A Guideline to Incorporate Geological Hazard Information to Spatial Planning for Local Governments in Indonesia

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Key words: Spatial Planning; Geological Hazards; Mitigation

SUMMARY

Spatial planning and Disaster management policies that have been developed since the Indian Ocean Tsunami in 2004 are reflecting the importance of spatial planning for disaster risk mitigation in Indonesia. Anyway, spatial planning does not sufficiently consider geological risks in many regions. The lack of capacities in local governments, the often inapplicability and lack of clarity of regulations and guidelines, the unavailability of geological hazard information in detailed scale and lack of awareness are just some of the obstacles for a georisk- sensitive spatial planning. To slacken these problems, the German Development Cooperation, implemented by the Federal Institute for Geosciences and Natural Resources (BGR) with the Geological Agency of Indonesia (GAI) (2003-2016) developed a Guideline for the incorporation of geological hazard information into spatial plans targeting local governments. The guideline is a basic guide to promote a georisk-spatial planning as a tool for sustainable development. The guideline gives an introduction to technical and non-technical approaches of spatial planning and information about geological hazard data, responsibilities, policies and assessment in a simple to read manner, through the evaluation of existing regulations, actual discussions and case studies.The guideline has been developed in coordination with stakeholders from the georisk and spatial planning sector, in order to assure the utility of the product. Since 2015 the guideline has been socialized to local governments and the content has been integrated in a training for the introduction to geology for spatial planning in the Human Resources Development Agency for Geology, Mineral and Coal.

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RINGKASAN

Kejadian Tsunami Lautan Hindia 2004, menjadi awal perlunya mempertimbangkan tata ruang dalam mitigasi bencana di Indonesia. Banyak rencana tata ruang di Indonesia belum memuat mitigasi risiko bencana. Kurangnya kapasitas pemerintah daerah, peraturan dan pedoman yang kurang jelas dan tidak dapat diterapkan, tidak adanya informasi bahaya geologi skala rinci dan kurangnya kepedulian merupakan hambatan tata ruang yang peka terhadap georisk. Untuk mengurangi masalah ini, Kerjasama Pembangunan Jerman, dalam hal ini Federal Institute for Geosciences and Natural Resources (BGR) bekerjasama dengan Badan Geologi Indonesia (2003-2016) menyusun Pedoman Penerapan Informasi Geologi Dalam Tata Ruang Untuk Pemerintah Daerah. Pedoman ini sebagai acuan untuk menyusun tata ruang yang peka terhadap Georisk dan alat pembangunan berkelanjutan. Pedoman berisi pendekatan teknik dan non teknik penyusunan

tata ruang, data bahaya geologi, tanggung jawab, kebijakan melalui evaluasi peraturan, diskusi dan studi kasus. Penyusunan pedoman berkoordinasi dengan berbagai pihak dari sektor Georisk dan tata ruang, ini untuk memastikan pedoman dapat digunakan. Sejak 2015, pedoman telah disosialisasikan kepada pemerintah daerah, serta telah di integrasikan dalam pelatihan pengenalan geologi untuk tata ruang di Pusat Pengembangan Sumber Daya Manusia Geologi, Mineral dan Batubara.

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1. BACKGROUND

Indonesia is located in the meeting place of three tectonic plates, namely the Indo-Australian Plate, the Eurasian Plate and Pacific Plate (Figure 1). The intersection of the three tectonic plates contributes to the frequent occurrence of geological hazards, such as volcanic eruptions, earthquakes, tsunamis and mass movement.

