INTERNATIONAL CONFERENCE
ON HAZARD MITIGATION IN GEOGRAPHIC AND
EDUCATION PERSPECTIVES
(ICHMGEP)

Grand Inna Malioboro Hotel - Yogyakarta, Indonesia,
September, 28-29, 2018

Organized by;
Geography Education Department
Faculty of Social Science
Universitas Negeri Yogyakarta
PREFACE FROM THE ORGANIZING COMMITTEE

COMMITTEE CHAIRPERSON OF
THE INTERNATIONAL CONFERENCE ON HAZARD MITIGATION
IN GEOGRAPHIC AND EDUCATION PERSPECTIVES

Assalamu’alaikum . Wr. Wb.

First of all, praise be to God, the one Almighty who has given us His blessing and guidances that we could hold an international conference on Hazard Mitigation in Geographic and Education Perspectives in Grand Inna Malioboro Hotel. This is the first international that we organize.

In this conference, we invite two keynote speakers from abroad namely Prof. Abe Ryogo from Aichi University of Education, Japan and Dr. Ekammol from Chulalongkorn University Thailand. We also invite speakers from Indonesia such as Prof. Dr. Suratman (Gajah Mada University) and Prof. Dr. Siti Irene AD, M.Si (Universitas Negeri Yogyakarta).

This conference is organized to address the disasters that occur in this country, hope fully this conference may contribute to produce a plenty of ideas to deal with disaster mitigation which often occurs.

We would like to thank the Rector of Universitas Negeri Yogyakarta who has provided a financial support to organize this conference. Our special thank also goes to all invited speakers and participants coming from many different cities in Indonesia who have spent their time to participate in this conference. We also thank all committee who have successfully organized this conference. Finally, I do hope that this conference may provide insight contributions which are beneficial for Indonesian Society in particular and for the world in general.

Thank you,
Yogyakarta, September, 28th, 2018
Committee Chairperson of the conference

Suhadi Purwantara
PAPER PRESENTATION: KEYNOTE SPEAKER

“FOR DISASTER MANAGEMENT IN DISASTROUS JAPAN: THE VULNERABILITY AND SOCIAL RESILIENCE OF INTERNATIONAL MITIGATION”

Prof. Abe Ryogo

(Aichi University of Education)

INTERNATIONAL CONFERENCE ON HAZARD MITIGATION IN GEOGRAPHIC AND EDUCATION PERSPECTIVES (ICMGEPE)

Grand Inna Malioboro Hotel – Yogyakarta, Indonesia, September, 28 – 29. 2018

Organized by Geography Education Department Faculty of Social Science Universitas Negeri Yogyakarta
For Disaster Management in Disastrous Japan: The Vulnerability and Social Resilience of International Migration

ABE, Ryogo (Aichi University of Education, Japan)

1. Introduction

1.1 The characteristics of natural disasters after WWII in Japan

As known well, Japan is a “country of disaster”. Even during this whole year, it has experienced a lot of types of natural disasters like typhoons, heavy rains, and earthquakes. For example, on June 18, a magnitude 6.1 earthquake occurred 13 km directly below the city of Osaka and damaged many people and houses. Next in June to July, a localized heavy downpour caused by the 7th typhoon (Asian name: Prapiroon) widely hit the western part of Japan such as Hiroshima, Okayama, and Kyushu district, which took a lot of victims including more than two hundred toll of lives. Furthermore, another large typhoon came on shore in Osaka on September 4, so that the bridge across Kansai International Airport was destroyed by a washed out tanker. Most recently, a big earthquake happened in the southern part of Hokkaido with a large blackout.

Especially the year of 2018 is also the year of disaster. Even now Japan has not entirely recovered these devastated situations yet. As mentioned above, Japan always confronts a certain risk for natural disasters. These days, most of Japanese people recognized again that all of them are living on the disastrous islands. Actually looking back to the past, Japan had a lot of natural disasters since WWII. Specifically, there were the frequent occurrences for a while after 1945. But a long-calm period had come since 1960s until 1990s thanks to a new fundamental law for disaster prevention (Disaster Countermeasures Basic Act 1961).
What was an epoch-making event was the “Han-Shin Awaji Earthquake Disaster” in 1995. So far, most of Japanese had believed in the “Safety Myth” that the highly-developed Japan and its cities could not be weak with any disasters. However, such a big earthquake just underneath the city had changed their mind totally because thousands of buildings, roads, highways, houses, urban infrastructures, and even social systems in the metropolis collapsed (Pic 1).

And then on March 11 in 2011, the “Tohoku Earthquake and Tsunami Disaster” and the “Fukushima Daiichi Nuclear Power Plant Accident” gave the biggest shock to the Japanese society and national government (Pic 2). As known well, more than 20 thousands people passed away and all of nuclear plants around Japan stopped their operation. Now in Japan, we are ready for new possible big earthquakes in the near future (at Nankai Trough region and at Tokyo capital region). Therefore, these terrible past and possible future resulted in a paradigm shift on “disaster management” in the Japanese society and national government.

1.2 For the “national resilience” by the Japanese government

In response to 2011 tsunami, Fukushima disaster, and the others, on June 3 in 2014, the Japanese government published the *Fundamental Plan for National Resilience* and the entailing *Action Plans*. In this context “resilience” as a keyword means “strength”, “flexibility”, and “sustainability” against natural disasters. This fundamental plan is composed of following basic goals; 1) protect nation’s lives, 2) sustain national and social important functions without any fatal damages, 3) minimize damage to nation’s properties and public facilities, 4) immediate recovery and restoration from devastation.

Under these goals, the “national resilience” can be achieved concretely by 1) assessment of national vulnerability, 2) combination of physical and humanistic measures, 3) promotion of regional diversity and revitalization (except for Tokyo capital region). Particularly, the third point is geographically more important to actualize the “national resilience” because the overconcentration of population into
thecapital region might take the risk of disaster much higher, so that it is necessary to depopulate the region to some extent and redistributed dwellers into other parts of Japan. In doing so, the regional cities and local governments away from the capital region must be revitalized and get the local resilience against disaster.

However as the fundamental plan says, each local governments should consider their diverse localities such as landscape, natural environment, economy, community, human resource, and the unique characteristics of the vulnerable people in disaster (gender, the aged, children, disability, and ethnicity and so on). Then in this speech, I will focus on the relationship between disaster management and international migration in local contexts.

2. International migration: Vulnerable or not vulnerable?

2.1 Ethnic demographic constitution in Japan

Most recently, there are more than 2.63 million migrants residing in Japan, which is the most on record since WWII. They mainly consist of the four nationalities; Chinese (730,890 persons on 2017.12), Korean (481,522), Filipino (260,553), and Brazilian (191,362). Each characteristics of them are following:

- Chinese: permanent resident, International student, technical intern trainee
- Korean: Korean Japanese, permanent resident, international student
- Filipino: permanent resident, Japanese spouse, Japanese Filipino
- Brazilian: permanent resident, Japanese Brazilian, Japanese spouse

The figure 1 shows the changing number of international migrants by nationality from 1980 to 2017. It is clear that the total number increased rapidly just after 1990 because of the revision of Japanese Immigration Law in 1989, and also that there are two peaks so far in the transition. The first peak was in 2008 after when the global economic crisis (caused by Bankruptcy of Lehman Brothers) and succeeding 2011 disaster decreased the number of international migrants temporally. In particular, Brazilians returned to their home country because many of them were working at car and the related industrial factories as a temporal worker and were fired after the economic crisis 2009. Chinese also came back just after 2011 disaster. For example, Chinese students had gone because their parents felt...
anxious about their lives in Japan under the Fukushima accident. On the other hand, Filipinos rarely escaped from even 2011 disaster. Three fourths of them were/are women, in many case being married with a Japanese husband and having their children, so that they could not be back home with them left in Japan. And at present, Japan indeed experiences the second peak after recovery from depression and disaster although as never seen before. Perhaps, this new migratory trend will continue for the time being until a declining birthrate problem and the aging of society are resolved in Japan, because we already have a labour shortage problem in different labour markets.

