THE JAPAN FEDERATION OF ENGINEERING SOCIETIES

THE ARCHITECTURAL INSTITUTE OF JAPAN

THE JAPAN SOCIETY OF CIVIL ENGINEERS

THE WORLD FEDERATION OF ENGINEERING ORGANZATIONS

PROCEEDINGS OF
THE 8TH JOINT INTERNATIONAL SYMPOSIUM ON DISASTER RISK MANAGEMENT

- Education for Disaster Prevention, Reconstruction from Kobe Earthquake Disaster, and Adaptation Plan under Climate Change -

THE SCIENCE COUNCIL OF JAPAN

September 13, 2014
Faculty of Engineering, Kobe University,
Hyogo, JAPAN

Contents

FOREWORD

The World Federation of Engineering Organizations (WFEO) is an international non-governmental organization for professional engineering. Our major mission is to achieve socio-economic security, sustainable development, and poverty alleviation through appropriate applications of technology and innovation. The Committee on Disaster Risk Management (CDRM), which is one of the WFEO ten standing technical committees, pursues the issue of better management of disaster risks.

Disaster risk management is defined here as a process for understanding disaster risk, reducing potential risks, and promoting preparedness through engineering perspectives. The CDRM activities are more and more important to prevent and reduce disaster-induced damages and propose adaptations against destructive earthquakes, tsunamis, and global climate change for long-term sustainable development.

For example, the latest Global Assessment Report on disaster risk reduction (GAR 2013, by United Nations Office for Disaster Risk Reduction indicates that business can reduce economic losses caused by natural disasters by investing in disaster risk management strategies aiming at minimizing uncertainty and unpredictability, strengthening resilience, competitiveness and sustainability, and decentralizing production bases. In particular, recent rapid urbanization may result in a city with high exposure and vulnerability to disaster risks if business investors give less consideration to the reduction of disaster risks. The urban-growth would be repeatedly eroded by disaster-induced damages. Therefore, an appropriate strategy of disaster risk management is necessary to implement an urbanization plan.

According to the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX 2012, by Intergovernmental Panel Climate Change), disaster risk management and adaptation to climate changes at local and international levels are the key to reducing and mitigating economic losses from climate-related disasters. These disasters have increasingly occurred with the amount of damage over the last few decades, ranging from a few billions to 200 billion US dollars due to long exposure and vulnerability to disaster risks. The disaster risk management contributes to preparedness against future disaster losses.

The Open Working Group on Sustainable Development Goals, run by the United Nations General Assembly, recently reported in its discussions held for the UN development agenda beyond 2015 mentioned that the disaster risk management based upon the Hyogo Framework Action (HFA 2005) must be developed and implemented for adaptation to climate change and resilience and sustainability against disasters (cited from http://www.iisd.ca/sdgs/owg13/, managed by the International Institute for Sustainable Development’s Reporting Services).

The activities of the CDRM are good practical actions to create long-term sustainable, strong and resilient societies with less vulnerability and exposure to disasters. In this context, the 8th Joint International Symposium on DRM will be held on September 13, 2014 in Kobe, Japan. This symposium will provide an opportunity to discuss the lessons learned from the Kobe Earthquake Disaster in the fields of disaster prevention and reconstruction. It will also propose an adaptation plan to climate change based upon experiences world-wide. I believe that this symposium will undoubtedly contribute to the achievement of the WFEO mission.

Marwan Abdelhamid
President, WFEO

FOREWORD

Three years have passed since The Great East Japan Earthquake and Tsunami attacked Tohoku area of Japan. It also spends about 20 years after The Kobe Earthquake. These two huge earthquakes gave catastrophic damages on these areas. The main damage by The Kobe Earthquake was vibration of the earthquake itself. On the other hand, the main damage by The Great East Japan Earthquake was tsunami caused by the earthquake. The main reason of the damage was different each other. However, the lessons learned and researches on The Kobe Earthquake were useful to reduce the damage of The Great East Japan Earthquake. These are anti-vibration technologies, mitigation technologies, re-construction technologies, and etc. The investigations and researches on the earthquakes and tsunami disasters are useful to create the resilient societies for the future disasters which will attack us.

The other disaster problem is the extreme weather hazard caused by the Global Warming. In recent years, whether becomes to be more violent as strong typhoons, strong tornados, strong winds, and heavy rains. These give our societies many damages as floods, land slips, and collapse of houses. We are always to face many disasters which will attack near future.

Changing of experiences, information, and the research results in the world will support to protect the people from the future disasters and to mitigate the damage of the society. It will be increasingly important to reinforce mutual collaboration between our engineering societies. Cooperation considering innovative engineering schemes and multi-disciplinary approaches is a good way to get better understandings to minimize the risk of natural hazards in the world.

The 8th International Symposium on Disaster Risk Management is a joint effort of the Architectural Institute of Japan (AIJ) and Japan Society of Civil Engineers (JSCE) with support of World Federation of Engineering Organizations (WFEO) through Japan Federation of Engineering Societies (JFES) and Science Council of Japan (SCJ). This symposium will provide a unique opportunity for information exchange on the state-of-the-art of engineering approaches for disaster risk management through presentations and discussions.

I hope that this Symposium will provide the results utilized for improving resilience against disasters in every region in the world. Finally, I would like to express my sincere gratitude for the joint organizer and support organizations, AIJ, JSCE, WFEO, and SCJ, for their cooperation in planning and organizing this Symposium.

Jun'ichi Sato, Jun'ichi Sato
President, Japan Federation of Engineering Societies (JFES)

FOREWORD

I would like to make some welcoming remarks to coincide with hosting of the 8th Joint International Symposium on Disaster Risk Management. I am absolutely delighted that the symposium is being held as a part of the Annual Convention in Kobe of the Architectural Institute of Japan, which is raising the issue of internationalization as one of its major themes.

Three and a half years have now elapsed since the Great East Japan Earthquake. Work has finally started on land raising and the construction of public housing for disaster victims, but while signs of recovery are becoming visible, even now there are still 250,000 people living the life of evacuees in temporary housing units. Moreover, in Fukushima Prefecture, decontamination work is underway and many people are looking forward to being able to return home. During this time all sorts of recovery support work has been carried out, and various institutions have conducted disaster research and investigations. It is to be hoped that these activities and the results of the research are put to use in disaster prevention efforts concerning the expected earthquake with an epicenter directly below Tokyo and the Nankai Trough earthquake.

Elsewhere, the IPCC's (Intergovernmental Panel for Climate Change) 5th Assessment Report has been released since last year and during this year. The report states that global warming arising from an increase in greenhouse gases due to human activity is highly likely. Moreover, heavy rain, heavy snow, whirlwinds and so on thought to be due to climate changes arising from global warming are occurring frequently across the globe, and massive human damage due to floods, landslides and the collapse of houses is also taking place.

The theme of the 8th International Symposium is disaster prevention education. It is a vital topic in order to prevent disasters, and in the light of all these natural disasters I think it comes at a very timely juncture. I would like to take this opportunity to express my sincere gratitude to Dr. Toshimitsu Komatsu, chair of the planning committee for planning the symposium, and all the various committee members. The Architectural Institute of Japan is also indebted to the other joint hosting organizations for their assistance and support. I am confident that the Joint International Symposium will prove to be an enormous success.

吉野 博

Hiroshi Yoshino
President, Architectural Institute of Japan (AIJ)

FOREWORD

On behalf of JSCE, I would like to covey my congratulations on the 8th WFEO-JFES-JSCE-AIJ Joint Symposium on Disaster Risk Management.

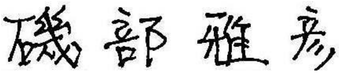
Three years ago the 2011 Great East Japan Earthquake hit the Tohoku region, inducing the destructive tsunami which caused tremendous impact on coastal areas in that region. The afflicted areas have been making their every effort to recover from the disaster and get back to normal, which have been in the first phase of recovery and reconstruction program yet. Sumatra Off-Shore Earthquake and Tsunami in 2004 is not a distant memory. Hurricane Katrina in 2005, Cyclone Sidr in 2007, Cyclone Nargis in 2008, Hurricane Sandy and Chao Phraya River Flood in 2012, large-scale natural disasters have occurred one after another lately.

While conducting studies and researched on the 2011 Great East Japan Earthquake, JSCE is improving its support and assistance so as to more effectively contribute the those earthquake-hit areas to recover from the disaster as quickly as possible. Also, the Society is devising disaster measures to respond to another large-scale earthquake along the Nankai Trough, being alarmed of the risk of its occurrence and impact.

Basic Act for National Resilience Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of the Citizenry was enacted last year. In response to this Act, the Society will further strengthen disaster risk reduction measures and preparations. It has dispatched several disaster damage assessment teams to disaster affected areas overseas, and has made advice and recommendations on disaster measures and preparations based on its knowledge and skills that it has gained from past experiences. Because living in a country prone to a range of natural disasters, we have developed knowledge, skills and technologies to reduce the risks and impact of natural disaster. I do hope that ours will help other countries to strengthen their disaster risk management measures and programs.

I therefore say that it is meaningful that WFEO, JFES, JSCE and AIJ are holding this symposium with their mutual cooperation at this time. I expect that participants will share views and ideas with each other and consider how to enhance natural disaster measures in not just a, but also global level.

Last, but not least, I would like to thank all of those who have worked hard to realize this symposium. Thank you very much, and congratulations.



Masahiko Isobe
President, Japan Society of Civil Engineers (JSCE)

FOREWORD

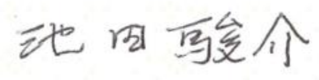
United Nations bodies have currently discussed the Sustainable Development Goals (SDGs), which may consist of a post 2015 development agenda based upon the Millennium Development Goals, proposed in the United Nations Conference on Sustainable Development held in Rio de Janeiro, 2012 (Rio+20). The SDGs, which are still being updated, suggests that the prevention, reduction, and reconstruction against natural disasters are very important to create a sustainable infrastructure. The standing technical Committee on Disaster Risk Management (CDRM) in the World Federation of Engineering Organizations (WFEO) in cooperation with the Japan Federation of Engineering Societies, supported by the Science Council of Japan as a host national member of the WFEO, has contributed to the creation of the sustainable infrastructure against disasters through CDRM activities since 2007 when the predecessor of the CDRM was established.

We have a Joint International Symposium related to Disaster Risk Management (DRM) annually, collaborated with the Architectural Institute of Japan, and the Japan Society of Civil Engineers. This symposium is useful to enlighten people on better DRM locally/internationally through global thoughts and discussions among DRM experts who have different backgrounds in their respective fields. The 8th Joint International Symposium on DRM will be held in Kobe (Japan), where the Kobe Earthquake disaster occurred in January, 1995. We believe that Kobe is a key example of how the DRM should be against disasters.

The Kobe is likely a good example of how a disaster affects sustainable infrastructure. According to the latest Global Assessment Report on disaster risk reduction (GAR 2013, by United Nations Office for Disaster Risk Reduction), the amount of trade in Kobe Port prior to the 1995 earthquake was the world’s sixth-busiest, but after the earthquake many efforts in reconstruction have not been successful in recovering the past trade conditions. Instead, the Kobe Port fell to 47th place in 2010 under the “lost decade” of Japanese economy. This decline caused by the earthquake might have been more mitigated if an appropriate countermeasure was created by the DRM.

Each victim story in Kobe Earthquake potentially suggests to us, how DRM should be in order to fight against catastrophic disasters. For example, a girl who lost her mother in Kobe said, “The earthquake killed people of all walks of life, and my effort to recover from the damages was meaningless as my mother is gone.”, and “However, I need to find something to dedicate myself to, in order to move forward in my life.” This story tells us that losing people, in itself, harms the very hearts of survivors. Once survivors remain hindered by their family’s death, they may never fully recover from disaster damages. For this reason, achieving zero mortality must be the first priority on the DRM although hardware-based reconstruction is also important.

Therefore, we believe that holding the DRM-related symposium in Kobe, where such a catastrophic disaster occurred, is very meaningful to discuss how we will reduce and manage disaster risks.




Syunsuke Ikeda
Chair, National Committee of WFEO
Science Council of Japan
Vice Chair, CDRM-WFEO

Toshimitsu Komatsu
Chair, CDRM-WFEO

PROGRAM

The 8th Joint International Symposium on Disaster Risk Management

- Education for Disaster Prevention, Reconstruction from Kobe Earthquake Disaster, and Adaptation Plan under Climate Change -

After the 1995 catastrophic disaster of the Kobe Earthquake, the Kobe-Hanshin region which was damaged severely was successfully reconstructed already. In reference to Kobe-Hanshin reconstruction processes, we have learned how to perform continuous reconstruction for the 2011 Tohoku Earthquake and Tsunami disaster. We are challenging against the extreme weather hazard potentially caused by climate change as an inexperienced disaster through appropriate adaptation development and disaster education. To promote the reconstruction and the preparedness effectively and efficiently, we need to collaborate and cooperate with a variety of academic societies and organizations which work for disaster prevention and reduction. This joint international symposium provides to the global community the dissemination, transfer and share of a better disaster risk management worldwide.

Organized by Japan Federation of Engineering Societies (JFES), Japan Society of Civil Engineers (JSCE), Architectural Institute of Japan (AIJ) and World Federation of Engineering Organizations (WFEO)

Supported by Science Council of Japan (SCJ)

Date and Time Sept. 13, 2014 (Saturday)

Venue Kobe University (Faculty of Engineering)

Opening Remarks (8:40 - 8:50)

Dr. Hiroshi Yoshino (Symposium co-Chair; President, AIJ; Professor emeritus, Tohoku University)

Session Part I (8:50 - 10:30)

I-1 ***Disaster Management – India’s Experience***

Er. Ashok Kumar Basa (Indian)

Member, WFEO-CDRM EQDRM and CBNDRM;

President, The Institution of Engineers (India)

Note: Er. is a Honorific title of Engineer.

I-2 ***Community Based Disaster Prevention: Take Taipei Wan-mei Community as an example***

Dr. Chia-Nan Liu (Taiwanese)

Professor, National Chi-Nan University (Taiwan)

I-3 ***A Review on the Program of Disaster Management Capacity Building for Local Government (DMCB) in Taiwan from 2009~2014***
Dr. Sawyer Mars (Taiwanese)
Assistant Professor, Ming-Chuan University (Taiwan)

I-4 ***Enhancing Community Resilience through Community Disaster Education***
Dr. Yoko Saito (Japanese)
Senior Researcher, Disaster Reduction and Human Renovation Institution (Japan)

Break (10:30 - 10:40)

Session Part II (10:40 - 12:20)

II-1 ***Lessons from Recent Disaster Events to Enhance Tsunami Risk Reduction***
Erick Mas (Peruvian)
Assistant Professor, Tohoku University (Japan)

II-2 ***Research Needs for Efficient Quick Recovery from Earthquakes***
Dr. Oren Lavan (Israeli)
Visiting Associate Professor, Kyoto University (Japan);
Associate Professor, Technion-Israel Institute of Technology (Israel)

II-3 ***Joint Natural and Technological Disasters: An Emerging Risk Issue***
Dr. Ana Maria Cruz (Colombian)
Professor, Kyoto University (Japan)

II-4 ***Fostering Public Awareness of Disaster Prevention, through Architectural Designing***
Dr. Nobuaki Furuya (Japanese)
Professor, Waseda University (Japan); Vice President, AIJ

Closing Remarks (12:20 - 12:30)

Dr. Toshimitsu Komatsu (Symposium Chair; WFEO-CDRM Chair; Professor emeritus, Kyushu University)

DISASTER MANAGEMENT – INDIA'S EXPERIENCE

Ashok K. Basa

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Abstract: India, is vulnerable to disasters like earthquake, flood, cyclone, storm surges, tsunami, land slides etc. Before two decades, the approach to disaster management was conventional, having emphasis on Relief, Rehabilitation & Reconstruction. But within last two decades there has been drastic change in the form of post-disaster reactive approach to a pre-disaster pro-active approach, from response to preparedness and long term mitigation and prevention. The paper deals with the evolution of India's approach towards disaster management with significant examples. The importance of vulnerability Atlas of India is highlighted.

Keywords: *Disaster, management, vulnerability.*

1. INTRODUCTION

Indian subcontinent having its 59% land vulnerable to earthquake, 8.5% land to cyclone and storm surges and 5% of land to floods is considered as one of the world's most vulnerable to natural disasters. Disasters arising out of the natural hazards cause wide-ranging implications on the overall development of the effected region. Each disaster takes away with it years of infrastructure development that has taken place, assets that have been accumulated by households and their livelihoods. Physical losses, added to the reconstruction and rehabilitation costs deliver a body below to their economics. In most cases, natural disasters not only cripple, but also set back the pace of development of any developing country.

2. APPROACH TO DISASTER MANAGEMENT

The decade, 1990 – 2000, had been declared as the International Decade for National Disaster Reduction (IDNDR) by General Assembly of the United Nations (UN General Assembly). The importance of natural disaster reduction can be realized from the statement of UN General Assembly President Dr. Theo - Ben Gurirab "Disaster Reduction must become an essential element of international strategies and National Development plans if we are to mitigate - since we can not prevent - their devastating effects".

A World Conference on Natural Disaster Reduction was sponsored by the United Nations (U.N.) in Yokohama in May 1994 where in "Yokohama strategies for a safer world" was adopted as a symbol of the emphasis given by the U.N. General Assembly on disaster management and mitigation. Before this, after the occurrence of any natural hazard, India used to focus on **Relief, Rehabilitation & Reconstruction (3R)**. After the World Conference in Yokohama in 1994, India's approach towards disaster management has shifted from **post-disaster reactive approach** to a **pre-disaster pro-active approach,** from the response to preparedness and long-term mitigation and prevention. Further emphasis is being given on building culture of strategic thinking, disaster reduction through preparedness and quick response, effective co-ordinations. This leads to minimize the damage, losses and trauma to the people on one hand and reduce the cost of relief, rehabilitation and reconstruction. The disaster management strategy is also focusing on building disaster mitigation content in to the overall development plans with a view to minimize the impact of disasters.

"In a populous country like India, people live in disaster-prone areas. Hence ways and means have to be found out to protect their lives and to ensure that their social and economic activities are not adversely affected".

In any program of disaster prevention, mitigation and preparedness, the first and the foremost task is to identify the vulnerable areas where the impact of natural disaster namely earthquake, cyclone, flood could reach disastrous magnitude for the effected communities. Equally important is to identify the man-made buildings and structure and infrastructure, which will be exposed to the hazards, to assess the vulnerability of these exposures and determine the disaster risk to the communities. After the Yokohama conference in 1994, the Government of India, realizing the importance of disaster mitigation, formed a group to make a **"Vulnerability Atlas of India".** The group **within a short period of 3 years** came out with the said **Atlas containing state-wise hazard maps** and **district-wise damage risk table for the country** as a whole containing all the above requirements. India is probably one of the few countries in the world having taken such an important step after the Yokohama conference.

"Since the publication of the Vulnerability Atlas in 1997, hazard scenario especially with respect to earthquakes and floods has undergone changes. At the same time more information are available on seismo-tectonic feature of the country, Tsunami affect of earthquakes, storm surge, rainfall data and landslides. Housing scenario has also changed and the latest information is available through census 2001. Politically also new States have been formed and number of districts have been created. Keeping all these in view the then Ministry of Urban Development and Poverty Alleviation, Department of Urban Employment and Poverty Alleviation (now Ministry of Housing and Urban Poverty Alleviation), Government of India set up a Peer Group who had already come out with the revised version of the Atlas in 2007".

This revised Atlas is the outcome of valuable input from several organizations' and expert members' deliberations in a series of meetings. Pursuant to the terms of reference, the Peer Group, formulated the revised Vulnerability Atlas of India with respect to earthquakes, cyclones and floods.

"Finding the limitation of scale of the existing country level zoning maps for earthquakes, cyclones and floods, the Group found it necessary to prepare the hazard maps on larger scale in digitized form so that the information is readily available to the planners, administrators and disaster managers in a user friendly way. To facilitate action at state and district levels the Vulnerability Atlas contains the Seismic Hazard Maps, Cyclone and Wind Hazard Maps, Flood Prone Area Maps for each State and Union Territory and the Housing Stock Vulnerability Tables for each District indicating the level of risk to which different house types could be subjected to during the occurrence of natural hazards in future".

Besides addition of a chapter on Tsunami, Landslide hazard zones have also been included in the revised Atlas.

"A combination of local hazard intensity and vulnerability of existing house types based on observed performance has been used for carrying out risk analysis as indicated in the district-wise risk tables. **The Vulnerability Atlas, thus, provides ready information at the macro-level for use by the authorities concerned with natural disaster mitigation, preparedness and preventive actions**".

India's action on disaster mitigation did not merely stop at that. Concurrently recognizing the importance of Disaster Management as a national priority, Government of India (GOI) formed a High Power Committee in Aug'1999 and a national committee after the Gujarat Earthquake in Jan'2001. Their task was "for making recommendations on the preparation of Disaster Management Plans" and steps to be taken for proper mitigation mechanism. Finally **in December'2005, Disaster Management Act was formed by GOI** resulting in the creation of **National Disaster Management Authority (NDMA)** headed by the Prime Minister and **State Disaster Management Authority** headed by the respective Chief Ministers "to spearhead and implement a holistic and integrated approach to Disaster Management in India." This further indicates as to how India gives priorities on disaster mitigation.

3. SIGNIFICANT EXAMPLES OF DISASTER MITIGATION ACTIVITIES

The qualitative shift in India's strategy from a post-disaster reactive approach to a pre-disaster pro-active approach has been feasible because of advancement in science and technology, advancement in forecasting technologies and warning system, emphasis on Research & Development (R&D) and standardization etc. In order to reduce the effect of disaster, steps for getting early information in the form weather forecast, have been taken. Two case studies are being discussed in this paper.

3.1 The '99 Orissa Super Cyclone:

The Bay of Bengal which is adjacent to the Eastern part of Odisha, possess warm sea and still air, required for cyclone formation. Having the world's shallowest costal water, this is one of the sixth most cyclone prone areas on earth. Odisha coast is not only vulnerable to cyclone, but also to storm surge. It is one of the most storm surge vulnerable region of the world. Similarly wind and cyclone hazard map of Odisha reveals that almost one-fourth of the state is subject to very high damage risk zone with velocity 50 m/sec.

On 29 – 30th October 1999, a cyclone known as '99 Orissa Super Cyclone having a wind speed of 270 – 300 kilometer per hour (hereafter, kmph) touched the Odisha coast. Considered as one of the severest in the world, it had some unique features. When any cyclone moves towards inland, its intensity weakens. '99 Orissa Super Cyclone, anchored over the land near the coast for about 48 hours. Because of this, the moisture got carried by the surface wind into the cyclone system causing heavy and torrential rainfall extending hundreds of kilometers.