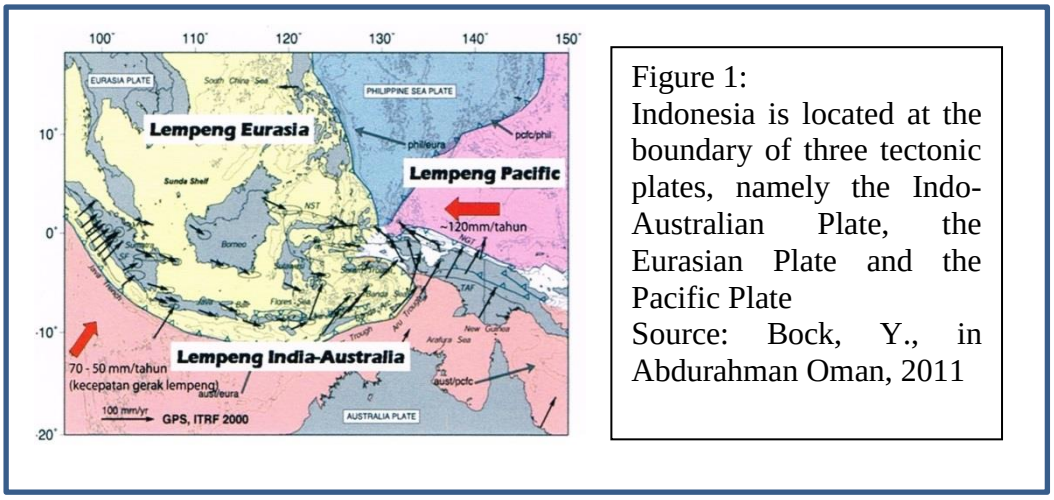

Figure 1:
Indonesia is located at the boundary of three tectonic plates, namely the Indo-Australian Plate, the Eurasian Plate and the Pacific Plate
Source: Bock, Y., in Abdurahman Oman, 2011

Generally, the incidence of geological hazards has different characteristics, depending on the magnitude and the regional setup-up. For example, Tsunamis occurred only a few times during the period between 2004 and 2016 but with high impacts on the country. The Indian Ocean Tsunami in 2004, triggered by an earthquake with the magnitude of + 9.1 SR, caused more than 150,000 fatalities, affected over 500.000 people (*Center for Excellence in Disaster Management and Humanitarian Assistance, 2015*), left broad areas completely destroyed and disabled the transport networks of the affected region (*Aon Benfield, 2015*).

Due to Indonesia´s economic development, infrastructure keeps being a critical factor and a major disasters could affect the country´s economy heavily (the loss might be reaching 3% of the GDP) *(Center of Excellence for Disaster Management and Humanitarian Assistance, 2015).*

Compared to the tsunami events, the frequency of landslide events in Indonesia is high (figure 2). According to the Geological Agency, 197 landslides occurred in Indonesia in 2016 (*Ministerial*

meeting, 2016). Anyway, the occurrence of landslide has caused few fatalities in comparison, but causing the disruption of economic activity in a high number of areas in Indonesia on a day-to-day basis.

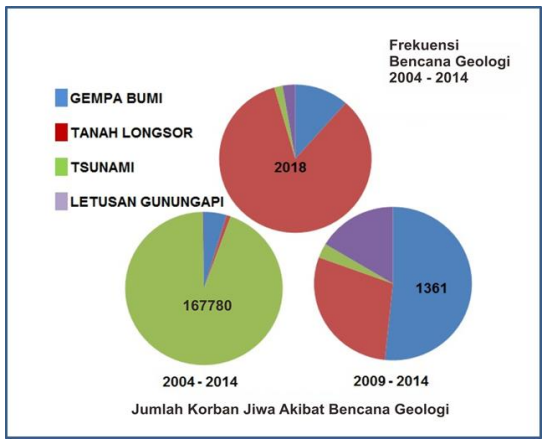

Figure 2 :
Frequency of geological hazards and number of casualties in Indonesia (2004 -2014).
Source : Andiani, Kastl, et all 2015

Based on the frequency and intensity of geological hazard events in the past, the provision of maps of geological hazard prone areas in Indonesia becomes absolutely necessary. The Geological Agency of Indonesia under the Ministry of Energy and Mineral Resources has the mandate to provide geological maps, including hazard maps for earthquakes, tsunamis, volcanoes and landslides.