2.2 Ethnic geographical distribution and regional diversity

Next I will refer to the ethnic geographical distribution and regional diversity focusing on the top four nationalities. As figure 2 shows, international migrants living in Japan are concentrating into only three metropolitan areas; the capital region (Kanto district, Tokyo), Kinki district (Osaka), and Chubu district (Nagoya). First, in Tokyo capital region Chinese are the biggest ethnic group and Brazilian is the smallest one. On the one hand, Kinki district has the larger population of Korean than the others, which comes from the unique history between Korea and Japan. At last, Chubu district (including Nagoya metropolitan area) has the most balanced ethnic constitution among them. What is noteworthy in this district is a large scale of Brazilian. Chubu district is very famous for the most accumulated area of car industries around Japan such as the headquarters of Toyota motor company. So there are a lot of manufacturing factories located around Nagoya metropolitan area where Brazilians have usually been working as unskilled labour.

As noted above, Japan is certainly going to the ethnic diverse country. All of those ethnic demographic characteristics and the geographical differences lead to the regional diversity, entailing

![Figure 2. The ethnic geographical distribution by the top four nationalities in 2017](image-url)

(Based on Statistics on the foreigners registered in the differences of agenda for disaster)
management. However, the regional diversity can also be the regional vulnerability? In other words, migrancy briefly means social vulnerability in Japan?

### 2.3 Migration and social vulnerability in disaster?

The government’s fundamental plan surely positions foreign residents (International migrants) as one of “the weak in disaster (a person to be helped at the time of disaster)”. For example, usually they may have more or less disadvantage of Japanese language, so that they cannot easily get any adequate information at the time of disaster. Furthermore, a part of them, especially the migrants from countries where no earthquake happens very often, hardly has the cultural knowledge of an earthquake. Also they don’t know the Japanese evacuation systems and social institutions when an actual disaster happens. Those mean that they don’t know what to do and where to go in disaster. Or, they are just so busy for work every day that they may not be able to think of and be ready for emergency. Anyway, as a consequence if a disaster occur, they can be immediately victims and the only object to be helped by Japanese neighborhood.

Nevertheless, they can be more active against disaster and for disaster prevention as well unless they are physically handicapped, because many of them consist of young and working age compared with the aging Japan. I think, if their language barriers entailing cultural handicap are removed only a little, international migrants should be an active and positive helper rather than just a passive and negative people dependent on Japanese society. Namely, we must not leave them vulnerable in disaster anymore.

To do so, first we have to provide international migrants with multi-lingual support at the time of disaster. An example is set-up of a multi-lingual support center where volunteer staffs speaking many kinds of languages act, giving multi-lingualized information to foreign residents suffering from disaster. Japanese residents are expected to evacuate to the nearest shelter around their house: usually an elementary school. A life in the shelter is stressful even for Japanese but it can be more stressful for foreign residents because of language and cultural barriers. Therefore to mitigate the sort of stress, a multi-lingual support is necessary at a shelter.

Of course, it is more important to educate and enlighten them before disaster not to leave them vulnerable. Education should include not only a Japanese language lesson but also a disaster prevention lecture itself. For example, at a certain public housing in Chubu district I used to investigate where many Brazilian residents lived, a residents’ association practiced an activity to research the nearby dangerous places in disaster, urban land use, and topography around the apartment houses, and to make a multi-lingual hazard map for both of Japanese and Brazilian residents. Not only that, but they were walking together around neighborhood with the map in their
hands. Also in other case of Chubu district, a part of foreign residents joins the disaster drill held by a local residents’ association and learns about how to actually evacuate to a shelter, sometimes even experiencing a stay thorough the nigh there.

Finally in Nagoya metropolitan area, as a new trend, “Disaster Prevention Network for Multicultural Society” was established in 2016. This multicultural anti-disaster network is so called a peak body of a lot of kind of volunteer groups, NPOs, NGOs, and individuals active in the area. Then the principle of this network is “everybody who is concerned with disaster prevention can help each other at the time of disaster beyond languages, cultures, and nationalities”. Only the sort of activities can change the social vulnerability of international migrants to the social resilience against disaster.

3. Conclusion: For the future of disaster management in Japan

Today it is already pointed out that the natural environment on earth is getting worth such as global warming, so that we may experience more and more natural disasters beyond our prediction including typhoons, heavy downpours, and others in the near future. Therefore we have to rapidly construct disaster management systems and achieve the social resilience against disaster. To do so, we need the multicultural or diverse perspective of disaster management including social differences such as gender, age, disability, sexuality, religion, and ethnicity. Why do we need such a diversity perspective for disaster mitigation? Because life precede such social differences of a human.
PAPER PRESENTATION: KEYNOTE SPEAKER

“ROLES OF GEOGRAPHY AND GEOINFORMATION IN ANTHROPOGENIC HAZARD MITIGATION: A CASE STUDY OF THAM LUANG CAVE”

Dr. Ekkamol Vannametee
(Chulalongkorn University, Thailand)

INTERNATIONAL CONFERENCE ON HAZARD MITIGATION IN GEOGRAPHIC AND EDUCATION PERSPECTIVES (ICHMGEP)

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Universitas Negeri Yogyakarta
Roles of Geography and Geoinformatics in Tham Luang Cave Rescue
Chiang Rai, Thailand

Ekkamol Vannameteek, PhD
Department of Geography, Chulalongkorn University, Thailand

Chanist Prasertburanakul
GIS Co.LTD & ESRI Thailand

Hazards and Disasters

- Hazard is a naturally occurring process or event that has potential to cause loss of life or properties
- Disaster is termed when the natural processes occur in places that are highly populated and have effects on lives and resources

Source: ADPC
Hazards or Disasters?

Natural & Anthropogenic Hazards

**Natural Disaster vs Man Made Disaster**

- **Natural disasters** are caused by natural forces
  - Examples: tsunamis, floods, landslides, hurricanes, wildfires, droughts, volcanic eruptions, etc.
  - Steps can be taken to minimize the effects

- **Man made disasters** are caused by the activities of men
  - Examples: hazardous material spills, explosions, chemical or biological attacks, etc.
  - Can be avoided with careful planning and prevention methods

- Natural hazard is a threat of a naturally occurring event will have a negative effect on humans
- Anthropogenic hazards occur as a result of human interaction with the environment
**Geography and geoinformatics in the rescue mission**

**Thailand cave rescue sparks celebration of ‘mission impossible’**

Operation leads to worldwide praise as last four boys and football coach are brought out.

- Geological knowledge about the cave
- Survey and Mapping
- Data collection & Interpretation
- Topographical interpretation
- Hydrology
- GIS technology

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**Basic Knowledge about the Cave**

- Cavity or hollow in the rock/earth
- Horizontal or vertical; straight, upward or downwards
- Primary cave
  - Developed at the same time with host rocks and enlarged later by other processes, e.g. volcanic cave, coral cave
- Secondary cave
  - Developed later after the host rocks were formed, e.g. sea cave, ice cave, etc.
Basic Knowledge about the Cave

- Soluble cave
- Dissolution of soluble rocks
  - Limestone, Dolomite, Salt rock
- Cavities in the rocks
- Cave system / series of caves
- ‘Cavern’

Basic Knowledge about the Cave

- Rain water is naturally acid
- CO\(_2\) reacts to rain water to form carbonic acid
- Acid solution flows through fissures and reacts to the rock bodies
- Dissolution of limestone under the surface in the bedrock
- Formation of complex cave system

\[
\begin{align*}
\text{CO}_2 + \text{H}_2\text{O} & \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{HCO}_3^- + \text{H}^+ \\
\text{H}_2\text{CO}_3 + \text{CaCO}_3 & \rightarrow \text{Ca(HCO}_3)_2 \\
\text{H}_2\text{CO}_3 + \text{MgCO}_3 & \rightarrow \text{Mg(HCO}_3)_2
\end{align*}
\]
Basic Knowledge about the Cave

