Flood Risk Management and Illustrative Approach

*N. Lummen, Y. Nagayoshi, H. Shirozu, T. Hokamura,
S. Nakajo, N. Okada and F. Yamada*

*Graduate School of Science and Technology,
Kumamoto University,
Applied Coastal Research Laboratory*

Summary

Floods are considered to be one of the most frequently recurring Natural Hazards.

Globally, flood impacts has increased exponentially

Floods and flooding are inevitable, their impacts however can be mitigated

This can be achieved and enhanced with the use of good communication tools especially at the local community level

Risk Sensitization

Illustrative Flood Risk Management Approaches

Presentation Outline

- Introduction
- Flood Risk Management - Illustrative Approaches
- Case Study
- Conclusion
- Areas for Improvement
- Further Research

Introduction

Calgary, Canada 2013

China 2013

Colorado, USA 2013

Philippines 2013

**Tropical Storm
Haiyan, 2013
(Typhoon
Yolanda)**

Introduction

Flood impacts can be mitigated against with the use of Flood Risk Management (FRM)

FRM hinges on comprehensive access to and dissemination of information about the elements and the people at risk.

Flood Risks need to be established through risk and vulnerability assessments and

Communicated to all stakeholders (Lummen & Yamada, 2014).

This can be achieved through **Risk Sensitization**

Only if the relevant authorities, agencies and people at risk, are aware, can they evaluate, mitigate and respond to their risks.

Introduction

Risk Sensitization is brought about and enhanced through good communication

Multiple Stakeholder Relationships in Kumamoto, Japan

Introduction

Introduction

Risk Sensitization can be achieved and enhanced with visual and spatial communication tools. Such as:

1. **Flood Simulation**
2. **User Friendly Real Time Graphs**
3. **Electronic Community Based Flood Hazard Maps**

These, graphically illustrates the spatial distribution of hazards, risks, exposure, elements at risk, and Vulnerabilities

Understanding the spatial allocation and dissemination of hazard effects allows for better Hind-casting and Forecasting

Method - Illustrative Approaches

Flood Simulation

There is an ongoing need for accurate identification of previous inundation areas, as well as prediction of future floods and potential inundation areas.

Numerical Simulations are often used by FRM officials to create and or recreate flood events in an effort to better understand flood risks and exposures (Butler & Pidgeon N., 2011; Hall, Meadowcroft, Sayer, & Bramley, 2003; Yamada, Kakimoto, Yamamoto, Fujimi, & Tanaka, 2011).

Numerical Simulations and Flood Animations are examples of good FRM Illustrative Communication tools

Method - Illustrative Approaches

Flood Simulation

Method - Illustrative Approaches

User Friendly Real Time Graphs

Using precipitation rates, river water volume and tide levels, a real time monitoring site was set up for the Shirakawa River, Kumamoto, Japan.

This site illustrates changes in the river's water levels owing to precipitation inputs.

This is correlated with tide levels, and using an algorithm the site illustrates the integrated data sets and resulting water levels within the river.

This helps community members to better understand the existing situation in their respective communities as well as make effective decisions

Method - Illustrative Approaches

In Japan flood risk information is made available on several websites

In an emergency situation local citizens lack the skills needed to combine all the data sets, analyze and make effective decision.

Additionally, it is difficult for them to think clearly, monitor all the sites, synthesize the information and act accordingly.

Evacuation orders are issued by the local government who then filter the information to the relevant multiple stakeholders, including local citizens.

This takes time and reduces the response lead time of citizens especially in fast onset floods.

There was a need for an Illustrative Integrated Approach

Method - Illustrative Approaches

Precipitation Data

(<http://www.jma.go.jp/jma/index.html>)

Shirakawa Watershed

Water Level within the River

(<http://www.river.go.jp/>)

Tide Levels

(<http://www.bousai.pref.kumamoto.jp/>)

Method - Illustrative Approaches

Electronic Community Based Flood Hazard Maps

Following the July 2012 flood gaps were identified in Kumamoto City`s existing Flood Hazard Maps.

In an effort to update the existing Flood Hazard Maps we sought to identify ways in which the process can be updated and improved.

As such we decided to make digital maps, using the existing process.

Community Based Electronic Flood Hazard Maps allows for, easy updating, easy projection and discussion, ease of combination of surrounding community maps to make complete city maps as well as ease of updating yearly at a lower cost.

