Tool 3 : Lessons Learned from the Extreme Natural Disasters

Contents

1. Methodologies and Scope of Survey

In this Chapter, some major disasters that occurred in the past (especially in the 1990s and later) are examined. Information on the description of occurrences of the disasters and the impact on supply chains and economic activities are organized, and lessons are derived therefrom. (Disasters already described in the Study Report 1 are also examined, with additional updated information.)

Table 1 Methodologies and Scope of Survey

Information obtained through survey	Methodologies of Survey	Scope of Survey
Information on major disasters that occurred in the past and lessons derived therefrom	Collect information from open-source materials available on the internet, etc.	Search information from the websites, etc. listed below: ・ Asian Disaster Reduction Center (ARDC) ・ The International Centre for Water Hazard (ICHARM) ・ Other open source materials

Natural disasters covered under this survey include, geo-hazards such as earthquakes, volcanic activities and eruptions, and landslides; tsunamis; and hydrometeorological hazards such as floods, hurricanes/typhoons, and high tides. Droughts and forest fires, and biohazards such as outbreak of infectious diseases and incidences of infection in animals and plants are not covered by this survey.

In particular, the following disasters listed in the following Table 2 are selected to represent each type of extreme natural disaster described above and are examined.

Table 2 Past natural disasters examined in this Survey

Disasters		Country
Earthquakes and Tsunamis	2011 Tōhoku Earthquake	Japan
	The Great Sumatra Earthquake and the tsunami in 2004	Indonesia, etc.
	1999 İzmit Earthquake	Turkey
Floods	2013 Flood in Jakarta	Indonesia
	2011 Flood in Thailand	Thailand
Hurricanes/typhoons	2008 Cyclone Nargis	Myanmar
	2005 Hurricane Katrina	USA
	2004 Typhoon Muifa/Unding	Philippines
Volcanic activities and eruptions	2010 Eruptions of Eyjafjallajökull	Iceland
	The eruption of Mt. Pinatubo in 1991	Philippines

2. Information and Data Compiled in Appendix

In Appendix, information and data regarding the description of occurrence and impacts on supply chains and economic activities with respect to the natural disasters described above are presented.

Table 3 Information and Data Compiled in the Appendix

Information and Data Compiled in the Appendix	Summary
Description of occurrence of past disasters and their impact on the supply chains and economic activities	Detailed information on the above natural disasters, including the description of occurrence and impact on economic activities, etc. are provided here, as well as the description of source of information. (The information presented in the Study Report 1 is not included.)

3. Summary of Survey

1) 2011 Tōhoku Earthquake (Japan)

Items	Contents
1. Time of occurrence	14:46 JST on March 11, 2011
2. Place of occurrence	Epicenter: Offshore of the Sanriku Region (130 km east-southeast of the Oshika Peninsula)
3. State and scale of the disaster	● Large earthquake and tsunami occurred mainly in the Pacific coastline of the Tōhoku region. ● Tsunami inundated a total area of approximately 561 km^2 ● Devastating damage was caused to human lives and residential houses, as well as infrastructures/lifelines etc. ● Due to the accident at Fukushima Daiichi Nuclear Power Plant and shutdown of thermal power station, Tokyo Electric Power Company, Inc. (TEPCO) conducted scheduled power outage in its service area for a total of ten days, starting on March 14, 2011. ● Since some of the oil refineries halted production and because of difficulties in securing transportation due to damaged roads, etc. in the disaster affected area, it became extremely difficult to deliver petroleum products to places where such fuels are vital to lifesaving and survival purposes including hospitals, communication stations, local fire department, etc. ● As for urban gas, LNG facility of Sendai City Gas, the largest gas company in the Tōhoku region, was damaged by the massive tsunami. Manufacturing facility was inundated and some equipment was swept away by the tsunami, resulting in serious damage to the facility. ● Due to severe damage to facilities in the entire Pacific coastlines, mainly in the Tōhoku region, roads and railroads were blocked in many places. ● All of the ports in Tōhoku region located on the Pacific coast side, suffered enormous damage to port facilities, including breakwater, berthing facilities, cargo-handling machines, etc. ● Sendai Airport was flooded by the massive tsunami, and it took more than one month to recover.