1. Denudation of landscape by external processes
2. Sinkhole collapses, exposing empty caverns near surface; some of them are not caverns anymore
3. Groundwater level drops
4. Formation of dry & wet caves

Basic Knowledge about the Cave

- Features in cave/cavern formed when caves are dry or semi-dry cave
- Decoration stage of the cave/cavern
- Layers of calcite deposits build up on the ceilings, walls, and floors of the cavern
- Speleothem -- crystalline formations that grow by continual deposits
Gathering and Generating Topographic Data

- Collecting topographic data
- Generate a New DEM by Inpho
- Generate Stereo Images
- Generate New Orthophoto

- Topographic Map
- Ortho Photo (MOAC2545 / RTSD2552)
- Digital Elevation Model (MOAC / NASA)
- Geologic Map

Interpret & Extract

- Interpret and Extract the cave information from French cave surveyor “EXPEDITION THAI-MAROS 1986” and 1987
- Translate the Caves of Thailand (Martin Ellis) documents. The book indicates that the cave was surveyed by British surveyor in 2014-2015
- Extract Tham Luang cave information and cave leveling from cave surveying files (SRV) in 1987 and 2014-2015 (extracted from Cave Registry Data Archive web site published by British Cave Association)
Interpret & Extract

- Search for the 1987 detail survey map of French survey
- Create Cave Passage Sections Map

Cross Section Analysis by ArcGIS
Basin Calculation by ArcGIS Hydro

Location: Northern of Cave, Ban Pha Mee

Location: Southern of Cave, Ban Pha Hee

Flow Accumulation by ArcGIS Hydro

Location: Northern of Cave, Ban Pha Mee.

Location: Southern of Cave, Ban Pha Hee.
Flow diversion plan in the Northern part of the cave:
Using pipe for draining water over the fault line.

Determine possible drilling locations:
- Calculate 3D distance
- Calculate distance from drilling location to cave
- Calculate inclination angle
- Calculate azimuth from drilling location to cave
Monitoring Rainfall Intensity by ArcGIS Spatial Analyst

Conclusion: How ArcGIS Hydro tool help in this mission

- Cross Section
- Hydrologic Analysis
- Monitoring Rainfall Intensity and Water Level
- Determine X, Y for flow diversion
- Determine Location for drilling
- 3D Visualization
Summary: Geography and geoinformatics helped in Thailand Cave Rescue Mission
PAPER PRESENTATION: INVITE SPEAKER

“GEOGRAPHY INNOVATION FOR DISASTER MITIGATION IN DIGITAL ERA”

Prof. Dr. Suratman Woro Soeprojo
(Faculty of Geography Gadjah Mada University)

INTERNATIONAL CONFERENCE ON HAZARD MITIGATION IN GEOGRAPHIC AND EDUCATION PERSPECTIVES (ICHMGEP)

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GEOGRAPHY INNOVATION FOR DISASTER MITIGATION IN DIGITAL ERA

BY: PROF SURATMAN MSC
KLMB FACULTY OF GEOGRAPHY UGM

INTERNATIONAL CONFERENCE UNY. INA GARUDA
YOGYAKARTA 28 SEPTEMBER 2018

PRESENTATION

• DISASTER AND GLOBAL DISASTER
• DISASTER MANAGEMENT
• DISASTER MITIGATION
• RISK AND DISASTER RISK REDUCTION
• DRR IN INDONESIA
• GEOGRAPHY INNOVATION & INDUSTRY REVOLUTION 4.0
• INNOVATION LEARNING FOR DISASTER MITIGATION
WHAT IS NATURAL DISASTER

• A NATURAL DISASTER IS A SUDDEN EVENT THAT CAUSES WIDESPREAD DESTRUCTION, LOTS OF COLLATERAL DAMAGE OR LOSS OF LIFE BROUGHT ABOUT BY FORCES OTHER THAN THE ACTS OF HUMAN BEING.

• A NATURAL DISASTER MIGHT BE CAUSED BY EARTHQUAKE, FLOODING, VOLCANIC ERUPTION, LANDSLIDE, HURRICANES, TSUNAMI, etc.

GLOBAL DISASTER MAP

World Risk Index of vulnerability to natural disasters
Currently erupting volcanoes 2018-04-07

GLOBAL SEISMIC HAZARD MAP
GLOBAL DROUGHT HAZARD MAP

Drought periods were defined using an index known as the Weighted Anomaly of Standardised Precipitation (WASP). The WASP index assesses the precipitation deficit or surplus over a three-month running average for the 24-year period from 1980–2000. Findings show that about 30% of the world’s land area has some level of drought exposure.
Five deadliest natural disasters

1. 100,000 - 400,000 by floods in China 1931
2. 900,000 - 2,000,000 by Yellow River floods in China 1887
3. 300,000 by Cyclone in India 1839
4. 500,000 by Bhola Cyclone in Bangladesh 1970
5. 830,000 by Earthquake in China 1556

Global disasters

PEOPLE IN THE DISASTER PRONE AREA IN INDONESIA

- Tsunami prone area >>> 5 million
- Flood prone area >>>>>> 63.7 million
- Landslide prone area >> 40.9 million
- Volcanic eruption prone area > 1.2 million
- Earthquake prone area >> 148.4 million
GEOGRAPHICAL HAZARD

• Is natural environmental hazard
• Extremely natural process caused by geological, geomorphologic, climatic, hydrological, soils, man made, technology, and social
• Impact to people and living
• Destruct landscape environment and resources

GEOGRAPHY INNOVATION FOR GLOBAL DISASTER MITIGATION
Disaster Management Plan

On-site Emergency Plan

For incident which could affect people and the environment inside the works only

Off-site Emergency Plan

For incident which could affect people & the environment outside the works as well

Hazard Classification(1) By Origin

INTERNAL GEO-DYNAMIC PROCESSES
- SEISMIC
  - GROUND VIBRATION, SPECTRAL RESPONSE, ACCELERATION, INTENSITY
- GROUND FAILURE, LIQUEFACTION, LANDSLIDES, TSUNAMI, CONTINENTAL CRUST
  - SUBSIDENCE/UPLIFT

HYDRO-METEOROLOGICAL
- VOLCANIC
  - Eruptions, Pyroclastic, and Lava Flows, Tsunami, Gas, Vapor Emissions, Acid Rain, Glacier Meltdown, Lahars
- CLIMATE VARIABILITY, EL NIÑO, TROPICAL CONVERGENCE, TROPICAL WAVES, TROUGHS, CYCLONES, POLAR THRUSTS, OROGRAPHIC AND CONVECTIVE STORMS, TORNADOES

EXTERNAL GEO-DYNAMIC PROCESSES
- GLOBAL-REGIONAL-LOCAL PROCESSES
  - ERUPTIONS, PIROCLASTIC, AND LAVA FLOWS, TSUNAMI, GAS, VAPOR EMISSIONS, ACID RAIN, GLACIER MELTDOWN, LAHARS
- CLIMATE VARIABILITY, EL NIÑO, TROPICAL CONVERGENCE, TROPICAL WAVES, TROUGHS, CYCLONES, POLAR THRUSTS, OROGRAPHIC AND CONVECTIVE STORMS, TORNADOES

- EROSION
  - GEOLOGICAL, HYDROLOGICAL, TROPICAL, TROPICAL WAVE, CYCLONE

- LANDSLIDES
  - TORRENTIAL DEBRIS FLOWS

- SOIL NUTRIENT LOSS, SLOPE UNDERMINING, LAND DEGRADATION, EPHEMERAL RIVER DAMMING AND BED AGGRAVATION, TORRENTIAL SEDIMENTATION DEPOSITION

- INTENSE RAINFALL
- DROUGHT
- WIND

- EXTREMES IN HYDRAULIC BALANCE: EXCESS DEFICIT, FLOODS, INCREASE DECREASE IN ALBEDO, LAND DEGRADATION
Concept of Risk

Risk(R)

HAZARD(H)

↓

VULNERABILITY(V)

↓

DISASTER

(Diagram modified from C. Wamaler, Lund University 2012)

DRR definition

“The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.”

