Initial Report

International Research Institute of Disaster Science (IRIDeS)

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"IRIDeS Fact-finding missions to Philippines"

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INITIAL REPORT of IRIDeS Fact-finding mission to Philippines

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Contents

1. Executive Summary

Super Typhoon Haiyan, called Yolanda in the Philippines, devastated the Eastern Visayas and part of the Central Visayas on November, 8, 2013. Haiyan caused over 7,000 casualties, displaced over 4 million people, and damaged or destroyed over 1 million houses due to remarkably high wind speed, storm surge and large waves.

The International Research Institute of Disaster Science (IRIDeS), at Tohoku University in Sendai, Japan dispatched several investigating teams from December, 2013 through March, 2014 to gather information from governmental, hospital and research organizations in Manila. In addition, the teams assessed damage in several areas on Leyte and Samar islands with local counterparts. The name of the mission was the "IRIDeS fact-finding mission," and the IRIDeS survey team consisted of 4 teams; 1) Hazard and Damage Evaluation team, 2) Warning and Evacuation Assessment team, 3) Disaster Medical Science team, and 4) Disaster Recovery team.

The Hazard and Damage Evaluation team first conducted the damage interpretation using satellite images in order to identify severly damaged areas and to provide important information to focus the activities for the on-site field survey (**Chapter 3**). This kind of rapid damage assessment can contribute actively to emergency response and relief effort allocation and management when disasters impact a large area. In addition, a numerical simulation of the storm surge and large waves using Delft-3D and SWAN with a parametric hurricane model was promptly conducted for Leyte and Samar Islands in order to understand the magnitude and features of surges and waves induced by Haiyan (**Chapter 4**). From the simulation results, it was found that the water levels were dominated by wind-driven storm surge near Tacloban and by waves in eastern Samar.

During the on-site survey in Leyte and Eastern Samar on January 16 – 24, 2014 (**Chapter 5**), inundation heights of storm surges and large waves were measured, and a detailed inundation map in Tacloban was developed, mainly based on local interviews with eyewitnesses. For example, storm surge heights up to 6 m were measured near the shoreline in Tacloban and wave runup of up to 12 m were measured in Eastern Samar. In addition, typical damage to houses and seawalls by strong wind, storm surge and high waves in Leyte and Eastern Samar were investigated throughout the survey. Based upon the initial analysis and on-site survey, several problems and recommendations are presented in this report. Data analysis and numerical simulations are still ongoing.

The Warning and Evacuation Assessment team aimed at examining and recording evacuation behavior and information notification in the area affected by Haiyan. A questionnaire survey in Tacloban city and Palo and Tanauan municipalities on Leyte Island was implemented from March 14, 2014 to March 22, 2014 and in total 642 samples were taken. The survey shows that the ratio of evacuation away from home was about 70%. Patterns of evacuation behavior differ with location, gender and age. Although all survey sites are located in the same coastal area, preliminary analysis shows that reasons and clues for evacuation are different at each site.

The Disaster medical science team investigated the immediate medical and public health response, domestic and international medical aid, outbreak of infectious diseases, psychosocial problems and mental health of the affected people in collaboration with medical and public health researchers in the Philippines, WHO, the Department of

Health and others to promote collaborative research and publicizing of the results. According to the geographical mapping of the possible hospitals and health related facilities in the affected area, individual visits to health facilities and interviews were very effective for understanding the structural, non-structural and functional damage of health related facilities. They observed the sanitary and health condition of the affected people and also visited international humanitarian assistance agencies. They established and extended the collaborative relationships between IRIDeS and San Lazaro Hospital, DOH, WHO and WPRO, Univ. Philippines Manila and Angeles Univ. to exchange information and knowledge about disaster medicine and public health. They shared their experience of the Great East Japan Earthquake and made recommendations at DOH in a technical discussion to establish safe hospitals as a building last standing in a disaster.

Research on post-disaster recovery needs to track several areas affected by the typhoon in the Philippines for a long time. The Disaster Recovery team organized three groups according to timing of surveys and topics. The first group was in charge of data acquisition necessary to understand the social context of the Philippines, to study long-term recovery phenomena, and to obtain basic information. They obtained statistic data, maps and geospatial data from the Government for IRIDeS's study. They also conducted field surveys, including building damage records and interviews of affected people and local governments, in Daanbantayan in Cebu, and in Basey on Samar Island. Although some analysis of building damage is in progress, several regional specific problems facing recovery were clarified by the surveys.

The second group conducted a collaborative field survey between UCL-IRDR and Tohoku University-IRIDeS four months after the typhoon. Interviews and accompanying structural engineering surveys of the respondents' dwellings were conducted for 160 households in 12 coastal barangays. Regarding evacuation, the system of using barangay leaders to disseminate warnings appeared successful in terms of reaching people, although in many cases the severity of the storm surge was underestimated. Almost all interviewees knew about the 40m no-build zones, but this policy does not reflect variations in hazard associated with variable coastline topography. Those within these zones seemed to have little idea about relocation plans while most households outside these zones wanted to stay in place. It appears that cash distributions from an NGO, despite likely causing price inflation, were useful in allowing the purchase of reconstruction materials. Property insurance is sparse in the Philippines and the surveys highlighted the lack of awareness about it. More than half of the temporary shelters examined were built without the aid of professional advice or help leading to people living in precarious, makeshift conditions. Therefore, training programs are needed in the early stages of the transitional phase of recovery to ensure lower vulnerability to future natural disasters.

The third group emphasized to investigate community resilience, to a lesser extent, issues on post-disaster planning and policies, as well as roles that NGOs and private firms have played. The group held various interviews with national and local government officers, Civil Society Organizations (CSOs), the private sector, community (Barangay) leaders, and local residents, in the cities of Tacloban and Ormoc, where the major causes of devastation were storm surge and strong wind, respectively. Intervies were also held in Manila. Key findings from reconnaissance include: i) Land use along the seashore has been seriously discussed after typhoon Haiyan, and local governments are planning land use measures to reduce risk, including relocation of communities. Yet, the opportunity to achieve this goal is decreasing as time proceeds; ii) an innovative disaster management act named "the Philippines Disaster Risk Reduction and Management Act of 2010" has not yet nurtured the disaster management capacity of local governments in practice. However, the role of Philippines-based stakeholders, including national and local CSOs as well as the private sector, has been important in disaster response and mitigation; and iii) Barangays, as the smallest administrative body, have sufficient ability to respond to and recover from smaller disasters. However, the impact and the scale of typhoon Haiyan were overwhelming to infrastructure, and as a result, local communities were devestated.

The results of these fact finding surveys are presented in this report. Priority proposed activities for investigating the disaster caused by Typhoon Haiyan are listed below.

1. A rapid response Task Force Team is formed within IRIDeS

2. The Task Force Team will consider conducting the following activities:

1) Setting clear objectives and deliverables of the Task Force Team and giving assignments to each Division Chief and volunteer
2) Gathering information on the identified subjects and setting up a website to share information within IRIDeS and beyond
3) Dispatching research missions to the affected area to gather on-site information for better analysis and provide useful guidance to the authorities and communities
4) Publishing IRIDeS reports based on the findings of the Task Force
5) Sharing lessons learnt from the disaster in an international symposium

3. Proposed subjects to be pursued and confirmed by IRIDeS researchers are as follows:

1) Hazard perspective: investigation of storm surge, flooding, landslides, and wind.
2) Structural and engineering perspective: survey of buildings damaged by storm surge and strong wind
3) Non-structural measures: early warning system, public awareness and education.
4) Social, human and behavioral perspective: impacts on socially vulnerable communities including illegal settlements, gender and other social issues, review of evacuation and shelter options, management of shelters.
5) Environmental perspective: land use.
6) Public health and medical perspective: epidemiological survey of victims, management of transmittable diseases, mid-term to long-term medical assistance, psychological impacts.
7) Economic perspective: investigation of damages and losses, recovery processes, business continuity plans.

8) Others

4. Interaction with exchange students from the Philippines

5. Jointly organize supporting events

2. Summary of Typhoon Haiyan

A powerful tropical cyclone, named as Typhoon Haiyan, struck some areas of Southeast Asian countries. The Philippines was one of the most affected regions due to high winds and storm surges. Thousands of people are feared dead or missing after Typhoon Haiyan swept across the central Philippines on November 8, 2013. The details of Haiyan are described below.

2.1 Track of Typhoon Haiyan

According to the National Disaster Risk Reduction and Management Council (NDRRMC), at 4:40 am on November 8, 2013 at Philippine time, Haiyan made its first landfall over Guiuan, Eastern Samar with the maximum wind speed of 125 kt and central pressure of 895 hPa (Category 5 on the Saffir-Simpson Hurricane Scale). Haiyan kept the same maximum wind speed and made the 2nd landfall over Tolosa, Leyte at 7:00 am and its 3rd landfall over Daanbantayan, Cebu at about 9:40 am. At 10:40 am, Haiyan made its 4th landfall over Bantayan Island, Cebu and by 12:00 its 5th landfall over Concepcion, Iloilo. In the afternoon, it maintained its strength as it approached the Calamian Group of Islands, and it made its 6th landfall over Busuanga, Palawan at 8:00 pm. Haiyan weakened as it continued to traverse over the West Philippines Sea. **Fig. 2-1** shows the track of Haiyan at the Philippines local time: UTC + 8 hrs (Unisys Weather, 2013). **Fig. 2-2** shows the track of Haiyan in a large domain with the time series of the central pressure (NII, 2013). A rapid decrease of the central pressure of Haiyan can be seen from **Fig. 2-2**.

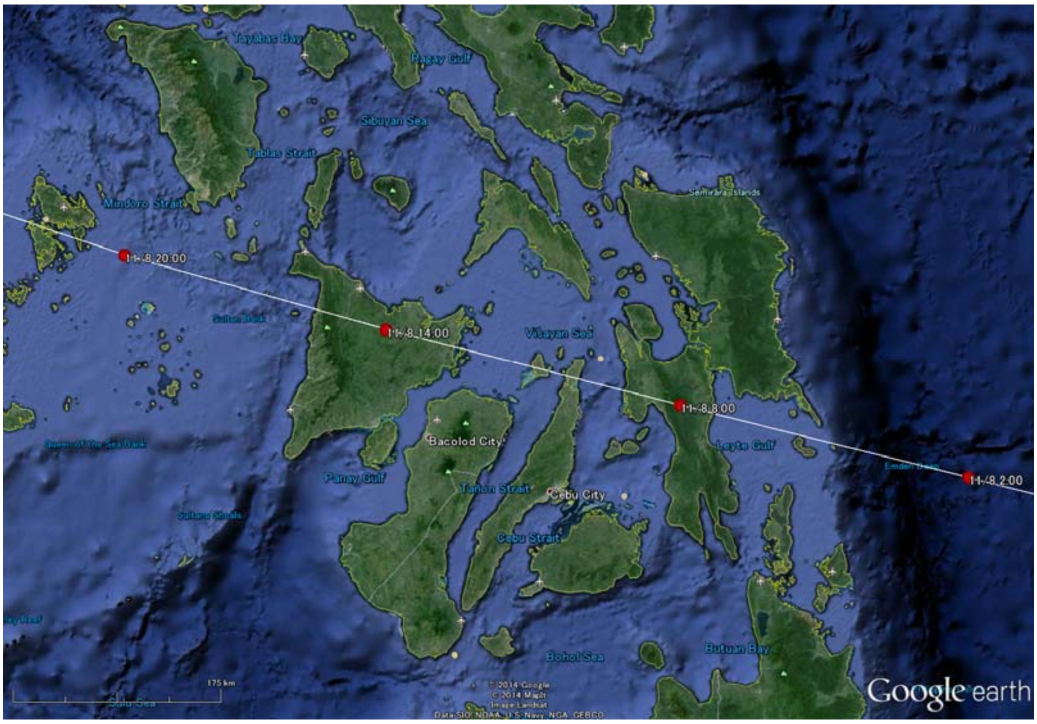


Fig. 2-1. Track of Haiyan shown by white line and red circles (Google earth). The time indicating along the track is based on the Philippines local time (UTC + 8 hrs).

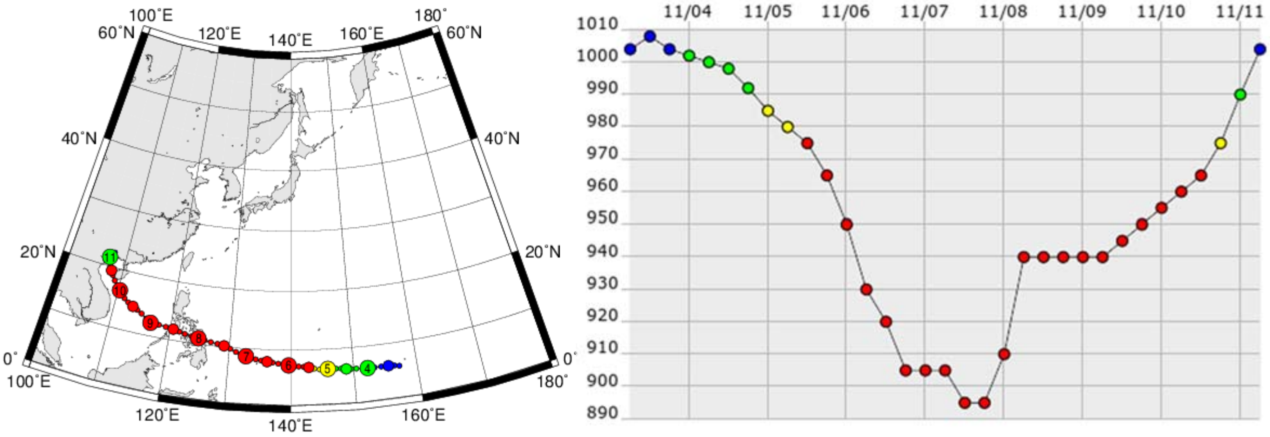


Fig. 2-2. Track of Haiyan (left) and time series of the central pressure of Haiyan (right), UTC (National Institute of Informatics [NII], Digital Typhoon: Typhoon 201330 [Haiyan]).

2.2 Ground observations

Fig. 2-3 shows the time series of the observed wind speed and mean sea level pressure at Tacloban weather station in Leyte and Guiuan station in Eastern Samar. The data was provided by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). The rainfall data is also measured at Tacloban station. The landfall time is around 8:00 am in Tacloban and 5:00 am in Guiuan on November 8. A rapid increase of wind speed and rainfall and a decrease of mean sea level pressure toward the peak landfall time can be clearly seen from **Fig. 2-3**. It should be emphasized that the observation equipment was totally destroyed due to the high wind and/or storm surge inundation and data recordings stopped around the peak time, so that the observation may have missed the peak values of the wind speed and pressure. These incidents prove that the wind speed on the ground and storm surge were enormously strong during the Haiyan event.

Fig. 2-4 shows the time series of the predicted astronomical tide at Tacloban and Guiuan. The data was also provided by PAGASA. The tide levels are based on the average mean sea level. It is noted that the tide level data at Tacloban in **Fig. 2-4** is based on the linear interpolation of the predicted peak tide level data. It can be seen from the figure that the tide level was not so high during the landfall of Haiyan. If the landfall had occurred during the high tide, the damage by storm surges and high waves would have been more serious.

Fig. 2-5 shows 24-hr rainfall depth during the Haiyan event (13:00, Nov. 6 – 12:00, Nov. 9, UTC) over the Philippines obtained from GSMaP data (JAXA). GSMaP (e.g. Kubota et al., 2007) developed by JAXA is based on satellite-derived rainfall data. From this figure relatively high 24-rainfall more than 150 mm was observed in several regions during the Haiyan event. These heavy rainfalls may have caused flooding in rivers and landslides in the mountainous regions. However, it should be noted that satellite-driven rainfall data provided by GSMaP may have some uncertainties and biases.

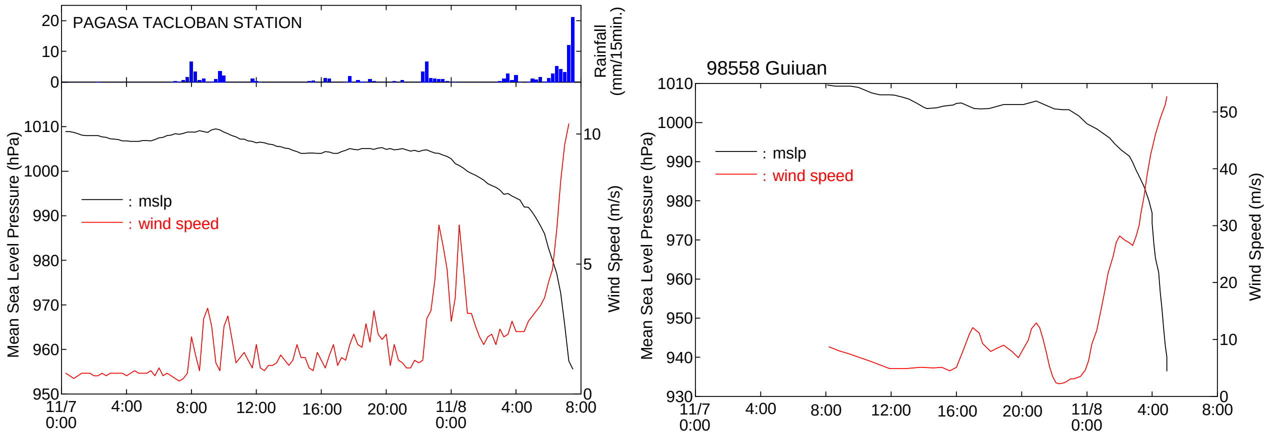


Fig. 2-3. Time series of wind speed and mean sea level pressure at Tacloban station in Leyte Island and Guiuan station in Eastern Samar from 0:00 on November 7 through 8:00 am on November 8.

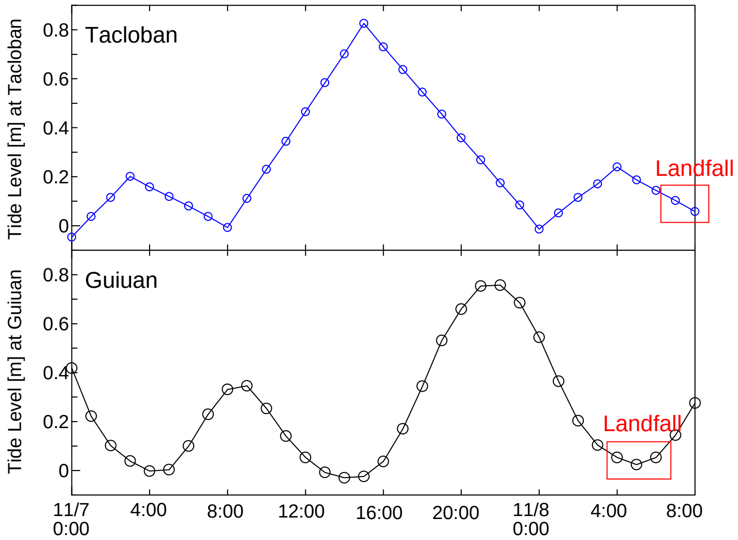
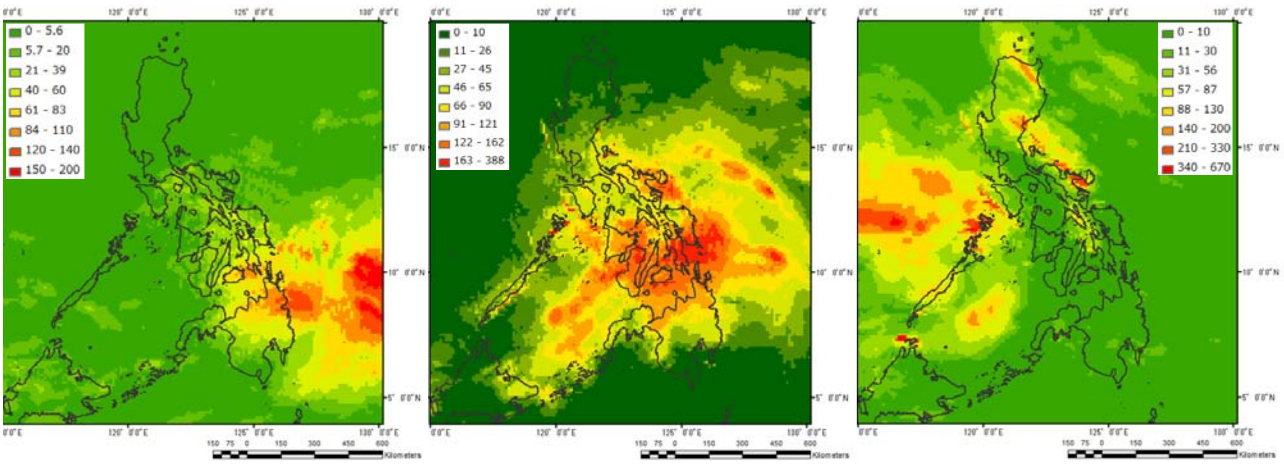


Fig. 2-4. Time series of the predicted astronomical tide level at Tacloban and Guiuan from 0:00 on November 7 through 8:00 am on November 8.



13:00, 11/6 – 12:00 11/7 (UTC) 13:00, 11/7 – 12:00, 11/8 (UTC) 13:00, 11/8 – 12:00, 11/9 (UTC)

Fig. 2-5. 24-hr rainfall depth [mm] during the Haiyan event over Philippines obtained from GSMaP data.

2.3 Summary of Damage

Haiyan caused massive damages in Philippines. As of 6:00 am on March 14, 2014, 6,268 individuals were reported dead, 28,689 injured and 1,061 are still missing. A total of 3,424,593 families (16,078,181 persons) were affected in 12,139 barangays in 44 provinces, 591 municipalities and 57 cities of Regions IV-A, IV-B, V, VI, VII, VIII, X, XI, and Caraga in Philippines. The number of damaged houses was 1,140,332 (550,928 totally and 589,404 partially). The total cost of damage is PHP 39,821,497,852.17 with PHP 19,559,379,136.11 for infrastructures and PHP 20,262,118,716.06 for agriculture in Regions IV-A, IV-B,V,VI, VII, VIII, and CARASA (NDRRMC, 2014).

Especially, human casualties in Tacloban city and Palo and Tanauan municipalities of Leyte were very high. The locations of those places and DEM of Leyte and Samar are shown in **Fig. 2-6**. The number of deaths and missing people are 2,603 in Tacloban, 1,101 in Palo and 859 in Tanauan (as of February 25, 2014) according to the information provided by each municipality. It means that more than 60 % of human casualties from Haiyan were concentrated in those 3 cities in Leyte. **Fig. 2-7** shows the population, the number of deaths and missing people due to Haiyan and fatality ratio [%] in each barangay in Tacloban, Palo and Tanauan of Northern Leyte Island (Kure et al., 2014). A barangay is the smallest administrative division in the Philippines. Barangays with more than 10 % of the fatality ratio can be found along the coastal zones in three cities, and the damage clearly indicates the massive external force of the storm surge during the Haiyan event and the vulnerability of those coastal areas.

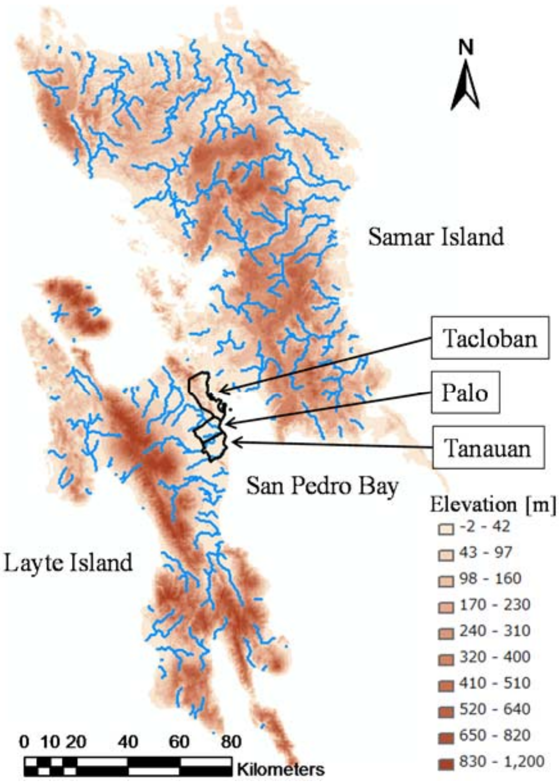


Fig. 2-6. Locations of Tacloban, Palo and Tanauan and DEMof Leyte and Samar Islands.

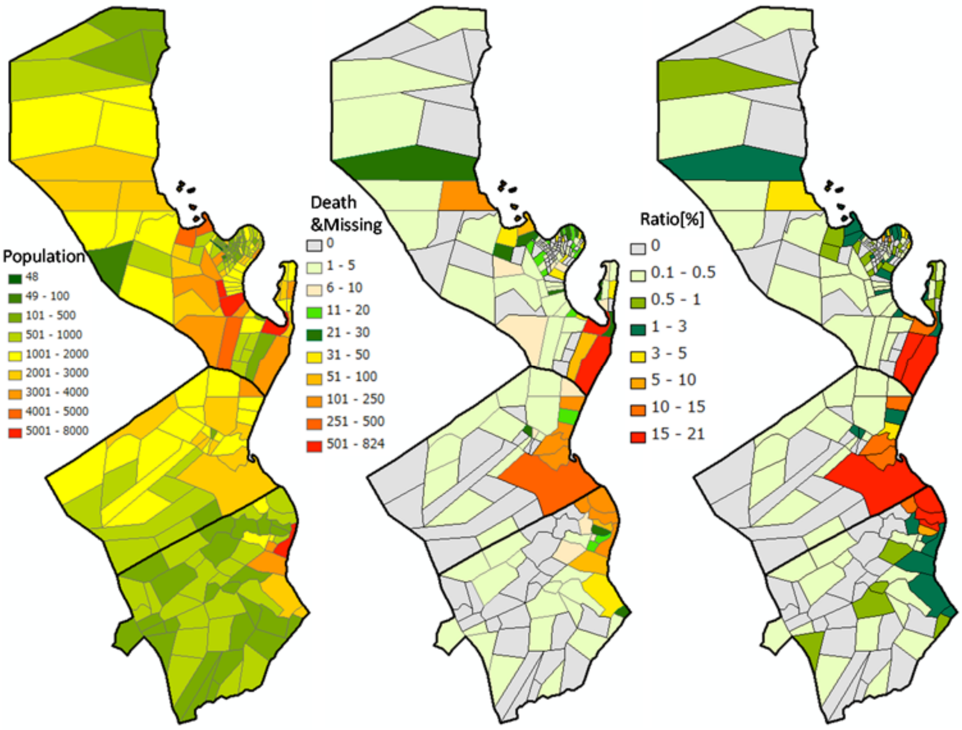


Fig. 2-7. Population (left), number of deaths and missing people (middle) due to Haiyan and fatality ratio [%] (right) in each barangay of Tacloban, Palo and Tanauan (Kure et al., 2014).