	● Massive disaster waste was generated (an estimated 22.6 million tons of debris including destroyed houses, etc. was generated by the tsunami), and disposal of such waste is an ongoing problem.
4. Economic damage	● Total damage of the disaster amounts to approx. 16.9 trillion yen (estimated). ● In addition to shutdown of manufacturing facilities, scheduled power outage implemented in Tōhoku and Kanto region to overcome the crisis of power shortage, also had a great impact on the production activities in Japan. ● In March 2011, Japan's mining and manufacturing production dropped 15.5% from the previous month (adjusted to seasonal variations). As for specific sector, production of transportation equipment industry including automobile and auto parts, dropped 46.7% from the previous month, which made the largest negative contribution.
5. Human damage	● Number of death 15,883; number of people missing 2,676; number of people injured 6,144. ● Damages to buildings: totally collapsed 126,421; half collapsed 272,028; partially damaged 740,572.
6. Impacts on supply chain and business activities	● Interruption of auto parts production in Japan affected overseas productions via global supply chain. For example, production of automobiles/auto parts in USA in April 2011, dropped 8.9% from the previous month (adjusted to seasonal variations). ● On the other hand, production activity recovered to some degree after one month from the disaster. Japanese manufacturing companies' quick initial response is said to have contributed to the prompt recovery. ● According to the survey result conducted by Ministry of Economy, Trade and Industry, more than 60% of the companies in basic materials business and 40% of the companies in the processing business grasped the size of impact of the disaster on their supply chain within one week following the earthquake (Level of damage suffered by the supplier, possibility of procuring parts and materials, etc.). Also, by early April, more than 60% of the manufacturing facilities had finished recovery, and 80% of the companies in processing business and 60% of the companies in basic materials business had gradually secured alternative suppliers.
7. Response	● Immediately after the earthquake, the government established the Headquarter for Emergency Disaster Control to handle immediate issues. And in June 2011, the legislature passed the basic law on reconstruction in response to the Great East Japan Earthquake to promote recovery of the disaster affected area. In February 2012, Reconstruction Agency, a new government office, was established. ● Supplementary budget worth 415.3 billion yen was approved for measures for disaster recovery for fiscal 2011 (as of May 2, 2011).
8. Lessons learned	● Manufacturing companies in the disaster affected area temporarily stopped its production after the earthquake. However, the efforts of the companies, early recovery of infrastructures including lifelines and transportations, and the government's approval of budget for disaster recovery together with implementation of series of policies, all had helped to give the affected companies the prospects to recover their business within one month from the disaster. ● Scheduled power outage and oil fuel shortage that occurred after the earthquake were problems that had to be faced for the first time, and these events seriously affected the industrial activities throughout Japan. Such events highlighted the importance of securing energy supply during time of widespread disaster.

2) The Great Sumatra Earthquake and the tsunami in 2004 (Indonesia, etc.)

Items	Contents
1. Time of occurrence	December, 2004
2. Place of occurrence	The earthquake occurred in the Indian Ocean in the offing of the Sumatra northwest in the western Republic of Indonesia. Moreover, Tsunami generated over about 1,500-km area from the sea near Andaman and Nicobar Islands to the sea near northwestern Sumatra. (In particular, Thailand, Malaysia, Indonesia, Myanmar, Sri Lanka, India, the Maldives, African countries, etc.)
3. State and scale of the disaster	● An earthquake of magnitude 9.3 occurred at about 160km west of Sumatra islands in Indonesia, with an epicenter at a depth of about 10km. Then, within 24 hours after the main shock, aftershocks occurred within 1,200-1,300km from the epicenter. Large aftershocks of about magnitude 5 occurred 26 times. ● Tsunamis with an average height of about 10m rolled on to the Indian Ocean coast several times. It is estimated that the seabed was raised about 2-3m when the tsunami struck, and the velocity of tsunami was about 700 km/h. It is pointed out that speed of the tsunami that reached the coast east of the epicenter was slower compared to the tsunami that reached the coast west of the epicenter. ● In Aceh Province, Indonesia, tsunami reached 4-5km inland. It has been reported that the speed of tsunami reached 7.7m/sec at the point 2km inland, and with the pressure of 4 ton per square meter, residential buildings were swept away in an instant.
4. Economic damage	● According to the announcement of the United Nations, emergency aid of 977 million dollars will be needed, and economic damage of the disaster has reached approx. 11.5 billion dollars. ● Out of the 3,500 small and medium sized companies in Aceh province (total number of employees: 17,854), approx. 65% of the companies were reported to have stopped their business due to the Sumatra earthquake and tsunami. The percentage of losses suffered due to damage to small and medium sized companies in each region was estimated as follows: Banda Aceh 70%; Sabang 90%; West Aceh Regency 95%; and Aceh Singkil Regency 20%. Market system in the area stretching from Aceh to Medan in North Sumatra Province lost its function, and such situation contributed to the stagnation of social and economic activities of the region.
5. Human damage	● Some 300,000 or more people are reported to be dead or missing, and about 5 million people were affected by the disaster. Except for in Aceh Province, Indonesia, most damage was caused by tsunami.
6. Impacts on supply chain and business activities	● Japanese companies operating in Indonesia, Thailand and Malaysia did not suffer serious damage, because these companies had their manufacture/sales base in Java or in the inland of each country, distant from the epicenter. ● Fortunately, the Arun LNG Terminal which is an export base of liquefied natural gas (LNG) for Japan did not sustain damage, although it was located at the north end of Sumatra close to the epicenter. Also, there was no significant damage to tankers and ships