Source UNISDR, 2009
Hyogo Framework for Action 2005 - 2015

- Make DRR national priority;
- Identification, assessment and monitoring of disaster risks;
- Using knowledge and innovation for DRR;
- Reducing underlying factors and
- Strengthening preparedness capacities.
TARGED DRR 15 YEARS

• 1. REDUCING THE VICTIM FROM DISASTER
• 2. REDUCING IMPACT TO PEOPLE
• 3. REDUCING SOCIAL ECONOMY IMPACT
• 4. REDUCING INFRASTRUCTURE DAMAGE
• 5. IMPROVING HEALTH AND EDUCATION SERVICES
• 6. TO DEVELOP GLOBAL NETWORK OF DRR
• 7. TO DEVELOP DISASTER EARLY WARNING SYSTEM

4 PRIORITY PROGRAM OF DRR

• 1. EDUCATION FOR RISK DISASTER TO PEOPLE/COMMUNITY
• 2. DISASTER MITIGATION
• 3. TO DEVELOP DRR IN EVERY COUNTRY
• 4. PREPAREDNESS IN DISASTER MITIGATION

RESILIENT COUNTRY
RING OF FIRE

FIGURE 14.15
World distribution of earthquakes for a nine-year period. (Data from NOAA)

Major Volcanoes of Indonesia
(with eruptions since 1900 A.D.)

http://vulcan.wr.usgs.gov/Volcanoes/Indonesia/Maps/map_indonesia_volcanoes.html
BIG TSUNAMI IN INDONESIA

Sumber: Puspito, Kompas 2 Nov. 2002
TSUNAMI DAN ZONA TEKTONIK

162 tsunami akibat gempa (periode 1801 - 2004)

Sumber: Puspito, Penelitian Asahi 2004

EARTHQUAKE IN INDONESIA

EARTHQUAKE $M \geq 4.0$, 450 /YEARS
SHALLOW EARTHQUAKE M>6.0 IN INDONESIA

EARTHQUAKE POTENTIAL FOR TSUNAMI IN INDONESIA
POTENTIAL OF TSUNAMI IN INDONESIA (BMKG)

TSUNAMI BY EARTHQUAKE

Mekanisme terjadinya tsunami di zona subduksi
HEIGHT OF TSUNAMI

Tinggi gelombang membesar saat mendekati pantai

CONTOH LANDSAT TM SEBAGIAN MEULABOH
Simulasi Tsunami Aceh

$t = 5$ menit
Lab. Seismologi GM-ITB

$t = 10$ menit
Lab. Seismologi GM-ITB
FLOODING IN JAKARTA

MUD FLOOD

TRESS DAMAGE

Banjir Lumpur
DROUGHT, PEOPLE LOOK FOR WATER IN THE DRY RIVER
DISASTER IMPACT

ENVIRONMENT DAMAGE
NATURAL RESOURCES DAMAGE
SOCIO ECONOMIC IMPACT
VICTIM, STRESS IMPACT
SECURITY IMPACT
INFRASTRUCTURE DAMAGE

LANDSLIDE ZONE AND SETTLEMENT
LANDSCAPE AND DISASTER IN JAWA

Climate CHANGE

- FLOODING, DROUGHT
- UPRISING WATER SEA LEVEL

FIGURE: LANDSCAPE, Geology, Climate, Hydrology and disaster

DRR BY LANDSCAPE AND DISASTER ANALYSIS

MUD DISASTER OF LAPINDO EAST JAWA >> IMPACT TO SETTLEMENT AND SEA ECOSYSTEM
GEOGRAPHY REVOLUTION IN DIGITAL ERA (INDUSTRY 4.0)

GEOGRAPHY-DIGITAL APPROACH

GLOBAL ECO SPACE GEOGRAPHY

GLOBAL DIGITAL SOCIETY NETWORK

TRANS-REGION DEVELOPMENT

GEOGRAPHY SCIENCE TECHNOPARK

GLOBAL REMOTE SENSING TO LOCAL DIGITAL INFORMATION (GEO INNOVATION)

MAPPING INNOVATION BY DRONE FOR LANDSLIDE

DRONE
GEOGRAPHY REVOLUTION IN DIGITAL ERA (INDUSTRY 4.0)

GEOGRAPHY-DIGITAL APPROACH

CYBER ECO SPACE GEOGRAPHY

GLOBAL DIGITAL SOCIETY NETWORK

TRANS - REGION DEVELOPMENT

INOVASI GEOGRAPHY SCIENCE TECHNOPARK

WHAT IS GEOGRAPHY OF INNOVATION

• GEOGRAPHY OF INNOVATION IS DEVELOPED FOR DRIVING PRODUCTIVITY GROWTH BASED ON R&D

• RESEARCH INNOVATION AND DEVELOPMENT (R&D) FOR ADVANCED TECHNOLOGY AND INFORMATION FOR GEOGRAPHICAL ANALYSIS BASED ON IT

• GEOINNOVATION NETWORK FOR GEOGRAPHICAL RESOURCES PROMOTION REGIONAL ECONOMIC GROWTH

dev
tech
eco
GEOGRAPHY OF INNOVATION FOR DISASTER MITIGATION

- GEOGRAPHY OF INNOVATION FOR E DISASTER PLANNING
- GEOGRAPHY OF INNOVATION FOR E WARNING SYSTEM
- GEOGRAPHY OF INNOVATION FOR E DISASTER LEARNING AND TRAINING

ESD – GEOGRAPHY INNOVATION FOR DISASTER MITIGATION
NEW APPROACH IN GLOBAL EDUCATION

1. ESD CURRICULUM FOR DISASTER
2. RESEARCH INNOVATION FOR E DISASTER
3. MULTIDISCIPLINARY DISASTER LEARNING
4. COMMUNITY EMPOWERMENT FOR RESILIENT VILLAGE
5. COOPERATION AND PARTNERSHIP FOR DISASTER MITIGATION PROGRAM
CONCLUSION

• GLOBAL DISASTER IS VERY SERIOUS PROBLEMS FOR GEOGRAPHY INNOVATION LEARNING

• GEOGRAPHICALLY INDONESIA IS A MULTIDISASTER COUNTRY IN THE WORLD

• DIGITAL GEOGRAPHY IS IMPORTANT TO BE DEVELOPED RELATED TO INDUSTRY 4.0 FOR DISASTER MITIGATION IN DIGITAL ERA

• ESD BY GEOGRAPHY INNOVATION IS MAIN ISSUE FOR DIGITAL CYBER GEOGRAPHICAL LEARNING

SAVE OUR EARTH

Thank you!
PAPER PRESENTATION: INVITE SPEAKER

“DISASTER MITIGATION IN SCHOOL RESILIENCE PERSPECTIVES”

Prof. Dr. Siti Irene Astuti Dwiningrum, M. Si
(Faculty of Education – Universitas Negeri Yogyakarta)

INTERNATIONAL CONFERENCE ON HAZARD MITIGATION IN GEOGRAPHIC AND EDUCATION PERSPECTIVES (ICHMGEP)

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Disaster Mitigation in School Resilience Perspectives

S. I. A. Dwiningrum¹, Prihastuti², Suwarjo¹

¹Faculty of Education Universitas Negeri Yogyakarta, Indonesia
²Faculty of Psychology Universitas Airlangga, Indonesia

Email: siti_ireneastuti@uny.ac.id, prihastuti@psikologi.unair.ac.id, suwarjo@uny.ac.id

Abstract. Indonesia is a disaster-prone country. Disaster mitigation requires the role of the community. Schools are one of the strategic elements of the community for the education process related to disaster mitigation goals. The role of schools in disaster mitigation requires synergy between structural and non-structural mitigation. With disaster mitigation, schools can reduce casualties and material losses. Disaster-related education will make school elements more responsive and proactive in dealing with disaster events. Mitigation in the perspective of school resilience requires a core strategy of increasing knowledge, awareness of disasters and reinforcing elements of school resilience. In this study, the status of disaster knowledge and awareness of students in disaster-prone areas was evaluated. The results of this study prove that disaster knowledge of students still needs to be improved in its implementation so that it is not only understood in the cognitive level, but up to the application. Meanwhile, the level of disaster awareness of students from ORID perspectives is still low, thus strengthening of social relations is needed to build the school resilience for successful disaster mitigation. To build school resilience is determined by the synergy of teachers and students by choosing a variety of strategies.