Method - Illustrative Approaches

Electronic Community Based Flood Hazard Maps

Method - Illustrative Approaches

Electronic Community Based Flood Hazard Maps

Method - Illustrative Approaches

Electronic Community Based Flood Hazard Maps

Case Study - Illustrative Approaches

Location of Study Area - Kumamoto, Kyushu, Japan

Figure1: Map of Kumamoto, Kyushu, and Japan

Case Study - Illustrative Approaches

Watershed of Shirakawa River

Figure 2: Shirakawa River Watershed

Case Study - Illustrative Approaches

Following the July 12, 2012 flood event, the Implementation Research and Education System Center for Reducing Disaster Risk (IRESC) was developed by Professor Fumihiko Yamada, Kumamoto University.

The philosophy of the centre is the deployment and sustained early realization of disaster mitigation-oriented society that can respond flexibly and quickly to disasters, by promoting research and educational activities related to disaster prevention and mitigation widely

One such research and development project was the creation of a real time monitoring site for the Shirakawa River, create a platform for the creation and storage of electronic community based flood hazard maps and the communicating these strategies to local community members (Risk Sensitization).

Case Study - Illustrative Approaches

1. Flood Simulations

2. User Friendly Real Time Graphs

3. Electronic Community Based Flood Hazard

Maps

Case Study - Illustrative Approaches

Figure 3. Recreation of the flood situation on July 12, 2012, -
Measured value every 10 minutes

Case Study - Illustrative Approaches

Figure 4. Recreation of the flood situation on July 12, 2012, -
Measured value every hour

Case Study - Illustrative Approaches

Figure 5. Recreation of the flood situation on July 12, 2012, - Verification Graph Measured Every 10 Minutes

Case Study - Illustrative Approaches

Figure 6. Recreation of the flood situation on July 12, 2012, -
Verification Graph Measured every Hour

Case Study - Illustrative Approaches

1. Flood Simulations

2. User Friendly Real Time Graphs

3. Electronic Community Based Flood Hazard

Maps

Method - Illustrative Approaches

Shirakawa River in Kumamoto - <http://www2.kumamoto-bousai.jp/anpi/sirakawa/index.html>

Wakaba downtown (Kumamoto City, Kumamoto prefecture) small channel - http://www2.kumamoto-bousai.jp/anpi/wakaba/pcopen_toppage.php

Kumagawa River (Hitoyoshi City, Kumamoto prefecture) - http://www2.kumamoto-bousai.jp/anpi/kuma/pcopen_toppage.php

Tsuboi River (Kumamoto City, Kumamoto prefecture) - http://www2.kumamoto-bousai.jp/anpi/kosen/pcopen_toppage.php

Hirose River (Amakusa City, Kumamoto prefecture) - <http://www2.kumamoto-bousai.jp/anpi/hirose/index.html>

Case Study - Illustrative Approaches

Water levels (m)

Tide (m)

Figure 7: Real Time monitoring of the Shirakawa River Basin - Measured value every 10 minutes

Case Study - Illustrative Approaches

Water levels (m)

Tide (m)

Figure 8. Real Time monitoring of the Shirakawa River Basin - Measured value every hour

Case Study - Illustrative Approaches

1. Flood Simulations
2. User Friendly Real Time Graphs
- 3. Electronic Community Based Flood Hazard Maps**

Case Study - Illustrative Approaches

Demonstration Site

<http://www2.kumamoto-bousai.jp/anpi/demo6/#>

Real Time Updating

<http://www2.kumamoto-bousai.jp/rehm/>

Case Study - Illustrative Approaches

Figure 9. City Hall's flood hazard map (City Hall, 2012)

Figure 10. City Hall's flood hazard map making process (City Hall, 2012)

Case Study - Illustrative Approaches

Figure 11. Final stage of City Hall's handmade flood hazard map (City Hall, 2012)