	operating in the Strait of Malacca which is an important location for transportation of resources, such as for the crude oil imports for Japan. ● However, operations of ports were interrupted in some area, and there were cases of delay in delivery of products such as parts. For example, port of Chennai located on the east coast of India is a landing base to deliver goods to the inland where IT enterprises and automobile related companies are concentrated, and because part of the function of this port was interrupted due to tsunami, the local factory of Denso, a subsidiary of Toyota, was unable to unload the parts for the radiator supplied from Japan, and was forced to consider adopting an alternative means of transport.
7. Response	● National governments and international organizations including UN-related organizations such as UNESCO and WFP, and the Red Cross, provided relief and reconstruction support immediately after the disaster. As for relief efforts, national governments, international organizations and volunteer workers provided emergency relief assistances, and Japan also provided emergency support mainly through mobilization of Japan Disaster Relief Team and the Self-Defense Forces. While secondary disaster such as disease outbreaks caused by poor hygiene was a major concern, such secondary disaster was prevented through prompt burial/cremation of dead and appropriate epidemic prevention measures/medical services provided by the relief party. ● In order to rehabilitate/restore the economy of the region stretching from Aceh Province to North Sumatra Province, the Ministry of Commerce of Indonesia established 240 emergency markets, with the aim of substituting the local market system which was shut down.
8. Lessons learned	● Although there was fortunately little influence on the business activities and supply chains of Japanese companies, it can be suggested that it is important to discuss alternative means of transportation of important parts and products beforehand, in preparation for the case where transport infrastructures such as port facilities suffer damage. ● For most of the disaster affected areas, it was their first time to experience earthquake or tsunami. Therefore, the people were unfamiliar with tsunami warnings, and it is pointed out that such condition exacerbated the loss of lives. ● It is said that in the offing earthquake of Sumatra, countries in the Indian Ocean and residents thereof were unprepared and unaware of tsunami, and that insufficient utilization of disaster information and lack of information infrastructure have caused the expansion of tsunami damage caused by the earthquake. From such observations, it could be pointed out that it is important to communicate emergency disaster information correctly and quickly, in order to minimize earthquake and tsunami damage.

3) 1999 İzmit Earthquake (Turkey)

Items	Contents
1. Time of occurrence	August 17, 1999
2. Place of occurrence	The epicenter of the earthquake was near Izmit in Kocaeli province located in the northwest part of Turkey (Approx. 55 mile east-southeast of Istanbul). Heavily industrialized areas, including Izmit, Sakarya, Istanbul, Bolu, Bursa and Eskishir were majorly affected. Also, the main naval base of the Turkish Navy at Gölcük was hard-hit by the earthquake.
3. State and scale of the disaster	● A magnitude 7.4 earthquake occurred, with an epicenter at 11 km southeast of the City of Izmit, located in the northwest part of Turkey. Large area of approximately 31,250 km^2 was affected by the earthquake. Height of tsunami generated by the earthquake was 2.5 m. ● Approximately 40% of heavy industry in Turkey was concentrated in this region.
4. Economic damage	● Turkey's central bank chief has estimated the cost of earthquake damages at between 5-7 billion USD. ● The total estimated loss for port facilities in the region was around 200 million USD.
5. Human damage	● Number of death : 17,127 ● Number of people injured : 43,953 (as of October 19, 1999)
6. Impacts on supply chain and business activities	● A devastating fire destroyed large parts of the facilities of the state-owned Tupras oil refinery, the largest in Turkey. The fire-fighting capability of the refinery was lost immediately following the earthquake because of the ruptures of the water pipeline from Lake Sapanca, 45 km east of the refinery. For this reason, it took longer to extinguish the fire (the fire was finally extinguished on August 21). According to the Istanbul stock exchange, the damage reported by Tupras oil refinery amounts to 115 million USD. ● Operation of state-owned petrochemical company Petkim was interrupted for three months. ● The area affected by the earthquake is an important industrial hub in Turkey, especially for automotive industry, and 93% of Turkey's vehicle productions are carried out in this area. Ford, Hyundai and Toyota operate motor vehicle assembly plants in the epicentral region. Pirelli and Goodyear are located nearby, and Sabanci, which is one of the biggest companies in Turkey has several joint-venture facilities in the region. Among these companies, Hyundai is reported to have experienced significant nonstructural damage. Toyota car factory had fault ruptures in its parking lot. Pirelli Tires had difficulties in restarting its operation since critical production equipment was in heavily damaged sections of the facility. Time to normal operation varied between 7 and 75 days depending on the severity of damage.
7. Response	● The Government of Turkey announced three phase plan on August 30 to meet the needs of the homeless: The first phase provides tents to immediate victims; the second phase will provide prefabricated housing by the end of November; third phase will be long-term reconstruction (no details provided). Also, the Prime Minister's Crisis Management Center (PMCMC) prepared temporary shelters for earthquake victims in earthquake affected cities.