1. Background

The Southeast Asia region is one of the most disaster-prone areas in the world. More than 50 percent of the world’s natural disaster casualties during 2004-2014 periods are from this region. Likewise, the biggest country in Southeast Asia, Indonesia, is the most vulnerable country to disasters in the world based on data released by the United Nations Agency for the International Strategy for Disaster Risk Reduction (UN-ISDR). Millions of Indonesians are exposed to the threat of disasters. Indonesia’s National Disaster Management Agency (BNPB) recorded 148.4 million people living in earthquake-prone areas, 3.8 million in tsunami-prone areas, 1.2 million people in areas prone to volcanic eruptions, 63.7 million people in flood-prone areas, and 40.9 million people live in landslide-prone areas. In Indonesia there are 386 districts / cities in the moderate-high earthquake hazard zone. Furthermore, there are 233 districts / cities in tsunami-prone areas, 75 districts / cities which are threatened by volcanic eruptions, 315 districts / cities with medium-high risks of floods, and 274 districts / cities in areas with medium-high risks of landslides.

Disaster risk reduction and mitigation efforts are carried out by strengthening social capacity especially on the ability to control resources and technology in the event of disasters. In this context, government and non-government institutions must develop facilities, infrastructure, technology, information, and strategies based on to their respective functions. Law No. 31 of 2009 on Meteorology, Climatology and Geophysics has been enacted as legal basis to generate policies regarding the risk of hydro-meteorological disasters such as floods, tornadoes, extreme weather, drought, fire, and geological disasters such as earthquakes, volcanic eruption, and landslides. However, the implementation of those government policies is still not optimum, for example in the case of 2018 earthquake in Lombok which costed high human, material, and economic loss.

The policies of the Indonesian government are in line with global commitments on building disaster awareness, such as the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030. Those policies should be supported by the community to achieve the targets: (a) Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the
decade of 2020-2030 compared to the period of 2005-2015; (b) Substantially reduce the number of disasters-affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade of 2020-2030 compared to the period of 2005-2015; (c) Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030; (d) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, such as health and educational facilities by 2030. One of the strategies is by developing community resilience; (e) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020; (f) Substantially increase adequate and sustainable international supports to developing countries for implementing this Framework by 2030; (g) Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. The community supports and social synergy also needed to realize four main priorities of SFDRR 2015-2030 program (table 1).

Table 1. The Four Priorities for Action Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030

| Priority | Description |
|----------|-------------|
| 1. Understanding disaster risk | Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response. |
| 2. Priority Strengthening disaster risk governance to manage disaster risk | Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership. |
| 3. Investing in disaster risk reduction for resilience | Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment |
| 4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction | The growth of disaster risk means there is a need to strengthen disaster preparedness for response, take action in anticipation of events, and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures |

According to SFDRR 2015-2030, schools have a strategic role on providing education related to disaster mitigation (Amaratunga, D& Haigh, R, 2016). The role is very critical due to the fact that 3,900 schools throughout Indonesia are in tsunami-prone areas, according to Indonesian Disaster Data and Information (DIBI). For example, Special Region of Aceh in Sumatra Island which located in one of the most vulnerable areas and has as many as 457 schools in high tsunami risk zones. Due to its location in several tectonic plates, the "golden time" in to evacuate students after the tsunami warning in Aceh is 15-30 minutes. This reality proves the strategic role of the school as the forefront of disaster awareness culture building. However, based on the data from National Development Planning Agency (Bappenas) on 2017, the people in disaster-prone areas in Indonesia still have low level of disaster preparedness. As the results the human, material, and economic losses in the event of disaster is still high, human sacrifice and damage and losses are sometimes difficult to predict. To improve disaster preparedness Bappenas launched National Action Movement for Disaster Risk Reduction. Unfortunately the effort still has not succeeded. This proves that disaster mitigation programs socialization to the community, schools and families in Indonesia need to be improved. Schools as formal education institutions have an important role in building an effective culture of disaster preparedness. For that purpose, schools should conduct routine simulations and training on disaster preparedness as suggested by United Nations Development Programme (UNDP). Government must facilitate and support those activities particularly in disaster-prone areas. Moreover, Indonesia is
one of 18 countries participating in the regional project "Strengthening of School Preparedness for Tsunami in Asia-Pacific Region" which contributes to the achievement of SFDRR 2015-2030 targets to reduce fatalities, the number of people affected, and economic losses due to natural disasters. The effectiveness of the disaster preparedness program can be evaluated using self-assessment tools from UNDP. An example of its application is the use of a mobile application to measure tsunami awareness of students before and after simulation at 16 schools in Banda Aceh and two schools in Mentawai, West Sumatra which was supported by the Government of Japan, UNDP in Indonesia in collaboration with Japan International Cooperation Agency (JICA), Banda Aceh City Parliament, Regional Disaster Management Agency (BPBD), Ministry of National Education, National Safe School Program Secretariat, Banda Aceh Disaster Risk Reduction Forum, and the Red Cross. The self-evaluation is critical so that schools can conduct self-evaluation to develop its own disaster mitigation program.

Due to the importance of knowledge and awareness of natural disasters, the role of schools in disaster mitigation is very critical. The existence of a culture of responsive and proactive disaster preparedness in schools is very important. Here, we conducted preliminary study to formulate the optimum disaster mitigation strategies for schools in disaster-prone areas. In this paper will be presented some key conclusions from the results of research in schools in disaster-prone areas with the formulation of the problem as follows: 1) Why schools have an important role in disaster mitigation? 2) How to indicate that students have sufficient knowledge and awareness about disasters? 3) How to build school resilience in disaster-prone areas?

2. Literature Review

2.1 Basic Concepts and Objectives of Disaster Mitigation

The disaster related issue involves various dimensions of life, thus a comprehensive approach is needed to manage it. Disaster management is the science related to efforts to minimize risks, which include the act of preparation, support, and rebuilding society when disaster strikes. In general, the disaster management is a continuous process undertaken by individuals, groups and communities in managing disaster as an attempt to avoid or reduce the impact of disasters. The actions taken depend on the perception of the risks faced. The effectiveness of disaster management depends on the integration of all elements; both governments and non-government institution. Activities in each hierarchal structure (individual, group, society) bring influence on different levels. The disaster management cycle consists of four stages: 1) Prevention / mitigation; 2) Preparedness; 3) Emergency Response; 4) Rehabilitation and reconstruction (Dwiningrum, 2008, 2010, 2017).

Mitigation is action taken to reduce the impact caused by the disaster. Mitigation stage focuses on the long-term action to reduce the disaster risk. Implementation of mitigation strategies can be considered as a part of the recovery process if mitigation is done after the disaster. However, despite it is considered as recovery efforts, mitigation also can be described as the action taken to eliminate or reduce the risk of future disaster (Krishna S. Pribadi, 2008). In general, mitigation action can be categorized as structural and non-structural mitigation. Structural mitigation is an action taken to reduce or avoid possible impacts of physical disaster, e.g. the construction of earthquake-resistant housing, infrastructure development, construction of embankments along the river, etc. Non-structural mitigation is the action related to policy, development of awareness, knowledge development, public commitment, and implementation of the methods and operation, including participatory mechanisms and dissemination of information, which is conducted to reduce the risks related to the impact of disasters (Dwiningrum, 2017).