Related to this mandate, the Geological Agency of Indonesia has been supported by the German Development Cooperation, implemented by the German Federal Institute for Geosciences and Natural Resources (BGR), from 2003 until 2016, cooperating for the mitigation of georisks in several fields of work. The experiences gained through the cooperation activities showed, that the focus on the purely technical assessment of geological hazards is not enough to prevent geological disasters, but that an integrated approach to disaster mitigation, including the implementation of basic concepts of spatial planning are key features for a successful disaster prevention. This finding encouraged the Geological Agency of Indonesia to develop a simple to understand guideline that would promote concepts of spatial planning and decision making but also would approach the weakness of data availability and lack of technical knowledge in data survey. The guideline was meant to be an initial support for local governments towards the enforcement of a georisk-sensitive spatial planning.

2. INFORMATION AVAILABILITY of GEOLOGICAL HAZARDS

Under Law 23/2014 on Regional (Local) Governments (Autonomy Law), the Geological Agency of Indonesia has the obligation to provide geological hazard maps for the entire territory of Indonesia and to take out hazard assessment. Earthquake and tsunami hazard maps have been created in a

scale of 1: 100,000, while landslide maps are already available on a scale of 1: 50,000. Anyway, more detailed maps in a scale of 1:25,000 or even bigger are not available in the Geological Agency yet, and due to budget and human resource limitations the maps are only available in some areas of Indonesia. Most complete are the volcano hazard maps, which are available for all the 127 active Category A volcanoes of the country.

Even though the tsunami of 2004 showed that geological hazards information is indispenbsible for disaster management and since then, hazard data is used as a reference for national disaster mitigation (including as a reference for decision-making for the development of national projects), disaster prevention is still not priority in the implementation of spatial plans.

3. SPATIAL PLANNING IN INDONESIA

After the tsunami in Aceh in 2004, the Indonesian government has formulated a number of laws and regulations aiming at the mitigation of disaster risks,geological disasters.

Two important laws have been enacted in Indonesia, which can be considered as reference for the development of regions in Indonesia, namely Law No. 24/2007 on Disaster Management and Law No. 26/2007 on Spatial Planning. Law No. 24/2007 is implemented by the National Disaster Management Agency (BNPB). The Spatial Planning Law 26/2007 is implemented by the Ministry of Agraria and Spatial Planning (ATR formerly Ministry of Public Works). Both institutions are represented on provincial and district levels.

Both laws are closely related, as the Disaster Management Law in article 35 states that spatial planning is an element of disaster management and the Spatial Planning Law states in article 6 that spatial plans need to consider the physical condition of Indonesia, which is disaster prone.

Generally, spatial planning can be located in the disaster risk management cycle most importantly in the development and prevention phase, but already reconstruction should consider spatial planning approaches.

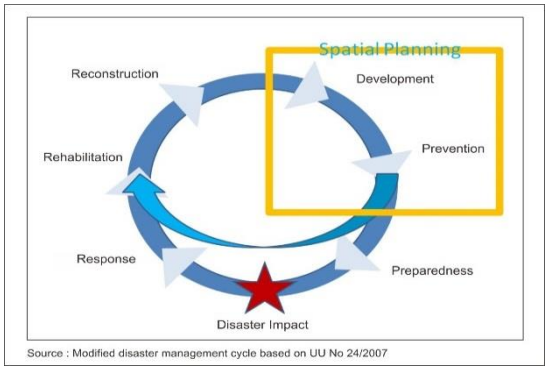

Figure 3:
Location of Spatial Planning in the Disaster Risk Management cycle

Source: Andiani, Kastl et all, 2015

Various guidelines have been issued as technical guidance for geological hazards and spatial planning, including the Ministerial Regulation No. 21 / PRT / M / 2007 on the Guidelines for Spatial Planning in Prone Areas to Volcanic Eruptions and Earthquakes and the neighboring Ministerial Regulation No. 22 / PRT / M / 2007 on the Guidelines for Spatial Planning in Landslide Prone Areas. Both guidelines were issued by the Ministry of Public Works and regulate the acquisition of geological hazards information related to the zoning regulation applied in Indonesia.
In addition there are general guidelines for the preparation of spatial plans, like the Ministerial Regulation No. 21/PRT/ M/ 2007 on the Guidelines for the Preparation of Detailed Spatial Planning (Scale 1: 25,000) by the Ministry of Public Works, that support local governments to fulfil their duties.