	● In September 1999, Prime Minister Ecevit expressed concern over the fact that many settlements are established in areas prone to natural disasters such as earthquakes and floods, and emphasized that Turkey needs to pay more attention to geological data in planning settlements. Ecevit announced that Turkey has started to consider relocating at least three major settlements battered by the earthquake, and stated that the Adapazari, Gölcük and Degirmendere are on the agenda. Among these settlements, Adapazari, with a population of 300,000, was relocated to a restoration estate 12 km away from Adapazari and tens of thousands of people moved to the new restoration estate. However, it is reported that there are many issues to be addressed with regards to the livelihoods of the settlers[1]。 ● Total amount of foreign aids from national governments and international organizations, etc. was 116,413,423 USD[2].
8. Lessons learned	● Disaster risk: If industrial agglomerated area is located in areas prone to disasters, it is desirable to consider measures including relocation plans. During Izmit earthquake, area where automobile industry was concentrated was hit hard by the earthquake, and this suggests that existing industrial agglomerated area should also reassess its disaster risk and risk awareness should be shared among involved parties. ● Infrastructure: Port is a crucial facility which supports the business of industrial agglomerated area and thus, early recovery from disaster is desired. Also, oil fuel supply is also vital to the operation of industrial agglomerated area. ● Government response: Because not only the employees working in the industrial agglomerated area, but also their families will suffer from the disaster, relief measures for the citizens offered by the Government will also become an important factor when considering Area BCP.

[1] Details of the relocation plan of Gölcük and Degirmendere unknown.
[2] http://stage.unocha.org/ftsext/arfts/nd1999/tur991.htm

4) 2013 Flood in Jakarta (Indonesia)

Items	Contents
1. Time of occurrence	January, 2013
2. Place of occurrence	The entire city of Jakarta
3.State and scale of the disaster	● Major floods and submergence occurred all across Jakarta, due to heavy rainfall continuing from early dawn of January 14, 2013. Water depths of the flood areas ranged between 50 cm and 150 cm. ● About 40% of the city of Jakarta is below sea level, and due to its poor drainage system and lack of maintenance thereof, the area is prone to flood during rainy seasons. In addition to such background, the water level at that time was high due to prolonged rain in the area, and when the flood gates located at the upstream of Ciliwung River, which is running through the city, were opened, the river water overflowed into various parts of the city and caused flood.
4.Economic damage	● According to the figures announced by Asosiasi Pengusaha Indonesia (Apindo), the economic damage suffered by the entire capital reached approx. 15 trillion rupiah (approx. 140 billion yen).
5.Human damage	● 20 people or more dead; 6,000 people or more evacuated. ● Jakarta has experienced major flooding in the past (e.g. 1996, 2002 and 2007). The damage from the flood in 2007 was especially severe, with 200,000 or more people evacuated, and lifelines for 70,000 households or more affected.
6.Impacts on supply chain and business activities	● Logistics in Pulo Gadung Industrial Park in east Jakarta and in industrial parks in north Jakarta including Sunter, Marunda, and Cakung were disrupted due to flooding. ● Approximately 300 plants were shut down in the Pulo Gadung Industrial Park region where companies such as Dai Nippon Printing Co., Ltd. have their plants. Water immersion between 30 to 100 cm continued and electric power supply was also disrupted. In addition, operation hours of the plants of Toyota Motor Corporation and Daihatsu Motor Co., Ltd. were delayed by one to two hours because plant workers were stranded during their commute. ● Most of the suburban industrial parks in which foreign manufacturers are agglomerated, continued most part of their operations. However, it is reported that in some suburban industrial parks, delivery of parts and export of completed products from ports and inner-city area were disrupted. ● Tanjung Priok Port in north Jakarta, which is the largest seaport in Indonesia, operated normally, although some of the cargo was damaged by water due to rain water pooling in one part of the yard. However, the amount of inbound freight reaching the port decreased to one half of the normal level due to disruption in logistics as described above. Also, trucking business delivering freights to Tanjung Priok Port suffered a loss of 7.5 billion rupiah (approx. 69 million yen) per day. ● Furthermore, daily sales in public transportation and general cargo sector were reduced by 40 to 60 %.
7.Response	● As discussed above, logistics were disrupted in part of the region, but no information was found as to alternative measures utilized to respond to the situation. Factories which suffered interruptions due to power outage and employees' commuting difficulties, responded to