Mitigation is considered as the most efficient action to reduce the impact caused by the disaster. In developing mitigation strategies, the aspects of community governance, risk management, and other related fields need to be considered. Disaster management is not an end in itself, but one end point in the much larger process of community governance. As such it involves a wide range of people and disciplines, not just those designated as ‘disaster managers’.

Citizen awareness about disaster mitigation is very important (Dwiningrum, 2017). This is based on one of the principles in disaster management which is the development of human capabilities. The rationale of this study is built based on the approach to disaster management that develops "capacity management", which in principle develops these two aspects (Ma’arif, 2009:36-37):

1. Human Resources Capacity
We must admit that the capacity of disaster management in Indonesia needs to be strengthened. Strengths and resources that exist within the community must be further identified and developed. Cultural values that are rooted within the community must be explored and cultivated as social capitals that can enhance the resilience of the people against disaster. By utilizing the advance science and technology, we will be able to strengthen our capacity in handling disaster, as well as reducing its impacts.

2. Utilities

Series of disaster that occurred simultaneously in Indonesia has increased the awareness on the importance of available standard equipment that normally required during sudden-on-set emergency that threaten the lives of thousand of people with vast impacts. The standard utilities that must be available or at least made available include:

i. Reliable and functional communication system in the affected areas where the regular electricity power and communication line are damaged.

ii. Transportation means (air, land and sea) which available anytime with dependable emergency management system.

Disaster management and building disaster awareness require a comprehensive approach. The importance of education in promoting and enabling Disaster Risk Reduction (DRR) has already been identified by researchers and policy makers. Moreover, employing knowledge, innovation, and education to build a culture of safety and resilience also promote the integration of DRR as an intrinsic element of Sustainable Development (United Nations Decade of Education for Sustainable Development, 2005-2015). In doing so, there is a renewed focus on disaster risk education in primary and secondary schools. Mainstreaming DRR into school curricula aims to raise awareness and provide a better understanding of disaster management for children, teachers and communities. There is increasing evidence that students of all ages can actively study and participate in school safety measures, and also work with teachers and other adults in the community towards minimising risk before, during and after disaster events. Methods of participatory, vulnerability assessment, capacity assessment, and hazard mapping have been be used with broader communities surrounding schools and other institutions of education and research. Government can effectively reach out to communities and protect them by focusing on schools in DRR initiatives to achieve greater resilience to disasters.

2.2 The Level of Awareness ORID

The level of awareness can be determined by the level of knowledge possessed. Assessing the level of awareness can be conducted by ORID (Objective, Reflective, Interpretive, Decisional) discussion method which will help schools to develop various programs to increase level of disaster awareness and school resilience in general. In a psychosocial perspective, efforts to assess students' awareness status cognitively determine success in responding to disaster events and carry out mitigation actions. The mechanism of thought and response to the disaster is expected to be an indicator that can accurately and completely assess the level of students' understanding of disaster risk and mitigation capabilities that have become their knowledge and perspective. The ability to think comprehensively in understanding disasters, especially disaster risk through the dynamics of thinking and acting in the perspective of ORID (Objective, Reflective, Interpretative and Decision) (Lazan & Maria, 2003) was assessed in this study. The indicator is revealed by questions on the recall process: (1) the extent to which students are sensitive in responding to disasters through their sensory capabilities (Objective); (2) The extent of the student's reflective level in living experience, internal reactions, and students' perceptions of disasters (comparing with the conditions before and after a disaster, fear, and possibly a positive experience (Reflective); (3) The extent to which the reality awareness experienced by students? This requires interpretive abilities of students to express the direct and indirect effects of disasters on schools, families and the future (Interpretative);
(4) With the thoughts and responses experienced in steps 1-3, then students with their personal decisions are expected to build commitment in facing disasters and adapt to various changes caused by disasters (Decision).

2.3 School Resilience

Resilience as a concept is used more in ecology rather than in other fields. Therefore, resilience has not become an important study in other fields like that which stresses on the significance of social system and biophysical system to encounter a wide range of danger of disasters and how the people can recover from them (Shiwaku et al., 2016). Maguire and Hagan introduce three dimensions of resilience towards disaster, comprising resistance, recovery, and creativity. Within their study, resistance is defined as a distance between pre-disaster levels and the time required by people to recover from distraction (Shiwaku et al., 2016). Allan and Bryant (2013, pp. 109–129) suggest that the key of success in the recovery planning and city design because of an earthquake is putting resilience as a framework which gives significant contributions towards the quality of life recovery.

Schools as a critical environment are expected to develop students’ potential optimally to rise from adversity and adapt to various demands for change, as well as develop academic, social and vocational competencies. This is in line with the statement from Ririkin and Hoopman regarding resilience (Handerson 1991):

“Resilience can be defined the capacity to spring back, rebound, successfully adapt in the face of adversity, and develop social, academic, and vocational competence despite exposure to severe stress or simply to the stress that is inherent in today’s world.”

Related to the definition above, everyone needs to develop their resilience in order to continue to exist and adapt to the various demands of social changes. However, each person has different abilities on developing resilience. Resilience is the ability to recognize thoughts and trust structures and utilize the power to increase accuracy and flexibility of thinking to regulate emotions and behavior more effectively. This ability can be measured, taught, and improved. In that case, school can be a place for further developing and strengthening the resilience.

School resilience itself is a process in which schools go through various stages as follows (Dwiningrum 2010, 2017): a) Increase bonding, b) Set clear and consistent boundaries; c) Teach life skills; d) Provide caring and support; e) Set and communicate high expectations; f) Provide opportunities for meaningful participation. The dynamics between elements needed to build school resilience must work synergistically. Teachers have an important role in driving all those aspects for students.

3. Method

Teachers and students of high school / equivalent in disaster-prone areas in Indonesia (Bantul, Sleman and Kediri regencies) were the subjects of this study. Quantitative and qualitative (Creswell, J. & Clark, V. (2003), data was collected from 100 students and 20 teachers from each school by questionnaire, observation, focus group discussion, and documentation. Research subjects were teachers and students. The respondents were 100 students to every school, and teacher is 20 for each school. Data sources are compared with questionnaires, active participation, observation, FGD, documentation, digging related data. There are three instruments used in this study: 1) instrument A is used to explore teacher's knowledge about disaster; 2) instrument B is used to assess the level of student awareness about disaster using ORID perspective; 3) C instrument is used to describe school resilience. Reduction and categorization were conducted to the collected data. While data analysis was conducted by "mixed method", where descriptive statistic was used for the quantitative data and suitable qualitative analysis was used for the qualitative data.

4. Results and Discussion

4.1 School in the Perspectives of Disaster Mitigation

School policy on disaster mitigation is an urgent matter because as explained earlier that geographically most schools are in disaster-prone areas. With existing technological advancements, the school environment should be designed to provide space to develop capabilities and the application of early detection systems, socialization and dissemination of information on the threat of natural disasters to the school community. Therefore, the policies made must be more focused on identifying and mapping disaster-prone areas so that protection for the community can be built into social contexts that
are responsive to all disaster events (Krishna, 2009). Structurally, environment must be designed to withstand various types of disaster, and culturally all school residents should be knowledgeable, responsive, and ready to face disasters by being able to do personal / group mitigation.