2.4 Evacuation Warning

Warning Record

A tropical storm spotted over the Caroline island in the Pacific Ocean on November 4 and it was named as Haiyan at 8:00 am at the Philippines local time. PAGASA officially announced the Weather Advisory #1 as the warning of Haiyan at 11:00 am on November 5. The Joint Typhoon Warning Center (JTWC) assessed the system as a Category 5 super typhoon on the Saffir-Simpson hurricane wind scale on November 6. Accordingly PAGASA upgraded the warning to the Sever Weather Bulletin #1 at 11:00 am on November 6. The Japan Meteorological Agency (JMA) estimated the system's one-minute sustained winds to 315 km/h and gusts up to 378 km/h at 3:00 am on November 7. At 11:00 am, PAGASA announced the Sever Weather Bulletin #3, warning that the storm surges might reach up to a 7-meter wave height in the coastal areas of Eastern Samar, Samar, Leyte and Southern Leyte in Visayas. Then, as explained in **Section 2.1**, Haiyan made its first landfall over Guiuan, Eastern Samar with the peak intensity at 4:40 am on November 8. President Aquino declared the state of "National Disaster" from the damage of Haiyan on November 11.

It should be emphasized that PAGASA estimated and warned the 7-meter wave height in the coastal areas with the leading time of about 18 hours before the first landfall in Guinuan. This estimation was based on the numerical simulations technically supported by the JMA and historical records of the waves that PAGASA has. It was found from the survey after the Haiyan event that the estimation of 7 m wave height of PAGASA was appropriate, and the storm surge of about 6 m high attacked Tacloban city in Leyte.

Disaster Information Transfer System

A disaster information transfer system in Philippines is shown in **Fig. 2-8** (Miyamoto et al. 2014). The figure was provided by Dr. Mamoru Miyamoto (International Centre for Water Hazard and Risk Management [ICHARM]). Disaster information from PAGASA is transferred to the NDRRMC, National Media, and the public departments concerned such as the Department of Public Works and Highways (DPWH). The NDRRMC transfers the information to the Barangay through the Regional, Provincial and Municipality Disaster Risk Reduction Management Councils (DRRMC). Then, the disaster information is conveyed to a house to a house in local barangays. As explained in the previous section, PAGASA warned the 7-meter wave height in the coastal areas before the landfall. Thus, it is important to assess whether this information transfer system worked well or not during the Haiyan event and how long it took for the houses to receive this disaster information.

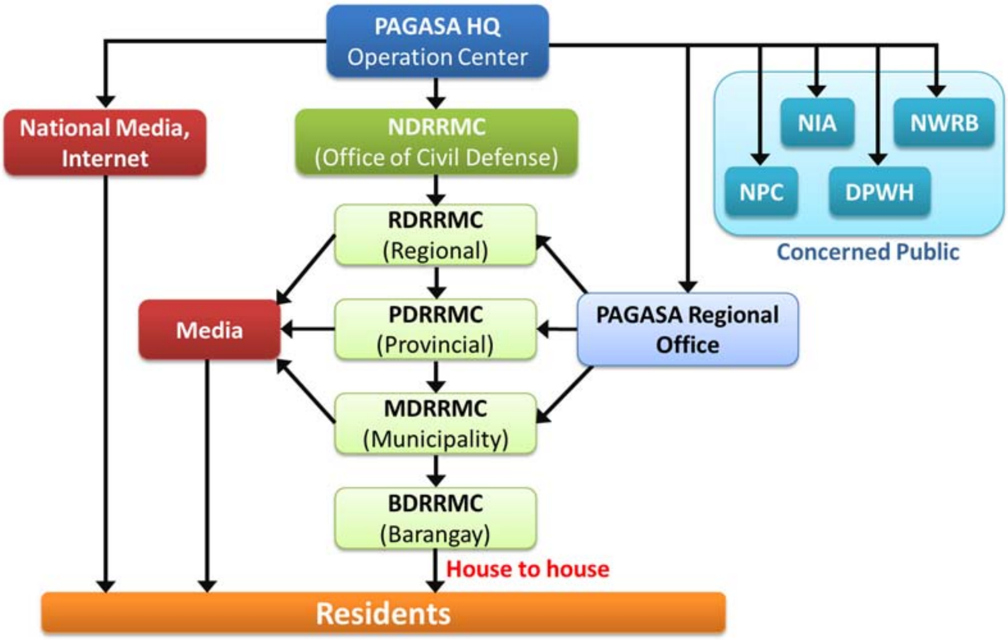


Fig. 2-8. Disaster information transfer system in Philippines (Miyamoto et al., 2014).

Problems for Evacuation

Several problems related to the evacuation to prepare for Haiyan were found through the on-site survey and local interviews by the IRIDeS team, as discussed in later chapters. Main problems were lack of education, poverty and inappropriate evacuation facilities. It is a famous story that many people did not understand what a storm surge is. During the local interview by the IRIDeS team, many people claimed that they did not understand the meaning of the storm surge that was used in the evacuation warning from PAGASA and local DRRMCs. They also claimed that if the warning had been made by using the word "tsunami," they would have evacuated. This incident clearly indicates the importance of disaster education.

Another problem is the poverty. Young strong men had to stay in their houses during the Haiyan event in order to protect their properties from being stolen by somebody during the evacuation. This kind of social problem should be seriously considered by the government, and some kind of insurance system or a guarantee system from the government should be discussed.

It is also a famous story of Haiyan that the evacuation facilities were not appropriate against the storm surges and enormously strong wind. For example, the Tacloban City Convention Center in Tacloban is located near the coastline as shown in **Fig. 2-9** (left). About a thousand people evacuated to the center, and the center was inundated by the storm surge induced by Haiyan. Again, this incident shows the importance of disaster education. Another example is the Leyte Convention Center located in Palo. About 400 people evacuated to this center but this center was completely destroyed by the strong wind as shown in **Fig. 2-9** (right). It was very fortunate that nobody died from Haiyan in those centers because people who evacuated to the Tacloban City Convention Center could escape upstairs after the center began to be inundated by the storm surge, and those who went to the Leyte Convention Center could evacuate to another facility before it collapsed. We confirmed this with local offices. For future typhoons, evacuation facilities should be evaluated and selected considering their strength and appropriateness. However, the population of Tacloban is more than 200,000, so that it is not easy for the government to provide appropriate evacuation facilities for all the people living in Tacloban.

Fig. 2-9. Tacloban City Convention Center in Tacloban city (left) and Leyte Convention Center in Palo city (right).

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3. Initial damage mapping by satellite images

3.1 Rapid Damage Assessment

Introduction

After the impact of Super Typhoon Haiyan to the coast of Tacloban city, a set of satellite images was obtained to grasp the extension of the damage using visual interpretation of pre- and post-event satellite optical images. Satellite imagery has been used to assess the extent and level of damage in areas with limited access and on need for support and quick emergency response (Wegscheider et al., 2013).

Manual visual interpretation method was used following the first steps described on the methodology to develop tsunami fragility functions (Koshimura et al., 2009; Suppasri et al., 2011; Mas et al., 2012). It is one of the most accurate methods when using very-high-resolution (VHR) imagery (Wegscheider et al., 2013).

Satellite Image Data

The pre-event data used for the damage interpretation was obtained directly from Google Earth, retrieved by November 8, 2013; while the post-event image was acquired on November 13, 2013 through Digital Globe in Google Earth. A zoom into the Anibong area in Tacloban city is shown in **Fig.3-1**.

Methodology

For the visual inspection we classified the damage interpretation into two levels according to the following criteria:

a. High damage or destruction. Here, roofs that had been reduced by more than 50% between pre- and post-event images are included together with structures that had been washed or blown away.

b. Low damage or survival. These are structures where only a small variation on its geometry or roof shape could be observed. Structures in areas near the coastline where flood was expected are also considered into this classification of low damage and survival.

Results and discussion

Fig.3-2 shows the area of Tacloban city and the damage interpretation resulted in this area. As shown in the figure, the areas to the north and the south near to the coastline presented high damage, while the center of Tacloban, the downtown area was less damaged by the winds or surges in comparison.

Following the remote sensing approach, the field survey observations confirmed qualitatively the damage in these areas (Mas, E. et al., 2014). Reasons for the distribution of such damage in the areas were confirmed during the field survey and can be summarize as follows:

a. The structures to the north and to the south of downtown Tacloban city were built based on lightweight material and very near to the shoreline. Thus, high vulnerability to wind and storm surge was confirmed. Structures in downtown Tacloban are mainly of concrete frame buildings and brick walls with corrugated galvanized iron sheets for houses with one or two stories.

b. The topography of downtown Tacloban is higher at some points compared to its northern and southern areas. In addition, to the north, in the Anibong area, following the low-lying flat area a immediate steep slope could be observed. This slope might have caused refraction of waves and wind damaging and triggering slope failures.

c. At the Anibong area, ships were found stranded inland. The storm surges carrying these ships inland caused more damage to the urban settlements.

Conclusion

The damage interpretation using satellite images provided important information to grasp the damage in the areas and, in our field survey team case, focus the activities for our field survey. A rapid damage assessment such as the one developed here can contribute actively to the emergency response and relief effort allocation and management when disasters impact on wide areas.

Fig. 3-1. Close view of the Anibong area in Tacloban city from pre- and post-event satellite images used on the visual damage interpretation.

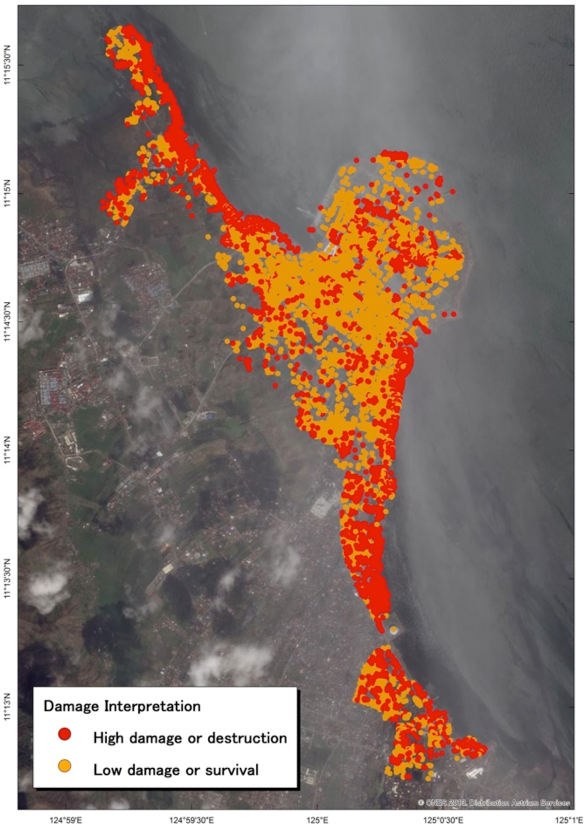

Fig.3-2. Result of the visual damage assessment using pre- and post-event satellite images of Tacloban city.

3.2 Rapid Inundation Mapping

Introduction

In response to the Super Typhoon Haiyan event, a rapid inundation mapping was conducted (Adriano, B. et al., 2014). Here, visible near-infrared (VNIR) imagery from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) sensor was used to infer the extent of the possible flooded areas. Using the Normalized Difference Water Index (NDWI), the presence of water features can be enhanced and then observed as a result of image processing.

Satellite Image Data

ASTER data was used, where the pre-event VNIR image was taken on June 1, 2008 and the post-event VNIR image was taken on November 15, 2013.

Methodology

The index analysis of ASTER's VNIR images using NDWI was performed using ArcGIS software. To enhance the water features and discover wetland areas, the following equation is applied during image processing:

$$NDWI = (Green - NIR)/(Green + NIR)$$

Where “Green” refers to the green band from the color band spectrum of the VNIR image; and “NIR” stands for the near-infra red band of the VNIR image.

The equation is applied to both, the pre- and the post-event, images and finally the difference of post- minus pre-event image is applied to obtain the new wetland areas presenting the post-event image condition, as shown in blue in **Fig.3-3**.

Results and discussion

The blue areas presented in **Fig.3-3** correspond to areas with high probability of presence of water. A preliminary estimation of flooded areas by the typhoon was observed from the shoreline to the inland following the blue colored areas. However, field survey observations and measurements were needed to differentiate the cause of the flood, either by storm surge, rainfall or river.

Conclusion

A rapid assessment of possible inundated areas form the storm surges in Super Typhoon Haiyan event was conducted using satellite imagery. The NDWI analysis of pre- and post-event images provided a preliminary estimation of areas possibly flooded and where damage could occur. Field survey was necessary to confirm the origin and intensity of the flood at each location.

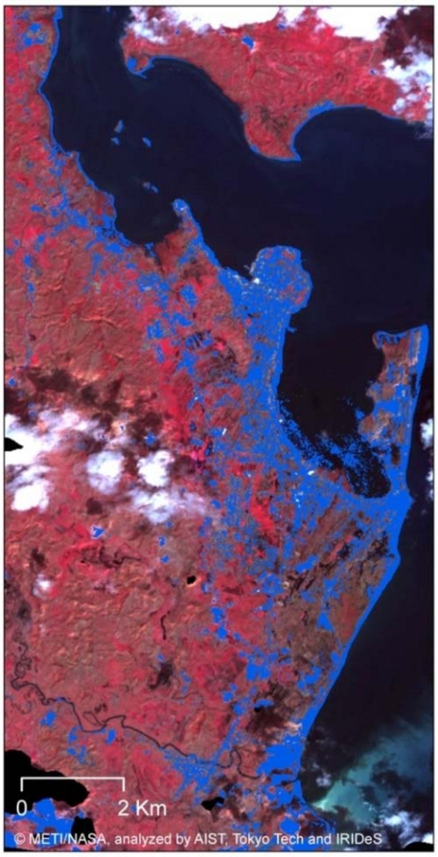

Fig.3-3. Result of the NDWI analysis of pre- and post-event satellite images. The blue areas represent areas which experienced flooding. Areas where storm surge was responsible for the flooding can be inferred by connectivity with the shoreline.

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4. Storm Surge Simulation

4.1 Methodology

The behavior of Typhoon Haiyan was hindcast using typhoon track data from the Japan Meteorological Agency (2013), which was input into a parametric hurricane model (Holland, 1980) for air-pressure field estimation, followed by the moving-typhoon model of Fujii & Mitsuda (1986) as described in Veltcheva & Kawaii (2002) for estimation of the wind field. The typhoon track data included data on location of the center of the storm, surface-level air pressure at the storm center, and maximum sustained wind speed. However, it did not contain information on the radius to maximum winds, so a radius to maximum winds of 25 km is assumed (Quiring, 2011).

The hindcast pressure and wind fields are input into a combined hydrodynamic and wave model to hindcast the water level and wave heights induced by the typhoon. The hydrodynamic model used is Delft-3D (Deltares, 2011), and the spectral wave model used is SWAN (Booij et al., 1999). Delft-3D and SWAN are run together, with the hydrodynamic model repeatedly passing water level and current fields to the wave model, which calculates the wave field including the effects of currents and storm surge. The wave model in turn passes the radiation stress field back to the hydrodynamic model, which uses this information to calculate wave-induced setup and nearshore currents. Tides are included using the Global Tide database TPXO (2014) as a boundary condition to the hydrodynamic model.

Rough bathymetry was taken from GEBCO (2014) and topography from SRTM (NASA, 2014). Detailed bathymetry of Leyte Gulf was digitized from a nautical chart (NAMRIA, 1980) by Associate Prof. Hiroshi Takagi of the Tokyo Institute of Technology, and topography of downtown Tacloban and Tacloban Airport were surveyed during the January 2014 IRIDeS site visit. Nearshore coral reef topography east of Samar is not available, so the horizontal extents of reefs were digitized from Google Earth images, and a depth of 1 m relative to mean sea level was assumed. Model resolution is 2.5 km for the large domain (**Fig.4-1**), 100 m for the Tacloban domain (**Fig.4-2**), and 50 m for the Guiuan (**Fig.4-3**) and Hernani (**Fig.4-4**) domains. Manning's *n* was assumed to be 0.025 everywhere, though for more detailed inundation analysis in the future, this will need to be adjusted for land use.

4.2 Results and Discussion

The water levels shown in **Fig.4-1** were dominated by wind-driven storm surge near Tacloban and waves in eastern Samar. **Fig.4-1** (right) shows maximum (in time) hindcast significant wave heights during the storm, reaching up to 20 m off Eastern Samar, and decreasing to less than 5 m in Leyte Gulf near Tacloban. **Fig.4-2** shows the storm surge (wind-dominated) near Tacloban, including inundation of downtown Tacloban and Tacloban Airport. The 5-m surge extends up the San Juanico Strait to Bogulibas, then rapidly dissipates where the strait narrows. Damage along Tacloban's shoreline (**Fig.4-2c**) indicated waves atop the surge (**Fig.4-2b**) were strong enough to wreck RC structures, and to cause erosion near building foundations. Inland from the shoreline (**Fig.4-2d**), damage resembled that of a slow, deep flood. In Eastern Samar (**Fig.4-3** and **4-4**), wind- and pressure-driven storm surges were small (**Fig.4-3a** and **4-4a**), but wave-induced setup over the broad coral reefs in these areas generated a surge up to 5 m high (**Fig.4-3b** and **4-4b**). Waves on top of this wave setup (**Fig.4-3c** and **4-4c**) wrecked structures (**Fig.4-3d** and **4-4d**) and transported concrete and coral debris up to 50 m inland.

An important item that this surge and wave modeling has not resolved, however, is the tsunami-like behavior of the flood captured on film in Hernani by a member of the NGO Plan Philippines International. Monserrat et al. (2006) describe mateo-tsunamis, which are bore-like seiches that can cause destruction similar to that of a tsunami. If the present phenomenon is indeed a meteo-tsunami generated by the travelling low-pressure system (the typhoon), the Delft3D shallow water model should be able to reproduce it, and the lack of this effect in the model result indicates that either the local topography/bathymetry data is insufficient, or the hurricane model is not sufficiently resolving the pressure field. Alternately, if the bore is related to wave phenomena (infragravity waves such as surf beat, for instance), the phase-averaged SWAN wave model would not resolve this physics; in this case, a phase-resolving wave model such as BOSZ (Roeber et al., 2010) must be implemented via further nesting under SWAN.

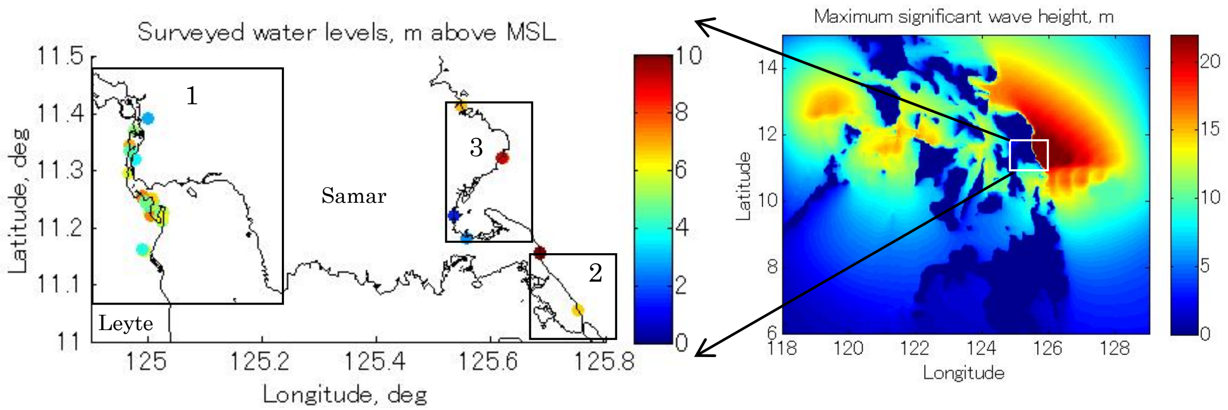

Fig.4-1. (left) Maximum water level (including both surge and waves) measured by the IRIDeS survey team (**Chapter 5.2** and Mas et al., 2014). (right) Maximum significant wave height hindcast by SWAN. Note the jagged result east of Samar is merely an artifact due to hourly model output.

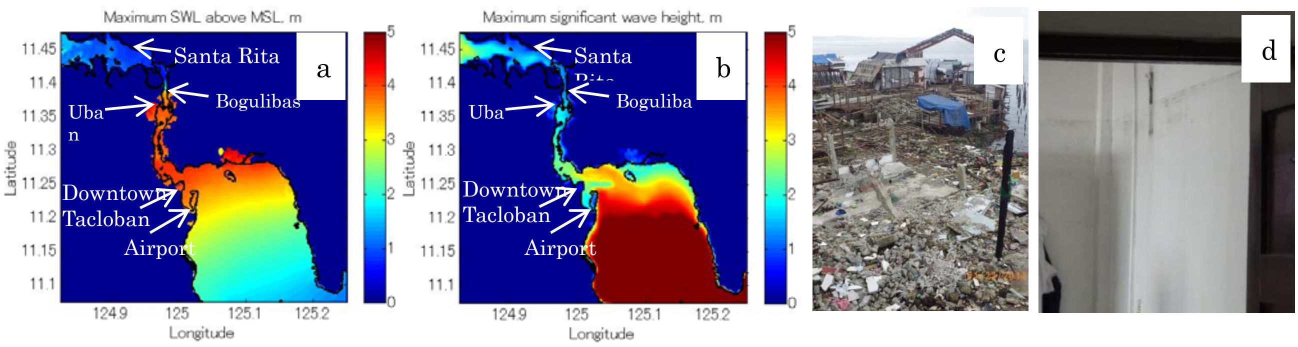

Fig.4-2. (a) Maximum storm surge for small domain (1) of **Fig.4-1**. (b) Maximum significant wave height. (c) Typical damage along the coast of downtown Tacloban. (d) Typical water line in inland downtown Tacloban.

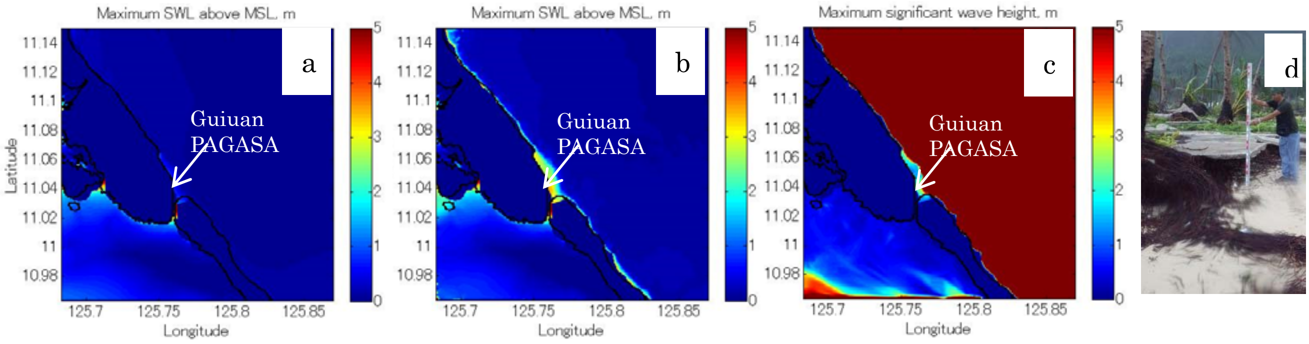

Fig.4-3. (a) Maximum storm surge neglecting wave setup for domain (2) of **Fig.4-1**. (b) Maximum storm surge including wave setup. (c) Maximum significant wave height. (d) Damage along coast near Guiuan PAGASA station.

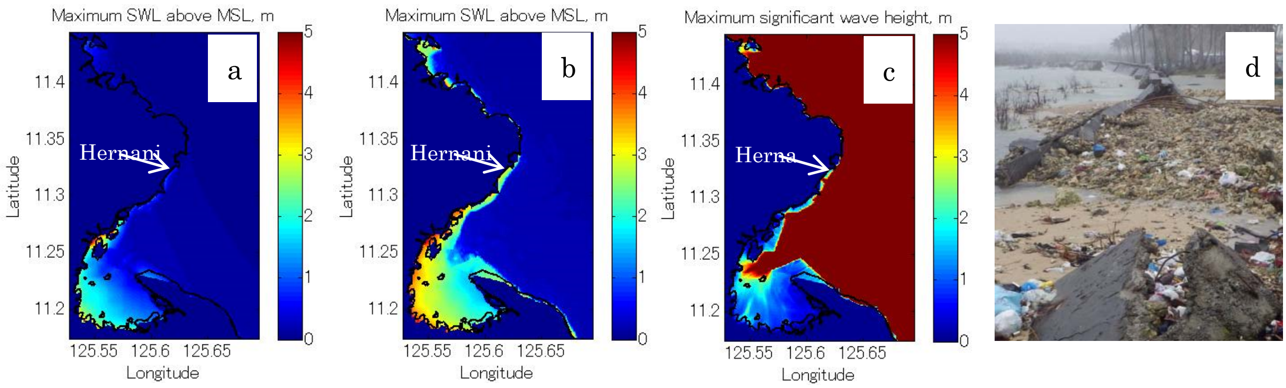

Fig.4-4. (a) Maximum storm surge neglecting wave setup for domain (3) of **Fig.4-1**. (b) Maximum storm surge including wave setup. (c) Maximum significant wave height. (d) Damage to seawall in Hernani.

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5. IRIDeS fact-finding mission, Hazard and Damage Evaluation Team

5.1 Missions and local collaborators

IRIDeS sent the Hazard and Damage Evaluation Team to conduct an on-site field survey to collect general information including evacuation response, inundation time and depth, emergency response by local government, etc. and obtain spatial data, statistical data and documents related to the damage caused by Typhoon Haiyan. And discussed with local authorities about possible collaborations to mitigate typhoon-related disasters in the future.

