected to focus more on prevention, mitigation, preparedness and early warning. The DMC has convened a National Disaster Management Coordination Committee (NDMCC), which is a national platform to coordinate action amongst all stakeholders and to ensure the implementation of the Sendai Framework for Disaster Risk Reduction and the outcomes from the 2015 United Nations Climate Change Conference (COP21). The DMC has established District Disaster Management Coordinating Units (DDMCU) affiliated with the District Secretariat in all Districts as a mechanism to devolve activities.

Since its inception, DMC has worked closely with various national and local governments, regional and global level agencies and non-governmental organisations to provide guidance and strengthen the disaster risk reduction capacity of the country. The agencies under the purview of the DMC facilitate and provide several national, sub-national level platforms to bring together policy and decision makers, planners, practitioners, managers, scientists, academia and experts from across the field of disaster management.

DMC seeks to promote and build a resilient and safer Sri Lanka by strengthening knowledge as well as developing networks and partnerships for the replication of proven disaster risk reduction practices. We believe that one organisation or institution alone cannot design, fund, manage and implement the broad range activities that are necessary for a comprehensive disaster management and risk reduction actions. If disaster risk reduction and resilience policies and measures implemented are to be effective, it is vital that a broad constituency for disaster risk reduction and resilience is built and sustained through continuous awareness, promotion, capacity building and shared collaborations.

The national responsibility that has been assigned to the DMC is to implement the disaster management mechanism in Sri Lanka with support divisions. The main divisions are as follows: Mitigation Research and Development; Preparedness

and Planning; Training and Awareness; Emergency Operations; and, Early Warning Dissemination. To implement this national, island-wide policy, there are District Disaster Management Coordinating Units (DDMCUs) established at the district level to help ensure that the disaster management mechanism can be implemented within the country efficiently and effectively.

The requirement to manage disasters in a holistic, scientific and planned manner is recognised by the Disaster Management Act of 2005. The Act empowers the NCDM, DMC and the Stakeholder Agencies to prepare the National Policy, National Disaster Management Plan, National Emergency Operation Plan and the Sector Plans. Accordingly, a number of plans were formulated and implemented by the Ministry and the DMC between 2005 and 2017 to ensure preparedness for disasters and other emergencies, risk prevention, and prevention/mitigation of disasters, with a view to counter any disaster or impending disaster.

In the light of the above, the DMC was instrumental in the formulation and implementation of:

1. **Roadmap (2006-2016) for Disaster Risk Management** - “Towards a Safer Sri Lanka”, identifying specific projects in coordination with multiple stakeholders through a holistic strategy;
2. **National Disaster Management Plan (2013-2017)** with an aim to “reduce disaster impact on communities, infrastructure, lifeline facilities, shelter, agricultural property, economic and development activities in Sri Lanka.
3. **National Emergency Operation Plan - NEOP (2017)** in order to provide a framework for implementing effective disaster response activities and immediate restoration of essential services.
4. **Sri Lanka Comprehensive Disaster Management Programme – SLCDMP (2014-2018)** to supplement the NDMP (2013-2017) with an overarching objective to create and facilitate an enabling environment for a multi-hazard, multi-sector, multi-agency partnership-oriented disaster risk management programme, using risk knowledge as the base, in line with global conventions and frameworks. The SLCDMP, which was formulated in line with the Hyogo Framework of Action – HFA (2005-2015), has focused on eight strategic areas to achieve the spelt-out objectives. It has resulted in the following major outcomes:
  - National and sub-national level agencies capable of assessing disaster risk and making decisions for short, medium and long-term disaster management.
  - Key development sectors able to incorporate Disaster Risk Management (DRM) in their respective development initiatives/ processes/ activities at different administrative levels.
  - Communities, local governments and sub-national agencies that have necessary capacities and mechanisms to respond to and recover from disasters, and

- A system in place for obtaining advice and continuous monitoring, learning and adapting to facilitate the on-going planning and implementation process.
5. **Sri Lanka Post-Disaster Needs Assessment – PDNA (2016 & 2017)** to ensure efficient and effective recovery process by identifying and estimating recovery needs. The Ministry of Disaster Management with the assistance of UNDP, European Union and the World Bank has accomplished PDNA (2016) after the immediate relief phase of 2016 calamity. The same was repeated in 2017 and shall continue in the years to come as and when required. The recovery strategy proposed by the PDNA is guided by a variety of principles such as improvement of the quality of recovery, maintains equity and inclusion, and promotes risk reduction, in compliance with ‘Building Back Better’ (BBB) approach recommended by the Sendai Framework.
  6. **Community Based Disaster Risk Management (CBDRM)** - This programme was implemented by the DMC to build resilience and reduce the vulnerabilities and impacts of disasters on communities, while also making institutions engaged in disaster management more proactive. As a result, the CBDRM approach gained wider acceptance among the communities and other DRM actors as a proven way to develop community capacity and resilience against disasters. In line with the CBDRM framework, a number of other stakeholder agencies have implemented projects in many areas.
  7. **Standard Operational Procedure (SOP) for Tsunami Early Warning and emergency response** - This guideline based on the synergised Standard Operational Procedure seeks to strengthen the Sri Lankan tsunami warning and emergency response by describing the country’s Standard Operating Procedures (SOPs) for Tsunami early warning. It provides a description of the regional (Indian Ocean) Tsunami Warning and Mitigation System, and the procedures to be adopted by Sri Lanka National Tsunami Warning centre (Which is Department of Meteorology), National Disaster Management Organisation (i.e. Disaster Management Centre) and all other actors as recipients or potential recipients of warnings, and their subsequent response actions. Accordingly, it promotes alignment, interoperability and consistency among all Sri Lankan actors that have responsibilities in the end-to-end tsunami warning system, which covers upstream, interface and downstream.
  8. **Disaster Risk Index** - After completing the Sri Lanka Hazard profile for nine hazards DMC has released the first version of the Risk Profile for the country with respect to the Floods, Droughts, Landslides, and Tsunamis considering the population as the key element at risk. These risk profiles will be further strengthened considering the critical infrastructure and services, economy, agriculture environment etc. as other elements at risk. Accordingly, risk assessments will be expanded into sectors such as agriculture, transport, energy. Disaster risk assessments is very important for the mainstreaming disaster risk reduction into

development sectors. It is therefore important to update the risk information periodically as vulnerabilities and capacities continue to change.

### ***Sendai Framework for Disaster Risk Reduction 2015-2030***

In 2015, the Sendai Framework for Disaster Risk Reduction 2015 – 2030 (SFDRR) was adopted by Sri Lanka and other members of the United Nations at the third UN World Conference on Disaster Risk Reduction. SFDRR serves as a global blueprint in disaster risk reduction and management in conjunction with the sustainable development framework and the Paris Agreement. It is a non-binding agreement, which the signatory nations will attempt to comply with on a voluntary basis. SFDRR aims for the “substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries.” Through SFDRR, countries recognise the importance of not only managing disasters but managing disaster risk.. SFDRR states that to strengthen resilience, countries must prevent new and reduce existing disaster risk, and accordingly the outline of the framework of a coordinated approach to reducing disaster risk.

It outlines four global priorities for action to reduce disaster risk: understanding disaster risk; strengthening disaster risk governance to manage disaster risk; investing in disaster risk reduction for resilience; and enhancing disaster preparedness for effective response, and to ‘Build Back Better’ in recovery, rehabilitation and reconstruction. The Sendai Framework aims to achieve seven global targets by 2030. This expected outcome will be monitored via indicators against 7 targets.

SFDRR places government as the apex body of disaster risk reduction with the framework emphasizing the need to strengthen the disaster risk governance ensuring the participation of all stakeholders. In Sri Lanka, this is vested on the Disaster Management Centre, within the context of Ministry of Defense acting as the Focal point. DMC is committed, as per the SFDRR, to reduce disaster risk, by addressing existing challenges and prepare for future ones by focusing on monitoring, assessing, and understanding disaster risk and sharing such information.

### ***Sustainable Development Goals***

The Sustainable Development Goals (SDGs) represent a universal call to action to end poverty, to protect the planet and to ensure that all people enjoy peace and prosperity. The SDGs, are a set of seventeen aspirational “Global Goals” with 169 targets and 244 indicators between them to be achieved by April 2030. The SDGs were born at the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012.

The SDGs focus on areas such as economic inequality, innovation, climate change, sustainable consumption, peace and justice-among others. The commitment of the Government of Sri Lanka (GOSL) is reflected in having a separate ministry for

Sustainable Development, appointing a Parliament Select Committee on SDGs, and establishing cluster committees on SDGs etc. it promotes resilience and DRR as a foundation of sustainable development. It calls for strengthening the capacity of all countries, in particular developing countries, to reduce risk, increase resilience and adapt to climate change. DRR cuts across different aspects and sectors of development. There are 25 targets related to DRR in 10 of the 17 SDGs, firmly establishing the role of DRR as a core development strategy. The United Nations Office for Disaster Risk Reduction (UNDRR) recognises that progress in implementing the Sendai Framework supports the global community in meeting the Sustainable Development Goals.

The Paris Agreement was also agreed on in 2015. Both agreements (Paris Agreement and Sustainable Development goals ) highlight the importance of climate adaptation and disaster risk reduction.

### ***Climate Change Adaptation and Disaster Risk Reduction***

Both climate change adaptation and disaster risk reduction are cross cutting subjects. 90% of disasters are climate-related, observing that these disasters push 26 million people into poverty annually and cost the world economy US\$520 billion per year. Therefore, coherence between the Climate Change Adaptation and disaster risk reduction is crucial for the sustainability of the both programmes as experienced impact of climate change induced disasters severely and affecting the normal life pattern of the people.

National Environment Policy and Climate Change Adaptation Policy are the key policies directly addresses Climate Change Adaptation in Sri Lanka. Article No. 2.2.10 of the National Environment policy of The Government of Sri Lanka states: “The risks of climate change will be managed by implementing adaptive strategies that minimize the impact of climate change on both the people, and the economy, of Sri Lanka” giving more emphasis among others on the “*Review the effect of climate change on Sri Lanka through the development of impact scenarios and response strategies for sea level rise, changing water resource available including storm and drought frequency on agricultural production and the economy as a whole and for disaster response*”

Climate Change Adaptation Policy (CCAP) has been enacted in 2011 by the parliament provides guidance and directives for all the stakeholders enabling to address the challenges. The National Climate Change Adaptation Plan of Sri Lanka 2015–2024 has been developed since then with the support of all relevant stakeholders by the Climate Change Secretariat and the disaster management has specific actions to be implemented. Through the National Disaster Risk Management Plan 2020 -2030, DMC contributes towards meeting the SDGs by promoting ‘joined up action” across the 2030 Agenda which consists of Paris Agreement on climate change and addressing DRR via SFDRR.

### ***National Disaster Risk Management Plan 2020 -2030***

The National Strategy for Disaster Risk Reduction and Action Plan (2020-2030) Sri Lanka is a roadmap or a common understanding of the prevalent disaster risk, an evaluation of the current DRR system and its capacities to DRR goals and targets. It is guided by Sri Lanka's development priorities and aims specifically at achieving a set of objectives, including setting basic DRR, increasing awareness and knowledge of DRR approaches and opportunities, establishing legal and institutional bases for effective planning and implementation of disaster risk reduction, and contributing to the inclusion of DRR in development policies, programs and projects.

This plan is designed to provide guidance and assistance to DRR in Sri Lanka; reinforcing a crucial shift from "Managing Disasters" to "Managing Disaster Risk", while enabling resilience building for "Build Back Better", attributing to its overall Goal to: "Prevent New Risks, Reduce Existing Risks and Strengthen Resilience". The scope of the strategy evolved around the four priority areas of the SFDRR, namely: Understanding Disaster Risk, Strengthening Governance to Manage Disaster Risk, Investing in Disaster Risk for Resilience, and Enhancing Disaster Preparedness on Effective Response in Recovery, Reconstruction and Rehabilitation for "Build Back Better".

In recognition of the structural, implementation, coordination, monitoring and evaluation deficiencies in those earlier planning initiatives, the 2020-2030 strategy and the plan attempts to introduce a holistic DRR plan for the country for the next 10 years, together with detailed management interventions for implementation during its Foundation Phase from 2020 to 2023 in particular. This plan has placed a special emphasis on enabling a methodology for timely implementation, monitoring and evaluation to realise its expected outcomes, through a collective and coherent involvement of national to village level stakeholders, including the communities. DMC is the key agency which is mandated to implement, monitor, evaluation and revise the National Disaster Risk Management Plan 2020 -2030.

What would it be like to live in a world in which government authorities, businesses, communities and individuals work together to create a society that is able to withstand the effects of unforeseen events and threats? At the Global Centre for Disaster Resilience we are working with stakeholders at the global, national and local level to make this happen.

The Global Disaster Resilience Centre (GDRC) is committed to excellence in research, education and advocacy to improve the resilience of nations and communities to disasters.

With growing population and infrastructures, the world's exposure to hazards is increasing. When disaster strikes, communities may need to be rebuilt physically economically and socially. At the same time, it is vital that any reconstruction activity pro-actively considers how to protect people and their environment, and reduce a community's vulnerability.

At the Global Centre for Disaster Resilience, our vision is for a society that has the capacity to resist or change in order to reduce hazard vulnerability, and to continue functioning physically, economically and socially when subjected to a hazard event.

We seek to achieve our vision by undertaking work that crosses the traditional boundaries between academic disciplines and schools of thought. We provide strategic advice and practical guidance based on rigorous, stakeholder informed research. We are also supported by a worldwide network of partners from policy, government, industry and academia.

GDRC is part of the School of Art, Design and Architecture at the University of Huddersfield in the UK. In November 2013, the University of Huddersfield was awarded the Times Higher Education University of the Year. The University excels in enterprise and innovation and in 2012, was named the Times Higher Education Entrepreneurial University of the Year.

Professor Dilanthi Amaratunga and Professor Richard Haigh together with their team have actively contributed towards establishing better informed and more socially inclusive public policy-making and implementation towards the development of a disaster resilient built environment in Sri Lanka, since 2004. This impact has occurred in Sri Lanka through their input to the capacity development of national and local stakeholders. In doing so, their research is contributing to a reduction in the vulnerability of communities to the threat posed by hazards of natural and human origin. If our research is to benefit both research users and society as a whole in Sri Lanka, it is essential that it not only has the

potential to make a practical difference, but is disseminated and effectively used. This is what we have been doing in Sri Lanka (We started contributing to the disaster management domain since 2004 even though our wider involvement in Sri Lanka goes back to 1997):

- Producing excellent research outcomes that advance knowledge and understanding across all sectors of the economy and society;
- Exchanging knowledge and ideas with business and professional partners, especially through effective use of communications, to make sure as much of my best research as possible is translated into powerful services and products;
- Conducting research that underpins high-quality teaching and learning, equipping our students with the intellectual and practical skills they need in an increasingly competitive employment market;
- Carrying out research that has a focus on social, economic, cultural, scholarly or scientific impact, the value of which is recognised by the external community through support from funders and users of research;
- Producing research outcomes that have a major, visible impact and showcasing them through the media and our website to benefit regional, national and international stakeholders, as well as society at large.

Key activities that have been carried out by the University of Huddersfield team in Sri Lanka can be categorised under the following themes:

- International Conferences
- International research collaborations
- Partners in the capacity building Making Cities Resilient campaign in Sri Lanka
- Working with the local authorities
- Engagement with industry
- Make risk knowledge, assessments and risk reduction part of the university curricular
- PhD projects
- Key note speeches and other sessions linked to Sri Lanka
- International Conference presentations

The following are some of the current/recent DRR programs being implemented by University of Huddersfield in the country, with academia, policy and practice:



### ***Localising tsunami early warning systems***

**Funded by:** QR/GCRF.

**Partners in this initiative include:** UNESCO (IOC-UNESCO) ICG/IOTWMS WG 1 on Tsunami Risk, Community Awareness and Preparedness; ITB, Indonesia; Ministry of Public Administration and Disaster Management, Sri Lanka; Disaster Management Centre, Sri Lanka; National University of Maldives, Maldives; National Disaster Management Center (NDMC), and Maldives Meteorological Services, Maldives; University of Yangon, Myanmar; National Disaster Management Agency and the Department of Meteorology and Hydrology (DMH), Myanmar; Asian Disaster Preparedness Center, Thailand.

### ***Building Resilience in Tropical Agro-Ecosystems (BRITAE)***

**Grant value:** € 910,000

**Lead partner:** University of Ruhuna, Sri Lanka

**University of Huddersfield team::** Dilanthi Amaratunga (PI) and Richard Haigh (COI)

**Scheme:** European Commission Erasmus+ CBHE

**Partnership:** University of Central Lancashire, UK; University of Huddersfield, UK; Tallinn University of Technology, Estonia; VGTU, Lithuania; University of Ruhuna (leading), University of Sri Jayewardenepura, Sabaragamuwa University, University of Peradeniya, University of Colombo, University of Moratuwa from Sri Lanka

### ***Technological Applications Associated with Multi-Hazard Early Warning Systems in Sri Lanka.***

**Grant value:** £ 6000.00

**Partnership:** A collaboration with University of Moratuwa, Sri Lanka,

### ***The impact of the disaster induced relocation on the affected people due to Landslides in 2016 in Sri Lanka***

**Funder:** URF

**Grant value:** £ 4260

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**University of Huddersfield Team:** Professor Richard Haigh (PI), Prof. Dilanthi Amaratunga (PI)

**Partners:** University of Colombo, Sri Lanka and National Building Research Organisation of Sri Lanka (NBRO).

***Governance of the upstream-downstream interface in end-to-end tsunami early warning systems***

**Funder:** GCRF/QR/URF

**Grant value:** £ 45,000

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Partners:** Disaster Management Centre, Sri Lanka; Ministry of Disaster Management, Sri Lanka; Department of Meteorology, Sri Lanka; INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION of UNESCO, Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS); University of Yangon, Myanmar; National University of Maldives, Maldives; Asian Disaster Preparedness Centre (ADPC), Thailand.

**Start:** October 2018 for 1 year

***Disaster Risk Reduction Impact support***

**Funding from:** University of Huddersfield URF Scheme

**Amount:** £ 8000

***Integrating education with consumer behaviour relevant to energy efficiency and climate change at the Universities of Russia, Sri Lanka and Bangladesh" [BECK]***

**Scheme:** European Commission, CBHP

**Lead:** Vilnius Gediminas Technical University, Lithuania

**University of Huddersfield Team:** Prof. Dilanthi Amaratunga (PI), Professor Richard Haigh (COI)

**Grant value:** € 892,955

**Duration:** 3 years commencing November 2018

**Partnership:** Vilnius Gediminas Technical University, Lithuania; University of Huddersfield; Tallinn University of Technology, Estonia; Moscow State University of Civil Engineering, Russia; Kaliningrad State Technical University, Russia; University of Ruhuna, Sri Lanka; Alma Mater Studiorum – University of Bologna; Peter the Great St.Petersburg Polytechnic University, Russia; Association of Educational Civil Engineering Institutions, Russia; Lomonosov Moscow State University, Russia; Patuakhali Science and Technology University, Bangladesh; University of Colombo, Sri Lanka

### ***REGARD – Rebuilding After Displacement***

**Scheme:** European Commission Erasmus+ Strategic Partnerships for higher education

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Grant Amount:** € 449,000 (approx)

**In partnership with:** Tallinn University (Estonia), Lund University (Sweden) and University of Colombo (Sri Lanka); **Duration:** Three years commencing November 2018

### ***CABARET (Capacity Building in Asia for Resilience Education)***

**Scheme:** Erasmus+ Call: Capacity Building in the Field of Higher Education EAC/A04/2015

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Value:** € 993,340.00

**Duration:** January 2017 to January 2020

**Partnership: 15 partners: From Programme Countries (from the EU) -** University of Huddersfield, UK (leading); University of Central Lancashire, UK; IHC Cantabria - Environmental Hydraulics Institute, Spain; Mining and Geology University, Sofia, Bulgaria; University of Malta, Malta; Riga Technical University, Latvia; **From Partner Countries (Asia) -** University of Moratuwa, Sri Lanka; University of Peradeniya (UoP), Sri Lanka; ITB Bandung, Indonesia; University of Andalas, Indonesia; Maldives National University, Maldives; De La Salle University, Philippines; Ateneo de Manila University, Philippines; Mandalay technology University, Myanmar; Yangon University, Myanmar

### ***Disaster Resilience and Sri Lanka***

**Scheme:** Erasmus + ICM

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Partnership:** 5 universities - University of Moratuwa, Sri Lanka; University of Colombo, Sri Lanka; University of Ruhuna, Sri Lanka; University of Peradeniya, Sri Lanka; South Eastern University, Sri Lanka

University of Huddersfield Value: € 103,000.00

**Date of commencement:** July 2017 for 2 years

***CRESCENDO (CRESCENDO: Community Resilience Engaging Society, Culture, and ENVironment against Disaster Outcomes)***

**Value:** £ 30,000.00

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Duration:** 3 years commencing 2016.

**Partners:** Global Disaster Resilience Centre, University of Huddersfield, UK (lead) ; University of Moratuwa, Sri Lanka ; University of Colombo, Sri Lanka ; University of Peradeniya, Sri Lanka; Institutions in the region (Universiti Teknologi Malaysia, Malaysia; Institute of Technology Bandung, Indonesia; RMIT, Australia; Griffith University, Australia; University of Auckland, New Zealand; Chiang Mai University, Thailand; Kyoto University, Japan)

***ASCENT – Advancing Skill Creation to ENhance Transformation***

**Scheme:** Erasmus+ programme – European Commission

**Value:** € 983,089.00

**Duration:** 36 months, starting March 2016

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield, UK

**Partnership:** 16 international collaborators - Global Disaster Resilience Centre, University of Huddersfield, UK (Lead) ; University of Central Lancashire, UK; Lund University, Sweden; Mid Sweden University, Sweden; Vilnius Gediminas Technical University, Lithuania; Tallinn Institute of Technology, Estonia; University of Moratuwa, Sri Lanka; University of Colombo, Sri Lanka; University of Ruhuna, Sri Lanka; University of Naresuan, Thailand; Chiang Mai University, Thailand; Dhaka University, Bangladesh; PSTU University, Bangladesh; BRAC University, Bangladesh; Federation of Sri Lankan Local Government Authorities, Sri Lanka (associate partner - industry); Asian Disaster Preparedness Centre, Thailand (associate partner – industry)

***A study of the upstream-downstream interface in end-to-end tsunami early warning and mitigation systems***

**Scheme:** RCUK/GCRF

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

**Partnership:** 8 partners - University of Colombo, Sri Lanka; ITB, Indonesia; Asian Disaster Preparedness Centre, Thailand ; National Disaster Management Agency (BNPB), Indonesia; Meteorology, Climatology and Geophysical Agency (BMKG), Indonesia; The Federation of Sri Lankan Local Government Authorities (FSLGA), Sri Lanka; Ministry of Disaster Management, Sri Lanka; Department of Meteorology, Sri Lanka

**Value:** £ 70,000.00

**Date of commencement:** October 2017 for 1 year

### ***CADRE (Collaborative Action towards Disaster Resilience Education)***

**Scheme:** LLP Multi-lateral projects

**Lead partner:** Global Disaster Resilience Centre, University of Huddersfield

Total value of the project: € 569 078 (2013 - 2016)

**Partnership:** 7 partners from EU and third countries – UK, Estonia, Italy, France, Sri Lanka - University of Huddersfield, UK (lead); Northumbrian University, UK; Tallinn Institute of Technology, Estonia; Vilnius Gediminas Technical University (VGTU), Lithuania; Federation of Sri Lankan Local Govt. Authorities (FSLA), Sri Lanka; University of Moratuwa, Sri Lanka; UNISDR, Switzerland

They have provided very large number of PhD study opportunities for Sri Lankan students. Recently, three students have successfully defended their PhDs and at the moment 4 other Sri Lankan students are reading for their PhDs at the University of Huddersfield.

For more information about our research, teaching and advocacy, please contact: Professor Dilanthi Amaratunga & Professor Richard Haigh, Global Centre for Disaster Resilience, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, United Kingdom.

w: [www.hud.ac.uk/gdrc](http://www.hud.ac.uk/gdrc). e: [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk) / [r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk).



## Asian Disaster Preparedness Center (ADPC)

APDC is an intergovernmental organization that works to build safer communities and sustainable development through disaster risk reduction (DRR). It provides comprehensive technical services across social and physical sciences to support sustainable solutions for DRR and climate resilience. ADPC supports countries and communities in building their DRR systems, institutional mechanisms, and capacities in becoming more resilient by utilizing its expertise and evidence-based knowledge.

ADPC was established in 1986 as a technical resource center and is headquartered in Bangkok, Thailand. Its founding member countries include Bangladesh, Cambodia, China, India, Nepal, Pakistan, the Philippines, Sri Lanka, and Thailand. The organization addresses challenges for resilience by focusing on six strategic themes - risk governance, urban resilience, climate resilience, health risk management, preparedness for response, and resilient recovery. ADPC works at the national and local level in partnership with governments, development partners, UN agencies, civil society, academia, and the private sector with a focus on resilience as a core element for development.

The organization has been supporting the Regional Consultative Committee on Disaster Management (RCC) since 2000 as its secretariat. RCC is comprised of National Disaster Management Offices (NDMOs) of 26 member countries and serves as a non-binding mechanism to develop action strategies for Disaster Risk Reduction (DRR), promote cooperative programs at regional and sub-regional levels, and provide guidance to ADPC on its future work and strategies in the region.

In Sri Lanka, ADPC started an in-country program with the implementation of the Asian Urban Disaster Mitigation Program (AUDMP) in 1995. ADPC has been assisting the advancement of DRR efforts in the country since then. The Sri Lankan government signed the intergovernmental Charter of ADPC in 2005 as one of the founding member countries. ADPC is currently implementing three in-country programs and three regional programs in Sri Lanka involving various government agencies, private sector entities, academia, local NGOs, and technical agencies. The following are some of the current DRR programs being implemented by ADPC in the country:



## Asian Preparedness Partnership (APP):

Localization of the humanitarian efforts was identified as one of the major areas of concern by the global DRR community at the World Humanitarian Summit in Istanbul in May 2016. Building on this momentum, the government, local humanitarian organizations, and the private sector networks from six high-risk countries in Asia have come together to form the Asian Preparedness Partnership (APP) in August 2017 with support from ADPC and the Bill and Melinda Gates Foundation (BMGF). APP is a regional partnership, consisting of the national and local governments, non-governmental organizations (local NGOs), civil society groups, and the private sector networks in Cambodia, Myanmar, Philippines, Nepal, Pakistan, and Sri Lanka. The overall goal of APP is ‘Safer and well-prepared communities through locally-led DRM actions, so that disaster impacts on at-risk communities of Asia will be reduced’. This goal is being achieved through improving the interface and partnerships between the various stakeholders for enhancing locally-led disaster risk management actions. The APP builds the disaster preparedness capacities of local actors through improved coordination mechanisms, capacity development, knowledge resources, South-South learning, and knowledge exchange. APP is scaling up and scaling out its outreach regionally and globally to have a greater impact on promoting the locally-led disaster preparedness, response, and recovery actions through the integration of sustainable mechanisms for locally-led actions, innovative approaches in DRR, and creating an enabling environment for humanitarian system transformation. More information on the APP can be found at <https://app.adpc.net/>. Sri Lanka Preparedness Partnership (SLPP) was established in 2018 under the umbrella of APP. It consists of government, LNGO, and private sector entities. SLPP is governed by three co-chairs namely: Disaster Management Center (DMC), Cylon Chamber of Commerce (CCC), and Janathankshan (Pvt) Ltd. The SLPP strives towards strengthening locally-led disaster preparedness, response and recovery actions.

### ***Strengthening Institutionalization of the Program for Enhancement of Emergency Response (PEER) in South Asia:***

The program is funded by the USAID Office of the U.S. Foreign Disaster Assistance. It aims to strengthen the institutional and technical capacity of national and regional partners to support the institutionalization and sustainability of the PEER Program in six South Asian countries namely Afghanistan, Bangladesh, India, Nepal, Pakistan, and Sri Lanka. The PEER has been a significant instrument for enhancing disaster preparedness in the region by forming and strengthening skilled emergency responder groups from communities, disaster response

agencies, and hospitals over the past 20 years. National institutions have embraced PEER training as a critical capacity-building initiative to prepare for disasters. The main PEER training components include Community Action for Disaster Response (CADRE), Medical First Responders (MFR), Collapsed Structure Search and Rescue (CSSR), Hospital Preparedness for Emergencies (HOPE), and Swift Water Rescue (SWR). PEER's success in training emergency responders and developing instructors has led to the identification of the inherent need to integrate the PEER approach, goals, and capacity building activities as an integral part of policies, strategies, budgets, and programs of national and sub-national governments and other non-government agencies including the private sector. This integration has been the focus of the current phase of the program.

### ***Regional Assessment of DRM Institutions in South- Asia:***

ADPC seeks to stock-take and map the capacities, needs and available resources of organizations engaged in DRM in seven South Asian with the funding support from the World Bank. These countries that namely include Afghanistan, Bhutan, India, Nepal, Maldives, Pakistan, and Sri Lanka. The purpose of the project is to determine the countries' abilities to implement DRM activities and support these countries in their efforts to improve institutional capacities in order to realize better results in DRM. With the Disaster Management Centre as the Focal Organization, ADPC and Duryog Nivaran- South Asia Network for Disaster Mitigation will conduct the DRM institutional assessment in Sri Lanka.

### ***Nature-based Landslide Risk Management in Sri Lanka:***

The project on Nature-Based Landslide Risk Management is implemented by the National Building Research Organization (NBRO) with the technical assistance from ADPC. This analytics and advisory services project is funded by the World Bank and is aimed at raising awareness on the subject and deepening the knowledge within the country on the role of nature-based solutions for landslide risk management. The knowledge from this project is expected to be applied in a number of pilot demonstration sites in the country.

### ***Post-Disaster Damage and Loss Reporting System for Sri Lanka:***

ADPC is supporting the Government of Sri Lanka to develop online disaster damage and loss reporting system with the funding support from the World Bank. The system is based on the design templates that were developed and validated through the Government of Sri Lanka stakeholders' consultations. It is expected to enhance the capacity of the government officials to report disaster damage and losses through guidelines and operating procedures and provide training on data reporting and retrieving.



***Innovative Decision Support Tools for Building SMEs' Resilience to Climate Change in Sri Lanka (BBCR):***

UNEP DTU Partnership, ADPC, the Ceylon Chamber of Commerce and MP Ensystems are working in a consortium with the objective of developing a disaster risk management (DRM) and business continuity product. They are being supported by the Nordic Climate Facility. It will allow flood-prone businesses in the SME sector in Sri Lanka to reduce their recurring losses while putting in place measures to continue their business operation during extreme weather events. The project will also look into developing approaches and tools that can help accelerate investment in risk management and supporting the adaptation of SMEs in the country.



## University of Moratuwa, Sri Lanka

The University of Moratuwa Sri Lanka is an independent state university located at Katubedda, Moratuwa overlooking the picturesque Bolgoda Lake. It was established as the University of Moratuwa (UoM), Sri Lanka on 22 December 1978 under the Universities Act No.16 of 1978 and operates under the general direction of the University Grants Commission. The institution was known as Ceylon College of Technology, Katubedda (Katubedda Tech) before gaining university status. Its roots go back to the Institute of Practical Technology founded in 1960 to provide technical education. University of Moratuwa, consists of five faculties namely, Architecture, Business, Engineering, Graduate Studies and Information Technology with twenty-two (22) academic departments offering twelve (12) Bachelor's degree programs to students selected by the University Grants Commission (UGC) and fifty-six (56) postgraduate programs together with MSc, MPhil & PhD research-based postgraduate degrees. The university has an undergraduate student population of 9916, and 1050 NDT diploma students of the Institute of Technology of University of Moratuwa (ITUM). University of Moratuwa has a highly qualified academic staff of 423 with an administrative staff of 31. It must be highlighted that the University has been increasing the annual intake of students over 75% overall and 200% in the IT Faculty during the last ten years to meet the increasing demand for our degree programs and thereby catering the human resource development of our nation. Tracer survey done in 2018, on employment patterns of graduates, reported that 90.5% of all graduates, 96.4% of the engineering graduates, 97.4% Quantity Surveying graduates and 100% of Architecture graduates were employed at the time of the convocation, showing that the graduates of university of Moratuwa are much sought after by the industry and its employers in noble task of developing the nation. Apart from the academic and research studies including undergraduate and post graduate studies, University of Moratuwa presents social and cultural activities, student services, societies, and sports and recreational activities. Further, University of Moratuwa is a leading institution which works collaboratively in national and global level towards the betterment of all mankind.



## The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS)

The Indian Ocean Tsunami on 26 December 2004 resulted in the loss of over 230,000 lives and the displacement of over 1.6 million people around the Indian Ocean, with estimated economic losses of US\$14 billion. The catastrophe brought renewed focus on the need for a regional tsunami warning system in the Indian Ocean. Following the disaster, the Intergovernmental Oceanographic Commission (IOC) of UNESCO was given the mandate to develop and implement the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). The Intergovernmental Coordination Group (ICG) for the IOTWMS was established as a primary subsidiary body of the IOC by its July 2005 Assembly (Resolution XXIII-12). Further mandates were given to UNESCO/IOC by the UN General Assembly through Resolutions 61/132 and 62/91. After 8 years of international collaboration and development, facilitated and coordinated by UNESCO/IOC, the IOTWMS became fully operational on 31 March 2013 with Tsunami Service Providers (TSPs) established by Australia, India and Indonesia.

The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) is an IOC subsidiary body. IOC has 150 Member States and is governed by its Assembly and Executive Council. The ICG/IOTWMS reports to the IOC governing bodies. Similar regional tsunami warning and mitigation systems have been established in the Pacific (PTWS), Caribbean (CARIBE-EWS) and North-Eastern Atlantic and Mediterranean (NEAMTWS).

Membership includes Twenty-eight (28) Member States of the IOC within and bordering the Indian Ocean: Australia, Bangladesh, Comoros, Djibouti, France (Indian Ocean Territories), India, Indonesia, Iran, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Myanmar, Oman, Pakistan, Seychelles, Singapore, Somalia, South Africa, Sri Lanka, Tanzania, Thailand, Timor-Leste, United Arab Emirates, United Kingdom (Indian Ocean Territories) and Yemen. There are three (3) Tsunami Service Providers: Australia, India and Indonesia. Tsunami Service Providers (TSPs) of Australia, India and Indonesia commenced providing service for the Indian Ocean on 12 October 2011, coincident with Exercise Indian Ocean Wave 2011. The IOTWMS works as a “system of systems” with 3 TSPs generating tsunami forecast information products simultaneously to all Indian Ocean coastal areas.

The ICG/IOTWMS holds biennial sessional meetings to report on the work of the intersessional period, and formulate actions and recommendations. The ICG/IOTWMS Officers are composed of a Chair and two Vice-Chairs. The Officers meet on the occasion of sessions of the ICG/IOTWMS and at meetings of the Steering Group. The Secretariat of the ICG/IOTWMS is based in Perth,

Australia, and is in support of UNESCO/IOC and is funded and hosted by the Australian Bureau of Meteorology (BoM).

Indian Ocean Tsunami Information Centre (IOTIC) is based in Jakarta, Indonesia and is funded and hosted by the Indonesian Agency for Meteorology, Climatology and Geophysics.

The TSPs make tsunami forecast information products available to the Tsunami Warning Focal Points (TWFPs) of the Indian Ocean countries that operate on a 24/7 basis. It is the ultimate responsibility of the National Tsunami Warning Centre (NTWC) of each IOTWMS Member State, who may also be the TWFP, to evaluate the tsunami information provided by the TSPs, decide on appropriate national action and issue tsunami warning instructions to their public.



## The International Labour Organization (ILO) Country Office for Sri Lanka and the Maldives

For over one hundred years, the ILO, as a specialized agency of the United Nations, has been promoting social justice in the world of work. Sri Lanka became a Member State of the International Labour Organization (ILO) in 1948. In 2019, as the ILO marked its centennial, Sri Lanka celebrated 71 years of membership with the ILO.

With its unique tripartite structure, the ILO brings together governments, employer's organizations and worker's' organizations to set labour standards, develop policies and design programmes for promoting decent work for all women and men. The concept of decent work itself was derived through tripartite discussion and sums up the aspirations of people in their working lives for opportunities for work that are productive, deliver a fair income, security in the workplace and social protection for families. It is work that offers prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives, as well as ensuring equality of opportunity and treatment for all women and men.

The organization, both globally and at local level, advocates for full and productive employment coupled with rights, representation and protection in the world of work: as a means to reduce poverty. Because, "*Poverty anywhere is a threat to prosperity everywhere*" - *The ILO Declaration of Philadelphia (1944)*.

(<https://www.ilo.org/global/lang-en/index.htm>).

With a view to generating future prosperity for all, the ILO continues to conduct analysis on the dynamic evolutions of labour markets and develop appropriate policy responses anchored in tripartite consensus. It also plays a strong role in supporting its members to fulfil their commitments to the Sustainable Development Goals up to 2030 and beyond. One of the most pressing concerns both globally, and particularly in Sri Lanka, is the impacts of climate change on poverty and jobs. The following details some of the work the ILO in Sri Lanka is doing to enhance resilience and transform rural communities facing climate change shocks.

### ***Climate Fragility and the Development Nexus: The Intersect of the ILO Decent Work Agenda***

There is abundant evidence that the worst impacts of global warming and climate change are intrinsically linked to poverty and marginalization. The poorest communities are always disproportionately affected by climate change and have the fewest resources to mitigate its impacts. Rural communities are particularly vulnerable, and those working in the informal economy often have the least

resilience to climate change shocks and disasters. The ILO recognises the critical importance of transforming economies to address climate change, both through the creation of sustainable, environmentally-friendly jobs and through the greening of all sectors of the economy. It acknowledges the special vulnerability of those working in the informal economy, as well as the key role that women and marginalized groups can play in addressing climate change. It is not only working towards preserving existing jobs and productivity, but by 2030, the ILO envisions the creation of 24 million new jobs around the globe if the right policies to promote a greener economy are in place. This 'Greening with Jobs' action is designed to offset structural changes which may lead to the loss of more than six million jobs. Evidence is already accumulating around the world that the greening of economies can significantly boost employment creation through the adoption of sustainable practices and the expansion of renewable energy, waste management and pollution control sectors. ([https://www.ilo.org/asia/media-centre/news/WCMS\\_575288/lang--en/index.htm](https://www.ilo.org/asia/media-centre/news/WCMS_575288/lang--en/index.htm))

### ***The ILO priorities for decent job creation and advancing social justice for high climate-risk communities in Sri Lanka***

Through Decent Work Country Programmes, which drives the work of the ILO at national level, the ILO in Sri Lanka is working on climate change mitigation to strengthen environmental and economic resilience. The work targets those in the informal economy including in the smallholder agri-business sector, a sector that thousands of people depend upon for a livelihood, and where risks of seasonal fluctuations and disaster risks are the highest. Both severe flooding and droughts have decimated parts of the country in recent years. The ILO is taking a proactive approach rather than focusing on post-disaster support. It has created opportunities for strengthening watersheds and water resources management in the affected areas, to ensure long-term climate resilience. Further, the ILO has extended its support to micro, small and medium enterprises (MSMEs) to increased disaster preparedness through Business Continuity Management trainings and capacity building. Communities with the highest exposure to climate change risks have been targeted. The pilot interventions have been carried out in the worst affected districts of Kalutara and Ratnapura (South Western region) for flood and landslide mitigation, and in Kilinochchi for drought mitigation. In addition to working with agricultural communities, smallholder farmers in the tea sector and entrepreneurs in the Kithul industry, ILO ensured the sustainability of its Livelihood Resilience Building model through knowledge products and training modules for local government officials.

([https://www.ilo.org/colombo/whatwedo/events/WCMS\\_673677/lang--en/index.htm](https://www.ilo.org/colombo/whatwedo/events/WCMS_673677/lang--en/index.htm))

### ***The work and the knowledge products produced in this regard include:***

Publication and Training on Tools and Guidelines for improved watershed and land use management in livelihoods

These ILO tools for flood and landslide risk communities are targeted towards smallholder tea producers and subsistence farmers in watershed areas. They provide guidance on measures to mitigate disasters through climate sensitive local development programmes that incorporate better watershed and land use management practices. ([https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms\\_722289.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms_722289.pdf))

### ***Food security and reviving Kithul industry***

Recognising that isolated and low-income villages could potentially overcome increased poverty during times of disaster by adopting innovative home garden techniques to ensure food security, the ILO has supported efforts for resilient livelihood building. The focus has been on strengthening organic Kithul-based products. The Kithul tree-planting programme primarily aimed at expanding the marketability of the Kithul industry and economically revitalising communities, while also helping to prevent soil erosion during flood and landslide events.

Minor tank (water reservoir) irrigation enhancement to mitigate drought impacts

In the north, the ILO effectively piloted mitigation against prolonged drought experienced by rural communities through renovating minor irrigation tanks. This helped strengthen groundwater recharging mechanisms and provided a guaranteed water supply to the community for year round farming and drinking. Using participatory and labour intensive approaches, the ILO invested in community driven infrastructure improvements for tank de-silting and turf work on the tank bund.

### ***Publication: Policy and legal framework in disaster mainstreaming***

Recognising the importance of developing effective policies on climate change, climate-proofing jobs and building green economies, ILO carried out a policy analysis for identifying opportunities for mainstreaming disaster resilience in national policies and the legal framework in relation to rural development.

([https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms\\_735671.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms_735671.pdf))

Through the additional financial support from the Government of Japan, the ILO carried out the following work under a sister project, *“Support to re-establishing and building resilience among micro and small enterprises in flood affected communities in Sri Lanka.”*:

- A Training of Trainers programmes for 140 government officers who work with micro, small and medium enterprises (MSMEs) on business continuity planning;

- Supporting 3,212 entrepreneurs of MSMEs in the flood-affected areas of Ratnapura and Kalutara through training in business continuity planning;
- Creation of a database of flood affected MSMEs in Ratnapura district which has been linked to the Small Enterprises Development Division of the Ratnapura District Secretariat for further support;
- Enhancing the capacity of 30 female entrepreneurs in flood vulnerable areas to build flood resilient kitchens in Amupitiya, Ratnapura;
- Supporting 10 entrepreneurs in Kalutara district to rebuild their enterprises after the natural disaster in 2018;
- Facilitating 21 entrepreneurs with disabilities to strengthen their enterprises and improve their business acumen to compete in the competitive market.

The project also published a local language booklet on Business Continuity Planning (BCP) targeting disaster prone MSMEs. Over 1,000 copies were distributed to government officers involved in development, and a reprint of 750 copies to meet further demand.

[https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms\\_714400.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-colombo/documents/publication/wcms_714400.pdf)





## Driving Positive Change for Children in Sri Lanka

### ***Who is ChildFund?***

ChildFund is an International non-governmental organization working for the protection and development of children. The organization works in 25 countries, assisting 17.6 million children and their families.

ChildFund has been working in Sri Lanka since 1985. The organization helps deprived, excluded and vulnerable children have the capacity to improve their lives and grow up to be young adults, parents and leaders who bring lasting and positive change in their communities.

### ***Programs***

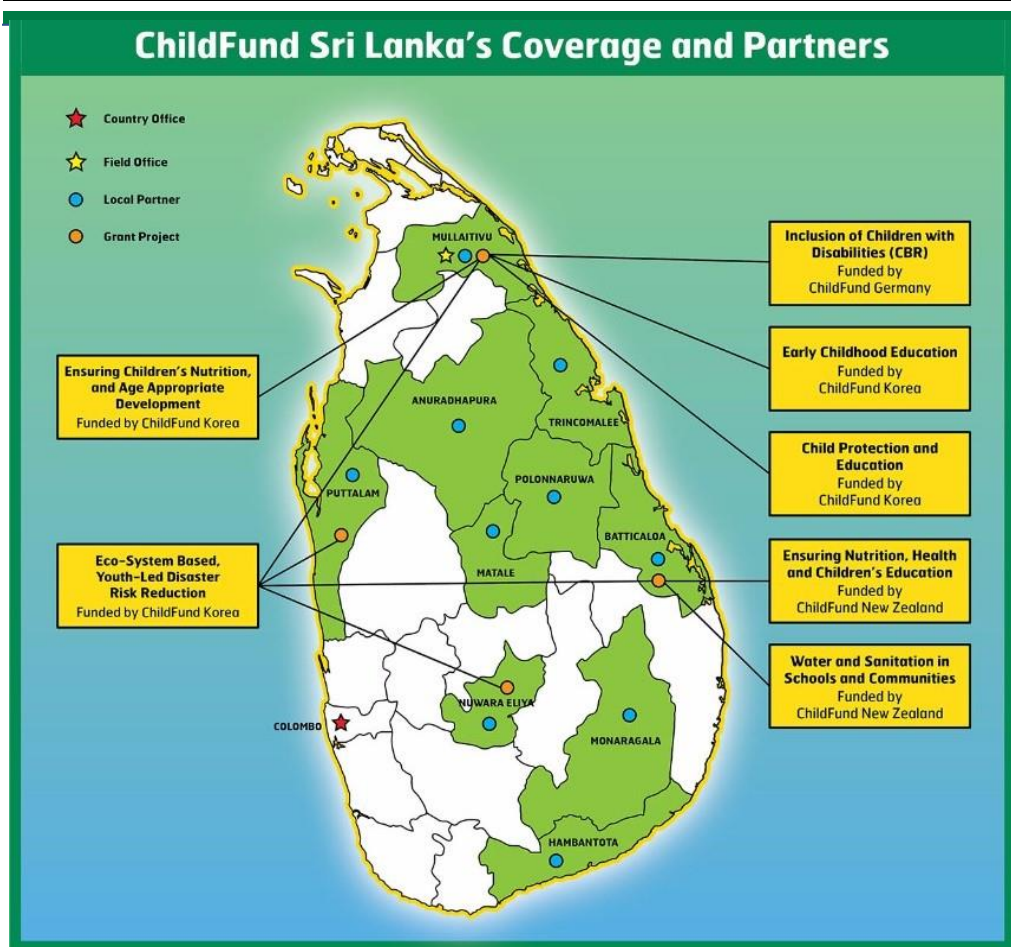
ChildFund's programs adopt a holistic approach to child development and protection. They are designed based on technically sound methods, and are driven by the ideas, experiences and aspirations of children, young people and their communities.

Programs aim at realizing long-term, sustainable change for children and youth, and fall under three core strategic categories based on age groups: 0-5 years (healthy and safe infants), 6-14 years (educated and confident children) and 15-24 years (skilled and involved youth).

ChildFund currently works in 10 districts, implementing projects through 6 community-based partners and reaches over 100,000 children, their families and communities in Sri Lanka, covering a number of sectors including early childhood development and nutrition, education, youth empowerment, child protection, inclusion of children with disabilities and disaster risk reduction. Programs are designed to ensure that young children grow in a healthy, protective and developmentally supportive environment to reach their full potential.

### ***Partnerships***

The organization has established relationships with national, international and community-based organizations, academia, private sector partners and central and district local governments.



ChildFund Sri Lanka

# 44/3-1-1, Narahenpita Road, Nawala, Phone: +94 11 2501238 I

[www.ChildFund.org](http://www.ChildFund.org)

## To promote the availability and application of research, science and technology to support implementation of Sendai Framework for Disaster Risk Reduction 2015-2030

**JICA** SRI LANKA PROFILE

### JICA's Initiatives

#### A Bridge Linking Japan with Partner Countries

JICA assists and supports partner countries as the executing agency of Japanese ODA. In accordance with its vision "Leading the world with trust" JICA supports the resolution of issues of partner countries by using the most suitable tools of various assistance methods and combined regional, country and issue-oriented approach.



**JICA set forth a new vision of "Leading the world with trust."**  
JICA, with its partners, will create a world where all people and countries are bound together by trust.

JICA President Shinichi Kitaoka

#### Project for Construction of New Bridge across Kelani River

JICA is financing the construction of a 6-lane extra dozed bridge across Kelani river, connecting to Colombo-Katunayake Expressway on the north, Port Access link on the west and ending at Baseline Road on the south. Because of the extra dozed technology, piers are not required to be constructed on the river bed minimizing any impact to the water-flow and ecological balance. Over 400 underserved households at the project site were relocated receiving new housing units with all amenities in close proximity. The bridge when completed will become the gateway to the city of Colombo.  
**Implementation:** Road Development Authority



Construction of Kelani bridge

#### Greater Colombo Transmission Distribution Loss Reduction Project

The project provides support for the underground power transmission and distribution network in Greater Colombo, meeting the demand for power in this principal business area. The project aims to reduce the transmission and distribution losses and make the power supply more reliable. The Greater Colombo Area accounts for approximately half of the GDP, and the power demand there has risen rapidly in recent years along with economic growth.  
**Implementation:** Ceylon Electricity Board



Kelanitsa Grid Substation, which will be augmented under this project

#### Kalu Ganga Water Supply Expansion Project (I)

Kalu Ganga as a new water resource is being developed under JICA's assistance. In particular, Kandana Water Treatment Plant (WTP), which can currently produce up to 120,000m<sup>3</sup>/day, was developed through a previous JICA project. This project will construct 140,000m<sup>3</sup>/day another WTP to expand the water supply capacity of the Kandana WTP complex to meet future demands. The project also aims to raise service levels by the expansion of service areas and reduction of water leakages.  
**Implementation:** National Water Supply and Drainage Board



Water Treatment Facility at Kandana

#### The Project for the Establishment of Research and Training Complex at the Faculty of Agriculture, University of Jaffna

JICA's grant assistance enables the students to learn practical knowledge and techniques in the newly built Research and Training Complex, which also has essential equipment and facilities for researchers. Japanese university professors also supported the Project by giving technical advice on establishing training curriculum and training manuals. This will contribute to increasing agricultural productivity in the Northern Dry Zone, and therefore, improving the livelihood of the people.  
**Implementation:** Ministry of Higher Education, Technology and Innovation  
**Location:** Kilinochchi



Research and Training Complex

#### Rural Infrastructure Development Project in Emerging Regions (RIDEP)

The project aims to improve living standards and to develop livelihoods of local people through improvement of essential rural infrastructure, such as rural roads, medium and small size irrigation and potable water supply facilities in Northern, Eastern, North Central and Uva Provinces, thereby contributing to development of rural economies, reduction of regional disparities, and alleviation of poverty in the country.  
**Implementation:** Ministry of Public Administration, Home Affairs and Provincial Councils & Local Government



Small and medium irrigation schemes will be rehabilitated under this project

#### Project for Capacity Strengthening on Development of Non-structural Measures for Landslide Risk Reduction (Project SABO)

A number of lives have been lost due to landslides in mountain area. JICA has been supporting the National Building Research Organisation (NBRO) to strengthening landslide risk reduction including hazard mapping, early warning and risk-based land use regulation. The Project is called as Project "SABO", which means sediments prevention and mitigation in Japanese, but now becomes an international term. The "SABO" will contribute to reduce landslide risks in Sri Lanka.  
**Implementation:** National Building Research Organisation  
**Project area:** Badulla, Kegalle, Mataara



Field activities of Japanese Expert

#### Health and Medical Service Improvement Project

The project aims at providing facilities to improve diagnosis and treatment capacity mainly 'cath labs' for cardio vascular diseases in five selected tertiary hospitals over the country. As a further step taken to strengthen the diagnostic capacities, the project will contribute to improve the training capacity of the Medical Laboratory Technicians (MLT) by providing necessary training equipment for the MLT schools. Furthermore, the technology for the maintenance management of medical equipment under the Bio-Medical Engineering Services will also be strengthened under this project.

**Implementation:** Ministry of Health, Nutrition & Indigenous Medicine  
**Project Area:** Kandy, Kurunegala, Anuradhapura, Trincomalee, Badulla, Colombo and Kalutara



Existing angiography system in Kandy Teaching Hospital which will be strengthened by the project.

## The Japan Overseas Cooperation Volunteer Programme (JOCV)

The programme first commenced in Sri Lanka in 1981 and to date has brought over 1000 volunteers providing development support in diverse fields. The key to the success of the highly acclaimed programme is the commitment of volunteers who have given their best imparting knowledge and establishing strong bonds of friendship.

#### Major Impact Areas:

**Education**  
Pre-school Education

**Social Welfare**  
Sports

**Environment**  
Vocational Training



Football training in progress



Volunteer helping to overcome disability

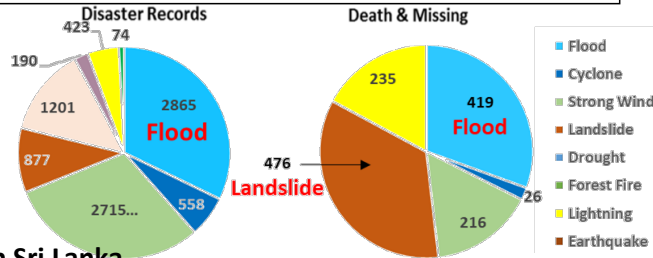


## DRR cooperated by JICA

**FLOOD:** Well-balanced DRR investment among important river basins

**EARLY WARNING:** Mechanism under Inter-Agency Coordination

### Natural disasters occurred in Sri Lanka during 2009-2018



**LANDSLIDE:** Efficient investment and prioritization on landslide DRR

**DRR Governance:** Strengthening Local DRR Governance, more concretely, Practical Local DRR Plan in Line with Basin-based DRR Strategy

### Key Concept of DRR in Sri Lanka

- Aiming at reduction of economic losses could have wide-ranging effects not only in terms of ensuring sustainable development but also improving mortality. Improvement of early warning mechanisms would also be necessary as a supplemental measure.

- In order to effectively promote DRR throughout the country, it would be essential to make urban area "safer" and to make remote area "more resilient".

Based on Sendai Framework

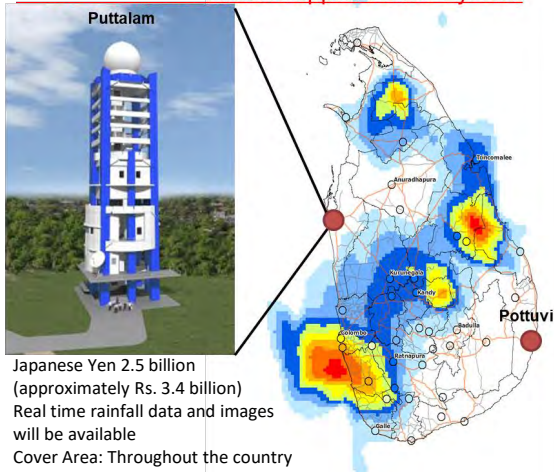
JICA Cooperation

No.	Latest and on-going Projects/Activities	Counterpart Agency
1	Project for establishment of a Doppler weather radar network <span>Grant Aid</span>	Dept of Met
2	Landslide disaster protection project for national road network (LDPP) <span>Concessional Loan</span>	RDA,NBRO
3	Project for Strengthening Capacity on Development of Non-structural Measures for Landslide Risk Reduction (SABO) <span>T/A</span>	NBRO
4	Disaster Risk Reduction Advisor for Sri Lanka	MOD,DMC
5	Project for Storm Water Drainage Plan in Selected Areas in Colombo Metropolitan Region <span>T/A</span>	SLLDC
6	Public Private Partnership with Japanese SMEs <span>Collaboration with Japanese SMEs</span>	NBRO
<b>Future Projects/Activities (from 2020)</b>		
7	Landslide disaster protection project for national road network 2 (LDPP2) <span>Concessional Loan</span>	RDA,NBRO
8	Mainstreaming DRR through establishing local DRR plans based on river basin strategy <span>T/A</span>	DMC
9	Development of early warning technology of rain induced rapid and long traveling landslide <span>SATREPS</span>	NBRO

Sub-sectors  
Weather forecasting  
Land slide protection  
Flood mitigation

### Establishment of a Doppler Weather Radar Network

#### Two Dual Polarization Doppler Radar System



Japanese Yen 2.5 billion (approximately Rs. 3.4 billion)  
Real time rainfall data and images will be available  
Cover Area: Throughout the country  
Frequency: Every ten minutes  
Product: 1km × 1km mesh rainfall map, Real-time rainfall amount

JICA Sri Lanka office - <https://www.jica.go.jp/srilanka/english/index.html>  
- [facebook.com/jicasrilanka](https://www.facebook.com/jicasrilanka)  
- [youtube.com/user/JICASriLankaOffice](https://www.youtube.com/user/JICASriLankaOffice)

### Landslide Disaster Protection Project



Loan amount: 7.62 billion JPY(=11 billion LKR), PMU: RDA and NBRO  
Mitigation works for sediment disasters(slope failure, landslides, rock fall)

### Disaster Risk Reduction Advisor for Sri Lanka



To strengthen the institutional and operational capacity of the Ministry which is in charge of Disaster Management through advising for Early Warning, DRR Plans etc., contributing to implementation of the Sendai Framework for Disaster Risk Reduction.