Landfall date of the cyclone was close to the period of high tide, which resulted in a very high surge level. Over 10,000 people were killed and above 15 million people were affected. About 0.35 million cattle died, 2.4 million hectare agricultural land involving paddy crop was destroyed. Innumerable houses were destroyed, nine million trees were uprooted.

According to the estimate of Odisha Government, the loss was to the tune of Rupees 62 billion. These did not include the properties of Govt. of India like, Railways, Telecommunication etc. The total financial loss was more than Rupees 100 billion.

The roads to the places affected by the super cyclone were obstructed by the trees which fell down. Roads were breached. The relief line was cutoff. Telephone line, power etc. were terribly affected. Effected places were quite inaccessible. Local radio station was severely damaged. There was massive damage to infrastructure. Communication network was cutoff. Water supply and power system failed. The state practically remained cutoff from outside world without connectivity (Television, broadcasting and telecommunication).

3.1.1 Lessons Learnt

The following lessons have been learnt from the above super cyclone:

a. A disaster of such magnitude can not be managed by only the Government machineries. There should be convergence of institutions to make a combined effort. A nodal agency is required to co-ordinate the activities of all organizations. This is how Odisha State Disaster Mitigation Authority (OSDMA) was formed in 2000.

Awareness campaign is necessary at the community level of the problem affected areas to take preventive measures so that in case the disaster takes place, the loss is minimized.

Previous to the super cyclone, the approach to any disaster management in India was confined to **3R known as 'Relief, Restoration and Rehabilitation'.** Besides short term management, for any long term disaster management, **3P known as 'Planning, Preparedness and Prevention'** are necessary to be added.

b. To achieve the reduction of the loss of life in a natural disaster like super cyclone, a timely warning to public as regards an imminent disaster provides them with an opportunity to go to a safe place. When people become aware of the risk elements they have to confront and the various options they have, the probability of "taking good risk-avoidance/ mitigation action are higher." During the super cyclone it was realized that Odisha's infrastructure was quite insufficient for reducing the death toll. Odisha had only 23 cyclone shelters.

c. The communication system during and after the super cyclone was practically non-existent. Roads were cut off. The effected areas were inaccessible and marooned for days together. Hence emphasis was given on provision of much better communication system in the cyclone prone areas considering the hazards of super cyclone. The control rooms at the field level should be strengthened for communication.

d. Because of high storm surges, heavy lives were lost. Since the surge height was as high as 8 – 9 meters, it is necessary to have cyclone shelter considering such high surge waves. The people in the super cyclone effected areas mostly have non-engineered buildings, having non-standard materials and construction. These are susceptible to damage and are quite unsafe. Hence people should be made aware to go in for engineered building.

e. "Government officials, volunteers of NGO's need to be supported with training and information inputs. For incorporating disaster preparedness into all normal developmental activities, Public Institution like schools should be encouraged to play a very important role in disseminating information in local languages on disaster preparedness, safeguarding the environment, preventive health measures and responsibilities of various Govt. agencies."

f. All communication systems in the vulnerable areas have to be equipped with phones of Very High Frequency (VHF) etc. The roads and other communication system shall be designed in a manner, so that they can withstand submergence and tidal surges. Similar effort should be made to strengthen embankments and coasts from tidal surges and surge currents.

g. In fact, OSDMA is the first such organization of its kind which came up in India having its focus "to create a disaster resilient Odisha through construction of disaster resistant infrastructure, setting up of disaster management organizations at grass root level and building the capacity of vulnerable communities."

h. Disaster Resistant Infrastructure:

It was felt that number of deaths were more in the affected areas during the Super Cyclone due to non-availability of safe shelter buildings in the coastal villages, which could have withstood the intensity of the cyclone and the storm surge. Only 23 cyclone shelters were constructed by Indian Red Cross before the super cyclone, wherein about 42,000 people took shelter and saved their life. In the aftermath of the Super cyclone 1999, Government of Odisha decided to construct multipurpose cyclone shelters along the Odisha coast to provide safe shelters to the vulnerable people during flood and cyclones.

The locations were identified through a scientific survey conducted by Indian Institute of Technology, Kharagpur with two major postulates i.e. No person will have to travel more than 2.25 km to get a safe shelter and without crossing a natural Barrier. The building is designed to withstand wind speed up to 300 kmph and moderate earthquakes. Its plinth is above High Flood line and standing on a stilted floor, it can remain unaffected in storm surge up to the 1st floor level. 478 no. of Multi-purpose cyclone shelters have been constructed by OSDMA within 10 Km of the coastline in the coastal districts of Odisha. About 400 more are under construction.

i. Indian Space Research Organization (ISRO) is helping the Odisha Government to set up 220 Nos. of Automated Weather Stations in different parts of the state to generate digital data on different weather parameters.

j. The near total failure of communication during the super cyclone had taught a big lesson. Hence initially a dedicated civil VHF network at 414 locations covering all District and Block Head Quarters (HQs), even in some villages, has been set up. All districts of the state have been connected by Satellite phone. Vulnerable locations have been provided with 21 HAM radios. Training has been imparted to volunteers for operation of HAM radio. But presently all communication up-to village level have been made through satellite based with the help of ISRO.

3.1.2 Measures for Disaster Management.

a. Creation and Strengthening of Disaster Management Organisations:
At the village level "Cyclone Shelter Management and Maintenance Committees (CSMMC)" has been constituted who take care of the cyclone shelters. CSMMC members have been given training on shelter management.

b. Training on First Aid, Search and Rescue technique have been given to shelter based Disaster Management Teams (50 volunteers per shelter). 32 types of Basic search and rescue equipment have been provided to all Cyclone shelters.

c. OSDMA has created ten units of "Odisha Disaster Rapid Action Force" (ODRAF). 91 types of sophisticated equipment required for disaster management including branch cutter, tree pruner, road clearing equipment, concrete cutter, RCC cutter, generator, hydraulic rescue kit, inflatable tower light etc. have been provided.

d. Emergency Operations Centre (EOC) at State and District level has been provided with required communication and other equipment. District-EOCs and State EOC have been installed with toll free telephone number.

e. Under United Nations Development Programme (UNDP) assisted Disaster Risk Management program, Disaster Management Teams (DMTs) at Block, village level have been constituted. Disaster Management (DM) plans for villages have also been prepared and updated through the DMTs.

f. Every year on 19th June Mock drills are practiced. On 19th June, 21st May and 16th October 2010, as a measure for preparedness for the cyclone, three Response Drills involving CSMMC, was conducted in all the cyclone shelters.

g. Intensive implementation of Government of India and UNDP, which have assisted Disaster Risk Reduction (DRR) program, is also being conducted by OSDMA. The aims of the DRR program are to strengthen the institutional structures to undertake disaster risk reduction activities at various levels and develop preparedness for recovery.

Though natural hazards like super cyclone are not avoidable, but by taking short term and long term measures on mitigation, the loss of life and properties can be minimized. In order to take care of vulnerability of cyclone, National Cyclone Risk Mitigation Project (NCRMP) was formed under Home Ministry. The management of NCRMP was transferred to NDMA in September'2006.

3.2 "PHAILIN" – 2013:

The Very Severe Cyclonic Storm (VSCS), named as "PHAILIN", hit Odisha coast on 12.10.2013 at 8.30 PM and the landfall point was Gopalpur in Ganjam District. The wind velocity was recorded to be 205-220 kmph. After hitting the Gopalpur coast, the **cyclonic storm with tidal waves of 3.0 to 3.5 meter height** ravaged the five coastal districts. of Ganjam, Puri, Khordha, Jagatsinghpur and Kendrapada. Apart from the five coastal districts, 12 No. of the adjoining districts have also been seriously devastated by this VSCS and the resultant flood in some districts. The cyclone was accompanied with torrential rains for 3 days, leading to floods in a number of major rivers. Incessant rains and flood with high wind has also caused serious damage to other districts of the State.

In Ganjam district alone 2,812 villages have been affected. Apart from loss of life, power supply, water supply system and communication system were totally disrupted and a large number of people were rendered homeless. Public and private properties, agricultural crops and horticultural plantations have suffered severe damage. All surface communication systems, telecommunication, power supply and water supply were totally disrupted. For the first time after the Super Cyclone of 1999, the State has witnessed a VSCS of rare severity.

Following the cyclone, due to heavy rainfall, Baitarani, Budhabalanga, Rusikulya, Subarnarekha and Jalaka rivers witnessed floods/ flash floods affecting the downstream areas of mainly, Mayurbhanj, Balasore, Bhadrak, Keonjhar, Jajpur and Ganjam districts.

On getting information from the Indian Meteorological Department (IMD), regarding formation of a cyclonic storm, the State Government started closely monitoring the situation. The track of the system i.e." Depression over Bay "was thoroughly analyzed in GIS at regular intervals on 9th, 10th, 11th and 12th October 2013. The position and movement of the system was intimated to all the Collectors and to the print and electronic media.

On 10.10.2013, the IMD reported through an "Orange Message" that the Deep Depression had intensified into a **VSCS, indicating the threat to Odisha Coast along with track and intensity of the system.**

3.2.1 Response Measures:

The response measures taken up by Government after receipt of the warning from the IMD were as follows:

a. As soon as the 1st cyclone warning was received on 8th October 2013, the Collectors of all the 14 cyclone prone districts were alerted through e-mail, fax and telephone.

b. They were instructed to take immediate steps to activate the preparedness and ensure that the District Administration is fully prepared to meet the possible disaster.

c. The Collectors were advised to convene meeting of the District Disaster Management Authority to review the status of preparedness of all the Departments and organizations at the district level and below having a role in cyclone disaster management and give necessary directions to take further measures as may be necessary. The preparedness of the local authorities in the district may also be assessed and ensured.

d. Collectors were asked to ensure that all the officers and staff are in position and those on leave may be recalled.

e. OSDMA was intimated to conduct mock response drill in all the cyclone shelters immediately during which besides rehearsal of the disaster management techniques, various equipment available in the cyclone shelters may be test-used and steps be taken to repair the defective ones.

f. The Ministry of Home Affairs, Government of India and the National Disaster Management Authority (NDMA) were also requested to make necessary advance arrangements to keep the concerned authorities in readiness for deployment Indian Air Force (IAF) helicopters/ National Disaster Response Force (NDRF) force on short notice, if required.

3.2.2 Preparedness arrangements:

The following preparedness arrangements were also made.

a. Dissemination of cyclone warning through various channels.

b. Arrangement to keep the communication systems operational.

c. Mock Response drill in each multi-purpose cyclone shelters/ flood shelters.

d. Test check of various equipment in cyclone shelters including Generator, Water Pump, Inflatable Tower Light and Mechanized Tree Cutters; Steps for repair of defective ones.

e. Identification of other school, college and other public buildings as cyclone shelters- Arrangement of Lighting, Drinking Water, Temporary Toilets.

f. Readiness of ODRAF, Fire Services, NDRF for search and rescue operation.

g. Call back the fisherman who are inside sea and also instructed not to allow any body to go inside sea.

h. To ensure a **ZERO casualty,** the Collectors of Ganjam, Gajapati, Nayagarh, Khordha, Puri, Jagatsinghpur and Kendrapada were directed to evacuate all people living in low lying areas and in kutcha houses to the nearby cyclone/flood shelters or other identified buildings by morning of 12th October 2013, and to ensure that no one stays in a kutcha houses in the night of 12th October 2013 when the VSCS was expected to make land fall. Note that the houses made with high quality materials throughout, including the floor, roof, and exterior walls, are called **pucca house** and that the houses made from mud, thatch, or other low—quality materials are called **kutcha house**.

i. Similar steps were advised to be taken to shift the livestock to safer places.

j. People were appealed through electronic and print media to go to safer places along with their domestic animals, food, valuables and important documents in polythene bags.

k. The Health and Family Welfare (FW) Department took steps to pre-position adequate quantity of medicines and form mobile medical teams.

l. The Fisheries & Animal Resources Development (F&ARD) Department took similar steps to take care of the cattle health.

m. Works, Rural Development (RD) and other Government Departments made necessary arrangements for quick restoration of road communication.

n. The chain saws of Odisha Disaster Rapid Action Force (ODRAF) units, Fire Service units and cyclone shelters were ready to be used for cutting of uprooted trees.

o. Steps were taken to deplete the water level of different reservoirs to accommodate the inflow on account of cyclonic rainfall.

p. All the 14 cyclone-prone districts were provided with satellite phones for ensuring communication in case of failure of telephone/ cell phone.

q. All Collectors were directed to activate Control Rooms round the clock at Blocks, Sub-divisions etc.

r. People living adjacent to rivers and creeks up to 20 km upstream from the mouth were also evacuated to safer places.

s. **About one million people were shifted in the 36 hours preceding the landfall of the cyclone.**

t. Free Kitchen centers were opened from the night of 11th October 2013 for the evacuated people.

u. The cattle population was also shifted to safety and cattle feed/ fodder arrangements were made for them.

All 10 units of ODRAF, 28 units of NDRF, 12 units of Central Reserve Police Force (CRPF) and 10 platoons of Odisha State Armed Police (OSAP) were pre-positioned at strategic and vulnerable places for search and rescue operation. More than 350 teams consisting of mostly Fire Service personnel with some Home Guards and Civil Defense volunteers were formed for various tasks to be performed in the pre and post cyclone period.

3.2.3 Damages caused by PHAILIN:

a. As per report received from Collectors, 13.24 million people in 171 Blocks, 44 Urban Local Bodies, 2164 Gram Panchayats (GPs) and 18,374 villages in 18 Districts have been affected. **44 (21 due to cyclone, 23 due to flood) persons have lost their lives due to cyclone and the floods thereafter.** The standing crops in 0.67 million hectares have been damaged. The fishing communities have been severely affected due to huge loss to their boats and nets. The poor artisans have lost their looms, equipment, accessories and raw materials. The farmers have lost their livestock and sericulture farms. Some other districts also suffered from damage of houses and crop due to the wind and heavy rainfall activity of the cyclone.

Massive and unprecedented damage has been caused to public properties like canal / river embankments, roads, bridges, culverts, drains, water works, tube wells, Lift Irrigation (LI) points, electrical installations, telecommunications infrastructure, Government buildings etc.

b. **House Damage.**

430 pucca houses and 121,246 kutcha houses have been fully damaged due to the cyclone and the flood thereafter. Besides, 7,174 pucca houses and 80,406 kutcha houses have been severely damaged and 180,628 houses (both pucca and kutcha) have been partially damaged. These apart, 52,161 huts and 99,155 cowshed attached to houses have been damaged.

c. **Crop Damage.**

About 651,490 hectare of agriculture and horticulture crops and perennial crops have sustained crop-loss more than 50% due to cyclonic storms and floods.

d. **Livestock Affected**

7 million livestock were affected due to cyclone and floods.

e. **Loss of livelihood.**

Due to cyclone and flood, 3,455 traditional craftsmen of 19 districts have been affected causing damage to their equipments and raw materials. 767 handloom weavers have been affected. Similarly, 11,111 sericulture farmers have been affected.

f. **Damage to Nets and Boats of Fishermen.**

8,198 boats and 31,058 fishing nets have been damaged due to cyclone and floods.

g. **Damage to Sericulture Farmers.**

157 hectares of Tasar plantation, 308 hectares of standing mulberry crops, 196 hectares of crops of 2,536

nos. of farmers, have been sustained loss 50% and above due to cyclone and floods.

The total assistance sought by the State Government before the Union Government was Rs.42,420 million (About 770 million USD).

3.3 Comparison of effects of "99 Orissa Super Cyclone" and "PHAILIN – 2013"

"'99 Orissa Super Cyclone" bears a tragic memory in the heart of people of Odisha in particular, India in general. The death of more than 10,000 people and 0.35 million cattle along with 15 million effected people is a black spot in the history of any country.

We, in India, learnt many lessons from this tragedy. Lack of preparedness, improper communication system, lack of capacity building, complacency in acting even after getting information, lack of relief line operation, lack of proper co-ordination amongst different departments and organizations etc are few such examples. After this tragedy, Government both at state and national level took utmost care to take care of the above lacunae and limitations. Therefore, when "PHAILIN" came in 2013, after a gap of 14 years, a different India faced it with full confidence and preparation. **About one million people were shifted within 36 hours preceding the landfall of the cyclone.** Mostly the people were persuaded to come to safer places. Few persons who did not agree to move were forcibly brought as per a new act under NDMA. This was done with meticulous planning with hired vehicles. **This is probably the largest evacuation program in such a short time in the world.** During the '99 Orissa Super Cyclone, many areas remained in-accessible for many days. After PHAILIN 2013, **within 48 hours roads up-to block level were cleared.** Thus relief materials could reach to the people without difficulty. **Because of such wonderful preparation for the pre and post cyclone, only 23 persons died as against 10,000 during '99 Orissa Super cyclone even though the target of the Govt. was to have "Zero casualties" during the PHAILIN.** Due to proper planning and preparedness, normalcy came back to the effected region within 48 hours, which is purely amazing. The successful management of PHAILIN brought in lot of appreciation from all over the globe which was possible because of a constant and continuous growth of disaster management program both at the sate and national level.

4. CONCLUSION

"The declaration of 1990 – 2000 as the IDNDR by the U.N. and the recommendation of the U.N. sponsored conference in Yokohama in May 1994 for a safer world brought in revolutionary changes in the approach of Disaster Mitigation. GOI has taken a very serious view on the above recommendation. Besides 3R namely Relief, Rehabilitation & Reconstruction, which used to be the basis of approach for disaster mitigation, now a days 3P known as Planning, Preparedness & Prevention are necessary to be added for any long term disaster management. It is well known that disaster cannot be avoided. But proper planning along with preparedness and prevention tend to minimize the damage, losses and trauma to the people on one hand and reduce the cost of relief, rehabilitation and reconstruction on the other hand". Therefore it is imperative to have emphasis on disaster management. It is praiseworthy that India has taken the right stride in that direction. The successful management of PHAILIN 2013, bringing global appreciation, is an apt example indicating the results of such great efforts.

Acknowledgement

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COMMUNITY BASED DISASTER PREVENTION: TAKE TAIPEI WAN-MEI COMMUNITY AS AN EXAMPLE

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Abstract: The concept of disaster prevention in Taiwan was inspired by the Chi-Chi earthquake (09/21/1999) and evolved into related actions. The landslides and debris flows caused by earthquakes resulted in mass casualties, triggering the public sectors to promote community based disaster prevention, which educated the civilian how to get ready and respond during disasters. Recently, the developing “debris flow prevention communities” and “flooding prevention communities” expand to “slope disasters prevention communities” due to the mountainous terrain in Taiwan is susceptible to cause “temporary isolated island” when disaster striking. This study took Wan-mei Community of Taipei City as an example and introduced how the community located on the slope area against slope disaster functioned by Taiwan’s public sectors.

Keywords*: Slope Disaster s, Community Based Disaster Prevention, Disaster Prevention Organization*

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1. PREFACE

When frequent disasters had become normality, the perspective on disaster in different countries had evolved from human dominance into coexistence with disasters. We put more efforts on disaster prevention and promotion in advance rather than disaster prevention engineering. According to the experience from Federal Emergency Management Agency of United States, the government began to create its own disaster prevention plans based on their characteristics of locality and played as an auxiliary role (Burby, 1999).

Their job mainly focused on “project impact”, which enhanced the strength and protection in different regions and conveyed knowledge of risk identification and mitigation preparedness. Another Community Emergency Response Team (CERT) Program comprised members with firefighting backgrounds in the community as a team, which participated in the routine training and responded to incidents during disaster.

Japan inherited its own nationality of bond with locality and developed the concept of protecting their village on their own (「自分たちの町は自分たちで守る」). This experience from bottom to top was the strength to promote disaster prevention community with less governmental dominance. Due to bond with geography, history and the characteristics of Japanese culture, the local had enough disaster prevention energy. For example, the experience of mobilization and organization in Kokubunji city, Japan, showed the fact and effect of the private sectors energy after disaster (Hung, 2001).

Through the understanding of the process of disaster prevention community promotion in U.S. and Japan, we could infer that the key point of community based disaster prevention was local mobilization. The U.S. learnt from their experience of promotion process while Japan inherited its own nationality and bond with locality. Hence, different countries had its own situations but there were historical tracks and characteristics in community based disaster prevention.

The definition of community based disaster prevention varies: Maskrey (1989) thought that community based disaster prevention was based on the community to conduct the disaster prevention efforts, including mitigation, response, recovery and reconstruction, which were controlled by community inhabitants and spontaneously-formed groups to discover problems and solve them. The scholar from Taiwan, Liang-chun Chen (2005), indicated that community based disaster prevention was participation and learning by civilian organizations in peace time, understanding the people, things and characteristics in the community to control the safety and disaster prevention issues in the community. With assistance of professional teams and administrations, we could communicate with inhabitants to develop disaster prevention strategies and action plans.

To sum up, it was necessary to have inhabitants in community based disaster prevention. The public sectors began to assist community based disaster prevention efforts and introduce professional knowledge of disaster prevention for the inhabitants as references. Because of limited resources and without consensus of community, it was easy to fall into the concern that the work is dominated from top to bottom. Therefore, we had to think the needed community's conditions and contents for community based disaster prevention. This study would describe the patterns of community based disaster prevention conducted by public sectors in Taiwan and bring up the advantages, disadvantages and the possibility of future development. Meanwhile, the case of Wan-mei Community of Taipei City not only adopted the past experience in Taiwan but also shifted the authority from central governments to local government. This was the milestone in the process of community based disaster prevention in Taiwan.

2. THE HISTORY OF COMMUNITY BASED DISASTER PREVENTION IN TAIWAN

2.1 Background

The origin of community based disaster prevention in Taiwan could trace back to the 921 earthquake. With the policy and the concept of community built by that time, the recovery efforts began with participation of local inhabitants. When the recovery work was accomplished, the preventative experience was not developed continuously for spontaneous disaster prevention. Taiwan is located between Eurasian Plate and Philippine Sea Plate, the active movement of the crust and orogeny resulted in various and complicated terrain. More than 70 percent of area in Taiwan is covered by mountains and hills. Besides, typhoons caused landslides, flooding, debris flows and so on, almost every year, It draws much more attention than earthquakes which is without warnings.

