

## Conference Paper

# Exploring Community Preparedness for Complex Disaster: A Case Study in Cilegon (Banten Province in Indonesia)

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## Abstract

This study aims at examining how local communities in City of Cilegon (Banten province in Indonesia) consider 'complex disasters', and clarifying their subjective perceptions. The present research is considered as the first step in our comprehensive research design beyond a specific case study. The nuclear accidents in the Great East Japan Earthquake and the huge flood in Thailand provide lessons that natural disasters can cause catastrophic influences on industries and they generate cascading effects and damages. We define such complicated phenomena as 'complex disasters' in this article. Cilegon is potentially exposed to such complex disasters because it has natural disaster risks (among others, the Krakatau volcano sits adjacent to it, and recalling historical earthquakes and tsunami) and industrial disaster risks (a lot of heavy industry facilities including chemical ones), and these two types of risks can be combined and made reality. A 'model for the communication of risk' developed by Rodriguez et al. (2007) is adopted as an analytical framework in this study. The model predicts involvement of many types of actors and can be considered as an adequate framework for our study. This study mainly focused on one industrial gas facility of Pertamina, a state-owned energy company, and its surrounding community (Lebak Gede village) in Cilegon. The qualitative methodologies were used in this study: One focused group discussion (FGD) and three key informant interviews were implemented by the authors. The participants of the FGD were twelve leaders of the neighborhood associations (locally described as 'RT' and 'RW' in Indonesian acronym) closest to the Pertamina facility (two RW leaders and ten RT leaders). The key informant interviews were separately and additionally conducted with a head of a village, a neighborhood association leader (this leader was different from the FGD participants) and a local forum entity, in order to reinforce observations at the FGD. Our survey observed that

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involvement of the Indonesia Power, a subsidiary of state-owned electricity company whose facilities adjacent to Pertamina's facility, as one of the industry actors, local governmental agencies and the Indonesian Red Cross. On the other hand, we did not clearly identify any clear involvement of the educational institutions and the mass media, although the model of Rodriguez et al. (2007) estimates their engagement. People in Lebak Gede village have already expected potential threats by large-scale natural disasters. Furthermore, they recognize that such disasters give influence on the industrial facilities and the consequences are catastrophic. Although local residents in Lebak Gede village had a lot of experiences of industrial accidents in the past, these experiences did not initiate a significant mindset change for a more organized preparedness. Instead, they paid larger attentions to floods as their preparedness priority.

This study adopted the qualitative method for gathering specific information, but more comprehensive research can contribute to verify preparedness and risk perception on the complex disasters. Although this article selectively dealt with one village (Lebak Gede village) and its preparedness and perception, the findings is to be further clarified in detail for generalizing community preparedness for the complex disasters.

**Keywords:** community, risk perception, natural disaster risk, industrial disaster risk, complex disaster, Cilegon

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## 1. Introduction

### 1.1. Background of this study: Why focusing on 'complex disaster'?

As we learned from the nuclear accidents in the Great East Japan Earthquake and the huge flood in Thailand in 2011, natural disasters give influences on industries and they cause snow-balling effects and damages. In that sense, the supply chain management is one of the most typical issue. The authors recognize these phenomenon as 'complex disasters', and consider that it should be examined based on research findings both of natural disaster research and occupational health and safety research. Some previous works, such as Linden and Perry [1], Sengul et al. [2] and Youngman [3], have already explored the complex disaster. However, the relevant research has been still limited, and further efforts are required to contribute to the society.

City of Cilegon (Province Banten in Indonesia) is potentially exposed to such complex disasters, because it faces with natural disaster risks (the Krakatau eruption in 1883, historical earthquakes and tsunami) and industrial disaster risks (a lot of heavy industry

facilities and accidents). Cilegon is a one of the most famous and significant heavy industrial zones (Adiningsih et al. [4]; Hudalah et al. [5]; Cahyandito [6]). Historically, the first development of the Cilegon industrial zone was organized in the steel industry, and then the chemical industries have been added gradually (Moon [7]). Sucilo et al. [8] wrote that Cilegon is exposed to the Krakatau volcano eruption risk and other earthquakes. Furthermore, the BNPB (national disaster management agency in Indonesia) introduced tsunami risk in addition with the Krakatau volcanic eruption and other seismic risk (BNPB [9]). BNPB [9] clearly noted that "If there is a major earthquake in the Megathrust segment of the Sunda Strait, the most threatened area of the tsunami is the industrial area in Cilegon City." The Health Crisis Center of the Indonesian Ministry of Health has already conducted the mapping of chemical disaster-prone areas in Cilegon, although the results are not publicly available.