	the situation by methods such as delaying their operation until the situation was resolved and it was possible to restart their business. No information on implementation of precautionary measures by such factories was found. ● Learning from the past experiences of havoc caused by floods, the government of Jakarta Special Capital Region was working on measures including the construction of two flood canals (Banjir Kanal Barat [BKB] which is currently under construction, and Banjar Kanal Timur [BKT] which started operation in 2010); improvement and dredging/cleaning of rivers; and construction of tide embankment/tide gates to prevent storm surge. However, these measures were still incomplete when the flood hit, and the effects of reducing the impact of the disaster were limited.
8.Lessons learned	● The disruption of operation and power supply which occurred in some industrial parks due to flooding, indicate the importance of anticipating flood risks in industrial parks and the necessity of adopting countermeasures such as securing back-up power sources. ● Even industrial parks that were not directly hit by the flood suffered indirect impacts caused by delays in delivery of parts and export of completed products at the port. Also, commuters were stranded by paralyzed traffic. These facts show the necessity of adopting appropriate preparation/measures based on the assumption that transport infrastructure and public transportation can be disrupted even when they are not directly damaged by the flood. ● In Jakarta, it is pointed out that river water that comes from the south is prevented from flowing freely into the open sea during storm surge, and that the overflow of river water induced by such storm surge is the main cause of the flood in the city. Therefore, it is necessary to exercise great caution, especially during high tide, by implementing appropriate flood control measures (e.g. management of flood gates).

5) 2011 Flood in Thailand (Thailand)

Items	Contents
1. Time of occurrence	July, 2011 – January 2012
2. Place of occurrence	Northern and central Thailand
3. State and scale of the disaster	● Heavy rain brought by several tropical storms including Nock-ten, continued to pour across northern and northeastern Thailand causing floods in fifteen provinces. ● Precipitation in 2011 was 145 % above normal (estimated to occur once in 50 years). In the middle and downstream basin of Chao Phraya and in the peripheral area of Ayutthaya, the flood started in early September, and the floodwaters breached the dikes between mid to late September. Waters from the breached dikes flowed into Ayutthaya region and caused massive flooding in the industrial parks in the periphery of Ayutthaya. The volume of water flowing through the breached dike is considered to be 5 billion m^3 or more. The total flood volume was estimated to be 15 billion m^3. ● In Thailand, most of the rainfall over the northern and central regions flows into the Chao Phraya River. In addition, there is not sufficient difference in elevation between Ayutthaya and Bangkok to drain excess water, and such topographical feature is pointed out to be contributing to the bad drainage of the area. Furthermore, with respect to river improvement policy, the Thai government has been focusing on drought mitigation measures rather than flood management, and therefore the country's flood protection measures were inadequate.
4. Economic damage	● The World Bank estimates 660 billion baht in damage to property such as real estate, and 700 billion baht in opportunity losses, for a total economic damage of 1.36 trillion baht (approx. 3.5 trillion yen). ● According to the announcement of the Ministry of Interior of Thailand, the area of damaged agricultural land throughout Thailand was 18,291 km^2 (about the same size as the Kanto plain). In the industrial sector, 804 companies in seven industrial parks suffered flood damages, and among them were 449 Japanese companies. ● Economic damage increased drastically when the flood reached the industrial parks in central Thailand (Ayutthaya province and Pathum Thani province) after mid-October. International firms in the electronic and electrical industries are concentrated in these provinces, creating an industrial agglomeration (cluster). Seven industrial parks located in the two provinces were inundated, and 955 companies were affected by the disaster (out of which 484 companies, nearly half, were Japanese companies). Total number of man power working in the industrial park was 380,000 workers.
5. Human damage	● Number of death：753 ● Number of people missing：3 ● Number of people affected by the disaster：4,176,763 （current as of December 2011）
6. Impacts on supply chain and business activities	● Companies that suffered from flood damage were mainly located in the industrial parks on the periphery of Ayutthaya (including many Japanese companies). Also, it is pointed out that some of the industrial parks were located in places prone to flood and exposed to flood risks such as areas near the narrow upstream section of the river.