Project Duration:  
June 2017 – June 2020



Oxfam in Sri Lanka has been active in the country for over 30 years and consistently deliver programmes and impact. The key areas of our intervention are economic development, climate and weather resilience and water and sanitation. In all our programmes, gender is an overall priority and is reflected in everything we do.

Our work in climate and weather resilience is focused on putting innovative thinking and new technologies in function of improved resilience of the country, communities and business to impact of natural disasters and climate change. All developed solutions incorporate women and girls active participation and leadership throughout the process. Our flagship projects are:

### ***Automated water management system (AWMS)***



*Figure 1. Water level monitoring sensors in Batticaloa*

Oxfam in Sri Lanka developed and introduced AWMS that consist of network of water and ground sensors that measure the level of water in the tanks, irrigation channels and control fields. The information is broadcasted in regular time intervals and displayed in series of displays where the authorities and communities can see them. This has made decision making about water release accurate, timely and in real time, while the system also offers a possibility that the information about the location, quantity and time of water release to be shared with the farmers. The information is available on a website and has controlled access reserved for the actors with legal mandate and liability for sharing

information on water levels, irrigation and emergency, and selected trained community representatives such as farmer leaders.

We have seen amazing results related to increased quantity of water available for irrigation, reaching last mile communities, reduced water related disputes, and improved safety for women.

### ***Weather Index Insurance (WII)***



*Figure 2. Weather station installed in Batticaloa*

Sustainable agriculture in times of disrupted weather patterns and increased numbers and intensity of natural disasters greatly depends on availability of functional insurance. Oxfam in Sri Lanka in cooperation with the partners introduced Weather Index Insurance scheme with an aim to offer affordable insurance products for small holder farmers in Sri Lanka.

The scheme is about monitoring the weather event/s that has been identified as a key risk (e.g. rainfall, wind speed), measuring agreed above and below thresholds that impact the crop, knowing in advance the amount to be received in case of claim and the time need for payment to be made.

The system consists of network of automated weather stations located in targeted locations that monitor 24/7 the weather parameters identified as a key risk. The information is being broadcasted daily to farmers and insurance agents, and in case of reaching the threshold the claim payment is automatically triggered.

The scheme is fully transparent, timely and efficient, and full automatization contributed to establishing trust between the famers and insurance companies.



*Figure 3. Sonar sensor installed to monitor Kalu Ganga in Ratnapura*

### ***ReachMe***

ReachMe is a digital platform that connects humanitarian demand and supply, and it includes early warning system, evacuation alert, real time GPS tracking, recommended routes to the safe zones, and has a facility to report immediate needs, safeguarding and protection issues. The platform further gathers the reported information, analyse and provides a comprehensive information about the needs and locations. the data is presented at the dashboard that can be customised for diverse audience (government, humanitarian actors, private sectors, media and others) that decide and inform other actors about the response and supplies that are to be provided. The system enables real time coordination between multiple actors in providing targeted response as per the actual need.

It includes a network of automated rain gauges to measure the likelihood of landslides, sonar-based flood sensors, and can be adjusted to provide water reservoir alerts. Thereby the range of Early Warning alerts accumulates a range of data, which supports in the distribution of accurate and timely evacuation alerts.

### ***Rainwater harvesting system***

Unpredictable rainfall patterns are adding to the challenge that families in rural and coastal areas of Sri Lanka are facing. This makes it even more important to harvest and preserve all the water we can especially in rainy seasons.

OiSL developed a low-cost rainwater harvesting and purification system suitable for rural and coastal households of Sri Lanka. This is a system which collects, stores and treats rain water for drinking purpose through a locally developed



purification mechanism, which is cost effective, easy to maintain and powered with solar energy. The system also has been extended to collect the excess water in artificially constructed low cost rainwater harvesting underground storage that can be used for small scale agriculture. The system consists of three levels of filtration of water and a disinfection process designed by Oxfam technical team.

### ***The Cube***



*Figure 4 3 feet size Cube to safeguard household items*

During disasters, we are all focused on saving lives and it is great to see that number of casualties in Sri Lanka has been continually decreasing. This has allowed us to focus on other reported problems like lost documents, valuables, tools, lack of charging facilities and potable water.

The Cube is Oxfam in Sri Lanka solution to the problem: it is a water-proof, buoyant, multi-purpose storage system made of fibre glass used by the families to store valuable household items . The Cube can also store up to 400litres of clean drinking water and is equipped with a GPS tracking device and emergency equipment. The entire storage unit can be towed as required.

Oxfam in Sri Lanka,

15, Manthri Place, Colombo 05, Sri Lanka

<https://sri-lanka.oxfam.org/>





## United Nations Development Programme

United Nations Development Programme (UNDP), as the development arm of the United Nations, works in some 170 countries and territories, helping to empower lives and build resilient nations.

In Sri Lanka, UNDP has been working as a key development partner of choice in Sri Lanka since 1967, to achieve sustainable human development in economic, social and environmental fronts. Working closely with the Government at national, regional and local levels, and civil society and the private sector, UNDP aims at eradicating extreme poverty, and reducing inequalities and exclusion to protect both people and the planet.

As UNDP celebrates partnering for development for over 50 years in Sri Lanka and beyond, UNDP is now focused on helping Sri Lanka achieve sustainable human development through the Sustainable Development Goals. UNDP supports the Disaster Management Centre through Projects. Following are the on-going Projects at UNDP related to disaster risk resilience.

### ***Climate Resilience Integrated Water Management Project (CRIWMP)***

CRIWMP is implemented by the Ministry of Mahaweli, Agriculture, Irrigation and Rural Development with the technical support of UNDP Sri Lanka. Government of Sri Lanka. Project aims to strengthen the resilience of vulnerable smallholder farmers in the country's Dry Zone; particularly women, who are facing increasing risks of rising temperatures, erratic rainfall, and extreme events attributable to climate change. It will address technical, financial and institutional barriers related to achieving integrated water management to improve agriculture-based livelihoods of smallholder farmers in the Dry Zone.

One of the main outputs of the project is Strengthening climate and hydrological observing and forecasting systems to enhance water management and adaptive capacity of smallholder farmers to droughts and floods

Under this output, participatory co-development of weather and agriculture tailored advisories will ensure that weather and climate information is incorporated into decision making in agricultural and water management in the three river basins. This Output also addresses capacity barriers at local level to plan for and identify response measures to warnings and advisories. It will focus on identifying responses to floods, through mapping flood inundation levels, as well as developing plans, which identify appropriate spill areas in cascade

systems and agricultural assets and infrastructure at risk. It will also develop response plans for agriculture to seasonal forecasts and associated advisories, as well as appropriate water management options. This output includes the following key activities:

- Activity 3.1 Establish effective monitoring systems for drought, floods and water management
- Activity 3.2 Co-develop and disseminate weather- and climate-based advisories for agricultural and water management through ASCs and FOs to farmers and village water managers:
- Activity 3.3 Develop climate-risk management response measures based on advisories and forecasts for agriculture, water management and flooding in cascade systems

### ***Partnerships for Strengthening School Preparedness for Tsunamis in the Asia Pacific region***

The United Nations Development Programme Bangkok Regional Hub (UNDP BRH) implemented the first phase of “Partnerships for Strengthening School Preparedness for Tsunamis in the Asia Pacific region” from June 2017 to November 2018 to mitigate the impact of tsunamis by empowering school preparedness in 18 high risk countries in the Asia Pacific region. Given the impact and lessons learnt, the second phase aims to keep the momentum going, fill the gaps, scale-up and integrate the preparedness programme and drills into the school curriculum and systems. The project emphasises institutionalising disaster preparedness in schools for sustainability beyond the projects.

The Disaster Management Center under the Ministry of Defense has been identified as the mandated agency for Disaster Preparedness and Planning. During the implementation of the Project Phase 1 in 2018, the DMC conducted similar drills in 5 schools successfully. With the past experience and approvals from Ministry of Education, DMC will be collaborating for Technical Guidance and assistance. This exercise will be conducted in 3 selected schools which are vulnerable to Tsunamis in Jaffna, Mullativ and Ampara Districts in-order to enhance disaster/Tsunami Preparedness in schools

### ***Preparation of Sri Lanka’s Third National Communication (TNC) to the UNFCCC***

The project “*Preparation of Sri Lanka’s Third National Communication (TNC) to the UNFCCC*” is designed to generate a national report on climate change of Sri Lanka. The report will contain updated inventory of Greenhouse Gases (GHG), associated Vulnerabilities and Adaptation Measures (VAM) to climate change impacts and Mitigation Options (MO) considered in reducing GHG emissions apart from National Circumstances (country’s general information) and Other Information such as technology transfer, research, capacity, systematic observations and public awareness actions implemented and gaps. The country

submitted its Initial National Communication in November 2000 and the Second National Communication in March 2012. The national communication is an important mechanism for the exchange of information on Parties' responses to climate change and UNFCCC process. It allows Parties to highlight issues, problems, gaps and constraints faced as well as technical and financial support needed by the Parties. The national communication can form a two-way communication with the Convention in addressing climate change.

The implementation of the project will ensure the key delivery of the Third National Communication on Climate Change report and in addition to such following additional interventions would be developed;

- Online climate change reporting related data sharing platform
- National climate change research and communication strategy
- Symposium structure to publish climate change related research and findings
- Digital repository to organize and store national climate change related research literature

### ***Climate Change Adaption Project - II***

Climate Change Adaption Project (CCAP) II funded by Adaptation Fund is a USD\$ 2.8 Million, primarily focusing on increasing the adaptive capacities of the Rural farmer communities of Walapane, Madirigiriya and Lankapura Divisional Secretariat divisions in the Mahaweli River Basin of Sri Lanka. The objective of the Project is to introduce economically effective alternative livelihood options and capacitating the local stakeholders on climate risk reduction processes was a priority. The project mainly focused its activities covering 2 main components

- Diversified and strengthened livelihoods and sources of income for vulnerable farm families in minor irrigated and rain-fed areas
- Strengthened ownership of climate risk reduction processes and increased potentials of adaptation strategies at local and basin/ sub national level.

Alternative livelihood opportunities were created under 5 value chains and communities were empowered through this initiative towards creating stable income during climate shocks. Under climate risk reduction process, training were provided to different stakeholders on new farming techniques to adapt to climate risk, meteorological centers were established to obtain weather forecasting and disseminate weather forecasting to farmer communities and officials were trained on creating adaptive strategies for the community level farmer organizations and farmers.

Following are some examples for DRR work in Sri Lanka as summary of the current Project activities.

1. Support DMC to strengthen the disaster preparedness and response capacity in the project selected tanks cascades in Anuradhapura, Vavuniya, Kurunegala, and, Puttalam and Trincomalee
2. Strengthen the flood early warning capacity in the Malwathu Oya, Yan Oya and Mi Oya river basins, Flood Risk Assessment was started by mapping flood affected households and developing vulnerability data base in flood affected DS divisions.
3. Strengthen the Divisional Disaster Preparedness, and, Early Warning and Response capacity in the flood-affected areas in above river basins in Anuradhapura, Vavuniya, Puttalam, Kurunegala, Trincomalee and Mannar districts.
4. Develop a flood model with the aim of establishing a flood early warning and decision support system for the Mi Oya river basin. The Irrigation Department, DMC and District and Divisional Secretariat are the key stakeholder agencies.
5. In order to strengthen the hydrological monitoring network of the Irrigation Department eight automatic water level recorders were installed and connected to the online data monitoring system.
6. To strengthen the weather observation capacity of the Department of Meteorology, CRIWMP has installed 10 automated rain gauges and 5 Agro-met Automated weather stations.
7. Conduct 03 evacuation drills on Tsunami Preparedness in three selected schools in the North and the East.
8. Co-fund the International Symposium on 'Multi-Hazard Early Warning and Disaster Risk Reduction' organized by DMC.

SAVING  
LIVES  
CHANGING  
LIVES



## Strengthening National Capacity for Building Resilience; Emergency Preparedness and Response Planning

The United Nations World Food Programme (WFP) is the leading global humanitarian agency that works to save lives, protect and empower vulnerable communities, and strengthen the capacity of government systems to meet the needs of their people. WFP supports disaster preparedness to help mitigate impact, save resources and protect development progress.

In Sri Lanka, WFP addresses the underlying causes of food insecurity and malnutrition to support long-term recovery and resilience for thousands of people. Projects aim to improve the productivity and incomes of smallholder farmers and vulnerable communities, with a particular focus on women. They also work to ensure that children receive school meals – a critical step in tackling the causes of high and stagnant malnutrition rates – and assist the government in preparing and responding to the impacts of climate shocks. WFP has been present in Sri Lanka since 1968.

Given this unpredictability and the large number of people it affects, Disaster Risk Reduction, and Emergency Preparedness, have become national priorities. The long-term consequences of climate shocks will adversely affect agriculture production, infrastructure development, public health and nutrition.

In 2016 WFP has signed a memorandum of understanding with disaster management authorities in Sri Lanka to provide capacity strengthening services including development of information systems and also facilitating linkages to global technological advancements.

WFP has joined hands with USAID (OFDA) and AusAid (DFAT) enabling multi-year projects to support the government

### WFP'S STRATEGIC SUPPORT TO THE GOVERNMENT

The WFP Country Strategic Plan 2018–2022 aims to strengthen the capacity of the government in DRR & emergency preparedness and response at all levels.

WFP will provide technical and capacity-building assistance to disaster management agencies to conduct a periodic emergency readiness audit; review disaster management plans and guidelines, operationalize National Emergency Operations Plan with a focus on effective emergency coordination; develop emergency-preparedness action plans, relief management guidelines and training modules; and perform simulation exercises at various levels. A letter of understanding and joint action plan has been signed with the Government respectively to confirm these partnerships.

### OUR STRATEGY IN SRI LANKA

The WFP Country Strategic Plan aims to invest USD 46.8 million between 2018 and 2022 to ensure that:

- Crisis-affected people have access to food all year round (e.g. through the emergency preparedness and response programme)
- School-aged children in food-insecure areas have access to food all year round
- Children under 5, adolescent girls and women of reproductive age have improved nutrition
- Vulnerable communities and farmers have strengthened livelihoods and resilience in the face of shocks and stresses all year round





# WFP Five Year Programme Focus

## Disaster Risk Management

### KEY CONTRIBUTIONS AND COLLABORATIVE EFFORTS

In the past five years, WFP has provided significant support to the government of Sri Lanka to increase its effectiveness in emergency preparedness and response planning. The key activities implemented jointly by WFP and the government were:

- **Reviewing and developing the NEOP:** WFP supported the Disaster Management Centre in finalizing the National Emergency Operations Plan (NEOP). WFP also assisted the national disaster relief services centre in developing scenario-based contingency plans at a sub-national level, which will enable the implementation of systematic and coordinated emergency relief planning.

- **Real-time impact monitoring systems:** WFP presented the government with information about the consequences of disasters that occurred in 2016 and 2017 through conventional measures and a 72-hour assessment methodology based on satellite imagery and data analysis.

In 2017, WFP introduced the Platforms for Real-Time Information and Situation Monitoring System (PRISM) for monitoring drought impact using remote sensing data.

- **Emergency logistics capacity development:** WFP supported the creation of a trainings-of-trainers (ToT) course on emergency logistics in Sri Lanka. Disaster management stakeholders representing relevant government agencies, the military, the UN, civil societies and private sector organizations participated in the training.
- **Scenario-based disaster simulations:** The purpose of these simulations was to practise the coordination of a timely and effective response to a nationwide emergency. It also aimed to identify opportunities to improve emergency preparedness and to strengthen response planning.
- **Shock responsive safety nets:** The Sri Lankan government and WFP held a joint lesson learnt workshop in May 2017, which produced key recommendations for coordination, data analysis, transfer modality and other financial processes, training and monitoring and evaluation to improve the shock-responsiveness of current safety-net programme.

### PRIORITY ACTIONS: 2020-2022

- **Enabling an environment to implement risk-sensitive planning** create a policy dialogue on understanding risk and risk governance initiatives, particularly given the negative impacts of a changing climate. This can be facilitated through sensitization programmes, and development of guidelines and information materials on risk -sensitive planning. This is focused to build coping capacities in changing climate context in the country.
- **Implementation of NEOP operationalization:** The NEOP underway, and relevant standard operating procedures (SOPs) with specific actions will be developed and tested. NEOP processes involving disaster warning systems, search and rescue, relief/camp management and early recovery will be standardized. WFP will assist the government in developing scenario-based contingency planning guidelines for humanitarian relief operations and improving the functional capacities of officers of the NDRSC.
- **Scaling up PRISM to measure impacts of sudden onset disasters:** A flood model will be tested and automated in this project. Experiments will be carried out to estimate projected impacts in three stages: just before disaster using rainfall forecast, during disaster using real-time watershed precipitation, and 72 hours after a disaster using satellite images of inundation.
- **Standardized and tested guidelines and tools for emergency relief management:** During disasters in the past few years, the government and other stakeholders have identified gaps in the existing relief management process, such as a lack of common management guidelines to direct government officers to systematically deal with emergency relief. WFP is assisting NDRSC in improving this process.
- **Improved shock-responsiveness of safety nets:** WFP supports the government in building an improved and unified shock-responsive social safety net system to deliver timely, adequate and targeted response to the most vulnerable families affected by natural disasters. WFP will review the existing safety net business model, advocate for a coordinated targeting methodology that prioritizes women and children, as well as provide training and technical support to relief workers through social protection schemes.



*Facilitating simulation exercise*



*Advocacy for the Government*

WORLD FOOD PROGRAMME, No. 2, Jawatte Avenue, Colombo 5, Sri Lanka

PHONE: +94 11 2586244, FAX: +94 11 2502468, EMAIL: [WFP.Colombo@wfp.org](mailto:WFP.Colombo@wfp.org) , <https://www.wfp.org/countries/sri-lanka>



## ABOUT WORLD VISION...

World Vision is a Christian, relief, development and advocacy organization working with children, families and communities to overcome poverty and injustice.

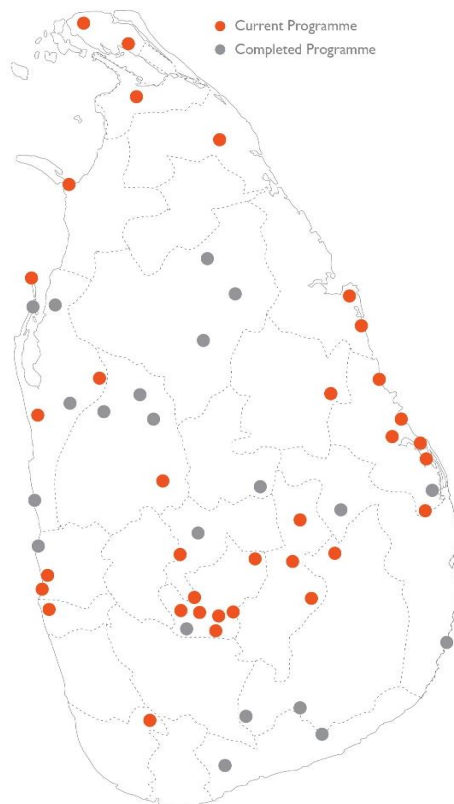
Established in 1950, we are dedicated to working with the world's most vulnerable people regardless of their religion, caste, sexual orientation or ethnicity.

World Vision commenced operations in Sri Lanka in 1977 and we have responded to almost every disaster the country has faced since then.

We not only focus on life-saving emergency aid and helping communities rebuild their lives after a disaster but also on making them disaster-ready.

## OUR CONTRIBUTION TOWARDS DRR...

Almost all our economic development programmes especially in the agriculture sector has a special focus on disaster resilience. From home gardens to cultivation methods, ensures food secure homes during disasters and quick recovery of livelihoods.



## In 2019...



**99** producer groups trained in livelihood resilience



**169** Community-Based Organisations trained on developing disaster risk reduction livelihood plans



**622** farmers were supported with diversified crops and livestock rearing



**2,755** households received capacity building in disaster-resilient livelihoods.

## OTHER PROJECTS THAT CONTRIBUTE...

### 'Building Resiliency of Disaster Prone Communities' Project (2012 – 2015)

The Project focused on capacity building of the government officials, designing of community disaster management plans, formation and capacitating of Village Disaster Management Committees (VDMC) and linking them with District Disaster Management Coordination Units (DDMCU) and promotion of insurance schemes and alternative livelihoods for families.



Mullaitivu and Kilinochchi Districts



World Vision Australia



### Child Centered Disaster Risk Reduction (Ongoing)

CCDRR empowers children and communities to be active participants in the disaster mitigation activities in their communities. The project also empower government officers to supporting children.



Ratnapura, Galle, Kalutara and Badulla Districts



UNICEF

### The Natural Farming Project Phase III (2019-2021)

This Project focuses on climate-friendly natural farming practices.



Vaharai



KOICA







## The Association of Disaster Risk Management Professionals of Sri Lanka (ADiRiMP)

In May 2015, the UN General Assembly endorsed the Sendai Framework for Disaster Risk Reduction (2015-2030), which was adopted by UN Member States in March 2015. The Sendai Framework for Disaster Risk Reduction charts the global course over the next 15 years. It recognises that the State has the primary role to reduce disaster risk, but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. It urges states to better understand disaster risk, strengthen disaster risk governance, invest in disaster risk reduction and enhance disaster response to 'Build Back Better'. Its implementation compels the channelling of expertise from multiple disciplines for informed decision making and innovative policy formulation. During the consultations and negotiations that led to finalisation of Sendai framework, strong calls were made to develop practical, evidence-based guidance to support implementation, ensure engagement and ownership of action by all stakeholders, and strengthen accountability in disaster risk reduction.

Reducing disaster risk is an issue cutting across different sectors, which requires trans-disciplinary and trans-boundary approaches with the support of the natural and social sciences, including for natural hazards and applied fields such as health, agriculture, economics, environment, engineering and technology. This necessitates a professional approach to their management as relevant competencies have to be developed continuously.

In Sri Lanka, recognition of disaster risk reduction (DRR) as a core professional discipline, which implies a proactive approach to managing disasters and reducing the risks is yet to be achieved. Such expertise is available but is scattered in silos of professional disciplines and not utilised in the current realm of DRR in the country. There are real benefits to be gained from an integrated approach as it will leverage existing institutional knowledge and political support to promote both goals. Many of the strategies and tools overlap, especially for disaster risk reduction and adaptation.

The Association of Disaster Risk Management Professionals of Sri Lanka (ADiRiMP) aspires to address this need. ADiRiMP is an assembly of professionals representing varied disciplines to nurture a culture of safety in Sri Lanka from the impact of disasters. ADiRiMP envisioned to be an association of DRR practitioners, scientists, and enthusiasts from government, international / national organizations and other DRR entities in Sri Lanka. It will provide a platform for dialogue to achieve effective implementation of the Sendai Framework, the Paris Agreement (2015 - 2030) and the related Sustainable Development Goals. *"It's*

*inconceivable that we'll achieve the SDGs if we don't get a handle on reducing disaster risk, including climate risk."*

Efforts to build resilience will benefit from integrating DRR and climate change adaptation with existing efforts in DRR and other similar planning processes. Its influence will flow from its continuing and highly visible functions: to develop professional excellence, to raise public awareness, and to be engaged in relevant research. Through its work, it will help to define and set standards for the professional field and to promote high standards of quality through forms of recognition. The underpinning principles of ADRIMP will provide an excellent opportunity for the integration of DRR into the professional competencies.

Further information including objectives of ADRiMP is available at :  
[www.adrimp.org.lk](http://www.adrimp.org.lk)

## International Journal of Disaster Resilience in the Built Environment



Review process:

Double-blind peer review

Frequency:

5 issues per year

ISSN:1759-5908

Current Volume:11,2020

### Editors:

Professor Dilanthi Amaratunga &  
Professor Richard Haigh,

Global Disaster Resilience Centre,  
University of Huddersfield, UK

This Q1 ranked, Scopus indexed and ISI Web of Science TM Core Collection, Emerging Sources Citation Index (ESCI) listed title focuses on research and scholarly activity that examine the role of building and construction on anticipating and responding to unexpected events that damage or destroy the built environment.

This is the only journal in the field to specifically promote research and scholarly activity that examines the role of building and construction to anticipate and respond to disasters that damage or destroy the built environment. Although the origins and causes of

disasters are varied, the consequences to human society are frequently similar: extensive loss of life, particularly among vulnerable members of a community; economic losses, hindering development goals; destruction of the built and natural environment, increasing vulnerability; and, widespread disruption to local institutions and livelihoods, disempowering the local community. In particular, it aims at developing the skills and knowledge of the built environment professions and will strengthen their capacity in strategic and practical aspects of disaster prevention, mitigation, response and

reconstruction to mitigate the effects of disasters nationally and internationally. The journal publishes original and referred material that contributes to the advancement of the research and practice and provides contributing authors with an opportunity to disseminate their research and experience to a broad audience.

The coverage of the journal includes, but is not limited to: Disaster mitigation, response and reconstruction; Disaster risk reduction; Physical, social and economic resilience in the built environment; Reconstruction and sustainable development; Participatory approaches to reconstruction; Empowerment of women and vulnerable groups; Project management for post-disaster reconstruction; Waste management; Business continuity management; Knowledge management; Governance and transparency; Corporate social responsibility; Law and regulatory frameworks; Conflict sensitive reconstruction; and, Social impact of reconstruction.

Further details on coverage details of the journal are available at [http://www.emeraldgrouppublishing.com/products/journals/author\\_guidelines.htm?id=ijdrbe](http://www.emeraldgrouppublishing.com/products/journals/author_guidelines.htm?id=ijdrbe)

The Journal is indexed in: British Library, Construction and Building Abstracts, ICONDA - The International Construction Database, Business Source Premier (EBSCO), ABI INFORM Global (ProQuest), Cambridge Scientific Abstracts (ProQuest), INSPEC, SCOPUS and ISI Web of Science TM Core Collection, Emerging Sources Citation Index (ESCI)

To submit your paper online, you must first create an author account at <http://mc.manuscriptcentral.com/ijdrbe> then follow the on-screen guidance which takes you through the submission process. If you do not have an author account on the International Journal of Disaster Resilience in the Built Environment, then you will need to create yourself an account, even if you have an account on a different journal. Please see the instructions below explaining how to register. Scholar One Manuscripts is an intuitive and author-friendly interface for submitting articles to Emerald journals over the Internet. Online submission facilitates a fast and efficient publication service and provides the author with the ability to track their paper through the review process.

If you have any ideas for a paper which falls within the scope of the journal, editors are happy to discuss the ideas further with you. Contributions are welcomed relating to a range of aspects of disasters in the built environment.

Submit your contribution now via

[http://www.emeraldgrouppublishing.com/products/journals/author\\_guidelines.htm?id=ijdrbe](http://www.emeraldgrouppublishing.com/products/journals/author_guidelines.htm?id=ijdrbe)

Set up your Emerald profile to receive the table of contents alerts for this journal and more <http://www.emeraldgrouppublishing.com/ijdrbe.htm>

To contact us, find out more on the scope of the journal and more, please visit: <http://www.emeraldgrouppublishing.com/ijdrbe.htm>

## **Keynote Speakers**



**Dr Srinivasa Kumar Tummala**

*Head of ICG/IOTWMS Secretariat  
Perth Programme Office  
PO Box 1370, West Perth  
WA 6872, Australia*

[sk.tummala@unesco.org](mailto:sk.tummala@unesco.org)

***Short bio - Dr. Srinivasa Kumar Tummala***

Dr. Srinivasa Kumar Tummala acquired more than 21 years of experience in ocean observations, information and advisory services, specialising in establishment of end-to-end early warning systems for tsunamis and storm surges. Currently he is based in Perth Australia, as Head of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) Secretariat of the Intergovernmental Oceanographic Commission (IOC) of UNESCO, instrumental in enhancing intergovernmental coordination and facilitating technical enhancement to the IOTWMS. Prior to his current assignment, Dr. Tummala held progressively senior techno-managerial positions at the Indian National Centre for Ocean Information Services (INCOIS/MoES) and the Indian Space Research Organisation (ISRO) in India.

All through his career, Dr. Tummala managed large scientific projects involving multiple national / international institutions, scientists, vendors and end users, having led the design, underpinning scientific foundation and implementation. Post the 2004 tsunami, as Project Manager he coordinated the successful establishment of the Indian Tsunami Early Warning System that acts as one Tsunami Service Providers (TSPs) under the IOTWMS framework, providing tsunami information to 28 Indian Ocean rim countries. Dr. Tummala was the former Chair of the IOC-UNESCO IOTWMS and the Task Team on Tsunami Watch Operations, contributing substantially to the design, development and operationalisation of regional tsunami warning service in the Indian Ocean and service definition for globally harmonised tsunami watch operations.

Dr. Tummala completed Master of Science in Marine Biology & Oceanography with First Rank, and a Ph D in Marine Science. Dr. Tummala's academic interests include Disaster Risk Reduction, Marine Resource Management, Coastal Zone Management and Satellite Oceanography. He made about 60 publications in peer reviewed scientific journals with a cumulative impact factor of 49, total citations of 1087 and H-index of 17.



## **Intergovernmental Oceanographic Commission of UNESCO**

*IOC UNESCO secretariat to the intergovernmental coordination group for the Indian Ocean Tsunami Warning And Mitigation System (ICG/IOTWMS)*

### ***Background***

Following the 26 December 2004 tsunami, which killed over 230,000 people, displaced more than 1 million people and left a trail of destruction around the coasts of the Indian Ocean, the coastal nations of the Indian Ocean decided to design and implement an early warning system for the region and requested the Intergovernmental Oceanographic Commission (IOC) of UNESCO to form an Intergovernmental Coordination Group (ICG) for the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). This was formally established by Resolution XXIII-12 at the IOC Assembly in Paris in June 2005, and a secretariat was established to provide administrative support and to coordinate the activities of the ICG/IOTWMS, that is being hosted and supported by the Government of Australia at Bureau of Meteorology in Perth. IOC-UNESCO also established the Indian Ocean Tsunami Information Centre (IOTIC) in Jakarta supported by Government of Indonesia.

### ***Current Status of the IOTWMS***

After 8 years of international collaboration and development, facilitated and coordinated by IOC UNESCO, the IOTWMS became operational on 31<sup>st</sup> March 2013 with Tsunami Service Providers (TSPs) established by Australia, India and Indonesia providing independent tsunami advisory services to the National Tsunami Warning Centres (NTWCs) of 28 Member States of the region. ICG/IOTWMS Member States include Australia, Bangladesh, Comoros, Djibouti, France, India, Indonesia, Islamic Republic of Iran, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Myanmar, Oman, Pakistan, Seychelles,

Singapore, Somalia, South Africa, Sri Lanka, Tanzania, Thailand, Timor Leste, United Arab Emirates, United Kingdom and Yemen. The NTWCs use this information to determine and issue warnings for their coastal communities at risk, as is their sovereign responsibility.

The main objective of the IOTWMS is to identify and mitigate the hazards posed by tsunamis. The goal is to create and sustain a fully integrated end-to-end warning system built on three pillars: tsunami risk assessment and mitigation; tsunami detection, warning and dissemination; and tsunami awareness and response. The work of the IOTWMS is conducted by technical Working Groups, with Task Teams established to undertake specific time-bound activities identified by the ICG. Currently there are 3 Working Groups and 3 Task Teams, with members who are experts in their fields, responsible for establishing standards and for developing work plans. They report their recommendations to the ICG for endorsement and implementation. The ICG established a Steering Group in 2006 to coordinate and integrate the work of the ICG in the intersessional periods.

The IOTWMS developed risk assessment guidelines, enhanced observing networks (140 Seismic Stations, >100 Sea level Stations, 09 Tsunameters), generated awareness material and continues to conduct bi-annual communication tests, biennial tsunami drills and capacity development workshops. The most recent tsunami drill IOWave18 was conducted during 4 - 5 September 2018 and attracted participation of 24 Member States with 11 of them conducting community evacuation involving a record 116,000 people. Capacity development activities include Standard Operating Procedures (SOP) Workshops for NTWCs and Disaster Management Offices (DMOs) to develop their national SOPs, and training courses on Tsunami Evacuation Maps, Plans and Procedures (TEMPP) to provide NTWCs and DMOs with methodologies and tools to create tsunami inundation maps and evacuation maps for their respective countries.

### ***Ongoing and Future Work***

The Indian Ocean is much safer against the threat of tsunamis than it was in 2004. However, due to the nature of the hazard, it is important for the coastal communities to always be prepared and ready to respond. Current and future work of the ICG/IOTWMS is focused towards system sustenance and enhancements, strengthening early warning in the Makran region as well as enhancing community awareness and response. The 12th Session of the ICG/IOTWMS held in Kish Island, Iran in March 2019 recognised the Palu and Sunda Strait tsunamis generated by near-field atypical sources as being very complex from an early warning perspective, thus emphasising the urgent need to update hazard assessments, strengthen warning capabilities and enhance community preparedness. The ICG decided to conduct IOWave20 exercise and continue trainings on Standard Operating Procedures (SOPs) and Tsunami Evacuation Maps, Plans and Procedures (TEMPP) to support national implementation of Tsunami Ready initiative. [Tsunami Ready is a community performance-based programme that facilitates a structural and systematic



approach in building community tsunami preparedness through an active collaboration of the public (community), community leaders, and local and national emergency management agencies].

The Sendai Framework for Disaster Risk Reduction (2015-2030) highlights international, regional, sub-regional and transboundary cooperation and calls for a broad and more people-centred preventive approach to disaster risk. The IOC Tsunami Programme, through the intergovernmental coordination of regional warning systems, capacity development activities and the support of national and regional projects, is a key stakeholder for tsunami risk reduction at the global level. Going forward, the IOC is committed to continuing to facilitate, coordinate and provide governance for the Indian Ocean Tsunami Warning and Mitigation System and the other regional systems. Upcoming international initiatives such as the United Nations Decade of Ocean Science for Sustainable Development will serve as a major platform for further strengthening cooperation in tsunami and multi-hazard early warning systems.



### **Professor Priyan Dias**

*Senior Professor of Civil Engineering,  
University of Moratuwa, Sri Lanka*

Email: [priyandias55@gmail.com](mailto:priyandias55@gmail.com)

#### **Short bio:**

Priyan Dias graduated from the University of Moratuwa in 1980, and obtained a doctorate from Imperial College, London in 1986, working in the area of Concrete Technology. He is now a Senior Professor of Civil Engineering at the University of Moratuwa, and was Director of Research at the university from 2014-17. Together with his colleagues he has helped to promote the use of fly ash and offshore sand in the Sri Lankan construction industry; and also the in-situ assessment of structures. In addition, he has given leadership, through Sri Lanka's Disaster Management Centre and National Building Research Organization, in the preparation of guidelines for buildings to resist natural disasters. He is also the current Vice-President of Sri Lanka's National Academy of Sciences and Associate Editor of the international journal *Civil Engineering and Environmental Systems*. He has recently published a book with Springer Nature titled *Philosophy for Engineering: Practice, Context, Ethics, Models, Failure*.

## **Disaster Risk Reduction through Multi-Hazard Resilient Infrastructure**

### **Synopsis:**

While knowledge of specific hazards and their likelihoods will contribute to measures for reducing vulnerability and increasing preparedness, the complexity of and interactions between today's natural and social systems mean that some hazards may not be easily predictable. It is in that context that inherent resilience becomes important. In the domain of structural mechanics, the components of resilience (or toughness) are understood to be robustness, redundancy and ductility. Ductility and redundancy are especially important components, that can arguably be traded off against each other. Where structures are concerned,

morphology (form) and topology (connectivity) can give us guidelines for designing resilient infrastructure. These ideas for generating resilience can be translated to the planning, design and use of infrastructure. Examples of infrastructure that embody these concepts are given, as are suggestions for others.



**Dr Ananda Mallawatantri**

*Country Representative*

*International Union for Conservation of Nature - IUCN*

*53, Horton Place, Colombo 7*

*Sri Lanka*

**Short bio:**

Dr Ananda Mallawatantri is currently the Country Representative of International Union for Conservation of Nature - IUCN in Sri Lanka.

Dr. Mallawatantri holds a Bachelor of Science Special degree in Chemistry and a Diploma in Business Administration from University of Colombo. He received his Doctorate in Soil Physics and Masters in Environmental Science from the Washington State University, Pullman, USA as a Junior Fulbright Fellow.

Before joining IUCN, he served as the UNDP Assistant Resident Representative for Environment Sustainability and Disaster Resilience in Sri Lanka and as the Senior Advisor and Director for Energy and Environment at USAID Colombo.

## Green Infrastructure and Nature Based Solutions towards Disaster Risk Reduction

**Synopsis:**

Disaster risk reduction in a changing climate requires enhancing capacities of agencies and promote multi-sector approaches including the management of ecosystems and natural resources. In that context, ecosystem thinking could be mainstreamed into planning and engineering designs to protect lives and assets, alleviate poverty, sustain livelihoods and manage climate change impacts.

Ecosystem-related tools and approaches to reduce disaster risk (Eco-DRR) combined with climate change adaptation (EbA) are part of the broader Nature-Based Solutions (NBS) approach that is gaining momentum and traction. The diversity of ecosystems, landscapes and hazards in Sri Lanka provide a unique learning and engaging environment for scientists and practitioners to work on multi-sectoral landscape approaches to minimize disaster and climate risks. NBS

allows us to bring together the concepts founded in hydrology, biodiversity, climate change, landscape restoration, culture and heritage, coastal and marine etc. while facilitating inter-agency collaborations and joint research.



**Dr Harkunti Pertiwi Rahayu**

*City and Regional Planning,  
School of Architecture, Planning and Policy Development,  
Institute of Technology Bandung, and Research Center for Disaster Mitigation,  
Indonesia*

**Short Bio:**

Harkunti Pertiwi Rahayu, PhD is an affiliated Faculty Member of Urban and Regional Planning Department – School of Architecture, Planning and Policy and Development – The Institute of Technology Bandung, Indonesia.

She is currently active as (1) President of Indonesian Disaster Expert Association (IABI) 2017-2020, (2) Member of National Research Council and as the chair of Technical Committee for Environment and Disaster (3) Chair of Working Group 1 of Intergovernmental Coordination Group on Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) focusing on Tsunami Risk, Community Awareness and Preparedness for 3 period from 2012 to 2021, with 24 Member Countries, and (4) member of Technical Committee of ISO/TC 292 Trans-Disciplinary Approach, Japan Society of Civil Engineers. Harkunti was an active member of the National Task Team for the development of End to End Indonesian Tsunami Warning System.

She has over twenty years of experience in teaching, conducting researches, training, workshops, national guideline and policy development in the Disaster Mitigation and Management especially on tsunami Early Warning System. Further she is experienced in Disaster Risk Assessment, Mainstreaming Disaster Risk Reduction into Policy Planning, and Behavioral Science in Disaster Risk Reduction field.

Harkunti has won many international research grants. Recently, she won a research grant from the British National Environment Research Council-Newton Fund and Ministry of Research, Technology, and Higher Education of Indonesia (Kemenristekdikti) on Mitigating Hydro-Meteorological Hazard Impacts through Transboundary River Management in The Ciliwung River Basin (2019-2021). Further, she has been a Co-Principal Investigators for Newton Institutional Linkages, “Mainstreaming Integrated Disaster Risk Reduction and Climate

Change Adaption Strategies into Coastal Urban Agglomeration Policy”, Funded by Newton – British Council (2017-2019).

She is also one of the Principal Investigators for PEER Science Cycle 6-NAS; Converging Climate Change Adaptation and Disaster Risk Reduction Into Agglomeration Policy for Coastal Metropolitan Planning (2017-2020). In addition to that she has been a Principal Investigator for PEER Science Cycle 3-NAS Sub-Grant; Integrated Local Emergency Operation and Response Policy Improvement and Capacity Building for Advance-Early Warning System in the Face of Near Field Tsunami Risk, 2014 –2018. Harkunti can be contacted via [harkunti@pl.itb.ac.id](mailto:harkunti@pl.itb.ac.id); [harkunti@gmail.com](mailto:harkunti@gmail.com)

## People-Centered Early Warning System in the Face of Near Field Tsunami – A Lesson Learned from Indonesia

### **Synopsis:**

Tsunami early warning system is a complex and dynamic system, defined as an integration of physical, technological, social and cultural phenomena. Less than a decade, the occurrence of two devastated mega tsunamis generated by 9.0s magnitude earthquake, i.e. 2004 Indian Ocean Tsunami and 2011 Tohoku Tsunami, have become the wake up calls not only for affected countries but also for international community. The 2004 event has made Indonesia, as well as other affected countries in Indian Ocean region, to put the highest priority for the development and establishment of tsunami early warning system (TEWS) under collaboration with the national, regional and international community, since no such system existed in the region. Adapting and improving existing technology of UPSTREAM component of warning system have been intensively and extensively done, still the DOWNSTREAM component of the system has not been fully enhanced. Complexity of downstream component not only include warning chain that could reach the last miles, but also comprehensive initiatives in promoting disaster risk reduction countermeasures to increase readiness of the city and preparedness of all people at risk. As it was tested by a number of tsunami occurrences, the people and all stakeholders of several national show case cities still have shown lacks of responses when strong shaking felt and tsunami warning/evacuation order issued. Without any doubt, if *the expected scale of tsunami* were occurred, a massive loss of life would likely to be remained or even worse; then the effectiveness of tsunami warning and countermeasures implemented at those cities becomes a *critical question*. At the other hand, the 2011 Tohoku tsunami has become as wake up calls as well for international community the Japanese to understand and review for the resilience of downstream component and the interface between upstream and downstream to response near-field tsunami.

Therefore, this paper will present initiative done to response the above challenges by improving the governance of downstream tsunami warning system. An in-depth case study was done in Padang City. As the Indonesian constitution has mandated the responsibility to save people’s lives against natural disasters to

local government in the city and regency level, the responsibility of downstream component is relied on the local government. In Padang City, the existing regulation related to early warning system—Padang Mayor Regulation 14/2010—mainly considers inter-agency in provincial and city level while only utilizes mass communication ways methods such as siren and mass media for disseminating evacuation orders. This raised a problem as people-centered approach has been the main agenda for early warning systems and have also been shown to increase resilience. This study aims to identify the gaps in the current policy and propose a viable framework for policy improvement regarding people-centered tsunami early warning chain in Padang City. The study found that the existed regulation lacks extension nodes to relay warnings to the last mile population. Moreover, receiving warning information from both formal and informal sources is important to mobilize people evacuation more effectively during an emergency. The study found that community masjid and disaster preparedness leaders are the potential actors who should be involved in the local early warning chain. The research finding was presented as a recommendation to Padang City government and have been legalized as the new tsunami early warning chain procedure in the Padang City Mayor Regulation 19/2018.



## **National Launches**

## Standard Operating Procedures for the Tsunami Early Warning and Mitigation System in Sri Lanka.



Experience over recent years of the impacts of tsunamis has shown that inadequate preparation for, and response to, emergency situations have contributed to widespread damage and the avoidable loss of lives and livelihoods. The shortcomings in preparation have been due to a lack of warning through poor regional detection and communication systems, but also reflects inadequate awareness, planning and coordination.

A 2015 United Nations (UN) report estimates that each year, an additional 60,000 people and \$4 billion (US\$) in assets are exposed to the threat of tsunami hazard. As demonstrated by the human and economic losses from the 2004 Indian Ocean and 2011 Tōhoku disasters, and most recently in Palu, Indonesia, tsunamis inflict death and damage through violent, powerful flooding along the world's coastline. Sri Lanka suffered very high human and economic losses from the 2004 Indian Ocean tsunami. It also has a tsunami risk index of 8.9 (from 10), highest among several types of disasters.

An effective end-to-end tsunami warning system begins with the upstream rapid detection of a tsunami wave, including detection, verification, threat evaluation, and forecasting. It ends with a well-prepared community that is capable of responding appropriately to a warning, including delivery of public safety messages, risk assessment and management, initiating counter-measures, and standardised reactions.

An integrated Standard Operating Procedure (cross-agency SOP) within Sri Lanka for generating and disseminating tsunami warnings to their relevant emergency response agencies has been significantly updated and tested in a project led by the Global Disaster Resilience Centre at the University of Huddersfield, UK. The project is being undertaken in collaboration with Disaster Management Centre, Sri Lanka; Ministry of Disaster Management, Sri Lanka; Department of Meteorology, Sri Lanka, and Asian Disaster Preparedness Centre, with the

support from Intergovernmental Oceanographic Commission of UNESCO IOTWMS. The revised SOP was tested in IOWave 2018 exercise, which was used to simulate Indian Ocean countries being put in a tsunami warning situation. Although improved, it revealed several significant challenges and shortcomings in the existing standard operating procedures and decision-making criteria in Sri Lanka. Recommendations included:

- Further development and validation of the SOPs for the issuing of public safety messages, ordering evacuations and issuing all-clear messages
- Testing of downstream SOPs, including those within key agencies
- Identifying staff training requirements to ensure that SOPs are understood and that they can be performed seamlessly and quickly during an event

### ***Standard Operating Procedures***

The foundation of effective, reliable warning systems is having the right Standard Operating Procedures (SOP). SOPs are a set of written instructions for routine/repetitive organisation activities and part of planning and emergency procedures. It consists of detailed work processes conducted/followed within an organisation and documents the way activities are performed for consistent conformance to system requirements and an organisation's mission.

All warning systems require SOPs, but for tsunami, rapid evaluation, warning and response is essential to save lives. In an end-to-end system, communication links between stakeholders must be robust or a warning chain will be broken. SOPs should be developed, practiced and modified as necessary – a “living document”. SoP will also help understanding the division of roles and responsibilities in the warning chain:

- Upstream: Detection, verification, threat evaluation, tsunami forecast, warning dissemination
- Downstream: Delivery of public safety message, initiate national counter-measures, prepare and implement standardised reaction

Coordination is essential in making sure efficient and immediate actions to ensure public safety prior, during, and after the event. A range of stakeholders are involved in tsunami early warning, including scientific, technical and disaster management agencies responsible for receipt of warnings, evaluating threats and preparing warning information. These must be supported by other key stakeholders who will help to deliver warning information to communities at risk, and initiate counter measures. These might include: Local Authorities, Emergency Services, Government Agencies, NGOs, the Private Sector (health, tourism, transport, utilities, education, fisheries etc.), the Media and the Public. When developing SOPs, stakeholders need to consider:

- What information will be given by other agencies?
- When will information be given? Will it be public safety guidance, or instructions?
- Who will disseminate it?

- How / Where – transmit /communication method will it be found?
- Who will answer questions?

### ***Objectives***

This project seeks to strengthen tsunami warning and emergency responses by:

- Understanding the division of role and responsibility in warning chain between the appointed NTWC, NDMO/LDMO and the National Stakeholders
- Revisiting SoPs for Tsunami Early Warning and Mitigation System to ensure that the roles of all agencies are clearly defined and that there is better communication amongst stakeholders
- Promoting stronger coordination, cooperation and communication between NTWC and DMO (N/L) using the latest multi-mode communication
- Synergising the SOPs across agencies, especially among NDMO/LDMO (including Media) and NTWC
- Testing the SOPs through a table top exercise to ensure readiness and identify potential improvements
- Developing or revising flow charts, criteria tables, timelines, checklists, and pre-scripted templates that can be used to convey procedures that need to be followed quickly and correctly
- Identifying any gaps in the current SoPs
- Identifying areas of further work, including to address other hazards, such as flash flooding

### ***Planned outputs***

1. Updated SoPs
2. Briefing paper on improved decision-making criteria for tsunami evacuation.
3. Presentations at UNESCO on up to date Sri Lanka Standard Operating Procedures for Tsunami Early Warning and Mitigation System at the forthcoming Intersession Meeting of the IOC UNESCO IOTWMS, to be held in Jakarta, Indonesia in September 2019
4. International Conference on Tsunami Early Warning in association with IOC UNESCO
5. Scientific papers to disseminate the findings

### ***Implementing partners***

- Global Disaster Resilience Centre, University of Huddersfield, UK (Lead)
- Disaster Management Centre, Sri Lanka

### ***Associate partners***

- Intergovernmental Oceanographic Commission of UNESCO IOTWMS

For further information:

Mr. Sunil Jayaweera, Director Planning, Disaster Management Centre, Sri Lanka.  
[jayaweera\\_s@yahoo.com](mailto:jayaweera_s@yahoo.com)

Prof Dilanthi Amaratunga, Prof Richard Haigh & Dr. Nuwan Dias, Global Disaster  
Resilience Centre, University of Huddersfield, UK, [n.dias@hud.ac.uk](mailto:n.dias@hud.ac.uk)

## Reviewing and Updating Standard Operational Procedures (SOPs) for Landslide, Flood and Cyclone

### ***The Rationale***

Major natural disasters that have occurred in Sri Lanka in the recent past are due to intense weather conditions, upper atmospheric disturbances or low pressure resulting in excessive rainfall, causing severe flooding and landslides.

Disaster Preparedness and Response Planning is one of the key areas in disaster risk management. As per the Disaster Management Act, preparedness and response plans are being prepared for Districts, Divisional Secretary Divisions, high-risk Grama Niladari divisions, Local Authorities etc. to establish an efficient and effective management system to implement the disaster response activities during a disaster situation.

An efficient and effective end-to-end warning system is needed, ready to react 24 hours a day to any potential disaster threat, alert those at-risk communities, and motivate them to take immediate and appropriate steps to save their lives.

Development of Standard Operation Procedures (SOP) is one of the important parts of early warning dissemination. There was no proper early warning system in Sri Lanka before 2004 Tsunami. Preparation of SOPs started for all hazards after 2004 Tsunami and currently, SOPs are available for most of the common hazards in Sri Lanka. However, upgrading of SOPs with the improving technologies and change in disaster patterns is vital. In addition, vertical and horizontal communication and identity upstream and downstream in the communication and dissemination process is very important.

Realizing the importance of reviewing and updating the existing SOPs for proactive early warning, Disaster Management Centre (DMC) prioritized the same as one of the key activities under the Sri Lanka Preparedness Partnership (SLPP) lead by the government sector. The SLPP has been established as the country chapter of the Asian Preparedness Partnership (APP) formed with the participation of six countries namely Pakistan, Philippines, Cambodia, Myanmar, Nepal and Sri Lanka to strengthen preparedness for emergency response through partnerships and coordination, capacity building and knowledge sharing and dissemination.

### ***Scope of the SOP development***

- Hazards – Flood, Landslide, Cyclone;
- Consider only upstream – information from the relevant technical agency up to DMC
- Institutions focused- Disaster Management Centre (DMC), National Disaster Relief Services Centre (NDRCS), National Building Research Organization (NBRO), Meteorological Department, and Irrigation Department

- documents referred- National Emergency Operation Plan (NEOP), Disaster Management (DM) Act, DM Policy, and other relevant circulars
- Phases of Disasters – Before, during and after for early warning

### ***Objectives***

Through Standard Operational Procedures it was expected to develop a decision making criteria for possible floods & landslides occur as a result of heavy rainfall and Cyclones developing in the Bay of Bengal. Standard Operation Procedures (SOPs) has been developed for the Disaster Management Centre, taking the different phases of disasters, stakeholders involved in response and responsible officers for each activity into account. The key objectives of this exercise are as follows:

- Reviewing and validated SOPs for upstream (DMC) of Flood, landslides and cyclones
- Development and testing of decision-making criteria for evacuation

### ***The Methodology adopted***

1. Initial discussions were carried out with the officers of Disaster Management Centre in order to identify their requirements, new developments in terms of human resources, physical resources and policy changes with regard to disaster early warning dissemination.
2. A two day Stakeholder workshop was held with the participation of all the technical agencies involved in landslide, cyclone and flood early warning and officials of Disaster Management Centre representing Emergency Operation Centre, Preparedness and Planning division, Human resource division and Disaster Mitigation Division to identify the gaps in existing early warning system. Technical agencies presented their early warning issuing mechanism and required time period to issue a field verified and scientifically or statistically tested disaster early warning.
3. Three district level one day workshops were held in Badulla, Batticaloa and Kilinochchi districts with the participation of relevant district level officers, divisional level officers, Grama Niladaris and the community to identify their expectations from updated SOPs. Landslide early warning system was discussed at the Badulla workshop. Flood and Cyclone early warning systems were discussed at Batticaloa and Kilinochchi district workshops respectively.
4. Developed early warning flow charts and SOPs were validated at the workshop held with the participation of technical agencies and relevant officials of Disaster Management Centre.
5. Finalized Standard Operational Procedures handed over to the Disaster Management Centre to be circulated among relevant stakeholders in landslides, floods and cyclone disaster early warning.

## Disaster Risk Index of Sri Lanka



The Sendai Framework for Disaster Risk Reduction 2015-2030, which was adopted by the Member States of the United Nations in 2015, is designed to support the reduction of existing level of risks and prevent new risks from emerging. Meanwhile The first priority for action of the Sendai Framework – understanding disaster risk – outlines a set of recommendations for ensuring that policies, measures and investments use risk information properly targeted towards reducing risk effectively. Having being understand the unavailability of risk information as a hindering factor to ensure disaster risk reduction and promoting disaster resilience which considered as a cornerstone of all long-term sustainable development Disaster Management Center Sri Lanka has taken initiatives introduce disaster index for the country .

The Risk Index analyze risk based on hazard (Flood, drought (Drinking water scarcity), landslide and Tsunami), vulnerability, capacity considering the population as element at risk using multi criteria evaluation facilities available in ArcGIS 10.7 using the Grama Niladari Division as Mapping unit.

All Grama Niladari Division have been categorized into high moderate and low levels of risk against the mentioned hazards facilitating national to local level decision makers, DRR practitioners to make risk sensitive decision making ensuring the Sendai Framework target (g) on making disaster risk information available to public. Moreover embedding disaster risk index and integrating it into the governance and daily work are key to empowering all actors in DRM arena with an improved understanding of disaster risk. The Risk Index recommends for understanding disaster risk that should be integrated with related policy and planning mechanisms available in respective sectors.



## **Special Plenary**

## Science, Policy and Practice Nexus for Risk Analytics, Early Warning Systems and Emergency Operations Centers (EOCs): Perspectives from the Asian Countries



### ***Focus Area***

Application of Risk Analytics, Early Warning Systems and EOCs for Risk Reduction through nexus among Scientific Tools, Policy Directives and Practices at local levels

### ***Session Organizers***

Disaster Management Center, Sri Lanka Preparedness Partnership, Asian Preparedness Partnership Member Countries (Nepal, Sri Lanka, Pakistan, Philippines, Cambodia and Myanmar), Asian Disaster Preparedness Center, and the University of Huddersfield, United Kingdom

### ***Background***

Emergency Operation Center (EOC) usually serves as the nerve center for the risk communication and coordination of the emergency response. The EOC serves as the hub for receiving and transmitting/ disseminating of early warnings to all concerned parties and communities at different levels, coordinate response actions, and manage resources by making informed decisions. On the other hand, Early Warning Systems (EWS) are an integral component of disaster preparedness, and it has been proven that early actions can prevent loss of life and reduce the economic and infrastructure impacts of disasters.<sup>1</sup> Risk analytics provides a shared understanding of risks for planning and coordination of required risk reduction initiatives and response capacities. Therefore, it is important that the EWS is supported by Risk Analytics about the actual and potential risks that a hazard poses, as well as the measures to be taken to prepare for and respond to its adverse impacts. The Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030 recognizes the benefits of risk assessment and multi-hazard early warning systems and highlights them in one of its seven global targets (target g): “Substantially increase the availability of and access to multi-

---

<sup>1</sup> <https://public.wmo.int/en/resources/world-meteorological-day/wmd-2018/multi-hazard> (accessed on 18.02.2020)

hazard early warning systems and disaster risk information and assessments to people by 2030”.<sup>2</sup>

In order to reduce disaster impacts on vulnerable communities, the strengthening of nexus between Risk Analytics, EWS and EOCs is important, and timely policy debate. The role of the research, policy enablers and scaling up of good practices on this arena can specifically accelerate the implementation of Sendai Framework Target G and Target E “Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020” while contributing to achieve target A, B, C, D and F. It is also important to understand how the multiple stakeholders including the government, LNGOs, the civil society organizations, the private sector and the academia have a role to play in strengthening this nexus. With this regard, the plenary session on ‘Science, Policy and Practice Nexus for Risk Analytics, Early Warning Systems and Emergency Operations Centers (EOCs): Perspectives from the Asian Countries’ is being organized and will lead to multi-sectoral interaction and overall collaboration between multiple stakeholders for promoting locally-led actions.

### ***Session Objectives***

The plenary session will bring together perspectives from different Asian countries on current practices in Risk Analytics, EWS and EOCs and their nexus and applications while keeping research, policy and good practices as enablers for accelerating the SFDRR implementation. Key objectives of the session are as follows:

- To share good practices in usage of Risk Analytics in Early Warning Systems and EOCs from South and South-East Asia;
- To discuss the role of multiple stakeholders in strengthening nexus of locally-led EWSs, EOCs and Risk Analytics; and
- To promote the linkages between research, policy and practice for strengthening the nexus between EWS, EOC and Risk Analytics.