In general, spatial plans in Indonesia differentiate between two land use patterns: built up areas and protected (conserved) areas. Built up areas are settlements, industrial areas, trade areas and agriculture, whereas protected areas are forests cultural heritage areas and areas prone to geological disasters.

3.1. The Spatial Planning System in Indonesia

The Spatial planning System in Indonesia is based on a top-down- bottom-up approach which is related to the National Development System. The National Development Planning System establishes a Long-Term Development plan which is valid for 20 years and Mid-Term DSevelopment Plan which is valid for 5 years for the national, provincial, and district/ city levels.
The spatial planning hierarchy in Indonesia (Figure 4) leads from the national spatial planning scale of 1: 1,000,000, which is prepared by the central government (RTRWN to the the provincial spatial scale of 1: 250,000, the district/ city spatial planning scale of 1: 50,000 and the Detail Plan with a scale of 1: 25,000, prepared by the local governments. Spatial Plans should not only be coordinated among the different administrative levels but also among sectors and neighboring areas.

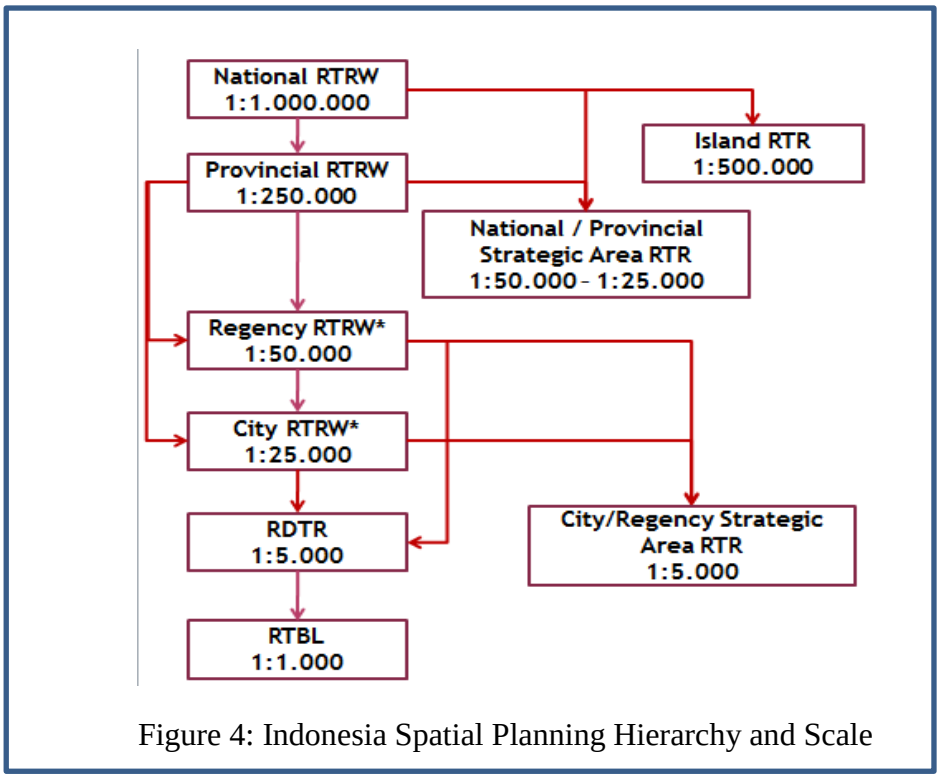

Figure 4: Indonesia Spatial Planning Hierarchy and Scale

In terms of spatial planning coordination, the Spatial Planning Coordination Boards (BKPRN for national level/ BKPRD for regional level) are the mandated bodies, consisting of line ministries and related agencies, including the Geological Agency of Indonesia. Inputs and recommendations are given through the board to make sure the alignment of spatial plans with national/ provincial strategies and the representation of sectorial interests. After the approval of spatial planning regulation drafts in the boards, documents are endorsed by regional leaders.