Name of the mission

IRIDeS Fact-finding mission to Philippines (2nd mission, January 16 - 24, 2014)

Hazard and Damage Evaluation team

1. Ass. Prof. Shuichi Kure (Team Leader, Disaster Potential Study)
2. Assoc. Prof. Jeremy D. Bricker (Technology for Global Disaster Risk)
3. Ass. Prof. Erick Mas (Remote Sensing and Geoinformatics for Disaster Management)
4. Ass. Prof. Carine J. YI (International Strategy for Disaster Mitigation)
5. Mr. Bruno Adriano (Remote Sensing and Geoinformatics for Disaster Management)

Philippines counterparts

1. Dr. Maritess S. Quimpo (Bureau of Research and Standards, DPWH)
2. Prof. Cristopher Stonewall P Espina (College of Architecture, UP)
3. Mr. Karl Taberdo (College of Architecture, UP)
4. Mr. Paul Tupaz (BS Economics Student, UP)
5. Mr. Christer Kim Gerona (BS Political Science Student, UP)

Tasks of the Hazard and Damage Evaluation team, IRIDeS

Target Area:

1) The city of Tacloban, Municipality of Palo, Municipality of Tanauan, and rural areas around rivers and mountains on Leyte Island

2) Coastal areas on Eastern Samar Island

Task 1. Verification of satellite image analysis using ground truth data and understanding the damage characteristics of buildings due to typhoons:

- Measurement of inundation levels

- Classification of buildings damaged by storm surge and strong wind
- Taking of photos with GPS information of damaged places and buildings

Task 2. Data measurement and collection for detailed storm surge and wave modeling:

- Measurement and/or collection of bathymetry data of Tacloban Bay and the straight that connects Tacloban Bay to Carigara Bay
- Collection of fine-resolution topographic data of Tacloban city and other areas that experienced significant inundation and storm surge damage
- Cataloging of coastal defenses (seawalls, levees, gates, if any) that existed before the storm, as well as their condition after the storm

Task 3. Investigation of other hazards (flooding, landslides, wave intrusion along the river, etc.) induced by Haiyan:

- Collection of hazard maps and hydro-meteorological data such as wind speed, rainfall, river discharge, tide level data, etc.
- Travel around rivers and mountainous regions to identify flooding and landslide damage induced by the typhoon
- Modeling of the flood due to heavy rainfall with high tide level induced by the typhoon.

5.2 Inundation map

The main objectives of the mission were to collect spatial data, statistic data and documents and measure the inundation heights from storm surge and waves to inspect the damage and magnitude of Haiyan, and to conduct and verify the numerical simulation and satellite image analysis results. In order to make an inundation map of Haiyan, we conducted an on-site survey in Tacloban city and towns on Leyte and Samar Islands.

The survey was mainly conducted based on local interviews to obtain inundation heights and reliable information because it was difficult to find clear water marks of the storm surge and high wave inundation due to heavy rainfall during the Haiyan event and severe building damage induced by the strong wind. On the other hand, many residents around the coast stayed in their houses until inundation occurred, and witnessed the flooding event. Measurements were conducted using a portable laser rangefinder referenced to sea water level at the time of the survey. Examples scenes from the survey are shown in **Fig.5-1**.

Fig.5-2 shows the area of the city of Tacloban where the most of survey point data was taken by the team. The bottom left inset shows the inundation heights measured in downtown Tacloban. In the right inset an estimated inundation limit was drawn as a result of the Normalized Difference Water Index (NDWI) analysis explained in **Chapter 3** of this report; the measurements were available from the field survey and interviews with eyewitnesses and residents in Tacloban (Adriano et al., 2014; Mas et al., 2014). The Storm surge height was measured as high as

6m near the shoreline. The survivors reported waves up to 4 m high atop the surge. Wave runup up to 12 m high was observed in Eastern Samar (Mas et al., 2014; Bricker et al., 2014). For more details, please see Bricker et al. (2014), Mas et al. (2014) and Kure et al. (2014). Also, the JSCE-PICE[1] joint survey team reported detailed inundation and run-up heights in Leyte and Samar (Tajima et al., 2014).

Fig.5-1. Pictures of the inundation survey in Leyte and Samar.

[1] JSCE: Japan Society of Civil Engineers / PICE: The *Philippine Institute of Civil Engineers*

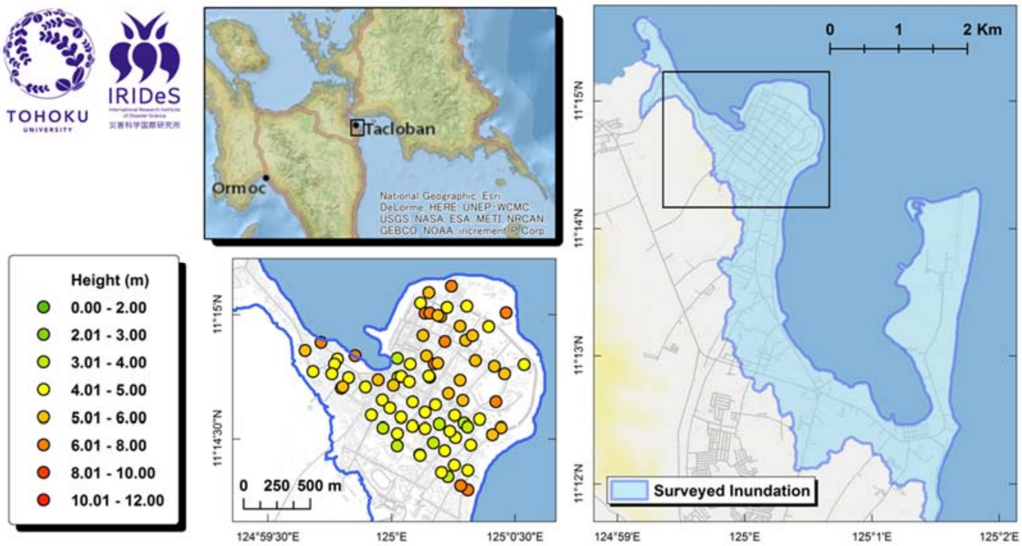

Fig.5-2. Measured inundation heights in Tacloban city based on survivors' interviews (left) and inundated area estimated from NDWI analysis (right) [explained in **Chapter 3**].

5.3 Northern extent of surge

The storm surge simulation hindcast a steep change in maximum surge elevation about 15 km north of downtown Tacloban, where the San Juanico Strait narrows and curves before widening again near Santa Rita to the north. **Fig.5-3** shows the result of the storm surge simulation near Tacloban. Between Tacloban Airport and Bogulibas, maximum storm surge height was about 5 m above Mean Sea Level. North of Bogulibas, storm surge elevation rapidly diminished to less than 1 m. In Santa Rita, the modeled storm surge elevation was less than 1 m, and during our team's field survey, interviewed residents reported no flooding in Santa Rita. **Fig.5-4** shows surveyed water levels, in close agreement with the simulated surge levels of **Fig.5-3** (since no flood was measured in Santa Rita, it is not included in **Fig.5-4**).

Fig.5-5 shows damage along the coast in Uban. The row of homes closest to the shore (near the seawall in the foreground of the photo) was destroyed, and one set of concrete stilts can still be seen amongst the wreckage. Homes further inland had been damaged, but already rebuilt. **Fig.5-6** shows wind waves up to 2 m high impacted Uban, and, atop the surge, these were likely responsible for destroying homes along the shoreline. Wind damage (i.e., missing roofing sheets) was not as severe in Uban as it was further south, and no wind damage was apparent in Santa Rita, indicating that the typhoon wind field diminished this far north. In addition to structural damage in Uban, surge flooded agricultural land tended by the town, destroying the season's rice crop due to salinization, and damaged the town's fishing industry because residents are hesitant to eat fish caught nearby the location of so many bodies (of the townspeople who drowned in the surge and whose bodies were not discovered on land).

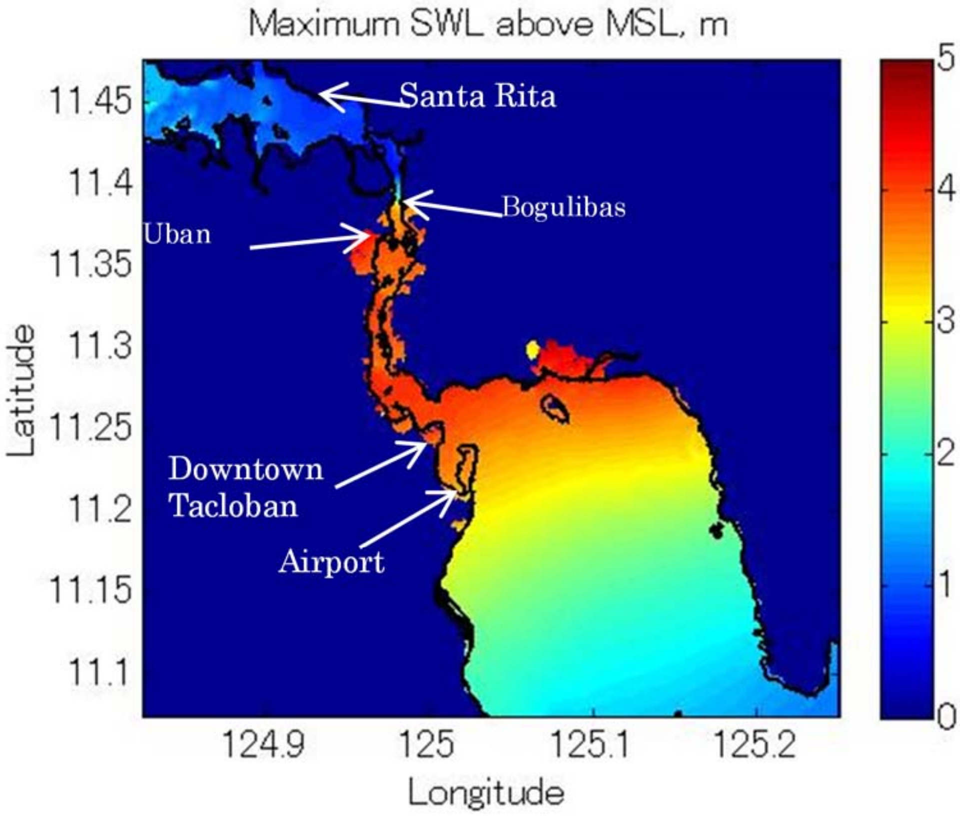

Fig.5-3. Simulated maximum water level due to storm surge near Tacloban.

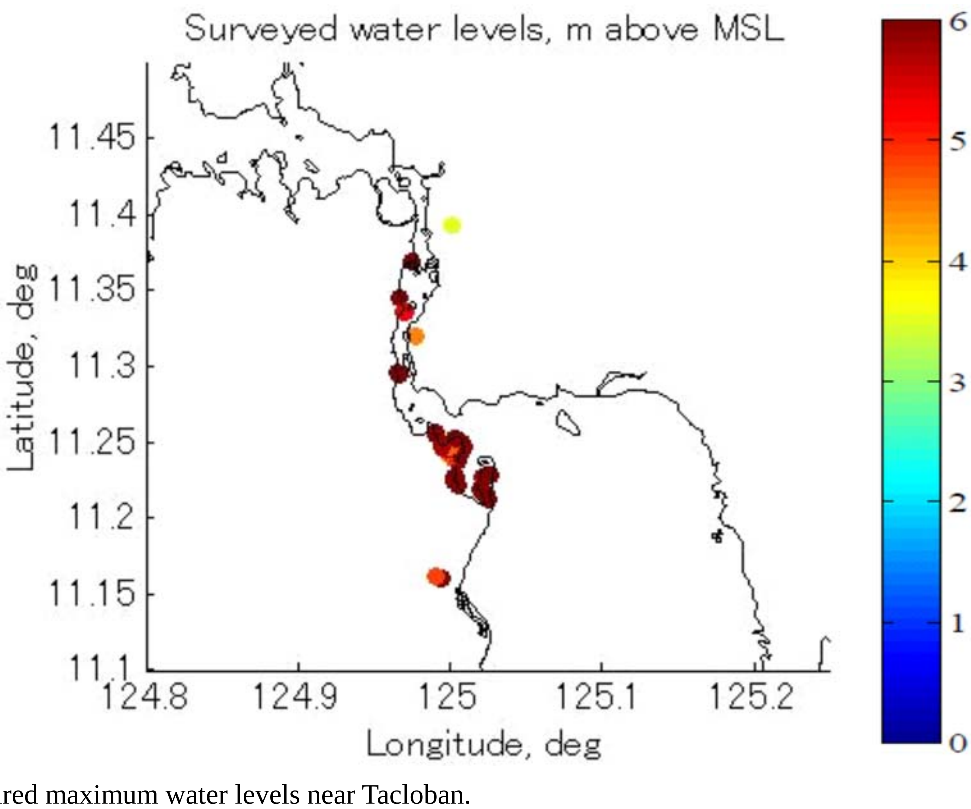

Fig.5-4. Measured maximum water levels near Tacloban.

Fig.5-5. Damaged and rebuilt homes in Uban.

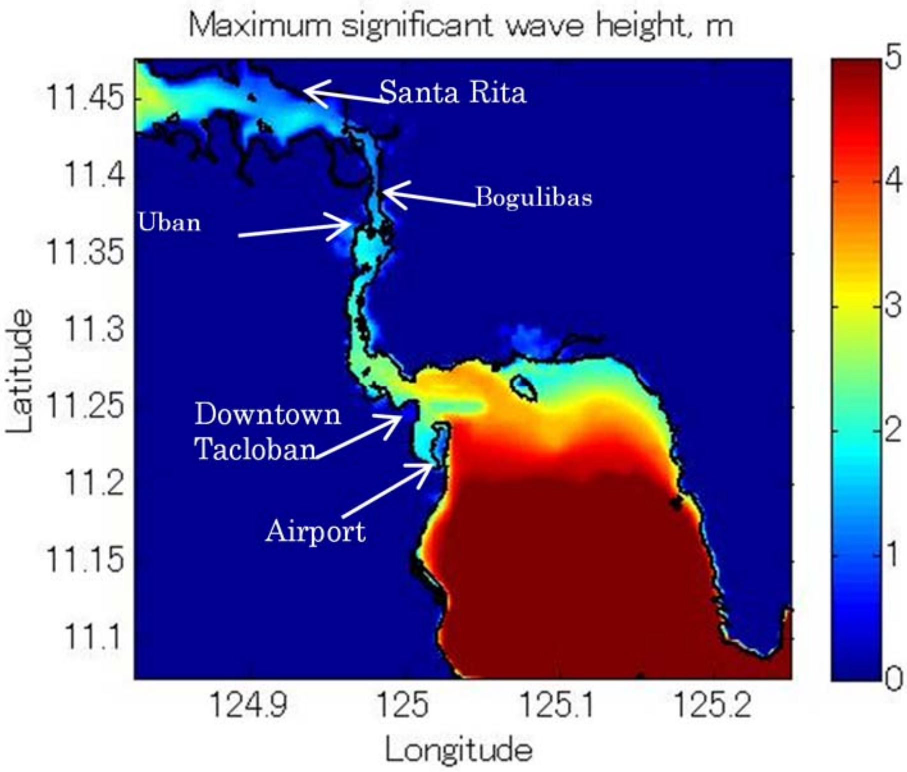

Fig.5-6. Maximum significant wave height near Tacloban.

5.4 Types of damage in Tacloban

Water-related damage in downtown Tacloban varied between two regions of the town: inland and coastal. In inland downtown Tacloban, buildings were dirtied by storm surge and by rain falling in through roofs that had been blown away. **Fig.5-7** and **Fig.5-8** show water lines inside buildings in inland downtown Tacloban. Most buildings are built of concrete or wood. While concrete buildings are concentrated in downtown Tacloban, poorly built and unsafe wooden houses are along the coastline. Typical houses are built with bricks and a longitudinal wire through the bricks whenever financial conditions allow for it. **Fig.5-9** is the typical brick house wall with only few longitudinal reinforced wires and this is common housing structure in Tacloban area. Soft walls and windows were broken out, equipment, furniture, and architectural elements inside these buildings were ruined by strong winds and rain. **Fig.5-10** shows a house in downtown Tacloban that was reconstructed using wooden studs and corrugated galvanized iron sheet. Houses along the coast in the Anibong area of Tacloban were also rebuilt with debris and distributed tents as shown in **Fig.5-11**.

Fig.5-3 shows the area of downtown Tacloban submerged by the storm surge, but **Fig.5-6** shows that waves in the same location were very small. Waves that were incident onto the city from the bay around it, were broken when they impacted structures on the shoreline. Unlike the damage seen in Japan after the 2011 Tsunami, buoyancy of structures did not seem to contribute to building failure; this is because in Tacloban most buildings are very porous, with water quickly flooding in through doorways and windows.

Along the coastline of downtown Tacloban, however, the presence of waves atop the wind-driven storm surge caused heavy damage. **Fig.5-12** shows the remains of a reinforced concrete building, with only its foundation and damaged columns still remaining. The rubble of its concrete walls is seen around the building's floor. **Fig.5-13** shows scour around the foundation of a building along the coastline. This is probably the result of waves; as such scour did not exist inland. Another mechanism of damage to coastal buildings was debris impact. **Fig.5-14** shows the foundation of a house leveled by a ship that lost its moorings in Tacloban Harbor and was then blown onshore in a residential area. Many houses along Tacloban's coastline were leveled by drifting ships.

Fig.5-7. Water line inside a building in inland downtown Tacloban.

Fig.5-8. Water line inside a building in inland downtown Tacloban.

Fig.5-9. Brick house wall with few longitudinal reinforced wire

Fig.5-10. A partially damaged house reconstructed its outer wall in downtown Tacloban.

a)  b) 

Fig.5-11. a) A house rebuilt with corrugated galvanized iron sheet and wooden studs, b) A house being rebuilt with debris.

Fig.5-12. Destruction of Reinforced Concrete building in coastal downtown Tacloban.

Fig.5-13. Scour of building foundation in coastal downtown Tacloban.

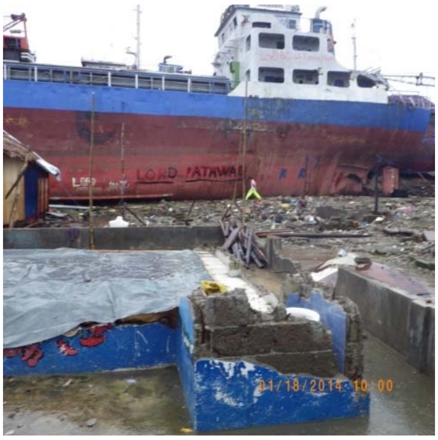 

Fig.5-14. Flattening of houses by a drifting ship in coastal Tacloban.

5.5 Wind damage

Damage due to extreme wind was present throughout the survey area. The major mechanism of wind damage was the ripping off of roofing materials from roof frames. Once the roof was destroyed, rain poured into the structure, ruining the architectural elements, equipment, furniture, and other items inside. **Fig.5-15** and **Fig.5-16** show examples of roofs ripped off public structures. In addition to destroyed roofs, wind-borne projectiles shattered windows and soft walls.

The most common roofing material in the region is Corrugated Galvanized Iron (GI) sheets, which are popular because of their low cost and ease of installation as shown as **Fig.5-16**. They are tied to the roofing frame/rafters (usually wooden, though sometimes metal) by nails. A common mechanism of failure of these ties is the nails ripping through the GI sheet. Sometimes the sheets and the nails are dissimilar metals, which can accelerate corrosion of both nail and sheet, further weakening the tie-down. In most cases, the roofing frames themselves remained tied down to the building structure quite well; contrast this to the US, in which the most common roof failure mode during hurricanes and tornadoes is the entire roofing frame lifting up off the building structure. The most direct method of preventing nails from ripping through GI sheet roofs is by using thicker GI sheets. However, this increases costs, and some hospitals complained that thicker GI sheets were not available (not in stock locally) for use in repair or reconstruction of their roofs after Haiyan, so thin GI sheets were used instead.

Fig.5-17 shows a building that was totally damaged by wind and storm surge, and **Fig.5-18** is a health facility partially damaged by only wind. Both health facilities were not functioning as of mid-January, 2014.

Coconut trees dominate the vegetation in eastern Leyte Island. These are the source of the coconut oil industry in the area. Many trees fell and snapped off their trunks during the storm. A devastated canopy of coconut trees was observed as shown in **Fig.5-19**.

Fig.5-15. Roof damage at a public area in Tacloban.

Fig.5-16. Corrugated Galvanized Iron (GI) sheet roof for residential house commonly found in Tacloban Area.

Fig.5-17. Roof damage at a hospital in Palo (south of Tacloban).

Fig.5-18. Tacloban Doctor's Medical Center affected by only strong wind.

Fig.5-19. The canopy of coconut trees was destroyed by strong wind.

5.6 Eastern Samar damage

The eastern coast of Samar faces directly into the Pacific Ocean, thus it was exposed to the 20 m height (offshore) waves generated during Haiyan. Most of the eastern coast drops rapidly to deep water, with coral reefs along the shoreline. However, there is a small, shallow bay (Matarinao Bay) near the town of General MacArthur. As **Fig.5-20** shows, high water levels (6 to 10 m) were measured along the coastline. Inside Matarinao Bay, lower flood levels (about 3 m) were inferred via interviews.

Near the Guiuan PAGASA station, **Fig.5-21** shows a surge (mostly from wave setup) of 3 to 4 m, and wave heights of about 3 m on the landward side of the reef. Approximating runup as surge plus wave height (i.e. against a vertical wall), the 6.6 m recorded water level is reasonable. **Fig.5-22** shows a foundation destroyed by the flood. Scour of sand under the foundation is responsible for some of the damage, as well as wave forces. Concrete blocks from foundations were drifted up to 30 m landward by the waves. In addition to the damage on the coast, the flood propagated far inland. **Fig.5-23** shows a school building half kilometer inland flooded by the surge. However, due to lack of ground-level topography data in this location, inundation here cannot be simulated. Since a palm forest over 1/2 km wide separated this school from the coast, waves could no longer have been sizeable by the time they reached this location, so it is likely that the flood here was due to surge induced by wave setup.

Further north, in a coastal Barangay of Salcedo, total water level was measured to have been at least 11.5 m above mean sea level. **Fig.5-24** shows a toilet vault along a debris line located on land at 9 m above mean sea level, and a building with its top story washed away. The base of the top story is located at 11.5 m above mean sea level. From these photos, it is evident that scour was also a major cause of destruction. The toilet vault had been buried in the sand before the storm, so sand around the vault must have been scoured to have allowed the vault to float. Sever scour (greater than 1 m) is also seen around the foundation of the house in **Fig.5-24**. Scour caused the house’s approach stairway to collapse, though the house itself remained standing because its foundation footings remained partially supported by sand. The reason total water level was higher in Salcedo than in Guiuan was probably because the reef in Salcedo was much narrower than it was at the Guiuan site, allowing larger waves to runup onshore, whereas at the Guiuan site waves broke over the reef, causing a large setup but lower wave heights onshore.

Fig.5-25 shows surge elevation and wave heights along the northern segment of Eastern Samar surveyed. At Quinapondan and General MacArthur, due to wave breaking over the broad reef at the entrance to Matarinao Bay, wave breaking inside the shallow bay itself, and shielding by islands inside the bay, wave heights were small. However, surge inside the bay, due to both wind-induced and wave-induced setup, was about 3 m above Mean Sea Level. This agrees with the water level measurements of **Fig.5-20** at the locations inside Matarinao Bay. **Fig.5-26** shows damage seen in the fishing village of Quinapondan surveyed. Some traditional low-lying wooden homes on stilts were destroyed by the surge, but damage was not widespread, probably due to the lack of large waves. A similar situation existed in the town of General MacArthur.

Further to the north, in the town of Hernani, damage was severe. **Fig.5-25** shows about 3 m of surge and 3 m wave heights, thus about 6 m runup height would be expected on the landward side of the reef; however, runup up to 9 m was reported by eyewitness accounts (**Fig.5-20**), indicating that local topography might have played a role in enhancing damage to this town (ground-level topography and actual nearshore bathymetry data for this area were not available). This town has been repeatedly damaged by typhoons, and had even been relocated from its previous location further southwest after the town in that location had been destroyed by a typhoon. Hernani has two seawalls, an old one slightly offshore which had already been demolished by previous storms, and a new one at the shoreward edge of the town. Nonetheless, damage to Hernani was severe. **Fig.5-27** shows an example of scour measured in the town. **Fig.5-28** shows the remaining frame columns of a wooden house washed away by a bore-like surge (filmed by Nickson Gensis, a member of Plan Philippines International). **Fig.5-29** shows the damage seen along the coast of the town, reinforced concrete structures demolished by waves riding atop surge. Note that the bore-like surge that struck Hernani may have been a localized phenomenon; Monserrat et al. (2006) describes the phenomenon of meteotsunamis, localized tsunami-like long waves generated by an atmospheric disturbance and enhanced by interaction with local bathymetry. The surge in Hernani may have been an example of this phenomenon, or it may have been due to infragravity motions such as surf beat. Research on this topic is underway.

In Llorente, north of Hernani, maximum water level was reported by witnesses to be up to 6 m above Mean Sea Level (**Fig.5-20**). However, the town experienced little damage. One reason for this is the elevation of the town, the coastal part of which is about 5 m above Mean Sea Level; this is in contrast to Hernani, where most of the devastated area was at most 3.5 m above Mean Sea Level. Also different from Hernani is that Llorente is in a bay and has no coral reef offshore. The lack of a coral reef would have allowed larger wave heights to reach the town's coast, but may have resulted in a smaller surge (wave setup) than existed at Hernani (**Fig.5-25**); however, the model resolution is too coarse, and nearshore bathymetry data nonexistent, making accurate hindcasting of the wave behavior near Llorente's coast difficult.

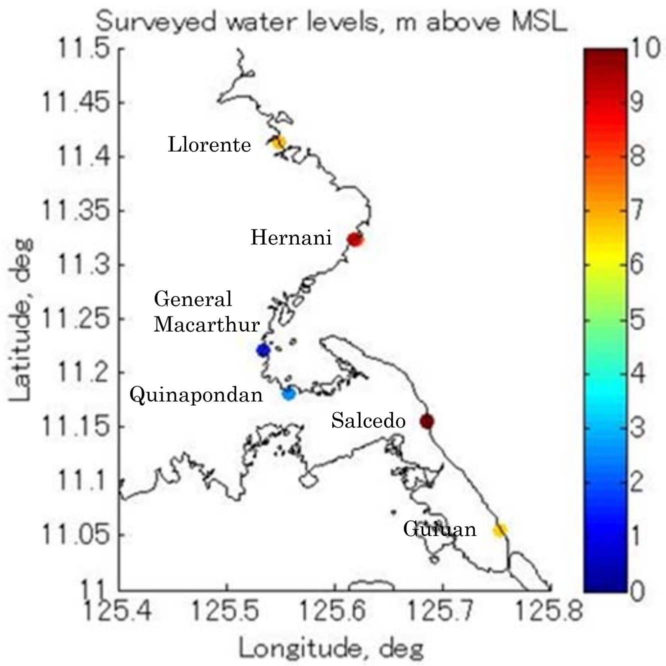

Fig.5-20. Measured maximum water levels in Eastern Samar (both surge and wave effects included).