The government cooperated with academic or professional teams through various projects bringing the resources into the community for local civilian to conduct disaster prevention efforts spontaneously. For example, in 2000, the next year of the 921 earthquake, the National Fire Agency, Ministry of Interior, established the project of "neighborhood rescue team" to increase participation of civilian force involving disaster rescue efforts; Soil and Water Conservation Bureau, Council of Agriculture, also conducted the operations of debris flows evacuation plans; National Science and Technology Center for Disaster Reduction cooperated with Graduate Institute of Building and Planning of National Taiwan University to build up "empowerment activities of community based disaster prevention" through the assistance of public sectors, experts, scholars and community organizations to participate in evaluation of vulnerabilities of the community and create mitigation strategies; The Executive Yuan provided "the action plan of whole community based disaster prevention" and selected 10 damaged communities as demonstration to encourage civilian involvement, reduce vulnerabilities and improve disaster preparedness and response capabilities for the community, and strengthen the public perspective of disaster mitigation and response.

The plans listed above showed that the community was the fundamental unit in disaster prevention efforts, whether in response of disaster or in preparedness phrase. From the 921 earthquake till now, for 15 years, the performance of debris flow prevention communities and flooding prevention communities had been recognized rather than others, no matter in the persistent promotion or in mobilization. Table 1 shows the comparison of community based disaster prevention for debris flows, flood, and for slope failure, respectively, in Taiwan.

Table1 The current status of community based disaster prevention in Taiwan

Promotion year	2001-now	2010-now	2013-now
Type of disaster	debris flows	Flooding	Slope disasters
Authority	Soil and Water Conservation Bureau, Council of Agriculture	Water Resource Agency, Ministry of Economic Affairs	Geotechnical Engineering Office, Public Works Department , Taipei City Government
Promotion Method	Assisted by professional teams	Assisted by local government and professional teams	Assisted by professional teams
Level	Central government	Central government	Local government
Residence	Rural community, Low population density	Both	Urban community, High population density
Cause of disaster	Typhoon, heavy rainfall	Typhoon, heavy rainfall	Typhoon, heavy rainfall, earthquake

Among these communities promoted by the governments, debris flow prevention communities promoted by Soil and Water Conservation Bureau, Council of Agriculture has the largest scale and the longest time. Until 2013, there were 367 communities has been participated in the program through receiving the training of debris flows prevention. The program originated from the 921 earthquake which resulted in many debris flows hereafter due to loose soil and typhoons. The authority responsible for soil and water conservation of slopes in Taiwan had to address efforts to disaster prevention in addition to engineering management. The communities in the areas potentially susceptible to debris flows were rural type with low population density and prone to be isolated with difficulty in getting outer support during typhoons and torrential rains. For this reason, debris flow prevention communities tried to set up the warning system, observe precipitation by local community leader to judge the signs of hazards and properly evacuate to take shelters.

Flooding prevention communities were established in 2010by central government of authority, Water Resource Agency, Ministry of Economic Affairs, and 98 flooding prevention communities were established by the end of 2013. Like debris flow prevention communities, flooding prevention communities were dominated by central government of authority while the difference was that they were also assisted by the authorized local governments. The areas potentially susceptible to flooding were widespread and the local governments were needed. The areas prone to flooding were not confined just in rural or urban areas and there were relatively more inhabitants needing to be evacuated. The program learnt from that of debris flow prevention communities setting up the SOPs of evacuation in the areas potentially susceptible to flooding and therefore teaching the inhabitants how to assess the circumstances and take shelters.

Besides typhoons and torrential rains which are the main reason for the other two hazards, the reason causing slope disasters included slope exploitation and inhabitants' activities. The promotion of slope disasters prevention communities was not dominated by the authority of highest level, the central government, but the local governments. For the communities potentially susceptible to slope disasters, the efforts of disaster prevention were to assist the communities to observe the signs of slope disasters, elevate consciousness of risks and conduct preventative evacuation necessarily before disasters.

2.2 Key Elements

From the current status of community based disaster prevention in Taiwan, three conclusions are conceived as follows:

2.2.1 Disaster prevention by inhabitants

According to the "Disaster Prevention and Protection Act" in Taiwan, each disaster was designated to specific central government of authority. The central government of authority located the affected inhabitants in the areas potentially susceptible to certain disasters by promotion of community based disaster prevention and cooperated with local community organizations to put efforts on disaster prevention and evacuation training. Regarding to debris flows, there was a certain warning value of precipitation to conduct evacuation in each village. The inhabitants should observe the rainfall and evacuate when the warning was issued by the government. Moreover, they should learn and judge signs of disasters to evacuate when necessary.

2.2.2 Communities

The range of community based disaster prevention promoted by the public sectors, according to different hazards, covered the most basic units as villages and neighborhoods of administrative areas. In the discussions with local leaders and seniors, we had found that an administrative village/neighborhood might be composed of several natural villages or be only part of one village. It was formed with a group of people because of their cultural characteristics. The range of community could be part or one single village/neighborhood or multiple village/neighborhood, which was determined by its history, geography and cultural characteristics. We had to communicate with local inhabitants to understand the proper range of community for promoting disaster prevention community.

2.2.3 Disaster prevention Community

The community owns organization, targets of protection, disaster preventions and evacuation plan toward disaster events. The organization of disaster prevention community was guided by the leader or seniors of village/neighborhood. The objects of protection were to establish the list based on the area potentially susceptible to disasters. The disaster preventions were to select shelters and evacuation routes according to the area potentially susceptible to disasters. The evacuation plan was the plan to conclude items mentioned above and discuss with inhabitants to practice preparedness and response actions during disasters.

Regarding the promotion of community based disaster prevention in Taiwan, the study concluded three key elements mentioned above and showed in Fig. 1.

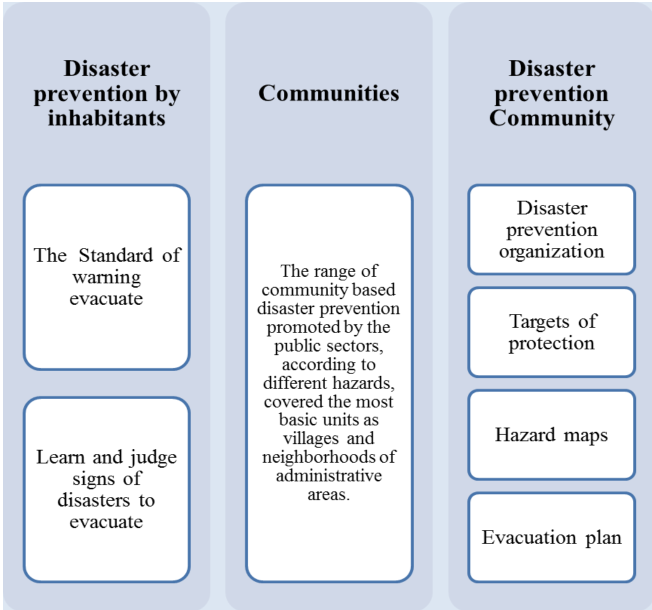

Fig. 1 Key elements of community based disaster prevention

3. EXAMPLE OF SLOPE DISASTERS PREVENTION COMMUNITIES: WAN-MEI COMMUNITY

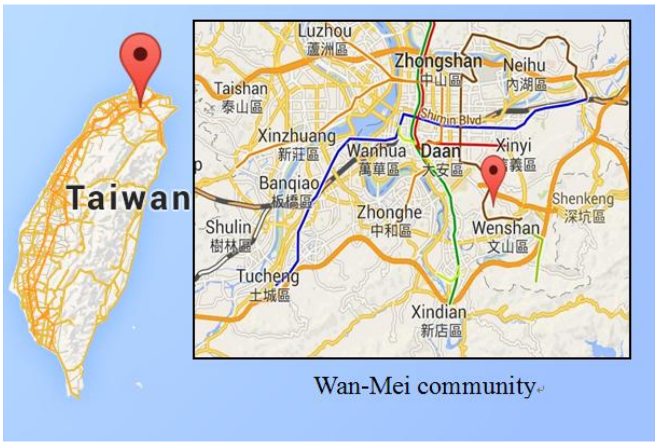

Fig. 2 Location of Wan-mei Community

Wan-mei Community which was located at Taipei City Wen-shan District (Fig. 2).Taipei City was the capital of Taiwan. The rapid urbanization in Taipei City made the citizen to extend their living space from the plain of the basin to the rim where Wan-mei Community was located.

There are three inclinometer were set up in Wan-mei Community by Geotechnical Engineering Office, Taipei City Government to monitor the deformation in the slope where Wan-mei Community is located. In the past, the inclinometers are monitored and slope is periodically patrolled with interval from one month to couple months). That usually cannot help the local inhabitants to realize the occurrence of slope disasters before the incident. The program helped setting up equipment to monitor the movement of the slopes and providing real-time condition with light signals of different colors (e.g. red, yellow, green). When the light signals changed, the disaster prevention organizations in the community responded correspondingly. More than hardware setup, some software approaches were taken to improve the Wan-mei Community to be more disaster preventive. The whole process of the promotion lasted for about 7 months, it is shown as follows:

Table 2 The promotion time table of Wan-mei community based disaster prevention

Date	Activity
2013.04.22	The first visit of the community
2013.06.06	The orientation of the program
2013.07.09 2013.07.15	The inspection of the circumstances in the community and the investigation of protection target
2013.07.27	The training for the members of disaster prevention organizations in the community
2013.08.15	Survey targets of protection
2013.09.17	The training for the members of disaster prevention organizations in the community
2013.10.31	The tabletop exercise before official drill
2013.11.24	The official drill of disaster prevention community

3.1 The first visit of the community

To start the promotion process, the leader of the Community, also the head of Wan-mei village, to understand the current living status, organizations and disaster records in the past. In addition to realize the fundamental information, the key object was to establish a good connection with the leader of the community then to facilitate processing of following work.

3.2 The orientation of the program

The purpose of orientation was to let the inhabitants to realize the methods and the intent of the disaster prevention community program. The inhabitants had to go to work in normal days so the professional team took advantage of monthly community committee meeting to express the content of the program, ignite the inhabitants' intention of disaster prevention, educate them how to identify the signs of slope movement, explain the meaning of monitoring equipment set up in this community and discuss any aspects regarding this program. Some photos of the orientations are shown as follow:

Fig. 3 The professional team express the key points of the program.

Fig. 4 The site of the orientation.

Fig. 5 Identifying the hazardous area in the community.

3.3 The inspection of the circumstances in the community and the investigation of protection targets

The inspection of disaster locations in the past was to realize the disasters occurred in the past and potential locations of disasters in the future by the experts. The location of the disasters in the past is shown in FiG.3. The retaining walls surrounding by the slope and the downgrade stairs appeared to be unstable.

The inspection of the circumstances included the locations of vulnerability and the cultural circumstances in the community. There were about 350 families and 1050 people in the community. There were 3 buildings and part of the parking lots situated at the vulnerable areas of slope disasters. Most of the inhabitants were nine-to-fiver and the elderly might be present in the public areas during daytimes while the elderly and people with impairment were accompanied by the foreign care workers. There were no designated parking lots but the vehicle information was registered so the car owner can be contacted when necessary. The cadre, and worker showed up in normal days, while security guards are 24 hours on duty. There was also a small park by the community, which could be used as temporary shelter. Most inhabitants could leave for their relatives when there was a slope disaster.

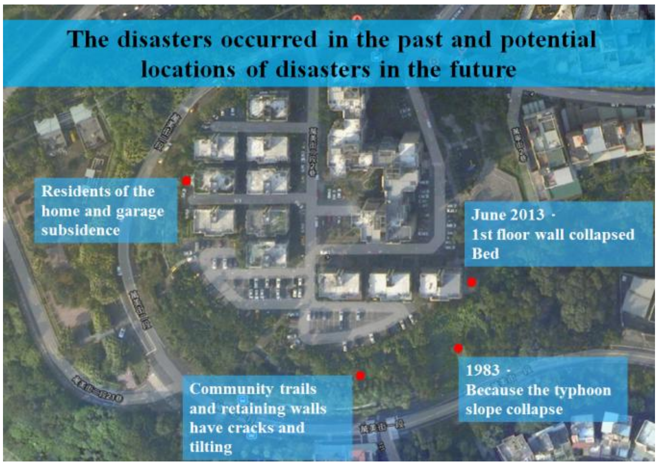

Fig. 6 The location of the disasters in the past and potential instability

3.4 The training for the members of disaster prevention organizations in the community

The training courses in the community were held on July 27th and September 17th focusing on circumstance orientation and tabletop exercise. On July 27th, the professional teams present the numerical simulation results of affected range of slope failure (Fig.7) and discussed to the inhabitants. Under the conditions of extreme rainfall, the team simulated the alert area and targets of protection if the slope disaster occurred in Wan-mei Community.

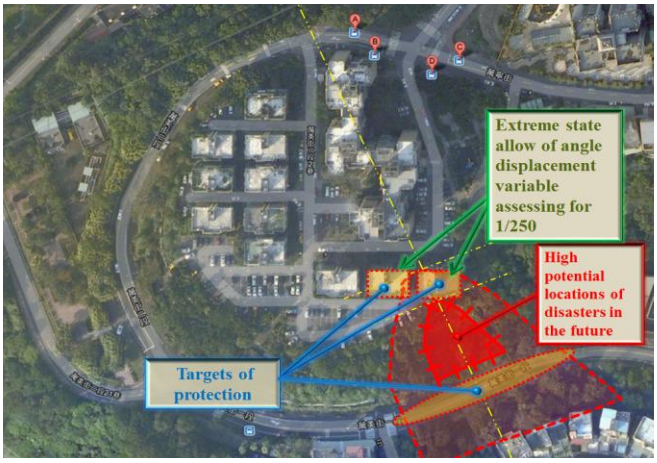

Fig.7 The alert area of slope disaster in the Wan-mei Community

In the meeting also reached consensus with the cadres of disaster prevention organizations in the aspect of the result of inspection and numerical simulation. More discussion covered how disaster prevention organizations can cooperated with each other when slope disaster occurred, including how to contact the targets of protection, and evacuate vehicles and inhabitants. In this phrase, the personnel of local government also attend the meeting to fully communicate with the community. Some photos of this work is shown as Fig.8 and Fig.9

The tabletop exercise (Fig.10 and Fig.11) on September 17 before official drill was to simulate the task assignment and to reconfirm the appropriate action of members of disaster prevention organization and targets of protection. An open discussion of the actions before, during and after the disaster was welcomed to reach consensus for actions of community based disaster prevention in the future.

Fig.8 Inspection of community circumstances with inhabitants

Fig.9 The personnel of local government discussed with inhabitants

Fig. 10 Speech of the leader of the Wan-mei Community

Fig. 11 The professional team members guided community to run the tabletop exercise

3.5 The official drill of disaster prevention community

The purpose of the drill was to actually operate the response actions of community organization during disaster. There were several important procedures on that day, including communication again in the meeting before drill, orientation of the program to inhabitants attended to this drill, official drill, and review meeting. The actual procedure was showed in Table 3.

Table 3 The timetable of the drill

Time	Content	Personnel involved
08:00-09:30	Meeting before drill	cadres of the disaster prevention organization
09:30-09:50	orientation to inhabitants attended to this drill	targets of protection, cadres of the disaster prevention organization, interested inhabitants
10:00-10:30	Official drill	targets of protection, members of the disaster prevention organization
10:30-11:00	Review meeting	cadres of the disaster prevention organization

The situations of the drill included:

a. the alert light signals changed to yellow;

b. mobilization of the disaster prevention organization;
c. inspection of the circumstances and notification to the inhabitants and the owner of the vehicles parked on vulnerable parking lot;
d. the alert light signals changed to red and evacuated the targets of protection and vehicles;
e. set the warning area and controlled the entry of personnel and vehicles;
f. inhabitant trespassed warning area;
g. settle down targets of protection;
h. the alert light signals changed to green and assisted inhabitants to return home.

The photos of the drill are shown as follows:

Fig.12 Tabletop exercise again

Fig.13 Many inhabitants attended the drill

Fig.14 Drill-evacuation

Fig.15 Drill-control of warning area

Fig.16 Discussion with inhabitants

Fig.17 Drill-assembly

There were several characteristics of this drill:
a. Increase cadres and inhabitants' understanding of disaster prevention community and establish interior consensus.
b. Help cadres of disaster prevention organization familiarize the content of their work by the drill.
c. The disaster prevention organization could respond appropriately during disaster.

4. DISCUSSION OF PROMOTION PATTERNSAND APPROACHES ON WAN-MEI COMMUNITY

The key patterns and approaches of disaster prevention working Wan-mei Community could be concluded in Fig.18.

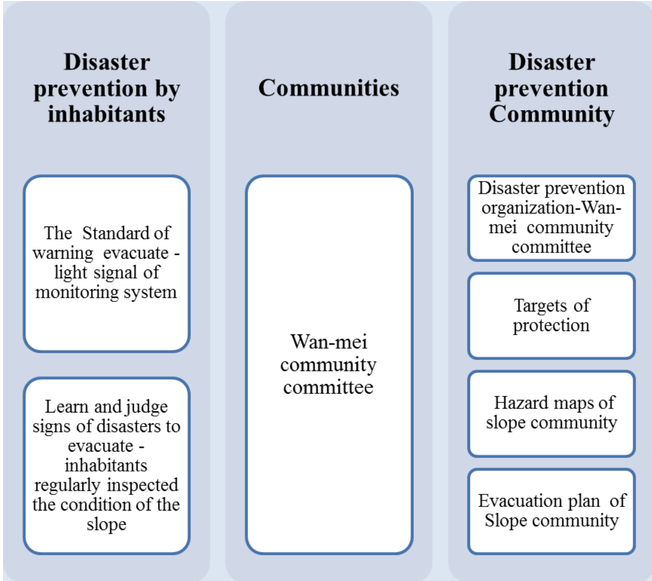

Fig. 18 The Key point of slope disasters prevention communities' promotion

4.1 Disaster prevention by inhabitants spontaneously

Instead of receiving notification from authorities, the security guards of Wan-mei Community were trained to notify the disaster prevention organization as they observed the change of alert light signal of monitoring system from green to yellow or even to red. Besides, instead of inspected by authority contractor every few months, the inhabitants were trained to inspected the condition of the slope in the community regularly. Fig.19 and Fig.20 is The warning light signals on the website and locations of the monitoring equipment.

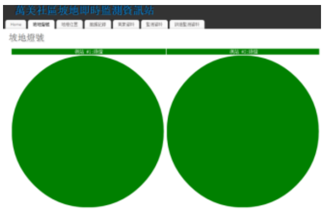

Fig.19 The alert light signals on the website

Fig.20 The locations of the monitoring equipment set up by professional team

4.2 Slope communities

In the experience of debris flows and flooding disaster prevention community, village/neighborhood was main unit to promote the community based disaster prevention. The features of slope community were condominiums with well urbanization and high population density. The range of the community differed from those of debris flows and flooding disaster prevention community, which was newly formed community because of urbanization, not traditional village/neighborhood formed by geography. The inhabitants shared the public resources so they needed mechanism to manage public affairs. The committee members selected by the inhabitants on behalf of them to dealt with public affairs. There was an executive secretary hired to deal with routine affairs while the committee was convened monthly. The committee members were basic cadres of the disaster prevention community.

4.3 Disaster prevention Community

The disaster prevention efforts in Wan-Mei Community generated some achievements, including establishment of disaster prevention organization, disaster preventions, lists of targets of protection and evacuation plan.

The disaster prevention community establishes five divisions of tasks, namely the command center, the administrative division, the evacuating division, the warning division, and the control division. The command center is responsible for the disaster emergency response, including decision to evacuate residents, resource integration and coordination, as well as internal and external information reciprocation. The administrative division provides the needed documents and makes records of protected residents and their status. The evacuating division is dedicated to works such as disaster notification and emergency evacuation. The warning division makes an instant judgment according to the warning light signal, t. If a yellow light is issued, the group members should look around and inspect the community situation. If a red light is issued, it should define the warning area and monitor the disaster condition. The control division is responsible for controlling traffic and maintaining law and order in the community.

The formation and task assignment of community based disaster prevention organization was the most important work in the community because it functioned when the disaster occurred. The program created the disaster prevention maps of the community with the locations of monitoring equipment, potential disaster areas, contact information of rescue resources, public transportation and temporary shelters. The map was designed with calendars to make it popular for all inhabitants.

In this preliminary case, it demonstrated the approaches of how the resources of public sectors in Taiwan were introduced into the community and provided different promotion characteristics from flooding and debris flows. This case provided the following experiences:

a. In the urbanized community, the committee was formed to manage the public affairs and it can also function as important organization in community based disaster prevention, which could be referred in future promotion of disaster prevention community in the circumstance of urbanization.

b. There was no traditional teaching material and learning opportunity of disaster prevention concept for the inhabitants. Therefore, through the coordination of professional team, community is trained how to activate the disaster prevention efforts. For example, spontaneously observing the changes of retaining walls in the community gave inhabitants the chance to acquaint themselves with the circumstances of potential disasters in the community.

c. A proper slope surface deformation monitoring system can provide alert and warning signals to slope community for their spontaneous disaster prevention action.

d. The operations of slope community was able to obtain the substantial benefits of establishment of disaster prevention organization, creation of targets of protection, illustration of disaster preventions and evacuation plan.

On the other hand, through the case of Wan-mei Community, some difficulties of community based disaster prevention executed by the public sectors are concerned:

a. With the input of public resources and professional team, the community was trained to conduct the disaster prevention efforts in such short time. However, after the resources of public sectors withdrew, could the community based disaster prevention continuously function as well?

b. The government of authority focused only on single disaster to conduct community based disaster prevention. If there were more than 2 potential disasters with 2 different governments of authority, how could they integrate to operate community based disaster prevention?

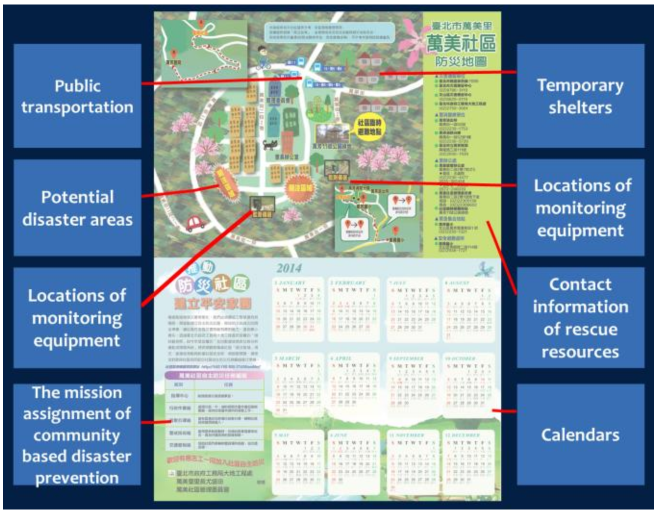

Fig.22 The key point of slope disasters prevention communities' promotion

5. THE CURRENT SITUATION AND FUTURE OF TAIWAN'S COMMUNITY BASED DISTER PREVENTION

Taiwan's community based disaster prevention initiated by the 921 earthquake. Recently, after reviewing the disaster prevention efforts of public sectors and the execution of related programs, some issues were drawn as follows:

5.1 The difficulty of community based disaster prevention executed by the public sectors as an active role

Conclusions should state concisely the most important propositions of the paper as well as the author's view of the practical implications of the results.