Efforts to reduce disaster risk should be the awareness of all citizens including school elements (students, teachers, principal, and staffs). Schools play an important role in disaster risk reduction. School is one of the main sources of knowledge which is the main capital in disaster risk reduction. Furthermore, schools own the ability to understand disaster threats, understand vulnerabilities and assess disaster risks. Therefore, knowledge of how to reduce disaster risk needs to be built in the same perception, because reducing risk can be interpreted as: 1) reducing harm; 2) reduce vulnerability or reduce capacity. Meanwhile, disaster risk management can be understood as: a) the way we understand our situation, b) understanding the threat of danger; c) understanding our weaknesses, d) assessing the risk of disasters being faced; e) plan actions to reduce risk; f) carry out risk reduction; g) monitor the results of the reduction; and h) re-understanding the situation. Those aspects can be gradually and continuously integrated into the learning process in schools, until a disaster awareness culture is formed. This target is in accordance with the global framework on disaster risk reduction. Disaster risk reduction is carried out with a comprehensive approach, as reported by Dwiningrum (2016) in several schools in Yogyakarta, Padang, Kediri (disaster-prone areas). It was reported that only some schools have implemented policies related to disaster mitigation, even awareness of the importance of disaster mitigation is not yet a primary school program. This fact proves that socialization of disaster risk management in schools in Indonesia is needed.

In disseminating disaster risk management, teachers should be able to deliver related information / knowledge creatively so that students' awareness can be developed. Creativity, in this case, does not only involve insight / thinking regarding sciences, but also creativity in the teaching process, and creativity in producing an expected action and / or behavior in disaster risk reduction efforts. The form of socialization about disaster management, especially disaster mitigation in schools can be started by changing the "mindset" that disaster is no longer seen as an event that occurs suddenly or purely naturally, but is understood as a risk that can be handled and anticipated by humans in various socio-economic and cultural dimensions. It is necessary to make a paradigm shift about disaster in the "fixed mindset" to growth-mindest". As explained by Sudaryono (2008), that disaster as a natural factor that cannot be avoided in people's lives must be addressed by developing a mindset to reduce the risk of sudden threats. Likewise, psychologically it is necessary to develop a comprehensive understanding of the threat of natural disasters by interpreting them more positively. Before a disaster occurs, the attitude of teachers and students is oriented towards caring and supporting each others in daily activities. The teacher must build a critical and positive attitude that everything depends on how to interpret events, not focus on events. Likewise, when a disaster occurs the teacher's attitude must be adaptive to the consequences of the disaster by not showing words and deeds that show concern and anxiety. The teacher is expected to calm the conditions and circumstances of students and families. School organizations are also expected to be ready to carry out evacuation actions, by conducting training for school residents, parents of students and the community regarding clear evacuation procedures. From the explanation above, the role of the teacher is very critical in equipping students with knowledge and attitudes related to disaster risk reduction.

Disaster mitigation is in dire need of school roles. One indicator that a school is able to develop and contribute to disaster mitigation programs is that the school has been able to develop school resilience. The existence of school resilience can develop students' potential optimally, fostering spirits to be able to withstand adversity and adapt to various demands for change, including in a state of disaster. Awareness of disaster mitigation is based on approaches to disaster management, namely the development of human capacities that are responsive to disasters (capacity management) (Ma’arif, 2009, pp. 36-37). Therefore, the approach through the development of”capacity management" is a very important foundation in designing school policies. In this context, the school can determine policies that are able to move all elements of the school to be actively involved in building a culture of disaster awareness. Observations on research locations in Yogyakarta prove that schools in general have tried to create programs that strengthen the existence of disaster response culture, but the existing form of activity has not been implemented systemically and sustainably so that it has not optimally developed students' responsive and proactive attitudes towards disaster events.

Disaster-related Knowledge
Disaster management is knowledge related to efforts to reduce risk, which includes preparation, support, and rebuilding the community when a disaster occurs. In general, disaster management is a continuous process carried out by individuals, groups and communities in managing hazards as an effort to avoid or reduce the impact of disasters. The actions taken depend on the perception of the risks faced. The effectiveness of disaster management depends on the integration of all elements, both government and non-government. Activities carried out by each hierarchy (individuals, groups, communities) produce impact with different levels.

Mitigation as an important part of disaster management requires knowledge as basic capital. Schools have an important role in providing knowledge about disasters, namely an element of non-structural mitigation related to policy, development of awareness, knowledge development, public commitment, and method and operational implementation, including participatory mechanisms and information dissemination, carried out to reduce risks related to disaster impacts. Therefore, mitigation is the most efficient action to reduce the impact of disasters. The results of research on disaster related knowledge that are explored from the teacher can be described as follows (Dwiningrum et al. 2013);

| Table 2. Disaster-related knowledge description |
|-----------------------------------------------|
| Aspect                                     |
| Knowledge on disaster risks                 |
| Knowledge related to disaster risk is needed in building objective awareness of the stages in disaster mitigation. Disaster risk tends to vary between regions; this is related to the types of disasters that often occur and signs of impending disaster that can be observed. Knowledge about disaster risk that is difficult to predict has also been socialized by schools. Students' knowledge of the risks associated with disasters tends to be the same, meaning that socialization related to disasters has generally been carried out by the school. Likewise, schools or related parties (government, community elements, and Non-Governmental Organizations) have identified all risks related to disaster events. |
| Policies, regulations, guidelines, and authority. |
| Community responses to government disaster policies tend to vary. Differences in response occur due to differences in conditions and situations between different regions. The government and the community have collected data on physical environmental conditions that are at risk of causing disasters in research locations. |
| Early Warning System                        |
| A disaster warning system is an important aspect in disaster mitigation because it is a starting point for awareness of the emergence of disasters. Each disaster has a different sign of emergence; consequently it is difficult to make a disaster warning system that can be immediately understood by the community. |
| Disaster Information System                  |
| Disaster information system is needed for the disaster mitigation process. With systemic information, it is expected that the community has the ability and awareness in disaster mitigation. |
| Participation in Disaster Mitigation         |
| Participation is an important aspect of disaster mitigation. Participation is manifested in various emergency response teams in the school environment and in society in general. In some cases there is also coordination with mass media, etc. Even with optimal participation the disaster mitigation process has not been successful in reducing disaster victims. Improving mitigation-related knowledge is needed to increase the responsiveness in the event of disaster. |
| Local Wisdom and Culture                     |
| Local wisdom is the ways and practices developed by a group of people, which comes from their deep understanding of the local environment, which is formed from living in that place for generations. |


Safety culture related to local wisdom possessed by the communities in reducing risks, facing and saving themselves from natural disasters has provided many valuable lessons for experts and policy makers.

7. Emergency Planning

Mitigation plan can be designed before and after a disaster. Mitigation plan as emergency planning needs to be announced by government and fully understood by the communities in disaster-prone areas. The initial description of students' opinions about emergency planning was that although government and local communities had formulated a disaster management plan, however, the plan was not fully socialized to the general public.

![Disaster knowledge of high student](image)

Based on Figure 1 above, 79.76% of high school students in Sleman know about disaster knowledge, followed by high school students in Bantul area at 66.98%, and Kediri at 60.30%. The facts above show that most students have knowledge related to disasters. However, this knowledge must be supported by the ability to make decisions responsively and proactively in the events of disaster. Therefore, simulation and training, for example evacuation training, is an important aspect for developing non-structural disaster mitigation in schools. Another aspect, what is needed by the school environment is structural disaster mitigation, for example by making earthquake resistant school buildings. Both aspects are expected to reduce casualties and losses due to disasters.