3.2. Spatial Planning Problems

The Geology Agency of Indonesia (GAI) has a mandate to provide inputs and comments/ recommendations on spatial planning related geological aspects and since the implementation of Law 23/2014, the Agency is the central authority for geological hazard data survey.

Anyway, most of the spatial planning documents in 34 provinces and 514 districts /cities evaluated in BKPRN, do not yet consider sufficiently geological hazards.

a. Spatial planning documents do not contain geological hazard maps at all
b. Spatial planning documents of use geological hazard map, that do not follow the regulations/ guidelines

c. Spatial planning documents do consider provided data in the description chapter only, but do not adapt the decision taking based on that data.

Those problems occurre due to several reasons:

a. Local governments face difficulties in implementing the rule to designate geological disaster-prone areas as protected area, due to the urbanized character of the planning area and the urbanization pressure on land.
b. The existing regulations and guidelines, do not take into account the limited capacity of local governments to create data and to analyze geological hazard information.
c. Data in detailed scale is still insufficient (data gap between data availability and data demand). Guidelines for spatial planning were drawn up on a scale of 1: 50,000 or more detailed, while the existing geological hazard information is provided on a scale of 1: 100,000 or 1: 50,000, that then are not used in a proper manner. As a result, information in the planning process can become biased and inconsistent.
d. The terms used in geological hazard maps are often not understood by the local governments and planners (lack of technical capacities).
e. Lack of awareness. Often, the local government particularly the G, Head of District or City Mayor do not take into consideration conditions of geological hazards in the region as a reference for determining the vision of local development.
f. Outsourcing to consultant companies: The lack of technical ability and capacity of local governments to conduct spatial analysis, leads to the tertiarization of spatial planning on local level. Anyhow, the lack of capacity on local level makes even quality control difficult.

The preparation of a simple to understand guideline using best practice samples and introducing to basic knowledge and approaches of spatial planning and hazard information is necessary to tackle these problems and to give local governments the opportunity to take a first step towards a georisk-sensitive spatial planning.

4. IMPLEMENTATION ON GEOLOGICAL GUIDELINE FOR SPATIAL INFORMATION

Since 2013, the Geological Agency of Indonesia, supported by the German Development Cooperation in the field of Mitigation of Georisks, implemented by the German Federal Institute for geosciences and Natural Resources developed a guideline for the consideration of geological hazard information in spatial plans to standardize the application of geohazard data in in spatial planning and to promote a georisk-sensitive spatial planning. The purpose of the guideline mainly aims at:

a. the creation of a reference for planning institutions and consultants at the national, provincial and local level for a georisk-sensitive spatial planning.
b. the discussion and explanation of existing and complementary regulations related to spatial planning and geological hazard assessment.
c. the promotion of a georisk-sensitive decision making.
d. the explication of alternative simple (technically) approaches of data creation and analysis based on data gaps.

e. the promotion as spatial planning and its non-technical elements as tools for sustainable development.
f. the creation of a reference in drafting the Terms of Reference (TOR) for the preparation (compilation) of national spatial planning or even for provincial and district / city.

4.1. Method of Compilation/Preparation

The Guideline for the Consideration of Geological Hazard Information for Spatial Planning has been has been prepared through several stages:

a. Evaluation of laws and regulations in Indonesia related to spatial planning and geological hazards by a working group from the Geological Agency of Indonesia together with stakeholders like some regional planning and development agencies as well as the Ministry of Home Affairs and the German Academy for Spatial Research and Planning (Hannover). As a first outcome the initial draft of the guideline was prepared.
b. Workshop, involving relevant ministries / agencies and local governments. Some of the participating ministries were: Ministry of Public Works, National Development Planning Agency, National Disaster Management Agency; Provincial Governments such are: Aceh, Central Java, West Java, the Ende Regency and Semarang City. The workshop's purpose was to harmonize points of views and to obtain feedback to enrich and verify the content of the document and its limitations.
c. Case study, focusing on the preparation of a detailed plan based on geological hazard mitigation for the Gunungsari sub-district in West Lombok-NTB regencies/districts. The case study was used as one best practice sample and supported the problem analysis and need assessment of spatial planning on local level.
d. Comparative study of several German and Philippine institutions like the German Federal Institute for Geosciences and Natural Resources (BGR), the German Academy for Spatial Research and Planning (ARL), Philippine Institute of Volcanology and Seismology (PhiVolcS) to determine planning approaches of disaster prone areas in other countries.
e. Testing the guideline to determine the possibilities and constraints faced by Local (Regional) governments in implementing the contents of the guidelines in order to prepare (compile) spatial planning.
f. Finalizing the Guideline

In 2015 the first edition oft he guideline was published. Since 2016 a second edition has been developed, in which several new policies and approaches were integrated. Since 2016 approaches and methods promoted in the guideline were incorporated in a training for geology based spatial planning, which is applied in the Human Resources Developments Agency for Energy and Mineral Resources (BPSDM ESDM).

4.2. Contents of Guidelines

The technical work on the guideline document were completed in 2014 and since then the documents have been revised to conform to changes in policy development in Indonesia. These

changes include ministerial nomenclature changes and adjustments to the rules and guidelines of the related ministries.

The guideline consists of basic chapters, which introduce to spatial planning and disaster management in general and specifically for Indonesia. In a second part, geological hazards are explained and alternative approaches of data creation, analysis and application are given. In a last part, topics regarding political procedures such as participation, control and coordination are presented. Conflict analysis and scenario building are two important topics that are indispensable for a sustainable and georisk-sensitive spatial planning which are addressed in the guideline importantly. These two elements support sustainable decision making and the harmonization of interests, anyhow they are not commonly applied in Indonesia.

As spatial planning can be considered a weighing process of different interests, in which economic short-term benefits compete with mid-and long-term benefits, which often are of minor interest in a political atmosphere, the the geologic- technical part of the guideline answers several questions:

a. What is the definition of each geological hazard?
b. Who has the mandate for each specific hazard?
c. Which data does exist for the specific hazard?
d. Which data can be used alternatively if information is not sufficient in order to take a step towards decision making?
e. How to read geological hazard data and how to use this data in spatial planning? See figure 5,6,7

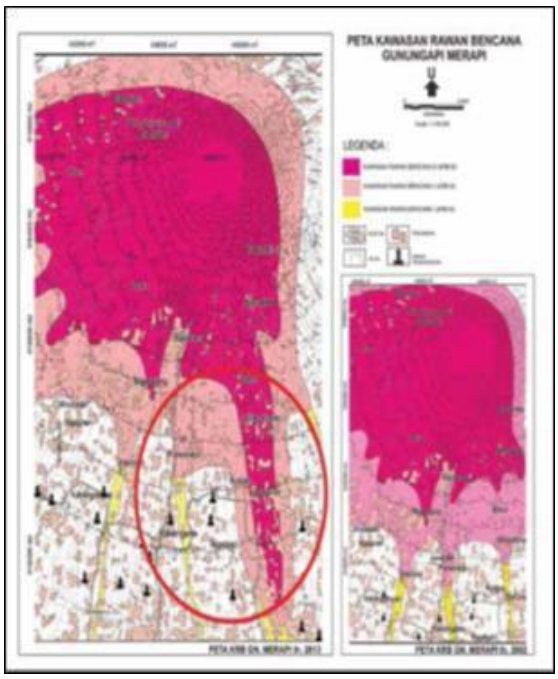

Figure 5: The change of Hazards map. The change of volcanic hazards maps as one of the most active volcanos in the world. Red circle on the left side map showing enlargement of hazard of volcano after eruption of Mt.Merapi in 2010. In the future, the areas will be threaten. To anticipate the victims, regional governments should limit the infrastrucrure development with may affect to the less human settlements.
Source: Andreastuti, S.A, Geological Agency Of Indonesia, 2010