In the recent experience of promotion, the scholars began to discuss the effects of the program. From the interviews in Nan-tou County, there were some issues in the promotion of disaster prevention among communities, governments and associate teams: The plight of community business hindered the development of disaster prevention; disaster safety management and organizational operations affected functions of disaster prevention; the government lacked for consideration of realistic rescue pattern and experience; the leader of local governments did not showed much attention to the program thus the officers of local governments were not enthusiastic; the inhabitants were short of concepts and practical action of disaster prevention and disaster prevention organization. In other words, when disaster prevention community were mostly promoted by the governments, the egoism of authority, passive cooperation of communities, shortage of professional assistance and the difference of tolerance of disaster risks between government and inhabitants, were frequent concerns in the disaster prevention community.

5.2 How the disaster prevention community to became active and sustained

Currently, there was no specific disaster prevention management agency in Taiwan. The government of authority focused only on its own disaster prevention work. After a major disaster, there were too many programs into the damaged communities while there was no resource in the normal days. In the aspects of time and space, the resources in the disaster prevention community were not integrated and well planned. When the governmental resources were no longer provided, would the community based disaster prevention still sustained efficiently? This issue needs continuous follow-up and considered.

5.3 The promotion of disaster prevention knowledge

After reviewing the educational material to understand why the community based disaster prevention could not be promoted, it is found that some reasons (Kuo. et ol., 2011). First, the courses and teaching materials of disaster prevention were not differed by the locations. Second, the cultivation of instructors was not standardized, so in the process of teaching and promotion, there was no teaching objects and learning plan. Third, the inhabitants, especially live in mountainous and rural regions, usually have to work hard to make their living. They believe in fate of the occurrence of disasters. Finally, people gradually reduce disaster prevention awareness after a major disaster. These limitations all affect community motivation and cognition of disaster prevention.

5.4 Are the four phrases of emergency management mitigation, preparedness, response, recovery suitable for communities in Taiwan?

According to "the operations brochure of disaster prevention community", the four phrases of community based disaster prevention should play roles as follows: to promote concepts, learn knowledge, ensure the safety in the community, reinforce the structure of the building, establish the database of disaster prevention resources and set up organization in mitigation phrase; to develop the emergency response plan, prepare disaster prevention and communication equipment, exercise the techniques, inspect the locations susceptible to disaster, contact disaster prevention organization members in the preparedness phrase. In the response phrase, the role of community based disaster prevention was to alert the disaster, evacuate, take refuge, settle and manage the civilian, search and rescue , conduct the medical care and treatment, collect and report the disaster situation, urgently transport and distribute resources, dispose of the waste and clean the environment. In the recovery phrase, the role of community based disaster prevention was to relocate the civilian, retrieve their living, rehabilitate their physic condition, and restore the infrastructure and lifeline facilities. Now the community based disaster prevention in Taiwan mostly focused on response mechanism of the disasters, and paid less attention on recovery of disaster and knowledge. The development of four phrases of community based disaster prevention were closely linked to sustainable disaster prevention in the community. In Taiwan, the ratio of four phrases reflected the role of governmental dominance of community based disaster prevention.

The inhabitants were the main part of community based disaster prevention, due to the local power had its instantaneous and location-based characteristics, they could respond immediately during disaster. The experience of promoting community based disaster prevention in Taiwan reflected the important role that the resources of public sectors and the coordination of professional team entered the community. How to lead the community to immediately response the disaster, generate the motivation of disaster prevention, transfer accurately the information, enhance the knowledge of community based disaster prevention, and balance the delicate efforts of disaster prevention both in peace time and disastrous time became the upcoming issues of continuous disaster prevention operations in Taiwan for the future.

The case was the important milestone of disaster prevention community in Taiwan, for it inherited the patterns of debris flows and flooding prevention community and displayed the special scenario of slope disaster prevention community. The dominance of Wan-mei community was transfer from central government to local government and the range of disaster prevention community was different from the past. Instead of village/neighborhood, the range was the community of urbanization, which the committee of management was the key organization, the basic unit of disaster prevention, in the urbanized community. The causes of disasters were not limited to natural factors, but the interactions of human development and environment were getting obvious.

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A REVIEW ON THE PROGRAM OF DISASTER MANAGEMENT CAPACITY BUILDING FOR LOCAL GOVERNMENT (DMCB) IN TAIWAN FROM 2009~2014

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Abstract: The implementation of DMCB Program helps the local governments in revising disaster preparedness plans, charting and disseminating of hazard maps, establishing emergency operation centers, assessing emergency shelters, educating and training local emergency personnel. Subsidies from the central government budget, setting operational objectives and promoting to the entire country, the Program defines a common standard for preparedness and response planning national-widely, which is Taiwan's very unique experience.

Keywords: *capacity building, local government, disaster management of Taiwan*

1. INTRODUCTION

In 2009, the Taiwan Ministry of the Interior initiated the Program of Disaster Management Capacity Building for Local Government (DMCB Program) for the first 5 years. Each municipality or county (city) government recruited its own partnership organization or university to assist townships with severe hazard risk.

Fig. 1 Scope of DMCB Program for local government

The implementation of the program has successfully strengthened the resilience of 135 townships and districts in the 1st phase from 2009~2013 and will be extended from 2014 till 2017 in the 2nd phase for the rest 233 areas. It helps the local governments in revising disaster preparedness plans, charting and disseminating of hazard maps, establishing emergency operation centers, assessing emergency shelters, educating and training local emergency personnel. The scope of DMCB Program is shown as Fig. 1.

2. BACKGROUND OF THE PROGRAM

There are two key aspects of understanding the background of the DMCB Program in which the project was proposed: the current characteristic of Taiwan's emergency management system and the critical challenges of the townships and districts administration confronted.

2.1 Principal features of Taiwan's emergency management system

Taiwan's emergency management system is composed of three levels in central, municipality or county (city), township or district level governments, with the definition of Disaster Prevention and Protection Act (DPPA) illustrated as Fig. 2. Each municipality or county (city) government generates indigenous operational regulations and procedures for local activities. The municipality or county (city) authorities are responsible for the field operation of all kinds of disasters, but some functional operation is supported under the jurisdiction of central governments or state-operated businesses.

In conducting disaster preparedness activities, there are 4 level documents of Disaster Prevention and Protection Plans: the basic plan (PDPP-Basic) is as strategic document of central government, the operational plans (PDPP-Operational) are prepared by the central authorities and critical infrastructure (CI) enterprises, the two levels of regional plan (PDPP-Regional) refers to the local governments of municipality or county (city) governments and township or district offices.

According to DPPA Article 10, the major missions of township level are promoting and commanding refugee accommodation and settlement; organizing, reporting and evaluation of disaster situations; execution of emergency

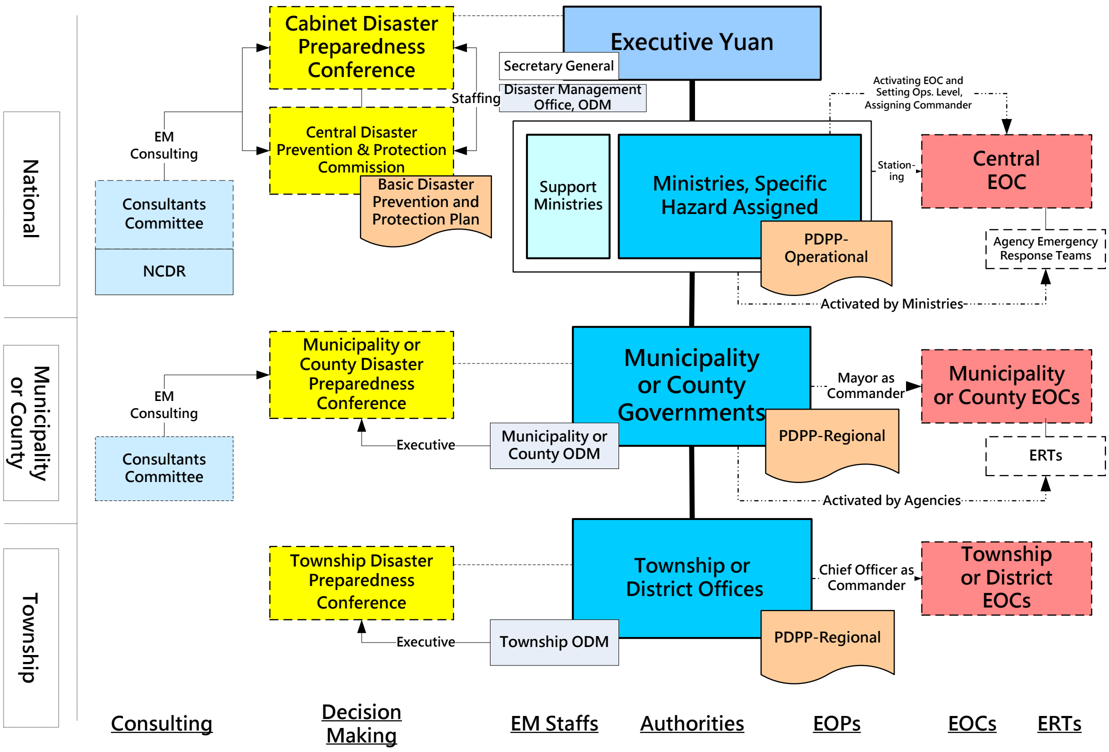


Fig. 2 Emergency management system in Taiwan

response measures; removal of barriers in the site of disaster; implementation of disaster rescue countermeasures; to promote community disaster prevention and protection affairs.

Notably, just not like Japan's township administration system, Taiwan's police, firefighting, emergency medical and large-scale rescue capabilities are not included in the obligation of township or district offices - these are operated by municipality or county (city) authorities.

2.2 Most Critical Challenges of Townships and Districts Confronted

In Taiwan, there is not an interoperated vertical design of disaster management system from central to local administrations. The central government operates emergency management system by Office of Disaster Management, Executive Yuan (ODM-EY) as cabinet staff and other ministries' agencies, just like National Fire Agency, play the roles of policy and regulation making and executive project managing. In the local government, municipality and counties usually use the combined operation of ODM-LOCAL and Fire Bureau; however the Civil Affairs Divisions take the major responsibility in township and district level's disaster preparedness services instead of the "supposed" ODM-TOWNSHIP framework.

The second, budget of townships in rural region is very limited due to poor financial condition, such that only very little or even no funds can support the disaster preparedness activities as shown in Fig. 3. The human resources of the township or districts is also not enough nor adequate for disaster management obligations. Heavy loading of the disaster related works make the Civil Affairs Division be the least desirable position in the office. Expertise and experience are very hard to be accumulated.

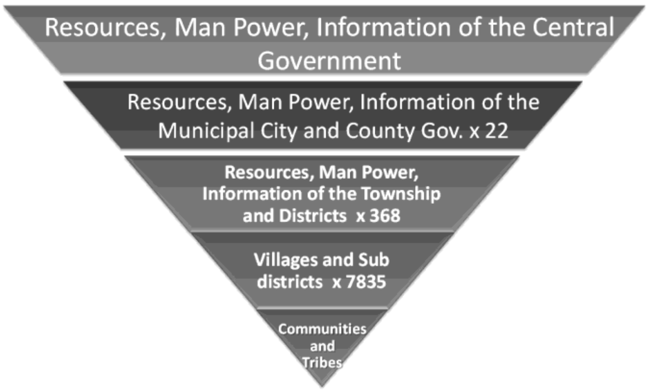


Fig. 3 The current resource distribution scheme of emergency management in Taiwan

3. OBJECTIVES & IMPLEMENTATION

Since the tasks included in Disaster Prevention and Protection Plans cannot be performed if there is no extra funding from the outside of township level, moreover, the long term deficiency of intelligence and specialized emergency management skills makes preparedness in local regions even more difficult. As a result, DMCB Program establishes 15 objectives and intends to enhance the emergency management capacities of township and district authorities (NDPPC, 2008).

a. Review the authority and duty of disaster management of municipality/county (city) and townships, resolve conflicts, and revise related regulations, plans, and procedures.
b. Examine and revise Regional Plan of Disaster Prevention and Protection of townships.
c. Develop standard operation procedures for specific type of hazard.
d. Establish emergency response mechanism for townships, such as Mutual Aid Agreements between local governments and the military forces.
e. Revise incident investigation and report procedure during emergency response.
f. Require experts of partnership organization to participate in EOC operation while activated.
g. Investigate and assess the risk of hazards, propose mitigation and prevention methods. Identify points of special vulnerability, such as floodable underpasses and river embankments that may burst during high water discharge.
h. Produce hazard and disaster maps, including electronic data and maps in electronic format. (Maps – hazard maps, vulnerability maps, evacuation maps, rescue maps)
i. Develop education and training material for city, county, and township personnel. Deliver education and training courses.
j. Identify and assemble lists on emergency response personnel, equipment, and resources of both public and private sector. (Resources analysis and inventory) (The location of key facilities, such as hospitals, fire, police and ambulance stations, and emergency operations centers.)
k. Develop storage and distribution mechanisms for emergency supplies. Validate Stand by Contracts for equipment and resources support with local business.
l. Assess capacity and safety of emergency shelters.
m. Determine evacuation routes and set up signs and map boards. (Evacuation zone, evacuation routes, evacuation procedures)
n. Conduct emergency response exercises.
o. Assist township office to promote disaster resilient community.

3.1 Program Implementation Structure and Mechanism

The roles in implementation of DMCB Program are shown as Fig. 4. The National Fire Agency (NFA) of the Ministry of the Interior supervises the program nationally wide. The local fire departments take responsibility of coordination in municipality or county (city) level. A project controls manager (PCM) team helps NFA establish program guidelines, requirements of project deliverables, and project control scheme. The PCM team also delivers necessary information to local partnership organizations, monitor the project progress, and evaluate the quality of project deliverables and the improvement of capacity.

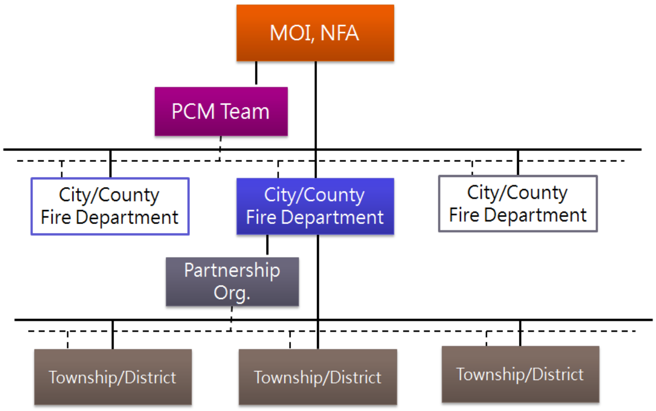


Fig. 4 Participants' roles in DMCB Program(Shan,2012)

As shown in Table 1, total of 15 partnership organizations join DMCB Program and collaborate with the municipality or county (city). The partnership organizations' responsibilities are helping local government to meet with the acquirement of the program objectives. The program execution structure and mechanism is shown as Fig. 5.

Table 1. NFA/PCM &15 partnership organizations 2008~2013

Partner Institution	Municipality or County (City)
Ridge Emergency Management and Security Affair Consultants	Project Controls Manager (PCM) team of National Fire Agency
National Taiwan University of S&T	Taipei Municipality
National Taiwan University	New Taipei Municipality
Taiwan Architecture & Building Center	Keelung City
National Central University	Taoyuan County, Hsinchu County, Hsinchu City, Miaoli County
Fengchia University	Taichung Municipality
National Chinan University	Nantou County
National Yunlin University of S&T	Changhua County, Yunlin County, Chiayi City
National Chungcheng University	Chiayi County
National Chengkung University	Tainan Municipality
National Kaohsiung University of Applied Sciences	Kaohsiung Municipality
National Pingtung University of S&T	Pingtung County
Mingchuan University	Yilan County, Lienjiang County (Matsu) Kinmen County
Kaoyuan University	Hualien County
National Taitung University	Taitung County
Taoyuan Innovation Institute of Technology	Penghu County

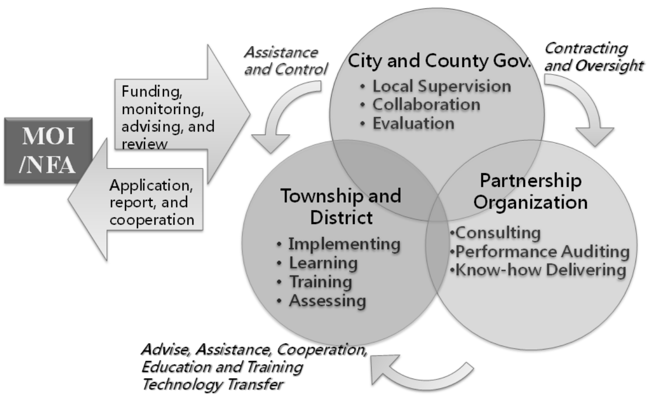


Fig. 5 DMCB Program implementation structure and mechanism

3.2 Budget of DMCB Program

The DMCB Phase I takes 5 years from 2009 to 2013 and the total budget is approximately NTD 390 million (USD 13 million). The central government provides the larger share of the budget, which is approximately NTD 375,500,000 (USD 12,700,000), the municipality or county (city) governments are compulsory in a matching budget ranging from 10 to 50% based on their size and financial capability. The first 5 years' program of the 135 participated township level governments divided them into 3 echelons to carry on, as shown in Fig. 6.

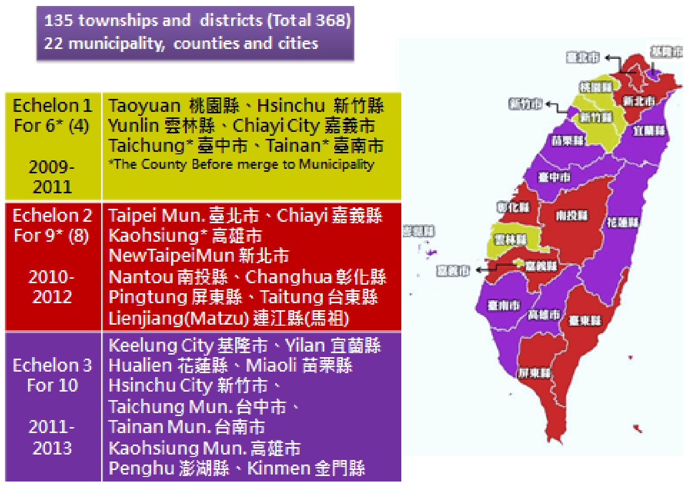


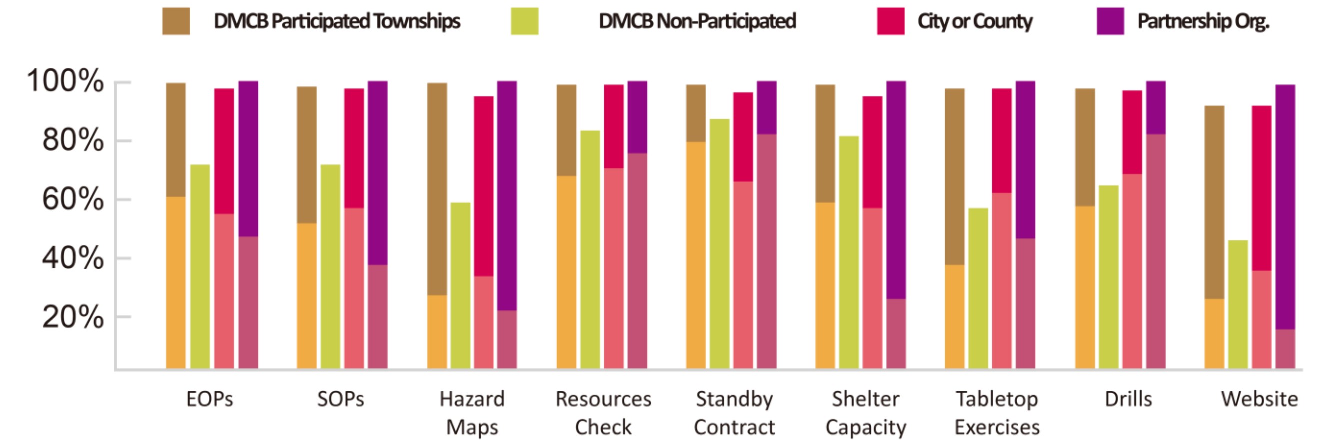
Fig. 6 The 3 echelons for DMCB Program Phase I

The 2nd phase budget of DMCB Program has approved on November 12th of 2012, It will take NTD 494 million (USD 16.7 million) for the rest 223 township level administrations from 2014 to 2017. The key issues of 2nd phase will be the integration of NGOs, local business and local communities into the emergency management network. Also continues working on update and upgrade hazard maps; maintenance of response and relief resources; improvement of education, training, and exercise; enhancement of emergency operation capabilities. (MOI, 2012)

4. RESULTS AND DISCUSSION

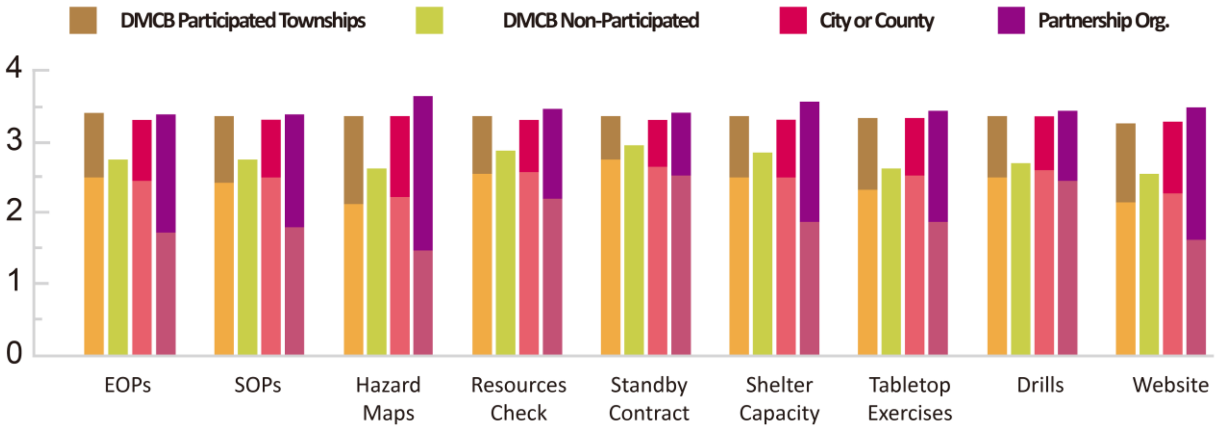
The Fig. 7 to 10 illustrate the multiple investigation results of pre- and post- of DMCB Program in participants' preparedness and response efforts both the ratio change of accomplishment and the quality index change of specified emergency affairs.