4.2 Students’ Disaster Awareness Level From ORID Perspectives

The success of mitigation is determined by the awareness of people living in disaster-prone areas. Likewise, mitigation in schools will be considered successful if all elements of the school have high disaster awareness. Awareness is a conscious mind that governs reason and parts of attitudes / behaviors that can be explained based on the universal law of cause and effect. The law of cause and effect will inspire the soul to make choices on every life event (Braurer 1986). Poedjawijatna (1986) explains that awareness is based on knowledge. More specifically, Neolaka (2008) defines awareness as knowledge related to concrete things that are profound and inspiring. In addition, awareness is part of the attitude or behavior associated with its ability to think, desire, and feel. With his mind, humans get knowledge, with his will, human directs his behavior, and with feelings human can achieve pleasure. Therefore, awareness strongly related to knowledge, attitudes and behavior aspects (Soekanto 1982).
Figure 2. The level of disaster awareness of students evaluated from ORID perspective

As shown in Figure 2, it can be concluded that from the quantitative data obtained there is a relatively large proportion of students who do not have a high level of disaster awareness if viewed from an ORID perspective. When compared to the three regions, students from Sleman have the lowest disaster awareness (60% show low disaster awareness). This shows that the relatively high level of disaster-related knowledge (shown in Figure 1) is not enough to build awareness based on ORID perspectives.

An in-depth exploration of 4 ORID elements (Objective, Reflective, Interpretative and Decision) regarding the level of student awareness was also carried out. From the qualitative data obtained, the level of knowledge of students related to disasters is sufficient to respond to disaster events accordingly, although most students still do not have the awareness needed to respond to disasters. In the objective aspect analysis, students were able to describe the signs before the disaster (explaining that when the volcano is about to erupt marked by rising temperatures, thunderous sounds, incandescent lava, and wild animals descending from the mountain). The reflective aspect analysis showed that each student is able to describe their feelings and circumstances if they experience a catastrophic event (sadness, fear, worry, feeling down, disrupted school activities, and experiencing material loss and even death). In the interpretive stage, most students explain that disasters will teach and provide a lot of experience such as being independent, reminding to protect the environment, closer and surrender to God. Finally, in the analysis of the decision stage, students explain their commitment to caring for the environment, promoting greening, as early as possible getting education about disasters, getting training or simulations about volcanic activity, types of hazards, and SAR methods, and conducting infrastructure (including bunker/rescue place) maintenance.

4.3 School Resilience in Disaster-prone Areas

School is an ideal place to develop resilience (Martinussen, M., Rosenvinge, J. H., & Hjemdal, O., 2005, Brown, C. 2008). Resilience will provide the ability to have a high level of accuracy in decision making, have many alternative scenarios, be flexible, and be able to rise to new opportunities in difficult circumstances. Based on these characteristics schools that have resilience will facilitate the process of developing disaster mitigation (Dwiningrum, 2017, Allan, P. & Bryant, M. (2014). However, school resilience in general has not been understood as an important aspect in disaster mitigation. Moreover, resilience has not been specifically studied in school life, especially in Indonesia.
The presence of the school resilience characteristics

![Graph showing the presence of school resilience characteristics in Bantul, Sleman, and Kediri regencies.]

**Picture 3.** Student’s perception on the presence of school resilience in their school

Regarding the matter, students in this study were given a survey on whether their school had resilience. As a result, more than half of the students stated that their schools did not have the characteristics of schools with resilience: there was a bond between students and schools, setting clear and consistent rules, teaching life skills, caring and supporting, realizing and communicating high expectations, giving opportunities to students to participate (Figure 3). The results indicate that school resilience is still not optimally built in schools in those 3 disaster-prone areas. In fact, school resilience is critical for disaster mitigation. Therefore, at present the school policy to build school resilience in disaster areas must be strengthened to support the disaster management efforts.

Based on the results of in-depth interviews and FGD, schools have been starting the efforts to build school resilience, even though the impact has not been optimal on the lives of students in schools and communities. The strategy to strengthen school resilience can be conducted in the following ways (Dwiningrum, 2017):

| Mitigating risk factor       | Teachers                                                                 | Students                                     |
|------------------------------|---------------------------------------------------------------------------|----------------------------------------------|
| **Increase bonding**         | a. Creating a fun learning environment.                                   | a. Comfortable and happy to be on school     |
|                              | b. Helping students to learn.                                             | b. Eager to learn.                           |
|                              | c. Applying empathetic communication.                                     | c. Create open communication with lecturers. |
| **Set clear and consistent boundaries** | a. Creating cooperative learning in schools.                     | a. Actively studying in school.               |
|                              | b. Playing active role in designing a creative & innovative school program| b. Getting involved in designing school programs |
|                              | c. Getting involved in the school program                                 | c. Getting involved in the implementation of the school programs |
| **Teach life skills**        | a. Getting involved in the development of environmentally                | a. Developing soft skills to be ready for life events. |

Tabel 3. Strategy to develop school resilience
and socially friendly school.
b. Strengthening personal resiliency.
c. Actively developing creative teaching methods.

b. Joining extracurricular program which develop resilience.
c. Developing creative activities for the environment and society.

| Building resilience |
|---------------------|
| **Provide caring and support** |
| a. Teachers build togetherness and cooperation in the event of disaster. |
| b. Teachers are involved in the disaster recovery process in schools and communities. |
| c. Teachers help school programs / make programs for disaster awareness. |
| a. Students are ready to become volunteers. |
| b. Students are ready to face disaster events. |
| c. Students help the community in the evacuation process. |

| **Set and communicate high expectations** |
| a. Teachers are used to deal with problems. |
| b. Teachers have a positive mindset in dealing with problems. |
| c. Teachers are responsive to disaster events. |
| d. Teachers are committed to helping students' problems. |
| a. Students are used to deal with problems / disasters. |
| b. Students try to deal with problems / disasters bravely. |
| c. Students try to be more resilient to various problems / disaster events. |

| **Provide opportunities for meaningful participation** |
| a. Teachers help overcome the effects of disasters. |
| b. Teachers develop learning strategies in the event of a disaster. |
| c. Teachers integrate material on disaster mitigation in the learning process. |
| a. Students help friends and communities affected by the disaster by raising funds. |
| b. Students learn to be involved in programs that mitigate disasters. |

Based on Table 3 above, it can be concluded that strengthening resilience requires the synergy of teachers and students. This is in line with the opinion of Barakin & Khanlou (2009), which state to understand resilience cannot be separated from two factors, i.e. protective factor and risk factor (Dewi and Hendriani, 2014, pp. 37–38). In addition to the above explanation there are a number of suggestions that can be considered to improve disaster-related resilience by: 1) strengthening sensitivity in responding to disasters; screening films are part of the process of dialogue and mitigation dissemination; 2) reflecting on disasters: simulating disaster situations, sharing stories of disastrous experiences, increasing faith, learning to be calm and patient; 3) build awareness to reduce disaster risk: provide knowledge to the community about the geological conditions of the local area, provide training in dealing with disasters; 4) making calculations of quick and appropriate actions in disaster situations: participating in disaster management training and participating in building facilities / infrastructure as a form of anticipation of disasters. Various strategies can be carried out to build school resilience that is very supportive to build the community resilience needed for disaster mitigation (Dwingrung, 2017). This is in line with several research results which conclude that building resilience in schools is the duty of teachers to build student resilience especially in vulnerable areas disaster. Therefore, in building school resilience is determined by the strength of the resilience from teachers and students. (Brooks, J., 2006; Brown, C. 2008; Condly, S. J. 2006; Thomsen, K.,2002). In this context, the role of personal resilience is an important aspect to be built on the personality of students. Resilience is an individual’s ability to revive and adapt to a disaster’s effects. Measuring resilience of disasters now becomes a study that gains more attention from researchers (Arbon et al., 2016, pp. 201–215).

5. Conclusions
Schools especially those located in disaster-prone areas have an important and strategic role in disaster mitigation. These schools are expected to be able to educate students who are responsive and proactive towards disaster events. Disaster mitigation efforts must be built on the basis of optimal knowledge
about disasters and increased awareness from an ORID perspective on disaster events. With knowledge developed according to local conditions, given in stages and continuously, students’ disaster awareness can be developed. To support this, increasing social capacity is an important aspect to be considered as a new paradigm in disaster management in schools, especially by building school resilience. Success in building schools is determined by the resilience of teachers and students.

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