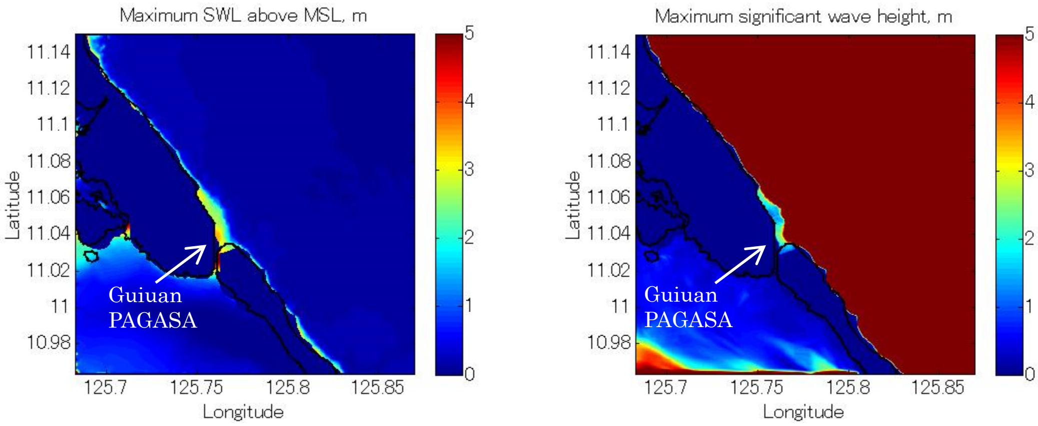

Fig.5-21. Surge water level and significant wave height near Guiuan.

Fig.5-22. Damage near Guiuan PAGASA station. Damaged foundation located 4 m above Mean Sea Level.

Fig.5-23. School building located about 1/2 km inland from Guiuan PAGASA. Flooded 2 m above floor level.

Fig.5-24. Damage in a coastal Barangay of Salcedo. Toilet vault (left) deposited on land at 9 m above Mean Sea Level. (right) top story at 11.6 m above Mean Sea Level washed away.

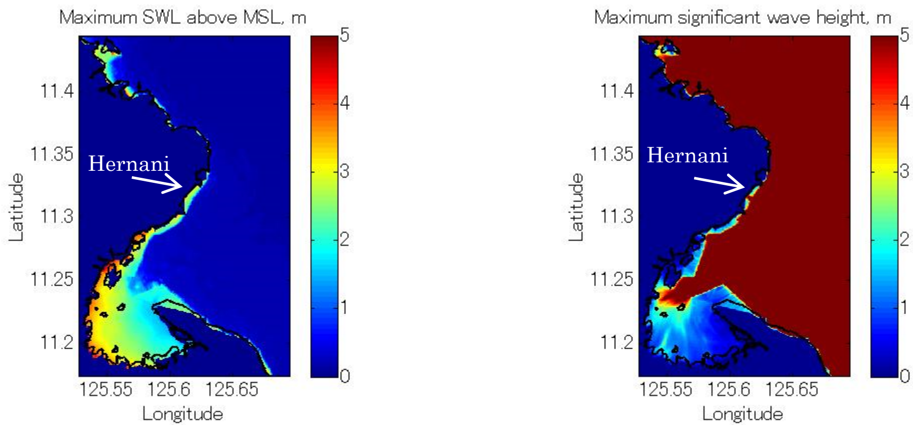

Fig.5-25. Surge water level and significant wave height near Hernani.

Fig.5-26. Damage in Quinapondan fishing village.

Fig.5-27. Scour up to 1 m deep around foundation in Hernani.

Fig.5-28. Piles of house washed away by bore-like surge in Hernani.

Fig.5-29. Debris from reinforced concrete house along coast in Hernani.

5.7 Seawall damage

Seawall damage was observed in areas with significant wave activity, both in Leyte and Eastern Samar. **Fig.5-30** shows one of the breaches on the eastern shoreline of Tacloban Airport. The seawall was pushed from its base a few meters inland. **Fig.5-31** shows similar damage at the MacArthur Memorial on the east coast of Palo, just south of Tacloban Airport. Damage was similar, with the revetment parapet pushed landward. The Palo seawall was a rubble-fill concrete structure with a concrete parapet. **Fig.5-3** and **Fig.5-6** show the maximum storm surge height and significant wave height at each of these sites. Surface waves were 3-4 meters high, on top of a 3-4 meter sustained surge. Since each seawall crest was about 3 m above water level, the mean water level (surge) reached at least the top of the parapets. This allowed the waves striking the seawalls to impact the full frontal area of the seawalls, and exert a large horizontal force. In addition, buoyancy caused by submergence of the seawalls reduced their weight, making them easier to slide. Finally, as seen clearly in **Fig.5-31**, overtopping caused severe scour landward of the seawalls, allowing them to be more easily displaced landward.

Fig.5-32 shows the Hernani seawall in Eastern Samar. This seawall is a coral-fill embankment topped by a concrete parapet and covered with grouted concrete armor on the landward and seaward faces. The Hernani seawall was breached in multiple locations. Coral-fill debris and pieces of the parapet and facing armor were scattered both landward and seaward of the wall's original location. **Fig.5-33** shows a steady surge of over 3 m near Hernani, indicating that water had risen to at least the crest of the seawall. **Fig.5-33** also shows wave heights on the landward side of Hernani's coral reef to also have been over 3 m. Since these waves were incident atop surge, they struck the seawall directly, and the impact force caused the destruction seen in **Fig.5-32**.

Fig.5-34 shows the seawall in Llorente, north of Hernani. This seawall consists of a concrete bulkhead wall held in place by gravity to retain fill used to elevate the town's coastline. The top section of the bulkhead wall is a recurved parapet. This seawall experienced no visible damage, indicating that the presence of fill behind the bulkhead wall prevented the wall from sliding under the wave forces to which it had been exposed. In addition to the strength imparted against sliding by fill, it's likely this seawall contained rebar sufficient to prevent the parapet section of the wall from breaking off the bulkhead section; this is in contrast to **Fig.5-31** and **Fig.5-32**, where the parapet section of each wall sheared off the revetment or bulkhead section. Another factor that likely prevented failure of the Llorente seawall is the concrete deck covering the fill on its landward side; this likely acted as armor to prevent scour of the fill behind the wall during wave overtopping of the parapet (wave overtopping of up to 2 m was reported by witnesses); this is in contrast to **Fig.5-31**, in which scour of the landside fill allowed waves to push the parapet section off the bulkhead section of the seawall.

Fig.5-30. Seawall breach on eastern coastline of Tacloban Airport. Crest height 3 m above Mean Sea Level.

Fig.5-31. Seawall damage at the MacArthur Memorial south of Tacloban Airport. Crest height 3 m above Mean Sea Level.

Fig.5-32. Damage to the Hernani seawall. Crest height 3 m above Mean Sea Level.

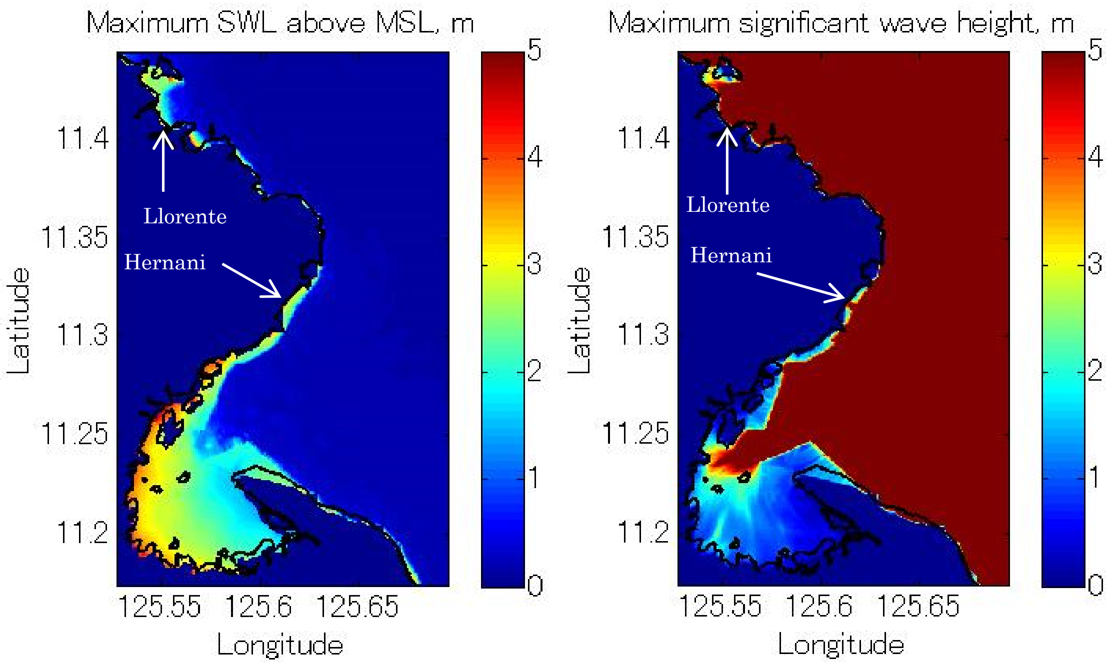

Fig.5-33. Maximum storm surge (left) and significant wave height (right) near Hernani.

Fig.5-34. Seawall in Llorente.

5.8 Conclusions and Recommendations

An on-site field survey in Leyte and Eastern Samar was conducted by the Hazard and Damage Evaluation Team, IRIDeS from January 16 through 24, 2014 in order to investigate damage due to storm surge, large waves, and strong wind induced by super typhoon Haiyan.

Inundation heights due to storm surge and high waves were measured by the team in Leyte and Samar and an inundation map of Tacloban city was developed mainly through local interviews. Storm surge heights up to 6 m were measured near the shoreline in Tacloban. Moreover, survivors reported waves up to 4 m high atop the surge. It was found from the survey that the surge travelled far to the north in the Samar-Leyte strait. Local river flooding and landslides due to heavy rainfall were also observed at several points in Tacloban and Palo. Also, runup due to large waves (up to 12 m) was measured in Eastern Samar.

Several types of damage induced by Haiyan were described in this chapter. Along the coastline of downtown Tacloban the presence of waves atop the wind-driven storm surge caused heavy damage. While concrete buildings are concentrated in downtown Tacloban, poorly built unsafe wooden houses are along the coastline because of poverty, causing vulnerability of Tacloban city against coastal water-related hazards. Another mechanism of damage to coastal buildings was debris impact. Also, seawall damage was observed in areas with significant wave activity, both in Leyte and Eastern Samar.

Damage due to wind was present throughout the survey area. The major mechanism of wind damage was ripping of the roofing materials off the roofing frame of each structure. Once a structure's roof was destroyed, rain poured into the structure, ruining the architectural elements, equipment, furniture, and other items inside.

The eastern coast of Samar faces directly into the open Pacific Ocean, and so was exposed to the 20 m high waves (offshore) generated during the Haiyan event. Scour of sand by large waves of the foundations of houses is responsible for some of the damage, but wave force is also responsible for much of the damage. It should be emphasized that the bore-like surge that struck Hernani and washed away some houses. The bore-like surge may have been an example of a localized phenomenon such as a meteotsunami, generated by an atmospheric disturbance and enhanced by interaction with local bathymetry, or it may have been an infragravity motion such as surf beat, but research on this is continuing.

From the survey the team concluded that storm surge, large waves, and high speed wind induced by Haiyan caused enormous damage to people, buildings and coastal structures in Leyte and Samar, and the vulnerability of the coastal area and fragility of houses made the damage more serious. Data analysis and numerical simulations of Haiyan are ongoing, but analysis and the survey results thus far have produced the following recommendations:

- Several observation weather stations should be installed for the monitoring of the wind speed, air pressure, tide level, rainfall, etc. The monitoring system should be protected against strong wind and storm surge, so that it should be effective even in the event of a super typhoon like Haiyan.
- Inland topography and local bathymetry along the coast should be measured in more detail for the numerical simulation of the storm surge and large waves in order to compute the inundation situation more precisely and clarify the mechanism of localized phenomena such as the bore-like surge that struck Hernani.

- Storm surge hazard maps should be updated and developed in coastal areas in the Philippines under the worst scenario considering the impacts of climate change, land use/cover change, etc.
- Seawalls should be reconstructed and multiple countermeasures such as combinations of seawalls, tide-water control forests, no building zones, etc. should be developed. These systems should be evaluated from the view point of efficiency, low cost and easy maintenance.
- New building structures and roofing system should be developed to withstand strong wind speeds during super typhoons. A small design change such as implementing a curved roof, using thicker GI sheets instead thin GI sheets, and screws instead of nails for connections may make a big difference and might cost less and save lives. The effects of these design changes should be quantitatively evaluated.
- Selection and construction of suitable evacuation centers and places
- Education to emphasize the urgency of evacuation
- Development of an early warning system for storm surge inundation

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6. IRIDeS fact-finding mission, Warning and Evacuation Assessment Team

6.1 Purpose

Warning and Evacuation Assessment Team aims at examining and recording evacuation behavior and information notification in the affected area by Haiyan. Empirical studies contribute to develop policies that will mitigate damages by coming typhoons in the future.

Although the team employed both of qualitative and quantitative methods for collecting information, it is focused on delivering some preliminary results by the qualitative approach in this article.

Warning and Evacuation Assessment Team

1. Ass. Prof. Yasuhito Jibiki (Team Leader, International Regional Cooperation Office)
2. Assoc. Prof. Miwa Kuri (International Regional Cooperation Office)
3. Ass. Prof. Shuichi Kure (Disaster Potential Study)

6.2 Method: Social survey

A questionnaire survey at Tacloban, Palo and Tanauan cities in Leyte Island was implemented from 14th March 2014 to 22nd March 2014. These three cities in the Philippines had different types of damages by storm surge, wind, and torrential rains.

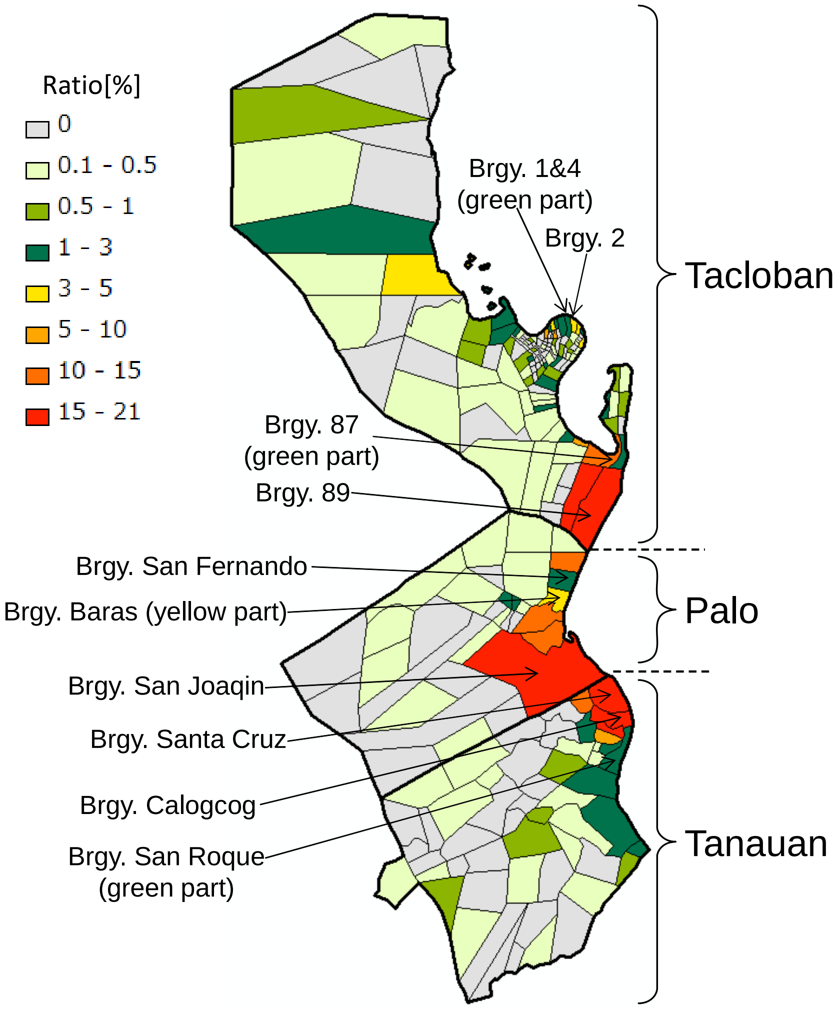
Fig.6-1 shows the death and missing ratio of each barangay in three cities based on hearing data from city governments and barangay offices. The designed total sample size is 600 and individual sample size of three cities is 200. High ratio sites are picked up in three cities as target sites. The complex situation and the heavy damages prevent the survey from employing the random sampling method based on the residential lists.

200 samples divide into 8 cells based on the population condition of generation and gender. The generation brackets are composed of 4 groups: 20-29, 30-39, 40-49, and over 50. According to National Statistics Office of the Filipino government, the ratio of male and female are almost same. Thus, the each number of the sample is divided equally in terms of gender. Contrary, the number of the young generation is larger than that of the elder (see **Table 6-1**). Therefore, designed number of 200 samples is allocated into 8 cells on actual population condition (see **Table 6-2**).

In addition with the settings above, geographical closeness are also considered. In each sites, it is biased if many samples are selected from specific barangays. However, the number of the samples in the survey is limited. Thus, samples are gathered from some barangays where locate along with coastal line of San Pedro and San Pablo Bay, and each barangays exist nearby in each other. For the control of geographical factors and hazard characteristics, the survey did not intend to distribute samples in Samar or other islands.

Each respondent were interviewed by enumerators. Finally 642 samples are gained. The final number of samples is bigger than the original designed number. Although in gender condition the number of female is slightly larger than that of male, a chi-square test demonstrates that the difference does not have statistical significance. In generation condition, the number of gained samples in each site is varied, but no statistical significance is observed amongst the difference. The final sample size is enough to be similar with the original designed sample size in the population condition of attribute, generation and gender.

For complementary information, 645 residents joined the survey, but 3 samples were excluded because their age was under 20 years old. **Table 6-3** shows the total number of the samples is 641. However, as shown in a note of **Table 6-3**, a respondent did not answer its gender and the respondent is included in the analysis in this report.



Source: Hearing data from offices of city government and barangay by the authors

Fig.6-1. Distribution of the death and missing ratio of each Barangay in survey area.

Table 6-1. Distribution of age population.

Age	20-29	30 - 39	40 - 49	Over 50
Ratio	30.5%	24.6%	19.6%	25.2%

Note: Age under 19 years old are excluded in the calculation.

Source: This table is made by the authors based on National Statistics Office.

http://www.nscb.gov.ph/beyondthenumbers/2012/11162012_jrga_popn.asp#tab2

Table 6-2. Design of allocated sample size in each cites (sample size: 200).

Age	20-29	30 - 39	40 - 49	Over 50	Sum
Male	30	25	20	25	100
Female	30	25	20	25	100
Sum	60	50	40	50	200

Source: This table is made by the authors.

Table 6-3. The number of the obtained samples by each survey sites.

Tacloban

	20s	30s	40s	Over 50s	Sum
Male	30 (14.4%)	24 (11.5%)	25 (12.0%)	22 (10.5%)	101 (48.3%)
Female	31 (14.8%)	29 (13.9%)	22 (10.5%)	26 (12.4%)	108 (51.7%)
Sum	61 (29.2%)	53 (25.4%)	47 (22.5%)	48 (23.0%)	209 (100.0%)

Palo

	20s	30s	40s	Over 50s	Sum
Male	31 (14.5%)	26 (12.1%)	21 (9.8%)	27 (12.6%)	105 (49.1%)
Female	31 (14.5%)	31 (14.5%)	21 (9.8%)	26 (12.1%)	109 (50.9%)
Sum	62 (29.0%)	57 (26.6%)	42 (19.6%)	53 (24.8%)	214 (100.0%)

Tanauan

	20s	30s	40s	Over 50s	Sum
Male	30 (13.8%)	28 (12.8%)	20 (9.2%)	27 (12.4%)	105 (48.2%)
Female	31 (14.2%)	31 (14.2%)	22 (10.1%)	29 (13.3%)	113 (51.8%)
Sum	61 (28.0%)	59 (27.1%)	42 (19.3%)	56 (25.7%)	218 (100.0%)

Total (Tacloban + Palo + Tanauan)

	20s	30s	40s	Over 50s	Sum
Male	91 (14.2%)	78 (12.2%)	66 (10.3%)	76 (11.9%)	311 (48.5%)
Female	93 (14.5%)	91 (14.2%)	65 (10.1%)	81 (12.6%)	330 (51.5%)
Sum	184 (28.7%)	169 (26.4%)	131 (20.4%)	157 (24.5%)	641 (100.0%)

Note: One respondent did not answer his/her gender. The respondent lived in Tacloban and 68 years old. The respondent is included in the analysis.

Source: This table is made by the authors.

6.3 Results on evacuation and discussions

6.3.1 Evacuation behavior

The survey data demonstrates that around 70% of the respondents evacuated to some places except their house (see **Fig.6-2.**). About 30% of the respondents did not evacuate to anywhere outside of their houses. In other words, they remained at their houses.

In the detail analysis, three types of cross tabulation were calculated. Regarding the cross calculation on the survey sites, a statistical difference is observed (χ^2 (2, N=589) = 8.265, p<.10). The respondents in Tacloban tends to not evacuate to anywhere outside of their houses, comparing with those in Palo and Tanauan. In terms of gender, a statistical difference is also detected (χ^2 (2, N=588) = 8.219, p<.05). The result indicates the male does not tend to evacuate to anywhere outside of their houses, in comparison of female. In the analysis between evacuation behavior and the age brackets, a statistical difference is observed (χ^2 (2, N=589) = 15.447, p<.01). According to **Fig.6-2**, the ratio in 30s and “Not evacuated” is higher than those of others. And, the percentage in over 50s and “Not evacuated” is also bigger than those of 20s and 40s.

These results implies that people in Tacloban has a different view on evacuation in the case of Haiyan, comparing with Palo and Tanauan. Thus, in further analysis, it seems important to examine the geographical uniqueness. Also, the statistical difference in gender and the age brackets, it can be interpreted that typical tendency might be observed in the case of Haiyan. Many cases in natural disasters, male hesitates in being absent from its house, and the elder has a comparatively greater difficulties in moving from its house to another places.

6.3.2 Reasons for evacuation to outside of houses

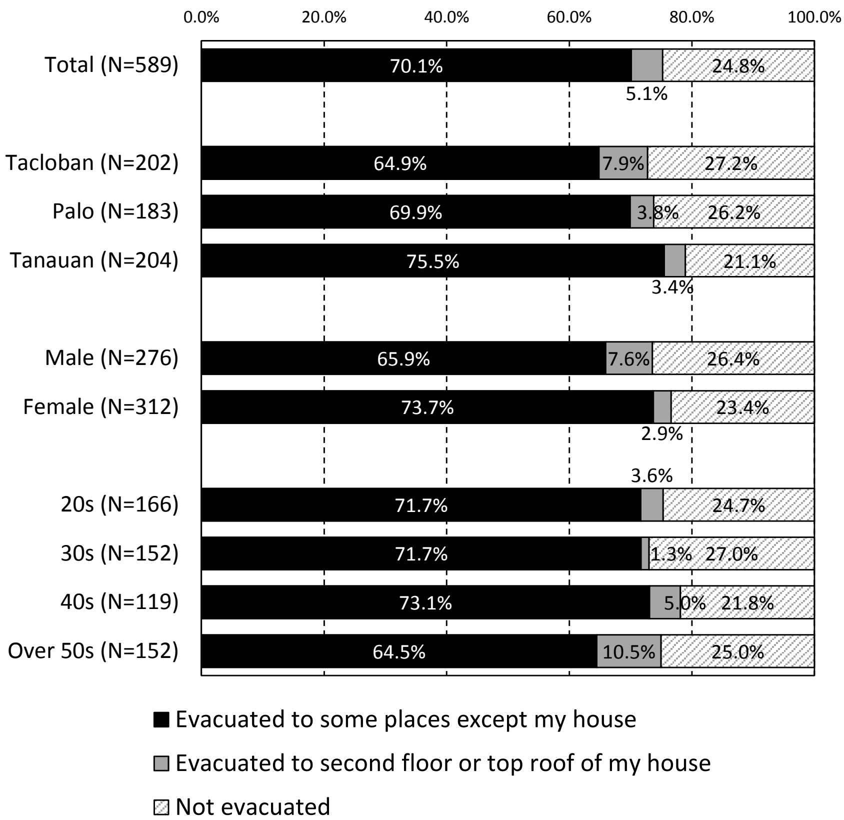
In the survey, the respondents, who answered that they evacuated to outside of houses, showed reasons for their behavior. The largest response is the recognition for the approach of super typhoon (37.7%). Next to that, the notion for the strong wind was high (30.0%). The role of barangay leaders (barangay captains) is the third largest (26.3%). It can be argued that the role of barangay leaders seems to be less significant rather than spontaneous evacuation by residents.

Results of cross calculations between the reason and the survey sites might imply that decisions by people in Tanauan were quicker than those of Tacloban and Palo. Statistical differences are observed in three answers (see items highlighted by red boxes in **Fig.6-3**). It can be interpreted that people in Tanauan did not wait for other persons’ decisions, because the ratio in Tanauan is the lowest in “Whole Barangay member decided to do that.” Also, the least percentages in the answer 7 and 8 might indicate that people in Tanauan did not face with or tried to avoid crisis of their lives. On the contrary, people in Tacloban evacuated because their houses were getting flooded due to sea water, and it means they have already been inundated and surrounded by water. Regarding “I felt I might be dead if I stay there,” response in Palo is remarkably higher than other two sites.

6.3.3 Reasons for not evacuated to outside of houses (remained at houses)

In contrast to reasons for evacuation to outside of houses, the survey had a question for those who remained at their houses. The most common answer is “the wave should not be that large” (64.8%). The second largest percentage is “my house was strong enough” (31.8%). These results indicate that many people were not able to imagine how Haiyan was severe. Furthermore, it is questionable for adequateness for contents of information including warnings and news programs which was disseminated prior to Haiyan’s landfall.

Cross tabulation analysis demonstrates four reasons have statistical significance with the difference of the survey sites (see items highlighted by red boxes in **Fig.6-4**). It can be considered that people in Tacloban and in Tanauan had a different point. Based on Tacloban response, people had sufficient knowledge about behavior in the emergency (in answer 1 of **Fig.6-4**, Tacloban has 0.0%), but they were unable to estimate Haiyan’s influence (see answer 2 in **Fig.6-4**). On the other hand, people in Tanauan were aware that their land was not high enough against Haiyan (see answer 2 in **Fig.6-4**), but they had no idea how to behave in face of disasters (see answer 1 in **Fig.6-4**). These difference seems to mention the importance to disseminate information and evacuation instructions taking into account of local contexts.