	● Industrial parks that were inundated by the flood are as follows: ➢ Saha Rattana Nakorn Industrial Estate (42 companies, including 35 Japanese companies) ➢ Rojana Industrial Park (218 companies, including 147 Japanese companies) ➢ Ban Wa (Hi-Tech) Industrial Estate (143 companies, out of which 70 % are Japanese companies) ➢ Bang Pa-in Industrial Estate (84 companies, including 30 Japanese companies) ➢ Factory Land (Wangnoi) Industrial Estate (14 companies, including 5 Japanese companies) ➢ Nava Nakorn Industrial Estate (190 companies, including 104 Japanese companies) ➢ Bangkadi Industrial Park (34 companies, including 28 Japanese companies) ● Thailand was the center of manufacturing of Hard Disk Drives (HDD) in the world with a 30 percent or more of the global market share. Major HDD manufacturers such as Western Digital Corporation and Seagate Technology and parts supplier for HDD productions such as Nidec Corporation have their manufacturing base in Thailand. Therefore, the flood caused spike in HDD prices, and affected the production of computers inside and outside of Thailand. ● Not all of the industrial parks were hit by the disaster, but it is reported that global supply chain and production activities in other industrial parks were widely affected. The area stretching from Ayutthaya to northern Bangkok where electronic and electrical product factories are agglomerated was worst hit by the disaster, but automobile factories in other regions where they were not submerged by floodwater, were also forced to stop production. This was due to the fact that automobile parts supply was heavily dependent on the electronic and electrical factories in Ayutthaya which suffered the flood damage. ● Among the many companies affected by the flood were: automakers such as Honda Motor Co., Ltd. and Toyota Motor Corporation; electric and electronic manufacturers such as Sony Corporation, TOSHIBA CORPORATION, and Hitachi, Ltd.; and food manufacturers such as Ajinomoto Co., Inc. ● For example, Honda Automobile (Thailand) Co., Ltd., which is the manufacturing base of automobiles of Honda Motor Co., Ltd., was forced to halt production from October 4 due to shortage of parts. This shut-down further delayed the procurement of parts, and automobile manufacturing base in Malaysia was also forced to halt production. Suzuka Factory and Saitama Factory which are engaged in automobile production in Japan, also adjusted their production. As for Toyota Motor Corporation, there was no actual damage to the factories of Toyota Motor Thailand Co., Ltd., but it had to halt production in three of its factories due to shortage of parts. As a result, factories in Japan and in Southeast Asian countries such as Indonesia and Philippines, and factories in North America and in South Africa had to adjust production. Also, Nissan Motor Co., Ltd., Mazda Motor Corporation and Mitsubishi Motors Corporation reduced or halted the production at their factories in Thailand. ● In Bangkok, flood control measures such as building an outer dike (King's Dike) and regulating land use, were implemented. However, because part of the construction of King's Dike was unfinished, and the land use regulation was insufficient, flood waters spilled over the dike and poured into the city of Bangkok. By

	mid-November, the flooded area extended from central Bangkok up to approx. 5 km north, reaching the Bang Sue Canal. To add further explanation, the flood control measure for Bangkok is made to drain floodwater from the upstream by means of waterways running east and west through the city. This measure is primarily aimed at protecting the important facilities located in the downstream side of the region.
7. Responses	● Sony Corporation restored its production of digital cameras manufactured in its Ayutthaya factory by means of alternative production at factories in Chonburi, China and Japan. Also, some of Sony's factories in countries/regions other than Thailand also had to adjust their production due to shortage of parts caused by the flood in Thailand. ● TOSHIBA CORPORATION was forced to halt the production of the manufacturing base in Thailand due to inundation. Production of hard disk drives (HDD) was restored through alternative production in Philippines. Production of semiconductors was also restored by alternative production in factories in Japan. ● Ajinomoto Co., Inc. responded to the production stoppage by increasing the production at factories in other regions owned by Ajinomoto Sales（Thailand）Co., Ltd., or by outsourcing production to other companies in Thailand. Also, in order to respond to the closedown of distribution center and the neighboring packaging plant in PathumThani province, distribution center and packaging plant in other region were utilized as alternative means. ● The Yingluck Administration proposed the "New Thailand" plan which is a 900 billion baht project involving both post-disaster reconstruction and long-term flood control measure. Out of the 900 billion baht, 100 billion baht will be used for restoration of the industrial parks, and the remaining 800 billion baht will be used for flood prevention measures to protect the industrial parks and for maintenance of facilities such as water control facilities. 140 drainage pumps were used to rehabilitate the seven inundated industrial parks.
8. Lessons Learned	● In Bangkok, problems including land use issues were left unaddressed in some part of the outer dike (King's Dike), especially in certain part of the dike in the north side. It is pointed out that these untreated portion of the dike allowed floodwater to pour into the city of Bangkok. Through this experience, it can be suggested that it is important to prepare for future floods by completing the flood control plan without flaw. ● It is reported that some of the industrial parks on the peripheral area of Ayutthaya were located in areas prone to flood, which means that they were exposed to flood risks from the beginning. In the future, locations of industrial parks should be reviewed and carefully determined based on the possibility of natural disaster risks, such as floods and submergence. ● In most of the cases, companies responded to the situation by seeking alternative manufacturing bases in completely different countries/regions, and no case was found where a company managed to continue production in the same factory by utilizing alternative infrastructure or lifelines. This means that companies without alternative manufacturing bases were unable to supply the needs of the customers. It may be inferred that, in order to be able to continue business operations during a disaster, it is efficient to