### ***Session Plan***

*Session Type:* Plenary Discussion

Co-chairs: Major General (Retd.) Sudantha Ranasinghe; Director General (DG), Disaster Management Center (DMC), Ministry of Defense, Government of Sri Lanka

Prof. Richard Haigh, Professor in Disaster Risk Management, University of Huddersfield, United Kingdom

---

<sup>2</sup> <https://www.preventionweb.net/sendai-framework/sendai-framework-monitor/indicators> (accessed on 18.02.2020)

### ***Panelists***

- Amplifying SFDRR Implementation: Target E and G, by ADPC;
- Application of Risk Analytics in the implementation of the National Disaster Response Plan (NDRP) and EOCs, Pakistan;
- End-user based Agri-Early Warning System in Bihar State, India;
- Risk Monitoring, Business Continuity Planning and EWS in the Private Sector, Philippines;
- Community-Based Flood Preparedness and Response in Cambodia;
- Early Warning to Early Actions: Role of Subnational Disaster Governance in Nepal;
- National Emergency Operation Center and the role of Civil Society Organizations in Response, Myanmar;
- National Emergency Operation Plan (NEOP), Standard Operating Procedures (SOPs) and EWS in Sri Lanka.
- 

### ***Session Time***

2 Hours (120 Minutes)

### ***Anticipated Audience***

All the participants of the symposium representing government entities, private sector, LNGOs, academia, technical agencies, UN agencies, World Bank and international NGOs in Sri Lanka and representatives from APP member countries.

### ***Tentative Session Schedule***

<b>Time (minutes)</b>	<b>Details</b>	<b>Time- keeping</b>
<b>0 - 05</b>	Welcome and introduction to the plenary session by the Chair	05 mins
<b>05 - 15</b>	Introduction of the topics and panel members by the Co-Chair	10 mins
<b>15 - 85</b>	Panel Presentations / Speeches (10 minutes each)	70 mins
<b>85 - 110</b>	Multiple rounds of questions to the panel members by the Co-Chairs and the audience	25 mins
<b>110 - 120</b>	Summary of the session, recommendations and wrap up by the Co-Chair	10 mins

Abstracts for the special plenary session are as follows.

***Abstract – 1***

## **Application of Risk Analytics in the Implementation of the National Disaster Response Plan (NDRP) and Emergency Operation Centers**

Emergency Operation Center (EOC) usually serves as a nerve center for the central communication and coordination of emergency response actions. In Pakistan National, Provincial and district level Emergency Operation Center (EOC) are activated to ensure uninterrupted coordination and monitoring of emergency response activities. The EOCs serving as incident command system, receiving early warning and issuing alerts to the concerned, engaging media, informing ministries & departments and coordinating humanitarian response activities. The EOCs will also lead and ensure the coordination and management of relief operations in affected areas.

The National Disaster Response Plan (NDRP) is the Government of Pakistan's "Multi-hazard" response plan. The purpose of NDRP is to enhance the country's ability to manage all disasters using a comprehensive national approach. NDRP classifies different types of hazards, level of vulnerability as well as the structure, functions and coordination mechanism of Disaster management authorities at all tiers and other government and non-government stakeholders. NDRP also stipulate activation of EOCs in case of emergencies.

The dissemination of information for the purpose of early warning to all concerned and activation of response activities will largely depend on processing and analysis before the information is disseminated/shared with communities for the purpose of early warning or responders to implement the response action. Therefore, Risk Analytics is an essential component of EOC as it provides a shared understanding of risks for planning and coordination of required response. It is also crucial for the operationalization of the National Disaster Response Plan as per the category of emergencies, which will emerge from the analyzed information/ risk analytics.

## **Abstract – 2**

### **Community Based Flood Preparedness and Response in Cambodia**

Mr. Sovann Son, Programme Coordinator of NRD

*Email: sovannson@nrdo.org*

*Cambodian Humanitarian Forum (CHF)*

*North-Eastern Rural Development (NRD)*

North- Eastern Rural Development (NRD) is a local NGO based in Kratie province. The area is one of the flood-prone provinces in Cambodia situated along the Mekong river in the North-Eastern of Cambodia. As the chairman of Cambodian Humanitarian Forum (CHF), it works closely with provincial authorities and other NGOs during floods seasons on flood assessment, flood coordination meetings, emergency relief distribution, and evacuation of flood-affected people to safe areas, etc. It has also been involved in the development of a provincial contingency plan in the Sambo district of the Kratie province. It is also supporting the district authority in Chalong district to develop a flood preparedness contingency plan this year. Community based flood preparedness and response in Cambodia is important because a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Floods have caused major disasters in Cambodia. This presentation demonstrates that lessons can be taken from the previous flood disasters when developing an effective flood preparedness plan at community level. As a common practice, disaster management is based on a top-down approach or is government-centred.

This presentation attempts to highlight the significance of developing a flood preparedness plan by involving the communities affected and local authorities. Another measure for community flood preparedness is the establishment of Community Volunteer to Response (V2R) in four provinces. The forming up of the V2R is based on the need of local communities to strengthen flood preparedness capacity at community level. This activity was initiated by CHF Steering Committee as a pilot activity. Each V2R group consists of 12 villagers from 6 villages of 1 commune committee member, 1 district representative (DCDM) and 1 PCDM from one province. Each V2R in each province has received technical support from one LNGO who is a member of CHF. Almost every year, the LNGO in each province with the support from CHF and ADPC deliver the following training to them such as flood preparedness, Community flood assessment and flood response etc... The V2Rs work on flood campaigns before the flood seasons by conducting flood assessments at the community level. At present they are working in six villages in four flood-prone provinces.

### **Abstract – 3**

## **End-user based Agri-Early Warning System in Bihar State, India**

Dr G S Srinivasa Reddy

*Director*

*Karnataka State Natural Disaster Monitoring Centre*

*Major Sandeep Unnikrishnan Road, Yalahanka, Bengaluru 560064*

*Email: [dmc.kar@gmail.com](mailto:dmc.kar@gmail.com) web: [www.ksndmc.org](http://www.ksndmc.org)*

The early warning (EW) is a major component of Disaster Risk Reduction (DRR) activity. It provides advanced information on an emerging hazardous situation that enables vulnerable communities to reduce the associated risks and minimize the damage/ loss. EW based actions have the potential to save lives and reduce economic and material impact. EW is only effective and sustainable with it is actively involved in vulnerable communities. Creating awareness and engaging in capacity building initiatives with the considerations of EW is essential.

Karnataka State Natural Disaster Monitoring Center (KSNDMC), has developed an ICT enabled Disaster Early Warning System which comprises weather monitoring stations network with GPRS enabled telemetric rain gauges and telemetric weather stations. The collected data is constantly being analyzed, published into reports, and disseminated through multiple platforms.

Bihar is an agrarian state. The agricultural activity is affected by droughts or floods. With the help of KSNDMC, the Department of Agriculture in Bihar has installed a similar system known as the Meghdoot Project. It will provide customized agro-meteorological warnings to farmers. The Telemetric Weather Station Networks provides real-time data and weather forecasts through a web portal in villages. Early warning and related advisories are developed and then disseminated to farmers via SMS. The Department of Planning has been mandated to upscale the Early Warning System in the entire state. 'Bihar Mousam Seva Kendra' is an institutional mechanism that is being established to provide self-specific early warning.

The Meghdoot services will immensely help the farming community plan agricultural activities to reduce losses and increase yield. The data will also allow the government to implement a crop insurance scheme in the state.

Floods have caused inevitable major disasters around the world as well as in Malaysia. This paper demonstrates that lessons can be taken from the previous flood disasters when developing an effective flood preparedness plan. As a common practice, disaster management is based on a top-down approach or is government-centred. This article attempts to highlight the significance of developing a flood preparedness plan by involving the communities affected. Qualitative analysis was adopted in order to gain in-depth insight of the communities. Two flood-prone communities were chosen: (1) Machang, Kelantan; and (2) Kuala Lipis, Pahang. There were two important things executed by the community for the preparation: (1) community-based disaster risk management; and (2) intensive mutual assistance.

**Abstract – 4**

**National Emergency Operation Center and the Role of Civil Society Organizations in Response, Myanmar**

Ms. Thiri Maung

*Deputy Director, Emergency Operation Center, Department of Disaster Management, Nay Pyi Taw, Myanmar.*

*Email: thirimaung.rrd@gmail.com*

Myanmar is vulnerable to almost all types of natural hazards including cyclones, tropical storms, tsunamis, rainfall-induced flooding, earthquake, droughts, fire, and landslide. In accordance with the Disaster Management Law (2013), the Disaster Management Centre (DMC) will be established under the Ministry of Social Welfare, Relief and Resettlement (MSWRR) to perform the disaster management effectively and timely by monitoring and screening information relating to disasters and prompt dissemination of early warnings. The Emergency Operations Centre (EOC) was established in 2015 in order to provide prompt technical assistance, to support the decision-making, to co-operate and coordinate with the concerned departments and agencies, and to effectively manage the response and rehabilitation tasks.

Myanmar CSOs developed a contingency plan which was introduced to and updated through the technical inputs by the MSWRR to effectively respond to disasters. The plan defines the roles, responsibilities, and tasks of sector-wise CSOs and how they should be performed. The CSO contingency plan usually is activated at the outset of disasters. The CSO contingency plan group submits its plan of response to MSWRR within 24 hours of the disaster. The MSWRR usually assigns CSOs in relief and rescue works, and resettlement in collaboration with other responding agencies to the affected areas. CSO contingency plan group receives regular updates and up-to-date information on the disasters from the website of the MSWRR and the EOC and takes necessary actions.



## **Abstract – 5**

### **Early Warning to Early Actions: Role of subnational disaster governance in Nepal**

Mr. Sushil Bhandari,

*Section Officer, National Emergency Operation Center, Ministry of Home Affairs, Nepal*

Integrated early warning system bridges the gap between the science and the practices in avoiding potential damages and losses caused by disasters. Policy coherence and robust information partnership among the tiers of governments have been playing crucial role on emergency lifesaving communications in Nepal.

National policies formulated in-line with Sendai Framework has entrusted local governments with important responsibility and identified dedicated resources for disaster management in Nepal. Information collected at local level is relayed immediately to concerned authority or even at end-to-end level that leads to immediate actions. For instance, hydro-met data collected at upstream is disseminated to downstream flood plain that reduces losses significantly. Similarly, observations and predictions generate information at national level is communicated immediately to concerned local governments/authorities and reached to probably affected population in the languages/dialects through media accessible to the target population. Local governments play intermediary role in early warning messaging between information producer and end-user, localization of such messages, and ensures early actions accordingly.

However, the access to robust technology, precision in prediction, scaling up to reach the last miles, readily available safe places for evacuation remains as challenges of local governance that impede early warning to early actions in Nepal.

## **Abstract – 6**

### **Risk Monitoring, Business Continuity Planning, and EWS in the Private Sector**

Philippine Disaster Resilience Foundation

In 2018, the Philippine Disaster Resilience Foundation (PDRF) opened the world's first national emergency operations center (EOC) run by the private sector. The EOC acts as a self-sufficient operations hub geared towards training for disaster preparedness and the coordination of relief and response efforts during major disasters.

The EOC provides alerts and updates to the PDRF network and coordinates asset inventory as well as the status of lifeline services during emergency situations. Using advanced communications software and technology, the EOC monitors climate-related and natural hazards in close coordination with deployed resources in the field. Primarily, the EOC provides and coordinates warnings, disaster evacuation, asset inventory, and emergency services integration. It also complements government efforts by providing commercial and civic inputs to total disaster efforts.

The central feature of the facility is its command center that harnesses data from local and international sources to enhance PDRF's capacity to monitor earthquakes, tropical cyclones, volcanic eruptions, and pandemics. It also maps data on public infrastructure to help protect communities from hazards. The EOC has a unified platform that eliminates the waiting time and provides focused efforts that enable member companies to assess and reduce their risk prior to potential disasters. The platform also allows these companies to plan their relief and rehabilitation efforts that complement their business continuity plans and programs.

As important as the hardware and software behind the EOC, PDRF built a network of more than 85 private companies ready to mobilize resources before, during, and after disasters. These companies are organized into eight clusters: Power, Fuel, and Energy, Water and Sanitation, Information and Communications Technology, Infrastructure, Search and Rescue / Medical, Finance and Insurance, Logistics, and Food and Non-food. PDRF firmly believes that disaster preparedness not only saves lives but also cuts economic losses and damage to homes, buildings, and infrastructures.

## ***Abstract – 7***

# **National Emergency Operation Plan (NEOP), Standard Operating Procedure (SOPs) and Early Warning System (EWS) in Sri Lanka**

## **National Emergency Operations Plan (NEOP)**

The NEOP is the overarching emergency response framework for the entire emergency operation of the country which sets necessary procedures and guidelines. NEOP Establishes an operational framework for the management and coordination of emergency response from pre-disaster stage to early recovery operations. Further, the Disaster Management Act 13 of 2005 provides platform for the entire Disaster Management spectrum availing National Disaster Management Plan (NDMP) and also the NEOP. Strategic development and capacity strengthening are carried under the NDMP. NEOP is written in accordance with the “Disaster Management Policy” and “Act” in Sri Lanka.

The NEOP assigns various planning and preparedness tasks to different government Ministries, departments, agencies, Districts/ Divisional administration, boards and local Governments emergency responsibilities. The NEOP designates preparation, response and early recovery activities by each agency According to respective mandate in most effective and efficient manner. The plan also spell out the role of UN Agencies, International Humanitarian Agencies, INGOs/ NGOs as well as volunteer organization and forces during three phases of disaster.

## ***Standard Operating Procedures (SOPs)***

The NEOP connects with Institutional Disaster Management Plans for respective organizations through SOPs of NEOP to facilitate the emergency operation, coordinated by the Disaster Management Centre. The NEOP is only the overarching higher-level but tactical execution of activities is supported by the specific SOPs and guides with appropriate detail level information to execute them. It covers the full range of complex and changing requirements prior to, during, and early recovery an emergency or disaster.

SOPs integrated to activate the NEOP in its supplementary actions and Institutions emergency SOPs which are integral part of Institutional Disaster Management Plans (IDMPs). These SOPs are to be tested regularly as per unique requirements or based on contextual changes including organizational alignments.

Coordination protocol will be clearly defined through the SOPs of the NEOP for the interface, when different agencies working together towards interagency response structure which directs respective agencies for activation, coordination and synergized emergency response actions with the implementation of individual agency SOPs depicted in their IDMPs.

Three phases of NEOP operation;

- Pre-disaster stage (Emergency Preparedness, Early Warning)
- During disaster stage (Emergency Response)
- Early recovery stage (Immediate aftermath of disaster)

Varied actions are carried out in each phase by responsible agencies at National, Regional, District and Divisional levels. Pre-Disaster phase focuses the emergency preparedness actions, assessing emergency situation, early warning issuance and dissemination, evacuation process and safety centre and other logistical arrangements.

## **Abstract – 8**

### **Amplifying SFDRR Implementation: Target E and G**

#### **ADPC**

Asian Disaster Preparedness Center (ADPC) works on disaster resilience with a holistic approach which includes amplifying disaster risk reduction strategies (Target E) and early warning and risk information (Target G) of the framework. Target E sets to increase national and local disaster risk reduction strategies with the SFDRR. The target seeks to have local governments implement and adopt local disaster risk reduction strategies in line with national strategies. Target G pursues to increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessment to the people. The target includes each country having a multi-hazard monitoring and forecasting system, local government and national dissemination mechanisms providing early warning information, local governments acting on early warnings, nations having accessible, understandable, usable and relevant disaster risk information and assessment for its population, and the at-risk population being protected through pre-emptive evacuation after early warning.

ADPC has worked in collaboration with the United Nations Office for Disaster Risk Reduction (UNDRR) to create partnerships in implementing and monitoring the SFDRR through status reports of 22 countries across the region for alignment with Target E. Identifying the progress of each country on an individual level allows the advancement of a local disaster resilience framework that is comprehensive and effective in the unique context of each country. These efforts are geared towards building resilience and response capacity at a community level across each of these nations. Asian Preparedness Partnership (APP) is also enabling the development of local disaster risk reduction strategies, plans and policies in the Asian region.

ADPC is also contributing towards Target G of the SFDRR by improving the quality and use of risk information in development planning; supporting national hydro-meteorological services to build meteorological forecasting and climate change modelling capacities; development of climate risk information, tools, techniques, and systems used in risk management and climate change adaptation; training and technical support to put people-centered warning systems in place, strengthen the end-to-end dissemination of warnings, and ensure effective utilization of information by at-risk communities and responding organizations.

## **Thematic Sessions**

## Sendai Framework, WHO's Health Emergency, Disaster Risk Management & Role of Disaster Medicine for multi-hazard early warning

Session title	<b>Sendai Framework, WHO's Health Emergency, Disaster Risk Management &amp; Role of Disaster Medicine for multi-hazard early warning</b>
Organisers	Faculty of Disaster Medicine – India & Nepal, Ministry of Health and Indigenous Medical Services
Chair and Co-Chairs	Prof Virginia Murray & Dr Peter Patel, Dr. Sunil De Alwis
Background and Rationale	<p>The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at the Third United Nations World Conference on Disaster Risk Reduction held in Sendai, Japan in March 2015. This Framework for Disaster Risk Reduction was ratified within the UN General Assembly and has strong public health messages particularly on Disaster Medicine. Seven global targets were agreed to support the assessment of global progress. The proposed session will focus on providing unique opportunity for developing countries to reduce health impacts of disasters through implementation of national and regional programmes for risk reduction, resilience building of their health care systems, enhancing multi-hazard early warning systems and implementing the WHO 13<sup>th</sup> Global Work Programme (2019-2030) and its related frameworks such as the <a href="#">WHO Health Emergency and Disaster Risk Management Framework</a></p> <p>The session aims to enable discussion on and review current status in the region of the implementation of the <a href="#">WHO Health Emergency and Disaster Risk Management Framework</a> (WHO Health EDRM) that was launched in August 2019. The Health EDRM Framework states the following:</p> <ul style="list-style-type: none"> <li>• The <b>vision</b> of Health EDRM is the “highest possible standard of health and well-being for all people who are at risk of emergencies, and stronger community and country resilience, health security, universal health coverage and sustainable development”.</li> <li>• The <b>expected outcome</b> of Health EDRM is that “countries and communities have stronger capacities and systems across health and other sectors resulting in the reduction of the health risks and consequences associated with all types of emergencies and disasters”</li> <li>• Health EDRM is derived from the disciplines of risk management, emergency management, epidemic preparedness and response, and health systems strengthening.</li> <li>• It is fully consistent with and helps to align policies and actions for health security, disaster risk reduction, humanitarian action, climate change and sustainable development.</li> </ul>

- Health EDRM aims to “strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks” (SDG 3d)

The session will also Introduce the WHO Kobe Centre host the [Health emergencies and disaster risk management \(Health-EDRM\)](#). People across the world are faced with the risks associated with health emergencies and disasters. Reducing such risks and their consequences is vital to health security and resilience across communities. Research and knowledge management on Health EDRM is critical in designing policies and programs.

---

Session Objectives

**Key Objectives:**

The four main objectives of the session will be to present current status of Disaster Medicine in developing countries, review progress made in building core capacity for disaster medicine and examine support and resources needed for the implementation of the WHO Health Emergency and Disaster Risk Management Framework with the view to:

1. Enhance the **resilience of national health systems**, including by integrating disaster risk management into primary, secondary and tertiary health care, especially at the local level; **developing the capacity** of health workers in understanding disaster risk and applying and implementing disaster risk reduction approaches in health work; and promoting and enhancing the training capacities in the field of disaster medicine; and supporting and training community health groups in disaster risk reduction approaches in health programmes, in collaboration with other sectors, as well as in the implementation of the International **Health Regulations (2005)** of the World Health Organization
  2. Plan and provide support for people with **life threatening and chronic diseases, due** to their particular needs. The plans and preparedness should include in the design of policies and protocols and clinical capacity to manage their risks before, during and after disasters, including having access to life-saving services.
  3. Enhance cooperation between **health authorities** and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and the building of resilient health systems.
  4. Promote the resilience of new and existing critical infrastructure, including water, transportation and telecommunications infrastructure, **educational facilities, hospitals and other health facilities**, to ensure that they remain safe, effective and operational
-



during and after disasters in order to provide live-saving and essential services;

**The above objectives form core part of the Sendai Framework (Section 30, 31 & 33)** and it is important that this symposium enables a review of the current status and future development needs in this sector.

Discussion agenda and structure	<p>Minimum one half day(3 hrs) session.</p> <p><i>Part 1. Speakers Session</i>  Key Note Speaker: Prof Virginia Murray – 30 min  3 x 20 min Presentations on current status of Disasters, Health Emergencies, Risk Reductions &amp; Disaster Medicine</p> <p><i>Coffee Break</i></p> <p><i>Part 2. 1 hour -</i>  Open Session for the delegates to interact with speakers, invite contributions from delegates to provide their assessment of gaps and needs in this sector, case studies of health impacts of disasters in their regions and/or countries, current plans for implementation of Sendai Framework for Risk Reduction in Health Sector and how the <b>WHO Health Emergency and Disaster Risk Management Framework can be more implemented at all health sector levels.</b></p> <p><i>Interactive session to include questions and answers.</i></p> <p><i>Part 3.</i>  Chair and Speakers to provide summary of discussions and suggest next steps.</p>
Proposed list of speakers	<p>Speaker 1: Prof Virginia Murray Chair &amp; Lead Speaker (Public Health England &amp; Faculty of Disaster Medicine - India &amp; Nepal) – 30 min</p> <p><i>Title:</i> WHO Health Emergency and Disaster Risk Management Framework</p> <p>Speaker 2: Name: Additional Secretary (Medical Services) to Ministry of Health and Indigenous Medical Services, Sri Lanka Dr. Sunil De Alwis Secretary– 15 min</p> <p>Speaker 3: Dr Peter Patel Co-chair &amp; Speaker (International Director, Faculty of Disaster Medicine – India &amp; Nepal) – 20 min</p> <p><i>Title:</i> Sendai Framework and Role of Disaster Medicine for multi-hazard early warning.</p> <p>Speaker 4: Dr Hema Herath, Ministry of Health and Indigenous Medical Services, Sri Lanka - Head of operations for the COVID-19. – 20 min</p>

---

Speaker 5: Dr Tausif Thangalvadi, Faculty of Disaster Medicine  
– India & Nepal Regional Lead. – 20 min

*Title:* Hospitals and Healthcare Preparedness for disasters &  
role of early warning systems.

Speaker 6: – Dr. Chandana Siriwardana, Department of Civil  
Engineering, University of Moratuwa, Sri Lanka - 20 min

*Title:* Adapting WHO Safe Hospitals framework to Sri Lanka.

Followed by delegates

---

Expected outcomes	<ol style="list-style-type: none"><li>1. Get clear view of the current status of Sendai Framework Implementation in health sector via the WHO Health Emergency and Disaster Risk Management Framework</li><li>2. Improve multi-hazard early warning by use of the WHO Health Emergency and Disaster Risk Management Framework</li><li>3. Identification of core gaps and resource needs and</li><li>4. Make recommendations for way forward for developing and high-risk countries.</li></ol>
Post session plans	Establish a network of Countries interested in Role of Disaster Medicine in Sendai Framework Risk Reduction, share the WHO Health Emergency and Disaster Risk Management Framework and provide them learning and development opportunities to engage with the WHO Kobe Centre host the <a href="#">Health emergencies and disaster risk management (Health-EDRM)</a> support in this sector.

---

## Nature Based Solutions (NBSs) for managing disaster risks

Session Title	Nature Based Solutions (NBS) for a Resilient Future
Lead and Co-Leads	<ul style="list-style-type: none"> <li>• <b>Lead:</b> Asia Disaster Preparedness Center (ADPC)</li> <li>• <b>Co-Leads:</b> IUCN, The World Bank (WB) &amp; National Building Research Organization (NBRO), IWMI (tbc)</li> </ul>
Time of the session:	18 <sup>th</sup> February
Short Session Description	<p>Climate Change is a major threat to the global eco-system and therefore Nature Based Solutions (NBS) are currently fundamental in enhancing adaptive capacity by providing vital link between sustainable socioeconomic development with biodiversity and ecosystem conservation to achieve climate resilience. The session aims to share evidence from field and explore strategies to mainstream NBS into climate resilience narrative, policies and actions.</p>
Background to Session	<p>Climate Change is inevitable. Due to the distinct climatic variability across Asia, majority of the countries of the region are subject to climate change effects including occurrence of extreme events. Additionally, anthropogenic intervention has resulted in degradation of the natural eco-system resulting in reduced resilience to shocks and stress and some natural resources exploited beyond their regenerative capacity. The effect of these changes is likely to be worse in the least developed and developing economies in the region due to their low coping capacity and lack of awareness on the issue. Though structural measures were more prevalent to mitigate extreme events but over time policy makers and planners slowly shifted towards non-structural measures to better manage eco-systems while mitigating ill effects of climate change. Sustainable existence of the world's population depends solely on availability of resources while simultaneously striving to preserve the integrity and intrinsic value of the ecosystems. Healthy and diverse ecosystems are also more resilient to extreme events as they act as natural buffers to climate-related shocks and stresses. Thus healthy ecosystems play a key role in building climate resilience of the most vulnerable and contribute to the sustainable reduction of poverty and food insecurity. Nature based Solution (NBS) thus plays a vital role in building resilient communities, ecosystems, and economies by protecting, sustainably managing and restoring natural or modified ecosystems.</p> <p>Nature based Solutions (NBS) is a recent concept that link sustainable socioeconomic development with biodiversity and ecosystem conservation approaches as part of an overall strategy towards climate resilience, contributing to the Global frameworks and agreements e.g. the Paris Agreement, the Sendai Framework for Disaster Risk Reduction besides safeguarding human well-</p>

	<p>being in ways that enhance the resilience of ecosystems. NBs has been conceptualized and promoted by organizations like IUCN, WB, FAO and EU and is considered as the future for sustainable existence of mankind. This session aims to include NBs concepts of Climate Risk Management and Climate Adaptation Services, Ecological Restoration, Ecosystem-based Adaptation, Green Infrastructure and Ecosystem-based Disaster Risk Reduction and discuss the implementation approach, use and non-use values, in monetary terms to implement NBs complemented with scientific and case-specific knowledge of the eco-system in an adaptive decision-making process involving the relevant stakeholders. The session will feature experts across the above spectrum of NBs in both policy and practice who will showcase nature-based actions being undertaken in countries / the region, with a special emphasis on interventions in Sri Lanka, to build resilience for ecosystems, communities, and economies. The ultimate goal is to enable local communities to lead the integration of disaster risk reduction and climate change adaptation in the management of their ecosystems, through viable nature-based solutions and risk resilient natural infrastructure.</p>
Objectives	<p>Climate Resilience through Nature Based Solution (NBs) is the necessity for countries in the region as it is the most vulnerable region of the globe and transformative resilience-building actions, initiatives, policies, technologies, and financial innovations are the need of the hour. The current session aims to achieve this through the following objectives:</p> <p><i>Objective 1:</i> Sharing of evidence of effective Nature Based Solutions (e.g. Ecosystem-based Disaster Risk Reduction, Ecosystem-based Adaptation, Ecological Restoration, Climate Risk Management and Climate Adaptation Services, Green Infrastructure, etc) to address global societal challenges of climate change, disaster risk, food &amp; water security and Economic &amp; Social Development in countries in the region.</p> <p><i>Objective 2:</i> Relating evidences of NBs to policy decisions at national scale to ensure effectiveness through tools and methods to support planning, implementing as well as Monitoring &amp; Evaluation.</p> <p><i>Objective 3:</i> Strategy to scale-up and scale-out NBs by linking Science, Practice and Policy - opportunities and challenges both institutional and financial.</p>
Key messages	<ul style="list-style-type: none"> <li>• NBs are essential to meet the societal challenges arising out of ill effects of climate change.</li> <li>• Conventional solutions (structural measures) are an hindrance to better management of eco-systems while mitigating ill effects of climate change.</li> <li>• Communities as agents of change who will enable mainstreaming NBs into the climate resilience narrative, policies, and actions.</li> </ul>

Format for the Session	<p>The session will be conducted as a hybrid model of ignite talk followed by a case study snapshot and a talk show. The chair will trigger an active dialogue among the high-level guest speakers, through a semi-structured set of questions which the speakers will answer through their case study snapshots. This will be followed by more interactive session, allowing for audience participation to deepen the discussion. The chair will then synthesize the discussion to come up with some key messages based on the session objective.</p> <p>The chair will initiate the dialog by introducing the speakers and propose one or a set of question to each of the 5 expert speakers from partner organization (IUCN, WB, ADPC, NBRO, Academia) who will then present about 10 minutes each on the questions triggered by the chair to illustrate case studies or strategies or opportunities and challenges to mainstream nature-based solutions for climate resilient and sustainable development. A 30minutes audience interaction with speakers will follow as part of the talk show, followed by synthesis of the discussion by the chair (5 minutes).</p>		
Session Format and Programme	<b>Time (min)</b>	<b>Agenda item</b>	<b>Name/Lead</b>
	<b>00 – 05</b>	Welcome to participants, introduction of speakers / panelists and introduction of the session and structure of the event	ADPC
	<b>05 – 20</b>	Keynote Speech (Evidence sharing on NBs for eco-system based adaptation, eco-system based DRR - regional and national perspective)	Dr. Ananda Mallawatantri, Country Representative, IUCN, Sri Lanka
	<b>20 – 30</b>	Speaker 2 (Relating evidences of NBs for flood and landslide risk management – global and regional perspective)	Ms. Priyanka Dissanayake, Disaster Risk Management Specialist, WB Office, Sri Lanka
	<b>30 – 40</b>	Speaker 3 (Relating evidences of NBs for landslide risk management in Sri Lanka – opportunities & challenges)	NBRO
	<b>40 – 50</b>	Speaker 4 (Strategy to scale-up and scale-out of NBs: regional experience – opportunities & challenges)	IWMI
	<b>50 – 60</b>	Speaker 5 (Research and development support for	Academia

---

	promoting NBs to manage landslide risk in Sri Lanka)		
<b>60 – 85</b>	Q&A session		All
<b>85 – 90</b>	Key messages & closure of the session		Chair

---

## Discussion forum of ICG/IOTWMS Working Group 1: Tsunami Risk, Community Awareness and Preparedness

Session Title	<b>Discussion forum of ICG/IOTWMS Working Group 1: Tsunami Risk, Community Awareness and Preparedness</b>
Chair and Co-Chair	<p><i>Chair:</i> Dr. Harkunti Pertiwi Rahayu (Indonesia)</p> <p><i>Vice-Chair for Awareness and Preparedness:</i> Mr. AlYaqdhan Al-Siyabi (Oman)</p> <p><i>Vice-Chair for Hazard Assessment:</i> Dr. Gareth Davies (Australia)</p>
Short Session Description	<p>The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) was formed in response to the tragic tsunami on December 26th 2004, in which over 230,000 lives were lost around the Indian Ocean region. The Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) received a mandate from the international community to coordinate the establishment of the System during the course of several international and regional meetings, including the World Conference on Disaster Reduction (Kobe, Japan, 18 – 22 January 2005), and the Phuket Ministerial Meeting on Regional Cooperation on Tsunami Early Warning Arrangements (Phuket, Thailand, 28 and 29 January 2005). The IOC Assembly, during its twenty-third Session (21-30 June 2005), formally established the ICG/IOTWMS through Resolution IOC-XXIII-12.</p> <p>The Intergovernmental Coordination Group meets regularly to establish and implement working plans in the Indian Ocean region. To address specific technical issues it has formed three working groups and two task teams:</p> <ul style="list-style-type: none"> <li>• Working Group 1 - Tsunami Risk, Community Awareness and Preparedness</li> <li>• Working Group 2 - Tsunami Detection, Warning and Dissemination</li> <li>• Subregional Working Group for the North West Indian Ocean</li> <li>• Task Team on Tsunami Preparedness for a Near-Field Tsunami Hazard</li> <li>• Task Team on Scientific Tsunami Hazard Assessment of the Makran Subduction Zone</li> <li>• Task Team on Exercise Indian Ocean Wave 2020</li> </ul>

<p>This Symposium will host a discussion forum .</p> <p>Tentative Agenda will be as follows:</p> <ol style="list-style-type: none"> <li>1. Dr. Harkunti Rahau - brief on the WG1</li> <li>2. Localising tsunami early warning initiative - Prof. Richard Haigh</li> <li>3. Dr. Chandana Siriwardana and Mr. Charitha Ratwatte - Local tsunami early warning communications - Examples from Sri Lanka</li> <li>4. Brief on IOWave 2020 - Dr Harkuntiy Rahayu</li> <li>5. How can we work together in making Tsunami preparedness everyone's business?</li> </ol>	
Terms-of-Reference	<p>Liaise with other working group(s) and task team(s) within the ICG/IOTWMS and with working groups from the other ocean basins through the TOWS-WG to:</p> <ol style="list-style-type: none"> <li>1. Assist, develop and strengthen the overall capacity and capability of Member States in tsunami risk assessment and mitigation, community awareness and preparedness.</li> <li>2. Encourage Member States to mainstream tsunami Disaster Risk Reduction into sustainable development to help achieve resilient communities in the region.</li> <li>3. Identify areas of priority for action following assessments, exercises and real tsunami events.</li> <li>4. Provide advice on user requirements and utility of tsunami warning products and services.</li> <li>5. Provide advice to the Indian Ocean Tsunami Information Centre (IOTIC) on educational, awareness and preparedness materials.</li> <li>6. Promote collaboration among academia, research institutions and disaster management offices to encourage multidisciplinary and multi sectoral interaction in ensuring tsunami risk knowledge are streamlined to risk reduction strategies.</li> </ol>
Activities	<ol style="list-style-type: none"> <li>1. Monitor, assess and routinely report to the Steering Group and ICG on the status of Tsunami Risk Assessments, Community Awareness and Preparedness in each Member State.</li> <li>2. Seek resources and coordinate projects to build capacity in Member States.</li> <li>3. Organise workshops and symposiums for training and capability development.</li> <li>4. Contribute to the conduct of regular exercises of the IOTWMS.</li> <li>5. Encourage Member States to integrate tsunami risk assessment, community awareness and preparedness within national disaster risk reduction programmes for multi-hazards.</li> <li>6. Stimulate and share information on best-practices between Member States.</li> </ol>



	<ol style="list-style-type: none"> <li>7. Assist with development and application of guidelines on hazard, vulnerability and risk assessment and mitigation, exercises, and post-event surveys.</li> <li>8. Work with Working Group 2 "Tsunami Detection, Warning and Dissemination" to develop effective warning products, services, Standing Operating Procedures and warning chains.</li> <li>9. Under the direction of the Steering Group, assist with national assessments of the IOTWMS performance after each exercise and real tsunami event.</li> </ol> <p>The Working Group will be composed of members nominated by Member States, an invited IOTIC representative and other invited observers as required, with a chairperson and a vice-chairperson to be elected by the ICG.</p>
Members	<p>Mr. Ajay Kumar Bandela (India)</p> <p>Mr. Mahendra S. Ranganahalli (India)</p> <p>Mr. Saw Bun Liong (Malaysia)</p> <p>Mrs. Smreetee Cyparsade (Mauritius)</p> <p>Ms. Noura Al-Kaabi (Oman)</p> <p>Mr. Khalifa Al-Sundairi (Oman)</p> <p>Dr. Prasong Thammapala (Thailand)</p>
Invited Experts	<p>Prof. Dilanthi Amaratunga (Global Disaster Resilience Centre)</p> <p>Prof. Richard Haigh (Global Disaster Resilience Centre)</p>
Contact Details (Secretariat)	<p>The Secretariat for the ICG/IOTWMS is based in the IOC-UNESCO Regional Programme Office in Perth, Western Australia and is hosted by the Australian Bureau of Meteorology.</p> <p>Head of Secretariat: Dr. Srinivasa Kumar Tummala</p> <p>Secretariat Support: Ms. Nora Huia Gale</p> <p>Phone: +61 8 9226 0191</p> <p>Email: <a href="mailto:iotwms@unesco.org">iotwms@unesco.org</a></p>

## Thematic session on Sustainable design and construction to reduce disaster risk

Session Title	Thematic session on Sustainable design and construction to reduce disaster risk
Co-hosts	<p>Green Building Council of Sri Lanka</p> <p>Chamber of Construction Industry, Sri Lanka,</p> <p>Disaster Management Centre, Sri Lanka</p> <p>State Ministry of Urban Development, Sri Lanka</p> <p>Global Disaster Resilience Centre, University of Huddersfield, United Kingdom</p>
Background to Session	<p>There have been growing calls for greater engagement of the construction and property sector in disaster resilience building efforts, and a need for greater integration of disaster resilience concepts into the education of construction and property professionals.</p> <p>The vital role of property and construction in serving human endeavours means that when elements of the built environment are damaged or destroyed, the ability of society to function – economically and socially – is severely disrupted. The protective characteristics of the built environment offer an important means by which humanity can reduce the risk posed by hazards, thereby preventing a disaster. Conversely, post-disaster, the loss of critical buildings and infrastructure can greatly increase a community’s vulnerability to hazards in the future. Finally, the individual and local nature of the built environment, shaped by context, restricts our ability to apply generic solutions.</p> <p>In Sri Lanka, disaster risk is increasing due to unplanned urbanisation, outdated and poor-quality buildings and infrastructure, and the impacts of climate change. This is leaving economic assets exposed and people vulnerable to hazards such as floods, cyclones, landslides, droughts, coastal erosion and tsunamis. Sri Lanka’s flood risk profile is rising. In the Colombo Metropolitan Region, economic growth and changes in land use are exacerbating flood risk. Climate change is expected to increase the frequency and impact of hydro-meteorological hazards. Major flooding in 2010, 2011, 2014, and 2016 exemplifies a 20-year trend. According to World Bank estimates, the country’s average annual losses are \$380 million, or 3 percent of total government expenditure. Developing a more resilient built environment will help to protect Sri Lanka’s people and economic assets from such hazards. However, recent studies in Sri Lanka have revealed inadequate regulatory frameworks, unplanned urbanisation and city development, outdated building stock and infrastructure, unauthorised developments, inappropriate institutional arrangements, inadequate capacities at the local level, and a lack of skilled human resources.</p>

	<p>There is a need to rethink around how we build up practices and skills across Sri Lanka's built environment sector to meet the challenges associated with disaster risk and climate change, and to ensure economic viability for land and real estate firms while delivering on social needs and managing finite resources. This means promoting the concept of disaster resilience for the "Future of Construction".</p> <p>For example, professional bodies' future standards could start to include factors such as long-term value and common risk frameworks that might apply at a city scale, rather than at that of a single building. The construction and property sector could also play an important role in advising governments, promoting progressive investments, and sharing knowledge and technology to help cities prepare for potential risks.</p> <p>What are the opportunities and challenges that will promote or prevent such changes in Sri Lanka? This session will explore some of these issues and seek to provide a way to develop sustainable design and construction to reduce disaster risk.</p>
Objectives	<p>Objectives of the session are built around the following questions:</p> <ol style="list-style-type: none"> <li>1. What is driving the increases in disaster risk in Sri Lanka's built environment?</li> <li>2. What are the DRR strategies for resilient construction?</li> <li>3. How can we change the practices and skills across Sri Lanka's built environment sector to meet the challenges associated with disaster risk and climate change?</li> <li>4. What future actions are required to take this agenda forward?</li> </ol>
Format of the session	<p>This session will be chaired by Eng Nissanka Wijeratne, CEO the Chamber of Construction Industry. Professor Dilanthi Amaratunga will set the schene, followed by a panel discussion comprising the following distinguish speakers:</p> <ul style="list-style-type: none"> <li>• Professor Ranjith Dissanayake</li> <li>• Professor Richard Haigh</li> <li>• Professor Chitra Weddikkara</li> <li>• Harsha De Saram</li> </ul>
Expected Outcomes/outputs	<ol style="list-style-type: none"> <li>1. Understanding of the need for the construction industry to work more closely with other stakeholders and businesses to integrate disaster risk into their management practices</li> <li>2. Understanding of the need to incorporate disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, in formal and professional construction education and training</li> <li>3. Identifying how to integrate disaster risk reduction in construction practices</li> <li>4. Sharing case studies on best practices for mainstreaming DRR within construction</li> </ol>

- 
5. Exploring ways to incorporate key DRR elements within the continuous professional development (CPD) programmes that are formally recognised by key professional institutions
  6. Input to Colombo DRR 2020 declaration on mainstreaming DRR within the construction sector in Sri Lanka, including a briefing paper on practical methods of doing so.
- 

**Audience**

- Clients, consultants and contractors associated with land, property and construction professions such as Architects, Engineers, Town Planners, Quantity Surveyors, Facilities Managers
  - Government institutions with the relevant responsibility
  - Professional institutions including national and international bodies of construction
  - Local Government Leaders, Mayors, City Managers and other practitioners
  - University academics (relevant fields)
  - Other recognised professionals in the building and energy industry
- 

**Organisers**



**GREEN BUILDING COUNCIL  
OF SRI LANKA**



*University of*  
**HUDDERSFIELD**  
Inspiring global professionals



## DRR Partners' Forum - The DRR vision for 2030

Session Title	DRR Partners' Forum - The DRR vision for 2030
Background to Session	<p>Humanitarian organisations working to support disaster risk reduction (DRR) in Sri Lanka are guided by the Sendai Framework for Disaster Risk Reduction (SFDRR). The framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods, and health and the economic, physical, social, cultural and environmental assets of persons, businesses, communities, and countries over the next 15 years. The seven targets of the framework are: reducing mortality; reducing affected people; reducing economic losses; increasing countries with national and global DRR strategies; international cooperation in developing countries; the availability and access to multi-hazard early warning systems; and, disaster risk information and assessments.</p> <p>While guided by seven SFDRR targets, most of the UN/INGO and LNGO agencies consider the global key aspects of integrated risk management. These include: putting people at risk centre-stage; building on local and traditional resources and knowledge; linking humanitarian and development domains by focusing on livelihoods; addressing risk at a landscape scale; managing and restoring ecosystems; working on different time scales to ensure adaptive planning; linking local realities with global processes; integrating disciplines and approaches to encompass different risks; partnering with communities, civil society organizations (CSOs), government, knowledge institutes, private sector, and media.</p>
Partners	<p>The following partners will discuss and elaborate their organisational visions for 2030 based on the above mentioned key aspects.</p> <ul style="list-style-type: none"> <li>• UNDP</li> <li>• WFP</li> <li>• ILO</li> <li>• JICA</li> <li>• World Vision</li> <li>• Child Fund</li> <li>• Oxfam</li> <li>• ADPC</li> </ul>
Methodology	<p>The discussion will be facilitated by a moderator. After self introduction of the organisations, 2-3 discussion rounds will take place based on organisational priorities for 2030. Finally, the discussion will be opened to the audience.</p>

## **Associated Projects**



Co-funded by the  
Erasmus+ Programme  
of the European Union



## **CABARET (Capacity Building in Asia for Resilience EducaTion)**

7<sup>th</sup> International Conference on Building Resilience: Using scientific knowledge to inform policy and practice in disaster risk reduction and management, is being held in association with CABARET (Capacity Building in Asia for Resilience EducaTion).

A new project funded by the European Union aims to strengthen research and innovation capacity for the development of societal resilience to disasters. The project, called CABARET (Capacity Building in Asia for Resilience EducaTion), will provide support to build capacity for international and regional cooperation between Higher Education Institutes (HEIs) in Asia (Region 6) and Europe, and among Asian HEIs themselves, to improve multi-hazard early warning (MHEW) and increase disaster resilience among coastal communities. In doing so, CABARET focuses on a subject area and a world region not sufficiently addressed by projects already being funded under previous scheme.

CABARET will run for three years and is led by the University of Huddersfield's Global Disaster Resilience Centre, based in the UK. They are joined by a consortium of 15 European and Asian higher education institutions from Bulgaria, Indonesia, Latvia, Maldives, Malta, Myanmar, Philippines, Spain, Sri Lanka and the UK. Further the project works with 3 associate partners of Asian Disaster Preparedness Centre (ADPC), IOC/UNESCO and the Federation of the Local Governments Association in Sri Lanka.

Following the Indian Ocean tsunami of 2004, countries from within and outside the region quickly worked together to build the Indian Ocean Tsunami Warning and Mitigation System (IOTWS). There remains the significant challenge of building capacity to sustain the achievements to date and continue to enhance the systems now in place, including detection and warning systems, community awareness and preparedness. There is also a need to built capacity to broaden early warning to provide a comprehensive, multi-hazard framework.

Researchers and educators must work at the regional level, and with policy-makers and practitioners to co-design and co-produce research that can be used effectively. Higher education must also play a vital role in translating that research into action through its educational programmes. Capacity should be developed through scientific research and development of knowledge bases as well as through education and training.

Over three years, the CABARET consortium will identify research and innovative capacity needs across Asian higher education institutions in Indonesia, Maldives, Myanmar, Philippine and Sri Lanka to built capacity to broaden early warning to

provide a comprehensive, multi-hazard framework. The new UN Sendai Framework for Disaster Risk Reduction, agreed by member states in 2015, includes a strong call for higher education to support the understanding of disaster risk and promote risk-informed decisions and risk sensitive planning from the local to the global levels.

For further information on the CABARET project, contact Professor Richard Haigh ([r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk)) and Professor Dilanthi Amaratunga ([d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk)) or visit the website at [www.disaster-resilience.net/cabaret](http://www.disaster-resilience.net/cabaret).

## **Localising Tsunami Early Warning**

The process of disseminating tsunami early warning (TEW) information is complex as it involves a wide array of jurisdictional agencies and response partners, including national contact points, specialist agencies, and sub-national emergency operational centres and related actors. Limitations in preparedness and early warning have been exposed by the recent tsunami events in the Indian Ocean, which highlighted the need to build capacity to address tsunami and other coastal hazards, including multi-hazard and cascading threats, such as submarine landslides and liquefaction.

Recent studies of the Indonesia, Maldives, Myanmar and Sri Lanka have highlighted a number of specific challenges at the local level:

1. Sub-national actors have a vital role in disseminating early warning. There is a need for improved downstream Standard Operating Procedures (SOPs) to enhance institutional coordination and re-engage neglected political and representative bodies. The availability of such SOPs varies greatly among agencies and they tend to be fragmented in their approach. Poor coordination will also hinder the effectiveness of new technologies, such as 4th and 5th generation mobile technologies.
2. There is a need to strengthen awareness and knowledge at the community level, and embed early warning and evacuation in local disaster risk reduction planning. Community ownership of the early warning systems must be increased, where the community is engaged as equal partners.
3. Formal dissemination of warnings works alongside and sometimes in competition with other communication channels, including social media platforms, which may reinforce official messages, but also have the potential to undermine efforts, for example through social media's potential role as a catalyst for spreading misinformation and false news. There is a need to understand how formal and informal communication mechanisms can better co-exist to more effectively disseminate warning information.

This project seeks to address these challenges by focusing on the wider array of national and local actors that have a mandate to support effective TEW. It will also



seek to address the emerging challenge of cascading hazards that pose a tsunami risk, and the importance of linking tsunami early warning to a multi-hazard environment. The specific objectives of this project are to:

1. Map and measure the relationships and flows between downstream actors in the dissemination of tsunami early warning.
2. Understand the barriers and enablers for the next generation of TEW dissemination, including its ability to deal with emerging challenges such as cascading hazards and social media.
3. Explore the potential for synergising tsunami early warning with other hazards, to provide a multi-hazard early warning approach.
4. Further extend and test a self-assessment tool for capacity in tsunami early warning, that can be used at the national and sub-national level to determine the current state of tsunami preparedness.

***Planned activities/outputs include:***

1. Social network analysis of downstream actors in the Maldives, Myanmar and Sri Lanka that can inform more detailed and accurate standard operating procedures;
2. Expert interviews with key agencies and international experts, and a public engagement event in Maldives, Myanmar and Sri Lanka to explore the barriers and enablers for the next generation of TEW dissemination;
3. A series of expert workshops to explore synergies with other hazards, with the aim of developing a multi-hazard standard operating procedures in Sri Lanka;
4. A minimum of two SCOPUS indexed journal articles and two conference papers;
5. Briefing papers targeting key national and subnational actors for each country, and infographics;
6. A regional briefing paper and capacity building workshop for end user agencies, in cooperation with IOC-UNESCO IOTWMS Working Group 1.

***Implementing Partners***

1. Global Disaster Resilience Centre, University of Huddersfield, UK (Lead)
2. University of Yangon, Myanmar
3. Department of Meteorology, Sri Lanka
4. Disaster Management Centre, Sri Lanka
5. Asian Disaster Preparedness Centre, Thailand
6. Department of Meteorology (Maldives Meteorological Services), Maldives
7. Intergovernmental Oceanographic Commission of UNESCO IOTWMS
8. Maldivian National University, Maldives
9. Mandalay Technological University, Myanmar
10. Ministry of Disaster Management, Sri Lanka
11. University of Moratuwa, Sri Lanka

12. National Disaster Management Center (NDMC), Maldives
13. Department of Meteorology and Hydrology (DMH), Myanmar
14. Mandalay Technological University, Myanmar

***For further information:***

Prof Dilanthi Amaratunga, Prof Richard Haigh & Dr. Nuwan Dias

*Global Disaster Resilience Centre, University of Huddersfield, UK*

Email: [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk) / [r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk) / [n.dias@hud.ac.uk](mailto:n.dias@hud.ac.uk)



**For further information:**

Prof Dilanthi Amaratunga, Prof Richard Haigh & Dr. Nuwan Dias  
Global Disaster Resilience Centre, University of Huddersfield, UK  
Email: [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk) / [r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk) / [n.dias@hud.ac.uk](mailto:n.dias@hud.ac.uk)

Funded by:  **GCRF**  
Global Challenges Research Fund



## ***Outline***

REGARD (REbuilding After Displacement), is a collaborative research project co-funded by EU Erasmus+ programme. This three-year research initiative aims to develop competencies in rebuilding communities following disaster and conflict induced mass displacements from the perspective of the built environment. In achieving this aim, following objectives have been set out.

- To identify the needs of the communities following disaster and conflict induced mass displacements in the perspective of built environment
- To investigate the role of the built environment in enhancing social cohesion between host and displaced communities
- To explore the knowledge, skills and competencies required by the built environment professionals to address the needs of the host and displaced communities
- To develop, test and implement an innovative series of training courses in catering the needs of the host and displaced communities
- To develop associated curricula and resources for teachers and learners
- To introduce new uses of ICT in education by formulating technology-enhanced learning environments and materials to facilitate teaching and learning
- To propose policy recommendations to BE professional bodies in upgrading the professional competencies to address the needs of the host and displaced communities

Accordingly, this ongoing project addresses the needs of the host and displaced communities following disaster and conflict induced mass displacements and facilitate successful resettlement. In enabling this, project will address the knowledge gaps of BE professionals and help improving their competencies. The project also informs policy recommendations to BE professional bodies in upgrading the professional competencies to address the needs of the host and displaced communities. In doing so, the project is designed around 10 intellectual outputs and 4 multiplier events. Intellectual output 1 and 2 of the REGARD project is completed. Output1 investigated the needs of the communities following a disaster and conflict-induced mass displacements in the perspective of built environment. The finding of output 1 was disseminated at the stakeholder seminar which was held in Estonia on the 13th September 2019. Output 2 developed a synthesis report on the role of the built environment in enhancing social cohesion between host and displaced communities. Currently, the project approached to Output 3 which focuses on developing a guidance notes with recommendations on best practices of rebuilding host and displaced communities

following disaster and conflict-induced mass displacements from the standpoint of the built environment.

### ***Project Partners***

1. University of Huddersfield, UK (Lead)
2. University of Central Lancashire, UK
3. Tallinn University of Technology, Estonia
4. Lund University, Sweden
5. University of Colombo, Sri Lanka



TALLINNA TEHNIKAÜLIKOO  
TALLINN UNIVERSITY OF TECHNOLOGY



### ***Contact:***

*University of Huddersfield, Global Disaster resilience Centre, Research Team*

Dr. Chamindi Malalgoda - [c.malalgoda@hud.ac.uk](mailto:c.malalgoda@hud.ac.uk)

Prof. Dilanthi Amaratunga – [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk)

Prof. Richard Haigh – [r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk)

Dr. Chathurangane Jayakody - [C.Jayakody2@hud.ac.uk](mailto:C.Jayakody2@hud.ac.uk)



Co-funded by the  
Erasmus+ Programme  
of the European Union

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

## **Tsunami Early Warning Interface**

### **Governance of the upstream-downstream interface in end-to-end tsunami early warning systems**

Experience over recent years of the impacts of tsunamis has shown that inadequate preparation for, and response to, emergency situations have contributed to widespread damage and the avoidable loss of lives and livelihoods. A 2015 United Nations (UN) report estimates that each year, an additional 60,000 people and \$4 billion (US\$) in assets are exposed to the threat of tsunami hazard. As demonstrated by the human and economic losses from the 2004 Indian Ocean and 2011 Tōhoku disasters, and most recently in Palu, Indonesia, tsunamis inflict death and damage through violent, powerful flooding along the world's coastline. The shortcomings in preparation have been due to a lack of warning through poor regional detection and communication systems, but they also reflect inadequate awareness, planning and coordination.

Tsunamis can be broadly classified as local, where coastal residents feel an earthquake and have only minutes before the tsunami begins flooding, or distant, where coastal residents do not feel the earthquake and have an hour or more before tsunami flooding commences. In both types, an effective end-to-end early warning system is fundamental to mitigate losses. The decision on whether to evacuate an area is central to this system, but also fraught with difficulties. Failure to evacuate in a timely manner can leave tens of thousands of people exposed to a tsunami wave. Unnecessary evacuation and false alarms are also costly, as demonstrated by the Alaskan Earthquake in 1986, which is estimated to have cost Hawaii \$40M. A false alarm is also liable to reduce confidence in the reliability of any warnings that are issued and increase complacency among communities, thereby hindering preparedness for future tsunami threats. An end-to-end tsunami warning system begins

An end-to-end tsunami warning system begins with the upstream rapid detection of a tsunami wave, including detection, verification, threat evaluation, and forecasting. It ends with a well-prepared community that is capable of responding appropriately to a warning, including delivery of public safety messages, risk assessment and management, initiating national counter-measures, and preparing and implementing standardised reactions. Recent studies undertaken in Indonesia and Sri Lanka have identified that the interface between upstream and downstream activities is vital, as it involves a wide array of jurisdictional agencies and response partners, including regional tsunami service providers, tsunami national contact points, and a range of sub-national emergency operational centres and related actors. The problem has technical, legal and socio-cultural complexities. Several specific problems were identified, and the following will be addressed through the next phase of the research:

- Extend our previous study in Indonesia and Sri Lanka, which exposed significant differences in the legal frameworks and technical capacities of

the respective countries, to address two other Indian Ocean countries, namely Myanmar and the Maldives

- Develop a self-assessment tool on tsunami early warning at the interface between upstream and downstream activity
- Development and testing of decision-making criteria for Tsunami when the evidence is less straightforward, or the scenario is marginal

### ***Implementing partners***

1. Global Disaster Resilience Centre, University of Huddersfield, UK (Lead)
2. The Maldivian National University, Maldives
3. University of Yangon and Mandalay Technological University, Myanmar
4. Ministry of Disaster Management and Disaster Management Centre, Sri Lanka
5. Department of Meteorology, Sri Lanka
6. Asian Disaster Preparedness Centre, Thailand
7. Bandung Institute of Technology, Indonesia

### ***Associate partners***

1. Indonesian National Board for Disaster Management (BNPB)
2. Indonesian Broadcasting Commission (KPI)
3. Meteorology, Climatology, and Geophysical Agency (BMKG),
4. Indonesia National Disaster Management Center (NDMC),
5. Maldives Department of Meteorology (Maldives Meteorological Services),
6. Maldives Department of Meteorology and Hydrology (DMH),
7. Myanmar Intergovernmental Oceanographic Commission of UNESCO IOTWMS
8. Centre for Development Research and Interventions, Sri Lanka

### ***Planned outputs***

1. Briefing paper on improved decision-making criteria for tsunami evacuation.
2. Two country reports on the current status of the upstream-downstream tsunami interface, for Myanmar and Maldives.
3. Two journal papers based on near tsunami status and the tool kit.
4. Final toolkit, which will be disseminated to all 28 Indian Ocean countries as identified above [Training will be provided during the launch of the tool kit which will be held as part of the proposed impact conference].