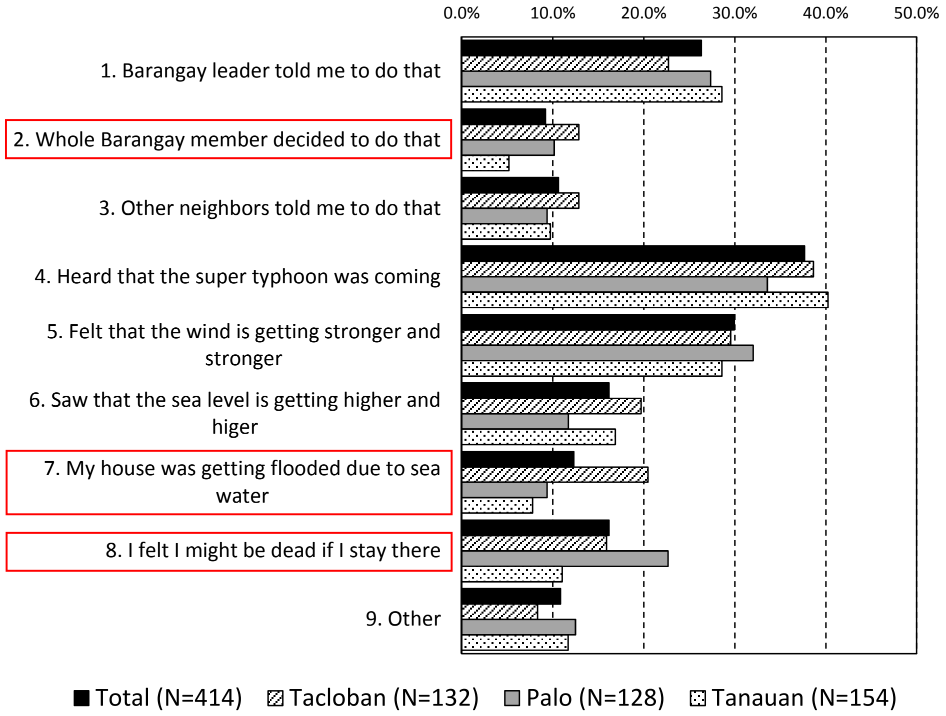


Note 1: Since one respondents did not answer its gender and was not able to include the calculation, the sum of the number of male and female is different from those of sites and age brackets.

Note 2: No answers and wrong answers are excluded in the analysis.

Source: This figure is made by the authors.

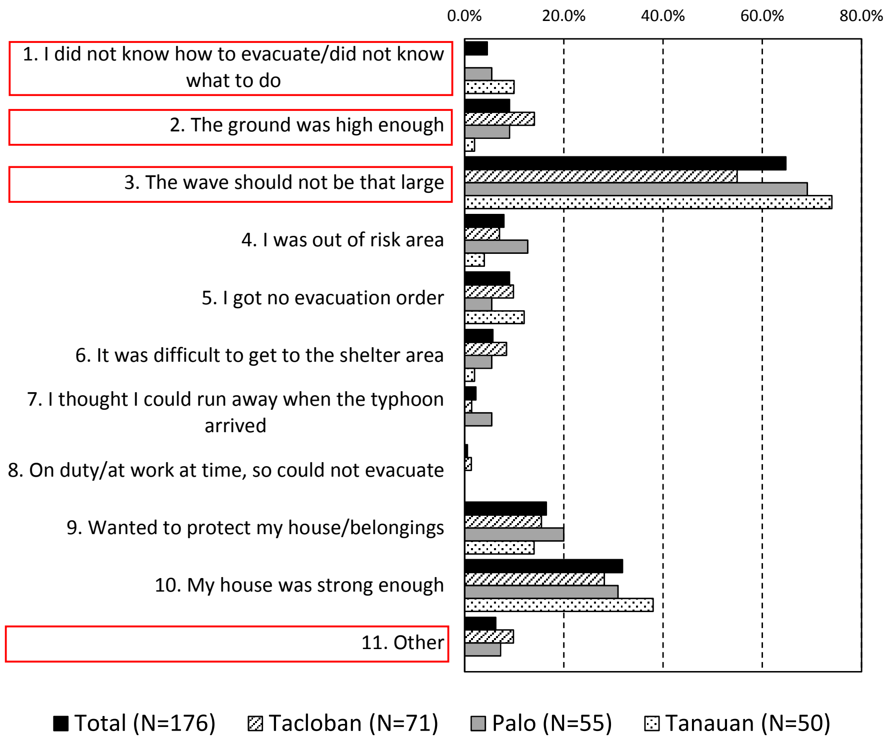
Fig. 6-2. Table calculations of evacuation behaviors.



Note: Answers highlighted by red boxes have statistical difference among the survey sites.

Source: This figure is made by the authors.

Fig.6-3. Reasons for evacuation to outside of houses (Multiple answer).



Note: Answers highlighted by red boxes have statistical difference among the survey sites.

Source: This figure is made by the authors.

Figure 6-4. Reasons for not evacuated to outside of houses (remained at houses) (Multiple answer).

6.4 Preliminary summary

This survey shows that the ratio of evacuation to the outside of houses is relatively high. However, evacuation in detail differs with sites, gender and age. Reasons and clues for evacuation to outside of houses and reasons for remaining at houses are also depend on the difference of sites. Although the survey sites locate in the same island and share the same coastal line, local characteristics are observed in the preliminary analysis. The finding is considered to be utilized in further inquiries.

It is required to clearly state that the research has two limitation. Just as a great problem which was occurred in Great East Japan Earthquake, a social survey by the team is able to contribute for revealing only survivors' behaviors. In other words, the analysis is lack of viewpoints from those who could not be survivors. Critical questions for identifying factors which differentiate survivors or not are complemented by qualitative interviews by survivors partially. Regarding the method in the survey, it cannot be said that the sampling covered the all affected area. Not only in Leyte Island, but also in Samar, Cebu and other islands, the large number of population was damaged by Haiyan. The results of the survey are required to be compared with other efforts.

In addition with the quantitative survey, the team conducted interviews in Samar Island (Samar Island is next to Leyte Island). Interviews were conducted in western parts of Samar. The team visited Basay and Marabut. Costal Barangays in Basay were severely affected by the storm surge. Contrary, damages in Marabut were due to the strong wind rather than the surge. The city of Calbayog was selected for complementary analysis. The city had relatively smaller damages by the typhoon, and supported affected local governments in Leyte Island. The interviewees are varied from the city mayor to Barangay captains and affected residents. These interviewees responded to questions about early warning, disaster information dissemination and public awareness for the coming typhoons. Findings from the qualitative surveys are required to be compared with results by the social survey.

Acknowledgements

Warning and Evacuation Assessment Team appreciates great contributions by Mr. Agathon Paul D. Tupaz, Mr. Christer Kim O. Gerona, Ms. Catherine Anne E. Sandagan, Mr. Janina Mae T. Elardo, Ms. Marie Elaine C. Roa, Mr. Ginbert P. Cuaton, Mr. Mark Jacob L. de Paz, Ms. Mary Kathlene A. So, Ms. Maiden Pearl Catilogo, Ms. Danica Mae D. Ballon, Ms. Ma. Veah Luisa O. Pascasio, Mr. Jed. P. Morantte, Mr. Jude M. Ubalde, Mr. Aibelle Cay Z. Tingzon, Ms. Flora Mae G. Sañosa, Ms. Michaela Rosabelle D. Magsangkay, Ms. Diana Grace A. Ellema, Mr. Sharmaine Joy P. Enales, Mr. Coleen O. Alonzo, Mr. Regine S. Abalos (students of University of the Philippines Tacloban). Even though they themselves were severely affected by the typhoon, they played the role of enumerators in the social survey. Without their efforts, the survey could have not been achieved.

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7. IRIDeS fact-finding mission, Disaster Medical Research Team

7.1 Missions

In order to establish the international standards for effective medical and public health response, Division of Disaster Medical Research has missions to investigate the acute and chronic phase of the response and recovery together with preparedness. In this Typhoon Haiyan disaster, we investigated the immediate medical and public health response, domestic and international medical aids, outbreak of infectious diseases, psychosocial problems and mental health of the affected people. We collaborated with the medical and public health researchers in Philippines, WHO, Department of Health and others to promote collaborative research and publicizing of the results.

Disaster Medical Research Team

1. Prof. Shinichi Egawa (Team Leader, International Cooperation for Disaster Medicines)
2. Prof. Toshio Hattori (Disaster-related Infectious Disease)
3. Prof. Hiroaki Tomita (Disaster Psychiatry)
4. Ass. Prof. Haorile Chagan-Yasutan (Disaster-related Infectious Disease)

7.2 Investigations

Disaster Medical Research Teams were dispatched in the 1st, 2nd, 4th and 6th investigations.

1. Common themes
   a. Interview at Japanese Embassy about their response and health problems of Japanese residents.
   b. Establishment of educational system in collaboration with the medical and health related universities about Disaster Medicine
   c. Establishment of collaboration with University of Philippines Manila (UP Manila) and Angeles University through MOAs.
   d. Establishment of collaborative relationship with DOH, WHO and WPRO

2. Division of International Cooperation for Disaster Medicine (Prof. Egawa)
   a. Investigation of structural, non-structural and functional damage of hospitals, Rural Healthcare Unit, Barangay Health System and other related facilities according to the satellite images.
   b. Post disaster change of the medical and public health needs of the affected people and areas.
   c. Elucidation of the obstacles to recovery and reconstruction of the damaged health related facilities.
   d. Observation of health and sanitary condition of the affected people together with some interviews
   e. Investigation of damage and reconstruction plan of medical educational institutions such as UPM-SHS, RTR foundation, Bethany Hospital.
   f. Discussion and recommendation in the DOH about the “Safe Hospital” concept. Structural, non-structural

and functional strengthening of the hospitals including hospital BCP, network promotion and systemic disaster medical response preparedness.

g. Investigation of domestic and international medical aids in collaboration with DOH and WHO.

h. Interview with JICA about their concept and role in the reconstruction of health related facilities.

3. Division of Disaster Related Infectious Disease (Prof. Hattori)

   a. The sanitary condition of affected area and the occurrence of Dengue, Leptospirosis, Tetanus, Measles, Tuberculosis, HIV and others.

   b. Establishment of early detection system and pathological analysis of the infectious diseases in collaboration with San Lazaro Hospital.

   c. A questionnaire survey health personnel in the Philippines to investigate a) awareness of the international frameworks related to disaster medicine and humanitarian response and b) risk perception of natural disasters and disaster-related infectious diseases.

4. Division of Disaster Psychiatry (Prof. Tomita)

   a. Investigation of mental health care of Japanese residents.

   b. Establishment of collaborative mental health research with researchers in Philippines.

   c. Investigation of the current situation and future perspectives of psychological primary care in the medical system in the Philippines.

7.3 Methods

1. Geographical mapping of the possible hospitals and health related facilities in the affected area in collaboration with remote sensing team (Dr. Carine Yi). Based on the prepared map, individual visit of the facilities and interviews with the medical directors of the hospitals together with architect from University of Philippines (Mr. Karl Taberdo).
2. Visiting the tent and temporary housing areas to observe the sanitary and health condition of the affected people with some interviews.
3. Visiting the international agents for humanitarian assistance including Red Cross, MSF and others.
4. Based on the MOA and collaborative history with San Lazaro Hospital (Dr. Elizabeth Telan), extended collaboration with DOH (Drs. Marilyn Go, Winston Go, Carmencita Banatin and Alex Dimapilis), WHO (Drs. Arturo Pesigan, Lester Geroy, Alice Ruth Foxwell and Jonathan Abrahams) and WPRO (Dr. Nevio Zagaria) to get the information about health cluster approach and humanitarian assistance.
5. Visiting Japanese Embassy (Drs. Junichi Nitta, Yasuyuki Matsumoto and Akira Yokoyama) and JICA (Ms. Atsuko ltsuki) to interview their health related response and plan.
6. Attending the annual congress of Philippines Psychological Association and DOH to get connected with the mental health stakeholders (Drs. Lourdes L. Ignacio and Benjamin V. Marte).

7.4 Results

7.4.1 Hospital Damages

We could visit the pre-searched hospitals and health related facilities as shown in **Table 7-1**. The mapping of hospitals and health related facilities through satellite images was quite useful for the comprehensive investigations. It is strongly recommended for the local governments and all clusters share such multi-information-layered maps at the time of disaster. Strong wind, heavy rain and storm surge devastated many hospitals and health related facilities not only in the coastal areas but also in the inlands (**Fig.7-1**). The damage to the roofs and windows paralyzed the function of the hospitals including X-rays, CT, MRI and laboratory instruments. There remained only one CT in Tacloban and Palo area (**Fig.7-1**, #5). The only psychological ward in that area was also devastated (**Fig.7-1**, #13). Most of the hospital rooms were too damaged to accept patients. Many hospitals accommodated small number of in-patients and kept the out-patient department partly open (ex. **Fig.7-1**, #10). There were almost daily deliveries in the maternity hospitals during the disaster. Nurses and midwiferies took care of the deliveries. The students also helped as much as possible to treat the patients.

Most of the hospitals saved the lives of in-patients as much as possible and among the facilities we visited only one patient in ICU lost his life due to the power outage as summarized in **Table 7-2**. The workers in the hospitals were also saved. There is the possibility, however, that patients who can go home in preparation to the Typhoon might have lost their lives. Most of the hospitals utilized the limited resources to keep running the out-patient departments to accept the surge of medical needs. Two hospitals had to completely shut down due to the complete outage of the resources (**Fig.7-1**, #7 and #6) at the time of our visit. One of these was taken over by Doctors Without Borders (MSF) to use the ward as the outpatient clinic and was planning to reopen the hospital in May, 2014 (**Fig.7-1**, #6).

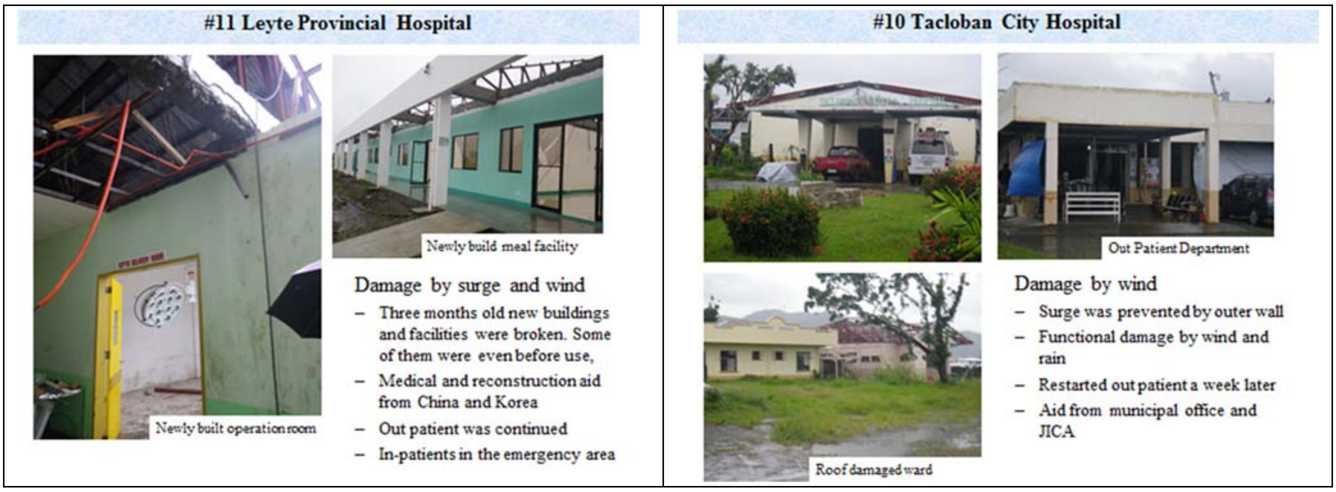
The buildings of the hospitals were built according to the latest building code to endure 200 km/h wind, but the real strength of the Typhoon exceeded the expectations (**Fig.7-1**, #5). Most of the hospitals had emergency power generator and water stock for daily use (not for drink). Fortunately, there was no lack of fuel supply for cars and emergency generators. Drinking water for the patients and staffs was provided by the city authority and international aids. Propane gas was used for cooking the meals in the hospital. Small number of the hospital had a contraction with the food vendors. Thus the outage of the lifelines of the hospital was limited, though the rehabilitation of the building was still on-going two months after disaster.

The preparedness of medical and health related facilities had been strengthened by the governance of DOH/HEMS (Health Emergency Management Staff) before the Typhoon. Every hospital should have disaster manager to be licensed and “Safe Hospital Campaign” was promoted by DOH in collaboration with WHO from 2008 to 2010. EVRMC owned by DOH (**Fig.7-1**, #1), the biggest tertiary center in the region, was inundated by the similar storm surge about 100 years ago but was not relocated. This time, the government decided to relocate the hospital to the safer place. JICA was planning to assist the reconstruction of EVRMC out-patient department, and was also intending to effectively assist the reconstruction of Rural Health Unit (RHU) that is important for the primary health care.

The information sharing at the onset of disaster still had problems, even the Typhoon developed very rapidly. Some hospital (**Fig.7-1**, #4) protected its glass wall by temporally shielding structures and had less damage to the wards. This hospital relocated the medical records to third floor and protected the record from storm surge inundation (**Fig.7-1**, #4). The remained CT scan in the region was located deep inside of the hospital to avoid the rain fall from the damaged roof (**Fig.7-1**, #5). This hospital also located the laboratory instruments at the deep inside and protected from the rain damage, though its ICU was totally devastated by the strong wind and rain though the broken glass window (**Fig.7-1**, #5).

Table 7-1. Hospitals and health related facilities in the affected area

ID	Name	Address
1	Eastern Visayas Regional Medical Center (EVRMC)	Tacloban
2	Ultrascan Diagnostic Center & Healthcare Services	Tacloban
3	Philippine National Red Cross	Tacloban
4	Divine World Hospital	Tacloban
5	Tacloban Doctors Medical Center	Tacloban
6	Bethany Hospital	Tacloban
7	Tacloban Maternity Hospital	Tacloban
8	Mother of Mercy Hospital	Tacloban
9	Remedios Trinidad Romualdez Medical Foundation (RTR)	Tacloban
10	Tacloban City Hospital	Tacloban
11	Leyte Provincial Hospital	Tacloban
12	U. of the Philippines Manila School of Health Sciences (UPM-SHS)	Palo
13	Zystostomiosis Research Institute	Palo



#13 Zystostomiosis Research Institute


Most of the roof tops were damaged


Open out patient


Psychology ward under rehab,

Damage by wind

- Only this hospital had psychiatry ward in this region
- Out patient was restarted two months later and few numbers of in-patient
- In the process of rehabilitation

#1 Eastern Visayas Regional Medical Center


Outer wall of sewage system


Inundated hospital ramps

Damage by surge and wind

- Located by the coast
- Largest governmental hospital in the region
- Kept running out patient and in-patient care and accepted community referrals

#7 Tacloban Maternity Hospital

Indication to show its history


Not functional


Ward room broken by wind

Damage by surge and wind

- Several deliveries at the time of Yolanda, but unable to keep running due to lack of resource
- Closed its history as the oldest maternity hospital in Tacloban
- No detailed information about re-opening.

#4 Divine Word Hospital


Less damage by board protection


Protected and functional ICU


Medical record on the 3rd floor

Damage by surge and wind

- Protected the glass window in front of ICU by hard board two days before Yolanda
- Roof tops were blown off, X-ray, MRI, labs were damaged
- Kept running out patient and in-patient
- New facilities reduced the risk

#5 Tacloban Doctors Medical Center


5th floor with roofs blown out


Glass windows in the front


CT was saved at the center of building

Damage by wind

- Kept running out patient and in-patients
- Only functional CT in the region
- Aid from parental group
- Emergency power generator was functional

#9 Remedios Trinidad Romualdez Medical Foundation


Operations at Tacloban and vicinity

Owns its medical and nursing school

Damage by wind

- Kept running out patient and in-patients
- Lost CT by power outage
- Got aid from congressman RTR and served as a center for medical and relief operations under control of disaster manager (medical director)
- Schools restarted two month later

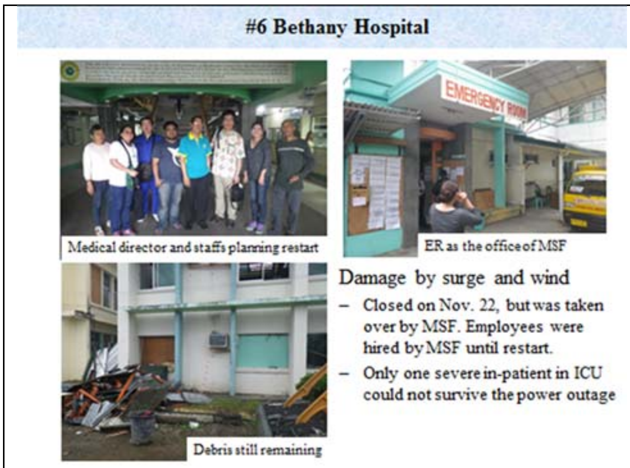


Fig.7-1. Hospital damages.

Table 7-2.

ID	Name	Beds	Human injury	Type of damage	Current Function
1	Eastern Visayas Regional Medical Center	360	3 medical staff 0 patient	Surge & Wind	Active
2	Ultrascan Diagnostic Center & Healthcare Services	0?	Not visited	Surge & Wind	Closed? (Sunday)
3	Philippine National Red Cross (operation center)	0	?	Surge & Wind	Active
4	Divine World Hospital	160	1 Guard 0 patient	Surge & Wind	Active
5	Tacloban Doctors Medical Center	35	0 medical staff 0 patient	Wind	Active (CT)
6	Bethany Hospital (with Schools)	150	1 medical staff 1 patient in ICU	Surge & Wind	Restoring (MSF until May)
7	Tacloban Maternity Hospital	?	?	Surge & Wind	Closed
8	Mother of Mercy Hospital	?	Not visited	Not visited	Not visited
9	RTR Medical Foundation (with Schools)	50	0 medical staff 0 patient	Wind	Active
10	Tacloban City Hospital	?	?	Wind	Active
11	Leyte Provincial Hospital	?	?	Surge & Wind	Active
12	UPM-SHS (Schools)	0	3 students	Wind	Active

7.4.2 Health-related needs of the affected people and the medical aids.

In fact, 6,300 people were killed by the typhoon and storm surge and more than one million houses were damaged (NDRRMC, 2014). Some of the affected people were already living in the restricted zone of within the 40 m from the coastal line and getting the food and water supply, partly working or finding any type of livelihoods.

Many international medical teams came in to provide medical relief and found that the number of injured patients was small, but that the medical needs relating diarrhea, pneumonia, bronchial asthma and their prevention were remarkable. Middle to long-term lack of food, lifelines deteriorated the health condition of the affected people and increased the risks of malnutrition and outbreaks (**Fig.7-2**). Water and food was supplied by the local government and humanitarian agencies, but the information where and when it will be supplied was insufficient. There are thousands of evacuation tents along with the coastal line but the tent did not have floor other than a simple sheet, and two to three families were living in one tent (**Fig.7-2**). The sanitary condition of the affected people was also very insufficient, burning foods by the wrecks and debris, washing close, running with sandals in the muddy water, toilet on the sea. People were educated not to drink the water from the well, but there are increased symptoms of the abdomen especially in the malnutritional areas.

The elementary school was opened but no lunch is provided. Thus, the children should bring their own lunch or had to go back home to eat lunch. This could cause malnutrition of the children and increase the vulnerability.

The international agencies provided the town clinic and visiting medical cares. JICA provided three terms of JDR as medical relief. These were coordinated by the health cluster meetings led by DOH and WHO. One private hospital (RTR, **Fig.7-1**, #9) provided medical care and relief goods to the Tacloban and Palo vicinities as a hub of private relief from the congressman in Manila. The coordination of private and public relief seemed to be necessary.

Fig.7-2. The life of the affected people.

Philippines had incorporated the Surveillance in Post Extreme Emergencies and Disasters (SPEED) system since 2010 (http://healthmarketinnovations.org/program/surveillance-post-extreme-emergencies-and-disasters-speed). This SPEED system collected the number of infectious and common disease occurrence and was effective to assist the preventative medical response such as mass vaccination campaign against measles and tetanus, preventative drug administrations and the improvement of sanitary conditions.

San Lazaro Hospital dispatched the special team to provide educations to early detection and treatment of tetanus (Dr. Alex Dimapilis). The medical teams through this education successfully saved all patients with tetanus. Most of the affected people were living in the coastal area and kids were playing with bare feet where the rusted nails from wrecks and debris could cause infection of tetanus. Prevention and the early detection is the only way to save the patients with tetanus.

7.4.3 The role of central and local governments and humanitarian agencies

The domestic and international medical and humanitarian aids were coordinated by the Health Cluster. There was few confusions within more than 100 countries, 1,200 delegates from international aids through DOH/WHO coordination with back-up from WPRO (**Fig.7-3**). Even so, the aids tend to concentrate on the Tacloban area which was most damaged and therefore the most frequent media appearance. It might have created the unreached area where the relief and aids were truly needed. Thus, the multilayered mapping of the affected area based on the demographical data is vital to provide effective relief.

The International and Philippine Red Cross had also cluster approach to provide the relief goods and help effectively (**Fig.7-3**, #3). Philippine Red Cross does not have any its own hospital, but is trained to act as emergency and disaster relief. The relief goods and the transfusion blood was stocked and provided at the operation center (**Fig.7-3**, #3). They provided the town clinic using 7-8 ambulance cars with two medical doctors and two nurses. This mobile clinic stayed in one place for five hours and cared 80-90 patients/day. They made briefings every day to reorganize the plans for effective relief. If the mobile clinic does not have a doctor, even the trained surgical nurse felt the frustration of treating the patients.

The communication was made through satellite phones and the resource was provided from the health and welfare sector in the airport. Public health nurses performed the assessment of the evacuation shelters and reported to DOH using SPEED system every day. The sanitary condition of the people were monitored and helped in collaboration with water, sanitation and hygiene (WASH) sector. Preventative administration of doxycycline was provided for the people who walked in the muddy water to prevent Leptospirosis. Educational gathering of the community people were frequently hosted by the humanitarian agents about the nutrition, hygiene and possible diseases in the current situation.