## 1.2. Literature review: A model for the communication of risk and risk perception

As an analytical framework in this study, we apply a 'model for the communication of risk', developed by Rodriguez et al. [10]. The 'model for the communication of risk' was constructed based on Nigg [11]. This model was constructed for exploring 'natural' disasters, but it can be considered to be applicable for other types of disasters including technological events (Donner and Rodriguez [12] and O'Hair et al. [13]). As shown in Figure 1, it illustrates interaction between many actors. The model demonstrates 'general population' as its basis, and it emphasizes the importance that risk information should be disseminated and understood by people. Additionally, 'emergency management agencies', 'mass media' and 'industry' are included in the model. Taking considering with the geographical uniqueness in Cilegon as the industrial city, the model can be considered as an adequate framework for our study.

Regarding risk perception, Gaillard [14] overviewed the earlier works. According to Gaillard [14], the previous research can be categorized into some groups. Among them, the authors of this study rely on a basic concept emphasizing the importance of 'social contexts' (Torry [15]; Susman et al. [16]; Hewitt [17]). This concept states that "the perception of a natural hazard and behavior that may affect the threat it poses, is more related to societal organization and values than perceptions of geophysical conditions and that disasters are not explained by behavior peculiar to the disaster event but rather by the nature of society in a particular geographic location (Gaillard [14])." Furthermore, Gaillard [14] indicated that "there might not be a causal relationship



**Figure 1:** Model for the communication of risk (reprinting from Rodriguez et al. [10]).

between risk perception and behavior; rather behavior would be constrained by social structure. Therefore, in order to understand risk perception, it would be necessary to understand the wider social context in which individuals are situated.” This way of thinking is fully consistent with the model of Rodriguez et al. [10]. The model relates people with a variety of social actors, and it can be considered that the model has an implicit assumption that risk information is communicated through interaction among the actors.

This study examines how local communities in Cilegon currently prepare for ‘complex disasters’. This article specifically clarifies their subjective understanding and perceptions. The present research is considered as the first step in our comprehensive research design beyond a simple case study.

## 2. Methods

As a case study, we mainly focused on one industrial gas facility of Pertamina, a state-owned energy company, and its surrounding community (Lebak Gede village) in Cilegon. Other industrial companies were not excluded but also included as necessary.

The qualitative methodologies were adopted in this study for obtaining primary information on risk perception of the local people: One focused group discussion (FGD) and three key informant interviews were conducted between 9th August 2017 and 12th August 2017.

The participants of the FGD were twelve leaders of the neighborhood associations (known as 'RT (Rukun Tetangga)' and 'RW (Rukun Warga)' in Indonesia) in closest to the Pertamina facility. Three RW are adjacent to the Pertamina facility and there are seventeen RT under these three RW. Two leaders of these three RW and ten RT leaders attended the FGD. Origins of the FGD participants did not concentrate on specific RW, but they were proportionally distributed. Also, the FGD participants were comprised of male and female leaders.

The interviewees of the three key informant interviews were a head of a village (the Indonesian name of the administration level is 'kelurahan'), a neighborhood association leader (hereinafter referred to as 'a head of a RW') and a local forum entity, in order to compare with and complement the results of the FGD. A head of a RW was different from the FGD participants, but the head's RW locates in Lebak Gede village. The local forum entity targets disaster risk reduction in Lebak Gede village, composed of volunteer villagers, and is independent from other institutions.