### ***Planned activities***

1. Primary data collection, including key informant interviews and expert focus groups, in conjunction with national key actors at upstream-downstream interface in Maldives and Myanmar.
2. Validation workshops to confirm interface status, in Maldives and Myanmar.
3. Development and testing of decision-making criteria for tsunami evacuation, in conjunction with ICG-IOTWMS, the Sri Lankan Department of Meteorology & Disaster Management Centre.
4. Development of self-assessment toolkit based on analytical framework, for dissemination across 28 member states of IOTWMS.
5. Testing of Tsunami interface self-assessment toolkit in Sri Lanka, Maldives and Myanmar.
6. International Impact Conference on Governance of the upstream-downstream interface in end-to-end tsunami early warning systems in collaboration with IOC-UNESCO IOTWMS, held in Colombo, Sri Lanka
7. Advisory panel meeting with Maldives, Myanmar and Sri Lanka in-country leads, and IOC-UNESCO IOTWMS Chair of Working Group 1, Dr Harkunti Rahayu. This will ensure that the research is aligned with regional priorities and the needs of ICG-IOTWMS, who are responsible for overseeing the warning system in the Indian Ocean.

### ***For further information:***

Prof Dilanthi Amaratunga and Prof Richard Haigh

*Global Disaster Resilience Centre University of Huddersfield, UK*

Email: [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk) / [r.haigh@hud.ac.uk](mailto:r.haigh@hud.ac.uk)

## **Life Two Years After Relocation:**

### **“Status quo of Natural Hazard Induced Displacements and Resettlements in Sri Lanka”**

Having been ranked at 63 in the World Risk Report 2017 on natural hazard risk driven vulnerability, Sri Lanka is undoubtedly one of such top countries which are disaster prone. Having a look at the statistics of recent years, during the period of 1st January to 31st December 2017, a total of 135,000 people was displaced due to natural hazards (International Displacement Monitoring Center- Sri Lanka, 2017). 49,364 families and 188,328 individuals have been affected by flooding and landslides during the year of 2018. (According to the National Disaster Relief Service Centre, 2018). Given the extent of property and human damages these hazards caused, relocation has been recognised as one of the options in the aftermath. However, research studies have shown that resettlement efforts following a natural hazard are often uncoordinated, inefficiently managed, poorly planned, and inadequately financed turning these projects into “Development Disasters”. Therefore, an evaluation of existing post-disaster resettlement strategies is a timely requirement which will enable the identification and implementation of a much more effective and efficient resettlement mechanism.\

In Sri Lanka, Kegalle can be identified as a key disaster prone area, which hasn't been adequately researched on disaster induced displacement and resettlement despite been affected on frequent basis. One such incident is the Aranayake-Samarakanda land slide occurred in 2016 resulting in displacement, deaths and various other socio-economic impact on the victims. The present study revolves around the relocation resettlement in Kegalle which was initiated post the said land slide in 2016.

#### ***Aim of the proposed research***

To understand the impact of the disaster induced relocation on the affected people in the Kegalle district, post Aranayake Landslide in 2016.

#### ***Associated objectives***

- To investigate the social and economic impacts of the disaster induced relocation
- To understand the impact of the institutional framework on the project
- To understand the overall attitude towards the project by the residents (e.g. on issues such as physical layout of the) building on the residents



### ***Planned outputs***

1. Two scientific, peer reviewed research papers
2. Detailed state of the art report to be submitted to the National Building Research Organisation
3. Briefing paper highlighting the key findings

### ***Project Team***

1. University of Huddersfield, UK  
Prof. Dilanthi Amaratunga [d.amaratunga@hud.ac.uk](mailto:d.amaratunga@hud.ac.uk)  
Prof. Richard Haigh [r.haigh@hud.ac.lk](mailto:r.haigh@hud.ac.lk)
2. University of Colombo, Sri Lanka  
Dr. Nishara Fernando [nishara.fernando@gmail.com](mailto:nishara.fernando@gmail.com)
3. National Building Research Organization  
Mr. Kishan Sugathapala [kishans@live.com](mailto:kishans@live.com)

*University of*  
**HUDDERSFIELD**



## **Technological Applications Associated with Multi Hazard Early Warnings (MHEWs)**

### ***Introduction***

Multi-Hazard Early Warnings (MHEWs) emerged as a foremost component in Disaster Risk Reduction (DRR) mechanism. The Sendai Framework for DRR (2015-2030) highlights the prominence of MHEWs by indicating it in one of its seven targets. Under this mechanism, the accurate and timely flow of information is vital so as to function the proper systematic behavior of MHEWs. Technological applications can be vividly incorporated along with the components in MHEW mechanism to upgrade the level of effectiveness. However, the applicability of such mechanisms for MHEWS seems to have inadequately utilized in many of the countries in the world.

Sri Lanka is a country, which is subjected to crucial natural hazards each year. Therefore, there is a huge potential for applying technology in MHEWs. On the other hand, Sri Lanka has the necessary technical capacity and skills to facilitate this. However, there are huge gaps and barriers of the proper application of such mechanisms such as lack of proper authorization for undertaking the ownership of the warning alerts, lack of proper collaboration among the interlinked stakeholders and the delays in issuing the Early Warning message by the issuing agencies. Further, the lack of faith towards the Early Warning alerts issued by the authorities was identified through a research study undertaken by the University of Moratuwa and University of Peradeniya.

Under this research study, the key focus is directed towards the identification of the barriers and gaps in the existing mechanism of Sri Lanka.

In order to focus on the research objectives, Disaster and Emergency Warning Network (DEWN) mobile application which was developed by Dialog Axiata PLC, Dialog-University of Moratuwa Mobile Communications Research Laboratory and Micro-image is undertaken as a case study.

To identify the status, gaps and barriers in the existing system of MHEWs, a Questionnaire survey will be conducted with the collaboration of Dialog Axiata PLC. The survey sample information will be identified from the Grama Niladari Divisions based on the areas in Sri Lanka where the hazard levels are higher in terms of Floods, Landslides and Tsunami. The collected data from the survey will be analyzed further to deliberate the final outputs of the research study. Further, these outcomes will be used to develop the current status of the DEWN mobile application and extension of the app for the emergency disaster alert warning situations.

### ***Key Objectives***

- To identify the current status, gaps and barriers in the existing Technological applications associated with MHEWs
- To develop strategies to bridge the existing gaps in the mechanism
- To identify the potential areas of expansion associated with MHEWs

### ***Project Deliverables***

- Briefing paper highlighting the key findings
- Scientific, peer-reviewed research paper
- Detailed report to be submitted to relevant agencies including Dialog Axiata PLC

### ***Project Team***



## **A study of the upstream-downstream interface in end-to-end tsunami early warning and mitigation systems**

### ***Investigators***

1. Professor Dilanthi Amartunga, University of Huddersfield, UK
2. Professor Richard Haigh, University of Huddersfield, UK
3. Dr Harkunti Rahayu, Bandung Institute of Technology, Indonesia
4. Professor Siri Hettige, University of Colombo, Sri Lanka

### ***Consortium***

1. University of Huddersfield, UK
2. Bandung Institute of Technology, Indonesia
3. University of Colombo, Sri Lanka
4. IOC – UNESCO ICG/IOTWMS
5. National Disaster Management Agency (BNPB)
6. Meteorology, Climatology and Geophysical Agency (BMKG)
7. The Federation of Sri Lankan Local Government Authorities (FSLGA)
8. Disaster Management Centre, Sri Lanka
9. Ministry of Disaster Management, Sri Lanka
10. Department of Meteorology, Sri Lanka
11. Asian Disaster Preparedness Centre (ADPC), Thailand

### ***Background to the problem***

This collaborative research project involves a detailed study of the technical, legal and socio-cultural complexities involved in communicating the rapid detection of a tsunami wave to jurisdictional agencies and response partners. These actors can ensure a well prepared community that is capable of responding appropriately to a tsunami warning. For all the progress and improvement at the detection end of the tsunami early warning system that has been developed since 2004, the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the coordinating body for the Indian Ocean warning system, has recognised that much remains to be done to ensure dissemination of effective warnings and improve the preparedness of communities to respond to such warnings.

Recent studies and practical experiences from the Indian Ocean region suggest that more attention needs to be paid to the cognitive and normative challenges in positioning the tsunami early warning systems and preparedness in the wider context of social change in the coastal societies and communities at risk, and for critical reflection of 'on-the-ground' experiences and lessons learnt. Although the ICG of IOTWMS has been largely successful in promoting regional cooperation to develop the technical hazard detection infrastructure, progress at the national and sub-national level has been far more variable. A review of national reports,

recent earthquake and tsunami threat responses, and practice evacuation exercises suggests uneven progress across the region, with some high-risk, low-capacity countries falling behind.

The interface between upstream and downstream activities is vital, as it involves a wide array of jurisdictional agencies and response partners, including RTSPs, tsunami national contact points, and a range of sub-national emergency operational centres and related actors. The problem has technical, legal and socio-cultural complexities. There is a lack of understanding into the approaches of different countries, or their effectiveness. This project seeks to provide a much clearer insight into what is happening at the national and sub-national levels, and the options available to member states if they wish to improve their standard operating procedures.

### ***Research to solve the problem***

This study will focus on the interface between upstream detection of the earthquake and tsunami threat, to the downstream response, including potential evacuation of the exposed communities. This interface involves a wide array of jurisdictional agencies and response partners, including regional tsunami service providers, tsunami national contact points, and a range of sub-national emergency operational centres and related actors. Although the detection infrastructure and warnings are shared between countries, protocols and standard operating procedures for processing and issuing warnings vary greatly at the national and sub-national levels. This is due to the wide variation of technical capacities, legal frameworks, and socio-cultural factors across the 28 states that surround the Indian Ocean. The planned activity will involve an initial detailed study and comparison of two member states, Indonesia and Sri Lanka.

### ***Activities of the project***

- Develop an inter-disciplinary analytical framework and survey instruments that encompass the technical, legal and socio-cultural challenges faced at the critical interface between upstream and downstream activities of the IOTWMS. This will be achieved through a series of expert focus groups that draw upon different academic disciplines and actors involved in IOTWMS. The analytical framework and instruments will be used in subsequent field studies.
- Undertake two field studies in coastal regions of Indonesia and Sri Lanka, focusing on the interface of end-to-end warning system at the national and sub-national level. The studies will specifically focus on the decision-making processes that determine whether to evacuate.
- Prepare a briefing paper for presentation at the next meeting of the ICG for the IOTWMS, laying the groundwork for informing future policy development within IOTWMS. This will provide an important basis for

significant impact, with a potential for reach across the Indian Ocean states.

- A minimum of two public engagement activities that will seek to engage communities in the data collection and to raise awareness on tsunami preparedness within high risk communities.
- A capacity building event with representatives of the 28 member states of the IOTWMS, to be held alongside an ICG IOTWMS event in Hyderabad, India during mid-2018.
- Develop a proposal to extend the study across 28 member states of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

### ***Benefits we hope to achieve***

The proposed activities directly address some of the challenges set out by the United Nations Economic and Social Commission for Asia and the Pacific, which stresses the importance of a regional approach and a need to compare and share national practices. There is a lack of understanding on how jurisdictional agencies and response partners for the IOTWMS, including their practices, vary across member states at the national and sub-national levels. It also directly addresses the needs and requirements of the following global frameworks:

- Sustainable Development Goals(SDG): addresses the challenges of economic development and well-being faced by countries in the DAC List of ODA recipients. It also addresses the need to keep cities safe and resilient (SDG 11), and develop global partnerships for sustainable development (SDG 17).
- Sendai Framework for Disaster Risk Reduction (SFDRR): one of the seven priorities is the availability of early warning systems.

## National Level Art Competition

To improve the knowledge and skills of the students regarding Disaster Risk Management



The poster features a yellow and orange watercolor background. At the top, the year '2020' is written in black. Below it, the title 'විදු නිජ්වණ් තර්ගාවලිය' is written in large, stylized red letters. Underneath the title, 'வரைதல் போட்டி Drawing Competition' is written in black. The central text in Sinhala reads: 'ආපදා අවදානම් කළමනාකරණය පිළිබඳ පාසල් සිසුන්ගේ දැනුම සහ කුසලතා වර්ධනය කිරීම උදෙසා පවත්වන දීප ව්‍යාප්තවිභූ නිර්මාණ තරගාවලිය 2020'. Below this, in Tamil, it says: 'මෙම චිත්‍ර තරගය පිළිබඳ වැඩිදුර විස්තර සහ අයදුම්පත www.dmc.gov.lk යන වෙබ් අඩවිය තුළින් ලබාගත හැක.' Further down, another Tamil line reads: 'அனர்த்த முகாமைத்துவம் தொடர்பில் பாடசாலை மாணவர்களின் அறிவு மற்றும் திறன்களை மேம்படுத்தலுக்கான வரைதல் போட்டி 2020'. Below that, in English, it states: 'National Level Drawing Competition to improve the knowledge and skills of the students regarding Disaster Risk Management 2020'. At the bottom, it says: 'Further details regarding the drawings and application form may be obtained from the www.dmc.gov.lk website.' On the left side, there is a cartoon illustration of a young girl with brown hair, wearing a green shirt and a white apron, holding a paintbrush and a palette. The bottom right corner has the text 'DMC / AWARENESS / MEDIA / 2020 ®'.

2020

විදු නිජ්වණ් තර්ගාවලිය

வரைதல் போட்டி Drawing Competition

ආපදා අවදානම් කළමනාකරණය පිළිබඳ පාසල් සිසුන්ගේ දැනුම සහ කුසලතා වර්ධනය කිරීම උදෙසා පවත්වන දීප ව්‍යාප්තවිභූ නිර්මාණ තරගාවලිය 2020

මෙම චිත්‍ර තරගය පිළිබඳ වැඩිදුර විස්තර සහ අයදුම්පත [www.dmc.gov.lk](http://www.dmc.gov.lk) යන වෙබ් අඩවිය තුළින් ලබාගත හැක.

அனர்த்த முகாமைத்துவம் தொடர்பில் பாடசாலை மாணவர்களின் அறிவு மற்றும் திறன்களை மேம்படுத்தலுக்கான வரைதல் போட்டி 2020

போட்டியின் மேலதிக விபரங்களை [www.dmc.gov.lk](http://www.dmc.gov.lk) என்ற இணையத்தளத்தில் இருந்து பெற்றுக்கொள்ளமுடியும்

**National Level Drawing Competition to improve the knowledge and skills of the students regarding Disaster Risk Management 2020**

Further details regarding the drawings and application form may be obtained from the [www.dmc.gov.lk](http://www.dmc.gov.lk) website.

DMC / AWARENESS / MEDIA / 2020 ®

The frequency, scale and distribution of disasters in recent years demonstrates that disasters are a global problem, threatening to disrupt communities in developed, newly industrialized and developing countries. Between 2002 and 2011 there were 4,130 disasters. Over 1.1 million people perished and a minimum of US\$1,195 billion was recorded in losses. In the year 2011 alone, 302 disasters claimed 30,000 lives, affected over 200 million people and inflicted damages worth an estimated US\$366 billion.

Ominously, global demographic trends suggest that more people are living in areas vulnerable to sudden-onset natural disasters. This is happening even as scientists predict that the frequency and intensity of these disasters are likely to increase as a result of the effects of climate change. More people and assets are located in areas of high risk.

For example, the proportion of world population living in flood-prone river basins has increased by 114%, while those living on cyclone-exposed coastlines have grown by 192% over the past 30 years. Over half of the world's large cities, with populations ranging from 2 to 15 million, are currently located in areas highly vulnerable to seismic activity. Rapid urbanization will further increase exposure to disaster risk.

These trends, coupled with recent high-profile disasters like Haiyan, or Yolanda, as the Philippines named the typhoon, are raising global awareness of the need to build the capacity of national governments, civil society organizations and international actors to prevent, respond to and recover from natural disasters.

Despite these escalating losses, more than 95% of humanitarian finance is still spent on responding to disasters and their aftermath, with less than 5% spent on reducing the risk of disasters. Without a major increase in investment to reduce current and future risks, spending on relief and reconstruction is likely to become unsustainable.

The challenge for humanity is to ensure that risk management is prioritized in policy frameworks and fully integrated in practice to help save lives, protect livelihoods and reduce economic losses. But what will happen if we fail to tackle disaster risk? What is the future for humanity?

To address this, as part of the International Symposium on Multi Hazard and Disaster Risk Reduction, in supporting the implementation of Sendai Framework for Disaster Risk Reduction 2015-2030, to be held from 16<sup>th</sup> – 18<sup>th</sup> March 2020, at Cinnamon Grand, Colombo, Sri Lanka, organised by the Disaster Management Centre, Global Disaster Resilience Centre, at the University of Huddersfield, UK along with several key stakeholders, a National Level Drawing Competition aiming at improving the knowledge and skills of the students regarding Disaster Risk Management will be held.

Disaster Management Centre, Sri Lanka, with guidance from the Ministry of Education and other stakeholders, is organising this Island-wide art competition to improve the knowledge and understanding of the School Children. The



competition will raise awareness and understanding about disasters, their origins, and what can be done to reduce their impacts . This contest also aims to generate awareness and a culture of resilience within children's and young people's minds. With the Art Contest, the voice and perspective of children and young people on their relation with disasters will be an invaluable contribution to discussions and efforts at local, national and international levels for making schools safer and more resilient.

The competition will be held in Sinhala, Tamil and English languages.

Themes associated with the Drawing Competition are as follows:

- Human activities leading to disasters
- Actions to be taken for the prevention of disasters
- Experiences at times of a disaster
- Minimising disaster risks for a safe community

Categories associated with the Art competition are as follows:

Caregory No	Category
1	Gades 6-7
2	Grades 8-9
3	Grades 10-11
4	Grade 12 -13

Evaluation of drawings will take place based at District level, Provincial level and Country /National level. 100 creations will be selected at the national level and the respected arises will be tasked to do their entry with the presence of the Board of /examiners, based on which the overall winners of each category will be selected.

Each category winner will receive their certificates and cash prizes at the opening ceremony of the International Symposium on Multi Hazard and Disaster Risk Reduction, to be held on the 16<sup>th</sup> March 2020.

Winning entries will also be showcased at various international events.

## **International Symposium Publications**

Authors whose abstracts are accepted for the symposium will have the option to submit a revised version of their abstract and to submit the corresponding full paper. Please note that the submission of a paper is NOT mandatory; it is only for the authors who will be invited to do so.

The submission period will be opened after the abstract closure date and the deadline for the submission of the full paper will be announced later. You need to submit your paper formatted according to the Full Paper Template. Please keep in mind that only high-quality submissions will be considered for the publication opportunities linked to the symposium.

Following are some of the options:

- Special issue of the international journal of disaster resilience in the built environment. Journal edited by Professor Dilanthi Amaratunga and Professor Richard Haigh (Published by Emerald publishing)
- A book volume with Springer publishers:  
*Book title* : Multi - Hazard Early Warning and Disaster Risk.  
*Editors for the book volume*: Professor Dilanthi Amaratunga, Professor Richard Haigh & Dr. Nuwan Dias.
- Input towards one of the four policy briefs - To be prepared as per the four Sendai priorities in summarising the key strategies in bringing science and policy together in positively making a change by implementing the Sendai Framework for disaster risk reduction 2015-2030.

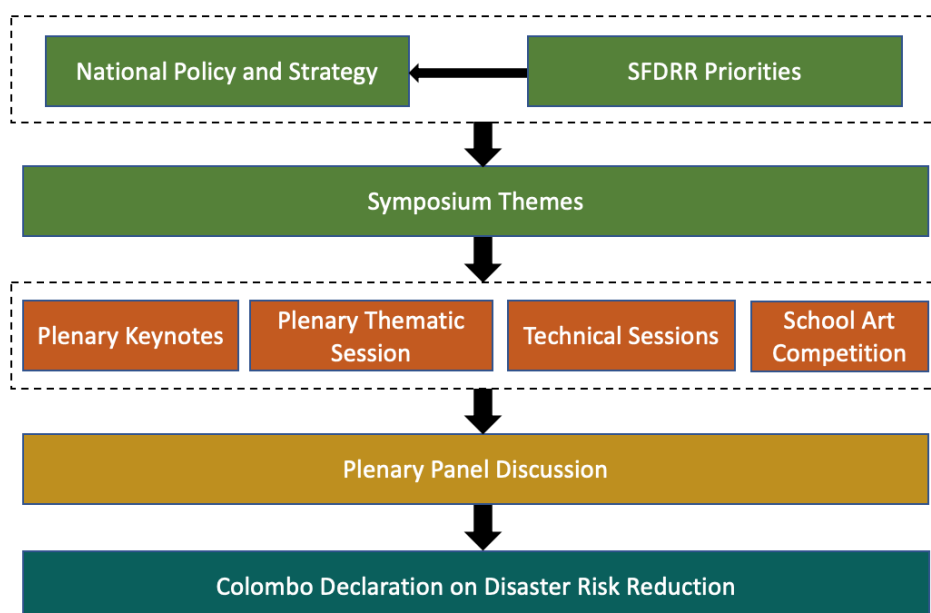
# **Colombo 2020 DRR Declaration**

## **“The Colombo Declaration” to promote the availability and application of research, science and technology on DRR to support implementation of Sendai Framework for Disaster Risk Reduction 2015-2030**

To be adopted at the International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction, 16th - 18th March 2020, Cinnamon Grand, Colombo, Sri Lanka

This Symposium is not just intended as an opportunity to discuss important challenges, or to share potential solutions that tackle the impacts of climate change and growth in disaster risk, both within Sri Lanka and elsewhere.

This event provides an important opportunity to bring together and promote collective action among Ministers, National Government Officials, the Private Sector, Representatives from Cities and Local Government, Representatives from Non-Governmental Organisations, International agencies, Universities and other Research Organisations.



The Symposium is structured to bring together the outputs and outcomes from keynote addresses, technical papers and presentations, and thematic events, and culminate in the endorsement of a roadmap for disaster risk reduction in Sri Lanka. This roadmap will set out national priorities and potential timescales for their adoption, as well as a declaration among key stakeholders to act upon those priorities. The roadmap will be setup to inform national policies and strategies in Sri Lanka.

The roadmap will attempt to address the following Symposium themes:

### ***Climate Change & Early Warning***

- Early warning in a changing climate
- Institutionalizing and sustaining early warning systems – technical, human and operational capacity, and localization
- Measuring early warning effectiveness and ongoing evaluation
- Multi – Hazard Early Warning (MHEW) Systems, including exploring the potential for synergizing tsunami early warning with other hazards

### ***Disaster Preparedness***

- Using GIS technology for disaster preparedness and early warning
- Local ownership, enhancing response capacity and community awareness
- Simulation exercises, drills and standard operating Procedures (SOPs)
- Disaster emergency food and sanitation

### ***Sendai Framework for Disaster Risk Reduction 2015-2030 / Sustainable Development Goals***

- Risk based / informed early warning and global agendas Sendai and SDGs

### ***Risk Transfer / Insurance***

- Risk transferring and forecast based financing for DRR
- Nature Based Solutions (NBSs) for managing disaster risks

### ***Innovation for Better Early Warning***

- The first mile – Hazard monitoring; forecasting and warning; new, innovative tools / products for strengthening EWSs

### ***Communications for Better EW***

- Early warning interface – legal and institutional framework, clearly defined actors, governance and institutional arrangements, vertical and horizontal coordination
- Reaching the last mile – Bringing the message to communities at risk – Technical, legal and socio – cultural complexities involved in communicating coastal based hazard early warning to communities
- Next generation of TEW dissemination
- Formal and informal communication mechanisms in early warning

### ***Disaster Risk Reduction***

- Transboundary disaster risk governance
- Displacement and relocation
- Disaster resilient urban planning and development

# **Book of Abstracts**

## **Introduction**

This section contains all abstracts being published and presented at the Symposium.

Experience over recent years of the impacts of tsunamis, cyclones, flooding and other major natural hazards has shown that inadequate preparation for, and response to, emergency situations have contributed to widespread damage and the avoidable loss of lives and livelihoods.

There are increasing calls for strengthened risk assessment and mitigation, community awareness and preparedness, and multi-hazard early warning systems at all levels. As emphasised by the Sendai Framework for Disaster Risk Reduction (SFDRR 2015-2030), this requires an integrated and holistic approach to early warning for multiple hazards, and for risks tailored to user needs across sectors and community awareness. Together these will help to mainstream disaster risk reduction and to support efforts towards the Sustainable Development Goals by 2030.

Authors were invited to submit abstracts that address the Symposium themes:

### ***Climate Change & Early Warning***

1. Early warning in a changing climate
2. Institutionalizing and sustaining early warning systems – technical, human and operational capacity, and localization
3. Measuring early warning effectiveness and ongoing evaluation
4. Multi – Hazard Early Warning (MHEW) Systems, including exploring the potential for synergizing tsunami early warning with other hazards

### ***Disaster Preparedness***

1. Using GIS technology for disaster preparedness and early warning
2. Local ownership, enhancing response capacity and community awareness
3. Simulation exercises, drills and standard operating Procedures (SOPs)
4. Disaster emergency food and sanitation

### ***Sendai Framework for Disaster Risk Reduction 2015-2030 / Sustainable Development Goals***

1. Risk based / informed early warning and global agendas Sendai and SDGs

### ***Risk Transfer / Insurance***

1. Risk transferring and forecast based financing for DRR
2. Nature Based Solutions (NBSs) for managing disaster risks

### ***Innovation for Better Early Warning***

1. The first mile – Hazard monitoring; forecasting and warning; new, innovative tools / products for strengthening EWSs

### ***Communications for Better EW***

1. Early warning interface – legal and institutional framework, clearly defined actors, governance and institutional arrangements, vertical and horizontal coordination
2. Reaching the last mile – Bringing the message to communities at risk – Technical, legal and socio – cultural complexities involved in communicating coastal based hazard early warning to communities
3. Next generation of TEW dissemination
4. Formal and informal communication mechanisms in early warning

### ***Disaster Risk Reduction***

1. Transboundary disaster risk governance
2. Displacement and relocation
3. Disaster resilient urban planning and development

Abstracts were expected to address the approach, results, concepts, and applicability of the study. In addition to welcoming the more traditional peer reviewed research paper, we also invited the submission of abstracts for policy and practice notes. All abstracts have been double blind refereed for quality, originality and relevance by the Scientific Committee.

This book includes over 145 abstracts by scholars, policy makers and practitioners around the world. A paper ID number (e.g., ID: 101) is identified under each abstract. This ID number was assigned at the start of the abstract submission process. Papers are listed sequentially according to their ID number. The detailed conference programme, which details the timing of paper presentations, identifies the associated abstract ID number and can be used to locate the abstract being presented. An index of authors is provided towards the end of this book.

Authors of selected abstracts have been invited to prepare full papers that will be published in the International Journal of Disaster Resilience in the Built Environment or a Springer Nature book entitled Multi-Hazard Early Warning and Disaster Risk Reduction.



## Plant Selection Criteria for Nature-Based Landslide Risk Management

Ganepola C.\*<sup>a</sup>, Karunarathna A.<sup>b</sup>, Dayarathna N.<sup>c</sup>, Kankanamge L.<sup>c</sup>, Perera D.<sup>c</sup>, Nawagamuwa U.<sup>d</sup>, Basnayaka S.<sup>a</sup>, Arambepola S.<sup>a</sup>

<sup>a</sup> Asian Disaster Preparedness Center, Thailand

<sup>b</sup> University of Peradeniya, Sri Lanka

<sup>c</sup> National Building Research Organization, Sri Lanka

<sup>d</sup> University of Moratuwa, Sri Lanka

\*chinthaka.ganepola@adpc.net

Nature-based landslide risk management (NBLRM) involves use of plants in mitigating slope instabilities. These interventions provide sustainable and cost-effective approaches for landslide disaster risk reduction. However, in Sri Lanka, a guiding framework in selecting plant species for landslide prone sites did not appear to be available. Effectiveness of plants for nature-based landslide risk management mainly depends on the root architecture and its mechanical properties. Ecological and socio-economic significance of plants species also play a major role in selection of plants, especially when the nature-based solutions are to be applied in disturbed landscape. After conducting a systematic literature review, five key factors were identified. Namely; Plant type and structural characteristics, Hydrological significance, Root strength characteristics, Ecological significance and Economic value. Performance of each species under respective factor were assigned a score, based on a scale of 4 depending on their suitability for stabilizing soil on slopes. A cumulative index greater than 2 and the compatibility with the eco-climatic region were considered when selecting plant species for landslide prone sites. The proposed plant selection criteria was used as a tool to rank 33 candidate plants collected from landslide prone areas in determining suitable species for NBLRM in Sri Lanka.

**Key words:** landslide, nature-based, plant, selection

Abstract ID: 001

## Study on Factors Influence Motivation to Engage in Disaster Preparedness: Case of Walapane Divisional Secretariat Division, Nuwara Eliya District, Sri Lanka

Prasanna L.J.\*<sup>a</sup>, Fernando P.R.N.<sup>b</sup>

<sup>a</sup> *National Building Research Organisation, Colombo, Sri Lanka*

<sup>b</sup> *University of Colombo, Sri Lanka*

\*judep1985@gmail.com

Landslides become the most calamitous event which severely affected the physical and cultural landscapes of uplands in Sri Lanka. Of the 65,000 Sq.km of land extent of Sri Lanka, an area of nearly 20,000 Sq.km encompassing 10 districts is prone to landslides. Being prepared for disaster is the most effective way to minimize the damage suffered by the affected population. Therefore, community preparedness in landslide prone areas is essential to minimise the landslide risk. Spatial distribution of buildings expose to landslide hazard are being identified through 1:10,000 scale landslide hazard zonation maps developed for the Grama Niladari Divisions in Sri Lanka. House-by-house questionnaire survey was carried out among 8463 housing units locate within very high and high landslide hazard prone areas of Walapane Divisional Secretariat Division of Nuwara Eliya District. Quantitative analysis of the data collected on housing units revealed; 10.5% of houses affected by disaster, 34% of residence believe their house/land is susceptible for disaster, 34% of houses record of tell-tale landslide signs at the vicinity of houses, only 6.7% of residents took precautionary measures against landslide during last three years, 54% of residents aware of availability of village disaster management committee. These findings indicate disaster preparedness status of the community is low and the necessity to motivate preparedness attitude of the community. Therefore, through literature review this paper attempt to (1) assess the factors influence motivation to engage in disaster preparedness (2) develop a conceptual framework to motivate preparedness attitude of the community.

**Key words:** Landslide, preparedness, community, motivation, factors

Abstract ID: 002

## Impact of Tsunami on Heterogeneous Economic Sectors: The Case of Sri Lanka

Weerasekara S.H.\*<sup>a</sup>, Wilson C., Hoang V., Lee B.

<sup>a</sup> *Queensland University of Technology, Australia*

\*sajeevani.weerasekara@hdr.qut.edu.au

Although natural disasters can bring enormous destructions to a country's economy, there remains an unsettled debate on whether disasters bring similarly large negative impacts throughout heterogeneous sectors of an economy. The literature indicates that the economic response differs according to the magnitude of a disaster although such findings are inconclusive when other variables such as the scope, scale, type of disaster, the type of economy, etc are taken in to account. On the one hand natural disasters –such as a tsunami- may destroy a large amount of human and physical capital as well as R &D facilities and therefore have a negative impact on an economy's growth rate. On the other hand such disasters may have a positive effect through rebuilding with superior more advanced technology. The 2004 tsunami brought extensive destruction to South East Asian economies and represented, historically, Sri Lanka's largest natural disaster. In this paper, we explore whether the 2004 tsunami produced, in all the three sectors of Sri Lanka's economy - agriculture, industry and services – a similar negative impact in both short and long run. To this end we assembled a panel data set of GDP and tsunami impacts for different tsunami affected provinces in Sri Lanka. We employ panel fixed effect, difference-in difference (DID) and panel vector auto regression (exogenous) (PVARX) estimation methods to identify the effects of the tsunami 2004 on the different economic sectors in the long and short terms. While DID helps to identify the effects of the tsunami on different provinces during three years after the event, PVARX model takes account of the direct impact of the disaster event and feedback mechanisms. The results suggest that the response on each economic sector differs widely. Although the impact is highly negative on all three economic sectors in the first year following the tsunami, the impact on the agricultural sector is comparatively greater and the recovery process is longer than other sectors. Moreover, the results suggest that industry and services sectors have experienced positive impact in the long term indicating the increase in demand for reconstruction and “building back better” infrastructure after disasters as well as considerable aid and grants being received for advancement of the industrial and services sectors.

**Key words:** Agriculture, Disasters, Economic Impact, GDP, Tsunami

Abstract ID: 003

## **Analysis of the Effectiveness of Early Warning System to Face Future Tsunamis in Sri Lanka by Comparing with Japanese Early Warning System**

Jayarathne J.M.A.R.\*<sup>a</sup>, Kodama M.<sup>b</sup>, Yumi S.<sup>b</sup>

<sup>a</sup> *Disaster Management Center, Ministry of Disaster Management, Sri Lanka*

<sup>b</sup> *ADRC, Japan*

Tsunami preparedness is vital important to both Japan and Sri Lanka due to tsunami risk. There is no equal opportunities such as physical, economical, technological and social factors in both countries. The Japan is a developed country thus they expected to have complete Early Warning and communication system than developing Sri Lanka. The present Early Warning System has designed for communicate from national to local levels in Sri Lanka. Research has conducted in both countries and data and information collected by questionnaire survey method in the various group of people and stake holders. Data are analysed by ranking method. Japan has to be developed a traffic plan and it should be integrated with the early warning system, evacuation messages should pass to the communities as soon as possible due to limited time for tsunamis thus improving conventional communication system to response even during the night time. Sri Lanka has to practise tsunami drill in the night time, integrate with local technologies which can be sustained and mechanism for conformed the dissemination and reception of the message It is recommended to be identified and established a common early warning system in all countries to overcome the early warning issues. Many sirens, many colour codes are been using for communicate the warning information to the public. Therefore, it is recommended to be standardized the sound that can be utilized as a common sound for disasters such as ambulance sound.

Abstract ID: 004

## **Typhoon Hagibis Disaster (2019) in Japan: Lessons Learned and Issues of Early Warning**

Nagai T.\*<sup>a</sup>

<sup>a</sup> *Japan International Cooperation Agency*

\*wind.sky-cloud@nifty.com

In 2019, Eastern Japan was hit by powerful typhoon Hagibis. 90 were dead or missing and 60,000 houses were damaged. I would like to introduce the outline of the disasters, the preparedness taken, the effect of the DRR, the characteristics of the damage and the lessons learned. As a result of consideration based on the rainfall data and disaster reports from MLIT and Cabinet Office, the major cause of the disaster was widespread extraordinarily heavy rainfall which exceeded historical records in many places. Japanese government disseminated warnings through all the possible ways, however, majority of residents did not evacuate. Normalcy biases in residents and some lack of the information in the hazard maps and so on could have led these results. The lessons learned to solve these problems are "Improving the disaster consciousness of the residents and the society" and "Providing information which can be a trigger of evacuation of the residents". Therefore, Japanese government is trying to improve early warnings that can be the trigger of residents' actions, such as simplifying and standardizing disaster information, devising information provisions from normal times. It is necessary to devise an early warning expression that is considering the characteristics of the expected disaster.

**Key words:** Disaster Consciousness, Evacuation Trigger, Normalcy bias, Typhoon Hagibis

Abstract ID: 005

## Real-Time Information that Improves Timely Decision to Support Evacuation Preparedness

Francis D. <sup>a</sup>, Munasinghe N.

<sup>a</sup> *Oxfam in Sri Lanka*

\*diluksionf@oxfam.org.au

Oxfam in Sri Lanka introduced a 'Sonar-Based Sensor System' to monitor the water level of the Kalu Ganga in Ratnapura District. The system was developed, tested and launched with the involvement of the government and the relevant communities. It monitors the water level and automatically sends SMS alerts to the designated recipients once the set thresholds are reached. The advantage of the system is that it is fully automated, inclusive and connects all key stakeholders involved in disaster management decision making tree reflective of their mandate. In turn, it allows for timely dissemination of alerts and activation of the evacuation procedures for the communities living in low lying areas. The system design was guided by Oxfam's extensive experience and research carried out in 2017 focusing on 5 landslide-prone villages in Ratnapura. It revealed that more than 82% of households have access to mobile devices while only less than 5% receives early warning to their mobile devices. Another finding was that women and children spent most of the time at home and excluded from receiving an early warning, information, increasing their vulnerability.

**Key words:** Automated system, threshold, sensors, women

Abstract ID: 006

## Public Addressing System in Religious Places as Early Warning Dissemination Nodes - A Case Study in Sri Lanka

Saja A.M.<sup>\*a</sup>, Lafir M.S.<sup>b</sup>, Sutharshanan M<sup>c</sup>

<sup>a</sup> South Eastern University of Sri Lanka, Oluvil, Sri Lanka

<sup>b</sup> DIPECHO Consortium project, Plan International, Yangon, Myanmar

<sup>c</sup> ACTED, Colombo, Sri Lanka

\*saja.aslam@seu.ac.lk

An effective disaster early warning system is instrumental in evacuation to reduce the disaster impact. In an end-to-end early warning cycle, an effective community early warning dissemination mechanism plays an important role. The identification of the population at-risk to which the early warning needs to be directed and the clarity of the risk communication with social and cultural awareness are two key attributes to enhance early warning dissemination strategy. The objectives of this study are two-fold: 1) to carry out a village level early warning dissemination system audit in 25 selected villages in three districts of Northern and Eastern Provinces of Sri Lanka, and 2) to assess the reliability of the existing public addressing systems such as loud speakers, bells, and flags (same technical devices are used for early warning dissemination during disaster alerts) in 44 religious places in the same 25 selected villages. The audit findings (objective 1) revealed that more than 90% of the villages have early warning committees established with 5-7 members and 'word of mouth' has been the most common warning dissemination strategy from the divisional secretariat to early warning committee through village administrators. 65% of the villages (16 of 25) have a megaphone as an early warning dissemination device. The assessment of early warning devices at the religious places (objective 2) found that the installation of the public addressing system was not effective in terms of their position, coverage, and technical sustainability in more than 75% of the religious places. The study provided set of recommendations to increase the effectiveness of the existing early warning dissemination method using the locally available resources and to develop the religious places as early warning dissemination nodes by improving the technical reliability of the existing public addressing systems.

Abstract ID: 007

## Comprehensive Preparedness for a Community at Extreme Flood Risk: A Case Study from Sri Lanka

Weerasinghe B. <sup>\*a</sup>, Samarawickrema G. <sup>b</sup>

<sup>a</sup> Janathakshan (GTE) Ltd, Colombo, Sri Lanka,

<sup>b</sup> Sri Lanka Preparedness Partnership, ADPC, Bangkok

\*buddhi4@hotmail.com

This paper describes an initiative to build comprehensive community preparedness for response aligned to the process advocated by the ISO 22320 of 2018. A participatory situation analysis of the area with the community revealed a worst-case scenario in May 2017, when the village was inundated and was cut off without access. The initiative unfolded with the formulation of a GIS database with the village youth involvement. An inclusive and participatory approach was undertaken to identify preparedness and response needs and their resolution with stakeholder collaboration. The village school was upgraded to serve as a camp site for the displaced without the need for outside assistance during flood emergencies. Early warning process was reviewed and community-based early warning enhanced. Identified capacity building has been carried out and a pilot endeavour to construct a 'floating store house' for protection of assets of household and micro-enterprises has been carried out. Stakeholder SOPs have been formulated and a community evacuation drill conducted.

**Key words:** Capacity building, Early warning, Evacuation drill, GIS database

Abstract ID: 008



## Flood ‘Survivors’ or Flood ‘Dependents’? Sociological Reading of Flood ‘Victims’ in Urban Sri Lanka

Samaraweera H.U.S.\*<sup>a</sup>

<sup>a</sup> *University of Canterbury, New Zealand*

\*unnathisamaraweera@yahoo.com

In order to grasp world-wide attention the identity of flood affected people is often constituted as ‘flood victims’ in global mass media including in Sri Lanka. This portrayal of flood affected people as flood victims not only limit their identity as disempowered, but also overlook their experience as ‘flood survivors’ during the post disaster contexts. This study aims to examine the role and impact faced by flood affected people in the post flood disaster context. The research problem investigates socio-economic responses of flood affected people during reactive, recovery and reconstructions stages of flood disaster. Using the purposive sampling method, fifty flood affected households in Kolonnawa were selected to conduct the household survey. Further, twenty-five in-depth interviews with flood affected people and two structured interviews with officials were conducted. The research findings suggest that the flood affected people have actually attempted transforming to flood survivors as opposed to flood victims. However, continuous representation and identification as flood victims and being a constantly vulnerable group living in a geographically flood prone area have positioned them to hold on to their identity more as victims rather than survivors. Therefore, the material and social assistance received from outside including the government and non-affected groups in the post disaster context had led them to be flood dependents as opposed to survivors. This research paper argues how the overwhelming dependency mentality of flood survivors in terms of material and sometimes social support have led them to hold on to their flood dependent role.

**Key words:** Flood victims, Flood survivors, Flood dependency, Sri Lanka

Abstract ID: 009

## Evaluate WRF-Based Lightning Potential Index (LPI) Lightning Parameterization over Sri Lanka During Second Inter-Monsoon in 2018

Premathilake D.S. <sup>\*a</sup>

<sup>a</sup> *Department of Meteorology, Colombo, Sri Lanka*

\*darshana.shamil@gmail.com

It is important to develop accurate and reliable lightning prediction system that can be contributed towards the safety of life, both concerning forecasting for the public safety and safety of aviation and electrical power. This study aims to evaluate WRF-based Lightning Potential Index (LPI) lightning parameterization and its applicability for predicting lightning over Sri Lanka during the second inter-monsoon. The WRF-ARW model 3.9.1 was used to produce predictions for three lightning events with various physical parameterization schemes with two nested domains with a resolution of 12km and 4km respectively. The model simulated LPI values were evaluated using the Earth Networks Global Lightning (ENGLN) dataset. Results show corresponding lightning simulations were produced with spatial distribution aligned with ground-based lightning data. Results consistently show a high correlation of the LPI index with an hourly CG flash rate over the three cases. Moreover, the WRF model was able to capture the lightning using LPI in Sri Lanka, suggesting that it can be used operationally to predict lightning potential region.

**Key words:** Lightning Prediction, LPI, Sri Lanka, WRF model

Abstract ID: 010

## Development of a Legume Based Disaster Resilient Emergency Food Product

Rathnayake H.A.<sup>\*a</sup>, Navaratne S.B.<sup>a</sup>, Navaratne C.M.<sup>b</sup>, Madushika N.V.G.S.<sup>a</sup>

<sup>a</sup> *University of Sri Jayewardenepura, Sri Lanka*

<sup>b</sup> *University of Ruhuna, Sri Lanka*

\*heshani@sci.sjp.ac.lk

Availability of safe, secure, convenient and nutritional foods for the dietary requirements of the affected community during disasters situations such as flooding, drought and tsunami are critically important in order to prevent outbreak of food borne illnesses and nutritional deficiencies along with fulfilling the requirements of hunger. Hence, early preparedness having with an emergent and continuous supply of sensorially acceptable food products are important as disaster resilient to cope with the requirements of major and short meals that are convenient to be handled and consumed during natural calamities. Under this circumstance, a legume-based emergency food product was developed using green gram as the major raw material. Therein, green gram was subjected to 12 producers friendly and cost-effective pre-treatment combinations and selected the best treatment combination accordingly in terms of cooking time, palatability and cost. The best treatment was the green gram subjected to overnight soaking (grains: water ratio of 1:4) followed by deep-freezing to form ice crystals and dehydration at 70°C in hot air oven. The resulted product can be cooked within 10-12 minutes without pre-soaking. The cooked grains have the hardness of 295±25.4g (according to texture profile analysis) which indicates better mouth feel of the developed product. Since the moisture content of the dehydrated green gram was lower (8.06±0.41%), the product can be stored for more than six months in double laminated packaging material. Moreover, the developed product does not contain any preservatives and artificial colorings, it is suitable for all persons in social cost profile (except infants). Therefore, this product can be used as an emergency food product that can be stored, handled and consumed conveniently as a disaster resilient for the affected community.

**Key words:** Disaster resilient, Emergency food, Food security, Green gram, Nutrition

Abstract ID: 011

## Least Community Awareness of Long-Term Changes in the Surrounding Environment Lead to Disasters

Aththanayaka A.M.N.D.\*<sup>a</sup>, Gunathilaka M.D.L.K.<sup>b</sup>

<sup>a</sup> *Department of Geography, University of Ruhuna, Sri Lanka*

<sup>b</sup> *Department of Geography, University of Colombo, Sri Lanka*

\*nimmidinesha@gmail.com

Lack of community awareness has created various disaster tragedies. Today waste also a cause of disaster due to various consequences. This paper quest for what the sequential changes made the Methotamulla waste fill collapse and the awareness on these factors in order to identify the constraints to understand the disaster. The study used drone images as secondary data and satellite images both primary and secondary data to detect the sequential changes around the landfill made waste, a disaster, along with ten interviews. The landfill was marshy land used for waste disposal. The digitized satellite images have shown the expansion of the landfill and the reduction of marshy lands. Importance of marshy lands for flood management has forgotten creating path for a disaster. Along with, the housing and population too increased compared to the landfill. The satellite image in 2005 clearly showed the extent of marshy where now settlements are distributed. Community over there had not noticed these changes. Considering the community awareness on these changes people only be alert over the direct impacts of landfill such as odour, mosquitoes. The proper management of a landfill was neglected too. Though, community awareness is must in disaster management, the interviews also revealed people have no much attention on the long-term changes in surrounding environment. This further illustrated the lack of awareness on proper management of a landfill too. Thus, lack of disaster awareness is a constraint on understanding and identification disasters and disaster preparedness.

**Keywords:** Community awareness, Constraint, Disaster, Long-term changes, Waste

Abstract ID: 012

## Applicability of Drywall Partitioning in Disaster Relocation Projects: Time Based Performance Analysis

Dilukshi H.N.<sup>\*a</sup>, Hadiwattage C.<sup>a</sup>, Shanika V.G.<sup>a</sup>

<sup>a</sup> *University of Moratuwa*

<sup>\*</sup>neeshdilukshi@gmail.com

Out of technological challenges occurred during disaster relocation projects, wall construction is critical as it occupies a considerable duration within the total project timeline. Although drywall partitioning technologies perform positive signs against the current wet wall technologies in terms of the time parameter, drywall partitioning technologies are yet to be practiced in disaster relocation of Sri Lanka. It develops a researchable gap in identifying the applicability of drywall technologies in improving the time efficiency of disaster relocation projects in Sri Lanka. To bridge the gap, this research focused on investigating time-based performances of different drywall partitioning technologies in the given context. Initially, a preliminary interview was conducted with 03 professionals in order to narrow down the drywall partitioning technology types identified from the literature review to the Sri Lankan context. Having considering time efficiency as a requirement in literature, it was divided into two as on-site time consumption efficiency and off-site time consumption efficiency under the preliminary interview. Next, expert questionnaire survey consisted with 48 respondents, was processed for evaluating time performance of different drywall partitioning technologies in terms of landslide disaster relocation. The selected sample was consisted with experts in disaster relocation projects, drywall experts and construction professionals. Mean Weighted Rating was followed to rank 10 drywall technologies against the identified two-time related wall construction requirements. As the utmost outcome, a ranked list of 10 drywall partitioning technologies were yielded under each time related requirement, delivering gypsum board, calcium silicate panels and cement bonded particle board as the most appropriate technologies under on-site time consumption efficiency, as well as gypsum board, calcium silicate panels and glass fibre reinforced panels as most suited under off-site time consumption efficiency for landslide disaster relocation projects in Sri Lanka.

**Key words:** Drywall partitioning technology, Landslide disaster relocation, Time, Sri Lanka

Abstract ID: 013

## Measuring Household Carbon Footprint: Population-Specific Adaptation and Validation of a Tool for South Asia

Wckramarathne J. <sup>\*a</sup>

<sup>a</sup> *University of Colombo, Sri Lanka*

\*drjanakacw@gmail.com

The effects of climate change occurs across the globe. Unless drastic action is taken to reduce the greenhouse gases, adapting to these untoward effects will be challenging and costly. As the first step, estimation of the green-house gases is of prime importance yet, there are no studies conducted in South Asian households partly due to non-availability of a valid assessment tool. To bridge this gap, this study aimed to validate a tool to assess the carbon footprint (CFP) of residents in a Sri Lankan household (HH). The 28-item Resources and Energy Analysis Program (REAP) Calculator which had been originally developed for developed countries was translated and followed population-specific adaptation using modified Delphi process with a panel of 10 experts to ensure its judgmental validity. Construct validity was assessed among 210 HHs by performing exploratory factor analysis and confirmatory factor analysis. Reliability was assessed using the test-retest method and internal consistency. After four rounds of Delphi technique and validation, CFP-Sri Lanka (SL) tool was identified as comprising a five-factor model of 20 items, explaining 64.3% of the total observed variance. The tool showed a stable factor structure (RMSEA=0.181; CFI=0.85; NNFI=0.813; SRMR =0.085; GFI=0.643) and reliability (internal consistency of 0.87). Therefore, Sinhala version of the CFP-SL tool is a valid and reliable tool to assess the CFP in urban and rural Sri Lankan HHs.

**Keywords:** Carbon footprint, Factor analysis, Greenhouse gases

Abstract ID: 014

## Bangladesh's Response in Disaster Risk Reduction through Forecast-Based Action and Learning

Nur A.S.M.N.\*<sup>a</sup>

*BRAC University, Dhaka, Bangladesh*

\*marjan.nur@bracu.ac.bd

Early warning systems, since its inception, has been an aid to communities during natural disasters and hazards. Communities have been more resilient, responsive and prepared to take action due to Early Warning. One of the world's most natural disaster-prone nations, Bangladesh has to live with recurring floods and cyclones which have claimed hundreds of thousands of lives over the past four decades. Over the last couple of decades, the country has demonstrated remarkable success in improving disaster preparedness with support from bilateral and multilateral agencies and non-governmental organizations (NGOs) contributing to strengthening end-to-end early warning systems in Bangladesh. This study focuses on identifying the key behind this success on how Bangladesh has managed institutionalizing and sustaining early warning systems in a changing climate to reduce the disaster vulnerabilities by reviewing case studies, consultation with DRR experts and local communities. The success of early warning is due to its dependency on local and reliable forecast, pre-defined triggers, set of protocols with clear roles and responsibilities and pre-defined set of early actions related to financing mechanisms.

**Key words:** Early Warning, Disaster Management, Forecast Based Action

Abstract ID: 019

## High Performance Glass-Bolted Joints for Disaster Resilient Glass Structures

Achintha M. <sup>\*a</sup>

<sup>a</sup> *University of Southampton, United Kingdom*

\*mithila.achintha@soton.ac.uk

Owing to fascinating physical characteristics of glass together with its potential for delivering energy efficient buildings, glass has become one of the most preferred façade materials in modern commercial buildings. Despite the benefits that glass facades offer, glass is the most fragile part of a structure when subjected to extreme loadings such as earthquakes, cyclones and other natural hazards. Failure of glass results in fragments that could seriously injure people during an event of urban disaster. Brittle material behaviour and the low tensile strength of glass means that connections in glass facades where onerous actions and complex states of stress present are most likely to trigger brittle failures. Provision of reliable connections is the main difficulty associated with glass construction compared to other construction materials, such as concrete, steel and timber. Contemporary mechanical fixings, essentially, clamped and bolted joints, lack ductility and failures often cause catastrophes. On the other hand, use of adhesives in structural glazing has not been fully proven and largely considered to be unreliable. This paper reports selected findings from an experimental investigation into enhancing load response and ductile failure behaviour of glass-bolted joints using externally-bonded Glass Fibre Reinforced Polymer (GFRP) strips as reinforcement. The load response and the failure behaviour of GFRP reinforced and unreinforced (i.e. reference) test specimens were investigated. The results showed that the peak load of the reinforced joints was significantly higher compared to that of the reference joints. Moreover, the reinforced joints showed ability to resist load even after the initiation of glass fracture in the vicinity of the joints, whereas reference joints failed in a brittle manner with zero post-fracture ductility. The results suggest the potential applications of GFRP reinforcement as a means of enhancing structural performance of glass-bolted joints against extreme loading situations such as events of disasters.

**Key words:** Bolts, Glass, Joints, Structures

Abstract ID: 020



## The Folk Religious Practices as an Indigenous Approach of Negotiating Disaster Risks In Sri Lanka

Piyarathne A. <sup>\*a</sup>

<sup>a</sup> *The Open University of Sri Lanka*

\*apiya@ou.ac.lk

The Sendai Framework for Disaster Risk Reduction (SFDRR 2015-2030) has emphasised an integrated and holistic approach including culture and heritage in addressing disastrous situations. In this context, the current paper explains how folk religious practices of ordinary villagers live on the eastern coast of Sri Lanka have contributed to cope with Tsunami in 2004. This research paper is based on a theme identified during an ethnographic fieldwork conducted on ethnic and religious dimensions in shaping everyday social life worlds in the rural village of Pānama between 2010 and 2012. The paper will detail how the villagers were protected by the goddess Pattini during various disastrous situations in general and Tsunami in particular. In general, people of the eastern coast are a group of traditional believers in goddess Pattini, a goddess of prosperity (which include the security or protection and sustainability as well) and care for them. Their everyday social life worlds are shaped by the said belief system enriched by folk religious traditions. The goddess Pattini has appeared in dreams of a few holy people in the village and warned about a precarious situation in the future. This led for the entire villagers to gather in the village shrine room, ampitiya devālaya and perform rituals which was an awareness creation and planning for reducing the risks of the community that ultimately saved their lives.

**Key words:** Disasters, Folk religions, Traditional knowledge, Cultural heritage

Abstract ID: 023

## **Saving Lives and Livelihood of the Mountain Communities Through Glacial Lake Outburst Floods Risk Reduction and Early Warning System Initiative: A Case Study of Imja Glacial Lake in the Everest Region Nepal Himalayas**

Deepak K.C. <sup>\*a</sup>

<sup>a</sup> *United Nations Development Programme (UNDP), Nepal*

\*deepak.kc@undp.org

Glacier retreat and Glacial Lake Outburst Floods (GLOFS) is one of the visible impacts of Climate Change among others in the Nepal Himalaya and Nepal has already experienced more than 24 catastrophic GLOFS. Imja Glacial Lake, one among six potentially dangerous glacial lakes, situated at an altitude of 5010m in the Mt. Everest region in the Nepal Himalaya, has been lowered by 3.4 metres thereby reducing GLOF risks. Automatic Weather/ Hydro-met Stations in the strategic location in Imja watershed in the downstream communities has been linked with community-based EWS for connectivity for risk reduction, benefitting thousands of indigenous people in the downstream including tourists from the project. Engagement of academia/research institutions, experts for detail assessments, survey/design was the first step and was followed by the involvement of Nepal Army for actual lake lowering work. High altitude with extremely cold temperature, remoteness, short working period etc are some of the challenges faced during the project implementation. The project has strengthened the capacity of the Government at all levels of risk assessments, climate change adaptation techniques, disaster preparedness through training, material supports and hardware interventions. Communities are investing on tourism business and also in agricultural farm in the downstream. Nepal and other countries in the region have such glacial lakes which needs urgent actions. The successful case needs to be replicated and upscaled.

**Key words:** Nepal Himalayas, GLOF Risks, Climate Change Adaptation, Early Warning System

Abstract ID: 025

## Landscape Transformation Increases Risk

Mohil D.\*<sup>a</sup>, Schreyers L.<sup>a</sup>,

<sup>a</sup> *Wetlands International South Asia, India*

\*dushyant.mohil@wi-sa.org

The landscape in Tampara basin is undergoing transformative changes, the lakes, ponds, marshes and floodplains that previously would have absorbed floods from abundant rains have been drained to make rice fields, or have been built over. Examining land cover changes with use of Landsat images over a 30-year period can help to understand the landscape dynamics, these images indicate a significant loss in wetland extent. Further to understand the human-nature interactions an ecosystem services assessment sheds light on community perceptions, preferences and attitudes for ecosystem services, data from 278 structured questionnaire survey of basin communities and eight focal group discussions (FGDs) indicated preferences for 19 ecosystem services identified as being derived from the wetland and states the heterogeneities within these communities, indicating the preferences. The land cover changes and FGDs further indicate increasing water stresses which can exacerbate communities' vulnerability levels. Water management interventions currently emphasis on hard engineering solutions, degradation of natural buffers such as wetlands and a lack of integrated land and water planning have been major causative factors in driving risk. Nature based solutions in particular community led wetland management approaches are well positioned and significant opportunity for addressing such risks.