We visited the base camp of the International Association of Red Cross and Red Crescent. The concept of base camp was first developed by the Danish Red Cross to provide the comfortable work place for the delegates. About 20 big tents with individual tents inside were built as the residential areas. There were showers and toilets. They had the water purification system and clean kitchen to provide safe water and foods. They first bring all the materials with them but gradually utilized the local resources as much as possible to prevent the suppression to the local industries. They had Sunday off so that the delegates could appropriately take rests and provided the mental and physical supports.

Fig.7-3. Humanitarian agencies in Tacloban.

In Manila, we shared the experience and the lessons from Great East Japan Earthquake in the technical discussion on making our hospitals/health facilities safer in emergencies "My Hospital: Last Building Standing in Disasters" in the presence of Secretary Dr. Enrique Ona and Undersecretary Dr. Teodoro J. Herbosa in DOH (**Table 7-3**). The systematic medical response in Japan was presented including Disaster Base Hospital, DMAT, wide area transportation, disaster emergency medical information system and medical-public health coordinators.

Table 7-3. My Hospital: Last Building Standing in Disasters: A technical discussion on making our hospitals/health facilities safer in emergencies at DOH.

Opening remarks	Hon Secretary Dr. Enrique Ona
Introduction and opening	Dr Roland Cortes, Assistant Secretary of Health Dr Julie Hall, WHO Representative in the Philippines
Technical presentations	Overview: Dr Arturo Pesigan, WHO Philippines: Safe Hospitals Programme: Assessment of Hospitals Dr Marilyn Go, Preparedness Div. Chief, HEMS Disaster Base Hospitals and Business Continuity Management: Lessons from the Great East Japan Earthquake: Prof Shinichi Egawa, Tohoku University, IRIDeS
Panel of reactors	Representative, Bureau of Design, DPWH Atty Violeta Seva, Earthquakes and Megacities, Inc (EMI) Professor Ruel Ramirez, UP Diliman
Technical inputs from participants and recommendations	Guided discussion on recommendations for Post Haiyan Recovery and safe hospitals Moderator: Dr Sandra Tempongko Deputy Director, SEAMEO-TROPMED Network

The Philippine Government worries about the delayed restarting of the schools due to the evacuated people and is planning to use hospitals and RHU as evacuation shelters. Further discussion will be necessary to reconstruct the health care plans. DOH is emphasizing the safe hospital concept with business continuity plans. The structural, non-structural and functional strengthening will be required.

The health insurance system in Philippines makes the difference between public hospitals where patient with low income can access to the medical service for cheaper expense and private hospitals where people who can afford the cost. This made the difference in the financial and temporal difference in the recovery and reconstruction process.

Embassy of Japan in the Philippines contacted all of the Japanese residents in the affected area to make sure the safety and physical and mental health conditions, and found out that there seems to be no serious health problems, which urge immediate care.

7.4.4 Infectious disease

Mass vaccination campaign and the extermination of mosquitos prevented the remarkable outbreak of infectious diseases. But, there was a tendency of measles outbreaks and the situations such as deteriorated sanitary condition, malnutrition and crowded populations especially in the coastal and relocated areas where people cook by burning the wrecks suggested the probability of respiratory and digestive disease outbreaks at any time.

The difficulties of medical access for the affected people will lead to the spontaneous termination of drug treatment of HIV or Tuberculosis resulting in the increased frequency of drug-resistance. The demographic analyses of the patients are urgently needed.

The future flooding and mosquito activities will also increase the chance of Dengue and Leptospirosis. In collaboration with San Lazaro Hospital, we studied various bio-markers using ELISA and Luminex and found that Gal-9 could serve as an important novel biomarker of acute DENV infection and disease severity and potential target to control DENV pathogenesis (Haorile et al. 2013).

We also performed a questionnaire survey that showed the awareness of international frameworks for disaster preparedness and response were not so high. Risk perception of natural disaster could be locally rather than globally influenced by the profile of natural disaster (Usuzawa et al. 2014).

Professor Hattori promoted the establishment of collaborative relationship between UP Manila and Angeles University. The long collaborative history with San Lazaro hospital made fruitful results not only with infectious disease but also the whole activities of Disaster Medical Research Team (**Fig.7-4**)

Fig.7-4. Contracting the MOA with UP Manila and collaboration with San Lazaro Hospital.

7.4.5 Mental health

The number of psychiatrists in Philippines is quite small as of several hundreds in the country, the majority of whom work in urban area around Manila, whereas the Philippine archipelago comprises over 7,000 islands, of which about 2,000 are inhabited. These situation causes remarkable shortage of psychiatrists and mental health care givers especially in rural areas, including the areas severely affected by Typhoon Haiyan. To improve the situation, the Philippine Psychiatry Association had provided a Training of Trainers for a psychosocial Intervention Program in Disasters, in 2007 and 2008, to develop leaders in the provision of psychosocial program in their respective regions in the country.

As for psychosocial support for the victims of Haiyan, a local mental health care giver who has taken the training course, along with the disaster mental health support teams lead by the National Center for Mental Health (NCMH) are the core of the mental health response and care for children in disaster, which are supplemented with private stakeholders. However, generally speaking, the middle- and long-term mental health supports are very insufficient.

It is important to centralize the mental health as a framework to improve the primary care and reconstruction in collaboration with DOH, National Mental Health Center, Philippine Psychological Association, World Association for Psychological Rehabilitation, University of Philippines, and other relevant organizations (**Fig.7-5**).

Fig.7-5. Establishment of collaborative relationship with Philippine Psychiatric Association by Prof. Tomita.

7.5 Future Perspectives

a. Investigations of the pathogens of infectious disease in Tacloban and its vicinity in collaboration with EVRMC and San Lazaro Hospital,
b. Investigation of hospital, RHU and BHS reconstruction in the affected area in collaboration with DOH, JICA, WHO and others.
c. Analysis of medical needs in the affected area including mental health in collaboration with UPM and others.
d. The statistical analysis of international medical aids.
e. Promotion of education and research on Disaster Medicine in the collaborative health related universities.

7.6 Establishment of Partnerships

1. Application of JST-RAPID emergency research project through Letter of Intent from UP Manila
2. MOA with San Lazaro Hospital was already concluded.
3. MOA with UPM is in progress.
4. MOA with Angeles University Foundation is in progress.

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8. IRIDeS fact-finding mission, Disaster Recovery Team

8.1 Data Acquisition and Field Survey in Cebu and Basey

Group members

1. Prof. Osamu Murao (Team Leader, International Strategy for Disaster Mitigation)
2. Ass. Prof. Kazumasa Hanaoka (Technology for Urban Resuscitation)
3. Ass. Prof. Kazuya Sugiyasu (International Regional Cooperation Office)

8.1.1 Introduction

Typhoon Haiyan widely affected urban areas in Philippines. It damaged 1,140,332 houses as of January 14, 2014: 550,928heavily, and 589,404 moderately (NDRRMC, 2014).

IRIDeS organized a team for research on the post-disaster recovery support and sent them to the areas affected by the typhoon and tidal wave twice in January and February 2014.

The purpose of the surveys was to obtain data, materials, and useful information for long-term post-disaster recovery research in Philippines, and to clarify specific problems toward its urban recovery.

8.1.2 Itinerary

The authors, members of the post-disaster recovery research team, conducted two surveys in January and February in 2014. The following is the itinerary and a map showing the places visited (**Fig.8-1**).

[Reconnaissance in January 2014]

Sunday, January 19:

21:30 Arrive in Manila

Monday, January 20:

-12:00 Interview, JICA Philippines Office

-15:00 Survey of statistic data, National Statistics Office

-18:00 Gathering materials and information

Tuesday, January 21:

-12:00 Gathering supportive information for field surveys

-14:00 Meeting with travel agencies

-16:00 Gathering materials and information

-17:30 Survey of maps and geospatial data, National Mapping and Resource Information Authority

Wednesday, January 22:

09:45 Depart for Tokyo

[Field Survey in February 2014]

Sunday, February 16:

21:30 Arrive in Manila

Monday, February 17:

-11:00 Purchase of statistic data, National Statistics Office

-13:00 Meeting with Social Housing Finance Corporation

-14:00 Purchase of maps and geospatial data, National Mapping and Resource Information Authority

17:00 Depart for Cebu

18:15 Arrive in Cebu

Tuesday, February 18:

-15:30 Field survey in Medellin: Community-led Disaster Rehabilitation Project

-16:00 Interview, Kawit Barangay Office

-17:00 Interview, Municipality of Daanbantayan

Wednesday, February 19:

06:00 Depart for Tacloban

06:40 Arrive in Tacloban

-09:30 Visit to some damaged areas in Tacloban

10:00 Arrive in Basey

-17:00 Field Survey in Basey

Thursday, February 20:

-12:00 Interview, Municipality of Basey

-15:30 Field Survey in Basey

16:45 Depart for Manila

18:00 Arrive in Manila

19:30 Interview, JICA Philippines Office

Friday, February 21:

10:00 Depart for Tokyo

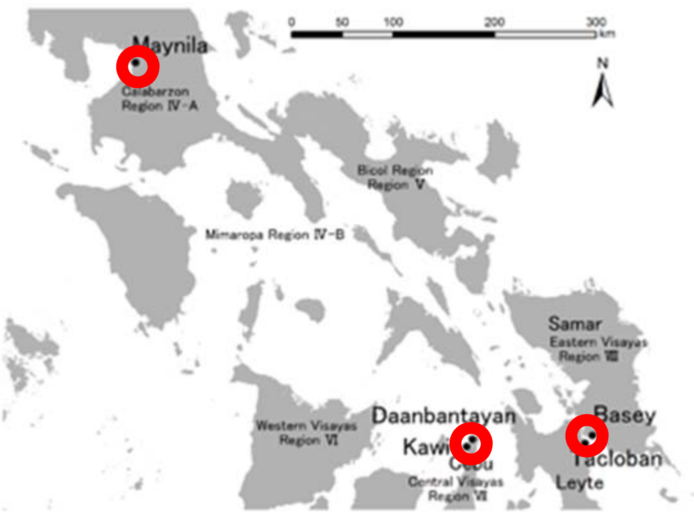


Fig.8-1. Areas visited for Surveys.

8.1.3 Data Acquisition

Spatial information and regional statistics are essential to understand the characteristics of affected areas and to conduct effective measures for recovery and reconstruction planning after calamities. Immediately after Typhoon Haiyan stroke the Philippines in November 2013, our team began to collect various spatial and statistical datasets available on the Internet. Thereafter, during our field surveys conducted in January and February 2014, we visited the National Statistics Office and the National Mapping and Resource Information Authority in Manila, the Philippines, to negotiate about data provision. In this section, we will first provide an outline of spatial and statistical database we obtained. We will then analyze characteristics of areas affected by Typhoon Haiyan based on the datasets.

We obtained the following datasets:

Online free sources: Due to the pervasiveness of the internet and systems like Google Earth and OpenStreetMap, international collaborations about mapmaking were easily achieved. Through the accumulation of such individual and research institutions' efforts (so-called volunteered geographic information), numerous datasets were created and disseminated. At the same time, several portal sites gathered such information and provided them through their websites. Spatial datasets ranging from administrative boundaries, roads, background imagery etc. to Typhoon Haiyan path, building footprints, damage assessment etc. were obtained. A list of useful web sites is presented below:

・Humanitarian OpenStreetMap Team
URL http://hot.openstreetmap.org/projects/typhoon_haiyan
・ArcGIS Online
URL http://www.arcgis.com/home/item.html?id=b5226c1f85954be0891b07ba43 b6e952
・Project NOAH(Nationwide Operational Assessment of Hazards)
URL http://noah.dost.gov.ph/
・Typhoon Yolanda Geonode
URL http://www.yolandadata.org/
・PhilGIS (Philippine GIS Data Clearinghouse)
URL http://www.philgis.org/freegisdata.htm
・Copernicus Emergency Management Service EMSR058
URL http://emergency.copernicus.eu/

Situation Report on the Effects of Typhoon Yolanda: The National Disaster Risk Reduction Management Council (NDRRMC) published a situation report about Typhoon Haiyan every day. Over 100 reports were put on the website (URL: http://ndrrmc.gov.ph/index.php?option=com_content&view=article&id=1125%3Asituational-report-re-preparations

-for-typhoon-qyolandaq&catid=1%3Andrrmc-update&Itemid=1). While contents of the reports differ slightly, they usually contain an updated list of victims and their characteristics such as age, sex, municipality and cause of death/injury. They also have statistical tables about human and housing damage and,and humanitarian assistance. We converted the list of victims and selected statistical tables to Excel format to link with our spatial databases in ArcGIS.

Census of Population and Housing 2000 and 2010 (CPH2000, CPH2010): The National Statistics Office (NSO) conducts the Census of Population and Housing every five years. The latest survey was conducted in May 2010 and already published. CPH 2010 consists of several forms. Of them, CPH Form 2 was distributed to all persons and households in the Philippines (i.e. a complete survey). We contacted the NSO about data provision in January and February 2014 and they appreciated the purposes of our data use and kindly provided CPH 2000 and 2010. Specialized software (CS Pro) for census operation was used to assist data manipulation, tabulation and export.

CPH Form 2 contains questions about both demographic attributes such as age, sex, and education level of household members and housing attributes such as type of building and construction materials of houses in which people reside. Since a large number of houses along the coast were washed away by the storm surge, we cannot survey construction materials from fieldwork and satellite imagery in same detail as from the census. CPH 2010 is the only data source to understand housing characteristics of affected areas before Typhoon Haiyan. We therefore tabulated the dataset by a selected demographic or housing variable and municipality to create thematic maps.

Datakit of Official Philippine Statistics (DATOS): DATOS is a collection of various statistics at barangay and municipality level. It contains information of (1) the number of facilities (hall, hospital, school, telephone, electric power etc.) at barangay level, (2) the number of establishments by types at the municipality level and (3) official population counts for 1980, 1990, 1995 and 2000. DATOS also includes ESRI Shapefiles of provincial and municipality, barangay boundaries for mapping datasets in DATOS as well as tables tabulated from CPH 2010.

Large scale urban maps of Tacloban and Ormoc (**Fig.8-2**): The National Mapping and Resource Information Authority (NAMRIA) published different types of maps. Large scale maps are however limited to large cities and they have not been updated frequently. CAD maps for Tacloban and Ormoc cities were fortunately available although they were last updated in the late 1990s. These CAD maps were converted to ESRI Shapefiles to overlay them with other maps. The maps contain shapes of buildings, elevation, roads, vegetation, etc. These large scale maps are useful for base maps for damage assessment and urban expansion analysis.

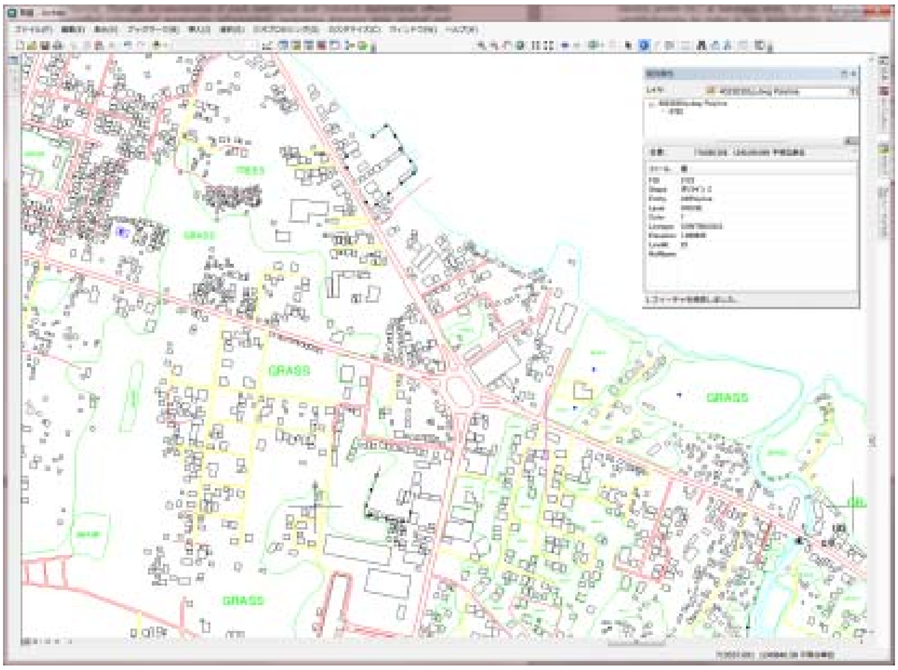


Fig.8-2. A large scale urban GIS map of Tacloban.

<u>Analysis based on datasets we obtained:</u>

By using situation reports on the effects of Typhoon Haiyan by NDDRMC, spatial distributions of housing and population suffered from Typhoon Haiyan are mapped in **Fig.8-3** and **Fig.8-4**.

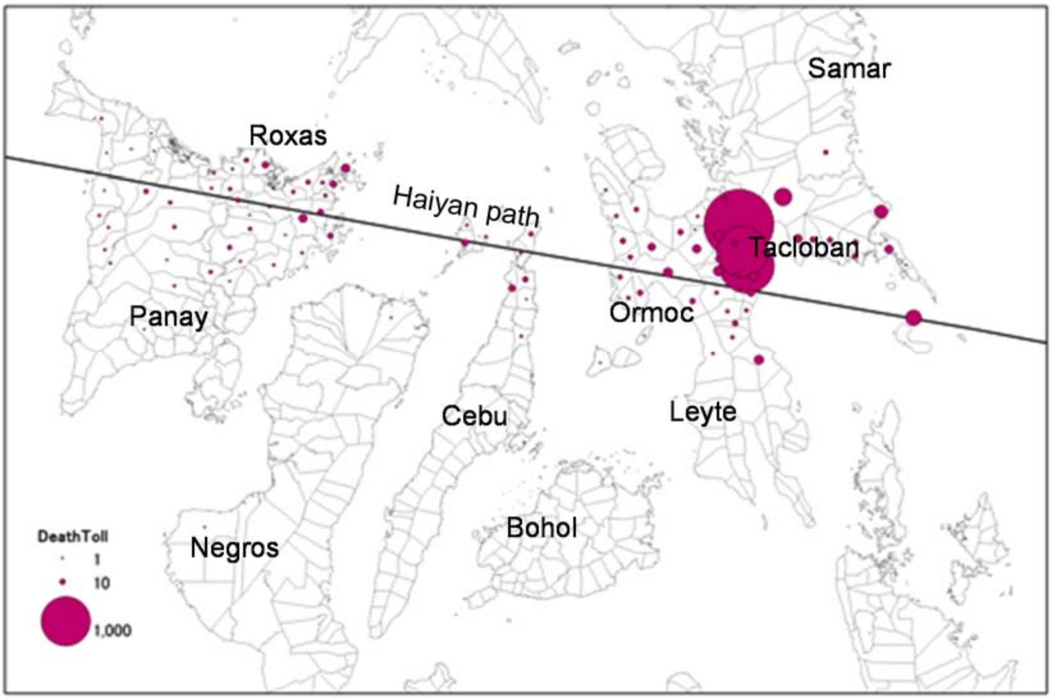


Fig.8-3. The number of dead (Source: NDDRMC Situation Report).

Fig.8-4. The number of houses damaged by Typhoon Haiyan (Source: NDRRMC Situation Report).

According to **Fig.8-3**, a large number of the dead were mainly concentrated in municipalities around Tacloban City where an extremely high storm surge and strong wind speed were recorded. On the other hand, the number of houses damaged is larger not only around Tacloban City but also in municipalities along the storm track. Inland municipalities also had housing damages possibly because strong wind destroyed rural houses constructed by light weight natural materials **(Fig.8-5**).

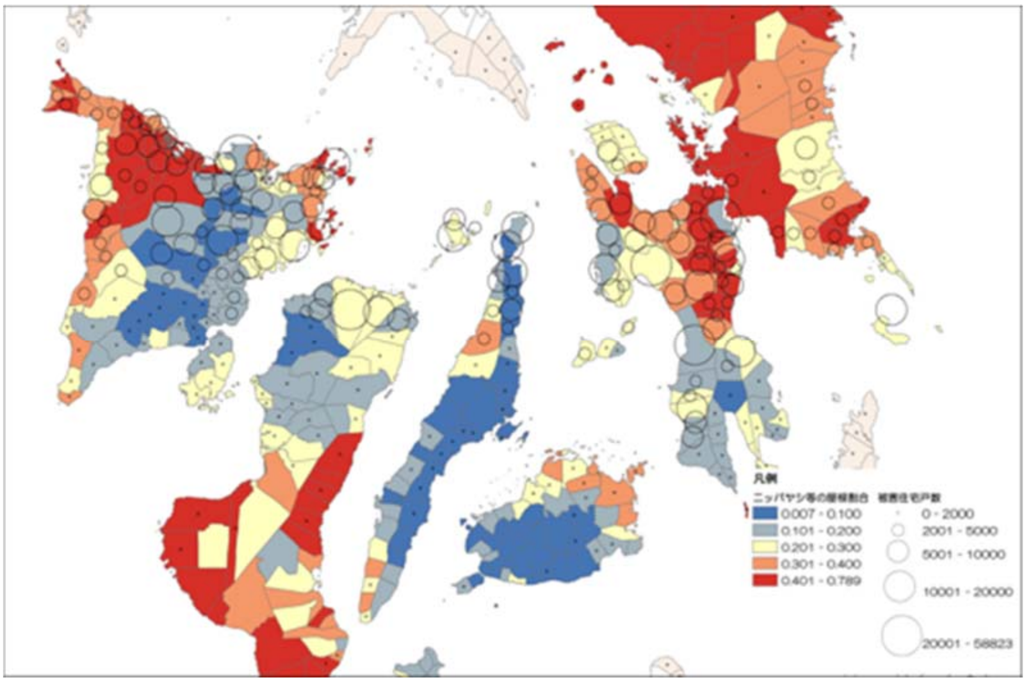


Fig.8-5. Proportion of houses with cogon/nipa/anahaw roof (Source: CPH2000).

In order to understand characteristics of the dead, we first tabulated counts by sex or age categories of victims and then estimated the total counts of the dead and injured per 10,000 people (**Fig.8-6**) based on population in CPH 2010. Our initial survey revealed males and the elderly are more likely to have suffered from Typhoon Haiyan. In particular, people aged 70 years old and over are ten times more likely to be killed.

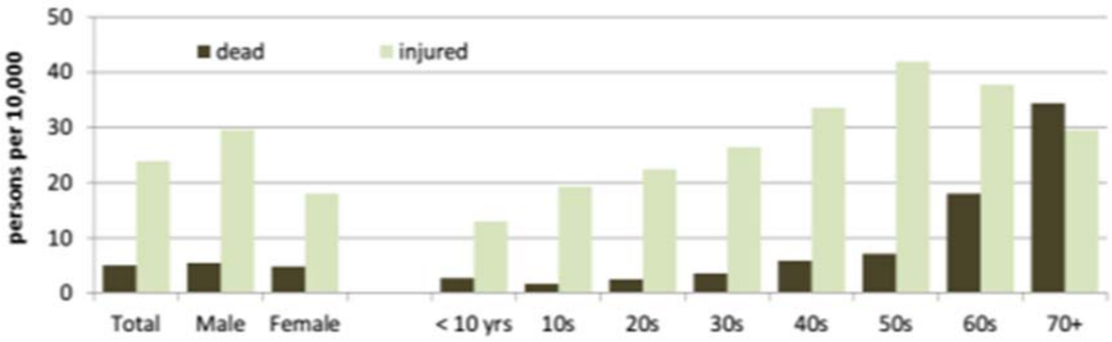
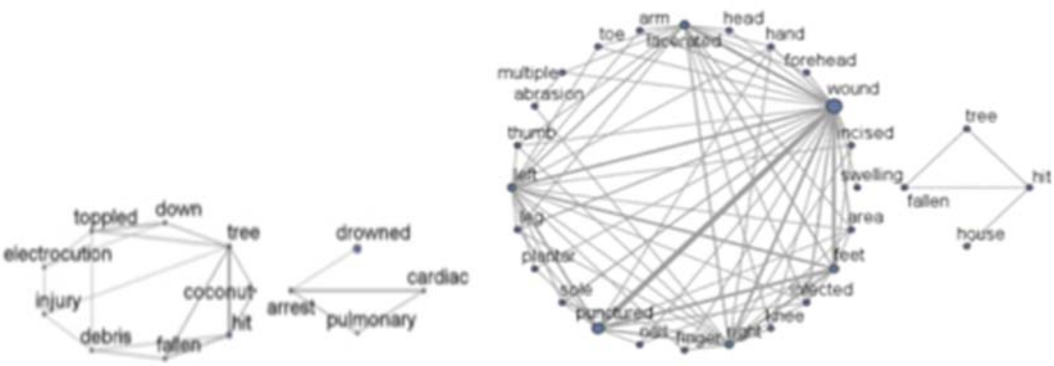


Fig.8-6. The number of the dead and injured by sex and age category (adjusted).

We experimentally applied text mining to words used to describe causes of death or injury in the list of victims for estimating possible causalities. **Fig.8-7** presents co-occurrence of words after excluding “previously reported unidentified”. Ranked by the number of times they appeared in the list, words are classified into three groups. The first group relates to “drown” (including “drowning”) which suggests that people were killed by storm surge. The second group includes words like “cardiac” and “arrest”, which also suggest an association with “drown” to some extent. The third group contains “tree”, “debris”, “hit”, “fallen” and “toppled”. Since these words were used concurrently, many people were possibly killed by collision caused by strong wind. On the other hand, “wound” (including “wounded”), “punctured” and “lacerated” appeared often with words relating to human body parts. These co-occurrences imply that people became injured during their evacuation.



causes of death causes of injuries

*Size of circle represents the number of times a word appeared in the list.

Fig.8-7. Co-occurrences of words used for describing causes of death and injuries in the list of victims.

8.1.4 Field Survey in Basey

(1) Outline of the survey

The municipality of Basey is located in Samar Island, northeast of Tacloban. According to material obtained in the field survey, Typhoon Haiyan caused 235 casualties including missing people, injured 714 people, and affected 15,583 families and 50,423 people in the municipality. The number of heavily damaged buildings is 7,175 and moderately damaged is 5,048.

The post-disaster recovery research team carried out a field survey to record the building damage conditions in Basey (**Fig.8-8**) in February for long-term post-disaster urban recovery monitoring. The team visited the Municipality Office to get information on the regional damage in order to understand the data obtained by the survey. We also interviewed people living in the coastal areas and in temporary housing who were affected by the typhoon.

Fig. 8-8. Map of Basey used for the Field Survey.

(2) Record of building damage conditions

The building damage recording method the team applied in the survey was as follows.