5. DISSEMINATION GUIDELINES

Technical guidance to local governments is one of the obligations of the Geological Agency of Indonesia and related events are conducted every year. Technical assistance aims at the strengthening of local governments in the field of geology (capacity building) and to disseminate outputs of the Geological Agency of Indonesia. In 2016, the guideline has been distributed in several technical guidance events (BINTEK) for stakeholders at national and local level, non-governmental organizations, the private sector and universities.

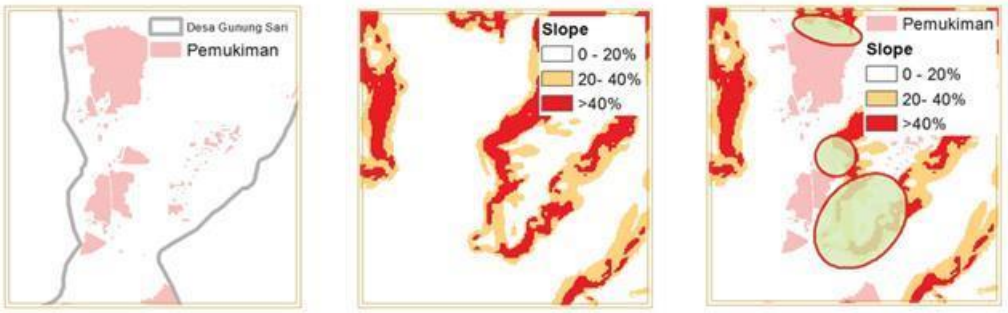

Figure 6 : Steps to determine conflict area.
Step 1 shows the existing land use (human settlements)
Step 2 land use map overlay with slope maps
Step 3 red circle shows human settlements located on the slope area map upto 40% as landslide prone areas. On the Spatial Planning requires consideration type of mitigation needed on the area and also the alternative locations when landslide occurred. Source: Guideliness of the application of Geologic Hazard Information for Spatial Planning 2016.
Source : Andiani, Kastl et al., 2015

Figure 7: Landuse
Left map: red color shows Aceh tsunami impacted areas 2004.
Right map: Area close to the beach detemined as conservation area, alternate land use as agriculture area (light blue) and tourism (dark blue).
Source: Andiani, Kastl et al, 2015.

Besides, since 2015 the Geological Agency of Indonesia supported the Center for Human Resources Development for Geology, Mineral Resources and Coal in the preparation of a training course on spatial planning, which takes into account contents of the guideline. The training is part of the training plan of the institution and will help to disseminate the guideline approaches and supports the harmonization of spatial planning in Indonesia towards the mitigation of geological risks.

6. CONCLUSION

This paper argues that the spatial planning documents in Indonesia do not sufficiently consider geological hazard information in order to prevent the government from future geological disasters. Different reasons play a role for the situation, mainly the lack of local capacity to prepare spatial plans. Even though, good hazard information is not fully available and needs to be addressed, there is the need to give simple guidance also on the application of spatial planning elements such as participation instruments and strategic approaches in order to enhance the quality of spatial decision making. A guideline that covers these topics and creates a direct linkage between technical data and political procedures can support to overcome these problems. The Geology Agency of Indonesia has prepared such a simple guideline in cooperation with several institutions and based on existing rules and guidelines.

The contents of the guideline do not cover all aspects of spatial planning and geological hazard analysis and is not always promoting state of the art techniques. However, the guideline is a useful

tool that meets the needs of local governements in Indonesia. It guides through the spatial planning process and gives technical advice based on the challenges local governments in Indonesia face.

The guideline can be understood as a tool to encourage local governments to take the first step to improve the realization of spatial planning based on geological hazard information in Indonesia, considering limited data, limited human resources and capacities and confined governmental budget.

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