We can see that the first 135 townships who participate DMCB Program are originally more unprepared for the 16 items on preparedness and response works, especially in hazard maps, shelters, websites for preparedness and EOC facilities and handbooks for response (NFA, 2013). The post-program capabilities building investigation shows the local authorities and their partnership organization did implement the program to meet the requirements made by NFA. The improvement of capabilities shows that the objectives of DMCB Program are significantly fulfilled and has particularly progressed in preparedness events.



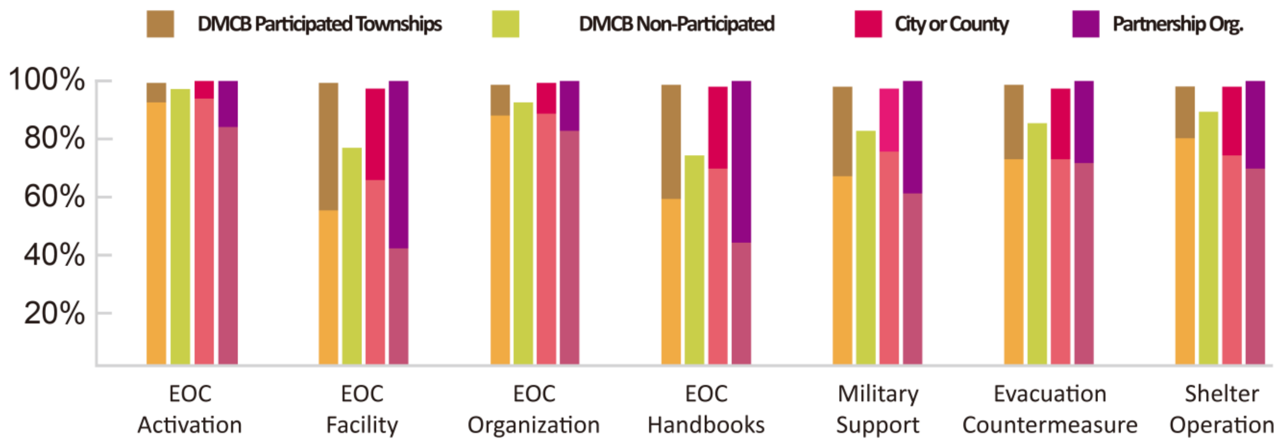
		EOPs	SOPs	Hazard Maps	Resources Check	Standby Contract	Shelter Capacity	Tabletop Exercises	Drills	Website
DMCB Participated Townships	Before	60	51.2	25.7	67.5	79.1	58.1	36.5	56.8	24.1
	After	99.1	97.9	99.1	98.8	98.8	98.4	97.2	97	91.2
DMCB Non-Participated	Before	71.2	71.3	58.2	83.5	87.4	81.2	56.2	64	45
	After	-	-	-	-	-	-	-	-	-
City or County	Before	54.5	56.1	32.2	70.2	65.6	56.4	61.6	68	34.6
	After	97	97.6	94.8	98.8	95.8	94.9	97.6	96.4	91.1
Partnership Org.	Before	46.3	36.6	20.3	75.6	82.1	24.4	45.5	82.1	13.9
	After	100	100	100	100	100	100	100	100	98.4

Fig. 7 The comparison by accomplishment ratio changes in preparedness events



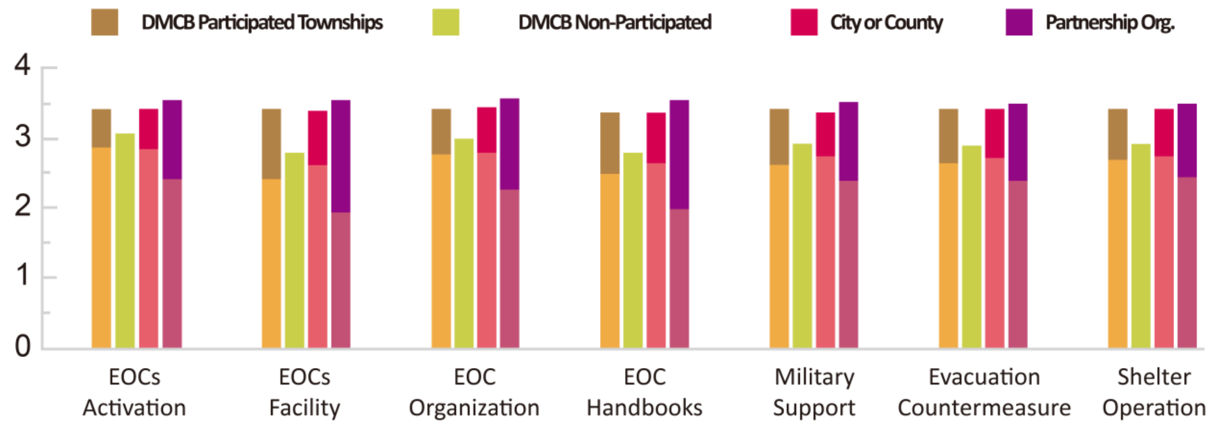
		EOPs	SOPs	Hazard Maps	Resources Check	Standby Contract	Shelter Capacity	Tabletop Exercises	Drills	Website
DMCB Participated Townships	Before	2.49	2.42	2.13	2.55	2.74	2.5	2.32	2.49	2.14
	After	3.37	3.34	3.33	3.34	3.33	3.32	3.31	3.33	3.24
DMCB Non-Participated	Before	2.76	2.75	2.63	2.87	2.96	2.86	2.63	2.7	2.54
	After	-	-	-	-	-	-	-	-	-
City or County	Before	2.45	2.5	2.23	2.58	2.65	2.51	2.52	2.61	2.28
	After	3.29	3.29	3.32	3.28	3.29	3.28	3.3	3.32	3.26
Partnership Org.	Before	1.71	1.8	1.48	2.2	2.53	1.86	1.88	2.45	1.63
	After	3.35	3.35	3.6	3.44	3.38	3.53	3.41	3.41	3.45

Fig. 8 The comparison by quality index changes in preparedness events



		EOC Activation	EOC Facility	EOC Organization	EOC Handbooks	Military Support	Evacuation Countermeasure	Shelter Operation
DMCB Participated Townships	Before	92.2	54.5	87.6	58.3	66.3	72	79.6
	After	99.3	99.5	98.8	98.8	97.9	98.8	98.2
DMCB Non-Participated	Before	96.6	76.4	92	73.2	82.1	84.8	88.5
	After	-	-	-	-	-	-	-
City or County	Before	93.2	65	87.7	68.9	75	72	73.3
	After	99.7	97	99.4	97.9	97.3	97.6	98.2
Partnership Org.	Before	83.7	40.7	82.1	43.1	60.2	70.7	69.1
	After	100	100	100	100	100	100	100

Fig. 9 The comparison by accomplishment ratio changes in response issues



		EOCs Activation	EOCs Facility	EOC Organization	EOC Handbooks	Military Support	Evacuation Countermeasure	Shelter Operation
	Before	2.87	2.43	2.77	2.51	2.62	2.64	2.7
	After	3.42	3.43	3.42	3.38	3.42	3.42	3.41
	Before	3.09	2.81	3.01	2.8	2.92	2.9	2.94
	After	-	-	-	-	-	-	-
	Before	2.84	2.63	2.81	2.65	2.76	2.73	2.75
	After	3.41	3.39	3.45	3.36	3.38	3.41	3.43
	Before	2.43	1.95	2.28	2	2.39	2.39	2.44
	After	3.55	3.55	3.58	3.55	3.51	3.5	3.5

Fig. 10 The comparison by quality index changes in response issues

The performance of DMCB Program can find several important features:

Subsidies from the central government budget, setting operational objectives and promoting to the entire country, the DMCB Program defines a common standard for preparedness and response planning national-widely, which is Taiwan's very unique experience.

As the regularly auditing and evaluating by NFA/PCM team, it will involve grant funding, coupled with the exchange of experiences and a comparison between the local authorities, thus creating considerable pressure to improve the quality of the overall emergency planning.

Since the implementation of the resource and service provided by DMCB Program, most local governments begin to re-consider the importance of disaster management affairs; the Program also provides the formation of preparedness and response information and professional exchange platform, for townships and municipalities/counties as well as academia constantly and frequently.

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ENHANCING COMMUNITY RESILIENCE THROUGH COMMUNITY DISASTER EDUCATION

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Abstract: This paper surveys a case of community disaster education in Bangladesh, a country that is regularly struck by cyclones. Its aims are to support the preparation of guidelines for cyclone shelter committees in regions where communities lead the building and operation of cyclone shelters and to prepare members of a community to respond when their region is struck by a disaster.

Keywords*: Resilience, Community disaster education, Bangladesh, Empowerment*

1. BACKGROUD

There have been many severe disasters recently around the world, such as in Sichuan, China in 2008, in Haiti in 2010, and the Great East Japan Earthquake in 2011. Because of natural disasters that occurred between 2002 and 2011, more than one million people have died and more than 2.5 million people have been affected. In many countries and regions, especially in developing countries, once disasters occur, their effects are severe because of a lack of resilience. Countries and regions that are vulnerable become more so when disasters strike, resulting in the loss of people's lives. Eighty-five percent of disasters occurred in Asia. Facing these disasters reminds us of the importance of emergency response as well as of the fact that more preparedness should be focused on reducing risks. The Office of Development Assistance (ODA) of the Japanese government in 2010 accounted for 32.4% of disaster-related filings for bilateral official support, but it requested none in 2005 (Ministry of Foreign Affairs, 2009). This proves the importance of supporting disaster preparedness and risk reduction. Although international organizations support building infrastructures, it is difficult to say that their efforts reach the people in need. For example, after the Indian Ocean Tsunami disaster in 2004, developed countries offered to set up early warning systems as rehabilitation support in Indonesia and Thailand. This was obviously important for reducing future risks. However, when the earthquake occurred on April 11, 2012, in Indonesia, an early tsunami alarm was raised, but it clearly did not work well; it took more than 30 minutes for someone to push the switch because local government officials were absent, and also four of the six bases were broken (Tanaka, T., 2012). It was also reported that people in the community switched off their systems to avoid confusion. As can be seen, the usage of high technology is meaningless if the benefited community is not educated and does not understand it. However, many developing countries unfortunately request to have high technology without understanding the importance of educating the people. Therefore, although the words, "community empowerment", appear in disaster management policy documents issued by government officials, there are no detailed plans and budgets. Vulnerability in urbanized Asian countries is increasing; it was also reported in the fourth report of Intergovernmental Panel on Climate Change (IPCC) that cyclones in the future will become more severe because of rising sea surface temperatures (2007). If disasters increase, the communities will be affected and will have to cope. It is important to support community disaster countermeasures at the policy level and to empower community members to reduce risks.

A key to building disaster-resilient communities is the people's participation. A community is not a discrete entity; it comprises many people. It is clear that people who are vulnerable under normal circumstances are more severely affected than others in times of disaster. This research, which focused on a case of Bangladesh, aims to show how disaster education contributes to building resilient communities.

2. POREVIOUS STUDY ON COMMUNITY-BASED DISASTER RESPONSE

2.1 Community emergency response

Owing to natural and geographic conditions, natural disasters repeatedly occur and result in the loss of many lives and much property. The affected countries and regions have learned from historical disasters and improved their countermeasures at the policy and practical levels to build disaster-resilient countries. Researchers have highlighted that communities tend to be excluded from the decision-making process in disaster management planning in Western countries; however, they gradually started receiving attention and involvement in the 1990s. It is not sufficient to enhance infrastructures and policies to avoid natural disasters unless community members, who are the first affected, as well as responders are involved. As Quarantelli (1988) observed, the top-down approach is not practical; it was found that 85% of the people were rescued by friends, relatives, and neighbors in the Mexican Earthquake in 1985. This is the case not only in developing countries but also in developed countries such as Japan. Japan has a traditional mutual-support system to complement local governments.

There are volunteer fire companies to manage fires and volunteer water companies to manage floods. In addition, the system sometimes builds and maintains community dikes, but these community ties become weaker when a city is urbanized. In the Hanshin-Awaji Earthquake in 1995, however, 30% of all buildings collapsed immediately after the disaster、It is estimated that 30,000 ridges (57,000 families), and 164,000 people were buried under the rubble. A researcher from the Institute of Social Science and Information Studies of The University of Tokyo reported that 19% of the people were confined, 15% of the people escaped on their own, and the remaining 4% needed to be rescued. Given the 164,000 people who were buried, 19% confined means that 35,000 people could not get out from under the rubble on their own. Fire service, police, and self-defense forces helped 7,900 people in the Hanshin-Awaji Earthquake, and 27,100 (77.4%) people were rescued by neighbors (Kawata, Y., 1997). After the earthquake, the keywords "self-help, mutual help, and public help" became popular as the country learned from the experiences of many other places that when fire service and self-defense forces could not reach, community members helped each other.

2.2 Community response in recovery

Affected communities attempt to rebuild as soon as possible; Quarantelli and Dyne (1972) observed that human beings have very strong tendencies to continue with on-going lines of behavior in preference to initiating new courses of action. Disaster victims react in an active manner and do not wait for assistance by outsiders or offers of aid from organizations. Anderson and Woodrow (1998) also noted that it is not always useful for aid to arrive soon after a disaster, except for emergency medical support, and it is not helpful for support workers to remain in the affected area. Gupta (2012) reported on the effectiveness of owner-driven and community-driven recovery projects compared with projects led by outsiders. For example, after the Popayan Earthquake in Colombia in 1983, the local government offered to train the community, and they rebuilt 1,153 houses within 18 months. Other similar cases were the Peru Earthquake, the Gujarat Earthquake in 2001, and Ache in Indonesia in 2004. After the Hanshin-Awaji Earthquake in 1995, community development associations became popular as community-based recovery organizations, and they played an important role in negotiating with the government and helping form opinions. These grassroots organizations can influence recovery processes.

2.3 Communities and disaster risk reduction

As is described above, it is important for communities to be involved in disaster risk reduction activities during normal times so the communities can be utilized in response and recovery. There are many case studies of community-based disaster management in countries and regions that have experienced severe disasters in the past, such as after the Hanshin-Awaji Earthquake, and in places where future climate change is a concern, such as in Bangladesh, as will be described further. Moreover, there are many studies on disaster risk reduction methodologies using tools such as risk communication, vulnerability assessments, the Disaster Imagination Game, and community workshops. However, Na (2008) noted that community participation workshops tend to lack the following: 1) two-way rather than one-way information-sharing and explanation; 2) a link between the information sharing and knowledge and actions; and 3) any influence from the silent majority.

2.4 Sustainable development

After Burke presented the importance of community participation in 1968, the concept of sustainable development became popular in the 1980s. As Chambers (1997) observed, historical top-down or control-management approaches bring unequal distribution of development and divide people into two groups: the upper class who have wealth and rights, and those who are poor and ignorant. The top-down approach might be used by experts who develop stereotypical projects. It is important to learn a community's reality and to identify problems and find solutions, and implementing or ceasing the project should be a basic concept of the methodology of participating in development. Rapid Rural Appraisals and Participatory Rural Appraisals diffused in the 1980s and 1990s, and community empowerment and the roles of NGOs received attention. Then, community-based projects such as resource management, forest management, and disaster management were implemented in various ways. At the same time, international organizations and NGOs began community-based disaster management programs in Latin American countries, Africa, and Asia. Maskrey criticized that top-down disaster-reduction programs ignored community vulnerability—the complex web of social, material, and economic environments—and were occupied by power-obsessed groups. Thus, community control is important, but support from outsiders is also needed. NGOs and residential organizations established a disaster response network in the Philippines in the 1980s, and in 1992, LA RED was established in Latin America. In addition, a similar network called Duryog Nivaran was formed in South Asia. These networks and NGOs advocated community-based disaster management to governments, and they recognized the importance at the international level. The principle of community-based disaster risk reduction is "people's participation and empowerment," "development-oriented activities," and "a multi-stakeholder approach," according to Willison and Gaillard (2012).

3. PARTICIPATION AND EMPOWERMENT

The word participation has various meanings. Although it can be used to mean the transition and distribution of power to find solutions, aid agencies sometimes consider it simple consultation. This definition refers solely to community participation in projects, and it lacks the perspectives of community empowerment, autonomy, and independence. Sometimes local governments mobilize people to participate, making it nonvoluntary participation, as Nishikawa observed (2002). Guijt and Shah (1998) and Cooke and Kothari (2001) criticized that "acts of violence, which are called participation" and "myth of community," became the objective of participation.

Pretty et al. (1995) found that community participation in projects aims to strengthen empowerment, sustainability, ownership, effectiveness, and efficiency, and they divided it into seven steps of involvement: passive participation; participation in information giving; participation in consultation; participation for material incentives; functional participation; interactive participation; and self-mobilization. The *Oxfam Handbook of Development and Relief* (1995) also identifies different levels of participation: 1) information-sharing, in which people are told about a development project and how it may affect them and so can (theoretically) decide on their level of involvement; 2) consultation, in which people are consulted on key issues and may provide vital feedback to project managers; 3) decision-making, in which people are involved in designing and implementing a project and thus influence its development at every stage; and 4) initiating action, in which people organize themselves to take action in the face of a shared problem or area of interest rather than responding to initiative actions by outside agencies.

4. DISASTER MANEGEMENT IN BANGLADESH

It is natural to address disasters by utilizing resources in any country or region. These efforts are made despite the existence of support systems from international agencies and governments. People as individuals and communities help each other by using indigenous knowledge, and they pass the knowledge of disaster risk reduction on to future generations. It is a fact, however, that many lives have been lost to natural disasters, especially in developing countries, which are vulnerable in their lack of firm measures such as infrastructure development and soft measures such as social security policies. These social systems are vulnerable, and the countries are directly affected by the level of the disaster. These disasters sometimes strike developed countries, but they do not cause as much loss in these countries. These disasters especially affect the vulnerable people in societies, as was discussed earlier. It is important to give affected people an opportunity for disaster education. The following section introduces a case study of cyclone shelter management by a community in Bangladesh.

4.1 History of cyclones in Bangladesh

Bangladesh is located in South Asia, bordered by the Bay of Bengal to the south and India to the west. Although the nation has an area of only 147,570 km^2, less than that of Japan, it has a population of 146.60 million. It is estimated to be one of the most densely populated countries in the world, with 839 people per km^2 (Bangladesh Bureau of Statistics Statistic Division Ministry of Planning, 2011). According to the 2008 *Human Development Report* (2011), the literacy rate was 52.5 percent, and the Bangladesh Central Bank indicates that its per capita income from July 2007 to June 2008 was US$624. The country ranked 146th among 182 nations in the *Human Development Report*. Geographically, Bangladesh contains the world's largest deltas, those of the Ganges and Brahmaputra rivers, and over 230 other rivers, canals, and streams crisscross the country. Both its location and its surface hydrology make it extremely vulnerable to natural hazards. These include floods, cyclones, tidal surges, riverbank erosion, earthquakes, drought, salinity intrusions, arsenic contamination, fires, and tsunamis. Bangladesh has suffered hundreds of thousands of deaths and massive property losses to cyclones. During the past 100 years, 508 cyclones have affected the Bay of Bengal region, of which 17 percent made landfall in Bangladesh. A severe cyclone occurs almost once every three years. The deadliest cyclone in Bangladesh (formerly East Pakistan until 1971) struck on November 12, 1970, and killed between 220,000 and 500,000 people. In 1991, another cyclone struck the country and claimed more than 130,000 lives. The recent cyclone Sidr, on November 15, 2007, struck the coastal area of southwest Bangladesh with 250 km per hour winds and 8-meter-high waves. It caused 4,234 fatalities (including 871 missing) and affected more than 9 million people. It, however, resulted in reduced casualties because three million people were evacuated by the early warning system and more than 1.5 million people evacuated to cyclone shelters (Government of the People's Republic of Bangladesh, 2008).

Another recent cyclone, Aila on May 25, 2009, again struck the southwest coastal area, caused 190 fatalities, and affected more than four million people. Compared with historical disasters, it is obvious that the fatality rate from cyclones is declining in the country because of improved infrastructure, early warning systems, and nurturing volunteers through international support for the national government. However, it is not difficult to state that Bangladesh is now resilient against cyclones except concerning their timing, tidal flooding, and cyclone paths. Moreover, the IPCC report mentioned that future cyclones will feature more severe wind speeds and rainfall, so that Bangladesh must address cyclones as an important issue.

4.2 Community-based disaster management in Bangladesh

There are 512 cyclone shelters in coastal Bangladesh, compared with 3,976 shelters at the time of Sidr in 2007; nearly half, 1,576, of these shelters were damaged by river erosion or abandoned because of dilapidated conditions resulting from lack of proper maintenance and repair. In addition to improvement in hard infrastructure, the development of a Cyclone Preparedness Program (CPP) is another contributing factor to cyclone mitigation. Established in 1972, the CPP is a community-volunteer-based cyclone warning transmittance program formed by the International Federation of Red Cross and Red Crescent Societies (IFRC) and the Bangladesh Red Crescent Society (BDRCS), in cooperation with the government of Bangladesh (GoB). When a cyclone occurs and the situation is serious, the Bangladeshi Meteorological Department sends the information to CPP headquarters, which then forwards the information to the 35 field stations located at the district or *upazilla* levels, from where the information is disseminated to 95 field substations. Note that 'upazilla' means a sub-district in Bangladesh. Here, the CPP volunteers use microphones and sirens to warn people of the approaching danger and urge them to evacuate. To become a CPP volunteer, one must first go through rescue, first aid, and other necessary training. The volunteers are not paid, but they receive necessities such as rain gear. As of June 2007, 42,675 people (28,450 males and 14,225 females) from 11 costal prefectures, 32 *upazillas*, and 274 unions were registered as CPP volunteers. During the cyclone of 1991, there were only half that number, approximately 20,000 CPP volunteers. However, there are 19 coastal districts in Bangladesh that still need CPP volunteers. The IFRC and BDRCS are currently in negotiation with the GoB to further expand the project (Bangladesh Red Crescent Society, 2007).