At first, we defined the boundary of objective areas that were affected by the typhoon and determined the driving route based on the map (**Fig.8-8**). Then we took a record of all buildings in the area with GPS driving recorder on a car. The building damage conditions are classified into four categories: completely damaged, heavily damaged, moderately damaged, and slightly damaged (**Fig. 8-9**). We are currently working on the analysis.

Fig. 8-9. Damaged and rebuilt buildings in Basey.

(3) Recovery conditions as of February 2014

As well as recording the damage condition, the team visited the Municipality of Basey and interviewed the Municipal Mayor, staff in the City Planning Department, and victims to understand recovery conditions and problems they were facing (**Fig.8-10**).

One of the significant problems for affected residents living in coastal areas was landownership. The government stated that they would adopt building regulations in the coastal zone within 40m from the coastline. This would influence the recovery situation of the residents and their resettlement

Another problem for the victims was the criteria to live in a temporary house such as the number of children they have. There is a temporary housing area on the outskirts of the town (**Fig.8-8**) and the floor area of each house is about 6 m^2. Some people who lost their houses had to keep living in a damaged area because they did not meet the criteria.

The recovery plan was under consideration when the survey was conducted.

Fig.8-10. Gathering information in the Municipality Office and temporary housing.

8.1.5 Field Survey in Cebu

(1) Outline of the survey and building damage conditions

The north of Cebu is non-tourism development zone as compared with other areas in Cebu island. According to NDRRMC report (2014), the number of damaged houses remained at 24,373 houses (18,752 completely / 5,621 slightly) and 8 persons were killed in the north of Cebu (the total in Municipalities Daanbantayan and Medellin) by typhoon Haiyan. When we conducted a field survey in February 2014, we found collapsed buildings everywhere (**Fig.8-11**, **8-12**). Our team conducted interviews focusing on how to provide recovery support for victims by NGO and the local government in Barangay Kawit (**Fig.8-13**).

Fig.8-11. Completely damaged buildings in Barangay Kawit, Cebu. Basketball gymnasium (left) and privately owned building (Right).

Fig.8-12. Slightly damaged buildings (roof and windows) in Medellin, Cebu.

Fig.8-13. Field survey area in Cebu.

(2) Recovery conditions as of February 2014

This time, the affected area in Cebu conducted self-reconstruction by victims. In addition, NGOs provided temporary employment and housing reconstruction support, and local governments of Cebu provided food supply assistance. However, we could not confirm financial assistance, localized recovery, or reconstruction plans for the affected areas in Cebu by the government.

(3) Support activity by NGO

In Barangay Kawit in Cebu, we contacted NGO staff (Joint team of Lihok Filipina Foundation, Pagtambayayong Foundation and PhilDHRRA) to inquire about support for the victims. They were providing temporary employment support (clean up the shack, Php300.00/day), housing support (construction of starter houses, Php8,000.00/unit and repair of housing units, Php4,000.00/unit) and others (**Fig.8-14**) for the victims. In addition, the standard of support that should be provided for the victims was determined by DSWD (Department of Social Welfare and Development) based on damage level of housing etc.

Community-Led Disaster Rehabilitation Project (Barangay Kawit, Medellin, Cebu)
Project Duration: December 2013 – April 2014

<u>Project Components</u>

Employment Generation & Livelihood (Cash for Work)
Php 300.00/day inclusive of 3 months SSS and 1 year Insurance
Construction of Starter Houses @Php8,000.00/unit
Repair of Housing Units @Php4,000.00/unit
Construction of Communal Toilet & Bath @Php60,000.00/unit
Provision of Hygiene Kit @Php50,000.00/Toilet
Information and Education Inputs/Activities
Psychosocial activities and support

Fig.8-14. Support for victims by NGO in Barangay Kawit, Cebu.

Temporary houses (starter houses provided by NGO) were located in the area 200m away from the coast. The houses were composed of simple structures such as wooden frameworks, tin roof and walls, and the material used were blue tarpaulin, wooden board and bamboo fence etc (**Fig.8-15**). To conduct this project, NGO faced two problems: how to provide clean water, and how to collect the fund and materials since Philippine Government didn’t establish a housing support system.

Fig.8-15. Temporary houses (starter houses provided by an NGO) in Barangay Kawit, Cebu.

(4) Support activity by Government

According to Barangay officers in Kawit, they provided food support for the victims, but they did not establish a housing support system by the government. Therefore, they needed to depend on NGOs for the main part of housing reconstruction assistance.

To start recovery process, the Philippine Government decided to set “no-build zone” in the Recovery Plan (2013) in order to prohibit housing construction within 40m from the coast and ensure safety for residents. However, the residential area has already existed in the coastal area in Kawit before Typhoon Haiyan. The Barangay Captain tried to encourage residences to move inland, but it was not so effective for them. Therefore, barangay officers think it is hard to keep a no-build zone.

8.2 The Post-Disaster Phase of Transitional Settlement: A Perspective from Typhoon Haiyan in the Eastern Philippines

Group members

1. Prof. David Alexander (UCL-IRDR)
2. Dr. Joanna Faure Walker (UCL-IRDR)
3. Mr. Joshua Macabuag (UCL-EPICentre)
4. Assoc. Prof. Anawat Suppasri (Earthquake induced Tsunami Risk Evaluation, IRIDeS)

8.2.1 Collaboration between UCL-IRDR and Tohoku University IRIDeS

The field mission to the Philippines to assess post-disaster recovery was part of an ongoing collaboration between University College London Institute for Risk and Disaster Reduction (UCL-IRDR) and Tohoku University International Research Institute of Disaster Science (IRIDeS). It was planned following a symposium on disasters held by UCL-IRDR and IRIDeS in London during November 2013. Prior to that, a UK-Japan workshop on disaster risk reduction entitled "Learning from the 2011 Great East Japan Earthquake" took place in Tokyo during October 2012 (Faure Walker et al. 2013). UCL-IRDR, UCL EPICentre, and IRIDeS members also collaborated as part of the EEFIT team which assessed the recovery process two years after the 2011 Great Eastern Japan Earthquake and Tsunami (EEFIT 2013). The text in this chapter is included within the IRDR Special Report 2014-01 "The post-disaster phase of transitional settlement: A perspective from typhoon Yolanda (Haiyan) in eastern Philippines".

8.2.2 Mission Aim

The aim of this field mission was to compare the effects of domestic and imported aid and assistance on the quality and speed of recovery. Another aim was to assess vulnerability during the transitional phase between the initial emergency and long-term recovery and reconstruction. The mission focused on households and the physical structures in which they live. It also considered socio-economic influences upon resilience and the role of insurance in reducing the impact or increasing the rate of recovery. Specifically, the team carried out systematic surveys of the quality of building repairs and reconstruction processes in conjunction with questionnaire surveys of the householders who inhabited the structures. In addition, key professional personnel were interviewed.

8.2.3 Survey Methods

A brief fieldwork campaign was conducted during March 2014, four months after the typhoon. Some 160 households were surveyed in 12 coastal Barangays (districts) of Tacloban, Palo and Tanauan in the province of Leyte, a part of the Philippine region of Eastern Visayas. According to 2010 census data, the survey covered about 2, 5 and 5 per cent of the population of these municipalities, respectively. The questionnaires were accompanied by a structural engineering survey of respondents' living quarters, which helped verify statements made about the processes of building shelter and established the quality of the shelters in terms of resistance to future typhoons.

Fig.8-16. Prof. David Alexander and Dr. Joanna Faure Walker interviewing a resident in Tanauan.

Fig.8-17. Joshua Macabuag and Dr. Anawat Suppasri conducting a survey of a house in Palo.

8.2.4 Need for Research on the Post-Disaster Transitional Phase

Research into risk and disaster reduction and post-disaster recovery is often focused on either the immediate emergency response phase or the long-term permanent recovery phase. Much less studied is the transitional phase, which begins when immediate relief winds down and continues into the start of permanent reconstruction. Some authors (e.g. Omidvar and Binesh 2012) have argued that there should be a direct passage from early recovery to final reconstruction, with the elimination of the transitional phase. Others (e.g. Alexander 2013) have probed the ways in which transition can become consolidated and institutionalised such that it reduces the impetus for full reconstruction. Meanwhile, evidence is mounting that attempts to shorten the duration of the transition between emergency response and full-scale reconstruction may involve skimping on design and consultation processes. As a result, policies may be implemented that are dysfunctional and do more harm than good (Ingram et al. 2006).

8.2.5 Themes

Regarding the emergency phase of the typhoon disaster, we were interested in assessing the effectiveness of warning messages and evacuation procedures, as well as that of aid and assistance. With regard to the families that lived in the path of the storm, we examined how socio-economic status affected recovery, and the extent to which employment suffered. We enquired into the means by which shelter was provided and constructed, and evaluated its effectiveness and safety in the face of continuing natural hazards. We were particularly interested to find out whether families had received expert help when shelter was reconstructed, and, if so, what impact this may have had on the safety of transitional dwellings. We also looked into the security and tenure of families, especially in the light of the Philippine Government's declaration of a 'no-build' (i.e. set-back) zone that will stretch 40 metres inland from the shore. Finally, we asked what future prospects families envisaged after their homes had been severely damaged or destroyed by the typhoon.

Various secondary questions arose from our survey work in the barangays. Was expertise on natural hazard resistance being utilised in the construction industry in order to make temporary shelters safe against wind and water damage during typhoons? What was the level of uptake of hazard insurance and what was the degree of interest in insurance (or possibly micro-insurance) schemes that cover typhoon damage? As judged by the recipients of aid, did the Government and NGO relief agencies perform well during the early stages of the disaster? How well did they succeed in providing assistance to the needy and stabilizing the situation at the local level?

What is the relationship between transitional settlement (in particular, transitional shelter), long-term reconstruction and overall economic and human development? Did the transitional situation offer any clues regarding the outcomes in the longer term? In the areas we studied, are opportunities for development and vulnerability reduction being taken or ignored? In other words, does the ongoing process of recovery in the Philippines embody any sense of 'bounce-forward' (Manyena et al. 2011), or building back to higher standards of resilience?

8.2.6 Key Findings and Recommendations

Our findings relate to a variety of elements of the situation. The first of these is **evacuation** prior to the arrival of Typhoon Haiyan. The standard practice was for evacuation warnings to be disseminated to individual households by Barangay leaders. Almost two thirds of households that participated in the survey evacuated either the whole family or most of its members before the typhoon arrived, while 8 per cent evacuated during the typhoon and 28 per cent remained in situ. Fewer of the families that remained suffered major damage to their properties that did those who evacuated, which suggests that the former anticipated lower risks by not evacuating. Of the families that evacuated, 55 per cent evacuated all members, 32 per cent left some men behind, 1 per cent evacuated children while leaving the parents behind and 12 per cent did not specify exactly who in the household left. Where men remained, the principal reason appears to have been the desire to guard property. Of 37 families in which men remained behind but women did not, we were able to verify that 13 (more than one third) suffered fatalities as a result. Overall, warnings successfully reached the majority of the people we interviewed. However, in many cases families underestimated the severity of the storm surge. Hence, the dissemination of warnings was effective, but the content less so.

The **distribution of money and basic goods** is one crucial aspect of the bridge between the emergency phase, in which mere survival is the objective, and the transitional phase, in which families must start to consider how they are going to recover in the long term. Studies show (Middleton and O'Keefe 1998) that the assistance people receive must help them recover rather than destroying local coping mechanisms (including local markets and businesses) and inducing aid-dependency. We found that almost all agencies working in the Tacloban area had furnished only minimal aid to the respondents of our survey. The Philippine Government provided basic foodstuffs, while INGOs gave hygiene kits and cooking utensils. Limited cash-for-work schemes were operated over a brief period. Over a period of two months, one INGO, acting independently of the others and of the Government, distributed cash to families. The grant varied from US$175-350 according to family size. Many of our respondents received it. Cash distributions are the subject of varied opinions in the literature (cf. Mattinen and Ogden 2006, Willibald 2006). Cash hand-outs may encourage corruption and heighten security risks. We found no evidence of these problems and instead that cash was highly beneficial in enabling people to buy building materials, subsistence foods, goods to sell in a small business or items such as fishing boats or rickshaws. However, like Mattinen and Ogden (2006), we also found that the influx of cash stimulated inflation in the price of building materials, which increased by between 20 and 100 per cent with respect to what it was before the typhoon. However, some of the increase can be attributed to a shortage of sawmill capacity. It would have helped if the Philippine Government and local authorities have endeavoured to control prices.

The Philippine Government has decreed that an area that stretches 40 metres inland from the current coastline will be designated as a **no-build zone** (known in other parts of the world as a ‘set-back line’), in which reconstruction will be prohibited and from which existing settlement will eventually be relocated. Local governments have been given the option to adopt or reject this measure. We found that 94 per cent of interviewees knew where the no-build zones were, and hence we conclude that the system of using large signs to indicate the no-build zones has been effective. However, despite its ease of communication, we question whether the 40m no-build zone policy is unreasonably simplistic. It does not reflect variations in hazard level with topography and may therefore lead to the underestimation of the risk in some places and its overestimation, leading to unnecessary relocation, in others.

The survey found that 99 per cent of householders interviewed did not have **property insurance**, which is consistent with national penetration rates of barely 1 per cent (de la Cruz Tendero 2013). Of those interviewees who lacked insurance, 34 per cent stated they would like it in the future, 20 per cent said it was too expensive and 38 per cent were unable to decide because they lacked basic information on the topic. Hence, we recommend that insurance companies and local government work to educate the population of high-hazard areas about whichever insurance options are available. Furthermore, we encourage those who are investigating alternative low-cost insurance options (possibly micro-insurance) to continue their work.

We were interested in **the pace of temporary and permanent reconstruction**. At the time of the survey, March 2014 (four months after the typhoon), 99 per cent of respondents had started temporary reconstruction, but 87 per cent had not begun the process of reconstructing their accommodation permanently. Half of the latter cited lack of money as the reason. Given the choice, 79 per cent of interviewees would reconstruct in situ, and this proportion rises to 90 per cent when one considers only households located outside the 'no-build zones.' More than half of the dwellings that we examined were built without the aid of professional advice or help. In very many cases, householders built their own transitional shelter, possibly with the aid of a local carpenter, whose qualifications and skills were probably minimal.

Those respondents who were awaiting relocation had little or no idea about to where they would be relocating or when it would happen. In terms of the demand for housing, the production of temporary shelters and the inability to start permanent reconstruction made the transitional phase of recovery inevitable, whether or not it was desirable in terms of the pathway to a stable, permanent reconstruction. It would have been helpful if local governments could have given householders more information about their plans for relocating them.

Fig.8-18. A ship that destroyed homes and subsequent transitional shelter constructed within the no-build zone in Tacloban City.

The survey was particularly concerned with the **quality of reconstruction**. We found that shelter built by householders without the aid of training or expert advice led to the proliferation of structures that are vulnerable to typhoons and storm surges, possibly also tsunamis, which could happen during the life of such structures. Philippine and international NGOs had formulated advice on good construction practice, but we found that it did not reach the householders that we interviewed. Even those dwellings that were built by carpenters with some experience in the construction industry lacked basic measures to ensure safety and robustness. Hence, in relation to the risk of future natural hazards, communities did not appear to be "building back better."

In general, the dwellings we surveyed lacked bracing to ensure lateral stability and tended to have foundations that were too shallow. Connections between roofs and frames were inadequate and steel sheets used as roofing material had little to restrain them against high winds. Regarding timber frames, structural members had inadequate connections, and the sizes of timber used tended to be inadequate and inconsistent, especially where the lumber was salvaged from the post-typhoon wreckage.

Reinforced concrete suffered from poor compaction, over-sized aggregate, inadequate rebar cover, the use of smooth steel bars (however, mainly in older constructions) and an excessively sparing use of reinforcement. Where cinder-blocks were used as a construction material, they tended to be low quality and hence weak. Walls were too thin and few ties existed between blocks and vertical posts.

As structures that were near to each other tended to be built using similar construction techniques, it seems that both defects and strengths were disseminated locally in either active or passive mode. The Philippine Technical Education and Skills Development Authority (TESDA) runs training schemes in the form of short courses on key skills. It is intended that those who attend the courses will pass the knowledge on to others in their barangays. Unfortunately, the householders we interviewed did not seem to be aware of these programmes.

Training programmes are needed in the early stages of the transitional recovery phase. In this respect, the TESDA programmes are promising, but they need to be more numerous and more widely accessible to beneficiaries. Community-level awareness programmes involving posters and local talks can be used to demonstrate basic principles and essential details of construction. They should be used to ensure that householders understand bracing for stability, frame connections (e.g. using more one nail per connection) and roof connections (abundant use of hurricane straps and better securing of the elements of roofs). Those authorities who commission reconstruction programmes need to be given presentations and other forms of awareness programmes. They include councillors and other community representatives, municipal staff and NGO operatives who are responsible for recovery and reconstruction processes.

More detailed training is needed for those people who are professionals in the construction trade, as they can be expected to put the lessons directly into practice and retain the knowledge in their future work. Training for all professional people in the construction trades is an unrealistic goal because it would be too expensive. However, with careful management, a 'cascade system' can be used in conjunction with a construction programme that uses the "supervised self-build" model. "Training of trainers" can include mentoring processes, transfer of skills and the consequent dissemination of expertise. Examples of appropriate schemes are given in Macabuag (2010) and Macabuag et al. (2012).

Construction Quality

General

Lack of lateral stability systems (e.g. bracing)	

Roof

Poor holding down of roof sheeting	

Timber

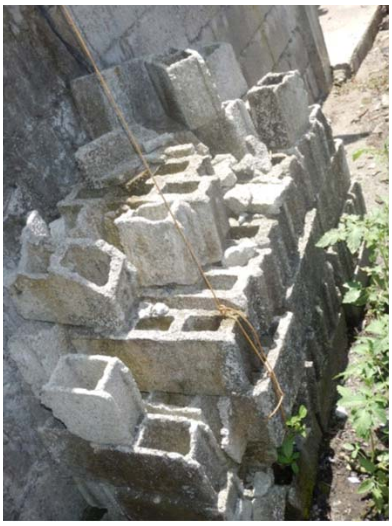
Inadequate and inconsistent member sizes (often because using salvaged timber)	

RC

Poor compaction	
Oversized aggregates	 
Smooth bars	

Inadequate cover	

Block

Thin and lightly reinforced block walls	
Weak blocks	 

Overly light reinforcement	
Few ties between blocks and vertical posts	

8.2.7 Conclusions

The transition between emergency assistance and permanent recovery is a critical phase (Leon et al. 2009). It can determine the course of reconstruction and recovery, and contribute much to its eventual success or failure. During this period, survivors can be either lifted out of poverty and destitution, and protected against further hazard impacts, or left to languish in a state of perennial vulnerability.

Our survey showed some positive aspects of the emergency phase, particularly in the dissemination of warnings and decision to evacuate. Not all evacuation ended in success, in that the storm surge was high enough to overwhelm places such as the Tacloban Convention Centre, in which many families were sheltering. Transitional shelter was mostly erected over a period of three months, during which many people lived in precarious, makeshift conditions. Some continued to live in tents four months after the event, but repair of local infrastructure and provision of basic housing were moving ahead.

Our main finding is that, among the people and families we interviewed, natural hazard vulnerability was reproduced during the transitional phase, while employment stagnated and long-term prospects were, for many interviewees, unfathomable. Hence, an opportunity to create safety and the conditions for a “bounce-forward” recovery essentially lost, or at least deferred until an unpredictable future.

Acknowledgements

This mission was funded by UCL-IRDR, UCL EPICentre and IRIDeS. We would like to thank our support staff in the field (Mr. Norvi Cajado, Filipe Jamile and Nole Candiza).

8.3 Path to "Build Back Better": involvement of local stakeholders in future disaster risk reduction and planning recovery and implementation

Group members

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2. Assoc. Prof. Kanako Iuchi (Comparative Mitigation Society)
3. Assoc. Prof. Michimasa Matsumoto (International Regional Cooperation Office)

Objectives

The focuses of the major interests by the participated researchers in this mission are social science, community resilience, post-disaster planning and policies as well as role of local stakeholders in disaster risk reduction (DRR). This field mission aims to learn: i) how are governments (both national and locals), Civil Society Organizations (CSOs), private sectors and communities had prepared against disasters in the past, responded as well as been recovered after Typhoon Yolanda; and ii) what are the emerging issues in recovery, in particular on resettlement and livelihood rebuilding practices. This trip occurred between March 4th and 13th, 2014.

Activities

The team visited Manila, Tacloban and Ormoc on 4-13 March 2014. The research was conducted mainly based on a series of meetings and interviews with government officers, CSOs, private sector representatives, and community leaders. The list of the interviewees include: the Center for Disaster Preparedness (CDP), Corporate Network for Disaster Response (CNDR), Asian Disaster Reduction and Response Network (ADRRN), the Eastern Visaya Network, Help Direct Initiative, the National Disaster Risk Reduction and Management Council (NDRRMC), Office of Civil Defense (OCD), Department of Public Works and Highways (DPWH), Philippine Institute of Volcanology and Seismology (PHIVOLCS), SRDP, Oriental Consultants, United Nations Development Programme (UNDP), Office of the Presidential Assistant for Recovery and Rehabilitation (PARR), City Government of Tacloban, City Government of Ormoc, Tacloban City Councilor, Barangay leaders from Barangay Uban, Barangay 68, Barangay 64, Barangay 59-B, Barangay 88, Barangay 31, and Barangay 61 in Tacloban, and the Barangay Luna, Guintigui-an, Quezon. Jr, Linac, Valencia, Bagong, San Antonio, and Can-untog in Ormoc.

8.3.1 Challenges and opportunities in involvement and contribution of local stakeholders (LGUs, civil society organizations, private sectors etc.) in disaster response and recovery

8.3.1.1 Future disaster risk reduction (DRR) strategy in the Philippines: strengthening the DRR capacity of local government units (LGUs)

The Philippines Disaster Risk Reduction and Management (DRRM) Act or the Republic Act No. 10121 was enacted in 2010 in order to strengthen the country's institutional capacity for DRR and management and to build the resilience of local communities to disasters including climate change impacts. Under this Act, provinces, cities and municipalities have a greater responsibility in building the disaster resilience of communities, and in institutionalizing DRR within their functions and operations (EMI, 2010). The Act made a paradigm shift possible in the disaster management strategy in the Philippines from the focus on emergency relief (post-disaster) to DRR (pre-disaster). This puts more emphasis on strengthening people's capacity to absorb stress, maintain basic functions during a disaster and bounce back better from disasters (DRRNetPhils, 2010).

The major characteristics of the Act are highlighted as the policy that emphasizes the needs and importance of:

- promoting involvement and participation of all sectors and all stakeholders concerned at all levels especially the local community,
- strengthening the capacity of the national government as well as the local government units (LGUs),
- mainstreaming DRR and climate change in development processes,
- recognizing and strengthening the capacity of LGUs and communities in DRR, response and recovery, and
- engaging the participation of civil society organizations (CSOs) and the private sector..

In addition, the Act transformed the then National Disaster Coordinating Council to the National Disaster Risk Reduction and Management Council (NDRRMC) and included representatives from CSOs and the private sector in the Council. Under the NDRRMC, the Regional Disaster Risk Reduction and Management Council (RDRRMCs) and the Local Disaster Risk Reduction and Management Council (LDRRMCs) were established in order to monitor and implement the action plans and ensure the integration of DRR and climate change adaptation into local development plans, programs, and budgets. Concerning the fund allocation for DRR and management, not less than 5% of the estimated revenue from regular sources is set aside as the Local Disaster Risk Reduction and Management Fund (LDRRMF) to support disaster risk management activities including post-disaster activities. Of the amount for LDRRMF, 30% is allocated as the quick response fund and 70% is allocated for DRR purposes. Furthermore, the Act encourages integrating DRR and management education in the school curricula of secondary and tertiary level of education whether private or public, including formal and non-formal, technical–vocational, indigenous learning and out-of-school youth courses and programs.

While the enactment of the Act became an important chapter of the disaster management history of the Philippines and demonstrated that the Philippines has fully committed to the enhancement of the DRR capacity and its implementation both at national and local levels, the question of the progress and extent of the implementation of the Act still remains 3 years after its enactment. In the interview with the municipality in Tacloban and Ormoc as well as a national CSO in the Philippines, gaps were addressed in the preparedness and response capacity of cities and barangays.

City Disaster Risk Reduction Management Offices (CDRRMO) were established in both Tacloban and Ormoc and played an important role in emergency relief when typhoon Haiyan struck these cities. In Tacloban, according to the CDRRMO officer, the hazard maps to prepare for tsunamis and storm hazards were distributed and the stockpile of relief items was prepared prior to typhoon Haiyan. The contingency and disaster response plan existed. However, the resources that the city possessed, such as equipment needed for the search and rescue activities were not sufficient, and at the same time, most of them were washed away. A certain time was required for assistance from the national and international levels to arrive. Furthermore, in the interview of the Barangay leaders, all of them emphasized that they did not have sufficient knowledge to understand what the storm surge was and the fact that they needed to evacuate immediately.

In Ormoc, due to their former experience of the flash flood in 1991, their understanding and knowledge on disaster preparedness was high. The direct damage and impacts were also less compared to the ones in Tacloban. The response activities were undertaken in close collaboration with the LGUs, the private sectors, and the communities. Even at the Barangay level, the preparedness training and evacuation drills were provided prior to the typhoon Haiyan. It showed that the past experience of disasters can be a crucial element of awareness raising on DRR.

In the Act, the CDRRMO is provided three staff for 1) administrative and training, 2) research and planning, and 3) operations and warning. One of the national CSOs in the Philippines commented that the current capacity of the CDRRMOs was not sufficient in order to conduct thorough programs and tasks for disaster preparedness. Therefore, while 90% of the municipalities established CDRRMOs, most of them are not yet fully operational. Further support to the LGUs for their capacity development of DRR is urgently needed. The collaboration and joint activities/programs with the CSOs and the LGUs may be one of the possibilities to explore in the future.

8.3.1.2 Involvement and participation of new local stakeholders in disaster response and DRR

National and Local Civil Society Organizations (CSOs)

A number of international organizations were actively involved in disaster response activities after this typhoon. In addition, the roles of the national and local CSOs in the Philippines in the disaster response should not be overlooked. In most cases of disaster response to a large-scale disaster ,international organizations and agencies from outside the affected countries play a key role in the disaster response, however, the coordination and collaboration with national and local CSOs are often neglected although national and local CSOs have long-term experience working with the community for many years and understand the risks, issues and conditions at the local level. As a result, in many cases, the internationally provided assistance does not take into consideration the local culture and practices and does not have a long-term perspective and emphasis on sustainability. In addition it leads to a disaster response that does not reflect the actual needs of the communities and causes the delay of the overall response and recovery efforts. The participatory approach is crucial in the effective disaster response and recovery by encouraging the involvement of various local stakeholders.