	establish alternative sources of lifeline utilities through combined efforts of the whole industrial agglomerated area, rather than through the exclusive effort of a single company. ● In addition, as an efficient method to prepare for the disaster, it is encouraged to gain better understanding of the supply chain (to visualize the supply chain). By identifying which products/parts depend on which primary and secondary suppliers, and where those products/parts are being manufactured, better understanding on the scale of the damage (including indirect damage) will be achieved and will lead to better preparedness and response to disasters. ● Also, decrease in water-holding capacity of the forest caused by recent deforestation in Thailand, and difficulties in discharging excess water from Chao Phraya River into the sea due to urbanization of floodway in eastern Bangkok, are pointed out as problems that need to be addressed. In the long run, it is suggested that comprehensive approach be adopted to deal with flood risk, including measures for forest conservation and urban development.

6) 2008 Cyclone Nargis (Myanmar)

Items	Contents
1. Time of occurrence	May 2 – 3, 2008
2. Place of occurrence	Southern Myanmar (Ayeyarwady Region, Yangon Region, Bago Region, Mon State, Kayah State)
3. State and scale of the disaster	● Cyclone Nargis made landfall in the Ayeyarwady Delta in southwest Myanmar. High-speed winds of up to 250 kilometers per hour and 3.6 meter storm surge caused the destruction.
4. Economic damage	● Association of South-East Asian Nations (ASEAN) reported that the total economic loss of Nargis was estimated at 4 billion USD. ● Over 700,000 ha (63%) of paddy land was inundated; 15,000 ha of fish and shrimp ponds, and 9,000 ha of salt farms were affected; and 50% of the buffaloes and 25% of the cattle were lost. The economic loss in agricultural, livestock and fishery sector is estimated to be 570 to 700 million USD. ● Economic loss in industry and commerce sector is estimated to be approximately 500,000 USD. ● Economic loss in water supply sector is estimated to be approximately 9 million USD. ● Economic loss in transport and communication sector is estimated to be approximately 185 million USD. ● Port of Yangon was severely damaged, and losses were estimated to be around $800 million USD
5. Human damage	● Number of death：84,537 ● Number of people missing：53,836 ● Number of people affected by the disaster：19,359 （current as of June 24, 2008）
6. Impacts on supply chain and business activities	● Almost 5,630 establishments sustained partial or complete destruction to business premises, equipment and machinery, and inventories. Many of these enterprises had to suspend operations or had to operate substantially below capacity for 2-5 months. Nearly 45% of industry losses are attributable to the larger firms located in several industrial parks in Yangon region. A large number of informal enterprises and small and medium enterprises have also been damaged but the damage and loss is not yet accounted for[3]. ● Nargis inflicted total or partial destruction on 70% of Yangon's 2,500 factories, depriving most of them of electrical power. More than 60% of the 496 factories, including power stations operating in Hlaing Tharyar Industrial Zone, suffered damage, and more than 150 lamp posts were felled. ● According to the Post Nargis Joint Assessment (PONJA), total damage and losses in the electricity sector was modest from a national perspective. The reason for minimal losses in the sector is attributed to the fact that the rural areas most affected by the cyclone have not been widely electrified. ● Port of Yangon was closed due to severe damage caused by Nargis,

[3] There is not much information on damages incurred by Japanese companies in Myanmar. Since the disaster took place prior to the democratization and liberalization under Thein Sein administration, there were only about 50 companies registered with the Japanese Chamber of Commerce and Industry in Yangon at that time. It could be assumed that number of companies which suffered notable damage was relatively few.