**Key words:** Ecosystem based DRR, Ecosystem degradation drives risk, Integrated approaches for building resilience

Abstract ID: 026

## The Impact of PDO on South West Monsoon Rainfall Over Sri Lanka and Monsoon- ENSO Relation

Sumathipala W. L.\*<sup>a</sup>, Hettiarachchi R. D.<sup>a</sup>, Navaratna W. C. W.<sup>a</sup>, Somarathne S.<sup>a</sup>, Premalal K. H. M. S.<sup>b</sup>

<sup>a</sup> *The Open University, Sri Lanka*

<sup>b</sup> *Department of Meteorology, Sri Lanka*

\*rdhet@ou.ac.lk

The sources of variation in rainfall over the Sri Lanka during past few decades are puzzling and much attention has paid to decadal climate predictions because of the recognition that there is a necessity for long-term decisions to adapt to the impacts of climate change. However, the impact of Pacific Decadal Oscillations (PDO) on the south west monsoon variability has not been satisfactorily discussed so far and no study has been explaining the detailed relation between PDO and south west monsoon mechanism. In this study, we investigated the fluctuations of southwest monsoon rainfall over Sri Lanka in relation to PDO observed in the sea surface temperature (SST) of the North Pacific Ocean. . Rainfall of 22 meteorological stations in Sri Lanka for a period of 50 years were included and analyzed. During the period studied, there were three (03) cold phases, two (02) warm phases of PDO, ten (10) El-Nino events and sixteen (16) La-Nina events. Post maps were constructed for cold and warm phases of PDO in El-Nino and La-Nina events separately, using the monthly rainfall composites during the south west monsoon period. In the warm phase of the PDO, dry condition and in the cold phase of the PDO, wet condition is observed to develop over Sri Lanka respectively. Furthermore, during the warm phase of the PDO, the influence of El- Nino (La-Nina) on the south-west monsoon rainfall is increased (counteracted). These associations indicate that the PDO extends its effect from the North Pacific Ocean to the tropical Pacific Ocean and changes the relation between the El-Nino Southern Oscillations (ENSO) and the south-west monsoon rainfall. The analysis provides a useful reference of when and where the ENSO – PDO extremes have significant impacts on southwest monsoon rainfall that can be used to enhanced the skills of seasonal forecasting in Sri Lanka.

**Keywords:** Pacific Decadal Oscillations, Cold phase, Warm phase, Sea Surface Temperature, El-Nino, La-Nina, ENSO

Abstract ID: 027

## Analyze and Comparison the Atmospheric Instability Using K-Index, Lifted Index and Convective Availability Potential Energy (CAPE) in Development of Thunderstorms in Sri Lanka

Fernando M.<sup>\*a</sup>, Millangoda M.<sup>a</sup>, Premalal S.<sup>b</sup>,

<sup>a</sup> *Department of Meteorology, Sri Lanka*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

\*rmpfernando@gmail.com

Thunderstorm is one of the oldest observed natural phenomena on the earth. Atmospheric instability is one of the important requirements to develop clouds. Therefore, identify and evaluate the relationship of some of the instability indices, favourable to develop cumulonimbus clouds are much important to establish better thunderstorm early warning mechanism. There are numerous instability indices available to assess the instability of the atmosphere for thunderstorm forecasting. Although there are various instability indices which combine thermodynamic and/or kinematic parameters utilized to forecast thunderstorms, effectiveness of these indices for this region have not been studied yet. Considering the importance, this study focuses to identify some instability indices such as K-Index, Lifted index and Convective Availability Potential Energy (CAPE), generate using NCEP FNL, Operational Global Analysis data and correlate it with the observation data and Lightning Data from GLD 360, for the same region for the month of November 2016. Results revealed that impact of CAPE in occurrence in thunder which is a direct outcome of atmospheric instability is low, although it is widely accepted that CAPE is a good measure to identify instability. However, for non-occurrence thunder scenario, CAPE range which captured most of the cases were 0-1000. It is evident that the KI is a good index for forecast thunderstorm in the Sri Lankan region. This study also showed that the higher KI values for occurrence of thunder and lower KI values for non-occurrence. When considering LI, again the outcome of this study is not in line with the normal threshold values which are generally accepted.

**Key words:** Thunderstorm, K-Index, Lifted Index, Convective Available Potential Energy

Abstract ID: 028

## Case Study and Synoptic Analysis on the Extreme Rainfall in December 2018: Northern Sri Lanka

Kohilawatta A.\*<sup>a</sup>, Premalal S.<sup>b</sup>, Inparajan S.<sup>c</sup>,

<sup>a</sup> *United Nation Development Programme, Sri Lanka*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

<sup>c</sup> *Disaster Management Centre, Sri Lanka*

\*awandi.kohilawatta@undp.org

The occurrence of floods and landslides associated with extreme rainfall are common in Sri Lanka during recent past with the changing climate. Analysis of climate data for the last 30 years evident that the increasing trend of one day to five-day heavy rainfall in many parts of the island. Not only that percentile based extreme heavy rainfall (above 95th and 99th Percentile) also shows an increasing trend. There was heavy rain over the northern part of Sri Lanka on 22<sup>nd</sup> December 2018 by impacting several sectors with a huge economical loss. Within 02 hours the precipitation level rose up to 300 mm at some places of the catchment of Iranamadu tank in the northern province and caused impact along the downstream of the Iranamadu tank. This study carried out to analysis the atmospheric changes which caused heavy rainfall over the particular region. JRA 55 and NOAA reanalysis atmospheric data were used to generate synoptic chart to identify the reason. Rainfall maps were prepared using SURFER software to find the rainfall distribution. Analysis of the atmosphere, indicated the sudden development of circulation with pressure drop over the northern part of island and it extended to the upper level. Strong vorticity over the northern part and suburbs also indicated the favourable atmospheric condition to develop active clouds to produce heavy rain over the northern part in Sri Lanka.

**Key Words:** Extreme Rainfall, Percentile Based, Low Level Disturbances

Abstract ID: 029

## Increase of Pluvial Flood in Borelesgamuwa Area with the Climate Change and Land Use Changes

Rajapakse P.<sup>\*a</sup>, Premalal S.<sup>b</sup>

<sup>a</sup> IHRA, University of Colombo, Sri Lanka

<sup>b</sup> Association of Disaster Risk Management Professionals, Sri Lanka

\*prajapakse7@gmail.com

Flood associated with extreme rainfall is a common phenomenon in urban city due to rapid urbanization. New constructions, paving of roads with tar and concrete pavements, filled marshy lands, dumping garbage are some of the reasons which triggered the flood situation. Colombo metropolitan area and suburbs are rapidly developed during recent past with the change of global economy. More factories and industries were constructed after 1980's with the implementation of open economy in Sri Lanka. In parallel garment industry were establish in Colombo and surrounding area under "Board of Investment (BOI)". Rural community was migrated to Colombo metropolitan area and suburbs to seek job opportunities. More buildings and house complexes were established with the migration of people and rapid land use change have been occurred. Due to all those changes Colombo and suburb area faced frequent flood situation. Borelesgamuwa area belongs to Borelesgamuwa urban council was one of the most flooded area in Colombo district. Government of Sri Lanka managed to mitigate flood in the area of Borelesgamuwa, after launching flood mitigation project. The present study is focused to identify the change of rainfall pattern with climate change and land use change in Borelesgamuwa area to identify reasons for flood in the said area. Annual rainfall trend, Coefficient of Variance (CV), Land use change, change of population and people's perception for the rapid change were analyzed to find the reasons for urban flooding. Results revealed that increase of rainfall intensity with the increasing annual rainfall trend is one of the reason for the flood situation in Borelesgamuwa area. Comparison of Coefficient of Variance (Variability) for two periods 1980-1997 and 1998-2015 also evident the increase of rainfall variability. Analysis of land use changes using ArcGIS indicated the city growth from 0.66 km<sup>2</sup> to 5.83 km<sup>2</sup> for the years 1975 and 2000. This has increased total impervious cover which will lead to pluvial floods.

**Key word:** Pluvial Flood, Land use change, Climate Change

Abstract ID: 030

## Analysis and Comparison of the Earthquakes over the Indonesian and Makran Zones: Towards Possible Tsunami Generation in Future

Jayaweera S.\*<sup>a</sup>, Premalal S.<sup>b</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

\*jayaweera\_s@yahoo.com

Sri Lanka is a vulnerable country for tsunamis, which are generated from an Indonesian Zone and Makran Zone due to an earthquake with higher magnitude. Sri Lanka hit a major tsunami in 2004 due to an earthquake near Indonesian region by impacting larger coastal area in Sri Lanka. Predicting a tsunami is not an easy task, but there should be better criteria to issue warning after an earthquake to save lives and properties. At present the criteria used is magnitude (>6.5) and the depth (<100km) from the earthquake epicentre. However, possibility of tsunami generation is higher if the magnitude greater than 7.4 according to the global perspective. Therefore, understand of the trend of earthquakes in Indonesian and Makran zone will be useful to issue alerts and warnings. Considering the importance, the present study focuses to analyses previous earth quake events along the Indonesian and Makran zone, which are greater than 6.5 magnitude, to find the current trend. Analysis further extended to categorize the events, which are favourable to generate tsunami according to the criteria. Not only that, comparison of earthquake events between Indonesian region and Makran region also studied. Historical earthquake data was downloaded from the USGS website. Analysis clearly showed that, the numbers of earthquakes and the possible tsunami generation is much higher during the last 3 decades.

**Key words:** Boundaries, Earthquake, Tsunamis, Magnitude

Abstract ID: 031



## Post Disaster Reconstruction for Resilient Community: Lesson Learnt Through Post Tsunami Reconstruction and Post- Conflict Housing Project, Sri Lanka

Gunasekara M.\*<sup>a</sup>, Rupasinghe P.<sup>a</sup>, Chanaka D.<sup>a</sup>, Samarakoon U.<sup>a</sup>, Perera A.<sup>a</sup>

<sup>a</sup> Red Cross Society, Sri Lanka

\*mahesh.gunasekara@redcross.lk

Large Scale post-disaster reconstruction projects are expected to follow international standards which include community participation, gender equality and other aspects related to social vulnerabilities. During a post-disaster period, people tend to feel helpless and discriminated. Further, these people who are considered to be vulnerable might end up in a rather disadvantaged situation. By following the aforementioned international agreed standards, it is expected to maintain a unified post-disaster reconstruction process which reduces the opaqueness. However, while following the above concepts, it is important to understand the practicality of these concepts at the grassroots level. The study was carried out to understand the lessons learned from the implementer's perspective. Related quantitative data was gathered from secondary information and key interviews conducted with project implementation officers to collect qualitative data about two approaches. This paper discusses two types of approaches used in two housing projects: Owner Driven and Donor Driven housing constructions. Even-though the numerical figures of the projects seem to be achievable, some of the donor driven project's after-effects illustrate that the effectiveness is hindered as decisions penetrate through multiple layers. However, the project implementers have no option but to work together while adjusting to the challenges that come their way. Further, the case studies discuss reasoning from implementing agencies in order to explore other possible approaches such as owner driven approach that may succeed in implementing similar projects.

**Key words:** Post Disaster Reconstructions, Donor Driven, Owner Driven, Community participation

Abstract ID: 032

## Analysis of Shoreline Dynamics in Spatial and Temporal Scales at Kalpitiya Coastal Window, Sri Lanka; An Approach for Informed Decision Making for Sustainable Coastal Administration

Wickramaarachchi B.<sup>a</sup>, Tajima Y.<sup>b</sup>, Samarakoon L.<sup>c</sup>, Athapattu B.C.L.<sup>d</sup>, Wijerathne, T.M.N.<sup>e</sup>

<sup>a</sup> Asian Disaster Preparedness Center, Thailand

<sup>b</sup> University of Tokyo, Japan

<sup>c</sup> Asian Institute of Technology, Thailand

<sup>d</sup> The Open University, Sri Lanka

<sup>e</sup> University of Moratuwa, Sri Lanka

\*engwicky@sltnet.lk

The coastal ecosystems, which consist of natural elements interacts with complex relationships, are dynamic in both spatial and temporal dimensions due to the natural and anthropogenic drivers. The dynamics might adversely disrupt the health of ecosystems and socio-economies built on ecosystem services. Hence it is vital to explore and monitor the dynamics of coastal environments for informed decision making on coastal governance and environment safeguards. Since the coastal dynamics spread over large spatial and temporal domains, applications of spatial earth observation have been identified as the appropriate technology for measuring the coastal dynamics. The coastal sediment process is a key element of the complex system that indicates the dynamics of the ecosystem at its first-mile as changes in the shoreline. Hence the degree of shoreline dynamics was measured in differential spatial and temporal resolutions of macro-, micro- and nano- scales within the Kalpitiya coastal window. Through the analysis, it was found that the shoreline is highly sensitive with endless dynamics. The scientific findings of the study were shared with various stakeholders who are directly or indirectly involved and affected by the dynamics. Possible causes and appropriate adaptation strategies were discussed to utilize in national & local administration for the sustainability of natural capital and secured economies.

**Key words:** Shoreline, Dynamics, Images, Sediment

Abstract ID: 033

## Understanding Alteration to Surface Cover in Developing Urban Heat Island: Enhancing City Climate Change Adaptation Capacity, Quezon City, Philippines

Raza T.\*<sup>a,b,c</sup>, Raza T.K.<sup>d</sup>, Liwag C.<sup>c</sup>, Andres A.V.<sup>d</sup>, Castro J.T.<sup>c</sup>, Espinosa R.I.<sup>a</sup>

<sup>a</sup> *Philippine School of Business Administration, Philippines*

<sup>b</sup> *U.P. Planning and Development Research Foundation, Inc.*

<sup>c</sup> *University of the Philippines, Philippines,*

<sup>d</sup> *Environmental Protection and Waste Management Department, Quezon City Government, Philippines*

\*tabassamr@psba.edu

The Philippines and its cities are on their fastest pace towards urbanization. For example, Quezon City (QC) is developing aggressively and the effects of urbanization, i.e., replacement of vegetation by building structures change the microclimate, raising summer temperatures by up to 7°C. Primarily, two major impacts have been identified and extensively studied. First, urbanization affects climate; cities tend to be hotter than the surrounding countryside and create what is known as Urban Heat Island (UHI). Second, urbanization affects hydrology; cities shed more water as run-off into their streams and rivers causing periodic flooding. If Climate Change Adaptation (CCA) is to be attained by future cities, we must learn to minimize said ecological effects. This research used Geographic Information System in mapping Urban Morphology Types (UMT) of Barangay (smallest political unit) Greater Lagro of QC in estimating Evapotranspiring, residential green area segregation, and variation of surface cover. 84% of Greater Lagro is currently Impervious, 7% is bare soil, and 9% is Evapotranspiring. Based on these estimations and surface cover analysis, Surface Run-off and Temperature are calculated in various temperature scenarios (1971-2000, 2006-2035, and 2036-2065). An action plan is recommended to prevent future Surface Run-off and prevent the development of expected UHI.

**Key words:** Urban Heat Island, Urban Morphology Type, Climate Change Adaptation, Geographic Information System

Abstract ID: 037

## A Conceptual Framework for Community Led Ecosystem-Based Disaster Risk Reduction

Zarouk Z.<sup>\*a</sup>, Mallawatantri A.<sup>a</sup>, Piyadasa R.<sup>b</sup>, Saja A.<sup>c</sup>, Attanayake K.<sup>d</sup>

<sup>a</sup> *International Union for Conservation of Nature, Sri Lanka,*

<sup>b</sup> *University of Colombo, Sri Lanka*

<sup>c</sup> *South Eastern University, Sri Lanka*

<sup>d</sup> *Child Fund, Sri Lanka*

\*zihanzar@gmail.com

Practice of Ecosystem-based Disaster Risk Reduction (Eco-DRR) is evident, thousand years ago, in tank-cascade systems to prevent droughts and floods. Mainstreaming Eco-DRR in modern context where land uses, disasters and human needs are different requires multi-sector and multi-stakeholder engagement with better Conceptual Frameworks (CF) with improved understanding of ecosystems, use of spatial tools and community engagement. This Conceptual Framework (CF) was conceived through research and development, during 2018-2019 period, that involved integrating global and local knowledge, engagements at national and sub-national levels and field applications of concepts of Eco-DRR. The CF is supported by qualitative information from secondary sources and Key Informant Interviews (KIIs). The components of CF consisted of a) Development Planning; b) Climate Change Adaptation; c) Disaster Risk Reduction; and d) Eco System Management. It includes four determining factors at community level: a) Socio – Political Setting; b) Risk Perception; c) Institutional Arrangements and d) Laws and Policies. Application of the model supports to i) Increasing Human Security; ii) Improving Sustainable Livelihoods; iii) Strengthening Resilience; and iv) Ensuring Environmental Sustainability. These components, factors and results areas of CF demonstrated intra- and inter- relations and overlaps leading to a 'Rubik's Cube shape model.

**Key words:** Ecosystems, DRR, NBS, Community

Abstract ID: 038

## Assessment of Knowledge and Practices of Grama Niladari Divisional Level Stakeholders on Watershed Management at Kalutara and Ratnapura Districts of Sri Lanka

Zarouk Z.\*<sup>a</sup>, Piyadasa R.<sup>b</sup>, Punyawardana B.V.R.<sup>c</sup>, Hearth S.<sup>b</sup>

<sup>a</sup> *International Union for Conservation of Nature, Sri Lanka*

<sup>b</sup> *University of Colombo, Sri Lanka*

<sup>c</sup> *Department of Agriculture, Peradeniya, Sri Lanka*

\*zihanzar@gmail.com

Consequent to the frequent disasters in the country there is a need for developing stronger resilience to avoid excessive damages. Climate - induced disasters such as floods, landslides and drought are highly influenced by watershed management processes in the high-risk locations which depend on knowledge and attitude of local level stakeholders on watershed management. The paper examines the level of knowledge of key grass route level stakeholders on Watershed Management. The study also deals with, identifying localized issues related to watershed management in the study area. A cross-sectional survey design was carried out for the study. Data were collected from 317 respondents which are purposely selected from Grama Niladari level government officials and community-based organization using a self-administered questionnaire and through structured focus group discussions. The questionnaire was developed based on a comprehensive review of the existing literature and expert inputs. Lack of knowledge on watershed management was found in the surveyed groups, more marked in Agricultural Extension Officers and with significant knowledge gaps on supporting legal framework for watershed management. The results of this study indicated that a high level of knowledge gaps among key stakeholders on watershed management. This study also indicates the importance of increasing learning opportunities for key stakeholders.

**Key words:** Watershed Management, Disaster Resilience, Stakeholder Capacity

Abstract ID: 039

## Application of Site-Specific Landslide Susceptibility Assessment Based on Decision Making Criteria; A Case Study of Resettlement Lands, Aranayake, Kegalle, Sri Lanka

Ariyaratna D.M.D.I.K.\*<sup>a</sup>, Wimalawardhana E.A.S.N.<sup>a</sup>, Balaarachchi B.A.U.P.<sup>a</sup>,  
Weerasinghe N.C.<sup>a</sup>, Jayasinghe P.<sup>a</sup>

<sup>a</sup> National Building Research Organisation, Sri Lanka

\*danuimaya@gmail.com

This study is focused on Site Specific Landslide Susceptibility Assessment (SSLSA) based on decision making criteria to verify the ground suitability of resettlement lands for homeless from devastated *Samasarakanda* landslide in Aranayake due to 2016, May event. Seven resettlement sites in Aranayake Divisional Secretariat Division (DSD) in Kegalle District were selected. Site Specific Total Score Values (TSV) based on the evaluation of SSLS for deciding risk reduction strategies by Dulanjalee et al., 2018 was applied. It is directly based on the landslide hazard mapping methodology developed by NBRO in 1995 and weight assigning process, were decided based on extensive field studies. The method considers six major factors (geology and bedrock structures, slope, hydrology, soil type and thickness, landuse and management and landform) which are crucial to occurrence of landslides. An area is then declared to be susceptible when the terrain conditions at a site are comparable to the areas where landslides have occurred in the past. The study reveals that man-made ground instabilities are possible when TSV of selected land is greater than 40 or it falls into medium risk range. Consequently, TSV of such medium risk areas increases to greater than 70 after developments. As much as possible lands; TSV less than 40, should be selected for resettlement lands otherwise, budget for mitigation measures should be additionally allocated. Hence, application of site-specific landslide susceptibility on decision making criteria in land selection for resettlement supports to get consistent and precise decisions at early stage by minimizing ground failures.

**Key words:** Landslides, Resettlement Process, Calculated Total Score Value

Abstract ID: 040

## Inter-Relation Between Landscape Alteration and Micro-Climatic Changes in the National Capital Territory of Delhi, India

Yadav S.\*<sup>a</sup>

<sup>a</sup> *Department of Geography, Jamia Millia Islamia, New Delhi, India*

\*sandesh\_official@yahoo.in

The changes in land use/land cover again during the pre-industrial times while got accelerated during the industrial revolution and thereafter. With the passage of time, urbanization has resulted in an expansion of Grey infrastructure and shrinkage of vegetation cover at the global level. Likewise, urbanization and related developmental processes have led to landscape alteration characterized by built-up expansion in the national capital territory of Delhi, India and impervious surface (concrete cover) increased drastically affecting the local heat budget due to increase in land surface temperature which in lieu induced the micro-climatic changes in the study area. These micro-climatic changes were observed in terms of urban heat island (UHI) effect, heatwave intensification and winter warming effect in the study area. The extraction of land use/land cover maps, surface temperature maps, vegetation index maps along with the data related to aspects like land surface temperature (LST) and the calculation of indices viz. Normalized built-up index (NDBI), normalized difference vegetation index (NDVI) has been done by using the satellite data viz. Landsat-4,5 (TM), Landsat-7 (ETM+) and Landsat-8 (OLI) for three different time periods 1990, 2000 and 2015 respectively. The results show increase in LST values, decrease in NDVI values and correlation between the two justify the micro-climatic changes in the study area.

**Key words:** Land Use, Land Cover, Built-Up, Vegetation Cover

Abstract ID: 041

## Disaster Evacuation and Community's Perception of Risk: A Study on Landslide and Flood-Prone Communities in Sri Lanka

Wijesinghe M.\*<sup>a</sup>

<sup>a</sup> *Janathakshan (GTE) limited*

\*menakew@gmail.com

The main life-threatening disasters in Sri Lanka are floods and landslides. The number of incidents reported on floods and landslides is showing an accelerating trend. During the past decade, annual seasons of meteorology induced disasters were disrupted and have become unpredictable. Permanent risk reduction measures such as relocating, major structural mitigation and safe housing would take a long time to be in place while people are becoming increasingly vulnerable. A study was conducted using three case studies in floods and landslide prone areas analysing primary and secondary data. The study identified that due to many practical or socioeconomic reasons, people may continue to live in vulnerable areas. Livelihoods, education, community links, and feeling of belongingness are some influential factors. Their risk perceptions are influenced by socioeconomic and psychological factors plus doubts about relocation and past relocation failures. Thus, communities have decided to live with risks rather than removing themselves from 'vulnerable' areas. Therefore, in its conclusion the study elaborates the need to have comprehensive community consultations as well as 'promotion' methods so that people could understand their life after relocation. Understandably, such far suitable relocation is complex and long-term nevertheless, pre-consultations and planning are far affective. The study further identified that, to keep communities safe early-warning, especially community based early warning is important until better relocation happens.

**Key words:** Relocation, Risk Perception, Socioeconomic backgrounds, Community Consultation

Abstract ID: 042



## Flood Risk Assessment and Community Based Early Warning System for Ratnapura DS Division

Vithanage N.\*<sup>a</sup>, Manjula, M.<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*saranga@dmc.gov.lk

Flood is an annual event in Ratnapura DS Area. Risk assessments and maps help to motivate people, prioritize early warning system needs and guide preparations for disaster prevention and responses. An effort was made in this study to identify the risk assessment and the development of community-based flood early warning system for the Ratnapura DS Division. Flood hazard assessment has formed on previous flood inundation data and flood simulation analysis. Flood vulnerability analysis has developed using population, business sector information and cost estimation of housing sector in each GN division. Awareness programmes, simulation exercises, availability of equipment, number of GN committees and GN plans has calculated as capacity assessment. Flood risk assessment was based on assigned weightings of hazard, vulnerability and capacity analysis. The information and communications technology (ICT) enabled system uses to for the transfer information about rising water levels. The flood warning is then disseminated via mobile phones to appropriate agencies and vulnerable communities downstream. More than 60 percentages and 30 percentage of the study area have high and moderate vulnerable to flood respectively. In this study has recommended proper flood and rainwater management system for the upper catchment area of River Kalu. Moreover, flood wall and land use planning system for whole study area and the development of community-based flood level monitoring system in identifying the critical location of the River Kalu and its main tributaries.

**Key words:** Hazard, Vulnerability, Risk, Early Warning

Abstract ID: 044

## **A Systematic Review of Community Engagement (CE) in Flood and Landslide Early Warning Systems (EWSS) in Kegalle District**

Vithanage N.\*<sup>a</sup>, Bandara A.<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*saranga@dmc.gov.lk

Sri Lanka is affected floods and landslide annually. Hence, there is an urgent need for the impending cost-effective early warning system for landslide and floods which caused by severe damage to people and properties. This paper focuses on the use of community-based early warning systems for flood and landslide in Kegalle District. Engaging the community, the Early Warning Systems (EWSs) play an essential role in saving lives, reducing injuries, and limiting environmental damage associated with disastrous events. Reliable disaster early warning is a prerequisite and a vital component of disaster response. The main objective of this study is to encourage communities to play a much more active role in their own protection. The first part of the work outlines the rainfall threshold analysis for flood and landslide inundation areas and the second stage of this study has evaluated the end to end community-based early warning systems. The methodology uses 50 years of rainfall data, GIS layers of flood, landslide, land use, soil, administrative, population data and GPS location of rain gauge received community. In this study has developed rainfall threshold analysis and standard analysis of community based early warning system. Within the monitoring element, communities were engaged in using rain gauges, both upstream and downstream, to monitor floods and landslides. Higher elevated areas of the study area have utilised for tea and rubber cultivation and settlement spared in 300 to 1000 m elevated areas and rain gauge distribution map and database of identifying community volunteers has developed. The system has structured to ensure that the early warning messages reach the last and most vulnerable person of the community. The early warning messages should help to reduce disaster risks and be beneficial for saving human, physical and financial capital of the community.

**Key words:** Community-based, Rainfall threshold, GIS, Early warning

Abstract ID: 045

## Disaster Resilience Building and Role of Primary Care – A Disaster Medicine Programme for Developing Countries

Jenna N.N.<sup>a</sup>, Kingsland J.<sup>b</sup>, Murray V.<sup>c</sup>, Patel P.<sup>\*c</sup>

<sup>a</sup> Meenakshi Mission Hospital & Research Centre (MMRC), India

<sup>b</sup> Public Health England, UK

<sup>c</sup> Faculty of Disaster Medicine – India & Nepal (FDMIN), Birmingham

\*peter@mpatel.net

This paper will present work on developing the role of Primary Care professionals for risk reduction for multi-hazard disasters in South India. According to UN estimates (January 2020) the population of South Asia is 1.93 billion, which makes the region most densely populated. Majority of population in these countries are vulnerable to one or multiple hazards. Morbidity and mortality from natural disasters in India is very high. A study of health impacts of disasters has shown that large proportion of affected populations from disasters suffer major injuries, disabilities, communicable and non-communicable diseases and other health related problems. FDMIN work in the region has shown that there is absence of concept of ‘disaster medicine and risk reduction. MMRC has established knowledge partnership with the FDMIN. MMRC is pioneering a dedicated post-professional course in Emergency & Disaster Medicine for Primary Care doctors. The course consists of 12 modules to upskill doctors and in 2020 will introduce 5 modules for allied health care professionals in disaster medicine. The course develops skills for disaster medicine planning, preparedness and recovery with the focus on risk reduction and resilience building for health sector. Outcomes of this training will be assessed over next five years.

**Key words:** Disaster medicine, disaster risk reduction for health care

Abstract ID: 046

## Developing Tsunami Risk Reduction Strategies for Gampaha District Derived from “Wave 17 Tsunami Simulation Exercise”

Vithanage N.\*<sup>a</sup>, Nishantha A.<sup>a</sup>,

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*saranga@dmc.gov.lk

Tsunami as a coastal hazard was abandoned in coastal management, planning, and development in Sri Lanka. Immediately after the December 2004 tsunami government of Sri Lanka declared a strip of land which varied in width between 100 m along the western and southern coasts. However, under pressure from various sources this buffer zone has been reduced (October 2005) to a minimum of 35 m along the western coast. The paper presents identified tsunami risk factors and recommended risk reduction strategies for Gampaha District, which was derived from the “Wave 17 Tsunami Simulation Exercise”. The assessment methodology applied follows a people-cantered approach to deliver relevant risk and vulnerability information for the purposes of early warning and disaster management. The analyses are considering the Wattala and Negambo DS Divisions in Gampaha District. Results and products like risk maps, guidelines, decision support information and other GIS products will be presented. The focus of the products is on the one hand to provide relevant risk assessment products as decision support to issue a tsunami warning within the early warning stage. On the other hand the maps and GIS products shall provide relevant information to enable local decision makers to act adequately concerning their local risks. The study has recommended based on the spatial explicit detection of e.g. high tsunami risk areas (and the assessed root causes therefore), specific disaster risk reduction and early warning strategies as additional installation of technical warning dissemination device. Community based preparedness, awareness programmes, structural and non-structural measures (e.g. land use conversion, coastal engineering), effective evacuation, contingency and household recovery planning within high tsunami risk areas.

**Key words:** Simulation Exercise, Early warning, GIS, Structural measures

Abstract ID: 047

## Increasing the Resilience of Urban Food Supply Along Rural-Urban Value Chains in Sri Lanka

Phillips I.\*<sup>a</sup>, Thiel F.<sup>a</sup>, Drechsel N.<sup>a</sup>, Drechsel P.<sup>a</sup>

<sup>a</sup> *International Water Management Institute, Sri Lanka,*

\*[l.felixgrau@cgiar.org](mailto:l.felixgrau@cgiar.org)

The role of an urban food supply within the planning of a sustainable and resilient urban sector is essential. However, the complexity of food systems that are linked to both rural and urban systems make them sensitive to shocks. Sri Lanka is one of the hotspots for food insecurity in the Asia-Pacific region and the country was ranked second in the Global Climate Risk Index (CRI, 2019). Using the Food and Agriculture Organisation (FAO) supported City Region Food Systems (CRFS) approach, this study identified the food supply regions of Colombo to analyse the levels of food (in)security within Colombo's regional context. The analysis has been conducted along the whole food value chain, from production to consumption, for key commodities consumed. Based on this study main vulnerabilities of the CRFS will be assessed, followed by a study and on how to become more resilient towards climate change related shocks and stresses. Additionally, throughout these studies, the extent to which gender and diversity influences vulnerabilities and coping strategies of different actors will be analysed and how the institutional setting is enabling a regulatory and financial environment to increase their resilience. Based on the envisioned findings, FAO will conduct multi stakeholder dialogues the most vulnerable group and actors to capacitate them for coping with climate change related hazards.

**Key words:** Urban Resilience, food systems, food value chain

Abstract ID: 048

## Spatial and Temporal Variability of Lightning Activity in Sri Lanka

Jayawardena I.M.S.P.\*<sup>a</sup>

<sup>a</sup> *Department of Meteorology, Sri Lanka*

\*shirojaya2000@yahoo.com

Sri Lanka is one of the major lightning prone countries in the South Asia. The spatial and temporal variability of lightning activity in Sri Lanka from 2015 to 2018 has been studied using GLD360 lightning flash data provided under the collaborative project “Severe Storm Warning Services for Sri Lanka (SSWSS)”. These data have been examined in 2km x 2km grid for depicting the annual, seasonal, and spatial distribution of the lightning activity. The study revealed that the annual mean flash rate is maximum in an area along the western foothills of central hills and decreases at higher elevation of central hills with highest annual average in Kegalle and Gampaha districts. It is linked with the convective activity due to solar heating of land, large-scale circulations, local winds, and orography. On the seasonal timescale, indicate that the bi-model pattern of lightning flash densities with maxima during the first inter-monsoon season, and second highest in second inter-monsoon season while lowest in northeast monsoon season. The analysis of this study provides a useful information of spatial and temporal pattern of lightning activities during four climatic seasons in Sri Lanka which is valuable for decision-makers in disaster risk management sector.

**Key words:** Lightning, spatial, temporal, variability

Abstract ID: 049

## Reducing Disaster Induced Displacement through Community-based Relocation (CbR): A Case Study of South Eastern Coast of Bangladesh

Quader A.<sup>a</sup>, Molla M.H.<sup>b</sup>, Shahjahan M.<sup>b</sup>, Baura P.<sup>b</sup>, Rahman M.A.<sup>b</sup>

<sup>a</sup> Ministry of Disaster Management and Relief (MoDMR), Bangladesh

<sup>b</sup> Young Power in Social action, Bangladesh

Displacement is one of the most serious consequences of climate change as people are being forced to leave their homes, land and livelihood because they have been destroyed by the disaster events as an effect of climate change. The present study explores the reduction of vulnerability of climate induced displacement through community-based relocation in the south eastern coast of Bangladesh. The study is mainly based on first hand data collected directly from field. Data have been collected through Key Informant Interview (KII) and Focus Group Discussion (FGD) as well as questionnaire survey. The study findings illustrate that frequent cyclone or storm surge, sea level rise and bank erosion are the key triggers for the displacement. Nearly three quarters of the displaced people are moving to urban and peri urban areas, particularly in the slum areas for their livelihood while one quarter of the people are staying adjacent areas as temporarily. Displaced people moved in urban slums do not get basic amenities from urban service providers. On the other hand, those remain behind and lived in temporary settings faced limited scope to meet their livelihood including shelters particularly those are ultra-poor. However, existing rehabilitation programs have been insufficient as it has many restrictions such as losing dignity, lack of social harmony, isolation of location as well as facing social, cultural, political and environmental crisis, and absence of other basic services like health, education. Under this context, Community-based Relocation (CbR) program has been successful as durable solutions to this problem ensuring access to basic rights and services in the relocated areas. Hence, CbR can be a sustainable planned relocation program for displaced people in the coastal areas of Bangladesh as it is community driven where every local formal and informal actor are involved and works together.

**Key words:** Displacement, Relocation, Community based

Abstract ID: 050

## Youth Volunteers as Change Agents in Disaster Risk Reduction in Sri Lanka

Vithanage N.\*<sup>a</sup>, Pathirana S.<sup>a</sup>, Wijesekara N.<sup>a</sup>, Chamara N.<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*saranga@dmc.gov.lk

Volunteerism has been present since the beginning of human history. The youth constitutes one third of total population in Sri Lanka. For this important portion of population, determination of national outlook is undeniable. This study looks into the national youth council and youth corps volunteers as case of youth volunteers in disaster management. Disaster Management Centre has identified importance of youth Voluntarism for DRR activities in Sri Lanka. The methodology of the Disaster Management Youth Volunteer Programme (DMYV) has consisted in three stages. The first stage was preparation of modules; the second stage preparation of youth groups and final stage was utilized trained youth groups. The module has consisted in basis concepts of DRR, importance of volunteerism, techniques of life savings, camp management, first aid and practices gain knowledge through simulation exercises. Institutional arrangement has done signing MOU with youth corps and youth council for identified youth groups. Identification jackets, t-shirts, badges, certificate has provided to the trained young volunteers. The model programme has conducted in Ratnapura District in 2016 which covering identified volunteers selected from each DS division. In the model programme two hundred youth has trained and a hundred youth joined as volunteers. In the 2017 flood such youth team came forward voluntarily for support flood victims with Disaster Management Centre. At the present disaster management Centre has conducting island wide youth group training programme for DRR in Sri Lanka.

**Key words:** Volunteerism, DRR, DMYV, Module

Abstract ID: 051



## **Role of Educational Institution for Community Awareness and Preparedness in Flood and Cyclone Management in Bangladesh**

Quader A.<sup>a</sup>, Akhter S.<sup>\*b</sup>, Khatun A.<sup>b</sup>, Molla M.H. <sup>c</sup>

<sup>a</sup> *Ministry of Disaster Management and Relief, Bangladesh*

<sup>b</sup> *Directorate of Secondary and Higher Education, Bangladesh*

<sup>c</sup> *Young Power in Social action, Bangladesh*

\*selina.shely@gmail.com

Bangladesh is a low-lying topography and a disaster-prone country in the south Asian region. However, Bangladesh Government has taken a collective approach towards Disaster Management which makes this country role model for the Disaster Management, specially flood and cyclone. The study mainly based on secondary and primary data. The secondary data has been gathered from relevant competent authority through reviews their documents. As well as, primary data have been generated from focused group discussion, semi-structured interview and questionnaire survey. This method has been operated with key officials of related stakeholders. In this regard, every relevant stakeholder those, related to educational Institutions along with related personnel are playing a vital role for the purposes of disaster risk reduction. Therefore, this paper will have been examined how educational institutions are playing pivotal attempt to make a Bangladesh role model for cyclone and flood management. Moreover, the study tries to give some policy guidelines and recommendations for how to improve the mechanism of coping with existing threatened and make it an opportunity.

**Key words:** Educational Institutions, Flood, Cyclone, Management

Abstract ID: 052

## Low Cost Technology in DRR: Using Open Data for Decision Making

Khatiwada P.\*<sup>a</sup>, Bajracharya R.<sup>a</sup>

<sup>a</sup> *Youth Innovation Lab, Nepal*

\*pradip@youthinnovationlab.org

For many years, governmental organizations have attempted to develop disaster-related portals to share disaster related information. In addition, there are various disaster-related datasets that have been produced by non-governmental organizations working in the field of Disaster Risk Reduction and Management (DRRM). The lack of integration of these datasets into a single platform makes it difficult to find disaster data, build a comprehensive picture of the situation and ensure rapid response in case of a disaster. Understanding these gaps, key informant interviews were held with the governmental and non-governmental actors regarding data gaps that can be addressed through technology. Upon the qualitative analysis, it was found out that a national portal covering all the spectrum of the DRRM cycle is essential. Under the government leadership, an integrated low-cost disaster information management system was developed.

**Key words:** Technology, Disaster Risk, Data Partnership, Open Data

Abstract ID: 053

## Synoptic Analysis for the Disastrous Heavy Rainfall in May 2016 Caused due to a Low-Pressure System

Warnasooriya A.\*<sup>a</sup>, Kumara K.W.S.J.<sup>a</sup>, Premachandra C.<sup>a</sup>, Premalal S.<sup>b</sup>

<sup>a</sup> Department of Meteorology, Sri Lanka,

<sup>b</sup> Association of Disaster Risk Management Professionals, Sri Lanka

\*rashanthie@yahoo.com

Sri Lanka is having tropical and monsoonal climatology and southwest monsoon is the longest monsoon season (May to September) which brings about 30% of the annual total rainfall. The onset of southwest monsoon normally occurs around 25th May (+/- 5 days) over southern part of Sri Lanka. Low level disturbances associated with the ITCZ develop over or vicinity of Sri Lanka and affects to the weather of the country during pre-monsoon season. In mid May 2016, atmosphere around Sri Lanka was very unstable. Extremely heavy rainfall exceeding more than 200 mm in a day, was received in many parts of the island leading to flood and land slide during 14th and 15th May 2016. It caused a massive damages to human lives and the economy of Sri Lanka. Total financial damage was 250–280 billion rupees (US\$1.7–2 billion) and nearly caused 200 casualties. This study is focused to analyse the synoptic situation during the said period. Synoptic observation, JRA 55 Reanalysis data are used to generate synoptic charts. Behaviour of wind patterns at different levels of the atmosphere, change of atmospheric pressure also analysed. Satellite data also analysed and analysis clearly showed that this extreme rainfall was associated with a low-pressure area developed in the Bay of Bengal closer to Sri Lankan eastern coast and it was initial stage of Cyclone “Roanu”.

**Key word:** Monsoon, Synoptic, Low Pressure Area, Extreme Rainfall

Abstract ID: 055

## Natural vs Manmade Disasters: Impact of Disasters on Small Holder Agriculture Systems in Gem Mining Areas of Sri Lanka

Elapata M.\*<sup>a</sup>, De Silva A.<sup>a</sup>

<sup>a</sup> *Sabaragamuwa University, Sri Lanka*

\*maheshwari.elapata@gmail.com

Natural vs manmade disasters are frequent incidents which devastating the livelihoods of gem mining areas. The study attempted to investigate the social, economic, physical, financial and human impact of both natural and manmade disasters on the small holder artisanal agricultural systems in gem mining areas. Three GN divisions of main gem mining district, Rathnapura were selected and 100 artisanal farm households were used to collect the primary data. Institutional analysis and interviews with key informants facilitate to develop the institutional landscape. Land use maps of the areas were used to develop disaster risk prone area maps. Unsustainable and illegal mining operations were directly linked with occurrence of frequent floods and landslides in the study area leading to soil erosion, sedimentation, removal of vegetation. Social, economic, physical, financial and human capital vulnerabilities were high among small scale artisanal farm households. Coping strategies were developed to mitigate the disaster risk and manage the vulnerabilities of small-scale artisanal farmers.

**Key Words:** Disaster, Gem-mining, Small holder agriculture systems

Abstract ID: 056

## Local Responsiveness to Changes in Climate: A Case of Underutilized Marine and Aquatic Resources

De Silva A.\*<sup>a</sup>, Ekanayake J.<sup>a</sup>, Basnayake R.<sup>a</sup>, Rajapaksha H.<sup>a</sup>, Kalpana S.<sup>a</sup>

<sup>a</sup> *Sabaragamuwa University, Sri Lanka*

\*desilva.achini@yahoo.co.uk

Fish and seafood plays an important role in culturally diverse Sri Lankan consumer market while being a key supplier of essential protein to their diet. An island nation placed among the worst hit counties of changing climate and adverse effect of it. Study attempt to find out the local responsiveness of fishery value chains to the climate shocks and prolonged changes. Rapid market chain analysis performed in southern, western, eastern, northern and north western provinces of Sri Lanka to obtain the primary data. Key informant interviews were instrumental on identifying the market trends. Sample profile strengthens with fishermen, fish processors, traders, export processors, consumers and support services. Actors of both marine and inland fishery value chains feed the study across various agro-ecological zones. Underutilized marine and aquatic resources were recognized as promising answer to mitigate the threat of dependency on few commercial fish species. Indigenous marine and inland species are moving into both local and international value chains. Markets receive new fishery products, diversified consumer choices while ensuring better returns to small scale fishers. Application of local knowledge on postharvest management and value addition opens up new avenues to female actors of fishery value chains.

**Key words:** Aquatic, Marine, Fish, Underutilized

Abstract ID: 057

## Rapid Response Mechanism for Major Disasters – Lessons Learned and Future Prospects

Alahacoon N.\*<sup>a</sup>, Amarnath G.<sup>a</sup>, Ghosh S.<sup>a</sup>

<sup>a</sup> *International Water Management Institute (IWMI), Sri Lanka*

\*n.alahacoon@cgiar.org

IWMI's Rapid Response Mechanism initiated in 2013, provide near real-time response during a disaster to support the government and non-government organizations. This paper presents the framework of rapid response mechanism, satellite data-access, product development and analysis and dissemination to end-users. In collaboration with disaster charter i.e. Sentinel Asia and International Disaster Charter (IDC), IWMI and National Disaster Management Agencies activates charter for major flood disasters. The approach uses historical flood footprints, flood detection using rule-based classification from the near real-time satellite images and finally integrate with thematic layers of agricultural, demographical, infrastructure, and socio-economic data to generate maps and rapid damage assessment. The rapid response products are disseminated to the disaster management, civil and security agencies for humanitarian relief efforts. IWMI supported the rapid response efforts in South Asia (Sri Lanka, India, and Bangladesh), South East Asia (Myanmar, Lao PDR) and Africa (Nigeria, South Africa). Presently the efforts is to improve the lead-time in satellite data processing using cloud-based platform i.e. Google Earth Engine and rapid dissemination and analytical tools to assist the flood disaster response community.

**Key words:** Rapid response, Satellite data, Flood disaster, End-users

Abstract ID: 058

## **A Site Specific Study on Peacock and Human Conflict- A Case Study from Jayanthipura Grama Niladhari Division, Polonnaruwa- Sri Lanka**

Herath H.M.N.T.<sup>a</sup>, Gunathilake K.L.W.I.\*<sup>a</sup>, Chandrasekara C.M.K.N.K. <sup>a</sup>

<sup>a</sup> *University of Colombo, Sri Lanka*

\*wathsalaindeevare@gmail.com

Studying human wild animal conflict is one of the best evidences to show the changes of their population and the carrying capacity, which increases the conflict. Peacock (*Pavo Christatus*) is distributed mostly across low country dry zone in Sri Lanka. Peacocks were identified widely in jungles in past whereas now they become one of the prominent bird species in human dominated land uses. Therefore, the present study was carried out to find the dynamics of peacock population and the problems encountered due to their exposure to the anthropogenic environment. Field observations and a structured questionnaire survey were conducted in Jayanthipura Grama Niladhari Division of Polonnaruwa district in Sri Lanka. A total of 50 birds were enumerated during the observations in the period between 1500 to 1900 hrs. 30% out of the total informants suggested seasonal climate change and agricultural pattern as the root causes for the dynamics of peacock population in the area. More than 80% of peacocks get disappeared during Yala season where they again begin to appear in Maha season due to the assurance of food during cultivation season. 60% of them come to the village from September to March during North East Monsoon in search of food. Availability of food sources and the easy access to water are the two key factors for the arrival of peacocks to this area during the Maha cultivation season. The results of the research will help to come up with more practical and effective solutions, more stakeholder's participation in human – peacock conflict management

**Key words:** Wild animal conflict, Food security, Seasonal Climate change

Abstract ID: 059

## **Collective Action and Co-Management Initiatives in Bush Fire Management – A Case of Belihuloya Mountain Range**

Basnayake B.M.R.L.\*<sup>a</sup>, Rajapaksha R.H.N.<sup>a</sup>, Sandamith M.<sup>a</sup>, Wickramarathna I.<sup>a</sup>, De Silva D.A.M.<sup>a</sup>, Gunatiliake S.K.<sup>a</sup>

<sup>a</sup> *Sabaragamuwa University, Sri Lanka*

\*ruwinibasnayake@gmail.com

A forest fire can be a real ecological disaster, regardless of whether it is caused by natural forces or human activity. Belihuloya mountain range of Sri Lanka is frequently exposing for man-made bush fires every year during dry season (August- September). Mountain range is home for large variety of flora and fauna and declared as wildlife reserves. Our approach was to investigate the social and economic impact of bush fires, to develop maps on fire scares and fire risk zones and to develop co-management mechanism to mitigate the bush fires. Qualitative data collection tools were instrumental to collect the data from key areas annually damaged by bush fires. Scattered villages home for both Sinhala artisanal farmers and Tamil estate workers. Bush fires and wild life pestilence made significant impact on poverty-stricken villages. Institutional analysis shows the institutional landscape; overlapping mandates, poor coordination and decision making. Weak or non-existence of community organizations hinders the bush fire prevention mechanism.

Abstract ID: 060



## Municipal Solid Waste Management Discourse in Sri Lanka

Fernando N.\*<sup>a</sup>, De Silva M.<sup>a</sup>

<sup>a</sup> *University of Colombo, Sri Lanka*

\*nishara.fernando@gmail.com

The history of Municipal Solid Waste Management (MSWM) in Sri Lanka runs to colonial times. Since then, it has undergone many changes and reforms. These modifications are the result of the changing social discourse of MSWM in the country. This paper attempts to study how the MSWM discourse has changed over time and factors that have contributed to these changes. The study incorporated a thorough policy review developed using a systematic review of Ordinances, Acts and policies on MSWM. Further, 20 in-depth interviews were conducted with MSWM stakeholders representing national and local level government agencies, the private sector and NGOs to collect primary data. The findings revealed that the British colonizers adopted a nuisance discourse of MSWM which was continued till the early 1980's. This led to the accumulation of MSW in rural areas and suburbs of Colombo and other major cities. As a result, a new narrative that defined MSWM as an environmental issue was added to the discourse in 1980. This mixed narrative continued till the early 2000's where the nuisance discourse again became the dominant narrative pushing the stakeholders to adopt a "out of sight; out of mind" approach to MSWM which is practiced to date. It was also revealed that factors including colonization, closed economy, neo-liberal governing after 1978, opening up of the market and urban beautification initiatives facilitated the changes of the discourse. The paper concludes that the discourse on MSWM has changed over time by incorporating new narratives.

**Keywords:** Municipal Solid Waste Management; Discourse; Social Narrative; Nuisance

Abstract ID: 63

## Arcgis is a Best Web GIS Platform for Modelling Flooding and Other Risks Connected with Climate Change

Nadiradze K.\*<sup>a</sup>, Phirosmanashvili N.<sup>a</sup>, Goginashvili M.<sup>b</sup>

<sup>a</sup> *Association for Farmers Rights Defense, AFRD, Georgia*

<sup>b</sup> *Tbilisi State University, Georgia*

The world has reached critical condition of environment, ecosystems and especially Agriculture and farming due to Climate Change and weather constraints, Ecosystems are collapsing. Farmers, Rural Communities requesting development of early warning systems particularly vulnerable to the adverse effects of climate change, especially in its coastal zones, high mountain areas of Georgia, where a landslide, floods, debris flows, heavy rains and subtropical cyclones results in considerable economic loss, humanitarian stresses, and environmental degradation. Early warning systems and different GIS platforms like: ArcGIS which is a best web GIS platform, that can be integrated and combined into mobile apps, and desktops for specific audiences such as Farmers and Agricultural Cooperative's, developers, and GIS professionals to create some scenarios and models of flood and etc. The methodology used to spatially distribute flood hazard by ArcGIS combines the extent of past flood events with the spatial distribution of causal factors. This combination enables the calculation of a weighted score for each individual causal factor. The spatial distribution of the weighted scores are then aggregated to derive the distribution of the flood hazard index before being reclassified to obtain the spatial distribution of the intensity level of flood hazard for the region covered by the e-scenario.

**Key words:** Georgia, ArcGIS, Flood, Scenario

Abstract ID: 064

## Human-Elephant Conflict and the Development Projects: An Empirical Study of Badulla District of Sri Lanka

Kumara E.M.L.U.<sup>\*a</sup>, Liyanage, R.<sup>b</sup>, Palliyaguruge, R.C.<sup>c</sup>

<sup>a</sup> Disaster Management Centre, Sri Lanka,

<sup>b</sup> Red Cross Society, Sri Lanka, badullabeo@redcross.lk

<sup>c</sup> Sabaragamuwa University, Sri Lanka

\*emludaya@gmail.com

The threat of wild elephants in Sri Lanka, which has caused a negative impact on the lives of the people. It has been gradually increasing with the implementation of larger scale development projects in Sri Lanka. In this practical situation, this study explores why, how and when human-elephant conflict occurs as its main objectives. How to mitigate human-elephant conflict and maintain sustainability is the research problem of this study. Recorded data and field survey reports along with key Informant Interviews (KII), focused group discussions and participatory observation method were applied as research method. When the wild elephants lost their natural habitats due to the development of the farmer colonies, especially utilizing the dry zone forest covers, the Elephant- Human conflict started escalating. The consequence impact of this issue have increased the social-economic problems in the communities and also increased the number of deaths of both human and the wild elephants. Further it found, in particular, a time of the year the wild elephant attacks occur as an annual rhythm. The factors behind this pattern were identified.

**Key Words:** Human-Elephant Conflict, Development Projects, Farmer Colonies, Socio-Economic Problems

Abstract ID: 065

## The Community Based Flood Disaster Mitigation

De Silva P.\*<sup>a</sup>

<sup>a</sup> *Sri Lanka Navy*

\*hgud1969@gmail.com

Flood mitigation is an integral ingredient in the flood management cycle. Community-based flood disaster mitigation could be considered as risk reduction activities which are designed primarily by and for the people in flood-prone areas. Flood disaster mitigation using all the stakeholders' interventions alone is inadequate as they pay little attention to address the community dynamics, perceptions, or priorities. Local communities are often either ignorant of formal flood disaster management interventions or they find the interventions inappropriate due to the lack of understanding of the community's vulnerabilities and capacities for flood mitigation in Sri Lanka amidst laid down national action plans for DRR. Aim of this study is to introduce various avenues in mitigation of floods in Sri Lanka by empowering respective communities and community-based flood disaster management. Method of the study is to reach the vulnerable communities identified for floods in Ratnapura district and investigate the level of community involvement in flood mitigation, grasp their experiences, difficulties weigh with the national action plans and mechanism along with the author's personal experience for introducing viable solutions. Findings highlights that Lapses in involvement of local communities for DRR were the reasons for ineffective flood mitigation supported by unnecessary bureaucratic procedures, poor coordination among stakeholders, lack of trust on authorities, lack of training and awareness. Communities and community-based flood disaster management requires an enabling and supportive organizational structure within a resonant framework, local capacities be strengthened to assess risks and develop mitigation strategies that are based on the communities' human, financial, information and material resources. Introduction of Leadership traits, team spirit, awareness and practical training on flood response and mitigation for vulnerable communities and involvement of military found proven success.

**Key words:** Disaster, Flood, Community, Mitigation

Abstract ID: 066

## Sri Lanka Navy's Approach towards Effective and Efficient Emergency Response Mechanism

Dayananda D.\*<sup>a</sup>

<sup>a</sup> *Sri Lanka Navy*

\*dumindu.finest@gmail.com

Sri Lanka with a dedicated Ministry for Disaster Management, national action plan and many stakeholders including military dealing with Disaster Risk Reduction (DRR); emergency response mechanism seemingly inefficient especially during floods being the most significant disaster affecting the country. Sri Lanka Navy (SLN) traditionally deployed flood response teams, yet failed to supply the demand and maintain required effectiveness and efficiency in response mechanism especially when in national level floods like in year 2011. Questions raised on adequacy of attention to actual victims in time and how our mechanism to be developed complying Sendai framework for Disaster Risk Reduction (DRR). By understanding the problem, SLN has taken initiatives to Introduce best practices aiming Effective and Efficient Disaster Risk Reduction Mechanism during Hydrological Disasters in Sri Lanka by identifying gaps, learning from mistakes, search for modern technology and trials since 2011. SLN formed a dedicated unit capable of swiftly responding hydrological natural disasters. In addition, establishment of Disaster Response Unit, National level DM Training School, Drone technology, GIS for flood forecasting, SOPs, simulation training, Proactive deployment, Consideration for humanitarian standards proved success during recent floods. SLN success obtained through continuous research is shared with other stakeholders through training and awareness programmes targeting achievement of Sendai framework for DRR targets by 2030.

**Key words:** Response, Rescue, Simulation, Training

Abstract ID: 068

## Is EMI of VLF and ULF Wave on Base Perceptible on Spectral Band for the Detection Level and Significant for Pre-Seismic Events?

Verma U.\*<sup>a</sup>, Mishra A.<sup>a</sup>, Nsinha M.<sup>b</sup>, Nandan R.<sup>b</sup>

<sup>a</sup> *COAST Jaipur Amity University, India*

<sup>b</sup> *Patna University, India*

\*mth@yahoo.com

Prior to numerous seismic events (medium to large magnitude) EMI by emitted ULF and VLF interacting to 50-500hz microwaves frequencies in radio telecommunication are reported. Interference hinders signal propagation, prevailing noises, blurred images or complete shut- down at receptor stations. Analysis of sampled data for seismicity on a global basis in one- or two-years bin establish the hypotheses: less attenuation more absorption as noise in microwaves or telecommunication signals. Computation and statistics of explorative investigations on Ionograms imagery on NCEI for resultant interference on radio telecommunication waves at one and MMC and TEC parametric variation on another view reveal diagnostics consequent to emitted VLF, ELF and ULF long waves. Test of parameters for alternative hypothesis rejects attenuation (null) hypothesis by confidence value  $z = +2.1$ , variance .05 and .065.SD, significance level  $\alpha = .005$  were ascertained for error RMSD=12 %. Maxwell and Faraday law better explains mathematical modeling. Computation of Data observant through NCEI, NOAA, and IPS Australia during Nepal 7.9M 25.4.2015 and POK 5.9M 26.09 2019 validate finding. Simulation work, analysis of spectral band prior interaction purview can detect ULF and VLF propagation specifically and hence signifies pre-seismicity. Implication of Piezoelectric and piezomagnetic nano-materials to sensing is proposed in advance research.

**Key words:** EMI, ULF, VLF, Ionogram

Abstract ID: 071

## Sustainable Development Goals and Disaster Risk Reduction, Targets and Challenges for India

Mishra H.S.\*<sup>a</sup>

<sup>a</sup> *New Delhi Television Limited (NDTV), India*

\*h\_mishra@yahoo.com

Sendai Framework for DRR 2015-30 ('Sendai Framework') and United Nation's Sustainable Development Goals (SDGs) have laid down a comprehensive global action plan to combat the impact of climate change, especially with regard to growing threat posed by climate-related disasters. Significantly, 10 of the 17 SDGs and 25 of the 169 Targets identified are related to disaster risk reduction. The 'Sendai Framework' too makes it imperative for States to implement a risk-informed and resilient sustainable global development agenda. India has committed to reduce Green House Gas Emission Intensity of its GDP by 33% to 35% by 2030 from the 2005 level. Government of India has informed Parliament it would require US\$ 2.5-trillion to achieve its SDG targets by 2030. This paper attempts to critically study the challenges and roadblocks India faces in implementing its commitments made under the 'Sendai Framework' and UN's SDGs. It seeks to critically assess the following questions: A) What are the challenges, roadblocks and policy bottlenecks India faces towards achieving the SDG-13 and 'Sendai Framework' related targets by 2030? B) How will India mobilize US \$ 2.5-trillion required to achieve its SDG-related targets by 2030?