In order to reduce the gaps in the needs of the communities and the assistance provided internationally, a CSO network in the Philippines took the lead for coordination between international organizations and national/local organizations during the response to typhoon Haiyan. The Eastern Visayas Network is a CSO network that includes various groups of women, farmers, elderly, youth organizations and multi-sectoral organization and consists of more than 30 organizations. The major objective of the network is capacity development of the member organizations regarding law, human rights, local development planning, project monitoring, budget management etc. In case of the Haiyan response, the Network played a role especially in information sharing about community needs and logistical conditions and in providing suggestions for the ways of assistance based on local culture and tradition according to the Executive Director of the Eastern Visayas Network. In addition, the Network shared the information and contacts of the national and local organizations with specific focuses and encouraged international organizations to work and collaborate with them.

Such national and local CSOs network was also supported by a regional CSO network called the Asian Disaster Reduction and Response Network (ADRRN). ADRRN consists of nearly 50 CSOs from 20 countries in the Asia-Pacific region. ADRRN has an experience of providing coordination between international organizations and national and local CSOs in other countries. ADRRN sent the assessment team to the Philippines after the typhoon Haiyan to conduct a needs assessment and analysis in coordination among national and local CSOs, governments and international organizations. The result of the assessment shared by the ADRRN Program Officer who joined the assessment team addressed the gaps in limited cultural sensitivity, lack of information sharing, fragmentation of coordination mechanism, and weak participation of local stakeholders in the coordination mechanism. Based on these findings, ADRRN proposed to establish a resource/coordination center for the national and local NGOs. These resource centers were temporally established in Cebu, Ormoc, Tacloban, Roxas and Guiuan. The Eastern Visayas Network managed the resource center in Tacloban. The major contributions of the resource centers include information sharing, capacity development of CSOs, strengthening horizontal coordination between international, national and local organizations. They also contributed to establishing an effective coordination system for emergency response and recovery based on local leadership. In case of the disaster response to the typhoon Haiyan, these centers can be identified as an attempt at a new type of collaboration in the Philippines between the international organizations and the national and local CSOs, and it encouraged the implementation of disaster response and recovery based on a participatory approach.

Private sector

The private sector has been also involved in disaster response to Typhoon Haiyan very actively. In Ormoc, the local business sector played a crucial role to distribute relief items and provide volunteers, and their contributions were acknowledged by the Mayor and Municipality. The positive aspects of the involvement of the local business sector are that they could respond to the disaster very quickly and distribute relief items that were most needed as they are also a part of the community and easily understand the actual needs. If the relief goods are mobilized locally, there is no need to wait to receive any assistance from outside. This type of preparation and contribution by the local business sector can be a good practice especially in case of a small and medium scale disasters.

In the Philippines, the initiatives of the private sector in disaster response have been seen from the 1990’s. The Corporate Network for Disaster Response (CNDR) is a network of corporations, business associations and corporate foundations, whose objective is to help improve disaster management efforts of the business sector before, during and after disasters. CNDR has more than 50 members in the corporate sector and many of them contributed to the emergency response in the case of Typhoon Haiyan by distributing relief items. The disaster response has been their key activity so far, however, the situation is slightly changing gradually from disaster response oriented to disaster risk management. According to the Program Officer, CNDR has initiated community-based disaster risk management projects and the business continuity management programs as well as capacity development projects for the local governments. The CNDR secretariat provides corporate sector members with the necessary technical assistance for project planning and implementation. CNDR launched the capacity development program for the local government in Cebu in March 2014 with the funding support from the CNDR members. The way of support by the private sectors is also becoming diverse not only for the disaster response.

In Tacloban, the Global Media Arts Network (GMA Network) provided great assistance in the housing construction project in the recovery stage (**Fig. 8-19**).

Fig. 8-19. Signboard set at the housing construction site in Tacloban and the construction site.

8.3.1.3 Importance of capacity development of local stakeholders

CSOs, LGUs, and private sectors

The implementation of the DRRM Act is a key for DRR and disaster risk management in the Philippines. Mainly two things need to be considered: a) how to develop the capacity of LGUs as well as other local stakeholders and b) how to motivate local stakeholders such as those from the private sector and CSOs to be involved in disaster management issues more actively, preferably DRR efforts. This is not an issue only in the Philippines. Even other disaster prone countries in Asia such as Indonesia have been facing the same challenges. In this research, the initiatives to assist the CSOs and the LGUs have been already identified. ADRRN and other CSOs network from the Philippines such as the Eastern Visaya Network initiated a project of capacity development of national and local CSOs in DRR. CNDR, which is a network in the corporate sector conducted workshops in Cebu to train the LGUs in DRR especially on project planning and implementation of community based programs. More importantly, these collaboration and joint activities among various stakeholders need to be systematic and sustainable. However, the sustainability can be one of the most challenging factors for the local stakeholders as their resources are often limited. Ideally, the assistance from the international community and the national government should be spent for these capacity development programs to build the community resilience. Once the LGUs and the CSOs developed their capacity in DRR, the knowledge can cascade down to the communities, and the communities themselves are equipped by the knowledge and skills to take action by themselves in case of a future disaster.

Communities

In an interview with one of the Barangay leaders in Tacloban **(Fig. 8-20)**, he emphasized the importance of the DRR training opportunities for Barangay leaders. He attended the training seminar on DRR that targeted the LGU officials and the Barangay (village) leaders prior to Typhoon Haiyan. 25 Balangay/municipal leaders were invited to this seminar, and 17 Barangay and municipalities sent participants. The training was planned and organized by the LGUs and they requested support from the national government for sending the trainers who had the knowledge and skills of DRR strategy to the program. The LGUs also mobilized the funding for the training by themselves. According to one of the Barangay leaders who participated in the training, due to the knowledge that he gained from the workshop, he was able to issue an evacuation order immediately after the warning to the communities as he deeply understood what the storm surge was, its risk, and the importance of the evacuation. At the result, there were no casualties from the village, although 167 out of 267 houses were damaged. It proved how important capacity development is, especially in the leaders as they also have the responsibility for the safety and security of the community members.

Fig. 8-20. Interview with one of the village leaders in Tacloban.

The village also had another DRR initiative by planting mangroves near the coast after Typhoon Haiyan. It was their local knowledge that the mangrove plantation could reduce the potential risks caused by a tsunami and storm surge. This time, although most of the mangrove was damaged by Typhoon Haiyan **(Fig. 8-21)**, the impact was minimum as the mangrove became a buffer against the typhoon. The community members replanted the mangrove with the purpose of disaster preparedness after the typhoon, to mitigate damage from a future disaster **(Fig. 8-22)**.

Fig. 8-21. Damaged mangroves by the typhoon in the Barangay Uban.

Fig. 8-22. The mangroves were replanted by the community members.

However, there is a challenge to maintain the capacity of the LGUs and the Barangay leaders in DRR. The turnover of the LGU staff is very high and even the Barangay leaders have fixed terms, therefore, the capacity of the LGU staff cannot be stable and sustainable. In order to overcome this particular challenge, regular trainings for the LGUs and the Barangay leaders need to be organized systematically with the funding support by the national government. CSOs also will be able to provide the technical support to such a program. In order to implement the DRRMN Act, the close collaboration and cooperative framework between governments, CSOs, the private sector, and communities needs to be established in the Philippines, and further assistance from the international and national levels need to be shared with the local stakeholders for their capacity development beyond the response stage.

8.3.2 Planning recovery and implementation: Initial status of "built back better"

The typhoon washed away buildings and the infrastructure of coastal cities mainly by the storm surge, and caused tremendous loss and damage to communities along the shore. In response, the Government of the Philippines is undertaking rebuilding with an emphasis on "building back better". As of March 2014, two major national rebuilding strategies for land use regulation and community relocations inland are proposed as major national rebuilding strategies and aims. This section explains the initial recovery status at 4 months after the typhoon from three planning perspectives of: i) on-going coastal land use discussions at the national level, ii) resettlement framework and on-going status in localities, and iii) principles for implementing reconstruction.

8.3.2.1 Regulating the use of coastal land: National discussions

In December 2013, the National Economic Development Authority (NEDA), a national governmental body responsible for coordinating economic and social planning and policy, published a document titled "Reconstruction Assistance on Yolanda: Build Back Better (RAY) (National Economic and Development Authority, 2013)", which includes an overview of the typhoon disaster, economic loss, and rebuilding plan that guides basic rebuilding procedure. The section on planning for recovery and reconstruction states: "(iii) streamline operational enforcement of 'no build zones' (National Economic and Development Authority, 2013, p.20).". Reasons for adopting this concept in RAY is not described in the document, however, an idea to strictly control the use of land between the coastline and 40 meters inland to prohibit any development was discussed immediately after the typhoon. This concept has its root in PD 1067 (Presidential Decree 1067: The Water Code of the Philippines) that governs "the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources (The government of the Philippines, 1976, p.1)" enacted in 1976.
Article 51 of this Decree states:

> *The banks or rivers and streams and the shores of the seas and lakes throughout their entire length and within a zone of three (3) meters in urban areas, twenty (20) meters in agricultural areas and forty (40) meters in forest areas, along their margins, are subject to the easement of public use in the interest of recreation, navigation, float age, fishing and salvage. No person shall be allowed to stay in this zone longer than what is necessary for recreation, navigation, floatage, fishing or salvage or to build structures of any kind.*

This however was not fully addressed in practice prior to the typhoon for two reasons. First, the zone did not have clear guidance on ways to interpret coastal lines – whether the zone should be declared as easement from the high or low tide marks. Second, there were many informal settlements along the coast that had neglected this Decree. With many informal settlements occupying the land along the coast[2], local governments could not force existing settlements to move out of the easement zone. Because of these reasons, after the disaster the national government

[2] As an example, the landownership of our field visit Barangay Uban is composed 60 percent informal and 40 percent formal.

had a strong intention to enforce land use control of the affected coastal areas through rebuilding, by adopting a maximum setback width of the easement cited in Article 51, so that future loss and damage from the typhoon will be minimized (See messages in **Fig.8-23** describing no build zone, constructed at different timing and interpretation by the local governments).

Fig. 8-23. Different messages in the "no build zone"

After the idea of a 40-meter setback was released, various responses were raised, including negative responses claiming that enforcing this land use will disrupt economic activities of coastal communities. With such reasons, the national government is currently facing a need to develop a scientific reasoning, which will help lead the affected local governments and citizens in understanding and following the setback in rebuilding. The Department of Environment and Natural Resources (DENR) and the Department of Science and Technology (DOST) at the national level are thus mandated to lead this assessment, by distinguishing between "safe" and "unsafe" zones with a modelling exercise that considers inundation and landslide occurrence. In addition, climate change aspects are being included, as there are on-going efforts by the Climate Change Commission to mainstream risk reduction related to climate change.

As debates proceeded in the first four months after the typhoon, the tone on the land use has softened from “no building” to “no dwelling”. Although the national government initially sought to have no construction of any structure in the 40 meter zone, they have shifted their thoughts to only prohibit residential use in the designated zone, as this will be a more practical solution for minimizing future risk. It is important to realize that there has yet been no revision regarding the land use of coastal zones after the typhoon, and the legal/regulatory base for the coastal land use still relies on PD 1067 of 1976.

8.3.2.2 Resettlement to reduce future risk: Local discussions and current status

General framework for resettlement

While waiting for a regulatory decision on coastal land use from the national government, the general consensus of local governments and communities (*Barangays*) that were hardly affected by the storm surge is to rebuild in locations distant from the coastal areas to extent possible, by adopting relocation programs prepared by the national government. By doing so, they are hoping that no one in the region will face such a tragedy in the future. The City of Tacloban is planning to put together the typhoon-affected relocating population with other relocating populations that already had a plan to be relocated. The project is a part of the “Slum Improvement Resettlement Program (SIR)” of the National Housing Authority (NHA)[3], for which the City, prior to the typhoon, had begun site construction for resettlement in the Eastern Visayas Regional Growth Center (EVRGC) targeting the underprivileged. The EVRGC is located in the north of Tacloban City, and has been considered as a growth center of the Leyte region to accommodate spillover population of the region and Cebu.

Meanwhile, the Slum Improvement Resettlement Program is identified in the Republic Act No. 7279 (RA 7279): Urban Development and Housing Act, which was passed in congress in 1992 to provide a basic urban development mechanism for a comprehensive and sustainable urban development and housing. The act particularly emphasizes improvement of living environments for underprivileged populations as stated in Section 2:

> *(a) Uplift the conditions of the underprivileged and homeless citizens in urban areas and in resettlement areas by making available to them decent housing at affordable cost, basic services, and employment opportunities;*

With an intention to merge the on-going resettlement site project funded by the NHA with the relocation of the disaster affected population, Tacloban City is currently speeding up site construction for permanent housing in the EVRGC area. The construction of these permanent houses is planned to happen through their donation by domestic, international, public and private groups and organizations.

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[3] The National Housing Authority belongs to the Office of the President of the Republic of the Philippines, and is the only national agency that is responsible for providing houses for the unprivileged. It is mandated to provide affordable housing with decent and adequate quality, together with needed utilities and facilities as well as with optimum access to social services. In Section 3 (p) of the Act, NHA is the mandated as an agency to manage the "Slum Improvement and Resettlement Program (SIR)".

Ormoc City, on the other hand, is solely targeting the typhoon-affected population to permanently relocate in its resettlement scheme. The City is utilizing assistance from the national government and private sectors, but the City itself is investing a substantial amount effort for the relocation of affected people. The City has prepared land to use for temporary housing, and is also preparing relocation sites for permanent settlements. The City, however, was not considering using the "Slum Improvement Resettlement Program" of the NHA in its rebuilding.

In summary, both cities of Tacloban and Ormoc are adopting assistance and programs prepared by the national departments and agencies as well as private sector as much as possible, aligning to the strategies stated in "Reconstruction Assistance on Yolanda (RAY)" for better outcomes. One of the key findings here was that a there exists a significant difference on how each local government –Tacloban City and Ormoc City – are taking into consideration future risks in rebuilding; Tacloban City is seriously considering the 40 meter setback of the "no build zone" although it is not yet been decided legally, while Ormoc City is not emphasizing much about incorporating this zone in rebuilding, except for existing illegal settlements along the riverbanks. Reasons for this are clearly emerging from their different experiences; Tacloban City faced tremendous loss and damage caused by the storm surge, while Ormoc City's loss and damage were mainly from the strong wind[4] in this typhoon. In addition, Ormoc has an experience of flash flood disaster back in 1991, which caused approximately 5,000 deaths and 3,000 missing, making flooding along the river a higher concern than storm surge. On a different note, although always challenging under compressed time in recovery, both city governments are investing efforts to reduce the stress of the affected population in transition. Some efforts include: putting the temporary housing site and the permanent housing site adjacent to each other so that a big move will be unnecessary; and providing additional care about space and details about utilities upon setting up the temporary housing.

<u>Status towards resettlement: from evacuation to temporary housing</u>

When the typhoon was approaching, both city governments shared as much information possible with the *Barangay* leaders for them to disseminate within their communities. By doing so, leaders were hoping that their members would be prepared for this largest-ever typhoon in the country's history. Many Barangay leaders thus sought assistance from Barangay officials, namely, *Kagawads* and *Tanolds*, for this information dissemination, and have done it in various ways. Some Barangays used megaphones while others knocked on individual doors to persuade the households to evacuate to the designated evacuation centers. The majority of the evacuation centers included elementary schools, Barangay offices, and other available public facilities. Some individuals evacuated to hotels considering that the structure of such buildings are more durable than private homes.

Following this initial evacuation, in the next month, affected populations begun moving back to the original site. They have begun constructing houses "temporarily" in the hope of finding more resilient sites, with less disaster risks, for permanent homes. Government had prepared temporary shelters in both cities around the time of this field reconnaissance, and least-privileged of the affected population were beginning to move in. Both cities were

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4 Damage caused by typhoon Haiyan in Ormoc City was also devastating. Number of death was 38, population displaced reached 97 percent of the total households (total households: 43,729), and 96 percent (or 42,303) houses were somehow damaged (totally damaged houses: 73 percent (or 31,921); partially damaged houses: 23 percent (or 10,382)).

mandated to prepare lands for this temporary use, and the temporary shelters, often locally called bunkhouses, were being provided by the national government. The Department of Public Works and Highways (DPWH) is responsible for constructing the bunkhouses, which are then turned over to the Department of Social Welfare and Development (DSWD) for distribution to beneficiaries. In total, DPWH has allocated 142 bunkhouse units[5] as of December 2013, which will accommodate some 3,336 families affected by the typhoon. Targeted regions for the provision include: Tacloban City; Palo, Leyte; Ormoc City; Basey, Samar; and Eastern Samar (DPWH, 2013). In mid-February, approximately 1,500 people had already moved into 60 bunkhouses prepared in the Eastern Visayas, to Tacloban City (222 families); Palo, Layte (429 families); Ormoc City (429 families); Basey and Samar (222 families); and Eastern Samar (673 families) (The government of the Philippines, 2014). The use of bunkhouses in the resettlement phase differed between Tacloban City and Ormoc City. Tacloban City has positioned this bunkhouse to function more as temporary shelters, aiming to house the vulnerable population – those having disabilities and financially disadvantaged – for limited period of time[6] prior to their permanent settlement. On the other hand, Ormoc City is using these bunkhouses as a temporary housing for people to live for a certain amount of time before moving into permanent homes. Thus, they prefer calling them “transitional shelter (houses)” rather than bunkhouses. During this time of field reconnaissance, other types of temporary houses were being prepared by donors, including international and domestic NGOs as well as the private sector.


Fig. 8-24. Bunkhouses in Tacoban City (left) and Ormoc City (Right).

<u>Tacloban City’s challenge to rebuild back better</u>

Plan for permanent settlement of the disaster affected population

The majority of public assistance targeted the most disadvantaged in the initial stage of rebuilding, often the informal settlers, as was also the case in Tacloban City. According the information office of the City, the number of families in informal settlements prior to the typhoon accounted for more than 30,000, 2,142 of which were still

[5] Each bunkhouse was initially designed to comprise approximately 24 units of dwellings, later modified to 12 units due to small size of each unit. Initially, a family with 3 to 4 members were planned to occupy 1 unit, where a unit has an area of 8.64 square meters.

[6] Their original intention was to use the bunkhouses for maximum of six months.

living in evacuation centers as of mid-March, 2014. Their building damage was so severe that totally damaged buildings exceeded 29,000 and partially damaged buildings accounted for more than 18,000. Among the totally damaged houses, about 14,400 houses were built in prospective no-dwelling zones.

In rebuilding, therefore, 20,000 permanent housing units are planned to be constructed in the EVRGC site north of Tacloban City. The rationale of this number comes from the number of informal settlement units in different locations. According to the city building office, the total number of informal settlement units adds up to 30,513 (see **Table 8-1)**. Units to be targeted for relocation will be 20,000 in total, with a breakdown of 14,433 units identified in the prospective no dwelling zone and about 5,500 units built in the zone identified as dangerous and in river basin beside subdivisions.

Table 8-1. Breakdown of informal settlements in Tacloban City by location type.

No dwelling zone (along coastal zone)*	**14,433**
Subdivision	**16,080**
Danger zone/ River basin*	5,567
Other areas	10,513
Total	***30,513***

Nevertheless, the City's short- and mid-term plan is to construct 10,000 rather than 20,000 units. The reason for this is because the city could only prepare lands that could accommodate this number of units; as of March 2014, the City has 92 hectares in total[7] for developing of which 85 hectares are prepared by the City and 7 hectares are donated by the Archdiocese of Palo. As for the construction schedule, the city is planning to develop 4,000 permanent housing units in 2014, and additional 4,000 units in 2015, continuing until the number reaches 10,000.

System of transitional phase toward permanent settlement

In Tacloban City, the governmental scheme towards permanent resettlement has three phases: emergency sheltering/temporary sheltering; temporary housing; and permanent housing. The first, emergency sheltering/temporary sheltering phase is the time when the typhoon affected population is seeking to evacuate and temporary stay in a place away from home. Most of the typhoon-affected population is currently in this phase, although there are two distinctive locations where people could be. One is the evacuation center, represented by schools, Astrodome and the tent city where majority of the population who have not yet decided to rebuild in their original place reside. The other is the bunkhouses provided by the DPWH through DSWD of the national government. This is currently located in the city center, in *Barangays* Abucay (8 bunkhouses), Motocross (27 bunkhouses), and NHA (17 bunkhouses). The goal of this bunkhouse use for the first batch of residents to move into temporary housing within six months. These population then will move out of temporary housing and into permanent houses when these are ready. By doing so, the second group of typhoon affected population can move into this bunkhouses six months later, and live for certain periods of time until the temporary housing becomes ready to move in. The City is planning to create such revolving system so that disaster affected population can

7 This includes 10 hectares of land that has already been developed with NHA's resettlement program

benefit from the bunkhouses.

The second in the “temporary housing” phase, where aspects of livelihoods are being reestablished, although the stay in such locations is not considered permanent. All temporary houses will be created in the north of Tacloban City, in EVRGC so that there will be no need to be displaced again into permanent homes for the resettling families. Transitional houses are currently being provided by various types of donors (See **Fig.8-25** for an example of transnational shelters).

Fig. 8-25. Transnational Housing in Eastern Visayas Regional Growth Center (EVRGC).

Lastly, the “permanent housing” is a phase when the typhoon affected population is settling into permanent houses. Currently, land development is on-going in an area which can accommodate 500 housing units (See **Fig.8-6**). As mentioned, the national government, including the NHA’s program, could only fund land development but not the individual housing units, thus, various partners and donors have pledged to donate 10,161 units of houses for the permanent relocation sites (See **Table 8-2**).

Fig. 8-26. On-going construction of EVRGC.

Table 8-2. Donor Pledges for houses and community facilities for permanent relocation sites.

Partner/Donor	Pledge	Area/Location
Philippines Red Cross	5,000 units	New Kawayan
GMA Foundation	400 units	Sto. Nino
Habitat for Humanity	852 units	Sto. Nino
SOS Children's Village Tacloban, Inc.	254 units	Palanogl 2
Zonta	20 units	Tacloban North
Kimse Yokmu	30 units	Tacloban North
DSWD	134 units	undecided
Habitat	2,500 units	undecided
Lions Club International	50 units	undecided
Philippines Institute of Civil Engineers	50 units	undecided
Unknown	871 units	unknown
Total	**10,161 units**	

Source: Tacloban City Information Office

Reflection

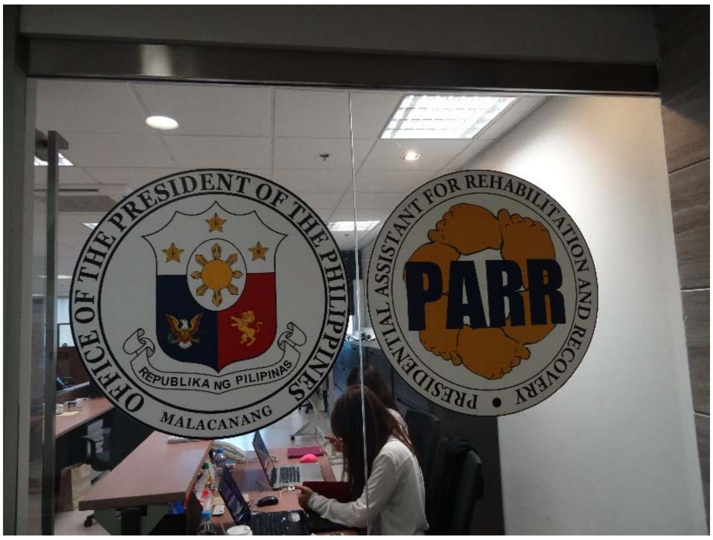
In parallel to all on-going efforts regarding construction of temporary and permanent housings, together with other non-construction efforts, the city government is currently crafting a master plan of the city. The initial master plan was to be finalized by the end of March 2014. Because there is no final official decision by the national government on ways to consider the prospective no-dwelling zones yet, planning efforts are stagnant with a fear of local governments making decisions conflicting with the national decision. Nevertheless, the city mayor is supporting the idea of relocating the coastal communities inland, especially the communities of the *Barangay* 88, where damage and loss from the storm surge were most destructive. At the same time, all *Barangay* leaders interviewed in the focus group agreed that all of their members are willing to relocate to safer locations to avoid future storm surge risks. Nevertheless, with limited resources available to accommodate the relocation of individuals seeking to relocate inland, many have temporarily given up on an immediate solution of this issue, and has begun to return to their original land for “temporary” living (**Fig.8-27**).

Fig. 8-27. Rebuilding “temporarily” in the original land.

8.3.2.3 Principles for implementing reconstruction

Reconstruction principles

The “Reconstruction Assistance on Yolanda: Build back better (RAY)” by the National Economic and Development Authority has set the stage to implement reconstruction of the typhoon affected regions. There are three principles in this recovery. First, the need of efficient coordination is called for, which combines strong central coordination and flexible implementation at the local level. At the same time, local governments are mandated for the responsibility of implementing reconstruction. Second, inclusiveness and sustainable livelihoods are underscored in the reconstruction processes, in order to address pre-existing poverty issues in the region. Finally, the third principle includes the need to incorporate gender perspectives in reconstruction, as a starting point is already different between males and females in reconstruction, and thus, empowerment of women in the rebuilding processes is needed for a more equitable society in the future.



There are two other key aspects in this reconstruction strategy. First is the partnership with the private sector. The national government is pushing further for a partnership with the private sector upon implementing this RAY, beyond emergency relief and response that has been implemented successfully. As part of evidence for this strategy being effective, some private foundations have already pledged to donate permanent houses for relocation sites to be developed by the government. Second is the institutional arrangement for implementing this reconstruction strategy, that the Office of the Presidential Assistant for Rehabilitation and Recovery (PARR) is designated as the coordinating body for implementing RAY. The PARR was appointed by President Benigno S. Aquino III in memorandum order No. 62 of December 6, 2013, to integrate efforts of all governments and agencies that are involved in this reconstruction as a manager and a coordinator. Their responsibility includes consultation with local governments in formulating recovery plans and programs that are required to submit the President, develop funding support for local implementation of the plans and programs, and oversee overall coordination between national agencies and departments as well as various non-governmental, private, and any entities engaged in rebuilding. The office has been set up since early January of 2014 in Bonifacio City of Taguig City, where Secretary Panfilo Lacson has been elected to be the head and rehabilitation czar. The duration of this office is confirmed until June 2016, when the six-year term of the current President Aquino III will terminate.

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