4.3 Community-led cyclone shelter building and management

This research was focused on the community's involvement in building and managing a cyclone shelter, and it assessed a process of developing a community cyclone shelter management guideline through training in disaster education. The guideline aims to improve disaster resilience in the community.

The community-led cyclone shelter is funded by an international NGO, and the NGO required community involvement in the planning stage. Thus, a Bangladesh NGO called the Bangladesh Disaster Preparedness Center (BDPC) facilitated and began consultation with the community. Then, they established a community cyclone shelter committee (42 members; 28 males and 14 females). They searched for sites for the cyclone shelter, and the land was donated by one of the committee members. They also explained the building process, so that committee members could check the cost of materials, which were brought by vendors. It was observed that the community as a whole would feel a greater responsibility for managing and maintaining the cyclone shelters if they were allowed to use the structures for social gatherings on various occasions. They are also discussing how they can earn operating costs in order to be sustainable. However, it is observed—in the midst of building the shelter, the negotiations for which were mostly conducted by the BDPC—that the community still tends to rely on the BDPC, which is natural for newly initiated projects. The BDPC also placed importance on capacity building training as well as infrastructure development. During focus group discussions with women in the community, one woman mentioned her concerns about security and safety in the cyclone shelter; the author and the BDPC then organized the next community training workshop.

4.4 Implementation of cyclone shelter management

This training was aimed at developing a cyclone shelter management guideline, identifying the committee members' roles and responsibilities, and encouraging preparedness to avoid confusion in times of disaster. The training workshop consisted of lectures on disasters and disaster management including cyclone preparedness, climate change adaptation, and gender perspectives in Community Based Disaster Management (CBDM), followed by open discussion.

The participants discussed various points for community cyclone shelter management from the viewpoints of the pre-, during, and post-cyclone phases. One community member stated that cyclones occur when two stars collide in space and that they were punishments by God in response to the question of how cyclones occur. These are the local conceptions of cyclones. The members also discussed climate change, saying that they felt they used to have six seasons in a year but now they have only three. A resource person facilitated the discussion on the importance of community involvement for sustainable shelter management using the example of the CPP. At the end of the workshop, the gender-segregated groups discussed and shared opinions about the contents of the guideline for cyclone shelter management.

Every discussed opinion was taken into consideration in the draft guideline, and it was distributed to the members of the shelter management committee for them to review. The draft was revised based on the members' discussion, and it was presented at the validation meeting with the upazilla government and politicians. The upazilla government officers and politicians raised a number of comments to further improve the guideline from their viewpoints, and the revised guideline was distributed to the members again for their final review. After confirmation of the final review by the members, the guideline was printed out and distributed. It consists of 13 chapters covering the constitution of the shelter management committee, the responsibilities of the cyclone shelter management committee pre-, during, and post-cyclone to ensure the proper use of the cyclone shelter, and resolving the difficulties faced by women, children, the elderly, and people with disabilities in cyclone shelters.

4.5 Change in consciousness of the committee members after the workshop training

The formation of the management committee was facilitated by the BDPC, and it was implied that the committee would request the NGO to fulfill its demands and requirements. During the training workshop, the committee requested the NGO to repair the access roads to the cyclone shelter. However, the author suggested that this issue be discussed with the upazilla government, which is responsible for development, along with a hand-drawn area map to explain the problems of the access roads. Accordingly, the NGO initiated a dialogue between the management committee and the union government involving local politicians.

The committee members met the chairperson of the union government and explained why the access roads needed to be repaired. Consequently, the access road to the shelter was repaired within three months. Following a discussion, the *upazilla* government agreed to repair 800 meters of road using 80,000 taka (US$1,163). This experience shows that community members need to know how to negotiate, not just receive from outsiders. Thus, it is important to give the community the opportunity for education; this will allow for the successful transfer of power and also enhance the committee's sense of responsibility and ownership.

Moreover, the committee members, both men and women, participated in the validation meeting with the upazilla government, during which members explained the contents of the guideline to the local government. The meeting was organized in the morning, an inconvenient time for women to participate because they are typically busy with household chores during this time; however, a number of women attended the meeting. This reflected the women's commitment to the committee and the positive attitudes of their family members. The female members gained confidence by being involved in developing the guideline.

In 2011, the committee organized a monthly meeting, a guideline study group, and planning for disaster drills. The drills would be organized by the committee with the BDPC funds. In regard to the operating costs for shelter management, the members do not have to rely on the local government or on the BDPC; they earn money by renting the shelter to external NGOs for trainings and meetings, and they receive donations from the wealthier people in the community. In addition, the committee began planting trees along the road to the cyclone shelter for resilience.

This study only targeted a small coastal area in Bangladesh, and thus, findings would be different for different cultures and societies in other coastal areas. It is expected that these communities will develop their own guidelines that fit their conditions in considering how community members can evacuate safely and remain at the shelters without worry.

5. CONCLUSION

When people experience any kinds of disaster, it is easy to remember the disasters, and they learn what they should have done through their own experiences. Thus, it is not difficult to understand the importance of disaster education. However, for people who have not experienced a severe disaster, it is not easy to raise community awareness. It is necessary to provide a true image of disaster impacts for disaster education. It is also difficult for developing countries such as Bangladesh to conduct disaster education apart from day-to-day lives. To overcome these challenges, the following can be said to be the lessons learned from Bangladesh.

5.1 Concretion of image

It is important to emphasize to the community why this kind of training is needed and how they can benefit from the training. Through the training, once people have a clear understanding of disasters, we must discuss what measures they can take to reduce disaster risk in their daily lives. Disaster risk reduction cannot be promoted among communities, especially in developing countries, if the countermeasures are not directly applicable in their lives; for example, climate change concerns and building dikes cannot be considered community matters. Thus, it is important to begin with the immediate environment and lead up to disaster-related discussions. In order to resolve the issue, when solutions are more specific, the people's awareness increases. The countermeasures should be suited to each area—there are no one-size-fits-all solutions.

5.2 Opportunity for participation

It is important for community members to have the opportunity for involvement in the process when workshops are organized. When workshops are planned, the targeted community members should be part of the discussion and should confirm the importance of the workshop, and they should discuss the contents of the workshop. "Education" sounds like one-way communication; the empowerment process might begin with one-way communication, but the goal should be for community members to be actively involved in organizing the workshops. In these cases, it is important to involve not only the groups that have power in the community but also vulnerable people. They should be given the opportunity for the training. As the case of Bangladesh demonstrates, if the community is involved in the process, they gain the confidence to affect other people, leading to disaster-resilient communities.

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LESSONS FROM RECENT DISASTER EVENTS TO ENHANCE TSUNAMI RISK REDUCTION

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Abstract: In the first decade of the 21st century, more than 2.7 billion people were affected by disasters in the world. Natural hazards resulting on disasters averaged at 400 per year from 2000 to 2012 according to the 2013 World Disasters Report. In addition, earthquake and tsunami are estimated on approximately 30 events on average per year. Some of these tsunami events are considered as mega-disasters based on their magnitude, extent of impact and number of victims. As examples remaining on the memory of this generation are the 2004 Indian Ocean tsunami, the 2010 Maule Earthquake in Chile and the 2011 Great East Japan Earthquake and Tsunami. In light of the facts recorded in these events, the scientific research, social experiences and ongoing reconstruction efforts, several lessons for tsunami risk reduction and community resilience are summarized in this paper.

Keywords: *Lessons from disasters, Tsunami risk reduction, community resilience.*

1. INTRODUCTION

In the first decade of the 21st century, more than 2.7 billion people were affected by disasters in the world. Natural hazards resulting on disasters averaged at 400 per year from 2000 to 2012 according to the 2013 World Disasters Report. In addition, earthquake and tsunami are estimated on approximately 30 events on average per year (Fig.1). Major events such as 2004 Indian Ocean tsunami (IOT), 2010 Maule Earthquake in Chile (MCH) and 2011 Great East Japan Earthquake and Tsunami (GEJET) remind coastal communities of the impending risk and the importance of warning systems and evacuation behavior. In light of the facts recorded in these events, the scientific research, social experiences and ongoing reconstruction efforts, several lessons for tsunami risk reduction and community resilience are presented here.

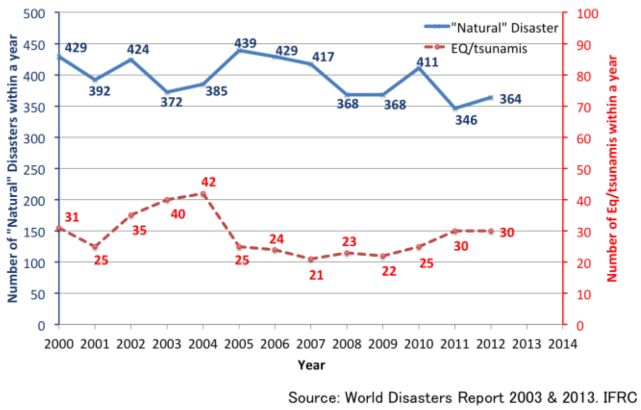

Fig. 1 The number of 'natural' disasters and earthquake/tsunami events recorded in the world from 2000 to 2012. (WDR2013, IRC)

2. THE 2004 INDIAN OCEAN TSUNAMI

2.1 Background

At 00:58 UTC on Dec. 26, 2004 a megathrust earthquake occurred off the west coast of Sumatra Island in Indonesia. The magnitude Mw 9.2 (Kanamori, H., 2006) earthquake triggered a major tsunami that affected not only the coast of Banda Aceh in Indonesia (Fig.2), but it hit other countries such as Sri Lanka, India, Thailand, Maldives and Somalia. Approximately 230,000 people perished due to the strong waves and the lack of warning information for evacuation in areas far from the epicenter.

Fig. 2 Impact of the 2004 Indian Ocean tsunami to a street in Banda Aceh. (Photo: Michael L. Bak)

2.2 Impact

This event has had a significant impact on the tsunami awareness in the international community. It was one of the most recorded disaster events and widely informed in the press at that time. One of the main reasons for the worldwide public attention, besides the huge earthquake and tsunami magnitude of the event, is the large number of European, North American and Japanese visitors who were killed or survived as eyewitnesses of the disaster (Spence, R. & Palmer, J., 2009). From this, we learned the importance of disaster prevention information and education not only to local people but also to the tourist and non-residents at risk areas. As Kelman et.al (2008) suggested in their report from interviews to tourists survivors of the 2004 IOT, three major topics were in need of further attention; (i) sustainable tourism and disaster vulnerability; (ii) the role of tourists in disasters; and (iii) disaster risk reduction education. It is also important to mention the impact of the lack of warning information during the event across Indian Ocean countries.

2.3 Reconstruction

Tsunami early warning became a big issue after this event and great steps have been made to develop a tsunami warning system for this region. The Indian Ocean Tsunami Warning System effort was initiated at the United Nations conference in 2005. The German-Indonesian Tsunami Early Warning System (GITEWS) went into operation at the Tsunami Warning Center in Jakarta in 2007 and it was completely handed over to Indonesia in early 2011 (Rudloff et. al, 2009).

Reconstruction at communities in Banda Aceh was conducted through community participatory methods in some villages. People and local government together decided whether to re-build in the same area increasing tsunami countermeasures, or re-locate. Since most of survivors wanted to rebuild their houses in the same location (Suppasri et. al., 2014), some tsunami countermeasures prepared were mainly vertical evacuation buildings (Fig. 3).

Fig. 3 Evacuation building in Banda Aceh in 2009. (Photo: Muhari, A. in Suppasri, A. et. al (2014))

Housing reconstruction was a priority in Banda Aceh on the first years after the disaster. A large number of international and national support organizations were involved. While the overall evaluation of housing reconstruction might appear successful, a social issue arose due to the intervention of different organizations, social pressure and lack of management from the local government. In Banda Aceh, as we mentioned before, the community participatory method was applied in some villages, however, in others, donors carried out the construction of housing under their own proposals for housing design and budget availability (Chang et. al, 2011). The different type of houses constructed from village to village, resulted on dissatisfaction from a group of residents who felt on disadvantage due to area, condition and design of donated houses (Lubkowski et.al, 2009; Steinberg, F., 2007). This experience stresses the importance od participatory planning and international regulations for donation and relief management.

2.4 Lessons to learn

Lessons to learn from 2004 IOT can be summarize as follows:

a. *Importance of Tsunami Early Warning*. A large number of casualties occurred far from the seismic source due to the lack of risk information dissemination.
b. *Evacuation Behavior*. Surprisingly hundreds of pictures from the day of the event show people watching the onslaught of the tsunami near to the coastline (Synolakis, C & Bernard, E., 2006), instead of looking for high ground immediately after the earthquake.
c. *Rapid fall or rise in coastal waters is a natural warning*—manifestation as a leading depression N-wave (LDN) or leading elevation N-wave (LEN) according to Synolakis, C. & Bernard, E. (2006). In 2004 IOT it was confirmed that LDN was observed to the east of the subduction zone, while the LEN was observed to the west. This means that for some areas there was no observation of receding water before the tsunami attack. The physical understanding of tsunami generation mechanism must be share with local people who believe on the rapid receding of water but not on the immediate rising feature of tsunami. People should not wait for the receding wave to confirm tsunami and evacuate, it is possible that an initial LEN wave is on their side.
d. *The necessity for a smart land use in coastal areas.* The devastation of housing in Banda Aceh, resorts and hotels in Thailand and the lack of high ground areas reminded that tsunami risk must be taken into account when planning urban development. Smart use of the land should provide comfort, safety and economic sustainability to the community.

3. THE 2010 MAULE EARTHQUAKE

3.1 Background

Offshore Maule in southern Chile at 06:34 UTC, a magnitude Mw 8.8 earthquake triggered a tsunami that devastated the coast of Chile and the islands nearby. The maximum tsunami runup of 29 m was found at Constitucion along a steep coastal bluff (Fritz et. al, 2011). The 2010 MCH earthquake is the largest in half a century in this area. Previous large earthquakes occurred south to this event, on 1960 near the Valdivia region of Chile. Post tsunami field surveys (Koshimura et. al, 2011) reported that experience of the 1960 and local tradition throughout generations helped on the fast reaction and evacuation of residents near the shoreline, despite that in 1960 the affected areas of 2010 did not experienced significant inundation.

3.2 Impact

The earthquake and tsunami resulted on approximately 521 fatalities. The majority of casualties are attributed to the earthquake, while 124 where killed by the tsunami (Fritz et. al, 2011). There were a few catastrophic failures of tall buildings during this massive strong ground. For instance, in Concepcion, the case of the Alto Rio building (Fig. 4) provided important lessons for the seismic and earthquake engineering (Lew et. al, 2010).

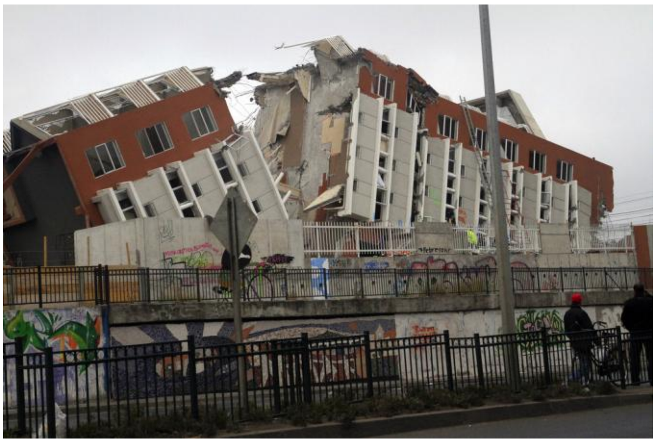

Fig. 4 Alto Rio building in Concepcion.
(Photo: Claudio Nuñez, posted on Flickr)

An important fact to remember from this event is related also to the tsunami warning information. Despite the magnitude of the earthquake, there was an absence of early official tsunami warning for evacuation, plus a failure in communication networks and, later, a serious criticism to the navy and government for failing to provide early warning information (Regalado, A., 2010). Here, a lesson is to pay attention not only to the technical component of tsunami forecast and warning dissemination, but also to the organization, protocol and training of personnel in charge of such important activities.

3.3 Reconstruction

Due to a strong building code in Chile, building damage related to the earthquake were limited, also this contributed to less casualties by collapse of structures—except for specific cases mentioned in the previous section.
Electricity was immediately shut down in the earthquake and the possibility of fires was reduced. Still, houses, which were built with older building codes, suffered the strong motion and 260,000 homes, 4,000 schools and approximately 70% of hospitals were damaged (Platt, S., 2011). According to Platt, S. (2011)'s survey of reconstruction, within 6 weeks nearly 60% of public infrastructure damaged was repaired and 11,000 emergency houses were built.

3.4 Lessons to learn

Lessons to learn from 2010 MCH earthquake can be summarized as follows:

a. *Tsunami Warning Systems.* Technology and development for tsunami forecasting and early warning has to be accompanied with intensive training, communication protocols and clear organization for emergency response.
b. *Earthquake and Tsunami engineering.* While good performance of buildings from strong ground motions was observed inland of Concepcion, the extensive damage from tsunami in areas like Talcahuano and Dichato revealed the importance of a tsunami engineering design to be incorporated on building codes when constructing in coast.
c. *Reconstruction process*. There is a limited time for master planning when social pressure and the dynamic of the economy in the region need to be reactivated. The lack of systematized, standardized and up-to-date spatial information limits the damage estimation, relief management and slows down the process to develop the reconstruction master plan.

4. THE 2011 GREAT EAST JAPAN EARTHQUAKE AND TSUNAMI

4.1 Background

On March 11, 2011, at 05:46 UTC, a massive earthquake was recorded in Japan, the magnitude Mw 9.0 at 24km depth was finally calculated by the Japan Meteorological Agency (JMA). A devastated tsunami was triggered which affected the north east coast of Japan. A maximum tsunami runup height of approximately 40 m was reported by the 2011 Tohoku Earthquake Tsunami Joint Survey Group (Mori, et. al, 2011). Similar to the 2010 MCH earthquake, the effects on structures from the strong ground motion were small compared to the devastation produced by the tsunami. However, in contrast with 2010 MCH case, in Japan, the majority of fatalities were attributed to the tsunami impact.

4.2 Impact

Approximately 560 square km were affected by the tsunami, and in total 15,887 people were killed (As of July 10, 2014). The GEJET is recognized as the deadliest disaster in the postwar history of Japan (Koresawa, A., 2012). A particular characteristic of this disaster is the evidence of a disaster chain reaction. It was first the earthquake damage followed by the extensive tsunami inundation, then, the outbreak of fires worsen by the spill of oil or combustible spread by the tsunami, and finally the Fukushima Daiichi Nuclear Power Plant accident threatening at least 30 km radius with a difficult-to-track and generally not well understood effects by the layperson. As accurately described by Koresawa, A. (2012), Japan is considered one of the most disaster-prone countries in the world, but also one of the most resilient to natural disasters. The toll of fatalities in the event would have been much higher if it were not for structural countermeasure and tsunami awareness present in the Japan communities (Fig. 5). It was not an unexpected hazard, but an unexpected magnitude. Casualties were possibly due to underestimations on early warning information that might have delayed the evacuation decision, hazard map expected inundations that were exceeded by the tsunami penetration and height, and the limited high ground areas within the flat coasts of Miyagi. In addition, vehicle evacuation and narrow streets contributed to traffic congestion and slowed of evacuation speed.

4.3 Reconstruction

One month after the disaster the government established the Reconstruction Design Council launching the recovery phase of the disaster. The vision, policies and guidelines for reconstruction were compiled on June, on the same year. There is a strong preference for relocation and land use regulation for the reconstruction.

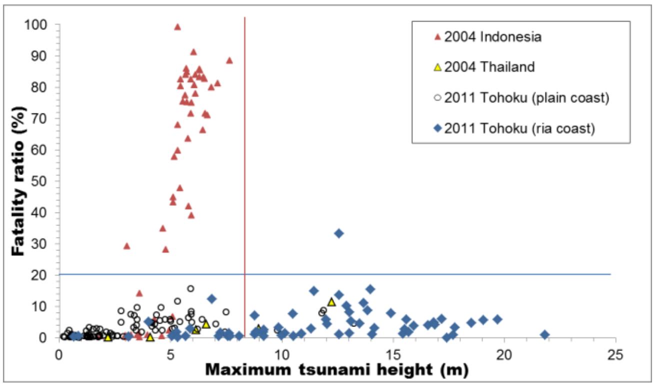

Fig. 5 Comparison of the 2004 IOT and the 2011 GEJET. Fatality rates were lower on 2011 GEJT event despite the larger tsunami heights compared to the 2004 IOT.

4.4 Lessons to learn

There is a large number of lessons to be learned from this event, the large amount of data—the compiled information from the disaster can be categorized as a Big Data—allows for an extensive analysis of population and infrastructures response to identify strengths and limitations at most sectors and levels of organization. Here, some lessons to be highlighted are described as follows:

a. *Tsunami Early Warning Information.* The first warning is of high importance since following updates might not reach population. In addition, the content and wording of it must be carefully selected to compel evacuation and avoid people at risk to overlook the information.
b. *Tsunami awareness.* Experience and information of historical earthquakes being transmitted across generations and frequently reminded through memorial events, landmarks, evacuation drills, etc. are key features to be incorporated on the annual activities of a community.
c. *Evacuation Behavior.* Immediate evacuation to high ground is always the best alternative. Avoid returning to the risk area. Prepare a family plan and trust on the good judgment of members fixing the meeting point at a safe place—behavior locally known in Iwate prefecture as 'tendenko'.
d. *Search for historical disaster records.* The information of 869 Jogan tsunami and 1611 Keicho tsunami as events larger than the expected Miyagi offshore earthquake must have been considered as scenarios for hazard mapping and tsunami mitigation.
e. *Extreme hazards happen, but extreme disasters can be avoided.* A new approach of preparing also for extreme events is being recognized in Japan and around the world. Extreme events might happen, but disaster management can be design to reduce the effects and impact of such events avoiding megadisasters. Structural countermeasures might be prepared at least for frequent events, however non-structural and organizational countermeasures should prepare for extreme events.
f. *Business continuity plan (BCP).* To enhance community resilience, economical activities must be reactivated as soon as possible. A BCP identifies critical operations and potential effects of a disaster in an organization. To avoid or minimize disruptions, response and recovery measures for BCP should be taken into account.

5. ENHANCING TSUNAMI RISK REDUCTION

Extreme hazards will continue to occur in the future, but we can avoid megadisasters by enhancing risk reduction. Then, how to enhance tsunami risk reduction?. Several efforts have been conducted since the 2004 IOT—now 10 years after—to improve technology, strengthen organizations and infrastructure, share experiences to understand hits and misses of disaster management. The following are worth to mention, however it does not pretend to be an extensive review of all ongoing activities related to disaster management.