Approaches

Figure 12: Relevant information is mapped

Case Study - Illustrative

Approaches

Hazard	Hazard	Hazard
☐ Flood hazard ☐ Steep slope collapse hazard ☐ Landslide hazard ☐ Collapse hazard ☐ Dangerous waterway ☐ Manhole ☐ Grating ☐ Become place for disaster prevention ☐ Place that is easy to inundation ☐ Inundation direction (2 points specified)	Evacuation ☐ One o'clock shelter specified ☐ One o'clock refuge area specified ☐ The aim of the evacuation ☐ Home need help in evacuation of people at the time ☐ Escape route	Facility ☐ Ward branch ☐ Police station ☐ Fire department ☐ Convenience store ☐ Public telephone ☐ Fire flood warehouse ☐ Nursery and kindergartens ☐ Long-term care insurance facility ☐ People with disabilities support facilities ☐ Medical facilities ☐ Heliport ☐ Other
Evacuation	Facility Equipment Other current assets System	☐ Fire protection water tank ☐ Fire hydrant ☐ Fire extinguisher ☐ Street lamp ☐ AED ☐ Toilet ☐ Toilet (multipurpose)
Facility	Other current assets	Equipment
Equipment	System	Other current assets
Other current assets		System

Figure 13: Relevant information is mapped

Case Study - Illustrative Approaches

Figure 14: Illustrative photographs taken

Case Study - Illustrative Approaches

Figure 15: All data combined to produce final map

Case Study - Illustrative Approaches

This map making process is taught to community members in tandem with city hall personnel.

By doing this, community members can become familiar with the process, the accuracy of the information contained and the legitimacy of the source.

Therefore when these maps are made public, there will be no hesitancy to access and utilize them.

These maps are now accessible by the public in Kumamoto City and surrounding areas.

Community members can now access the previously created maps to determine flood path and evacuation pathways.

Areas for Improvement

● Flood Simulation

Refined following the initial calculations using new data sets made available by the Ministry of Infrastructure. Overestimations in the lower reaches are now reduced and recalculated

Third measuring station is now up and running more data points for measuring and calibration

Also two types of data collection systems, Ultrasonic as well as Pressure Sensors.

Ultrasonic equipment has higher accuracy however in the event of a typhoon, heavy wind or tsunamis its reliability is reduced - e.g. July 12, 2012 flooding data showed huge oscillation margins. With Pressure sensors more accurate data is collected during these turbulent periods.

Areas for Improvement

● User Friendly Real Time Graphs

Currently strong winds and thunder affects the electricity supply.

Solution - Installation of back up batteries lasting up to 6 hours - allowing for continuous data storage and live broadcasting

LED lights for cameras and surrounding area monitoring lights, backed up with similar long lasting batteries

Each city hosts the servers used to carry the live feeds however maintenance is done externally, may cause delays in information relay (virus scans, clean up hard disks, download data to free up disk space)

Areas for Improvement

● Electronic Community Based Flood Hazard Maps

Information is currently available via the internet and can be accessed using mobile phones, computers and tablets.

Not all aged persons have access to the internet.

Also most are not familiar with the process of accessing and interpreting the data available.

Proposal to make the maps as well as the User friendly real time graphs accessible via television. So persons at home can access this data via their televisions

Conclusion

Measures such as the Flood Simulations, the User Friendly Real Time Graphs, and the Electronic Community Based Flood Hazard Maps and are but a few examples of possible Illustrative Approaches to effective FRM.

Kumamoto City and Amakusa Islands are currently using the User Friendly Real Time Graphs.

The Electronic Community Based Flood Hazard Maps are now available to Kumamoto City community members.

With time, this process will be replicated across different river communities and towns across Japan.

And can be replicated in other communities, countries and regions

Future Research

We are currently undertaking a new project that seeks to synchronize distress calls with our User Friendly Real Time Graphs

This new approach is called the **Triage System**.

Whenever someone calls into the command centre, from an impacted area, the operator fills out an information form and codes the form, A, B, C etc

This data is then entered into the electronic system and the Disaster manager can now make a more informed decision regarding response, dispatch etc

Thank you for your time and attention!

Questions?

NatainiaLummen@gmail.com

<http://iresc.kumamoto-u.ac.jp/>

<http://www.civil.kumamoto-u.ac.jp/coast/>

July 12, 2012 Flood Event

Tatsuda Junior High School

Tatsuda Jinnai

July 12, 2012 Flood Event

Ozeki Bridge

July 12, 2012 Flood Event

Kokai Bridge

10th International Conference of the International Institute
for Infrastructure Resilience and Reconstruction (I3R2)

July 12, 2012 Flood Event

Rujin Bridge

July 12, 2012 Flood Event

Landslide and debris flow in Mt Aso Area

July 12, 2012 Flood Event