### 3. Results

#### 3.1. Risk perception on the complex disaster

##### 3.1.1. Complex disaster

In the FGD, a discussion was made on complex disaster risk which can be caused by the Krakatau. The Krakatau volcano, locating within 60 km in the west from Cilegon, made an explosive eruption in 1883. The ejected materials from the volcano went down in the ocean, and they generated a huge tsunami (Nomanbhoy and Satake [18]; Maeno and Imamura [19]). Summarized by Maeno and Imamura [19], the runup height of the tsunami reached over 30 m, and the coastal areas of Cilegon were inundated. The FGD participants argued: A Krakatau eruption similar with the 1883 eruption will damage tanks of factories, and gas leakage can be happened, and it cannot be safer if people evacuate to the top of mountain (In the topographical characteristics, the Lebak Gede village faces with the Sunda Strait, and it has mountains behind the village). Also, they discussed that their village is surrounded by chemical factories and toxic gas are filled even though the villager can survive from tsunami waves. Apart from the Krakatau, the FGD participants did not clearly talk about tsunami which can be generated by earthquake under the ocean. Besides that, the FGD participants said they felt worried and afraid if Krakatau Mountain will erupt.

**Original discourse:** *Kalau saya mah membayangkan kalau Krakatau, walaupun kita evakuasi ke atas gunung, meleduk, pasti retak sih tangki yang ada di sekitar kita dari ujung sana, ya tetep, yang namanya pecah, gas, larinya ke gunung bahaya kan. Walaupun kita selamat dari tsunami, tapi gasnya itu kan yang ke mana-mana. Kalau sebelum ada tangki kita mungkin selamat naik gunung, sebelum ada pabrik-pabrik kimia. Tapi setelah ada pabrik kimia.*

**(Translation:** *If I imagine that Krakatau Mountain will be erupted, even though we are evacuating to the top of the mountain, the industries facilities and tanks around us are cracking, and the effect will reach the mountain. That's still dangerous for us. Even though we will be safe from tsunami, the gases will spread to everywhere. Before the chemical facilities and tanks have been built, maybe we could safe once we go to the mountain. But, it could not be, after chemical industries are built.)*

On the other hand, in the interview with a head of an RW, the person heard about the Krakatau eruption from father and grandfather and imagined that many villagers will be affected if the similar events of the 1883 eruption will be happened. However, the person did not explicitly connect the big eruption with the complex consequences.

**Original discourse:** *Itu pernah kejadiannya itu memang itu karena memang orang belum terlalu banyak sehingga korbannya gak banyak juga tapi itupun mencapai ribuan, tapi kalau sekarang mungkin ratusan ribu. Kalau dulu karena memang masyarakatnya juga belum ada belum penuh tapi banyak juga yang korban.*

**(Translation:** *It ever happened that it is because people are not too many so that the victim is not much too but itupun reach thousands, but if now maybe hundreds of thousands. In the past, because the people have not been full yet, there are many victims.)*

### 3.1.2. Fires and accidents in factories

Although some discourse in the FGD did not directly relate with the complex disaster risk, topics on fires and accidents in factories were often raised. For example, a discourse demonstrates that once a fire will be happened, it will cause other fires and the fires can be expanded. Some FGD participants were worried that a gas-pipe line goes through the village and many chemical facilities. The interview with a head of a

RW also showed us a past case of a large-scale fire. It is noteworthy that people are clearly aware of the industrial disaster risk.

**Original discourse:** *Wah diameternya kalo pabrik kimia tuh paling ada yang Cuma sampe dengan tembok. Sama-sama kimia, misalnya terjadi ledakan sekelas ini, itu kemungkinan ke sebelah, ke sebelah, ke sebelah lagi.*

**(Translation:** *Well, the diameter of the chemical plant can reach to the wall. Both are chemical. If there is an explosion this level, it is likely to reach next door, to the next, and to the next.)*

**Original discourse:** *Dari Peye sampai Banjarnegara, mungkin puluhan pabrik kimia. Jalur pipa gas ada. [...] Itu yang kita takutkan.*

**(Translation:** *From Peye to Banjarnegara, perhaps dozens of chemical plants. Gas pipeline exists. [...] That's what we're afraid of.)*

### 3.1.3. Floods

In addition, with the complex disaster risk and the aforementioned industrial disaster risk, floods were relatively more frequent in Lebak Gede village.

**Original discourse:** *Jadi belum ada, istilahnya sekarang tuh, belum ada wadah tim relawan, atau misalnya banjir, di sini kan sering banjir, pak.*

**(Translation:** *So, there is no, the term is now tuh, there is no container volunteer team, or for example flood, here's often flood, sir.)*

## 3.2. Risk information sharing with Pertamina

It was April 2013 when Pertamina started its operation (LPG tanks) in Lebak Gede village. However, our survey revealed that socialization activities prior to the tank construction was not sufficient. Risk information on the complex disaster did not reach surrounding communities.