5.1 Monitoring and Forecasting

2004 IOT revealed the necessity for tsunami warning systems, and 2010 MCH earthquake showed the importance of protocols and response organization when using warning systems. Finally 2011 GEJET highlighted the importance of first tsunami information and its content to effectively compel resident evacuation decision. On the other hand, worldwide early detection and real time forecasting of tsunami was improved considerably in 2001 with the first deep-ocean assessment and reporting of tsunami (DART) buoy array deployed by the National Oceanic and Atmospheric Administration (NOAA). Similarly, Ocean Bottom Seismometers (OBS) and tsunami cable pressure gauges (PG), available in Japan since 1979, have proofed to be of high contribution to monitoring and forecasting tsunamis. The Kamaishi OBPG, installed in 1996, recorded that the tsunami already had a height of more than 5m before it reached the coast in 2011 GEJET (Maeda et. al, 2011). A future of faster, more accurate and effective forecast technology with OBPG and super computing tsunami numerical simulation is in progress and must be accompanied with the training, education and preparation of administrators and users.

5.2 Risk assessment and damage impact

To assess the risk and provide measure to reduce it, first, data of population, infrastructure and spatial conditions of prone areas must be compiled and systematized. This information, in recent years, is being gathered at much more finer levels of granularity, demanding powerful computer systems to perform numerical simulations and analysis of the data. Such information and techniques contribute not only to the risk assessment on the pre-event, but also to the damage assessment in the first hours of the disaster (Fig. 6). Using remote sensing technologies, wide areas can be explored to estimate the damage and calculate the resources to be dispatch and the reliefs to be manage efficiently and on shorter times. Tsunami numerical simulation and evacuation simulation (Mas et. al, 2012) are powerful tools on the estimation of the risk and the identification of risks needed to be tackle.

5.3 Education and public awareness

It is of major importance to keep on building a culture of disaster prevention. Strengthen awareness and preparation in children by incorporating disaster prevention in schools, in adults by promoting their participation on disaster prevention activities and in elders by allowing them to share the experiences of past disasters and prepare themselves to respond based on their physical limitations.

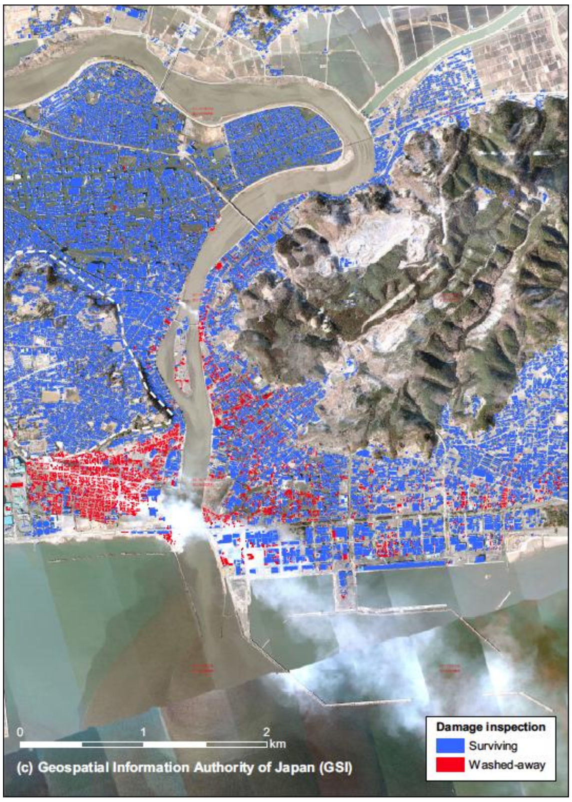

Fig. 6 Example of mapping building damage by inspection of post-event aerial photos (Ishinomaki city). (Koshimura et. al, 2013)

6. CONCLUSIONS

We might not be able to avoid megaevents, but we can prevent megadisasters. Tsunami risk assessment should include historical earthquakes and possible extreme events based on past records or paleotsunami information. Forecasting and warning must be delivered to the public as soon as possible, with the contents on the first issue being the most important to compel evacuation behavior. Updating tsunami risk assessments, damage estimations, response and recovery plan while reducing the actual risk conditions are continues tasks for communities at risk. Finally, sharing the experiences of 2004 IOT, 2010 MCH earthquake and the 2011 GEJET, identifying hits and misses of disaster mitigation on each case, and finding alternatives to reduce vulnerability conditions are the key to enhance tsunami risk reduction and build much more resilient communities.

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RESEARCH NEEDS FOR EFFICIENT QUICK RECOVERY FROM EARTHQUAKES

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Abstract: Since the first half of the twentieth century, earthquake engineering research has received much attention. Indeed, the valuable research outcomes presented a huge step forward in understanding earthquake hazard mitigation. In turn, the effects of past earthquakes were appreciably smaller than what they might have been. Nevertheless, serious damage was experienced in the 2011 Tohoku earthquake and the subsequent tsunami indicating that there is still much to be done. This paper presents the timeline of earthquake mitigation and recovery, as seen by the authors. Possible research directions where the authors think that many open questions still remain are identified. Those are based on the serious lessons learned from the 2011 Tohoku earthquake.

Keywords*: Research needs, earthquake engineering, quick recovery*

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1. INTRODUCTION

In the last half a century and more, earthquake engineering research has gained much attention. Indeed, a huge step forward was presented as a result of this valuable research. In turn, this appreciably reduced the effects of past earthquakes. Nonetheless, serious damage was still experienced as a consequence of the 2011 Tohoku earthquake and, in particular, due to the subsequent tsunami. Recovery efforts at inundated areas continue more than three years later. Every effort is still keeping paid for the stability and cleanup operations of tsunami-damaged Fukushima nuclear plants.

Effects of the 2011 Tohoku earthquake, in addition to the damage due to the subsequent tsunami, included subsidence, liquefaction and landslides. The majority of structural damage was experienced by older buildings due to their known deficiencies (Nilim and Bri, 2011; Nakashima et al., 2012). Nonetheless, nonstructural damage was quite significant (AIJ, 2012). This caused major disruption to business and social affairs (AIJ, 2012; Mori and Eisner, 2013). Another major source of disruption is associated with loss of utilities. This revealed that, in addition to the structural and non-structural damage states of the individual building, its overall performance is strongly governed also by the performance of other entities (AIJ, 2011, 2012). The overall results of the 2011 Tohoku earthquake manifest the importance of a quick recovery from such an event.

The 2011 Tohoku earthquake was indeed a major one. Nonetheless, stronger earthquakes with epicenters closer to more populated regions are expected to take place in Japan and in other countries in the not so distant future. Thus, preparedness for such an event and for prompt recovery is required. Those necessitate research efforts in related directions. This paper first presents the timeline of earthquake mitigation and recovery, as seen by the authors. Research needs that are related to the stages of earthquake mitigation are then identified. Finally, some conclusions are drawn. For more details the reader is referred to Nakashima et al. (2014).

2. TIMELINE AND RESEARCH NEEDS FOR EARTHQUAKE MITIGATION AND RECOVERY

The keyword "Resiliency" has been used by many researchers in the context of earthquake engineering and in many ways (see e.g. Bruneau et al., 2003, 2007; Cimellaro et al., 2009, and references therein). It is the authors' feeling that the most important aspect of resiliency is the recovery time. Hence, here we adopt the definition given in Nakashima et al. (2012) as the ability to recover to normal conditions (or functionality) as quickly as possible. The associated process is described in Figure 1 by plotting the functionality with respect to the time. It consists of two main stages: stage I describes the effect of the ground motion and the disruption it causes to normal functionality, while stage II describes the recovery stage. Also shown in Figure 1 are the earthquake mitigation needs to be elaborated on subsequently.

A quick recovery to normal functionality could efficiently be achieved by minimizing the effect of the ground motion and its disruption to normal functionality (stage I). This has been the focus of research for many years, and still is. Many efforts have been made to develop structural systems and technologies to result in "damage free" buildings, or at the least minimize damage. This presented a very important step forward. However, the 2011 Tohoku earthquake revealed that "damage free" cities are far from being a reality. Thus, minimizing the effect of the ground motion and its disruption to normal functionality is very important and, indeed, requires more research. Nonetheless, increasing the slope of the recovery phase (stage II), or the "rapidity" as defined Bruneau et al. (2003), will always play an important role in a quick recovery process.

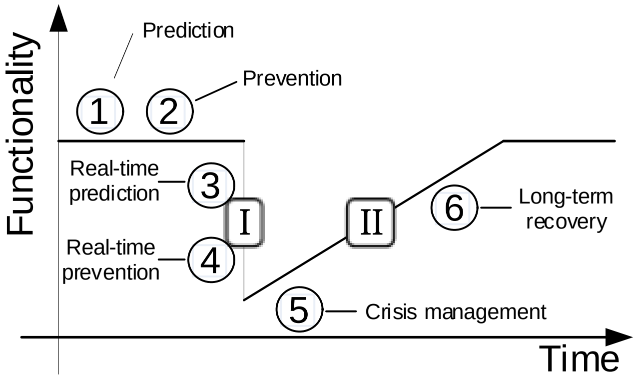

Fig. 1 Functionality versus time and earthquake mitigation needs (in circles) on the timeline of earthquake mitigation and recovery

Let us now present the timeline and needs for earthquake mitigation and recovery (depicted in Figure 1) as well as related research future directions. Those are:

2.1 Event (shaking and tsunami) magnitude and effect prediction

Reliable predictions of the loading magnitude are of much importance. These predictions determine the level of resistance that civil structures are designed for and the level of preparedness of emergency entities at the national level. Their importance is manifested by the 2011 Tohoku earthquake and the subsequent tsunami where a huge loss was a result of effects larger than predicted. In order to better prepare for such events, prediction efforts are constantly made, and new models for prediction are continuously formulated.

2.2 Design and retrofitting of structures and infrastructures

Appropriate seismic resistance of infrastructure and individual civil structures would minimize their damage. This is relevant in the design of new structures and in the retrofitting of existing ones. This, in turn, would decrease the initial disruption to normal functionality. As a consequence, a quick recovery would be made much easier and would require less efforts and resources. The importance of analysis, design and retrofitting of civil structures and infrastructure is well known and has been discussed for some years. This includes:

a. *Analysis of buildings to collapse*: The catastrophe associated with the collapse of buildings in general and high-rise buildings in particular is huge. As structures may experience seismic excitations larger than they were designed for, it is important to be able to quantify their collapse margin ratio. That is, the distance from the level of ground motion we design for to the level of ground motion that leads to a complete collapse (see e.g. FEMA, 2009; Zareian et al., 2010). Here, various complex phenomena that are often avoided, do take place, hence the challenge in prediction.
b. *Anti-liquefaction design*: The liquefaction experienced in not a few regions due to the 2011 Tohoku earthquake occurred especially in reclaimed lands, even though far from the epicenter (e.g. Tokyo, Chiba). This is probably due to the differences in the behavior of reclaimed soil compared to natural soil as well as the generally low height of reclaimed land above the sea level. This is also attributed to excitations comprised of small to medium amplitudes but with many cycles. Thus, new theory and analysis tools, as well as liquefaction criteria, are required, and anti-liquefaction design methodologies and measures should be developed.
c. *Tsunami hazard mitigation*: The 2011 tsunami washed away many reinforced concrete buildings. As the height of most buildings is low compared to possible tsunami height, many buildings would be all covered by such a tsunami. Those could, hence, not serve as a shelter and would have to be evacuated before the inundation. It is therefore considered more sensible to invest in early warning systems and escape routes to the hills and mountains (see real time prediction section 2.3a).
d. *Damage free technologies for buildings and infrastructure*: Prevention of failure of structural systems is important, but is not sufficient. Functionality of buildings and facilities is a very important aim as well. The development of damage free designs and technologies (up to a point), related to both structural and nonstructural damage, is indeed underway. Nonetheless, more research is needed in this direction. Moreover, the performance of a structure strongly depends on the performance of other entities within the same society (e.g. utilities, lifelines). Thus, in this context, efforts to develop damage free lifelines and utilities should also continue.
e. *Seismic retrofitting*: Seismically deficient buildings will still be a part of the landscape throughout the world in the near to far future. Hence, technologies and design approaches for seismic retrofitting are required. This has also been the subject of research for many years, and here too, more research is needed.

2.3 Real time prediction

The term real time prediction refers here to real time sensing of the seismic event parameters and the prediction of its effects. A real time prediction of the event very short time before it takes place is crucial for taking immediate actions to minimize its effects (see Need 2.4 below). This is defined herein as real time prevention of damage. Furthermore a real time prediction of the event's effects could make the crisis management much more efficient. Thus, this real time prediction supplies crucial data for Needs 4 and 5 below and is of supreme importance. Real time prediction consists of:

a. *Tsunami*: The 2011 Tohoku earthquake and subsequent tsunami took a toll of over 18,000 lives. Out of those, over 95% are attributed to the tsunami, mostly due to drowning. Hence, it is of much importance to develop real time prevention capabilities in the form of early warning systems and real time evacuation routes information systems against tsunami. In addition, such information could be very valuable for decision makers. For that purpose, real time prediction of tsunami and the expected regions to be affected, is required. Here, "real time prediction" means within a few minutes after the seismic event. This task could be divided to two sub tasks. One is related to an advanced measuring, where innovative and trustworthy technology that directly measures generated tsunami height should be developed. The other is related to a reliable analysis for prediction of the tsunami inundation. For that purpose, accurate geographical data is also required.

b. *Monitoring of individual buildings*: When severely shaken, structures may exhibit structural damage that may jeopardize their ability to resist aftershocks without collapse. Thus, the population often faces questions regarding whether or not one can stay in a building or should it be evacuated. To prevent evacuation of safe buildings, answers to such question are required within a few minutes. In the heart of large cities, that are often densely populated with thousands of people, such evacuation may lead to another disaster. This may also jeopardize the continuation of businesses that are financially crucial. In addition, data regarding the condition of these buildings is crucial for decision-making. For the sake of monitoring, more advanced sensing and monitoring technologies as well as theory for an immediate condition assessment and structural health evaluation are essential. Here, many sensors are required. Hence, the challenges are to develop low cost, handy and durable advanced sensors, as well as advanced theory. This research topic is not new. However, structural health monitoring in the discussed context requires much further research.

c. *Monitoring at the city block level*: For the sake of decision-making, means for condition assessment at the city block level should also be developed. One approach to attain such alternative means is by developing capabilities for an approximate, quick but meaningful, analysis at the city block level. For that purpose, a dense mesh of sensors to measure the ground motion history, hundreds of thousands of them, is required. Thus, inexpensive sensors are to be developed. This should be followed by development of structural analysis theory and application to allow approximate real-time simulation at the level of a city block. In addition, data of the building stock is also essential. Here, data sharing barriers in the form of privacy issues should be resolved. Furthermore, methodologies and tools are to be developed for automatic collection and digitization of such data to the level of detailed enough structural models in a reasonable time before the next big earthquake. This can rely on existing documentation as well as on new theories to automatically interpret the structural system based on digital photos, satellite images and alike.

2.4 Real time prevention

With real time prediction at hand, real time prevention could be made possible. Real time prevention refers here to early warning systems as well as shut down systems for functions where damage may endanger a large population (e.g. nuclear power plants, plants working with hazardous materials etc.).

2.5 Crisis management

The emergency resources available to mitigate extreme events are limited. Furthermore, efficient performance of one emergency entity relies on the actions of another. Thus, a well-coordinated collaborative effort of the different emergency entities is often required. In such cases, an efficient global crisis management is of much importance. The dependence of all entities on each other also makes crisis management much more complex. Hence, data, information and tools to assist crisis management are of much importance. Those could assist not only in managing resources, but also in the restoration of lifelines, utilities and medical services. To enable efficient crisis management and control capabilities, processed and interpreted data should constantly flow to the crisis management entities and to lifeline companies. To enable such data flow a few obstacles should first be overcome. Those are:

a. *Data sharing privacy issues*: Important data such as acceleration histories in privately owned buildings, lifeline state, merchandise supplies and more is privately owned. While such data is essential for efficient crisis management, privacy issues prevent its sharing. Such privacy issues should be removed and entities should be motivated to share data in times of crisis. This has been said many times but has not been applied to the extent required. Hence, a mechanism in which the different players consent to share data should be formed.

b. *Technical issues associated with the amount of data*: The amount of data to be shared is huge. This poses a technical issue associated with handling and sharing such mega-data. To allow that, efficient technology should be developed. This should be reliable in case of an earthquake. Furthermore, the essential data should be automatically identified and culled. In addition, efficient data saving formats should be developed. Finally, the data should be securely handled.

c. *Automatic interpretation of data*: The raw mega-data to be shared cannot be handled by people. Thus, automatic interpretation should be carried out to supply real time processed damage information, as well as resources information. For that purpose, theories and methods should be developed to identify the important pieces of information, to process those, and to complete the puzzle and present a clear map of the damage state, lifeline locations, supplies availability, population location etc.

d. *Decision-making support algorithms*: To further assist in managing the crisis, development of decision-making support algorithms should also be sought. Each emergency entity or lifeline company has its own policies, organizational structure and working methods. Thus, the developed algorithms should, at the first stage, be client oriented. At a later stage, interaction between lifeline companies should be considered. It should be the final goal to integrate all individual algorithms to enable a truly efficient crisis management.

e. *Collaborative effort of all entities*: To allow a truly efficient crisis management, new mechanisms to ensure collaborative effort of the different entities are required. This would also prevent duplicates of resource usage.

f. *Automatic information sharing with the public*: In case of a disaster, common media may be damaged or overloaded. Even so, sharing information with the public is of much importance. Hence, the development of communication technologies for such cases is needed. Furthermore, the information shared with the public should be condensed but meaningful. In this case, the position of the individual who seeks for information should be identified and the information should be location based.

2.6 Longer term recovery

In some cases the effect of the event is to the extent that a large population is moved from its residential area. Examples are washed away villages or nuclear affected areas. In these cases long-term strategies for rehabilitation of a community as a whole are required. This need requires research mostly on the political/societal side.

3. SUMMARY AND CONCLUSIONS

This paper presented research needs identified based on lessons learned from the 2011 Tohoku earthquake. First, the timeline of earthquake mitigation and recovery, as seen by the authors, was presented. Upon this timeline, important known research needs, where much research is still needed, were stressed. Additionally, important new research needs were identified.

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JOINT NATURAL AND TECHNOLOGICAL DISASTERS: AN EMERGING RISK ISSUE

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Abstract: Many countries have adopted regulations for prevention of chemical accidents during normal day-to-day plant operations. However, there is evidence that existing regulations may not be sufficient to prevent chemical accidents triggered by and concurrent with natural disasters (also known as Natechs) if the particular conditions associated with these types of events have not been factored in. This article provides an overview of Natech disasters, their characteristics, and the problems associated with Natech risk management considered as an emerging risk. It also provides some recommendations on strategies for Natech disaster risk reduction and points out future challenges.

Keywords*: Natech, chemical accident, natural disaster, risk management, emerging risk*

1. INTRODUCTION

Many countries have adopted regulations for prevention of chemical accidents during normal day-to-day plant operation. However, there is evidence that existing regulations may not be sufficient if the particular conditions associated with chemical accidents triggered by natural disasters, also known as "Natechs," have not been factored in. Natural hazard forces often act on large areas increasing the likelihood of multiple and simultaneous chemical releases from one or more sources. Thus, emergency response for Natech disasters can be particularly difficult because resources needed to attend to the natural disaster victims will have to be diverted to respond to the resulting hazardous materials (hazmat) problems. Furthermore, government agencies in charge of natural disaster preparedness often work separately from those in charge of chemical accident prevention, resulting in gaps in risk management and emergency response planning for these conjoint threats. This article provides an overview of Natechs, their characteristics, and the problems associated with Natech risk management as an emerging risk. The paper also discusses some recommendations on strategies for Natech disaster risk reduction and points out future challenges.

2. NATECH DISASTERS AND THEIR CARACTERISTICS

Natech disasters refer to natural disaster–triggered technological hazards or disasters. In this paper we are interested in technological hazards or disasters involving chemical accidents. The chemical accidents may involve releases in the form of toxic gases, liquid / oil spills, and fires or explosions from their containment vessels during and following a natural disaster. Furthermore, we are interested in damage to lifeline systems because they may impede or hamper a region's capacity to provide emergency response both to the natural disaster victims and to the chemical accidents themselves.

Natech disasters, as the word implies, may occur in areas subject to both natural and technological hazards. Highly industrialized and urbanized areas subject to earthquake, tsunami, flooding, and tropical cyclone hazards, among others, may be at higher risk of experiencing a Natech disaster. Thus, it is not surprising that the highest number of Natech events in the United States occur in the states of Louisiana, Texas, and California (Sengul et al. 2012) as Figure 1 shows.

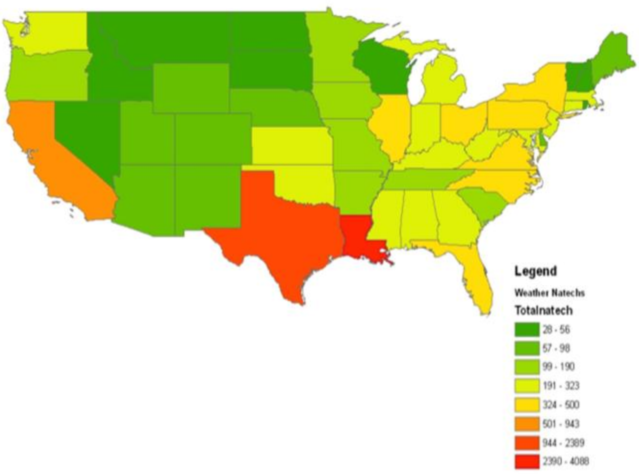

Fig. 1 Weather-related hazardous materials releases and oils spills in the United States in the period 1990-2008. (Source: Adapted from Sengul et al. 2012).

The enormous fires at an oil refinery in Kocaeli, Turkey (one of the country's largest), triggered by an earthquake on August 17, 1999, serve as an example of what can happen in highly urbanized and industrialized areas. The 7.4 magnitude earthquake triggered over twenty-one chemical accidents with off-site consequences to neighboring residential areas. The hazardous materials releases and fires threatened residents and nearby industrial plants storing anhydrous ammonia, liquefied petroleum gas, and ethylene, among other chemicals, posing an additional explosion hazard. Authorities were forced to order the evacuation of residents and emergency response personnel in at least two different municipalities less than twelve hours after the earthquake. The evacuation order resulted in the abandonment of search and rescue activities in both cities. Thus, search and rescue squads, as well as family and relatives of victims who are usually instrumental in carrying out search and rescue operations during earthquakes, were forced to leave victims behind, still trapped under damaged buildings and debris. Thousands of totally or partially collapsed buildings, electrical power blackouts, and shortages of emergency and rescue workers and equipment, compounded by hazardous material releases triggered by the earthquake, exceeded the government's and emergency planners' capabilities to respond to the event.