The methodology would involve an in-depth analysis of independent reports on climate change and weather-related disasters by UNDRR, official reports submitted in Indian Parliament, information and data personally collected during Jammu and Kashmir floods of September, 2014, official policy documents of Union and State Governments and interviews with law makers and weather scientists. India has taken first steps towards achieving its 'Sendai Framework' and SDG-related targets. But it urgently needs to put in place a new institutional roadmap, restructure its policy imperatives and align its developmental and disaster risk reduction-related objectives with global targets in a time-bound manner.

**Key words:** Sustainable Development Goals, Climate Change, Climate-related Disasters, Disaster Risk Reduction, Sendai Framework for DRR 2015-30.

Abstract ID: 073

## Drowning Prevention & Water Safety Sri Lanka: Challenges & Recommendations

Liyanaarachchige C.\*<sup>a</sup>, Jayaweera S.<sup>a</sup>, Nanayakkara S.<sup>b</sup>, Wijayarathne S.<sup>b</sup>, Jayawardena M.<sup>c</sup>

<sup>a</sup> *Disaster Management Center, Sri Lanka,*

<sup>b</sup> *Lifesaving association of Sri Lanka, asanka.nanayakkara@hotmail.com*

<sup>c</sup> *Lifesaving Victoria*

\*chathura@dmc.gov.lk

Sri Lanka is a tropical Island located in the Indian ocean with inland waters. Sri Lanka has the worst rates of drowning deaths in the world with 3 deaths on daily average, totalling over 800 drowning deaths per year according to Sri Lanka drowning report 2014 & 2020. Internationally ranking 12th highest in a comparison of 61 countries, and 10th highest low- and middle-income countries according to World Drowning report 2014. But 2020 drowning report revealed that Sri Lanka became the 48th due to implementation of drowning prevention and water safety action plan 2016-2020. The Disaster Management Centre (DMC) had taken a holistic approach with the technical support from the local and international lifesaving institutions. Initially, DMC has established the national steering committee for drowning prevention and water safety and five working committees, which include Public sector, private sector, NGO and INGO to prepare a National Plan of Action (NAP) on drowning Prevention & Water Safety for Sri Lanka. The NAP is aimed to utilize existing resources with an approach to turn the same problems into opportunities. Also creating an economic environment through tourism, provide basic swimming training is provided for schools and included "Swim for Safety" in the curriculum. Other objectives of the NAP are to ensure the safety of water related activities and building the capacities of first responders, enhancing employment opportunities and promoting water-related recreational activities through tourism. Media has to make aware the community with adequate information. Existing regulations are empowered and new regulations are imposed to prevent deaths due to drowning and water related activities through proper monitoring. Within this context, the aim of this paper is to create a platform to share Sri Lankan experiences and lessons learned from developing and practicing drowning prevention and water safety action plan 2016-2020.

**Key words:** Drowning, Prevention, Water, Safety

Abstract ID: 074



## National Emergency Operation Plan Sri Lanka: Challenges & Recommendations

Liyanarachchige C.\*<sup>a</sup>, Ariyaratna A.<sup>a</sup>

<sup>a</sup> *Disaster Management Center, Sri Lanka*

\*chathura@dmc.gov.lk

National Emergency Operation Plan (NEOP) is a plan describing the management arrangements; relationships; standard Operating procedures (SOPs); Strategies and mechanisms for ensuring effective response to disasters or emergency situations if and when they occur, specifying roles and responsibilities of multiple-Stakeholders in different scenarios. DM Act of Sri Lanka provides for the development of the NEOP. The NEOP Covers aspects of Emergency Operations, Including all activities ranging from “early warning (EW)” stating upstream, downstream and interface agencies through “Immediate recovery of essential services and public utilities”, covering in detail the emergency response and operations procedure for multi-stakeholder response in a disaster or emergency situations covering 21 hazards mention in the DM Act. NEOP will help to establish and maintain sustainable mechanisms/systems, resources, capabilities and guiding principles for responding to emergency situations if and when they occur in collaboration with all relevant stakeholders, in order to save lives and property, minimize harm and ensure physical health of the survivors; and immediate recovery of essential services. The users of this plan are the relevant stakeholders involved in emergency response activities comprising dissemination of EW, measures after EW, during and immediately after the Impact. DMC was appointed a steering committee with the participation of all DRM actors covering Public, private, NGO’s, INGO’s, UN agencies and community. Then organizations were categorized in to technical, first respondents, essential services and supportive servicers. After series of consultative meetings and workshops roles and responsibilities of each stakeholder agencies and their SOPS were developed; Hazard wise and scenario wise. Finally, NEOP was tested by conducting table top exercises at deferent level to find out any gaps to be filled. Within this context, the aim of this paper is to serve as a platform to share the process adapted by Sri Lanka and lessons learned of developing the NEOP 2020-2025.

**Key words:** Emergency Operation, Early Warming, Standard Operating Procedures, Servicers

Abstract ID: 075

## Management of the Dead in Disasters: Knowledge, Attitudes and Self-Reported Practices Among a Group of Army Soldiers in Galle District, Sri Lanka

Chaminda U.G.G.\*<sup>a</sup>, Warushahennadi, J.<sup>b</sup>

<sup>a</sup> *Department of Health Services, Southern Province, Sri Lanka,*

<sup>b</sup> *University of Ruhuna, Sri Lanka*

\*gihanchaminda@gmail.com

Improper management of the dead in disasters can hinder the identification, leads to loss of important forensic evidence and affects the dignity of the dead. Army soldiers play a vital role in dead body management in disasters. Objective of this study was to describe the knowledge, attitudes and self-reported practices on management of the dead in disasters among a group of army soldiers in Galle district, Sri Lanka. This study was conducted using a self-administered questionnaire. Based on the percentage of correct responses, participants were classified into three groups denoting their overall knowledge using pre-determined cut-off values (>70% - "good", <50% - "poor", 50-70% - "moderate" level of knowledge). The entire study population of 188 army soldiers (N=188) was included in this study. A majority (61.2%, n=115) had a moderate level and 32.4% (n=61) had a good level of overall knowledge. In particular, knowledge on wearing face masks by dead body recovery teams (8%) and spraying disinfectants to dead bodies (30.9%) was poor. Even though a majority had either moderate or good level of overall knowledge, deficiencies of knowledge in certain aspects were evident. A majority had more favourable attitudes and there is a space for improvement in certain practices.

**Key words:** Dead body management, Disasters, Army soldiers, Sri Lanka

Abstract ID: 076

## Assessment of Existing Disaster Resources Information and Design Interactive Resources Network for Effective Disaster Management

Kukulavithana S.\*<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*sampath@dmc.gov.lk

Resource mobilizing is one of the important area for DRM in a country. Most of the countries do not have proper mechanism to mobilize the needed resources immediately to save the life of victims and provide basic services during each phase of disasters. One of the key responsibilities of DMC is providing instruction and guideline to the stakeholders to mobilize the resource during each phase of disasters. As per the need DMC developed database, Sri Lanka Disaster Resources Network (SLDRN) and collect the information to support the disaster response. The goal of this Assessment will be attempted to measure the effectiveness of the existing resource distribution network and design interactive resources network for effective disaster management. The study revealed detailed phase-wise requirement of various types of resources. Data will be collected from Disaster Management Centre and community level through the volunteer contribution using android based mobile application and data analysed using ESRI ArcGIS server software and displayed in Emergency Operation Centre of DMC. The result from this study will not only help disaster risk management in Sri Lanka but also help in preparedness planning in other disaster-prone regions of the world.

**Key words:** Disaster Management, Resource Management System, Effective Resource Management, Sri Lanka Disaster Resources Network

Abstract ID: 078

## Evaluation of the Impacts of the Salinity Barrage in Kelani Ganga Using 1D-2D Hydraulic Model in Terms of Flooding

Siriwardena K.K.G.I.L.<sup>a</sup>, Widanapathirana S.<sup>a</sup>, Pannala P.A.A.P.K.<sup>a</sup>

<sup>a</sup> *Climate Resilience Improvement Project (CRIP), Sri Lanka*

Kelani Ganga is the main source to cater the water requirement of Colombo and Gampaha Districts, Sri Lanka. The main water treatment plant located at Ambatale and by 2040, with the expanding water requirement of the Port City in Colombo, the demand gap of Ambatale WTP will be increased up to about 15.2 m<sup>3</sup>/s (1.31 MCM/day). Kalani river bed has been considerably lowered since 1990s, as excessive sand mining. The intake at Ambathale was frequently subjected to salinity intrusion during the dry periods. As a result, NWS&DB constructed a barrage across the river just downstream of the Ambathale intake to overcome this problem. With the introduction of the barrage, the upstream water levels of the barrage has been increased during the recent floods. A cross sectional survey data was used to gather information on prevailing conditions in river morphology. This paper is evaluated the flood impacts of the barrier for 2016 and 2017 flood events using the hydro-dynamic 1D-2D Model study, built using Flood Modeller and TUFLOW linked software. Though the barrier is most feasible solution for salinity intrusion, it was created the head loss of 0.5 m, and the backwater effect about 10 km upstream for 2016 event and it is recommended either to keep the barrage top level at about -3.5 m AMSL to avoid the significant head loss or to move the water intake to the upstream to minimize the impact to the public during the flooding.

**Key words:** Salinity Barrier, Hydro-dynamic 1D-2D Model, Ambathale, Evaluation, NWS&DB

Abstract ID: 079

## The Variability & Trends of Precipitation & Air Temperature in Sri Lanka

Priyantha H.D.\*<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*hdgpriyantha@dmc.gov.lk

The *Germanwatch Climatic Risk Index* shown Sri Lanka is the second most affected country in the world. Last 03 decades Sri Lanka has increased water-related disaster in various climatic Zones and impact has increased due to climatic changes. This research has examined the variability and trends of precipitation and air temperature which influence to water-related disasters. The secondary data has been collected from technical agencies of the Department of Meteorology and affected information has been collected from the Emergency Operation Centre of the Disaster Management Centre. The analysis has been done through simple regression analysis, ANOVA and deviation graphs. The variation and trends of Monsoon Rains have been identified as follows. According to Observation Centres, 30% of the total annual rainfall of South West Monsoon has increased in Colombo up to 35.7%, Ratnapura 40.5%, and Nuwara Eliya 36.5%. Northeast Monsoon Rainfall which is 26 % of the total annual rainfall has slightly increased to 26.6% in Anuradhapura, which are major findings of the Research. As a result of the variations and trends in the rainfall over a period of 30 years, Sri Lanka has been subjected to frequent floods and droughts. This result facilitates Multi Stakeholders Agencies for the preparedness and mitigation measures which are required to reduce flood and drought disasters in the affected areas. Mitigating the climatic disaster impact in Sri Lanka, a proper and improved water management system is recommended to be implemented including Climatic Hazard Mitigation Projects.

**Key words:** Climate change, Climatic disaster, water related Disaster, climatic hazard mitigation project

Abstract ID: 080

## Gaps in Decision Making, Communication and Coordination within the Interface of Tsunami Early Warning System in Sri Lanka

Sakalasuriya M.\*<sup>a</sup>, Haigh R.<sup>a</sup>, Amaratunga D.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*maheshika.sakalasuriya@hud.ac.uk

Landslides become the most calamitous event which severely affected the physical and cultural landscapes of uplands in Sri Lanka. Of the 65,000 Sq.km of land extent of Sri Lanka, an area of nearly 20,000 Sq.km encompassing 10 districts is prone to landslides. Being prepared for disaster is the most effective way to minimize the damage suffered by the affected population. Therefore, community preparedness in landslide prone areas is essential to minimise the landslide risk. Spatial distribution of buildings expose to landslide hazard are being identified through 1:10,000 scale landslide hazard zonation maps developed for the Grama Niladari Divisions in Sri Lanka. House-by-house questionnaire survey was carried out among 8463 housing units locate within very high and high landslide hazard prone areas of Walapane Divisional Secretariat Division of Nuwara Eliya District. Quantitative analysis of the data collected on housing units revealed; 10.5% of houses affected by disaster, 34% of residence believe their house/land is susceptible for disaster, 34% of houses record of tell-tale landslide signs at the vicinity of houses, only 6.7% of residents took precautionary measures against landslide during last three years, 54% of residents aware of availability of village disaster management committee. These findings indicate disaster preparedness status of the community is low and the necessity to motivate preparedness attitude of the community. Therefore, through literature review this paper attempt to (1) assess the factors influence motivation to engage in disaster preparedness (2) develop a conceptual framework to motivate preparedness attitude of the community.

**Key words:** communication, coordination, decision-making, interface, Sri Lanka, tsunami early warning

Abstract ID: 081

## Introducing New Initiatives for Resettlement in Sri Lanka- An Analysis of Resettlement in Aranayake Kegalle

Mahendra J.\*<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*jagathm@dmc.gov.lk

In 2016, Sri Lanka faced massive disaster events due to adverse effect of South-West monsoon (SW). Continuous torrential rain for several days resulted in floods & landslides in central hills of Sri Lanka respectively. This study analysed the Aranayake resettlement process. In this study, data were collected through household discussions, key informant interviews, and focus group discussions. The secondary data was collected through literature surveys and case study itself. Research findings reveal new resettlement guidelines. Provision of US\$ 549.55 is inadequate to fulfil amenities and house for resettlement. Appropriate steps had taken for sustainable restitution considering safer land factors too. Through newly introduced owner, donor and government-driven policy on resettlement, displaced peoples were successfully building back. Within two years 644 families were resettled with permanent housing solutions in Aranayake. The conclusion of the study is the Aranayake resettlement process expanded a wide range of pivotal avenues to resettlement with all-inclusive such as, infrastructure facilities, livelihood assistance, safety land with permanent shelters, education and health facilities. In terms of disaster resilience, this enabled to receive affordable benefits for sustainable restitution of displaced victims in Sri Lanka.

**Key words:** Resettlement, Relocation, Landslide, Displacement

Abstract ID: 082

## Development of a Decision Support Weather Advisory System for Dry Zone Farmers in Sri Lanka

Dissanayake U.\*<sup>a</sup>, Premalal S.<sup>b</sup>, Wickramasinghe D.<sup>c</sup>, Gunaratne P.<sup>a</sup>, Jayasinghe A.<sup>d</sup>, Rienzie R.<sup>a</sup>, Kuruppuarachchi N.<sup>a</sup>, Hettige V.<sup>c</sup>

<sup>a</sup> *University of Peradeniya, Sri Lanka*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

<sup>c</sup> *United Nations Development Programme, Sri Lanka*

<sup>d</sup> *Mahaweli Water Security Investment Programme, Sri Lanka*

\*uvasarad@gmail.com

A study was conducted to assess the status of the present agro-meteorology information and advisory system including gaps to disseminate agro-met advisories to the interested parties, based on which to propose a suitable agro-meteorology advisory and information system to facilitate field-level decision making among vulnerable groups. The study comprised of both survey and interview-based approaches covering Kurunegala and Anuradhapura districts. It was found that there were substantial inefficiencies in the present system run by the Department of Meteorology (DoM) and Department of Agriculture (DoA) such as time-consuming and too general nature, while the lack of awareness among stakeholders. The proposed agro-met advisory information system has seasonal forecast and 3, 10 and 30-day forecasts which will be collaboratively prepared by the DoM and DoA. The DoA should also maintain and run the advisory information system. Instead of present top to bottom approach, these advisories will be disseminated regularly and simultaneously to the ground level, using a variety of ICT tools under two mechanisms. In one mechanism, advisory information will be sent to the tank-based farmer societies enabling them to make informed decisions and these will be monitored and supported by technical experts, while in the other, individual groups/ persons can access the information upon registration. Moreover, the new system facilitates a two-way real-time information and data management system based on which standard Operation Procedures were developed.

**Key words:** Weather advisory system, Dry zone

Abstract ID: 084



## Techno Physiological Approach to Reduce Drought Stress of Young Rubber Plantations in Drought Prone Areas - A Case Study in Moneragala, Intermediate Zone of Sri Lanka

Nakandala S.A.<sup>a</sup>, Weerasinghe K.D.N.<sup>b</sup>, Seneviratne P.<sup>a</sup>, Iqbal S.M.M.<sup>c</sup>

<sup>a</sup> Rubber Research Institute of Sri Lanka

<sup>b</sup> Ministry of Social Empowerment and Primary Industries, Sri Lanka

<sup>c</sup> Rubber Research Institute of Sri Lanka

<sup>d</sup> International Institute of Development Training, Sri Lanka

\*sanakandala@gmail.com

Expansion of rubber cultivation from Wet to Intermediate Zone of the country is one of the strategic initiatives to increase the national rubber production. Growing rubber in the Intermediate zone is threatening by the annual dry periods which are elongating, due to the global warming. Since the impact of drought on rubber nurseries and young rubber plantations would be higher, development of a techno physiological package is needed when shifting rubber to drier areas. Salicylic acid (SA), as a stress tolerance mediator, plays an important role in drought stress, activating intercellular defence mechanisms of the plant had been tested. The current experiment was conducted under nursery condition at Monaragala Substation, Rubber Research Institute of Sri Lanka in 2015. The effect of different SA concentrations viz., 0.0, 0.1, 0.3 and 0.5 mM on drought-stress induced changes in morphological and physiological growth attributes of rubber plants were examined. Results revealed that application of salicylic acid in a range of 0.3 to 0.5 mM significantly reduced the harmful effects on drought stress by improving the growth of young rubber plants. Based on the results a recommendation has been made on SA application as a prominent approach to increase the drought tolerance of young rubber plants.

**Key words:** Drought stress, Rubber nursery, Salicylic acid, Drought tolerance

Abstract ID: 085

## Life Two Years After Relocation: Status Quo of Natural Hazard Induced Displacement and Relocation in Kegalle, Sri Lanka

Fernando N.<sup>a</sup>, Amaratunga D.<sup>b</sup>, Haigh R.<sup>b</sup>, Wise B.<sup>a</sup>, Prasanna J.<sup>c</sup>

<sup>a</sup> *University of Colombo, Sri Lanka*

<sup>b</sup> *University of Huddersfield, UK*

<sup>c</sup> *National Building Research Organization, Sri Lanka*

\*nishara.fernando@gmail.com

The most destructive natural hazard was experienced on the 14th of May 2017 which resulted in severe landslides and floods in fifteen districts of Sri Lanka. The Disaster Management Center of the National Building and Research Organization (NBRO) reported 212 deaths and 717,622 people belonging to 184,265 families been affected. NBRO conducted a vulnerability assessment and decided to relocate families living in high and middle-level land exposed to landslides by introducing relocation as a 'landslide vulnerability reduction strategy.' Three relocation options namely Donor Driven, Government Relocation Sites (GRS) or Individual Relocation Sites (IRS) were made available. This paper explores the status of relocated families two years after, by interviewing a randomly selected sample of 435 household heads (129 Donor Built households, 190 GRS and 116 IRS households) from the Kegalle district in Sri Lanka. The findings reveal that households with a disabled member, a senior citizen or houses headed by a female preferred a donor-built house. Others who opted for the GRS housing type reported higher expenditure for construction activities. While the IRS option is more favourable, it has its own constraints. This research also recommends policy guidelines to make the relocation process more sustainable in the future.

**Key words:** Relocation, Risk reduction strategy, Relocation options, Resilience

Abstract ID: 086

## Research and Innovation in the Context of Disaster Resilience in the Sri Lankan Higher Education Sector

Hettige S.T.<sup>\*a</sup>, Weerasinghe K.D.N.<sup>b</sup>, Fernando N.<sup>a</sup>, Amaratunga D.<sup>c</sup>, Haigh R.<sup>c</sup>, Liyanage C.<sup>d</sup>, Navarathene C.<sup>b</sup>, Siriwardana C.S.A.<sup>e</sup>

<sup>a</sup> University of Colombo, Sri Lanka

<sup>b</sup> University of Ruhuna, Sri Lanka

<sup>c</sup> University of Huddersfield, UK

<sup>d</sup> University of Central Lancashire, UK

<sup>e</sup> University of Moratuwa, Sri Lanka

\*hettigesiri@gmail.com

The significance of developing robust, multi-stakeholder Disaster Resilience (DR) mechanisms has multiplied in the last few decades. Accordingly, countries around the world have taken measures to strengthen the capacity of Higher Education Institutions (HEIs) related to DR to generate research based guidelines and develop interventions. This paper investigates the status of research and innovation within HEIs in Sri Lanka by examining existing policies, infrastructure and the status of research staff. Key informant interviews were conducted with a purposively selected sample of academics from national universities, policy-makers and directors actively engaged in DR and Disaster Management (DM). Interview guidelines were developed based on a detailed literature review. The findings reveal that Sri Lanka lacks a national policy on R&I, which has reduced the support received by researchers. Inadequacy of funds to conduct quality research, lack of systematic training, absence of multi-stakeholder participation and limited permanent research staff are major barriers. HEIs should focus on establishing a national policy to develop R&I, allocate more funds and establish a permanent carder for highly qualified research staff to further improve R&I capacities. It concludes that the prevailing capacities of Sri Lankan HEIs are inadequate and emphasize the importance of taking prompt measures for improvement.

**Key words:** Disaster Resilience (DR), Funding; Higher Education Institutions (HEIs), Policy, Research and Innovation (R&I)

Abstract ID: 087

## Strategies for Women's Empowerment through Post-Disaster Reconstruction in Sri Lanka

Amaratunga D.\*<sup>a</sup>, Thurairajah N. Sridarran P.

<sup>a</sup> *University of Huddersfield, UK*

\*d.amaratunga@hud.ac.uk

Women are often left out of formal planning and decision making of disaster management procedures and marginalised from community authorities. As such, their needs and concerns are often overlooked, and their profound contributions frequently go unrecognised. Accordingly, the purpose of this research is to propose strategies to enhance women's empowerment during post-disaster reconstruction in Sri Lanka. The abstract is based on a qualitative study that comprises of three phases of data collection, including expert interviews and disaster-affected community interviews. The empirical study for this paper was conducted in Sri Lanka. The first phase of data collection contributed to the second phase design. The results are then triangulated with a comprehensive literature review and another set of interviews from the third phase. The study presents strategies for women's empowerment by highlighting women's difficulties, opportunities and obstacles that are present during post-disasters, enablers, and women's role in empowerment during post-disaster reconstruction. The strategies are presented in different phases of reconstruction at the household level and community level, to attain individual empowerment and collective empowerment. Women's empowerment in post-disaster has been widely highlighted among related studies. However, a limited academic engagement is shown in integrating women's empowerment in post-disaster reconstruction. Further, the literature hardly contains any empirical evidence on the elements in the process of women's empowerment within the reconstruction context. Thus, strategies for women's empowerment based on rigorous academic research is significant to reduce disaster vulnerabilities.

**Key words:** Women, Empowerment, Post-disaster reconstruction, Strategies, Sri Lanka

Abstract ID: 088

## **An Approach for Impact-Based Heavy Rainfall Warning Based on the ECMWF Extreme Forecast Index and Level of Vulnerability to the Hazard**

Mendis M.M.P.\*<sup>a</sup>

<sup>a</sup> *Department of Meteorology, Sri Lanka*

\*merilmdi@yahoo.com

This study focuses on developing a methodology for an impact-based heavy rainfall warning system in Sri Lanka. A risk matrix is used as a basic tool of the impact-based warning system. The matrix relates to the level of vulnerability to heavy rain hazards and the likelihood of occurrence of the severe weather. Likelihood of extreme weather is determined by Total Precipitation Index (TPI) from the European Centre for Medium-Range Weather Forecasts (ECMWF), Extreme Forecasts Index (EFI). The level of the vulnerability is examined by calculating exposure, sensitivity and hazards related to the heavy rain (mainly flood and landslides). Levels of impact are calculated by using the risk matrix. The severity of the warning is visualized using four colour map-based system. This approach is tested through five case studies of typical disaster events occurred around Sri Lanka. Case study results provide comprehensive evidence for the usefulness of vulnerability assessment in this study. Impact-based forecasts generated by all case studies are given equally good results and this information enables for disaster managers to take early action to prevent or minimize the adverse effects of hazardous weather.

**Key words:** Impact-based forecast, Risk matrix, Extreme Forecasts Index (EFI)

Abstract ID: 089

## Identified Sociological Issues on Resettlement in Sri Lanka - The Case Study of Landslide in Badulla, Kegalle and Rathnapuara

Mahendra J.<sup>\*a</sup>, Kumara U.<sup>a</sup>, Manjula S.H.<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka,*

\*jagathm@dmc.gov.lk

The events of climate change and the frequent climatic disasters in the hill country of Sri Lanka experienced in the past. At the same time displacement practices raised, due to this displacement, communities face sociological issues and it has been impacted on their sustainable settlement. In this context, the case study method has chosen on comparative and qualitative analysis at different community groups of the displaced areas in Koslanda, Aranayake and Rathnapura. The primary data were derived from household discussions, key informant interview and focus group discussion. Further, the secondary data was collected on a temporal basis as following the years of 2014, 2016 and 2017 at the case study area. The cases study found before Aranayake the compensation value for the resettlement is maximum US\$ 551.19 per household but after it was maximum US\$ 8819.07 per household. In conclusions identified following sociological issues in resettlement process of Sri Lanka such as housing structure (size, mode, material, location, ownership, construction), relief/concessions, embracing new paradigm, cultural & religion issues, land issues (acquisition, selection, plot out, distribution & ownership) livelihood, infrastructure development, financial imbalance, health, education, security, procedures of implement, public/private involvement.

**Key words:** Landslide; Displacement, Resettlement, Sociological issues

Abstract ID: 090

## Lessons Learnt from Implementing a Training Course on Ecosystems Resilience in Changing Climate for Mainstreaming Weather and Climate Information for Sectoral Development in Four Countries of South Asia and South East Asia

Jayasinghe S.\*<sup>a</sup>, Basnayake S. Gupta N., Weerasinghe K.D.N., Weerasinghe B.

<sup>a</sup> Asian Disaster Preparedness Center, Thailand

\*susantha@adpc.net

Practitioners and policymakers require understanding of weather and climate, slow and rapid onset of disasters, orientation towards disaster preparedness based on climate outlook to mainstream climate information application and utilize adaptive technological solutions as remedial measures to improve agriculture livelihoods. To ensure enhanced agro-ecosystem services and functions as part of policy interventions at the national and sub-national level we developed a 4-day training course on “Agroecosystem Resilience in a Changing Climate” for practitioners and policymakers. This course adopted a broader paradigm where the resilience of agro-ecological systems is entwined with concepts of sustainable livelihoods and food security. The training course trained government officials, academics, and NGO representatives in understanding agro-ecosystems, its functions and threats posed by weather and climate change to build a resilient agro-ecosystem. The objective of the workshop was to develop master trainers through training of trainers (ToTs) in four target countries namely Nepal, Thailand, Sri Lanka and Vietnam. Towards the end of each training course, an evaluation questionnaire was provided to each of the participants. Responses for Likert-type scaled questions were evaluated using percent agreement. A thematic classification of the open-ended questions was also carried out. Key findings from the workshop demonstrated: 1) participants with limited prior knowledge on climate resilience could be effectively trained as master trainers; 2) participants have expressed that time spent for theoretical content and the group activities were just adequate as they have different desirable outcomes; 3) the collaborative interaction between different stakeholders enabled the participants to foster a cohesive cohort of individuals which can advocate powerful cohort for proper implementation of agro-ecosystem resilience for enhanced livelihood of farmers; and 4) some deviation can be observed in the training course organised in Nepal where the training course hasn't been able to meet the expectations of many of the participants which may be due to under optimised time management.

**Key words:** Agroecosystem, Resilience, Training of Trainers, Climate Change

Abstract ID: 091

## **Built Environment Perspective of Post-Disaster and Conflict - Induced Displacement**

Jayakody R.R.J.C.\*<sup>a</sup>, Malalgoda C.<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*c.jayakody2@hud.ac.uk

The rate of forced displacement befalling in different countries all over the world today is phenomenal. Out of the various types of forces displacements, conflict-induced and disaster-induced forced displacement are among the biggest humanitarian challenges of the states and the international communities in the 21st century. The phenomenal rate at which people are being forcefully displaced puts significant pressure on the built environment which includes adequate and appropriate housing, sufficient infrastructure, and suitable built environment to both host and displaced communities. However, the built environment perspective of post-disaster and conflict-induced displacement has less academic engagement and is seldom addressed in policies. With the identification of this research gap, the project titled REGARD (REbuildinG AfteR Displacement) which is a European commission funded project, aims to develop competencies in rebuilding communities following disaster and conflict induced mass displacements from the perspective of the built environment. In achieving this aim, this ongoing project first identify the needs of the host and displaced communities. Subsequently, project will address the knowledge gaps of BE professionals and help improving their competencies. The project also informs policy recommendations to BE professional bodies in upgrading the professional competencies to address the needs of the host and displaced communities.

**Key words:** Built environment, disaster and conflict-induced displacements, Rebuilding communities, Resettlement

Abstract ID: 092



## Real-Time Flood Forecasting System for Mi Oya Basin

Priyankara W.M.S.\*<sup>a</sup>, Dias D.D.<sup>b</sup>, Meegastenna T.J.<sup>a</sup>

<sup>a</sup> *Irrigation department, Sri Lanka*

<sup>b</sup> *University of Peradeniya, Sri Lanka.*

\*wmspriyankara@gmail.com

Sri Lanka is highly vulnerable to climate change impacts. Extreme weather events such as high-intensity rainfall followed by flash floods and landslides, and scarce rainfall resulting in droughts are now becoming more common occurrences in Sri Lanka. These hazards pose significant threats to the people and to the social and economic development of the country. Mi Oya basin is one of the critical basins with respect to flooding due to spilling of reservoirs. Despite the functionality of reservoirs in flood retention, unavailability of flood forecast data and inaccessibility to real-time data limit the decision making on reservoir operations for better flood management. The objective of this paper is to discuss the development of a decision support system, manoeuvring the state-of-the-art hydrodynamic modelling software and available measurements. The suite of models consists of license-free software mainly hydrological, hydraulic, reservoir simulation, inundation mapping and real-time simulation platform for decision making. Measured rainfall and water level data from Hydro-Meteorological Information System (HMIS) and rainfall predictions are fed to the models and reservoir operations are analyzed to optimize downstream flooding. Results would be retrieved through a web-based flood warning system.

**Key words:** Mi oya basin, Real time flood forecasting, Hydro dynamic modelling

Abstract ID: 094

## Identifying the Coordination and Institutional Needs to Implement an Effective Natural Disaster Insurance Scheme for a Resilient Community

Cooray, H.\*<sup>a</sup>, Jalath I.

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*hashanthicooray@ymail.com

Sri Lanka lack of structured natural disaster risks transfer mechanisms and natural disaster insurances in order to reduce the impact of natural disasters on government and community. Studies on disaster insurance schemes in Sri Lanka revealed that several natural disaster insurance schemes are available and few of them are government schemes. Besides those insurance schemes are unsuccessful to satisfy the major priority area of Sendai Framework, “invest in DRR for resilience”. The objective of the proposed research is to identify alterations which could support and incorporate with the current existing natural disaster insurance schemes to fulfil the gaps and to reduce the government burden by improving the potential to manage future natural disaster risks efficiently and promote natural disaster insurance schemes by providing suggestions to other insurance companies. Several interviews and surveys were conducted in Katutura and Anuradhapura areas to identify weaknesses and required improvements for existing risk transfer mechanisms and random survey samples were selected based on vulnerability for household and agriculture from flood and drought. The results indicate that although the government is implementing these natural disaster insurance schemes by tolerating full cost burden, the risks cannot be transferred efficiently. Delays in the insurance process, low returns, valuation issues and corporate objectives of the related agencies have been found to be less satisfactory of the public on these schemes. Proposed research suggested incorporating with technology innovations, non-structural measures on DRR, introduce multi diversity insurance schemes and approaches to reduce livelihood and economic impact of the vulnerable communities.

**Key words:** Insurance, Risk Transfer, Natural Disaster, Resilience Community

Abstract ID: 095

## Measuring Household Carbon Footprint: Population-Specific Adaptation and Validation of a Tool for South Asia

Kalubowila K.<sup>\*a</sup>, Karunaratne P.<sup>b</sup>, Arambepola C.<sup>c</sup>

<sup>a</sup> Ministry of Health, Sri Lanka

<sup>b</sup> University of Peradeniya, Sri Lanka

<sup>c</sup> University of Colombo, Sri Lanka

\*kalubowilak@gmail.com

The effects of climate change occur across the globe. Unless drastic action is taken to reduce the greenhouse gases, adapting to these untoward effects will be challenging and costly. As the first step, estimation of the greenhouse gases is of prime importance yet, there are no studies conducted in South Asian households partly due to non-availability of a valid assessment tool. To bridge this gap, this study aimed to validate a tool to assess the carbon footprint (CFP) of residents in a Sri Lankan household (HH). The 28-item Resources and Energy Analysis Program (REAP) Calculator which had been originally developed for developed countries was translated and followed population-specific adaptation using modified Delphi process with a panel of 10 experts to ensure its judgmental validity. Construct validity was assessed among 210 HHs by performing exploratory factor analysis and confirmatory factor analysis. Reliability was assessed using the test-retest method and internal consistency. After four rounds of Delphi technique and validation, CFP-Sri Lanka (SL) tool was identified as comprising a five-factor model of 20 items, explaining 64.3% of the total observed variance. The tool showed a stable factor structure (RMSEA=0.181; CFI=0.85; NNFI=0.813; SRMR =0.085; GFI=0.643) and reliability (internal consistency of 0.87). Therefore, Sinhala version of the CFP-SL tool is a valid and reliable tool to assess the CFP in urban and rural Sri Lankan HHs.

**Key words:** Carbon footprint, Factor analysis, Greenhouse gases

Abstract ID: 096

## Decision Support System for Strengthening Multi-Hazard Early Warning and Disaster Risk Governance – A Case Study of Tropical Cyclone GAJA 2018, Tamil Nadu, India

Pal I.\*<sup>a</sup>, Dash I.<sup>a</sup>, Shanmugasundaram J.<sup>a</sup>

<sup>a</sup> *Asian Institute of Technology, Thailand*

\*indrajit-pal@ait.ac.th

Effective Early Warning system is needed in order to reduce loss and impacts. Due to lack of advanced technology or technical expertise, EWS are sometimes poor in the country. Sometimes, technical language used in early warnings can limit the ability of communities to understand and act appropriately to warnings. Numbers of attributes of governance under the federal systems are interplay in disasters, before, during and after a situation. Disasters are a true litmus test of governance. A decision support system (DSS) will greatly assist in decision making, through compilation of useful information and raw data, experiences from past disaster events as simulations and identifying risks and gaps, solve problems and decision making. With advances in Information Technology (IT) and Communications (ICT), there has been a significant growth in the use of these tools in disaster management. Present study explored the efficacy of risk governance mechanism and multi-hazard early warning through SMART system developed by Regional Integrated Multi-Hazard Early Warning System (RIMES). The research broadly focuses on the evaluation of entities in disaster risk management, especially the features relating to disaster planning, preparedness and response mechanism in the context of SMART system towards effective decision making by the provincial and local governments.

**Key words:** Risk governance, multi-hazard, early warning, decision support system

Abstract ID: 097

## Challenge to Evacuate People in Case of Nyiragongo Volcano Eruption

Munihire M.M.\*<sup>a</sup>, Karume K.<sup>a</sup>

<sup>a</sup> Goma Volcanic Observatory, Democratic republic of Congo

\*monyota7@gmail.com

Two hyperactive volcanoes, namely, Nyiragongo and Nyamulagira are located a few kilometres from the City of Goma in the Democratic Republic of Congo. The Nyamulagira Volcano erupts almost every two years (40km from Goma), while the recent eruptions of Nyiragongo Volcano ( five km from Goma) occurred on January 1977 and January 2002. The January 2002 Volcano Nyiragongo eruption killed about 250 people, left 120,000 homeless people, affected 13% of the urban area and destroyed 80% of the economy of Goma. Currently, Volcano Nyiragongo remains very active and can erupt sooner or later. Presently the City of Goma is developing in infrastructure, also population increased from 350,000 to 1,200,000 people between 2002 and 2019. This study has two major objectives: to contribute to the evacuation plan in event of an eruption of Nyiragongo volcano (i) also, allow people to access to information on the behaviour to adopt in order to better leave the risk areas in case volcanic eruption(ii). This research project will identify evacuation routes and also propose an evacuation plan for people. A survey questionnaire on volcanism is distributed to a sample of 1,200 persons selected from different groups of people to assess the level of understanding of risk by people.

**Key words:** Active volcano, Volcanic crisis management, Evacuation of people

Abstract ID: 098

## Assessment of Typical Sri Lankan School Buildings to Extreme Coastal Flooding

Del Zoppo M.<sup>\*a</sup>, Wijesundara K.<sup>b</sup>, Baiguera M.<sup>c</sup>, Dias P.<sup>d</sup>, Rossetto T.<sup>c</sup>, Robinson D.<sup>c</sup>, Wijetunge J.<sup>b</sup>, Di Ludovico M.<sup>a</sup>, Little A.<sup>c</sup>, Prota A.<sup>a</sup>

<sup>a</sup> *University of Naples Federico II, Italy*

<sup>b</sup> *University of Peradeniya, Sri Lanka*

<sup>c</sup> *University College London, United Kingdom*

<sup>d</sup> *University of Moratuwa, Sri Lanka*

\*marta.delzoppo@unina.it

Observations in the aftermath of the 2004 Indian Ocean tsunami show that many reinforced concrete school buildings in Sri Lanka suffered severe damage. Failure mechanisms included blow out of walls, scour of sandy soil leading to foundation failure (and consequent partial collapse). This work proposes a methodology to assess the physical resilience of existing Sri Lankan school buildings to future tsunami. A prototypical 2-storey school building is considered as a case-study. The structural analysis is carried out using a newly-developed approach that accounts for the effects of multiple tsunami loads, e.g. scour, hydrodynamic and pressure loads. In addition, the response of external infills in both in-plane and out-of-plane directions is investigated. The results of this preliminary assessment indicate that the model can simulate the damage mechanisms observed after the 2004 Boxing Day tsunami. A recently-awarded UK Global Challenges Research Fund project will extend this study within a multi-hazard assessment framework to assess education facilities in Sri Lanka's Eastern Province. The hazards looked at will include strong wind, mild earthquake and storm surge, and the analyses are to be carried out with the aim of developing multi-hazard school design solutions.

**Key words:** Multi-hazard fragility assessment, Extreme coastal flooding, School, Resilience, Tsunami

Abstract ID: 100

## Heavy Metal, Oil and Grease Pollution of Negombo Lagoon in Sri Lanka

Chandrasekara C.M.K.N.K.<sup>\*a</sup>, Weerasinghe K.D.N.<sup>b</sup>, Pathirana S.<sup>c</sup>, Piyadasa R.U.K.<sup>a</sup>

<sup>a</sup> *University of Colombo, Sri Lanka,*

<sup>b</sup> *University of Ruhuna, profweera@gmail.com*

<sup>c</sup> *Southern Cross University, Australia*

<sup>\*</sup>kanchanachandrasekara@gmail.com

Negombo Lagoon is located in the vicinity of a highly industrial and urbanized area. Thus, analysis of heavy metal, oil and grease in the lagoon is utmost important at present. The present study has been carried out to assess the contamination levels of heavy metals (Cd and Pb), oil and grease of water and sediments in the Negombo lagoon. Sampling has been carried out in 8 locations. Atomic Absorption Spectrophotometer and standard method of Microwave Digestion Detection by Atomic Absorption Spectrophotometry used for the heavy metal and oil analysis. Spatial interpolation technique in Arc GIS was used to analyse data. The Cadmium ion (Cd<sup>++</sup>) in Negombo lagoon were varied between 2.1-4.9ppb and Lead (Pb<sup>++</sup>) between 17.6-48.6ppb. The concentration of Cd <sup>++</sup> and Pb <sup>++</sup> of lagoon water in most locations were closed to the upper limit of the inland water standards. High Cd and Pb concentrations were observed in Eastern half of the lagoon. The concentration of oil and grease of the water were between 200-5600 µg/l which were extremely high when compared with the minimum quality of the inland water standard. Cd levels of sediments were varied between 1002-1280 µg/kg and Pb levels were between 12300 - 18300 µg/kg. Oil and grease concentrations of sediments were varied between 30000 – 3720000 µg/kg. The concentration of Cd in sediment compared to water was 477 times higher in its lower limit and 2526.2 times in its upper limit. Likewise, Pb in sediment is 699 times higher than the lower limit and 376 in upper limit in water. Oil and grease in sediments are 15times and 66.4 times higher than the lower limit and upper limit of the water respectively. The probable reasons for the contamination are lead to be the manmade activities linked to unplanned development with less attention on environment concern.

**Key words:** Lead and Cadmium, Oil and Grease and Water pollution

Abstract ID: 101

## Determination of the Feasibility of the Uses of Hyper KANAKO A Debris Flow System to Predict the Landslide Damage Zone of Sri Lanka, a Case Study to the Landslide at Meeriyabedda, Koslanda, Badulla, Sri Lanka

Hemasinghe H.<sup>\*a</sup>, Suzuki K.<sup>b</sup>, Matsumoto N.<sup>b</sup>, Uchida T.<sup>b</sup>

<sup>a</sup> National Building Research Organization, Sri Lanka,

<sup>b</sup> National Institute for Land and Infrastructure Management, Japan

\*hasali.hemasinghe@gmail.com

Landslide is a most recurrent and pressing disaster in the mountainous areas of Sri Lanka. National Building Research Organisation has developed Landslide Hazard Maps (LHMs) to identify the susceptibility of landslide initiations, but do not indicate the potential damage zones including both debris flow area and depositional areas. Identification of the entire impact zone is most important to manage the associated risk. In this study, a numerical simulation was conducted to the area of the landslide in Meeriyabedda, Sri Lanka using "Hyper KANAKO" a debris-flow model, to test the feasibility to incorporate the results into the LZMs. The sensitivity of input conditions such as the (1) percentage of fine grains (fluid density and sediment concentration), (2) input hydrograph (peak flow rate and debris flow duration), and (3) representative sediment particle diameter were tested at several cases by changing the values of each parameter. The calculation result is highly depending on all above parameters and the best fit values for (1), (2) and (3) were 0.2, 7 s/ (428.6 m/s) and 0.237 m respectively. Therefore, it is most important to set these parameters appropriately. The results confirmed that the Hyper KANAKO simulation is good enough to assess the potential inundation zone.

**Key words:** Landslide, Hyper KANAKO, Debris Flow, Damage Zones

Abstract ID: 102



## Inventory Survey of Slope Failures in Sri Lanka

Yang P.\*<sup>a</sup>

<sup>a</sup> *Nippon Koei Co., Ltd., Japan*

\*yang-pc@n-koei.jp

The most common type of landslides in Sri Lanka is shallow rapid slope failure, particularly in response to an intense, short-duration storm. Different from reactivated landslides, the slope failures frequently occur on steep natural and artificial slopes without indications, thus posing a significant risk to population and property. An inventory survey of slope failures showed that the slope failures were related largely to slope steepness and slope height, and more than 80% of the slope failures occurred on slopes with a slope angle of 25 to 45 degrees and a slope height of more than 5 m. A simple topographical model was developed based on the inventory survey results. The topographical model can be used to predict slope failure hazard areas and prepare slope failure hazard maps for residential developments and sloping area land use planning decisions.

**Key words:** Slope Failure, Inventory Survey, Topographical Model, Hazard Zonation

Abstract ID: 103

## Qualitative and Quantitative Assessment of Plastic Debris in the Coastal Eco System of Matara District, Sri Lanka

Weerasinghe K.D.T.N.<sup>\*a</sup>, Weerasinghe K.D.N.<sup>b</sup>, Jayathissa W.D.S.<sup>a</sup>, Williams K.S.<sup>c</sup>, Liyanage C.L.<sup>c</sup>

*a University of Ruhuna, Sri Lanka*

*b Ministry of Primary Industries, Sri Lanka*

*c University of Central Lancashire, UK*

\*thanya@mgt.ruh.ac.lk

Marine litter has become a pressing global challenge. The majority of this material consists of plastic waste which has originated from land-based dumping. Many countries are responsible for marine plastic, including Sri Lanka. The primary objective of this study was to assess the types and quantities of plastic waste arising from the marine environment. The study area chosen was Matara district, which comprised beaches and mangrove forest. Weekly monitoring was conducted from October - November 2019 at 5 sites of the type and quantity of plastic. Simultaneously, the role of local communities (Fisherman, villagers, hoteliers, NGOs and local authorities) to mitigate plastics from the environment was evaluated through face to face semi-structured interviews. This revealed the impact plastic waste was having on the community. Findings showed that coastal plastic has become a barrier in maintaining both the aesthetic and environmental health of the coastline. This in turn impacted on local communities which relied on tourism and fishing. The study showed that the majority of the accumulated plastics on coastlines were polyolefins, polystyrene and other “float plastics”. These had migrated along waterways from the interior to the ocean. Some local community actions such as beach cleaning and burning plastic waste were only providing temporary solutions. Therefore, more progressive measures are needed to give sustainable solutions to coastal plastics. This could be achieved through education programmes for all stakeholders involved in the plastic’s journey to the marine environment. Complementary solutions would be the provision of alternatives and by devising technological solutions to divert plastic from the environment.

**Key words:** Coastal Plastic, Community Engagement, Coastal Ecosystems, Mangroves

Abstract ID: 104

## Rainfall Triggered Landslide Early Warning System Based on Soil Water Index

Gamage H.G.C.P.<sup>a</sup>, Wada T.<sup>b</sup>, Senadeera W.\*<sup>a</sup>, Aroos M.S.M.<sup>a</sup>, Bandara D.M.L.<sup>a</sup>

*a National Building Research Organisation, Sri Lanka*

*b Earth System Science Corporation Limited., Japan*

\*wasantha.senadeera@gmail.com

Fourteen districts were identified as landslide prone in Sri Lanka. These districts fall in the wet and intermediate climatological zones where annual rainfall is over 2000mm. Short term heavy rainfall and long-term cumulative rainfall are active factors for landslide occurrences. Two indices were defined; Short Term Rainfall Index (mm/h) and Long-Term Rainfall Index - Soil Water Index. Hydrological Tank Model simulations were used to predict landslides with snake curves and probability curves. Three defined tanks; surface runoff, Intermediate and Ground water outflow with soil parameters of  $S_1..S_3$  - water amounts,  $\alpha_1.. \alpha_4$  - runoff ratio,  $L_1..L_4$  - height of the runoff holes,  $\beta_1.. \beta_3$  - infiltration rates,  $q_1..q_3$  - discharge rates, in each tank respectively, which depend on soil type and other geological conditions. Rainfall intensity act as the main triggering factor for Soil Water Index. With probability curves, better predictions were obtained on regional based soil water index of greater than 100 values to identify the landslide occurrences even though the Short Term rainfall index did not reach the level of 50mm/h. Region-wise Critical Soil Water Indexes were obtained by critical lines with soil parameters derived for Sri Lankan soil conditions. With derived long-term Soil Water Indexes, it is expected to produce effective predictions for landslides.

**Key words:** Soil Water Index, Rainfall, Tank Model, Critical Line

Abstract ID: 105

## Strategy Followed for the Establishment of Local Disaster Risk Reduction (DRR) Plans, in Sri Lanka

Nagai T.<sup>\*a</sup>, Samarakkody R.P.<sup>b</sup>

<sup>a</sup> *JICA Expert, Disaster Risk Reduction Advisor for Sri Lanka*

<sup>b</sup> *Disaster Management Center, Sri Lanka*

\*wind.sky-cloud@nifty.com

To formulate local DRR plans, comply with all level acts, statutes, ordinances, policies and strategies identified under SFDRR is essential. Therefore, the JICA supports Disaster Management Division & DMC of Defence Ministry for formulating Local DRR Plans as a pilot program, utilizing the “8 Steps Guide” which is prepared by JICA for complying SFDRR. We selected the Kalu River basin as a targeted basin and selected four pilot areas, considering the frequency of past disasters. Based on the disaster characteristics in the area, rain-induced disasters were selected as target disasters. Once the methodology is finalized for rain-induced disasters, the same mechanism could be extended to incorporate other areas and disasters. The series of workshops with members from National, Sub-National and Local-level authorities/organizations are conducted. Based on the 8 Steps Guide, “Risks and residual risks identification”, “countermeasure proposals” and “budget allocations and structures for implementing and periodical review” were discussed. This participatory approach is experimental and is being implemented through trial and error. Identified findings so far are “Necessity of clarification of the local organization’s role, organization set-ups and methods to secure budget”.

**Key words:** Local DRR Plan, Local Government, 8 Steps, Kalu River

Abstract ID: 107

## Development of Flood Warning Mobile Application

Wickramasooriya M.D.J.P.<sup>a</sup>, Priyankara W.M.S.<sup>a</sup>, Iqbal S.<sup>a</sup>, Ariyaratne K.H.A.A.<sup>b</sup>, Gayathri M.P.M.<sup>b</sup>

<sup>a</sup> Department of Irrigation, Sri Lanka

<sup>b</sup> University of Moratuwa, Sri Lanka

Sri Lanka is severely affected by seasonal flooding and climate change adversely increases the frequency and magnitude of floods leading to a huge loss of life and property. Having public access to responsible early warnings will be beneficial in flood risk mitigation. Despite the application of latest flood modelling software tools in Sri Lankan flood prone areas, reaching the last mile to deliver the flood warnings to the community is still improvable. Recent rapid development of Internet of Things (IoT) has upgraded the Information and communication technology field significantly to deliver real-time information to the crowd. This paper discusses the development of a mobile application, initially for android which is the most widely used mobile operating system of Sri Lanka, to disseminate the flood warnings to the users. REST (Representational state Transfer) Web Service is created to deliver the predictions obtained by the computational model and Android application displays the results of the predictions according to the geographical location of the user. This mobile application is important to allow sufficient time for evacuation, identify flooded roads with predicted flood levels, and manage disaster risk from the location of the user himself.

**Key words:** Flood early warning, mobile application, android, GPS, Flood risk

Abstract ID: 109

## Study on Landslide Early Warning by Using Rainfall Indices in Sri Lanka

Wada T.<sup>\*a</sup>, Gamage H.G.C.P.<sup>b</sup>, Senadeera W.<sup>b</sup>, Aroos M.S.M.<sup>b</sup>, Bandara D.M.L.<sup>b</sup>, Rajapaksha W.D.G.D.T.<sup>b</sup>

<sup>a</sup> *Earth System Science Corporation Limited, Japan*

<sup>b</sup> *National Building Research Organisation, Sri Lanka*

\*wada-tomoyuki@ess-jpn.co.jp

Japan International Cooperation Agency (JICA) and National Building Research Organization (NBRO) conduct projects to prevent and avoid landslide damages. Landslide early warning is one of the target of the JICA-NBRO project; analysis on rainfall indices, such as Soil Water Index (SWI), was carried out. The Soil Water Index is an output of conceptual hydrological model representing soil water content. Observed rainfall time series at 25 gauging stations from 2014 to 2019 were utilized to calculate rainfall indices. Moreover, past landslide records were utilized to analyse correlation between the landslide occurrences and the calculated rainfall indices. As the result, most of the past landslides were caused by severe rainfall events in which Soil Water Index exceeded 100-150. On the other hand, small scale slope failures were caused by relatively minor rainfall events. The critical values of rainfall indices causing landslides depend on the regional characteristics. The critical value in the south-western region tends to be higher than in the northern and southern regions. It seems that the higher rainfall in the south-western region increase the critical rainfall value of landslide occurrence. There is a possibility to improve accuracy of landslide early warning by using the rainfall indices considering regional characteristics.

**Key words:** Landslides, Early warning, Soil Water Index

Abstract ID: 110

## Enforcing Multi-Sectorial Approach for Hydro-Meteorological Drought Risk Reduction through Improved Water Use Efficiency Using Information Systems

Abeyratne I.\*<sup>a</sup>

<sup>a</sup> *United Nations World Food Programme, Sri Lanka*

\*Indu.abeyratne@wfp.org

Every year dry spell over many parts of Sri Lanka is creating negative consequences to several sectors. Drinking water, agriculture, hydropower are few to be noted. The decisions related to water issue has to be implemented through real-time information systems which could allow decision makers enforce regulations through scientific evidences. In 2017 WFP has embarked to develop a real-time information platform for Sri Lanka. The model system has named "PRISM" which is a map-based platform for real-time monitoring and assessment for hydro-meteorological hazards and their impact on livelihoods and food security through visualizations of automatically computed space data products. The system is capable to host wealth of data relating to climate, temperature, vegetation, cropland, population, socio-economic and food security. These data sets is transformed to rainfall anomalies, time-series standard precipitation indexes (SPI), vegetation health indexes (VHI) to interpret to obtain indication on meteorological, agricultural, hydrological or socioeconomic impact over the time period with potential impact scenarios on various sectors. This analytical information allows, decision makers to take short- and medium-term decisions on food security through risk sensitive planning towards resilience.

**Key words:** Risk sensitive planning, Resilience, Information Management, Early Warning

Abstract ID: 111

## Examining the Food Security in the Climate-Sensitive Mountain Region to Evolve an Alternate Policy Framework

Yadav N.\*<sup>a</sup>

<sup>a</sup> *Jawaharlal Nehru University (JNU), India*

\*nehayadav44444@gmail.com

The Sustainable Development Goals entails priorities for the mountain region to ensure food security. The increase in climate-mediated risk resulting in the new food crises in the mountain region demand for transformation in food systems and extending existing frameworks particularly in terms of the macro dimension of Food and Nutrition Security (FNS), the impact of external shocks and stresses to the FNS system (including recurrent food crises, natural disasters, and climate change) and considering the interaction of mountain specificities at macro and micro level. The research aims to study innovative food systems to explore the prospect and challenges in achieving food security. It evaluates various existing frameworks addressing malnutrition to examine the possibility of cross learnings between them for a more holistic framework/s. The study is based on a mixed-method; primary data is collected through a household survey conducted in 17 chronically disaster-prone villages (323 households) in Tehri Garhwal district, Uttarakhand. It includes participatory research with the community for the development of new approaches/ methodologies/ techniques and for identifying areas needing policy interventions. The study would be significant in enhancing the scientific and traditional knowledge about climate change adaptation approaches, resilient agriculture practices and provide insights for strengthening community-based interventions.

**Key words:** Food security, Himalayas, sustainability, SDG

Abstract ID: 112



## Introducing Preparedness Parameters for Sustainable Settlement in Sri Lanka. Application of Pinheiro Principles to Sri Lankan Settlements

Jagath M.\*<sup>a</sup>, Nishshanka H.<sup>b</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

<sup>b</sup> *United Nations Development Programme, Sri Lanka*

\*jagathm@dmc.gov.lk

Sri Lanka has introduced several parameters to resettle the disaster victims after 2016 floods and landslides. This study assesses the resettlement process of displaced persons in 6382 destroyed houses and 52543 damaged houses via descriptive and qualitative analysis. Primary data were collected by resettlement site visits, focus group discussions & key informant interviews, and secondary data by literature surveys and observations on resettlement policies and principles. The Pinheiro principle endorsed in August 2005 by UN establishes housing and property restitution for refugees and displaced persons aiming to bring sustainable restitution for internally displaced persons (IDPs) and refugees around the globe. When comparing the Sri Lankan resettlement process to the Pinheiro principle, it was found that Sri Lankan permanent resettlements are unsustainable. Hence, this study focused on parameters in Pinheiro principles and its application to the sustainable settlement in Sri Lanka. The research identified parameters such as; Vulnerability Capacity Assessment (VCA), psychology of victims, safer land identification, property and housing restitution procedures, social cultural dimension, livelihood assistance and infrastructure facility as important parameters for sustainable resettlements.