**Original discourse:** *Kita nggak tahu itu akan jadi tangki. Kita berpikirnya hanya untuk, pertama, apa, rumah sakit aja waktu itu*

**(Translation:** *We did not know it was going to be a tank. We think it's just for, first time, what, a hospital at that time.)*

**Original discourse:** *Minimal, pertemuan itu dilakukan mensosialisasikan dampak itu dan kesiagaan. Awalnya saya pengen begitu. [...] Tapi sampai sekarang belum.*

**(Translation:** *At a minimum, the meeting was conducted to socialize the impact and alertness. At first, I wanted to. [...] But until now not yet.)*

Also, the FGD demonstrated that some of the villagers are feeling difficulties in communicating with Pertamina, because all of management staffs of Pertamina are not necessarily located in their facility in Lebak Gede village (the headquarters office of Pertamina locates in Jakarta). Furthermore, when Pertamina will conduct maintenance of their facilities, they have sent announcements or letters to leaders of relevant neighborhood associations (known as 'RW (Rukun Warga)' in Indonesia in this context), and sometimes it actually happened that they did not notify anything at all.

**Original discourse:** *Ketika mereka akan mengadakan perbaikan, mereka hanya pemberitahuan ke kita, "kepada yang terhormat, pengurus RW 01, 02, 03, sampai 09". kebanyakan gitu, "bahwa kami akan mengadakan perbaikan, overhaul, overhaul, oleh karena itu kami mohon maklumnya.*

**(Translation:** *When they will conduct maintenance, they just give announcements to us, "to head of RW 01, 02, 03, until RW 09". Mostly like, "we will conduct maintenance and overhaul. Therefore, we hope your understanding.")*

In comparison with Pertamina, Indonesia Power (a subsidiary-power plant station of a state-owned electricity supplier) has already conducted a tsunami drill. Even though the detailed of the tsunami drill was not explained to the authors, people of Lebak Gede village is aware of difference with these two companies.

**Original discourse:** *Kalau Indonesia Power sudah melakukan. [...] Terakhir tsunami drill waktu itu ya, di lapangan bola Kelapa 7.*

**(Translation:** *Indonesia Power has done. [...] Last tsunami drill was yes, held on the soccer ball field Kelapa 7.)*

The local forum entity in Lebak Gede village has not collaborated with industries, including Pertamina. There is an association named 'Anyar Merak Cilegon Chemical Manufacturers Association (AMCCMA)' in Cilegon, which is composed of industries around Cilegon. However, the local forum entity does not have any experience to work with the AMCCMA, because the AMCCMA focuses on inter-company relation, and there is no contact between the forum and the AMCCMA. Therefore, the complex disaster risk sharing is quite limited.

### 3.3. Risk information sharing with the governmental agencies

Risk information on the complex disaster has not yet achieved by the governmental agencies such as the Cilegon city government and the Banten provincial government. According to some discourse in the FGD, government-lead volunteer organizations, such as 'Destana' and 'Siaga Bencana', have already been organized, and first-aid and evacuation trainings were conducted. However, the authors do not clearly confirm if the governmental bodies disseminated the complex disaster risk information to people.