Such events are not limited to just one part of the world. Hurricanes Katrina and Rita in 2005 triggered hundreds of hazardous materials releases with harmful impacts to the surrounding communities and the environment in the U.S. Gulf of Mexico. In one case, more than 1800 homes were affected by oil spills in Chalmette, Louisiana, resulting in a class action settlement for US $330 million. Figure 2 shows the oil spill mark on an affected home after flood waters receded.

Fig. 2 Oil spill mark on an affected home in Chalmette, Louisiana, after flood waters from Hurricane Katrina receded. (Source: Author's photo)

Although the hazardous materials releases and oil spills from Hurricane Katrina and Rita received less attention, they nonetheless represented an additional burden on emergency responders and remaining residents, and affected the supply of much-needed fuel for emergency response purposes.

Awareness of the dangers posed by Natech disasters has increased. There is growing consensus that government officials, industrial facility owners/operators, researchers, and the public need to better understand the potential impacts of Natech disasters on urbanized areas and neighboring industrial facilities.

3. NATECH RISK MANAGEMENT AND EMERGENCY RESPONSE

Natural disasters not only trigger chemical accidents, they also hinder response to the hazardous materials releases. In the case of a Natech disaster, the elements for emergency response to a natural disaster such as an earthquake must be joined with those for response to a chemical emergency. In an article published in Natural Hazards Review, Steinberg and Cruz (2004) explain that emergency response for a Natech is unlike ordinary response planning for chemical releases for a number of reasons including:

- The need to respond simultaneously to the natural disaster and the hazardous materials releases.
- More than one release may occur nearly simultaneously as the natural disaster will have a forcing effect over hazardous materials storage throughout the stricken zone.
- Lifeline systems expected to be available (e.g., water, power, and communications) may not be, chemical safety personnel are likely to be preoccupied, and mitigation measures (e.g., safety control panels, foam systems) may not function as anticipated due to upset from the natural hazard.
- Cascading events are more likely to occur during a natural disaster than during plant operations under normal conditions because the natural disaster increases the likelihood of multiple, simultaneous failures. If not taken into account during the planning process, emergency response needs are likely to overwhelm response capacity.
- In addition, the response for the technological disaster will inevitably complicate the response to the natural disaster siphoning away resources, creating greater confusion among citizens and emergency personnel, and potentially reducing the capabilities of the natural hazard response effort.

These unique aspects of response planning for natural disasters in conjunction with technological disasters make Natech disaster risk management especially challenging.

There are various ways in which the risk of chemical accidents triggered by natural disasters can be reduced. These may include the following (Steinberg 2004):

- Design codes and standards
- Chemical process safeguards
- Combined natural hazard and chemical process safeguards
- Land use planning (including analysis of domino effects)
- Disaster mitigation and response planning

Steinberg (2004) observes that it is important to understand that these measures all help to reduce the threat posed by potential chemical releases to a certain extent but do not eliminate them entirely. Also, it is necessary to address each of these issues from the perspective of Natech risk reduction. For example, it is not sufficient to carry out a seismic assessment of the processes of a plant that handles hazardous materials if the potential for damage caused by falling neighboring equipment (that does not handle these materials) or severe shaking and vibration from neighboring structures is not considered. Civil engineers are called in to design and construct buildings and infrastructure to meet certain design wind-loads or seismic codes at an industrial plant, but another group of engineers and technical personnel is called in to construct metal storage tanks, piping and connections, and other accessories that may not comply with design codes.

Land use restrictions are generally set based on the potential target populations that might be affected if a release occurs, but the triggering by natural hazards is often neglected.

Although most countries have adopted regulations for chemical accident prevention and have taken steps to protect their infrastructure against natural hazard forces, these actions may not provide adequate protection if the particular conditions associated with conjoint events have not been factored in (Cruz et al. 2004). Cruz (2006) studied and compared Natech risk management practices in the United States, several countries in the European community, and Turkey and Japan. The author found that only a few countries have taken steps to prevent or prepare for Natech disasters. Although the federal regulations of the United States do not address Natechs explicitly, the state of California does require a seismic assessment as part of the California Accidental Release Prevention (CalARP) Program rule. Italy is addressing flood-related Natechs by looking at ways to prevent flood-triggered chemical releases and to reduce potential losses caused by flooding. In 2003 France introduced amendments to its environmental law to reflect lessons learnt from past flood-triggered chemical releases and other industrial losses. In Kocaeli, Turkey, industrial plant owners and managers, as well as local government officials, are well aware of the need to improve risk management practices to prevent Natech disasters in the future (Cruz et al. 2006).

4. STRATEGIES FOR NATECH RISK REDUCTION

In order to address Natech risk, there must be awareness that the problem exists and the factors that contribute most to Natech risk must be identified. Thus, one of the first steps to be taken by regions that are at some degree of risk to natural hazards and that are home to establishments that handle hazardous materials is to carry out some preliminary Natech risk assessment. Often, it is difficult to find the political will or support from policy and decision makers to do this. It is not surprising, then, that Cruz et al. (2006) found that education was one of the top key Natech risk reduction strategies based on a workshop carried out with participation of civil protection authorities and researchers from more than thirteen countries. They include the following:

a. Education and awareness campaigns aimed at educating the public, government agencies, and decision makers on the risk of Natechs and on the preventive and preparedness measures that can be taken to minimize risk.

b. Emergency planning specific to Natechs. This includes prevention and mitigation, and preparedness response planning for Natechs at all levels of government.

c. Public participation in Natech risk reduction planning. Natech risk reduction should incorporate (1) the local population's perception of the level of Natech risk and (2) the level of Natech risk they are willing to accept.

d. Modification of risk management regulatory requirements so that they specifically address the potential impacts of natural hazards at industrial installations.

e. Land use planning, as an important technique for separating residents from hazardous facilities.

f. Risk mapping, possibly tied to a centralized information database.

5. FUTURE CHALLENGES

In 2012, an international workshop on Natech risk reduction was organized by the Organization for Economic Cooperation and Development (OECD) in Dresden, Germany. There was agreement among workshop participants that the particular problems associated with Natech disasters are still not understood and therefore tend to be overlooked. There are several reasons for this, including the facts that (1) Natechs have been relatively rare events and (2) until now there was little information available on the interactions between natural and technological disasters. A few actions can be proposed to improve awareness and understanding of Natech hazards and their damage potential. These include the following:

a. Better recording, documenting, and analyzing of Natech events

b. Probabilistic mapping of Natech risks—this would allow the identification of regions most vulnerable to Natech hazards, and could be combined with spatial land use planning initiatives for Natech risk reduction.

c. More detailed studies on Natech risk management at regional and city levels.

d. Collection of data on social-economic losses due to Natechs to quantify the problem.

e. Development of simple, easy-to- use Natech hazard and vulnerability assessment methods.

Furthermore, the study of Natech disasters and Natech risk reduction requires bringing together people from various disciplines. Overcoming communication barriers among people working in very different contexts is of vital importance. Different hazard communities may think of risk differently and are influenced by various interests. Levels of education, priorities, and time frames differ among people from the academic community, civil protection authorities, social scientists, industrial risk engineers, emergency managers, decision makers, and government officials. It is important to overcome political, economic, and cultural differences in order to agree on acceptable levels of risk and the trade-offs people are willing to make in order to address Natech risk.

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FOSTERING PUBLIC AWARENESS OF DISASTER PREVENTION, THROUGH ARCHITECTURAL DESIGNING

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Abstract: Many people in Tanohata village, Iwate prefecture, which is one of the seriously affected areas by the tsunami on March 11th. 2011, could survive because of their knowledge inherited beyond generations. There used to be close face-to-face contacts in their daily life, which was brought by numerous experiences through former great tsunami in 1896 and 1933.

Keywords*: Tsunami, Memory, Inheritance, Disaster prevention, Architectural design*

1. PREFACE

Architecture as a mnemonic device

Information in a memory is preserved by being continually externalized. Memory in a person's brain disappears when that person dies, but the content of a memory can survive the death of the person if it has been transferred during his lifetime to the brain of someone else or preserved in external form such as a book. For the same reason a mnemonic medium external to the computer is indispensable to computerized information management. The genes of organisms are also transmitted from individual to individual through the repeated replication of DNA. Information concerning a species is preserved for generations.

Information in a memory can be maintained in a readily accessible condition only if it has been reproduced externally. It is precisely because knowledge and memory of the time have been externalized and survive in architectural form that historians can elicit centuries-old information from ancient architectural remains. We are able to surmise to some extent what people in the past thought from surviving fragments of objects, even if memory no longer exists in linguistic or pictorial form.

Architecture and the city are themselves enormous mnemonic devices of humankind. Today, it is not impossible to translate such information, even if it is enormous in amount, into electronic form, but there are limits to the scope of vision of someone trying to access that information or the amount of information a person can assimilate at any given time. The information that can be assimilated is apt to be only a small part of the whole. However, by actually walking through a building a person can observe the whole and the details at the same time and find clues for eliciting memories of the past.

/“Shuffled”, FURUYA Nobuaki, 2002

2. TSUNAMI IN TANOHATA VILLAGE

The coastal areas of Tanohata village have been seriously devastated by huge earthquake and tsunami at least three times in the past about 120 years. After those experiences people of Tsukuehama district, one of those areas for example, had decided to move their settlement to the upper hillside, so that they could avoid severe human suffering this time. Also in many other cases, most of the inhabitants could escape on the upland and stayed over night there to survive, because their elders were always warning that they must evacuate to the safer place “TENDENKO” in local words: one by one. It suggests us that we should inherit such important experiences and memories to mitigate disaster impact in the future.

Fig. 1 Location and damage in Tanohata Village /Ashahi Newspaper on 3.26.2011

2.1 Damaged districts in Tanohata

There are four major districts severely affected by the tsunami on 11th of March 2011 in Tanohata village: i.e. Tsukue, Akedo, Raga-Hiraiga and Shimanokoshi, mostly harbor district in a gulf and they all had been protected with coastal high levee.

The settlement in former two districts had been already replaced to the upland after two times of previous tsunami in 1896 and that in 1933. There had remained fisherman's huts as a temporary base for the fisherman from upland and used to be also a nice visiting spot for tourism in Tsukue coast before disaster. In Akedo beach also, there were no residents after previous disasters, and used to be a camping site with a lot of pine trees for tide prevention. Although those resources in both areas were completely lost, nobody there was lost.

2.2 Kept memories of former tsunamis

The latter two districts, bigger than the former two, had major ports, the coastal railway stations and many houses. In Shimanokoshi port district a part of elevated railway and a station building as well as all port facilities were demolished. More than 120 houses built on lowland were all swept out. There were two ports connected by a tunnel in Raga-Hiraiga district where was the biggest center of coastal areas in the village. There is a 10-storey hotel building that was affected by the tsunami up to third floor level. There existed many shops, cafeterias, guesthouses and private dwellings along a portside street, however all of those buildings on the lower site were totally abolished.

Even though there was a mount of severe physical damages, most of residents have survived fortunately, because they were all keeping in mind their elder's suggestion that they should rush to upland immediately after big earthquakes. There exists also a visible mark: a memory rock of former Tsunami, which says not to build houses lower than its height above sea level. Both of such invisible oral tradition and visible monuments work effectively to keep local residents aware of the dangers of tsunami in those areas.

Fig.2 Damge in Shimanokoshi

Fig. 3 Tsunami rock in Raga

3. POST-TSNAMI ASSISTANCE

All telecommunications on line, such as telephone, facsimile, and internet, had been interrupted for more than two weeks after disaster. We could finally make a contact with Tanohata village office on the 28th of March 2011 to know the damage situation and information about necessary assistance. On the next day, we set up the Tanohata-Aid project team in our laboratory, and proposed portable cardboard partitions for the shelter for evacuees in the community hall and the gymnasium designed by Prof. N. Hozumi of Waseda University and myself in 1980's.

3.1 The post-quake activities in Furuya laboratory

Our activities immediately after earthquake are as follows:

-3.11.14:46: The first earthquake occurred.

-3.11.15:26: Tsunami swept at the costal areas in Tanohata.

-3.28.evening: Received the first phone call, devastated situation turned up. Improvement of refuge life and mental care were required.

-3.29: Set up Tanohata-Aid project team in Furuya Laboratory, Waseda University. Asked our graduates a donation for supporting activities.

-3.30: Kickoff meeting of the project team.

-3.31: Recovered the internet communication with Tanohata.

-4.04: Brought detailed information of the devastated area by Prof. T. Soda of Waseda University.

-4.05: Second project team meeting. Sent our proposal for the partition in the shelter.

-4.09: Opened an account for donation, received no less than 1,000,000yen in amount within the first three days.

-4.12: Advance group departed by a truck with materials.

-4.13-15: The first relief group arrived at the devastated area in the village.

-4.28: Called the 1st. Recovery planning committee by the village head.

-5.02-04: The second relief group visit. Improved the booth, and manufactured and delivered small tables.
Visited candidate sites for reconstructing new settlements.
Discussed with Prof. S.Miyake of Iwate University.

3.2 The first visit on site

We made the first relief visit during 13th to 15th of April and demonstrated a temporary booth for privacy in a shelter. People welcomed to have a private space in the beginning. On the other hand, they were reluctant to split completely each individual booth for families. The reason why they didn't want to be separated is that they had already lived with daily face-to-face communication for more than one month since disaster. Then we proposed and we were accepted to build several temporary booths for sick person, children's learning or women's dressing room, etc. The booth itself was made of reinforced cardboard, paper tube and vinyl curtain, which could be built quickly by two persons. Checkered pattern layout makes space double.

Fig. 4 Proposal of cardboard partition

People's response not to build whole partitions meant that it was more important to keep their daily communication rather than complete privacy, especially in uneasy days.

Fig. 5 Built temporary booths and cubbies

Fig. 6 Personal space in the shelter

3.3 The improvement of shelter life

The second relief group visit was held during 2nd to 4th of May, cooperated by interior designer K. Fujie and textile designer Y. Ando. Because we had a lot of cardboard materials left, we made folding exhibition screens with them for lost photographs found and washed by volunteers. There were some more elements to be improved, for instance, a place to eat or noise and touch of vinyl curtain. We made several prototypes of small table, and asked people's request: of which size, how many and how finished, etc.

Fig. 7 Request of small tables

Someone wanted bigger table, because she had a big family, and another one needed a square one but with round corner for small kids. We made those tables on their own requests and delivered them instantly. Table delivery assistance was delighted by the people, and they could enjoy meals on them. It was quite obvious that they could never argue their own preferences, and the shelter life was so stressful. Although fine and detailed personal response was seriously needed, it used to be almost impossible. The vinyl curtain was making noise when opening or closing it, and it was stiff and uncomfortable when touching it by hand. So, we changed the material of the entry curtain to very smooth and translucent organdy instead of white vinyl sheet. Even during a temporary stay in the shelter, people need comfortable life as much as possible, because it is a place to live, nothing else at that time. It last actually for four to five months.

Fig.8 Organdy curtain for entry

Fig.9 Improved temporary booths

4. PROPOSAL FOR NEW SETTELMENT

During the second visit, the village head asked me to help their recovery project making. We began to make a research on possible sites for the new settlement of the devastated people. Generally and traditionally in Tanohata area, they have moved to upland after big tsunami disasters. There is a big difference in height between costal districts and flat terrain on the Sanriku Rias: 100 to 150m ca. because of the intricate coastline of rias, the strong wave of tsunami often reaches deep inside land from the sea shore. Both in Shimanokoshi and Raga-Hiraiga, about 2/3 of the houses of each districts were washed away. Majority of those people hopes to go upside, however there are 1/3 of the houses not affected still remained. The local government faced a serious problem to reconstruct their settlements. It was pressing issue to investigate the people's intention in both areas.

Fig. 10 Map of candidate sites for the new settlements of Raga-Hiraiga district

4.1 Comparative research on candidate sites

We picked up two of the large upland sites and five small sites near the existing houses for Raga-Hiraiga district, and two in upland and four in nearside for Shimanokoshi district. Those sites were possible candidate for their new settlements to be shown to the affected residents. We made the comparative lists with advantages and disadvantages for their consideration and their choices.

Fig.11 Analysis on each site

Through the residents' response, the local government has selected final candidates for construction among those sites.

4.2 Proposal for the new settlement design

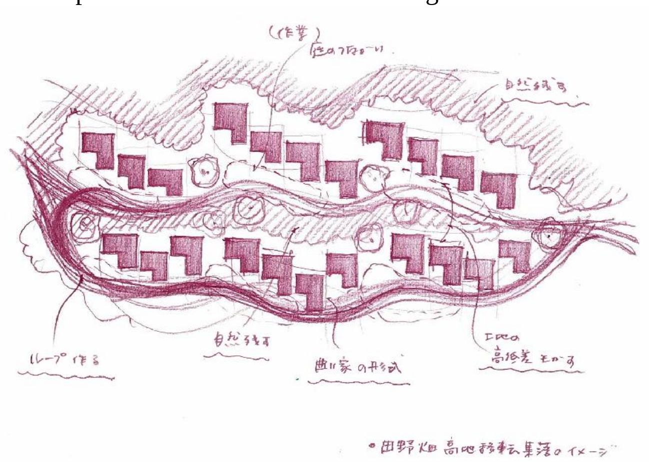

Fig.12 Proposal for the new housing plot

For fisherman's daily life on the coast, they need a working place in front of their houses as well as a small vegetable field for their own use. So, we proposed "MAGARIYA": L-shape house with such outdoor spaces connecting each other. The residents will be able to have face-to-face daily communications. The land making itself must be not in normal way but in topographical way on the natural slope.

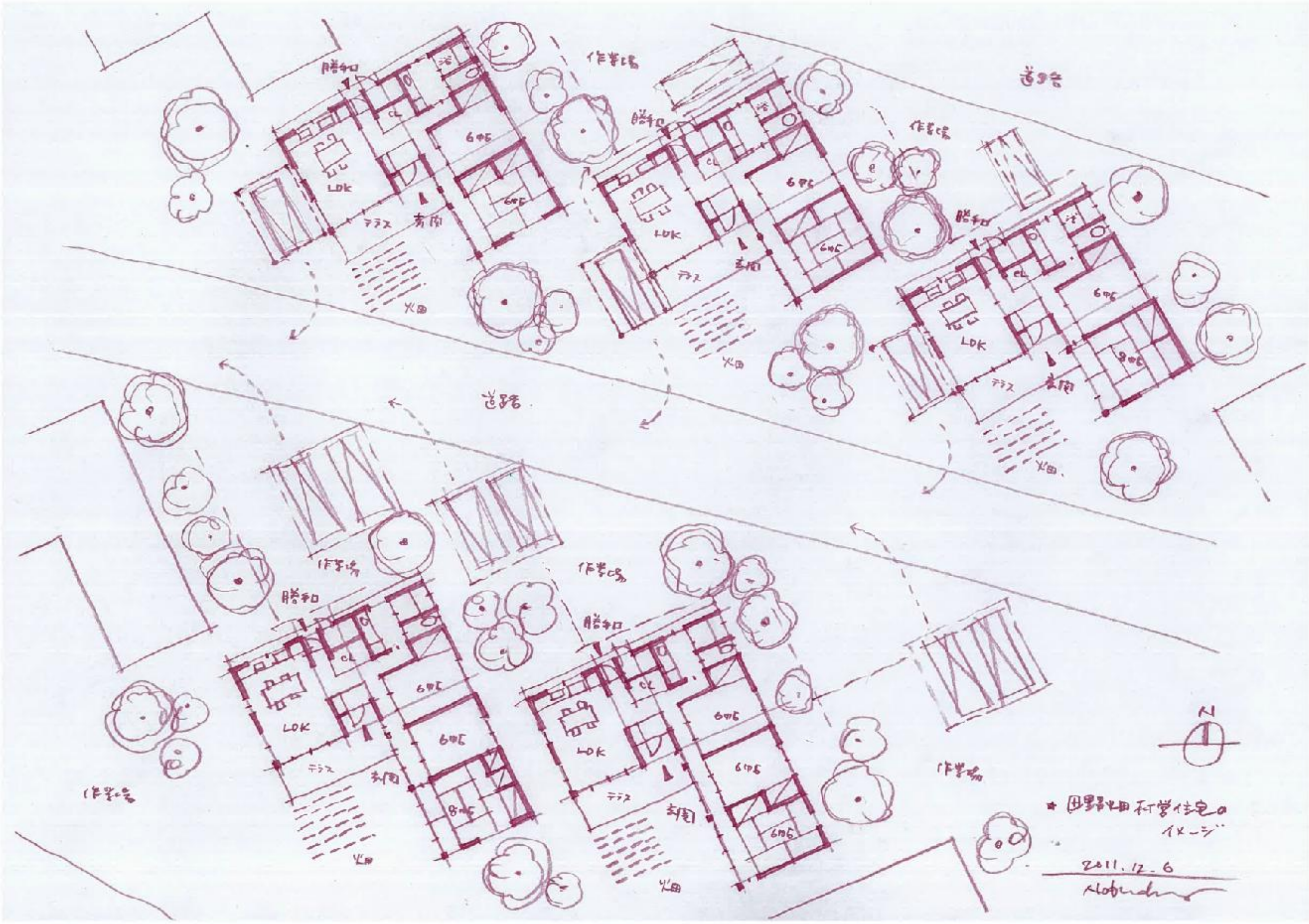

Fig. 13 Proposal for the new housing layout and plans

Fig.14 Model for the presentation

Fig.15 L-shape public housing (under construction)

We made an image of the new public housing and a model for presentation. Those materials were demonstrated in the community meeting hall of the temporary housing where the affected residents are staying. Finally the village head decided to construct over 50 public houses with this scheme, and ordered us to collaborate as a design architect with a housing consultant. We made a schematic design and some working drawings, and supervised the construction. The first houses were completed in July 2013. The residents all from the same Raga-Hiraiga district are living in those houses after two years of inconvenient temporary dwelling.

4.3 Conclusion

Not only the physical prevention but also the public awareness of disaster prevention will be practically effective. To foster such awareness in common, it is quite important to make an appropriate settlement design that enables the residents easily communicate each other in their daily life. Memories and experiences must be inherited beyond generations to save their/our own lives. Preventive measures just for emergency will not work effectively in case of real emergency. Built environment design can be our mnemonic device for the future.

THE 8TH JOINT INTERNATIONAL SYMPOSIUM ON DISASTER RISK MANAGEMENT

Organizing Committee Members:

Toshimistu Komatsu
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