**Key word:** Pinheiro principles, settlements, parameters, displaced persons

Abstract ID: 113

## Assessment of Tsunami Vulnerability for Hospital Buildings

Hasalanka H.H.H.\*<sup>a</sup>, Dias W.P.S.<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>, Kularatne W.D.M.<sup>a</sup>, Rossetto T.<sup>b</sup>, Baiguera M.<sup>b</sup>, Robinson D.<sup>b</sup>, Palomino J.<sup>b</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

<sup>b</sup> *University College London, United Kingdom*

\*hhhhasalanka@gmail.com

Hospitals located in coastal areas in Sri Lanka were severely hit by the 2004 Indian Ocean Tsunami, causing extensive damage. Hence, it is necessary to identify the level of risk for hospitals against Tsunami. Therefore, a preliminary assessment of six hospitals in the southern coast was carried out. The fieldwork information was first used to determine a risk index using the well-established Papathoma Tsunami Vulnerability Assessment (PTVA). However, such approach falls short in capturing; a set of buildings as a group (eg. a hospital); the effects from nearby waterways connected to sea; the vulnerability of a given (critical) unit within a building; and the risk to the operational aspects of units or hospitals. To overcome these limitations, two methods are proposed herein. The first seeks to refine the PTVA approach to suit hospitals, in particular by considering the vulnerabilities of the hierarchical entities of hospital, building and unit, incorporating both structural and functional aspects. The second approach is a more quantitative method for determining a Relative Risk Index (RRI). It presents the same hierarchical framework of the first approach but is determined by comparing the hazard and fragility of each unit, in terms of structural performance, scour potential, debris impact, in addition to functional aspects.

**Key words:** Tsunami, Hospitals, Structural Vulnerability, Functional Vulnerability

Abstract ID: 114

## **A Review on Incorporating Disaster Risk Reduction Mechanisms for Landslide Hazards in to the GREENSL Rating System for Built Environment in Sri Lanka**

Abeyasinghe A.A.S.E.<sup>a</sup>, Bandara C.S.<sup>a</sup>, Siriwardana C.S.A.<sup>b</sup>, Haigh R.<sup>c</sup>, Amaratunga D.<sup>c</sup>, Dissanayake P.B.R.<sup>a</sup>

<sup>a</sup> *University of Peradeniya, Sri Lanka*

<sup>b</sup> *University of Moratuwa, Sri Lanka*

<sup>c</sup> *University of Huddersfield, United Kingdom*

\*sonali.abeyasinghe@eng.pdn.ac.lk

Landslides are one of the major disasters that occur throughout the world, causing great destructions to both human wellbeing and economic assets. Although many developed countries show a great progress in reducing loss of life, and in managing their economic and social adverse impacts from landslides, less developed mountainous countries, especially in Asia and Central America, still need more focus. Sri Lanka is a South Asian developing country, highly vulnerable to landslides, specially the island's central part due to its mountainous condition resulting about 1,077 deaths, 14,926 building disruptions and 291,964 human displacements during 1965 to 2019. Therefore, it becomes a vital necessity to design and construct sustainable disaster resilient buildings to withstand natural hazards. Although Sri Lankan Green Building Council has promoted sustainability and resilience, specifically through reducing resource usage and energy consumption, it has not properly incorporated Disaster Risk Reduction mechanisms into their green rating tool. Therefore, this paper is focused on identification of structural and non-structural DRR mechanisms for landslides which are to be incorporated into the GREENSL® Rating System for Built Environment through a comprehensive literature review. Site selection with proper slope stabilization, suitable building foundation, orientation and shape, constructing suitable earth retaining & slope stabilization structures such as anchoring and soil nailing etc. and surface & sub-surface drainage networks are few of the DRR mechanisms identified for landslides

**Key words:** Disaster Risk Reduction, Landslides, Disaster Resilient Buildings, Sustainable Buildings

Abstract ID: 115

## Stakeholder Level Trust on Multi-Hazard Early Warning (MHEW) Mechanism; Sri Lankan Context

Shehara P.L.A.I.\*<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>, Amaratunga D.<sup>b</sup>, Haigh R.<sup>b</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

<sup>b</sup> *University of Huddersfield, United Kingdom,*

\*ishanishehara@gmail.com

In the Sri Lankan context, the stakeholders who are identified as the first responders are considered the first to receive Early Warnings in any disaster situations. It has identified that the level of preparedness of these set of responders in Sri Lanka is at a considerably poorer level in significant to the crucial damages and destructions induced from recent disasters. This directs the need to focus on the existing mechanism of Early Warnings and identify gaps and barriers in the existing mechanism. Under this, the stakeholder level trust is considered as a significant parameter in efficient delivery of the warnings. This trust level based on the mode and authority levels are explored to examine the existing level of the Early Warning mechanism in Sri Lanka. A questionnaire survey was conducted to capture the first responders associated with Disaster Management in Sri Lanka and 1004 responses were collected with the use of telephone interviewing. Fuzzy set theory was applied to analyze the responses over the trust level on warnings and the rankings were determined based on the trust level on the authorities. Accordingly, Disaster Management Center was ranked top among the first responders in delivering warnings. This was compared with the results obtained from a previous study based on community level trust in the Sri Lankan context.

**Key words:** First responder, Multi-Hazard Early Warning (MHEW), trust level, fuzzy set theory

Abstract ID: 116

## Nature Based Solutions and Hybrid Solutions instead of Applying Engineering Solutions Alone for Landslide Risk Management in Sri Lanka

Dissanayake P.\*<sup>a</sup>, Skempas M.<sup>a</sup>

<sup>a</sup> *The World Bank*

\*pdissanayake@worldbank.org

Ten Districts in Sri Lanka has high potential for getting impacted due to occurrence of landslides. Landslides can be shallow, deep-seated or rock-failures and are very localized phenomena, site specific mitigation measures are needed for slope stabilization such as geotechnical structural measures that include soil reinforcement, soil nailing, rock bolting, surface protection, slope modification, retaining walls, gabion walls, breast walls, soil removal works, steel pile works, etc. Almost all landslide mitigation measures in Sri Lanka to date have used engineered solutions. However, the structural measures require sophisticated designs, high costs and lacks an integrated approach. There needs to be land use planning, good land management practices in cropping, grazing and forestry, careful road construction, terracing and other contour-aligned practices in fields and plantations, and participation of local communities. The Nature Based Solutions (NSBs) for landslide risk mitigation have not been applied in Sri Lanka even though there have been significant advances in NSBs for landslide risk mitigation. The engineering solutions are costly and cannot be applied to large areas as the cost is very high. Therefore, the paper explores the potential of using NSBs as an attractive cost-effective option to apply alone or with engineering measures to develop site specific plans.

**Key words:** Landslides Mitigation, NSBs Hybrid

Abstract ID: 117

## Contribution of Nature Protection in Reducing Disaster Risks in the Jaffna District, Sri Lanka with Special Reference to Natural Sand Dunes in Vadamarchchy East, Sri Lanka

Ravi S.\*<sup>a</sup>, Rajkumar P., Wijesundra C.S.

<sup>a</sup> *Disaster Management Center, Sri Lanka*

\*rspillain@yahoo.com

The north-eastern part of Jaffna District has large extents of sandy areas, the major parts of which are sand dunes. These sand dunes are present from Manatkadu to Chundikulam along coastal areas. Sand dunes act as full barriers against extreme waves, thus preventing the inland movement of waves of Tsunami, flooding, winds and erosions. Sand dunes and associated vegetation of study areas have performed efficiently to reduce the impacts from natural disasters. The objective of the present study was to identify the impacts of sand removal on the risks of disaster. For the purpose of the study, over ten years of rainfall data and the impacts of the tsunami of 2004 and storms were collected as secondary sources and sand removal areas were surveyed and mapped using QGIS software. Sands are being removed often from Manatkadu, Potpathi and Nagar Kovil areas. However, Chundikulam area has not been subjected to sand removal. The study revealed that areas with a high density of sand dunes and associated vegetation contributed to reducing the risks from tsunamis, floods, storms and erosions. The areas from Thalaiyadi to Kaddaikadu are sandy but there are no specified dune sands, as a result, these areas were highly affected by the 2004 Tusunami. Sand dunes of many parts of the area have already been removed and these areas were flooded many times. The study concludes that the presence of a healthy dune system of Vadamarachchy East provides an environmentally important natural defense mechanism that has ability to mitigate the impacts of disasters such as Tsunami and floods. Dunes on which coastal vegetation of this area have grown performing more efficiently. Ensuring stability, greater energy dissipation and resistance to erosion of coastal line. Integrated institutional arrangements, ensuring the legal measures, public awareness and environmental friendly projects are major strategies to protect the natural resources such as sand dunes and to reduce the disaster impacts. This paper emphasizes that the Government of Sri Lanka needs to ensure provision of resources and funds towards the plans, activities, policies, laws and regulations channelled for disaster risk reduction for resilience through environmental conservation. Therefore, environmental conservation is considered as an effective and efficient methodology for disaster risk reduction in the Jaffna District.

**Key words:** Sand Dunes, Vadamarachchi East, Disaster Risk, Jaffna District

Abstract ID: 118

## The Impact of Natural Disasters on the Promotion of Ecotourism in the Jaffna District, Sri Lanka with Special Reference to Sand Dunes in Vadamarachchy East

Ravi S.\*<sup>a</sup>, Rajkumar P., Wijesundra C.S.

<sup>a</sup> *Disaster Management Center, Sri Lanka*

\*rspillain@yahoo.com

Ecotourism is traveling to relatively undisturbed natural areas with the objective of studying, admiring, and enjoying the scenery and its wild plants and animals. Sand dune is any accumulation of sand grains shaped into a mound or ridge by the wind under the influence of gravity. Sand dunes provide sand storage and supply for adjacent beaches. They also protect inland areas from natural disasters such as storms, Tsunami, flood-water and erosion. Sand dunes support an array of organisms by providing nesting habitat for coastal bird species including migratory birds. Sand dunes are also providing habitats for coastal plants. A sand dune of, Vadamarachchy East is potential to feeding groundwater aquifer of the district. They are distributed from Manatkadu to Chundikkulam in the Jaffna District. They are a major natural resource which is a potential source for promotion of ecotourism. Dunes have natural scenic beauty which can be developed for geo- tourism and disaster prevention measures. Therefore, sand dunes provide for some ecotourism activities such as enjoying the scenic beauty, bird-watching and hiking. The objective of the present study was to identify the impacts of sand removal on ecotourism. For the purpose of the present study, field surveys were used as a method for identifying the sand removal areas. These areas were mapped using a GPS. Sand dunes provide different ecotourism activities such as playing, nature walk, bird watching and plant observing. The study revealed that many dunes in Manatkadu, Potpathy and Nagar Kovil areas have been removed and dunes are being destroyed due to mining activities, as result dunes have lost their habitats for birds and vegetation and scenic beauty for supporting ecotourism. Sand dunes in the Chundikkulam area are not subjected to removals. This area has a high potential for ecotourism development. The study reveals that protection of sand dunes is important to prevent the impacts from disasters as well as to promote the ecotourism in the Vadamarachchy East area.

**Key words:** Sand dunes, Vadamarachchy East, Ecotourism, Disaster

Abstract ID: 119

## Investigating the Preparedness of Staff in Private Hospitals Against Fire Hazards

Kularatne W.D.M.\*<sup>a</sup>, Hasalanka H.H.H.<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

\*devmini.kularatne@gmail.com

Fire is a useful tool that can turn into a dangerous and uncontrollable hazard very quickly. Unlike most natural hazards, fire hazards do not depend on the location of the institution, but rather the activities which are carried out within it. Hospitals are among the institutions that have a high potential for fire hazards due to reasons such as the presence of volatile chemicals, large electrical networks and high waste generation. In addition to taking steps to prevent a fire from occurring, preparation of staff to face a fire hazard should also be done. This includes providing knowledge and practice regarding fire protection equipment usage, conducting fire evacuation drills and providing knowledge about local fire service departments. In this study, the training and preparedness of hospital staff in private hospitals regarding fire hazards were investigated, by conducting interviews using a structured questionnaire. Around 66 hospital staff of multiple major private hospitals were interviewed. The staff consisted of various staff positions ranging from medical staff to security staff and support staff. The study revealed that over 40% of the staff had training in fire safety preparedness and more responsibility in emergency response had been given to the maintenance staff and the security staff in the hospitals. Overall, the staff in private hospitals were suitably prepared for fire hazards, with all the institutions holding fire training programs annually.

**Key words:** Fire Hazards, Safe Hospitals, Disaster Risk Reduction, Fire Safety Training

Abstract ID: 120



## Improving Information Infrastructure for Natural Disaster Risk Reduction and Management of Sri Lanka: GIS/Remote Sensing Based Social and Physical Vulnerability Assessment Towards Sustainable Disaster Risk Reduction, Planning and Management

De Silva N.S.\*<sup>a</sup>

*a National Disaster Relief Services Centre, Sri Lanka*

\*rudnilu@yahoo.com

Tsunami 26/12 was a significant turning point in natural Disaster management in Sri Lanka. The importance of integration of reactive approaches (relief and recovery) and proactive approaches (damage prevention and preparedness) to minimize the impact of natural disasters was widely understood by the responsible authorities. However, proactive approaches are extremely information intensive. Further, it was re-emphasized by the flooding and landslide events occurred in 2016 and 2017. This paper scopes and analyses the physical and social vulnerability of the island to natural Disasters; and identify the most vulnerable areas by mapping the vulnerability. The objective of this research is to address the information gap which evidenced to be the unbeaten obstacle in planning effective recovery and rehabilitation programs, and identify the most affected areas and communities to target the response and relief services, and reinforce the information infrastructure need for implementing effective mitigation measures to 'Build back better'. GIS and remote sensing techniques will be deployed to analyze Physical and social vulnerability to disasters and produce a spatial vulnerability database. Physical vulnerability will be identified by the Construction of risk maps (Flood and Landslide). Social Vulnerability analysis will be achieved by conducting a Community Vulnerability Assessment (CVA) targeting communities of worst-hit areas and mapping the respective information.

**Key words:** Information Infrastructure, Risk Reduction, Planning and management, Build Back Better

Abstract ID: 121

## Analysis of Flood Vulnerability in Kalutara District Using Geospatial Technology

Wickramasooriya A.K.\*<sup>a</sup>, Walpita L.S.<sup>a</sup>

<sup>a</sup> *University of Peradeniya, Sri Lanka*

\*awickramasooriya@gmail.com

Flood events are frequently occurred associated with the Kalu Ganga in Sri Lanka. Therefore, people live within these areas are severely affected flood situations in each year. This study focusses on analyzing flood vulnerability areas in the Kalutara district. A digital thematic map is produced based on most causative factors influence to create floods such as distance from the drainage system (buffer zones), elevation and land use. For this purpose, most updated data has been utilized. Different weights are assigned for the above factors to analyze the flood vulnerability in the area using the pairwise comparison method. Expertise knowledge has been considered to assign different ranks for different conditions within each factor. After analyzing the weights using the pairwise comparison method, weights assigned for the buffer zone, elevation and land use as 54.4%, 34.6% and 11% respectively. Thereafter, Using Multi-Criteria Decision Analysis Method (MCDAM) and using weights assigned for factors and ranks assigned for different conditions within factors, flood vulnerability map has been introduced for the Kalutara district. According to this map, about 5.09% lands have very high flood risk, about 9.22% of lands have high flood risk, about 16.65% areas identified as moderate flood risk, about 49% of the area has low flood vulnerable while very low flood vulnerable areas recorded as 52.55%. The created flood vulnerability map was validated using flood vulnerability maps of 2003 and 2017 district. After validation, it was observed that about 92% of the flood vulnerable areas are matched with the 2003 and 2017 flood vulnerable areas. Therefore, the created map can be highly accepted.

**Key words:** Flood Vulnerability, Multi Criteria Decision Analysis (MCDA), Flood Risk Map

Abstract ID: 122

## Evaluation of Disaster Preparedness Level of Sri Lankan Hospitals in the Context of Multi Hazard Early Warning

Jayasekara J.H.P.R.U.\*<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

\*ravindujy@gmail.com

A high level of response and taking immediate actions are significant for the functionality of a hospital in an emergency. The level of response mainly depends on the preparedness level of the hospital. Preparedness of a hospital can be defined under two categories based on the origin of the hazard such as inside the hospital premises and outside the hospital and within the catchment community area. Enhancing disaster preparedness for effective response is a major concern in Sendai Framework for Disaster Risk Reduction (SFDRR). In the context of Multi-Hazard Early Warning (MHEW), this research focus on evaluation of preparedness of the hospitals for the hazards outside the hospital. Preparedness Index for the Health Emergencies and Disasters developed by the World Health Organization (WHO) and the Pan American Health Organization (PAHO) and Hospital Emergency Response Check List developed by the WHO Regional Office for Europe are studied and adopted to the Sri Lankan context. In this process Questionnaires, inspections and evaluation of currently available Standard Operation Practices (SOPs) and related documents are to be conducted to verify the applicability of globally developed frameworks in the Sri Lankan context and develop a Preparedness Index for the Sri Lankan hospitals. Finally the study concludes a framework for preparedness index of Sri Lankan hospitals in the context of Multi Hazard Early Warning, based on the hazard profile and the vulnerabilities of the catchment area of the hospital.

**Key words:** Safe hospital, Preparedness Index, All- hazard approach

Abstract ID: 124

## Investigation on Disaster Risk Reduction Governance and Ground Level Effectiveness, Case Studies from Sri Lanka, Myanmar and Maldives

Rathnayake W.K.D.\*<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>, Bandara C.S.<sup>b</sup>, Dissanayake P.B.R.<sup>b</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

<sup>b</sup> *University of Peradeniya, Sri Lanka*

\*kusaldanidu@gmail.com

There are different mechanisms in place to mitigate disasters induced by natural hazards. These mechanisms differentiate with the region as well as overtime. There are various factors (hazard profiles, vulnerability maps etc.) considered in generating the mechanisms to mitigate disasters. Yet the level of effectiveness of such mechanism is always getting questioned over the fact that the impact of disasters ever increasing. In this context, the research work has a methodology of identifying the disaster management mechanisms in Sri Lanka, Myanmar and Maldives. Then evaluates the ground level effectiveness of the respective mechanism. And finally, propose an ideal framework to govern the disaster risks. It was observed that there are certain similarities in the disaster management mechanisms especially in the area of policy utilizing. But there are different approaches in the implementation. Cultural behaviours of the respective country and region mainly affect the implementation process. The research finding suggests a mechanism to address disaster risk governance in a risk management approach. The results can be used in generating further policies and in empowering relevant governing bodies.

**Key words:** Disaster Risk Reduction, Risk Governance

Abstract ID: 125

## Capacity Building in Asia for Resilience Education for Strengthening MHEW for Coastal Resilience

Hemachandra K<sup>\*a</sup>, Haigh R.<sup>a</sup>, Amaratunga D.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*k.hemachandra2@hud.ac.uk

CABARET, a three-year project funded by the Erasmus Plus Programme of the European Commission was implemented in Asia (Region 6) to enhance coastal resilience in Asia through regional cooperation among higher education institutions (HEIs) and other socio-economic actors. This is to address the impact of the increasing occurrence of coastal hazards and to enhance resilience in the region. These hazards are caused by an unprecedented level of development along with climate change. Hence, the project conducted an extensive literature review to develop an initial conceptual framework, to identify gaps in present multi-hazard early warning systems and to assess the role played by the HEIs with their challenges in doing so. Accordingly, the project delivered a road map, an innovation hub, socio-economic partnerships along with a major online open course (MOOC) platform as its outcomes. These outcomes were achieved through conducting 4 international training workshops with more than 230 participants on MHEW and coastal resilience among HEIs members and socio-economic actors across Asia. 9 HEIs institutes from 5 Asian countries participated in workshops as partner countries with resource persons from 6 programme countries in Europe. Besides, 8 staff-exchanges with more than 35 participants, about 40 research papers, 5 national position papers, one regional paper, 5 briefing papers, 1 secondment activity, 6 sandpit activities were delivered. These outcomes were disseminated at many international conferences and other project media.

**Key words:** Multi-Hazard Early Warning System, Regional Cooperation, Higher Education Institutions, Asia

Abstract ID: 126

## Evaluation of the Level of Understanding among the University Students about the Spread of Disaster-Related Information in Social Media: Case Study Approach

Kannangara K.K.C.L.\*<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

\*chamikakannangara@gmail.com

Acquiring information from online sources is a common phenomenon among the young generation around the world. Hence, online social media platforms can be considered as one of the most effective methods that can be used to disseminate Multi-Hazard Early Warnings. However, with the increased number of information sources, there is a high chance of disseminating fictitious facts and unreliable information related to disasters. Hence, not having a mechanism to assess the reliability of the information is a major drawback. As a result, there should be a mechanism for evaluating the accuracy and authenticity of the information. Therefore, in this study recent epidemic situation of Coronavirus is taken as a case study. Considering the circulation of information, the variation of Google trend data was studied, and the facts disseminated through other social media platforms were examined to understand the verification process of the information by the general public. Finally, a questionnaire survey was used to evaluate the level of understanding among the University students about the modes of which spread disaster-related information in social media and up to what extent they tend to verify that information before taking any action.

**Key words:** Social Media Influencers, Social Network Analysis, Multi Hazard Early Warning

Abstract ID: 127

## Application of Social Network Analysis to Evaluate the Level of Influence of the Social Media Network in the Multi-Hazard Early Warning Dissemination Process

Jayathilaka H.A.D.G.S.\*<sup>a</sup>, Siriwardana C.S.A.<sup>a</sup>, Amaratunga D.<sup>b</sup>, Haigh R.<sup>b</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

<sup>b</sup> *University of Huddersfield, UK*

\*gaindusaranga@gmail.com

In the current global context, social media is played a vital role in disseminating reliable information immediately to the last mile. However, verification of the reliability of the information is a challenge. To overcome this, the identification of different stages and the influencers in the information flow is crucial. The origin of the information is the authority who is responsible for initiating the Multi-Hazard Early Warning. Dissemination of the information to the downstream via traditional media as well as social media will be done by the authority. Having a thorough understanding of different levels in the social media network and the interlinkages of the social media influencers are vital to improving the dissemination of the information. The study will be carried out the identification and categorization of different levels of stakeholders associated with Multi-Hazard Early Warning and social media. Social Network Analysis will be applied to recognize the relationship among stakeholders. Also, it is expected to recognize the bottlenecks, gaps and the limitations of the current social media network of disaster management and the strategies to enhance the network. The study will help the authorities to develop their social media operation strategies for an effective Multi-Hazard Early Warning mechanism.

**Key words:** Social Media Influencers, Social Network Analysis, Multi Hazard Early Warning

Abstract ID: 128

## A Study on the Importance of Commercial Aircraft Disasters and Its Preparedness in Sri Lanka

Fernando P.\*<sup>a</sup>

<sup>a</sup> *SriLankan Airlines, Sri Lanka*

\*prasadini85@live.com

Air transportation is considered as one of the safest modes of travel in the world. No matter how high the safety standards, the system and technology are created and managed by humans. The dealing with an emergency or a crisis after it occurs is counterproductive and, in most cases, its corporate suicide. By interviewing higher key post holders in the aviation industry and critically evaluating the existing procedure and implementation of industry best practices will be the mechanism to the study. The prior made legislations and regulatory guidelines will be an added advantage for any state who owns airspace. It's the preparedness that matters which leads to help an airline or a nation to overcome the present situation and return to its normal position. This study will identify the importance of preparedness to face an undesirable event as a state and what are the areas needs to be focused and demolished to ensure a proactive plan is in place by providing industry best practices and amalgamation of all stakeholders. The Leadership commitment, establishing of well-defined legal foundation and prompt media handing will be focused and as a state, it will be observed how far we are capable.

**Key words:** Aircraft Disasters, Emergency Preparedness, Leadership, Crisis Management

Abstract ID: 129



## Identifying the Disaster Risk as an Important Step to Disaster Risk Reduction: Landslide Risk Assessment in Kandy

Jayathilaka C.\*<sup>a</sup>

<sup>a</sup> *University of Peradeniya, Sri Lanka*

\*champikajayathilaka1121@gmail.com

Understanding disaster risk is the priority in DRR as illustrates in the Sendai framework. Landslide risk assessment aims to define the expected degree of loss due to a landslide and the expected number of lives lost, people injured, damage to property and disruption of economic activity. Risk assessment process consisted of steps including identify the hazard of a particular phenomenon and identify the elements at risk. However, in the Sri Lankan context National Building Research Organization (NBRO) produced landslide hazard maps assessing geology, hydrology and land use management strategies over the identified high hazardous areas for landslides. This research focuses on assessing landslide risk of the Gagawata Korale Divisional Sectarian Division including the Kandy Municipal Council area based on identified hazard zones by the NBRO. Population density and building density over the study area has been analysed using the Fuzzy overlay methodology with the aid of ArcMap 10.7 software. According to the results derived, Pahala Eriyagama, Thalwatta, Thannekubura, Mapanawathura and Bowalawatta Gramaniladari Divisions recorded the highest risk level. Further, economic land usage and road density need to aggregate to obtain to identify the total elements at risk and its temporal variation over the study area. Because, micro-level knowledge on risk assessment can be used for a sustainable approach to landslide mitigation, preparedness and response strategies.

**Key words:** Disaster Risk Assessment, Disaster Risk Reduction, Landslides, Kandy

Abstract ID: 130

## Identify Extreme Rainfall Events for the Period 1991-2017 in Sri Lanka Using Percentile-Based Analysis and Its Projections for 2100 for the Emission Scenarios RCP 4.5 and 8.5

Hapuarachchi H.A.S.U.<sup>a</sup>, Premalal S.<sup>b</sup>

<sup>a</sup> *Department of Meteorology, Sri Lanka*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

\*hasuhapu@yahoo.com

The hydrological hazards associated with extreme weather events have increased globally over the past few decades leading to flood, landslide, drought, heatwaves etc. The major reason for such hazards is an increase in the amplitude and frequency of weather extremes. Sri Lanka ranked second among countries most affected by extreme weather events in 2017 and is expected to see a 1.2% annual GDP loss by 2050 due to climate change. Identification of the trend of extreme climate events and project into the future will be important to find the adaptation strategies to mitigate the disasters associated with extreme weather. Therefore, this study focused on identifying the change of extreme rainfall events during the last thirty years by comparison of the number of heavy and very heavy rainfall events for the period 1991-2000, 2001-2010 and 2011-2017. Daily rainfall data for the 19 rainfall stations in the period 1991-2017 is used and analysis percentile-based extreme rainfall events. The results clearly show the increasing trend of extreme rainfall in Sri Lanka during 2011-2017 compare with the two decades 1991-2000 and 2001-2010 for the four climatic seasons. The analysis further extended to identify the future extreme events using the NEX-NASA CMIP5 daily rainfall data for the moderate emission scenario (RCP 4.5) and high emission scenario (RCP 8.5). The number of extreme events above the 90th and 95th percentile for the period 2005-2100 has been considered for the analysis. The base period used is 1975 to 2005.

**Key words:** Extreme Rainfall, Percentile Based, Emission Scenarios, RCP

Abstract ID: 131

## Stakeholder Engagement in Dengue Control – One Year after the Major Dengue Outbreak in Sri Lanka

Dheerasinghe D.S.A.F.\*<sup>a</sup>, Cader M.<sup>b</sup>, Weerasinghe W.M.I.P.<sup>c</sup>, Kodithuwakku L.<sup>c</sup>, Abeysekera I.<sup>c</sup>, Pannila Hetti N.<sup>c</sup>, Samaraweera P.<sup>d</sup>, Tissera H.A.<sup>e</sup>

<sup>a</sup> *Office of the Provincial Director of Health Services, Sri Lanka,*

<sup>b</sup> *National Programme for Tuberculosis Control and Chest Diseases, Sri Lanka*

<sup>c</sup> *National Dengue Control Unit, Sri Lanka*

<sup>d</sup> *WHO, Sri Lanka*

<sup>e</sup> *Epidemiology Unit, Sri Lanka*

\*shamalianoja@gmail.com

Sri Lanka experienced the largest ever Dengue outbreak in 2017 with more than 185,000 reported cases (833.9 per 100,000 population) and 440 deaths causing considerable burden to the already stretched health system. The mainstay of mitigation of Dengue outbreaks was the application of an Integrated Vector Management, especially the Intersectoral Coordination focusing multi-stakeholder engagement. This was evidenced by the results of entomological surveillance and premise inspection programmes data, finding a high percentage of Dengue breeding places, especially in construction sites and schools. This analysis aims to assess the stakeholder engagement in Dengue control after implementation of intensified interventions, promoting stakeholder engagement, during the 2017 outbreak. The measures implemented to promote stakeholder engagement in a significant manner towards Dengue control include; Reactivation of the Presidential Task Force (PTF) on Dengue Control in 2017 and carrying-out regular PTF meetings to review the control activities of the stakeholders; Special emphasis was given to improve the situation in construction sites and schools, where higher percentages of breeding places had been identified. Therefore, many steps were taken to control Dengue in the said premises. Special Mosquito Control Campaigns conducted in 2018 revealed an increase in both potential and positive breeding places compared to 2017 in schools and construction sites i.e. in schools (potential from 36% to 59%; positive from 5% to 12%), and in construction sites (potential from 41% to 55%; positive from 6% to 10%). Further, entomological data has also shown that stakeholder engagement in Dengue control activities is not adequate. Therefore, innovative strategies leading to behavioural impact, and continuous monitoring are mandatory for the establishment of sustainable Dengue control by stakeholders.

**Key words:** Stakeholder Engagement, Dengue Outbreaks, Sri Lanka

Abstract ID: 132

## Built Environment Disciplines' Role in Disaster Risk Reduction

Malalgoda C.\*<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R<sup>a</sup>.

<sup>a</sup> *University of Huddersfield, UK*

\*c.malalgoda@hud.ac.uk

Construction industry and the built environment (BE) disciplines are expected to play a predominant role in reducing the risks of future disasters. The proposed paper aims to establish the role of the built environment disciplines in disaster risk reduction. A broad range of practitioners from Europe and Asia involved with five stakeholder groups were interviewed: local and national government (20), academia (21), NGOs (12), community (15) and private sector (19) with a view of better understanding the roles of the BE disciplines. Besides, a comprehensive literature review was carried out to reinforce the findings of the primary data analysis. Thereafter, a desk review of Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), was carried out to map the roles of the BE disciplines with the SFDRR. SFDRR was the first major agreement of the post-2015 development agenda. It provides Member States with concrete actions to protect development gains from the risk of disasters. BE disciplines were not specifically referenced in the SFDRR; however, it highlights the importance of engaging multiple stakeholders in DRR. It also provides reference to most of the identified roles within the study except for few roles such as 'Investment appraisals and cost benefit analysis' and 'Advise on land boundary issues providing support on land rights and claims'.

**Key words:** Built Environment, Disaster Risk Reduction, Sendai Framework, Construction Industry

Abstract ID: 133

## Developing a “Local DRR Strategy for the Collection of Disaggregated Data” for the Reporting of Sendai Framework on Disaster Risk Reduction (SFDRR)

Weerasekara R.\*<sup>a</sup>, Samarakkody R.P.<sup>b</sup>

<sup>a</sup> *Disaster Management Division, Ministry of Defence, Sri Lanka*

<sup>b</sup> *Disaster Management Centre, Sri Lanka*

\*weerasekarawbmr@gmail.com

Development of Local Disaster Risk Reduction (DRR) strategy in line with the Sendai Framework for Disaster Risk Reduction (SFDRR) is an important task for a Country to achieve four priorities in SFDRR.

Sri Lanka is in the process of preparing Local DRR plans with the assistance of the JICA, at present using “8 Steps Guidelines”. Nevertheless, we have identified the data gaps in implementing a local level DRR plan. This attempt is targeted to use the same strategy for obtaining and gathering of local-level information on DRR.

As a pilot, data was collected for “Kalu River Basin” to develop local DRR strategy for rain-induced disaster. Secondary data was collected by the Department of Census and Statistics were used as a baseline and primary data collected from the officers of the government institutes, private and non-government institutes in the relevant local government area. Eg: - Gramaniladari, NBRO officer, Local authority member etc.

Compare the secondary data with the primary data overlaying together to find the available gaps using GIS technology.

Finally, the basic strategy is generated for a “Kalu river basin” and the same strategy can be used for other local authorities to collect the information to Local DRR planning and report to SFDRR Monitor.

**Key words:** Local DRR strategy; Disaggregation data; Baseline data,

Abstract ID: 134

## **Incorporating Accountability into Disaster Risk Governance**

Amaratunga D.\*<sup>a</sup>, Haigh R.<sup>a</sup>, Senanayake M.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*d.amaratunga@hud.ac.uk

This research aims to establish a sustainable governance structure that can address the issues of disaster risk governance in Sri Lanka based on the principle of accountability. Disaster management, disaster risk reduction, disaster resilience and disaster governance are relatively a new experience to Sri Lanka despite Sri Lanka is experiencing various types of disasters from ancient times. Sri Lanka has established a proper institutional and legal framework to deal with disaster situations only after the Indian Ocean Tsunami attack 2004. The Disaster Management Act, 2005, National Disaster Management Centre, 2005, Road Map for Safer Sri Lanka, 2005, National Council for Disaster Management, 2006, National Disaster Management Plan 2013-2017, Introduction of Ministry of Disaster Management and Human Rights (2006), National Disaster Management Coordinating Committee 2007, Disaster Management Policy, 2013, Comprehensive Disaster Management Program for 2014-2018, in 2014 and National Disaster Management Plan for 2019-2030 are central among them. Short literature survey revealed that post HFA frameworks such as Sendai Framework for Action 2015-2030 (SFDRR), Sustainable Development Goals and Paris Agreement have established to guide, regulate and to assist the global implementation of disaster governance, and accountability. SFDRR recognizes that strengthening disaster risk governance and bringing accountability into DRR as a priority and requirement for sustainable disaster risk reduction in all over the world with all stakeholders. On the other hand, low- and middle-income countries show a deficiency in accommodating the same in legal and institutional frameworks locally. Therefore, this study aims to introduce a governance structure line with the post HFA developments to bring accountability into disaster governance.

**Key words:** Disaster Governance, Disaster Management, Accountability

Abstract ID: 135

## **An Assessment on the Capacity Needs to Implement a MOOC System in the Developing Countries in Asia with Reference to the Energy Efficiency and Climate Change**

Focused group survey in Sri Lanka and Bangladesh under BECK project

Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>, Weerasinghe K.D.N.<sup>b</sup>, Navarathene C.<sup>b</sup>, Kaklauskas A.<sup>c</sup>, Senevirathne M.<sup>a</sup>, Priyankara C.<sup>b</sup>

<sup>a</sup> *University of Huddersfield, UK,*

<sup>b</sup> *University of Ruhuna, Sri Lanka*

<sup>c</sup> *Gediminas Technical University: Vilnius, Lithuania*

\*d.amaratunga@hud.ac.uk

The extreme climatic events are a result of modern human lifestyles and activities. Therefore, education relevant to energy efficiency and climate change is identified as a vital requirement in the present education sector. The BECK project funded by the ERASMUS+ programme aimed to address this research gap by introducing new harmonized MOOC modules to the higher education curricular of 4 European, 5 Russian and 5 Asian higher education institutions. A series of focus group surveys and workshops were carried out to identify the present capacity development needs relevant to the subjected topic. Accordingly, infrastructure development, awareness raising, curricular development, capacity building, integration and networking, research and development, and financial needs have been identified as the key areas requiring capacity development to integrate energy efficiency and climate change into the higher education curricular. The results have recognized that a MOOC system in curricular will allow better opportunities for research, awareness and capacity development initiatives. The relevant European best practices can be adopted into the Asian education systems to allow more opportunities in infrastructure, research, and networking development. The project continues to implement the MOOC modules in the partner institutions following a contextual research study and a cross-institutional module sharing assessment.

**Key words:** Climate change, Energy efficiency, Higher education, MOOC

Abstract ID: 136

## Transboundary River Governance Practices for Flood Risk Reduction in Europe: A Review

Clegg G.\*<sup>a</sup>, Haigh R.<sup>a</sup>, Amaratunga D.<sup>a</sup>

<sup>a</sup> University of Huddersfield, UK

\*g.clegg@hud.ac.uk

Transboundary rivers present complex governance challenges as they create interdependencies between the jurisdictions through which they cross. To manage river basins effectively, the different administrations need to work together to manage problems comprehensively and avoid duplications, or negative impacts elsewhere. The project *Mitigating Hydrometeorological Hazard Impacts Through Improved Transboundary River Management in the Ciliwung River Basin* aims to inform plans for improved transboundary river governance to tackle flood risk in the Ciliwung River Basin, Indonesia. To inform the project, a review of approaches to managing flooding in transboundary basins in Europe was conducted based on the literature. The approaches were reviewed in terms of three key aspects: legal/institutional, operational and political. The review identified aspects that are considered successful, as well as any persisting barriers or issues. This included availability of legal frameworks, coordination and collaboration between sectors and organisations, political will, participation and data and information exchange. The EU Water Framework Directive is considered successful in increasing the uptake of the basin-wide management approach, however, concerns remain regarding coherence between water and other sectoral policies, and the effectiveness of participation. Future work will compare these practices with others elsewhere, including Indonesia and Sri Lanka.

**Key words:** Europe; Flooding; Governance; Transboundary Rivers.

Abstract ID: 137



## A Flood Preparedness Model for Resilience Around Fluvial Disasters

Dziya I.\*<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*Isaac.dziya@hud.ac.uk

The researcher's background is Flood Resilience Partnerships Manager CMBC and the challenges of community participation in flood-related issues and community resilience. The flood risk disasters lack resilience frameworks to include community resilience and vulnerability; following after the United Kingdom Winter Floods of 2016. Literature review in property resilience of properties in the United Kingdom indicates several research gaps. The study aims to develop a community participation model for flood preparedness to address fluvial hazards, threats and disasters that improve the resilience of property and communities to fluvial flooding. The literature review has determined a centrist methodology. Interviews and questionnaires will be methods to be utilised for data collection, followed by data analysis. The study expects to contribute to resilience in all aspects of communities and properties exposed to fluvial flooding and come up with an operational framework. The framework will contribute to the adaptation required to deal with procedures in anticipation of changes and extreme flooding events to proffer strategies, choices for policy implications towards community resilience. The anticipated results for consideration will hopefully enhance the creation of quality livelihoods that stimulate the economy without endangering the environment. Conclusions and reflections flowing from the findings presented.

Abstract ID: 138

## Assessing the Effectiveness of the Relief Allocation for Drought Affected Area: A Case Study of Anuradhapura District

Senevirathne A.\*<sup>a</sup>, Ekanayaka R.<sup>a</sup>

<sup>a</sup> *Disaster Management Center, Sri Lanka*

\*anoja@dmc.gov.lk

Drought is one of the frequent hazards experienced in Sri Lanka. As it is slow-onset disaster less attention has been paid on that hence sustainable drought strategies have not been introduced and implemented nation to local level adequately. But still, huge amount of money has been used for drought response particularly on relief including drinking water distribution and compensation for farmers. The objective of this study is to monitor the distribution of drought in the Anuradhapura District and analyse the effectiveness of the relief distribution against the spatial and temporal distribution of drought within the district. This study uses MODIS satellite EVI products from the year 2015 to 2019 to develop VCI products and identified the divisional secretary-level drought-affected areas in Anuradhapura district based on the UN-SPIDER recommended practice for drought monitoring. Later, the drought-affected areas compared with the relief allocation data obtained from the divisional secretary level. Overall research finding indicate that the relief funds have not been utilized effectively in certain drought seasons. By utilizing this approach, the decision makers can evaluate whether the funds had been allocated effectively in respective areas.

**Key words:** Relief, Drought, MODIS, VCI

Abstract ID: 139

## **A Review on the Present Status of Community Level DM Committees in Tsunami Early Warning System in Sri Lanka**

Weerasena N.<sup>\*a</sup>, Hettige S.T.<sup>b</sup>, Amaratunga D.<sup>c</sup>, Haigh R.<sup>c</sup>

<sup>a</sup> *Centre for Development Research & Interventions, Sri Lanka*

<sup>b</sup> *University of Colombo, Sri Lanka*

<sup>c</sup> *University of Huddersfield, UK*

\*[namalww@yahoo.com](mailto:namalww@yahoo.com)

Preparedness and mitigation are essential components of disaster risk reduction, particularly concerning Tsunamis. Tsunami early warning system is recognised as the most effective way of predicting the occurrence of Tsunamis and reaching out to people who are at risk. An effective early warning system can help national and local institutions and communities to take necessary measures to respond to the warning emanating from the EWS when it is activated. Awareness and preparedness of community members are important aspects of the system that passes down the messages from the centre to regional and local level actors. Due to the convergence of communication channels, it is highly unlikely that an EW message does not reach the target communities. It is in this context that the mobilisation of the members of disaster management committees at village level has become critically important. Yet, it is a challenge to ensure their continued functioning. The purpose of this paper is to critically analyse the present state of the above committees in Sri Lanka and identify measures necessary to ensure their sustainability and functioning. A range of qualitative data collection techniques were used, including focus group discussions to collect data needed for the analysis. The field study covered five out of seven coastal districts affected by the 2004 Tsunami. The paper identifies reasons for poor functioning of the committees and makes recommendations for improving their functioning and making them sustainable in the long run.

**Key words:** Preparedness, Mitigation, Hazards, Community

Abstract ID: 140

## Understanding the Role of Creating Disaster Risk Resilient Cities in Facilitating the Achievement of Sustainable Development

Smart L.N. <sup>\*a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*lilian.smart@hud.ac.uk

The rate of the urban population increase in most developing countries of the world despite the lack of development is worrisome. With this increase, the achievement of the sustainable development goal agenda (SDGs) as well as the management of the recent occurrences of disaster risks in urban centres becomes a major course for concern. Regarding the increased disaster risks, it has been argued that urban centres are more exposed to natural disasters than the rural areas. This is mostly because the increased urban population which leads to inadequate housing facilities in the cities makes people to resort to living in slums and hazard prone areas such as floodplains, steep slopes, low-lying lands, riverine and coastal areas. Unfortunately, due to the high concentration of population and infrastructural facilities in these places, the sudden outburst of disasters leads to terrible damages and losses. With this, one can conclude that although cities are the hub of economic activities and equally considered as the key determinant factors in achieving the SDGs, urban disasters can hinder this goal. Accordingly, this paper aims at understanding the role of creating disaster risk resilient cities in facilitating the achievement of sustainable development in Nigeria. It is a call to think urban disaster resilience while thinking of sustainable development. This is a qualitative research design with interviews as the data collection technique. The findings will reveal to the governing authorities the role of disaster risk resilient cities in facilitating the achievement of the SDGs. Thus, help them to work towards the achievement of disaster resilient cities in the pursuit of the SDGs agenda.

**Key words:** Urbanisation, Cities, Disaster Risks, Resilient Cities, Sustainable Development

Abstract ID: 142

## Development of Disaster (Flood, Landslide, Drought and Tsunami) Risk Index for Sri Lanka

Seneviratne A.\*<sup>a</sup>, Ratnayake R.K.<sup>a</sup>, Idunil B.H.I.<sup>a</sup>, Wanasingha W.A.K.I.<sup>b</sup>, Dilshan M.W.R.R.<sup>c</sup>, Kuragama K.A.K.M.<sup>c</sup>, Lankathilaka R.A.D.B.M.<sup>d</sup>, Gunathilake J.A.S.P.<sup>c</sup>, Hapuarachchi S.P.<sup>c</sup>, Fernando G.S.<sup>c</sup>, Punchihewa S.P.G.<sup>e</sup>, Makevita M.A.K.P.<sup>e</sup>, Thulashika R.<sup>e</sup>

<sup>a</sup> Disaster Management Centre, Sri Lanka

<sup>b</sup> World Food Programme

<sup>c</sup> University of Moratuwa, Sri Lanka

<sup>d</sup> University of Colombo, Sri Lanka

<sup>e</sup> University of Sabaragamuwa, Sri Lanka

\*anoja@dmc.gov.lk

Over the past decades, frequency and the consequence of disasters record the increasing trend in Sri Lanka due to climate change rapid urbanization, population increase and unplanned development. Consequently, disaster risk has recorded increased trend setback the economic developments gains. Unavailability of risk information has been identified as hindering factor to ensure disaster risk reduction and promoting disaster resilience which considered as a cornerstone of all long-term sustainable development. DRR and disaster resilience should be promoted and mainstream into all development effort at all stages of economic and infrastructure development processes. The study analyse risk based on hazard (Flood, drought (Drinking water scarcity), landslide and Tsunami), vulnerability, capacity considering the population as element at risk using multi criteria evaluation facilities available in ArcGIS 10.7 using the Grama Niladari Division as Mapping unit. The Hazard were analysed with the administrative boundaries and calculate the affected area and weightage and the scoring were completed. The vulnerability and Capacity weigh are different from the type of hazard, therefore vulnerability and Capacity analysis output taken by using a mathematical model. Analysed results of all GND were further categorized into High, moderate and low risk levels by using a mathematical model. Further results depict that GN divisions which belongs to High risk category are not depended on the level of hazards as it directly depends on the population vulnerability. Therefore, planned urbanization and risk informed resettlement are main initiative for the disaster risk reduction in the country.

**Key words:** Risk Index, Hazard, Vulnerability, Capacity Disaster Risk

Abstract ID: 144

## Information Platform for Chemical Disaster Management and Impact Assessments

Kaushalya K.L.G.\*<sup>a</sup>, Dissanayake C.L.W.<sup>a</sup>, Premasiri H.D.S.<sup>a</sup>

*a National Research Building Organization, Sri Lanka*

\*gayani.nbro@yahoo.com

Studies conducted by NBRO has shown an increasing trend of industrial incidents in Sri Lanka ended up as disasters during past two decades. Most of these scenarios are commonly occurred in industries involving chemicals as raw materials, products/ by products or waste. The damage caused by these events were limited to industry premises and nearest surrounding or through relatively longer distances during fires. However, there is no proper methodology developed to assess the damage and the risk of chemical disasters in Sri Lanka. The main reason behind this condition is the un-availability of proper data management system to make use in a reliable assessment methodology. The data platform considered under this study was developed by collecting information available in several organisations to procedure one common platform and share it among responsible organizations such as government agencies, service providers, and industries with upgrading along with some limited access to general public. The information gathered were industrial location, type, using chemicals and quantities along with background information such as safety aspects and impact due to past incidents. The data platform can be used to assess the risk factor of each industry which is highly usable in disaster risk assessments. Similarly, in an emergency, general public may acquire basic understanding about the risk due to chemicals involved within the industry and safety measures for neighbouring communities such as need of evacuation. Furthermore, the responsible government organisations related to industrial safety and disaster management may acquire comprehensive understanding about the access routes, high risk areas, safety measures, and possible vulnerability. Correspondingly, this data platform is useful for disaster management and impact assessment leading to the reduction of chemical disaster impacts.

**Key words:** Chemical Disaster Management, Risk Assessment, Impact Assessment, Industrial Information

Abstract ID: 145

## Fire and Explosive Risk Reduction in Uncontrolled Dumpsites

Chandrasena W.K.N.\*<sup>a</sup>, Premasiri H.D.S.<sup>a</sup>

<sup>a</sup> National Research Building Organization, Sri Lanka

kasthurinalin@gmail.com

Methane (CH<sub>4</sub>) is a colourless and odourless gas which is generally stable in atmosphere. However, mixtures of CH<sub>4</sub> and air, with a CH<sub>4</sub> content between 5%(LEL) to 15%(UEL) by volume are highly explosive and fireable. It is a by-product of anaerobic decomposition and main sources of the CH<sub>4</sub> emissions are landfills, burning of biomass and fossil fuels in the world. Most of the developing countries practice uncontrolled dumping as their final option of the Municipal Solid Waste (MSW) management. Meethotamulla was one of the open waste dumps which operated in an immediate suburban location; Kollonnawa in City of Colombo resulted in a severe ground failure in 2017. After that collapse, field tests were conducted by the NBRO and revealed that organic composition of waste ranged from 40 – 45% with moisture level about 40 – 60% suggesting that the waste was in favourable condition to generate tremendous quantities of Landfill Gases (CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub> such as) during its decomposition process. The measurement on Landfill Gas (LFG) emissions conducted at the site, confirmed that the levels of methane at 1 ft below the surface of the waste were within the range of explosive limits with respect to methane where the methane is considered as the main emission of MSW dumping sites. However, trapped gases inside the dump will make a risk of sudden explosions without any indications due to pressurization of gases. Usually, LFG wells are used to manage the risk of gases in sanitary landfills though it is not easy for open dumps. The process of LFG well installation at Meethotamulla consists of site preparation, identification gas well locations and well depth calculation, selection of locally available low-cost material for construction, gas well installation and maintenance. Therefore, the installation of a simple and economical LFG collection system at Meethotamulla reduces the risk of fire and explosions in future.

**Key words:** Open Waste Dump, Landfill Gas, Fire & Explosive risk, LFG Well

Abstract ID: 146

## Decision Making when Evidence is Less Straight Forward - A Study to Further Strengthen Tsunami Early Warning Mechanism of Sri Lanka

Dias N.\*<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>, Premalal S.<sup>b</sup>

<sup>a</sup> *University of Huddersfield, UK*

<sup>b</sup> *Association of Disaster Risk Management Professionals, Sri Lanka*

\*n.dias@hud.ac.uk

Sri Lanka developed a comprehensive early warning mechanism after the 2004 Tsunami. Accordingly, if an earthquake occurs exceeding the magnitude 7.5, the decision-making is straightforward as the Tsunami Service Providers (TSP) send 'Tsunami threat' bulletins directly to the National Tsunami Warning Centers (NTWC). For earthquakes, which have a magnitude between 7.1 to 7.5, there is a high probability that TSPs send 'possible Tsunami threat' bulletin as the second bulletin. Accordingly, when the NTWC receives the second bulletin as 'possible threat' the decision making becomes less straight forward as the threat is not confirmed. In this scenario, NTWC and the National Disaster Management Organisation (NDMO) need to wait till the third bulletin is issued and if the third bulletin confirms the 'Tsunami threat', there may be less time to complete the evacuation process. Accordingly, there is a need to develop a new mechanism for decision making for earthquakes, which have a magnitude between 7.1 to 7.5. Addressing this gap, based on a comprehensive literature review followed by expert interviews and focus group discussions a mechanism was developed for earthquakes, which have a magnitude between 7.1 to 7.5. The new mechanism identifies alternative information sources and assessment methods for decision making. Upon the completion of the study, recommendations will be provided to further strengthen the tsunami early warning mechanism of Sri Lanka.

**Key words:** Tsunami Early Warning, Less Straight Forward Evidence, Decision Making

Abstract ID: 147



## Assessing Flood Risk in Malwathu Oya River Basini Northern Sri Lanka for Establishing an Effective Early Warning System

Mahakumarage N.<sup>\*</sup>, Hettige V.<sup>a</sup>, Jayaweera S.<sup>b</sup>, Hapuarachchi B.<sup>a</sup>

<sup>a</sup> UNDP, Sri Lanka,

<sup>b</sup> Disaster Management Centre, Sri Lanka

\*nandanageo@gmail.com

Recurrent flood events in 2016 and 2017 in Sri Lanka caused significant disaster impacts, with damages and losses estimated at LKR 170 billion. Post Disaster Needs Assessment 2016 highlighted a series of shortfalls in disaster risk management in Sri Lanka, including the absence of effective early warning systems. A major barrier to establishing an effective early warning system, is the lack of risk assessments, especially for floods. While many attempts were made to assess flood risk, none has progressed beyond mapping flood-prone areas. Lack of a scientifically conceptualized and practically tested methodology for risk assessment and data gaps has resulted in unavailability of risk assessments. A methodology, based on participatory techniques and GIS tools, tested at pilot scale in Southern Sri Lanka, was adopted for a basin-wide flood risk assessment in Malwathu Oya river basin. Under this, flood risk of 10,000 households in the Malwathu Oya river basin was assessed and validated at the individual household level, using GIS tools and participatory methodologies. Results suggest that individual household level flood risk assessment is possible with available data and thus, targeted early warning systems can be established for communities-at-risk.

**Key words:** Early Warning, GIS, Flood Risk, Flood Risk Assessment

Abstract ID: 148

## Translating the Guidance on Gender Inclusion in the Global Agendas into Action

Ariyabandu M.M.\*<sup>a</sup>, Miranda R.<sup>a</sup>, Nivaran D.<sup>a</sup>

<sup>a</sup> *South Asia Network for Disaster Mitigation*

\*mmariyabandu@gmail.com

When countries formulated the global guidance frameworks on disaster risk reduction for resilience building in 2015, the consensus was to focus on the capacities, empowerment and leadership role of women, on the engagement of all marginalized groups. Countries also recognized the specific vulnerabilities and concerns that various groups face due to social, economic and institutional conditions. A review of progress for the period 2016-2018 on implementing commitments on gender and social inclusion of the Sendai Framework for Disaster Risk Reduction in Asia based on updates from 10 governments and 12 non-state agencies found that while there is wide consensus on the importance of addressing gender equality and social inclusion and increasing political will for implementation, the translation of stated commitments into actions that would result in gender equality and social inclusion is constrained by several factors. Information for the progress review was collected through structured questionnaires sent to the representative governments of the Asia Partnership of the United Nations Office for Disaster Risk Reduction (UNDRR) and the organizations in the Stakeholder Group for Gender and Women's issues. The progress review raised several fundamental aspects that limit the efforts to achieve gender-inclusive and risk-informed early warning. These include failure to address the root causes of marginalization and structural barriers; poor awareness and understanding of the key issues for making a shift towards capacitating and empowering women and other marginalized groups, inadequate capacities, and the uncoordinated and patchy nature of the interventions.

Abstract ID: 149

## **An Analysis of the Adequacy of Tsunami Warning Towers as a Last Mile Warning for the Populations Exposed to Tsunamis in Sri Lanka**

Samansiri S.\*<sup>a</sup>, Senevirathne A.<sup>b</sup>, Fernando T.<sup>a</sup>

<sup>a</sup> *University of Salford, UK*

<sup>b</sup> *Disaster Management Centre, Sri Lanka*

\*srimalsl@yahoo.com

The Indian Ocean Tsunami, which originated from the Andaman–Sumatra subduction zone on the 26th December 2004, caused a massive loss of life and damage to property on the coastline of Sri Lanka. If effective early warning systems had been in place in the Indian Ocean region, the death toll would have been significantly lower. As a result, multiple warning mechanisms were established along the coastal zone of Sri Lanka, in anticipation of any future tsunami occurrences, to transmit early warning messages to citizens who live in the zones likely to be affected by tsunamis. The current tsunami warning tower system in Sri Lanka comprises towers at 77 locations. The objective of this study was to evaluate the adequacy of this tsunami early warning tower system in reaching everyone in the tsunami-affected area in Sri Lanka. This research has analysed the audible coverage of each tower in terms of reaching the population exposed to the maximum credible tsunami threat. Geospatial analysis techniques have been used to assess the population distribution and field data verification has been conducted to determine the effective audible strength of the warning messages from the towers to the exposed population. The results show that approximately over 865,000 residential citizens are at risk of the tsunami threat in Sri Lanka, but only 248,000 (30% of the potentially exposed population) can receive the audible early warning messages from the current tsunami tower system. Therefore, this paper argues that there is a need to strengthen the existing systems and introduce low-cost high-impact community-based warning systems linked to first responders (i.e. police, coast guard and military) along the coast.

**Key words:** Tsunami Warning, Audible Coverage, Population Density

Abstract ID: 150

## Knowledge, Reported Practices and Their Associated Factors on Disaster Preparedness Among Residents of MOH Area, Agalawatta

Ambagahawita A.<sup>a</sup>, Nandasena S<sup>b</sup>, Perera S.<sup>c</sup>

<sup>a</sup> Family Health Bureau, Sri Lanka,

<sup>b</sup> Deputy RDHS, Sri Lanka

<sup>c</sup> WHO, Sri Lanka

\*anjana625mango@gmail.com

Agalawatta is a natural disaster-prone area in Kalutara district which has a uniform weather pattern with seasonality. A descriptive cross-sectional study was conducted among aged 15-59-year-old permanent residents in Agalawatta Medical Officer of Health area, to assess the knowledge, reported practices and their associated factors of disaster preparedness. Interviewer administered questionnaire was used to ascertain data. A knowledge score was developed based on questions on different aspects of knowledge on disasters and disaster preparedness. Majority of the respondents found floods (72.9%, n=436) and landslides (67.1%, n=401) as the most commonly occurring natural disasters in Agalawatta. Only 16.2% (n=97) of the study population was having more than the middle value of the knowledge score (i.e. 45 out of 90). Participants with previous experience in natural disasters had higher knowledge compared to those who were not (58.7% vs. 41.4%,  $p < 0.01$ ). Only, 17.9% (n=107) of the population identified "divisional focal point" as a stakeholder who needs to contact during a disaster and 33.3% (n=199) of the study population has identified a potential safe location to move during a natural disaster in the area. Those who have experienced previous disasters were having higher knowledge and favourable practices than who haven't experienced a disaster.