### 3.4. Risk information sharing with Indonesian Red Cross

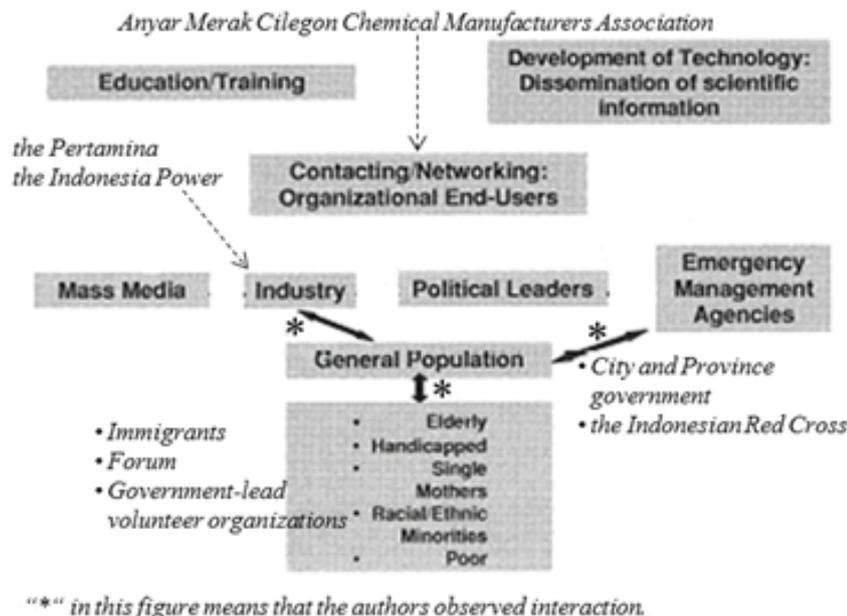
Indonesian Red Cross (known as 'PMI (Palang Merah Indonesia)' in Indonesia) implemented activities about flood management in Lebak Gede village from 2012 to 2014, jointly cooperating with the Japan Red Cross. Our survey demonstrates that their activities were recognized by local people, but the risk information sharing did not happen at that time. As a part of the Red Cross activities, a lot of evacuation signs were set in the village, but not all of the villagers do not understand them properly. The hazard maps were also developed, but they were not disseminated to individual houses, nor shown to the public. The participation of the villagers was limited to the Red Cross activities, and it can be reasonable to consider that the complex disaster risk information sharing did not happen.

**Original discourse:** *Itu kan cuma tanda aja, tapi nggak semua orang paham.*

**(Translation:** *It is just a sign, but not all community members know the meaning of the evacuate sign.*)

## 4. Discussion

This article examined the complex disaster preparedness and perception in Lebak Gede village in Cilegon, in accordance with the model for communication of risk by Rodriguez et al. [10]. The model estimates interactions for risk information sharing between many actors. Our survey revealed that involvement of the Indonesia Power (the industry), the governmental agencies and the Indonesian Red Cross were vital (see Figure 2). Contrary, any clear involvement of educational institutions and mass media was not clearly found during this study. The roles of actors need to be further elaborated.



**Figure 2:** Verification of model for the communication of risk (The addition (italic parts) was made by the authors. The original figure was reprinted from Rodriguez et al. [10]. The authors deleted some arrows which were not explicitly found during this study.)

The local people has already been aware of the potential threats by large-scale natural disasters, namely considering the Krakatau volcanic eruption. They can estimate that evacuation behavior might save life, but factories might be destroyed, and contamination can happen. On the other hand, not all of people can imagine such a complicated consequence due to the combination of the natural disasters and the industrial disasters. Also, not only low-frequency-big-disasters, but also more frequent disasters such as industrial accidents and floods were recognized by the local people. Some preparedness activities were conducted in the village, but they were not organized in consideration with the complex disasters, and the participation by the local people was limited. Furthermore, the local people experienced many industrial accidents in the past, but these experiences did not trigger a significant mindset change for a more organized preparedness. They had more focus on floods as their preparedness priority. These findings indicate that multiple risks need to be shown in a single map with an integrated method and raise the importance of understanding on the process of snow-balling effects and damages.

The model of the Rodriguez et al. [10] has an implicit assumption that there is a single risk and seems to show that the model is static. Communities like Lebak Gede village face with multiple types of risk. Thus, the model application is required to be further explored. Also, communities are not stable but dynamic and changed chronologically. In Lebak Gede village, according to an interviewee (a head of a RW), the number

of immigrants increased since the late 1990s, and approximately 40 percent of the villagers are not indigenous. Some villagers are members of the local disaster forum or staffs of the government-lead volunteer organizations. The composition of the 'local people', which was indicated by Rodriguez et al. [10], needs to be carefully considered in order to clarify if the local people is homogeneous.

This article adopted the qualitative method for gathering specific information, but more comprehensive research can contribute to verify preparedness and risk perception on the complex disasters. Although this article specifically focused on one village (Lebak Gede village) and its preparedness and perception, the findings will be further investigated for generalizing community preparedness for the complex disasters.

## Conflict of Interest

We the authors do not have any competing interests with relevant actors.

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