**Key words:** Disasters, Disaster preparedness, Floods, Landslides

Abstract ID: 151

## Developing a Framework for Disaster Risk Management Integrated Transport Planning Process - Exploring the Key Components and Unit of Analysis

Senevirathne M.<sup>\*a</sup>, Haigh R.<sup>a</sup>, Amaratunga D.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*malith.senevirathne@hud.ac.uk

The transportation system determines the connectivity among economic centers and amenities, and has been identified as a potential driver in disaster risk management and improving resilience. Studies into this focus can develop a logical thought process for the applications in transportation to improve response operations and resilience capacities in cities. The proposed research aims to identify the key analytical components in developing a framework to integrate disaster risk management approaches into the transport planning process. The extended literature review on this purpose indicated that the framework should be consisted of; a) guiding principles, b) local actions, and c) components to maintain the coherence between the entities a) and b). Accordingly, by using the Gephi software the eligibility of 30 components has been assessed based on a cause-effect analysis followed by a priority degree calculation to determine the strength of division and propagation of influence in each component. The results demonstrated a composition of global agendas and local actions linked by the infrastructure demand analysis in the proposed framework. The result will be further evaluated in a multiple, holistic case study to develop and validate the framework for integrating disaster risk management decisions into the transport planning process.

**Key words:** Disaster risk management, Early warning systems, Resilience planning, Transport planning

Abstract ID: 152

## What is the Disaster Resilient Properties?

Nissanka S.\*<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*chrishani.shavindree@hud.ac.uk

Disaster resilience has become the latest addition to sustainable development as it ensures current development gains are safeguarded for future generations in the event of natural hazards. The built environment made up of manmade structures which often constitute the weakest links will turn out to be the most dangerous places during natural hazards. The vulnerability of the built environment is further increasing with rapid urbanization and population growth. In deciding how to embed disaster resilience, exploring the characteristics of a given context for it to be disaster resilient is vital and these characteristics are named as disaster-resilient properties. Despite the critical necessity of making the built environment disaster-resilient, disaster-resilient properties of the built environment have not explored so far. However, disaster-resilient properties in different contexts such as transport systems, infrastructure systems are highlighted in the literature. In this study, a descriptive or mapping review is conducted to identify disaster-resilient properties in different contexts and finally a qualitative content analysis was conducted to derive a set of disaster-resilient properties for the built environment. This set of disaster-resilient properties could be used as a basis in developing a resilience pathway for the built environment.

**Key words:** Disaster Resilience, Disaster Resilient Properties, Built Environment

Abstract ID: 153

## Core Principles for Planning Public Open Spaces to Enhance Coastal Cities' Resilience to Tsunamis in Sri Lanka

Jayakody R.R.J.C.\*<sup>a</sup>, Amaratunga D.<sup>a</sup>, Haigh R.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*c.jayakody2@hud.ac.uk

Public open spaces in cities are often considered as an asset in making cities sustainable contributing to the three main pillars of sustainability; economic, social and environmental. Yet, the importance of public open spaces for disaster resilience is less recognised and still remains under-rehearsed in urban planning context. Within this context, this research explores the potentials of public open spaces to enhance the coastal cities' resilience to Tsunamis through planning and designing interventions. Further, this research is focused down to the Sri Lankan context, as Sri Lanka is one of the Tsunami prone countries fronting many challenges such as land scarcity due to the rapid urbanization, pressure on natural and built environment due to the unplanned urban development.

This research study adopted the grounded theory method as the research strategy. Accordingly, data collection involved 72 unstructured interviews covering wide variety of participants related to the field of study; Tsunami affected communities, disaster resilience experts, urban planners, sociologists and coastal planners, etc. The grounded theory coding procedure is used to analyse the interviews, visual images and documents.

The analysis reveals that there is a significant potential to use public open spaces to enhance the coastal cities' resilience to Tsunamis as an emergency evacuation directing point, as a primary place for emergency rescue, as an agent for temporary sheltering, as a facilitator for Tsunami disaster mitigation and as a mediator to provide Tsunami awareness. Finally, the results propose five core principles to plan and design public open spaces as a strategy to enhance the coastal cities' resilience to Tsunamis.

**Key words:** Disaster resilience, Public open spaces, Sustainable development, Urban designing, Urban planning

Abstract ID: 154

## Resettled or Displaced? A Social Inquiry on Tsunami Resettlement Program in Dickwella Divisional Secretariat, Sri Lanka

Kamalrathne T.\*<sup>a</sup>

*a University of Peradeniya, Sri Lanka*

\*thusharakamalrathne@gmail.com

Sri Lanka has been experiencing several coastal hazards, and significant attention was given by the government and other humanitarian agencies after the Indian Ocean Tsunami in 2004. 1,009,474 people were affected by the Indian Ocean Tsunami in 2004, which was the most recent tsunami experience in Sri Lanka and the economic loss of livelihoods and other infrastructure is estimated to be US\$208.2 billion. Many victims of the tsunami in 2004 were resettled by the Sri Lanka government and several non-government agencies in various places in the country known as tsunami resettlement schemes. The objectives of this paper are to highlight the social constraints faced by resettled people and to suggest a social management plan to address the social constraints. This study finds that the resettlement project has paid little attention to national and global safeguard policies such as the national involuntary resettlement policy, policies of aid agencies and donors. Livelihood restoration is a vital pillar in any resettlement project but this resettlement project has had a detrimental impact on livelihoods. Further, the absence of ownership of lands restricts access of children to government schools and impacts on social respect and identities. Therefore, the study shows that the resettlement programs lack prior social planning and remain unsatisfactory, as social issues of the affected people have not been addressed. Field research for this paper was carried out in the Dickwella divisional secretariat in Matara district. Focus group discussions and key informant interviews were used to collect primary data. Michael Cernea's Impoverishment Risks and Reconstruction Model (IRR) (Cernea 1997) was used as an analytical framework to study and analyze the impact of the resettlement.

Abstract ID: 155



## Application of Participatory and Appreciative Approach on Develop Comprehensive Disaster Risk Assessment Tool at Local Level: Special Reference to Jaffna District of Sri Lanka

Ravi S.\*<sup>a</sup>

*a Disaster Management Centre, Sri Lanka*

\*rspillain@yahoo.com

The local disaster risk reduction, sustainability and resilience are key principles which are being subjected to apply in disaster risk management due to increasing vulnerabilities of multi-hazard disaster risk at the local level in Sri Lanka. Jaffna district has annually experienced on multi-hazard disaster risk its impact on livelihood, infrastructure, and lives of people and properties. The causes of these disasters are dependent on various elements of vulnerability and risks at the local level. It has taken account to develop a comprehensive disaster risk assessment for mainstreaming disaster risk reduction which is aimed to support to reduce the impact on the development and ensure the disaster resilient. The objective of the present study is to develop a comprehensive disaster risk assessment tool by using the participatory method and appreciative approaches. For the primary data collection, through focus group discussion with beneficiaries and local level key informants' interview with decision-makers were used horizontally and Vertically. The study concludes that the participatory method and appreciative approach to developing the tool by enabling the potential for assessing multi-hazard disaster risks at the local level. The developed tool is capable of disaster risk reduction. The findings can facilitate to address the potential risks and support to discover the appropriate risk-based solution to reducing vulnerability and increasing the capacity with the active partnership.

**Key words:** Local, Participatory, Risk Assessment, Disaster Risk Reduction

Abstract ID: 156

## Preparedness on Problem Focused Solution of Disaster Risk Reduction: Case Study of Tsunami Affected Community at Uduthurai and Aliyawail of Jaffna District, Sri Lanka

Ravi S.\*<sup>a</sup>

*a Disaster Management Centre, Sri Lanka*

\*rspillain@yahoo.com

The event of the coastal area disasters is increasing globally and highly vulnerable and affected during the Tsunami occurred in 2004 in Sri Lanka. In this context preparedness of the rapid onset, the coastal hazard is one of the major priorities to reduce disaster impact at the last mile of the tsunami-prone area. Jaffna district consists of the majority of the area is coastal and vulnerable to coastal hazards disaster risk. The study has been considered that tsunami disaster preparedness and early warning and dissemination at the end to end and is the readiness to reduce impact. The study aims to investigate the preparedness action of the tsunami-prone area and its effectiveness of early warning and response practices at Uduthurai and Aliyavali. This study mainly utilized the primary data through focus groups discussion with last-mile people and different stakeholders at the community level, field level simulation exercise, and key informants with operational and incident commanders at the local level. The study tested the three main phases of disaster preparedness and early warning Dissemination, and implement participatory mitigation measures. The study found that area has high potential to the contributory and participatory partnership to strengthening preparedness level to reduce impact. This study has been recommended to encourage participatory and inclusive actions to disaster risk reduction and strengthening local-level early warning, dissemination, evacuation, and coordination mechanism implement among the stakeholders. The possible effective actions could reduce the vulnerability and make sure the safer and resilience community in future.

**Key words:** Participatory, Tsunami, Early Warning Dissemination, Preparedness

Abstract ID: 157

## Participatory - Geospatial Information Science and Technological Services (P- GISTS) Enhance Multi Stakeholder Partnership in Disaster Risk Reduction: Special Reference in Jaffna District, Sri Lanka

Ravi S.\*<sup>a</sup>

*a Disaster Management Centre, Sri Lanka*

\*rspillain@yahoo.com

Participatory - Geospatial Information Science and Technological Services (P- GISTS) play a key role in disaster risk management. P- GISTS include both spatial and non-spatial information which supports effective planning and management of Disaster. Jaffna District is affected by multi-hazards annually and Lack of effective database management system including both spatial and non-spatial that leads to negatively impact on the disaster risk reduction of the district. The present study is to identify the contribution of P- GISTS for disaster risk management of Jaffna District. The data collection through focus group discussion with village-level officers at a different level and key informants' interview with decision-makers at the vertical and horizontal level were used. Village level attributes data related to disaster-affected areas were collected through survey forms and different types of the map were produced through participatory methods with the usage of open sources as Google Earth and QGIS 3.3 were used to spatial data input and analysis the areas. Used Criteria based weightage application on hazard, Vulnerability, Capacity and risk were analysed. The study found that the potential risks areas of disasters at the village level were identified. The study discusses the potential benefit of P- GISTS on disaster risk management process. Implement and evaluate to overcome the current limitation of the triangle stakeholders such as beneficiaries, users & decision-makers. Finally recommended the P - GISTS facilitate to appropriate investment on disaster risk reduction through participatory the planning, implementation, monitoring and evaluation to effective decision making on at Local to National.

**Key words:** Geographical Information System, Participatory, Information Management, Resilient

Abstract ID: 158

## A Systematic Literature Review on Indigenous Knowledge in Disaster Risk Reduction

De Silva A.\*<sup>a</sup>, Haigh R.<sup>a</sup>, Amaratunga D.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*asitha.desilva@hud.ac.uk

Indigenous knowledge has protected communities from natural hazards for decades. The knowledge gathered throughout generations from observation has increased the capability of understanding the behaviour patterns of natural hazards specific to their local environment and thereby developed their own set of defence strategies. Recent DRR policies have highlighted the importance of indigenous knowledge, but evidence show a lack of translating that knowledge in to practice. Researchers have also shown the contribution that indigenous knowledge can make towards productive DRR practices across the global context. Therefore, the aim of this paper is to understand the role of indigenous knowledge in disaster risk reduction. The paper is based on a systematic literature review using academic literature published online after 2010 and current international policy documents related to DRR, based on the guiding questions of what are the areas where the indigenous knowledge is incorporated and how it has been integrated, using a key word search for the terms, indigenous knowledge and disaster risk reduction. Outcome of this paper which is the role of indigenous knowledge in DRR will be instrumental in identifying the areas of improvement for incorporation of indigenous knowledge which can be strengthened towards productive DRR practices.

**Key words:** Indigenous knowledge, Disaster risk reduction

Abstract ID: 159

## **An Evaluation of Existing Natural Disaster Risk Insurances in Sri Lanka**

Senavirathna C.\*<sup>a</sup>

<sup>a</sup> *University of Colombo, Sri Lanka*

\*danushikasenavirathna@gmail.com

Global warming lead by climate change has intensified the occurrence of disastrous events in the world. Global professionals in Disaster Risk Reduction are doing their best to ensure that cities are resilient through mitigation and preparedness strategies. However, the response and recovery sectors need to strategies to cope up with the devastating impacts of natural disasters, since the limited fiscal capacities slow the recovery process. Sri Lanka as a country prone to natural disasters, lacks the financial backup required for the disaster recovery stage. It is not always the government's responsibility to rebuild everything, but also the public should be responsible for their recovery. Therefore, disaster insurance schemes can support this recovery process by aiding the local communities with necessary financial backup. The main objective of this study is to identify the role of the insurance scheme in terms of natural disaster risk in Sri Lanka. The research is based on outputs of expert interviews among the top ten insurance companies and a literature review has been done to identify the global role of insurance companies in natural disaster risk and the existing gaps in the country. Results highlighted that the strength of insurance schemes for natural disaster risk is relatively low compared to some developed and developing nations prone to disasters. Policies have shown that despite the initiatives taken to launch such schemes; companies are reluctant to provide the services due to financial instability among communities. However, there is a significant room for improvement in the insurance sector, based on better location analytics. Such measurements would require further research into preparedness capacities and requirements of the affected communities.

**Key words:** Natural Disasters, Insurance, Risk, Preparedness

Abstract ID: 160

## Flood-Resilient Solutions of Urban Area

Piyumi M.M.M.<sup>a</sup>, Abenayake C.C.\*<sup>a</sup>, Wijayawardana N.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

\*chethika.abenayake@gmail.com

Low impact development (LID) has gained the attention of sustainable engineering and urban planning practice in the developed world, whereas need to be acknowledged by the practitioners in developing countries. LID-based simulations are much needed to be validated and popularized in the developing countries where rapidly urbanizing regions in the world are located. The objective of this study is to evaluate the effectiveness of LID options in reducing urban flooding in Nawalapitiya; a rapidly urbanizing small township in Sri Lanka. First, the Storm Water Management Model (SWMM) –an open source software application practiced in the United States- was employed and validated in the local context. Next, SWMM was utilized to simulate the effectiveness of stormwater drainage capacity improvement and two hypothetical LID options: rain barrels and green roof in reducing urban flooding. Results revealed that LID options are effective in enhancing the disaster resilience in built form by reducing flood exposure. Hence, LID can be recommended as an effective spatial planning and decision-making tool in the context of Sri Lanka, making future cities resilient.

**Key words:** Resilient Urban Planning, Urban Flood, GIS-Simulation, Regulations

Abstract ID: 161

## Introduction of a New Laboratory-Based Surveillance System (Rapid Antigen Notification System 1/RANS1) to Control Dengue Infection within the Western Province, Sri Lanka

Wedisinghe W.A.Y.<sup>\*a</sup>, Ranwala R.A.D.L.M.K.<sup>b</sup>, Jayamanne B.D.W.<sup>b</sup>, Perea S.K.<sup>c</sup>

<sup>a</sup> Provincial Directorate of Health Services, Western Province, Sri Lanka

<sup>b</sup> Health Informatics, Sri Lanka

<sup>c</sup> University of New South Wales, Australia

\*ywedisinghe@gmail.com

During the recent past, dengue fever and associated complications has been the most important concern for health policy makers of Sri Lanka. A rising trend has been observed and the numbers have increased remarkably over the past few years. Rapid investigation of suspected/diagnosed cases and taking appropriate action to prevent further spread has been the most effective control strategy so far. The provincial department of health services (PDHS), Western province introduced new laboratory-based e-surveillance system for notification and rapid preventive response of dengue cases within the Western Province, Sri Lanka. A new laboratory based online e-notification system was initiated in the Western Province. The notification process starts at the laboratories by creating a new notification whenever a Dengue NS1 Antigen test result is detected positive at a participating laboratory. Viewing of notifications, organizing and directing to the attention of the relevant Medical Officers of Health (MOH) is done on the same day when it appears in the MOH users view. The MOH user has 4 tabs, namely “new notices” “pending for action”, “completed” and “unidentified”. When the Public Health Inspector takes an action, it is updated to “completed” state. A dashboard visualizes each notification status with a color code. The Medical Officer of Health finally updates the system as “action implemented” to complete the notification process.

The new e-surveillance system will improve the efficiency of surveillance and action by field health staff, compared to the current paper-based notification system.

**Key words:** Early warning and response system, NS1 surveillance, real-time bio surveillance, Dengue

Abstract ID: 162

## Flood Risk of Porathivu Pattu in Batticaloa District: Sri Lanka

Prakashnie, M.P.\*<sup>a</sup>, Nianthi, K.W.G.R.<sup>a</sup>, Wickramasooriya A.K.<sup>a</sup>

<sup>a</sup> *University of Peradeniya, Sri Lanka*

\*rishipm515@yahoo.com

The Batticaloa District is one of the flood-prone areas in Sri Lanka. It creates an impact on the agriculture sector, disturbs the habitual life and makes people live vulnerable. This study examined the Flood Risk (FR) and introduced the Flood Hazard Map (FHM) for the Porathivu Pattu. Two river basins namely Andella and Navagiri have been selected to examine the flood risk. The parameters which are the most important factors influence flood disaster in the study area like, distance from the river, soil type, land use type, and elevation have been considered for flood hazard and risk analysis. FHM has been created using a weighted overlay analysis method in ARC-GIS 10.3 software. A flood risk map has been introduced based on FHM. The FR has been classified into five categories namely Very Low Risk, Low Risk, Moderate Risk, High Risk (HR) and Very High Risk (VHR) with the area coverage. This study also examined the effect of floods on paddy cultivation and home gardens based on the FHM. The Paddy Land (PL) (87% of PL in VHR and 90% of PL in HR) and Home Gardens (HG) (08% of HG in HR) have been identified within the VHR and HR areas. The study suggested to improve the structural and non-structural strategies more effectively in Porathivu Pattu.

**Key words:** Flood Hazard Map, Flood Risk Map, Paddy Cultivation, Home Garden

Abstract ID: 163



## Network Centrality Assessment: Assessing the Transport Networks Resilience for Urban Flooding

Kalpana H.N.<sup>\*a</sup>, Madusanka N.B.S.<sup>a</sup>, Jayasinghe A.B.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

\*hnhasinthanawod@gmail.com

Transport system is a vital element in the function of urban areas and minimizing distractions to transport networks caused by natural disasters is a key goal in disaster resilient urban planning and development. The study presents a framework to assess the transport networks' resilience for urban flooding. The proposed framework is developed based on network centrality and graph theory. The study utilized betweenness and closeness centrality to evaluate the transport networks' resilience for urban flooding and utilized Open Source GIS tools to compute centrality values. The case study is carried out in Colombo, Sri Lanka. The results revealed three key findings. First, spatial pattern analyses showed that the topological characteristics of the road networks changed during the flooding events. Secondly, the relative importance of the road segments under the flood situation is different to the same under the undisturbed condition. Thirdly, the betweenness centrality values of road segments as useful indicator to measure transport network resilient. The proposed framework can be utilized as a planning tool to find out transport networks' resilience and devising plans to address disaster risk.

**Key words:** Urban Flood; Urban Simulation; Transport Planning; Open Source GIS

Abstract ID: 164

## **Drought and Adaption Practices in the North Central Province in Sri Lanka**

Senavirathne E.M.H.G.N.P.\*<sup>a</sup>, Gunawardhana LM.N.P.<sup>a</sup>

<sup>a</sup> *Rajarata University of Sri Lanka*

\*hgshani@gmail.com

Climatologically drought is the consequence of lack of expected rainfall over an extended period, usually a season or more. Normally the drought management in Sri Lanka is largely limited to relief provision. The adaptation practices are also necessary to promote in drought-prone areas. The objective of this study was to examine the drought event occurred in 2016 and to find out the adaptation practices of the agrarian community in the Anuradhapura District of the North Central Province of Sri Lanka. The adaptation strategies adopted by the farming communities were examined with the help of 540 questionnaires in selected 08 DS divisions. The data has been analysed by factor analysis using SPSS software. The verity of drought adaptation strategies has been practiced by the farming communities for responding to drought. The traditional Bethma practices (39% respondents), mulching, avoidance of cultivation seasons, economical tank water usage, drought resistance cropping, crop diversification, etc. were identified as the on-farm adaptations. Engage with other jobs (24%), reduce foods consumptions, etc. were identified as off-farm adaptations. The factor analysis implied with 2.121 high initial eigenvalues. The study recommends implementing the National adaptation plan for climate change impacts in Sri Lanka (2016-2025) introduced by the Ministry of Mahaweli Development and Environment.

**Key words:** Adaptation Practices, Agrarian Community, Drought, Off-Farm, On-Farm.

Abstract ID: 165

## Remote Sensing Innovations for Index-Based Flood Insurance in India

Amarnath G.\*<sup>a</sup>, Alahacoon N.<sup>a</sup>, Ghosh S.<sup>a</sup>, Brahmanand P.S.<sup>b</sup>, Sikka A.<sup>b</sup>, McDonnell R.<sup>c</sup>

<sup>a</sup> International Water Management Institute (IWMI), Sri Lanka,

<sup>b</sup> International Water Management Institute (IWMI), India

<sup>c</sup> International Water Management Institute (IWMI), Italy

\*a.giriraj@cgiar.org

Protecting against floods and providing risk cover against losses due to floods has been a major area of concern for any government. Risk transfer through insurance is an important component in managing agricultural risks from disaster events. Index-based flood insurance (IBFI) is an innovative approach to developing effective payout schemes for low-income, flood-prone communities. The project integrates hi-tech modelling (combined hydrological and hydraulic) and satellite imagery to predetermine flood thresholds (flood height and flood duration), which could trigger speedy compensation payouts. Between 2017 to 2019 more than 1200 farming households in Bihar have signed up for a pilot IBFI scheme across different flood risk areas. In total more than 869 HH has received insurance payout over INR 1.7 million directly in their bank account. IBFI initiative promotes a closer linkage between risk transfer and risk reduction that could make this more sustainable and robust tool for flood-affected communities and reducing the burden of post-disaster relief funds for the government. IBFI has the potential to be part of a more wide-ranging and multi-faceted approach to make sure that South Asia remains flood resilient in years to come.

**Key words:** Flood disasters; Satellite data; Risk transfer; Index-based flood insurance

Abstract ID: 166

## Regional Drought Monitoring for Managing Water Security in South Asia

Amarnath G.\*<sup>a</sup>, Alahacoon N.<sup>a</sup>, Ghosh S.<sup>a</sup>, Rao K.V.<sup>b</sup>, Sikka A.<sup>c</sup>

<sup>a</sup> *International Water Management Institute (IWMI), Sri Lanka*

<sup>b</sup> *Central Research Institute for Dryland Agriculture, India*

<sup>c</sup> *International Water Management Institute (IWMI), India*

\*a.giriraj@cgiar.org

South Asia is challenged with water, food and energy security due to growing populations, incomes, resource degradation and vulnerability to climate change. Monitoring of drought and associated agricultural production deficits using meteorological and agricultural indices is an essential component for drought preparedness. Remote sensing offers near real-time monitoring of drought conditions and IWMI's has implemented South Asia Drought Monitoring System (SADMS) in 2014 as an online platform for drought early warning and support in drought declaration. SADMS operational system consist of four components: (1) a daily update of meteorological drought indices using satellite-based rainfall estimates with quality checks and bias correction; (2) an estimation of 10-day soil moisture using ESA's ASCAT data to derive Soil Water Anomaly Drought Index; (3) calculation of an integrated drought severity index that includes a vegetation condition index, precipitation condition index, temperature condition index, and a soil moisture index; and (4) classification of five drought classes ranging from "extreme" to "watch." Mapping drought hotspots enhance agriculture water management and enable science-based policies for addressing water security in the agriculture sector.

**Key words:** Drought monitoring; Agriculture water management; Water security; Drought risk reduction, South Asia

Abstract ID: 167

## **Making EWS Inclusive: The Philippine Experience on PWDS in Disasters – A Literature Review (Theme: Disaster Preparedness)**

Edwin S.\*<sup>a</sup>

<sup>a</sup> *Asian Disaster Preparedness Center (ADPC), Philippines*

\*edwin.salonga@adpc.net

This paper reviews existing literature on the plight of persons with disability (PWDs) in the Philippines in times of disasters. The Philippines ranked third among all of the countries with the highest risks worldwide according to the World Risk Report 2018. With 74% of the population susceptible to impacts of disasters, PWDs are disproportionately affected. Its government has developed an early warning system to keep the public informed of possible storm surges, floods, or landslides, up to 48 hours in advance. Early warning systems are further enhanced by the Free Mobile Disaster Alert Act of 2014, which mandates telecommunication operators to issue free public warnings via mobile phones. Existing literature suggests that while there is a shift towards inclusive approaches within international and national policy frameworks, the participation of PWDs remains limited. It is observed that early warning devices are not PWD-sensitive. In times of disaster, first responders would prioritize PWDs but they need to be accounted for in government records as registered PWDs. Recommendations for inclusive EWS include the development of simple and visual warning signals, implementation of lighting system or simple weather advisory, and having deaf interpreters sign the updated weather forecast in televisions.

**Key words:** Inclusive, EWS, PWD, Philippines

Abstract ID: 168

## Disasters, Climate Change and Development Nexus on Food Security Sector in Asia

Kumara M.A.S.J.<sup>\*a,b</sup>, Amaratunga D., Haigh R.,

<sup>a</sup> University of Huddersfield, UK

<sup>b</sup> Asian Disaster Preparedness Center, Thailand

\*sisira@adpc.net

Disasters report unprecedented impacts globally and regionally over the past two decades. Climate change is amplifying the impacts across vulnerable countries in the region. Frequency, seasonality and intensity of climate-induced hazards have shown significant changes across the region having adverse impacts on fragile sectors such as Agriculture, Water Resources, Health, among others. Food security, which depends on the physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life, has been compromised many parts of the world, including Asia. Chronic impacts of climate change such as the sea-level rise and temperature changes have impacted the production and productivity of the Agriculture sector, while climate-induced hazards have direct impacts on the performance of food security in developing nations. Sustainable Development Goal (SDGs) Two; '*Zero Hunger*' aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture. However, the progress and process have been challenged by climate change, disaster impacts and their nexus with development pathways. Climate change and disasters will not only impact SDG two but also other goals such as Goal 1 (no poverty), Goal 3 (good health and well-being), Goal 4 (quality education), Goal 6 (clean water and sanitation), Goal 11 (sustainable cities and communities), among others. Therefore, this paper discusses the disaster and climate change impacts on the food security sector and their nexuses with achieving sustainable development goals. The paper synthesizes the various studies and literature on the nexus between climate change, disasters and development paradigms in Asia. Further, the complex challenges that the global and regional communities face in achieving SDGs, targets of the Sendai Framework for Disaster Risk Reduction and the Paris Agreement will be discussed.

Abstract ID: 169

## Why Mobilising Women's Leadership is Critical to Effective Disaster Risk Reduction

Amaratunga D.\*<sup>a</sup>, Hemachandra K.<sup>a</sup>

<sup>a</sup> *University of Huddersfield, UK*

\*d.amaratunga@hud.ac.uk

Disasters don't discriminate, but people do. Research reveals that disasters reinforce, perpetuate and increase gender inequality in terms of loss of livelihoods, gender-based violence, and even levels of mortality during, and in the aftermath of disasters, making situations worse for women. This has been attributed to existing socio-economic conditions, cultural beliefs and traditional practices and neglecting their potential contributions to disaster risk reduction (DRR). Women are often the drivers, strong networkers, managers, organizers, and caretakers in the community, playing a constructive and productive role in DRR. There are plenty of success stories of women's achievements in reducing disaster risk and in building resilience at the community level. Nevertheless, women tend to be categorized as "victims" and as a "vulnerable group" in need of protection from the impact of disasters, failing to recognize women's capacities and contribution to DRR and to promote their leadership, and role as change agents in building community resilience to disasters. This is evident from where all DRR decisions are taken by men. Hence, the empowerment of women is considered as critical ingredient in building disaster resilience. While progress has been made in the implementation of the Hyogo Framework for Action (HFA), it is widely recognized that serious gaps and challenges remain in delivering on the international community's commitments to gender equality and women's rights in DRR efforts. Engagement and leadership of women as change agents in their societies are still often overlooked in disaster risk management. Within this context, this paper presents the findings of a recent study in setting the case for women leadership in disaster risk reduction, including good practices, barriers and recommendations.

Abstract ID: 171

## The Formation of a Capacity Development Framework to Improve Research and Innovation in Disaster Resilience in Higher Education Institutions in Asia

Liyanage C.\*<sup>a</sup>, McDonald R.<sup>a</sup>, Amaratunga D.<sup>b</sup>, Hayat E.<sup>c</sup>, Haigh R.<sup>b</sup>

<sup>a</sup> *University of Central Lancashire, UK,*

<sup>b</sup> *University of Huddersfield, UK*

<sup>c</sup> *Teesside University, UK*

\*cliyanage@uclan.ac.uk

The ERASMUS+ funded Advancing Skill Creation to ENhance Transformation (ASCENT) project aims to build research and innovation (R&I) capacity in the Asia Region 6 (as per ERASMUS+ guidelines) to enable the development of societal resilience to disasters. In collaboration with some Asian partner institutions from Thailand, Bangladesh and Sri Lanka, a comprehensive methodology was utilised to examine research and innovation practices. Literature review, roundtable discussions with international experts, interviews with staff from selected Higher Education Institutions (HEIs) from the aforementioned countries and national agents of influence, and a survey with academic and research staff in the selected HEI partners were performed. One main output of the comprehensive methodology was a Capacity Development Framework (CDF) - a conceptual framework bringing together results from the investigative methodology that outlined how research and innovation capacity can be developed within the said Asian countries. The CDF identified four main components of R&I practices within HEIs that allowed a conceptualisation of these practices in identifiable terms, i.e. research method skills knowledge, supplementary skills knowledge, utilisation of university-industry partnerships, and utilisation of international collaboration. These main components were in turn influenced by identified enablers and barriers of research and innovation practices. Therein, six main categories identified, i.e. policy, HR, training, funding, infrastructure, and cross-cutting. Finally, key performance indicators (KPIs) were developed within each of these categories to measure level of R&I capacity within the selected HEIs. The main components, enablers/barriers, and KPIs allow a comprehensive conceptualisation of research and innovation within Asian HEIs. The CDF was eventually used to develop a comprehensive training package to improve research and innovation within Asian HEIs that directly aligns with practical steps for capacity development to further the building of societal resilience to disasters in this region.

**Key words:** Capacity Building, Higher Education Institutions (HEIs), Policy, Questionnaire Survey

Abstract ID: 172



## Early Warning Disaster Risk Reduction Compliance Index for Public Private Partnership (PPP) Port Projects

Liyanage C.\*<sup>a</sup>, Romero F.V.<sup>b</sup>

<sup>a</sup> *University of Central Lancashire, UK*

<sup>b</sup> *EAE Business School, Spain*

\*fvillalbaromero@hotmail.com

Port infrastructure is a key element in the transport network and have become crucial for many countries as they are capital intensive infrastructures that are associated with a wide array of economic impacts. Port development and world trade are closely interrelated as they expand the market opportunity of firms. Besides, ports emerge as ideal locations to build and base integrated multimodal transport systems which serve as distributor of goods, services and people. Though traditionally, this type of infrastructure has been served and operated by the public sector, the Public Private Partnership (PPP) model provides an efficient mechanism for the construction and operation of large scale and complex projects and also has a key role in its funding and financing. However, there is an increase in risks and catastrophic losses in ports. Significant losses have been associated with large scale natural hazards, such as earthquakes, tsunami, cyclones, and other extreme weather events. Therefore, enhancing coastal resilience has become an important response to these events. As a result, Ports need to be considered in Disaster Risk Reduction (DRR) strategies worldwide and a PPP model could also include resilient features as building and M&A standards. This paper reviews case studies in PPP port projects, and using a QCA methodology, based on expert opinions, the paper aims to identify DRR measures in ports and rate the level of resilience, as an index approach. It further explores risk transferring mechanisms and existing issues in current projects. The relevant information was gathered via a documentary analysis and a secondary data collection to finally develop a DRR compliance framework for PPP port projects.

**Key words:** Public Private Partnerships, Ports, Disaster Resilience, Risk Transfer

Abstract ID: 173

## Assessment of the Minimum Time Requirement to Evacuate People from a Tsunami in the Galle City

Arachchi N.P.M.<sup>\*a</sup>, Sandika A.L.<sup>b</sup>, Prasanna R.<sup>c</sup>

<sup>a</sup> *Disaster Management Center, Sri Lanka*

<sup>b</sup> *University of Ruhuna, Sri Lanka*

<sup>c</sup> *Joint Center for Disaster Research, Massey University, New Zealand*

\*nuwandmc@yahoo.com

On 26<sup>th</sup> December 2004, Tsunami struck Sri Lanka claiming 35,000 lives and 900 Million USD of economic losses to Sri Lanka. Although DMC has introduced the Early Warning system to evacuate the population and protect their property in the Galle city, it is necessary to understand the limitations in an emergency situation. Therefore, the objectives of the study were to understand the peak population in the city, and to calculate the minimum time requirement to evacuate the population for safer places. The study was carried out in Galle Municipal area. Secondary data and purposive and descriptive sampling techniques were applied for surveying people to understand the background data. The volatile population in the city, in a peak hour, was calculated weekdays and weekend peak time average, assessing several time sequences. The average number of volatile people including permanent dwellers were 9950. The minimum time requirement for evacuating population from the town to a safer location was 61 minutes after the earthquake. New seven locations and seven priority routes are proposed to maintain as the evacuation routes and safety centres. The number of busses registered was 95. In an emergency condition, assuming the Passenger Car Equivalent factors, utilizing all available busses, 8850 people are able to transport to the safer locations and the rest of people are proposed to transport by private vehicle. The Galle-Colombo highway could be utilized to evacuate the people as additional route and for parking, all the vehicle arranging as one-way four-lane until Baddegama interexchange. Minimum seventy number of militaries or trained people are needed to manage the situation. Evacuation drills should be practised periodically.

**Key words:** Evacuation Time, Safer Routes

Abstract ID: 174

## Proposed Recommendations to Improve Preparedness in Hospitals Against Tsunami Hazards – Case Studies Carried Out in Sri Lankan Southern Coast Hospitals

Siriwardana C.S.A.\*<sup>a</sup>, Robinson D.<sup>b</sup>, Kularatne W.D.M.<sup>a</sup>

<sup>a</sup> *University of Moratuwa, Sri Lanka*

<sup>b</sup> *University College London, UK*

\*chaasi@uom.lk

Tsunami hazards occur infrequently, but their impact is fast and high. To date the Indian Ocean Tsunami (IOT) in 2004 was one of the worst disasters caused by a natural hazard, causing over 300,000 deaths in more than 15 countries in the world. The healthcare sector was one of the areas that were highly affected, having experienced deaths of hospital staff, damage to healthcare infrastructure and mass casualty admissions. It is therefore important that the hospitals are prepared for the occurrence of tsunami hazards at any time. As part of this study, six hospitals of various hierarchical levels in the Sri Lankan southern coast which were in the 2004 IOT inundation zone were visited. Fifteen years after the IOT occurred, the vigilance of the hospital staff regarding tsunamis had considerably declined. Although the hospitals are adequately prepared to face disasters that may occur in the community (mass casualty admissions), they are not similarly prepared to face a disaster that would directly affect the hospitals. In this paper, recommendations to improve the preparedness of hospitals and their staff regarding tsunami hazards are proposed, considering the areas of Disaster Management Planning, Staff Training for Disasters and Disaster Evacuation.

**Key words:** Safe hospitals, Disaster risk reduction, Tsunami hazards, Hospital preparedness

Abstract ID: 175

## Mechanism for Command and Control in Effective Incident Response Operations

Tillekaratne H.\*<sup>a</sup>, Ariyaratne A.<sup>a</sup>

<sup>a</sup> *Disaster Management Center, Sri Lanka*

\*hiran@dmc.gov.lk

Strategic and operative commands have to be separated during operations in major emergencies. Different levels of command clarify the different working levels on different time scales which need to be adopted as an integrated structure to match the complexities and demands of complex and dynamic incidents. To maintain accountability, efficient coordination of resources and rapid deployment; Committee on Command, Control, Coordination and Communication-Search & Rescue Teams (C4-SAR), was established; representing key eight (08) operational agencies. The modality maintains the unity of command and direction by providing a common hierarchy within different first responders at the operational level to achieve the tactical objectives. Shared doctrine is created in the response mechanism. Inter-relationship between the components is also clarified concerning the needs for joint planning, management, evaluation and evolution through the modality. The Modality Further meets the needs of incidents, allows personnel from a variety of civil-military agencies to meld rapidly into a common management structure by providing logistical and administrative support to the operational staff. Different coordination arrangements needed in tail-responses where both civilian and military authorities take part to be used the same resources (eg. Transport, Communication and joint contingency plans). Strong Civil-Military cooperation also to be strengthened for smooth transfer and demobilisation of humanitarian tasks.

**Key words:** Civil-Military, Incidents, Operations, Command-Control

Abstract ID: 176

## Displaced Communities: Methodologies to Explore the Psychological Impact

Robinson S.\*<sup>a</sup>, Liyanage C.<sup>a</sup>, Adams M.<sup>a</sup>, Barrett J.<sup>a</sup>, Brooks M.<sup>a</sup>, Satchwell C.<sup>a</sup>, Oni-Jimoh T.<sup>a</sup>

<sup>a</sup> *University of Central Lancashire, UK*

\*sjrobinson1@uclan.ac.uk

When people are forced to leave their homes due to events, such as war or natural disasters, the primary focus is to consider their physical needs. However, it is also important to consider the psychological impact that being displaced can have on wellbeing. This paper will outline two different methodologies which can be used to assess mediators of psychological wellbeing during and after displacement. Using these methodologies may give us an insight into how to promote resilience in displaced individuals.

The first methodology to be discussed will be a questionnaire design which has been used to explore people's reactions to a UK-based natural disaster. The study uses a mix of standardized and tailor-made measures to explore factors which may mediate psychological resilience in response to natural disasters. Specifically, the study explores the impact of natural disasters, such as flooding, which can affect people's homes. The paper will explore the advantages and disadvantages of using an online questionnaire to measure factors such as PTSD symptoms, post-traumatic growth, resilience, personality type, home attachment and social support. In addition, the paper will explore how the data collected will be analyzed and other data collection considerations such as the impact of recruiting participants online.

The second part of the paper will explore a more qualitative and novel approach to data collection. The proposed study will be examining the support needed to integrate refugees into UK society and will specifically focus on the impact of place attachment on refugees' wellbeing. The paper will outline a novel methodology of using guided walks in parks and other green spaces to assess people's attachment to their new landscape. The paper will explore the advantages and disadvantages of this qualitative methodology as well as considering the challenges of working with an interdisciplinary team.

Abstract ID: 177

## Psychological Considerations for Early Warning Systems: What Happens After the Last Mile?

Robinson, S.\*<sup>a</sup>, Ahmed, J.

<sup>a</sup> *University of Central Lancashire, UK*

\*sjrobinson1@uclan.ac.uk

Governments around the world have spent many billions of pounds creating early warning systems which can be used to alert populations to the imminent risk of a disaster. However, although an early warning system may work effectively at a technological level, there is no guarantee that people will attend, and respond to the warning as expected. This paper will explore the psychological issues that those responsible for responses to early warning systems should consider.

The study uses a vignette design to explore how individual UK citizens would respond to an order to evacuate following either a human-made or natural disaster. The online study recruited 137 participants who assessed on their preparedness and their response to an evacuation order following a disaster. In addition, participants' levels of optimism and strength of religious beliefs were also recorded. Previous literature has suggested that optimism levels would affect how likely someone is to prepare for a disaster and their likelihood to evacuate when ordered. However, the results presented here suggest that general levels of optimistic thinking are not associated with differences in preparedness or evacuation response. The study also considered the impact of religious beliefs on disaster behaviors. Previous studies have suggested that those who have strong religious beliefs are less likely to prepare for disasters or respond to evacuation orders due to their behavior that the disaster is an "act of god." The results of the current study indicate that religious strength does not impact on disaster preparedness. However, those with stronger religious beliefs were actually more likely to display evacuation behaviors. The paper will explore the mechanisms by which religious beliefs may impact on evacuation behaviors.

Abstract ID: 178

## Analysis the Capacity of Disaster Early Warning Reception of Kalutara District in 4 Most Vulnerable Divisional Areas in Sri Lanka

Kodippili K.A.D.P.K.\*<sup>a</sup>

<sup>a</sup> *Disaster Management Centre, Sri Lanka*

\*pradeepkodippili@gmail.com

Sri Lanka is continuously experiencing floods Since 2014. In many of these incidents, communities were not evacuated before the disaster and it resulted communities were stuck in flood-affected zones.

There were 2019 deaths recorded in 2017 floods. Despite the fact that the Disaster Management Centre issues early warning to the vulnerable public, the key issue is the reach of these warnings to the vulnerable public. Reach of early warning is a Sendai priority area as well.

A clear analysis is not done to identify whether these flood early warnings actually reach to the vulnerable communities in a timely manner.

Accordingly, this study tried to find out the reasons behind not reception of early warning in a timely manner to vulnerable communities. This study has been conducted to all 25 districts of Sri Lanka completing more than 2500 questionnaires and this abstract is based on the analysis conducted to Kaluthara District which analysed 100 questionnaires. Secondary data were collected from the situation reports and the DESINVETAR database.

Data were analyzed using Microsoft excel datasheets and SAS methods and charts, analytical maps, comparative carts.

Results indicate, that communities did not receive early warnings in some major events. Many communities were affected as the warnings were too late to receive or some had not received a warning at all. In 2017 floods 51% of the vulnerable community in the Kalutara district received warnings, but, 35% of the vulnerable communities had not received early warnings. 61% from the Paragoda community ( Divisional Secretariat area in Kaluthara District) did not receive an early warning in 2017 major floods.

Abstract ID: 179

## Policy Recommendations for Establishing a Long-Term Landslide Risk Management Strategy in Sri Lanka

Basnayake S<sup>\*a</sup>, Arambepola N.M.S.I.<sup>a</sup>, Sugathapala K.<sup>b</sup>, Amaratunga D.<sup>c</sup>, Ganepola C.<sup>a</sup>, Kulathilaka S.A.S.<sup>d</sup>

<sup>a</sup> Asian Disaster Preparedness Center, Thailand

<sup>b</sup> National Building Research Organization, Sri Lanka

<sup>c</sup> University of Huddersfield, UK

<sup>d</sup> University of Moratuwa, Sri Lanka

\*senaka\_basnayake@adpc.net

With landslides becoming increasingly frequent in Sri Lanka, the importance of related risk management is growing. Many of the recently reported landslides are associated with human interventions, land use changes and non or lack of efforts in compliance with existing policies. The shortcomings in policy compliance can be due to their poor technical understanding, implementation gaps, institutional weaknesses, interferences of influential parties etc. That indicates the necessity for major policy decisions centered around the theme of sustainable development. It also highlights the importance of having an appropriate effort for better risk governance and mainstreaming DRR through the introduction of appropriate institutional arrangements; the creation of appropriate policy & legal framework and the continuous resource allocations for the mitigation of landslide risk.

Within this context, setting up a development framework inclusive of landslide risk management interventions and climate change adaptation, will have very important long-term outcomes not only in reducing the future landslide risk but also in sustaining the gains of development. The Sri Lanka Community Landslide Risk Mitigation project, which was funded by the World Bank (WB) has been an appropriate initiative and opportunity for identifying essentials for developing such a long-term strategy for the country. The project study was based on four highly vulnerable Divisional Secretariat Divisions in Badulla District and covered assessment of degree of community vulnerability, analysis of major barriers, identification of future opportunities for the way forward. The paper presents the outcome of the study and recommendations for creating an enabling policy environment and improving the risk management practices as a part of a future long-term landslide disaster risk management strategy for the country.

Abstract ID: 180



# **Index**

<b>A</b>		Chanaka D.	28
Abenayake C.C.	137	Chandrasekara C.M.K.N.K.	50, 82
Abeyratne I.	90	Chandrasena W.K.N.	122
Abeysekera I.	110	Clegg G.	115
Abeysinghe A.A.S.E.	94	Cooray H.	77
Achinth M.	19	<b>D</b>	
Adams M.	152	Dash I.	79
Ahmed J.	153	Dayananda D.	56
Akhter S.	44	Dayarathna N.	4
Alahacoon N.	49, 142, 143	De Silva A.	47, 48, 135
Amaratunga D.	65, 69, 70, 71, 75, 94, 95, 104, 106, 111, 113, 114, 115, 116, 118, 119, 123, 128, 129, 130, 135, 145, 146, 147, 155	De Silva D.A.M.	51
Amarnath G.	49, 142, 143	De Silva M.	52
Ambagahawita A.	127	De Silva N.S.	100
Andres A.V.	30	De Silva P.	55
Arachchi N.P.M.	149	Deepak K.C.	21
Arambepola C.	78	Del Zoppo M.	81
Arambepola N.M.S.I.	155	Dheerasinghe D.S.A.F.	110
Arambepola S.	4	Di Ludovico M.	81
Ariyabandu M.M.	125	Dias D.D.	76
Ariyaratna A.	60	Dias N.	123
Ariyaratna D.M.D.I.K.	33	Dias P.	81
Ariyaratne A.	151	Dias W.P.S.	93
Ariyaratne K.H.A.A.	88	Dilshan M.W.R.R.	120
Aroos M.S.M.	86, 89	Dilukshi H.N.	16
Athapattu B.C.L.	29	Dissanayake C.L.W.	121
Aththanayaka A.M.N.D.	15	Dissanayake P.	96
Attanayake K.	31	Dissanayake P.B.R.	94, 103
<b>B</b>		Dissanayake U.	67
Baiguera M.	81, 93	Drechsel N.	40
Bajracharya R.	45	Drechsel P.	40
Balaarachchi B.A.U.P.	33	Dziya I.	116
Bandara A.	37	<b>E</b>	
Bandara C.S.	94, 103	Edwin S.	144
Bandara D.M.L.	86, 89	Ekanayaka R.	117
Barrett J.	152	Ekanayake J.	48
Basnayaka S.	4	Elapata M.	47
Basnayake B.M.R.L.	51	Espinosa R.I.	30
Basnayake R.	48	<b>F</b>	
Basnayake S.	74, 155	Fernando G.S.	120
Baura P.	42	Fernando M.	24
Brahmanand P.S.	142	Fernando N.	52, 69, 70
Brooks M.	152	Fernando P.	107
<b>C</b>		Fernando P.R.N.	5
Cader M.	110	Fernando T.	126
Castro J.T.	30	Francis D.	9
Chamara N.	43	<b>G</b>	
Chaminda U.G.G.	61	Gamage H.G.C.P.	86, 89

Ganepola C.	4, 155	Jayaweera S.	27, 59, 124
Gayathri M.P.M.	88	Jenna N.N.	38
Ghosh S.	49, 142, 143		
Goginashvili M.	53		<b>K</b>
Gunaratne P.	67		
Gunasekara M.	28	Kaklauskas A.	114
Gunathilaka M.D.L.K.	15	Kalpana H.N.	140
Gunathilake J.A.S.P.	120	Kalpana S.	48
Gunathilake K.L.W.I.	50	Kalubowila K.	78
Gunatiliake S.K.	51	Kamalrathne T.	131
Gunawardhana LM.N.P.	141	Kankanamge L.	4
Gupta N.	74	Kannangara K.K.C.L.	105
		Karume K.	80
	<b>H</b>	Karunarathna A.	4
Hadiwattage C.	16	Karunaratne P.	78
Haigh R. 65, 69, 70, 75, 94, 95, 104, 106, 111,		Kaushalya K.L.G.	121
113, 114, 115, 116, 118, 119, 123, 128,		Khatiwada P.	45
129, 130, 135, 145, 147		Khatun A.	44
Hapuarachchi B.	124	Kingsland J.	38
Hapuarachchi H.A.S.U.	109	Kodama M.	7
Hapuarachchi S.P.	120	Kodippili K.A.D.P.K.	154
Hasalanka H.H.H.	93, 99	Kodithuwakku L.	110
Hayat E.	147	Kohilawatta A.	25
Hearth S.	32	Kukulavithana S.	62
Hemachandra K.	104, 146	Kularatne W.D.M.	99, 150
Hemasinghe H.	83	Kularatne, W.D.M.	93
Herath H.M.N.T.	50	Kulathilaka S.A.S.	155
Hettiarachchi R. D.	23	Kumara E.M.L.U.	54
Hettige S.T.	70, 118	Kumara K.W.S.J.	46
Hettige V.	67, 124	Kumara M.A.S.J.	145
Hoang V.	6	Kumara U.	73
		Kuragama K.A.K.M.	120
		Kuruppuarachchi N.	67
	<b>I</b>		
			<b>L</b>
Idunil B.H.I.	120		
Inparajan S.	25	Lafir M.S.	10
Iqbal S.	88	Lankathilaka R.A.D.B.M.	120
Iqbal S.M.M.	68	Lee B.	6
		Little A.	81
	<b>J</b>	Liwig C.	30
Jagath M.	92	Liyanarachchige C.	59, 60
Jalath I.	77	Liyanage C.	70, 147, 148, 152
Jayakody R.R.J.C.	75, 130	Liyanage C.L.	85
Jayamanne B.D.W.	138	Liyanage R.	54
Jayarathne J.M.A.R.	7		<b>M</b>
Jayasekara J.H.P.R.U.	102		
Jayasinghe A.	67	Madusanka N.B.S.	140
Jayasinghe A.B.	140	Madushika N.V.G.S.	14
Jayasinghe P.	33	Mahakumarage N.	124
Jayasinghe S.	74	Mahendra J.	66, 73
Jayathilaka C.	108	Makevita M.A.K.P.	120
Jayathilaka H.A.D.G.S.	106	Malalgoda C.	75, 111
Jayathissa W.D.S.	85	Mallawatantri A.	31
Jayawardena I.M.S.P.	41	Manjula M.	36
Jayawardena M.	59	Manjula S.H.	73

Matsumoto N.	83	Piyarathne A.	20
McDonald R.	147	Piyumi M.M.M.	137
Mcdonnell R.	142	Prakashnie M.P.	139
Meegastenna T.J.	76	Prasanna J.	69
Mendis M.M.P.	72	Prasanna L.J.	5
Millangoda M.	24	Prasanna R.	149
Miranda R.	125	Premachandra C.	46
Mishra A.	57	Premalal K. H. M. S.	23
Mishra H.S.	58	Premalal S.	24, 25, 26, 27, 46, 67, 109, 123
Mohil D.	22	Premasiri H.D.S.	121, 122
Molla M.H.	42, 44	Premathilake D.S.	13
Munasinghe N.	9	Priyankara C.	114
Munihire M.M.	80	Priyankara W.M.S.	76, 88
Murray V.	38	Priyantha H.D.	64
	<b>N</b>	Prota A.	81
Nadiradze K.	53	Punchihewa S.P.G.	120
Nagai T.	8, 87	Punyawardana B.V.R.	32
Nakandala S.A.	68		<b>Q</b>
Nanayakkara S.	59	Quader A.	42, 44
Nandan R.	57		<b>R</b>
Nandasena S.	127		
Navarathene C.	70, 114		
Navaratna W. C. W.	23	Rahman M.A.	42
Navaratne C.M.	14	Rajapakse P.	26
Navaratne S.B.	14	Rajapaksha H.	48
Nawagamuwa U.	4	Rajapaksha R.H.N.	51
Nianthi K.W.G.R.	139	Rajapaksha W.D.G.D.T.	89
Nishantha A.	39	Rajkumar P.	97, 98
Nishshanka H.	92	Ranwala R.A.D.L.M.K.	138
Nissanka S.	129	Rao K.V.	143
Nivaran D.	125	Rathnayake H.A.	14
Nsinha M.	57	Rathnayake W.K.D.	103
Nur A.S.M.N.	18	Ratnayake R.K.	120
	<b>O</b>	Ravi S.	97, 98, 132, 133, 134
Oni-Jimoh T.	152	Raza T.	30
	<b>P</b>	Raza T.K.	30
Pal I.	79	Rienzie R.	67
Palliyaguruge R.C.	54	Robinson D.	81, 93, 150
Palomino J.	93	Robinson S.	152, 153
Pannala P.A.A.P.K.	63	Romero F.V.	148
Pannila Hetti N.	110	Rossetto T.	81, 93
Patel P.	38	Rupasinghe P.	28
Pathirana S.	43, 82		<b>S</b>
Perea S.K.	138	Saja A.	31
Perera A.	28	Saja A.M.	10
Perera D.	4	Sakalasuriya M.	65
Perera S.	127	Samansiri S.	126
Phillips I.	40	Samarakkody R.P.	87, 112
Phirosmanashvili N.	53	Samarakoon L.	29
Piyadasa R.	31, 32	Samarakoon U.	28
Piyadasa R.U.K.	82	Samaraweera H.U.S.	12
		Samaraweera P.	110
		Samarawickrema G.	11

Sandamith M.	51			<b>W</b>
Sandika A.L.	149			
Satchwell C.	152	Wada T.	86, 89	
Schreyers L.	22	Walpita L.S.	101	
Senadeera W.	86, 89	Wanasingha W.A.K.I.	120	
Senanayake M.	113	Warnasooriya A.	46	
Senavirathna C.	136	Warushahennadi J.	61	
Senavirathne E.M.H.G.N.P.	141	Wckramarathne J.	17	
Senevirathne A.	117, 126	Wedisinghe W.A.Y.	138	
Senevirathne M.	114, 128	Weerasekara R.	112	
Seneviratne A.	120	Weerasekara S.H.	6	
Seneviratne P.	68	Weerasena N.	118	
Shahjahan M.	42	Weerasinghe B.	11, 74	
Shanika V.G.	16	Weerasinghe K.D.N.	68, 70, 74, 82, 85, 114	
Shanmugasundaram J.	79	Weerasinghe K.D.T.N.	85	
Shehara P.L.A.I.	95	Weerasinghe N.C.	33	
Sikka A.	142, 143	Weerasinghe W.M.I.P.	110	
Siriwardana C.S.A.	70, 93, 94, 95, 99, 102, 103, 105, 106, 150	Wickramaarachchi B.	29	
Siriwardena K.K.G.I.L.	63	Wickramarathna I.	51	
Skempas M.	96	Wickramasinghe D.	67	
Smart L.N.	119	Wickramasooriya A.K.	101, 139	
Somarathne S.	23	Wickramasooriya M.D.J.P.	88	
Sridarran P.	71	Widanapathirana S.	63	
Sugathapala K	155	Wijayarathne S.	59	
Sumathipala W. L.	23	Wijayawardana N.	137	
Sutharshanan M	10	Wijerathne T.M.N.	29	
Suzuki K.	83	Wijesekara N.	43	
		Wijesinghe M.	35	
		Wijesundara K.	81	
	<b>T</b>	Wijesundra C.S.	97, 98	
Tajima Y.	29	Wijetunge J.	81	
Thiel F.	40	Williams K.S.	85	
Thulashika R.	120	Wilson C.	6	
Thurairajah N.	71	Wimalawardhana E.A.S.N.	33	
Tillekaratne H.	151	Wise B.	69	
Tissera H.A.	110			<b>Y</b>
	<b>U</b>	Yadav N.	91	
Uchida T.	83	Yadav S.	34	
		Yang P.	84	
		Yumi S.	7	
	<b>V</b>			<b>Z</b>
Verma U.	57			
Vithanage N.	36, 37, 39, 43	Zarouk Z.	31, 32	

This book brings together the abstracts presented and details of the industry, practice and policy events held as part of the International Symposium on Multi-Hazard Early Warning and Disaster Risk Reduction, Colombo, Sri Lanka from 16th March to 18th March 2020.

The event was organised by:

- Disaster Management Centre, Ministry of Defence, Sri Lanka
- Global Disaster Resilience Centre, University of Huddersfield, UK
- Asian Disaster Preparedness Centre, Thailand
- University of Moratuwa Sri Lanka

In association with

- The International Oceanographic Commission of UNESCO (IOC-UNESCO), Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) ICG/IOTWMS WG 1 on Tsunami Risk, Community Awareness and Preparedness
- IOC-UNESCO IOTWMS, WG 1 on Tsunami Risk, Community Awareness and Preparedness
- International Union for Conservation of Nature (IUCN), Sri Lanka
- Department of Meteorology, Sri Lanka
- Association of Disaster Risk Management Professionals in Sri Lanka (ADRIIMP)
- University of Peradeniya, University of Colombo, University of Ruhuna, Sri Lanka
- REGARD (REbuildingG After Displacement)
- CABARET (Capacity Building in Asia for Resilience EduCaTion) project on fostering regional cooperation for more effective multi-hazard early warning and increased disaster resilience among coastal communities
- Bandung Institute of Technology (ITB), Indonesia
- Regional dialog of Asian Preparedness Partnership (APP)
- The United Nations World Food Programme
- Asian Disaster Preparedness Centre (ADPC), Thailand
- The United Nations Development Programme
- The Japan International Cooperation Agency
- ChildFund Sri Lanka
- International Journal of Disaster Resilience in the Built Environment

**MHEW 2020**  
DRR Symposium



International Symposium on  
Multi-Hazard Early Warning and Disaster Risk Reduction  
16<sup>th</sup> - 18<sup>th</sup> March 2020, Cinnamon Grand, Colombo, Sri Lanka

ISBN 978-1-86218-173-1



9 781862 181731