	and import and export trades of companies which had depended on sea freight were interrupted for 1-2 months. Since cross-border trade activities were not allowed at that time, the only alternative was to use air freight, and the cost became a great burden for the garment manufacturing industry (cost of air freight may be as much as ten times higher than the cost of shipping). ● Many houses were destroyed and serious damages were caused to public facilities such as hospitals and schools, and infrastructures including water pipes, roads, bridges, electricity and communications (International Telecommunication Union (ITU) deployed 100 satellite terminals to help restore communication links in the aftermath of the cyclone). As a result, relief operation and shipments/supply of goods were hampered, and caused problems in delivering food, water, and medical/health services to the affected areas.
7. Response	● The Government of Myanmar's response to Nargis was immediate, and as part of lessons learned from the Asian Tsunami of 2004, the Government had already set up a National Natural Disaster Preparedness Central Committee (NNDPCC), chaired by Prime Minister. Soon after the disaster, ten Emergency Disaster Response Sub-Committees (EDRSCs) were formed to effectively coordinate Government response. ● The Government set aside an immediate emergency response package worth K 50 billion (USD 45.45 million). ● The Tripartite Core Group (TCG) consisting of ASEAN, the Myanmar Government, and the United Nations was formed to coordinate domestic and international relief efforts in order to carry out effective mid-term recovery plan (Post-Nargis Recovery and Preparedness Plan [PONREPP]). TCG conducts monitoring and periodic review of the recovery process. ● The closure of the Port of Yangon raised the need for a new land route for trade. In order to respond to this situation, JETRO, Japanese garment manufacturers, Myanmar Garment Manufacturers Association and Myanmar International Freight Fowarders' Association implemented a joint project to develop a new land route and carried out trial freight transport for different routes. Trial freight transport was carried out several times between Oct. 2009 and April 2010, and the results showed that the transit time could be reduced to 53 hours, compared to approx. 2 weeks by sea transport. After the reopening of Mae Sot (Thailand) - Myawaddy (Myanmar) border in late 2011, JETRO conducted a research to find out whether the route is usable to transport products other than garments. However, report released on April 2013 concluded that, while Mae Sot-Myawaddy route may be useful in the future, it has not yet reached the stage of commercial use at the moment. ● In the early stage, military leaders' refusal of international aid created a serious problem. However, the military gradually relaxed the restrictions and accepted the offer of foreign aid[4].
8. Lessons learned	● Disaster risk: When an industrial agglomerated area is located in a low-lying coastal area, it is necessary that the problems such as storm surge be seriously addressed. ● Infrastructure: Availability of electric power and accessibility of ports are vital to the continuity of operation of industrial agglomerated area. Electricity systems in developing countries are vulnerable to disasters and it is necessary to exercise great caution. Because ports are relatively vulnerable to natural disasters, it is

[4] http://fts.unocha.org/reports/daily/ocha_R10_E15549_asof___1307040203.pdf

	desirable to secure a land route. However, for a land route to be useful, it will require development of road facilities and collection/delivery center, as well as establishment of structures such as customs and cargo distributors. ● Response of the Government: Flexible response of the Government is desirable; i.e. change in usual trade procedures, acceptance of foreign aids. ● BCP: Companies affected by the disaster experienced business interruptions and deep production cuts which lasted about 2 – 5 months. In such cases, financing of the company becomes an important issue. Also, small and medium size local enterprises can suffer severe damages from disasters. If an industrial agglomerated area is depending on parts supplied from small and medium size local enterprises, ensuring the business continuity of such enterprises may also become an important issue.

7) 2005 Hurricane Katrina (USA)

Items	Contents
1. Time of occurrence	August 23, 2005
2. Place of occurrence	Hurricane Katrina formed as tropical depression southeast of Bahamas, and made initial landfall in Florida on August 25. It moved across Florida into the Gulf of Mexico and made its second landfall on August 29 in Louisiana. Louisiana, Mississippi, Florida, Georgia and Alabama were majorly affected by the hurricane.
3. State and scale of the disaster	● Hurricane Katrina was a Category 1 hurricane (Saffir-Simpson Scale) when it made its first landfall in Florida. After it moved across into the Gulf of Mexico, the hurricane strengthened to a Category 5 hurricane on the 28th , just before making its second landfall (Maximum sustained wind 175 mph, minimum central pressure 902 hPa) ● At least 80% of New Orleans was under flood water on August 31, largely as a result of levee failures of nearby lake.
4. Economic damage	● Total economic loss of Katrina is estimated to be $125 billion
5. Human damage	● Number of death : 1,833 ● Approx. 10,000 people evacuated to Superdome in New Orleans.
6. Impacts on supply chain and business activities	● Power outage occurred in Louisiana, Mississippi, Alabama, Florida, Kentucky and Tennessee. According to US Department of Energy, 2.7 million customers lost power at the height of Katrina. As of September 23, 246,884 customers remain without electric power in Louisiana and Mississippi. ● Katrina had a profound impact on Louisiana/Mississippi oil and gas industry, which accounts for nearly 30 % of total domestic crude and 20% of domestic natural gas production. More than 30 oil platforms were damaged or destroyed and nine refineries were damaged and/or shut down for weeks following the storm. ● Gasoline prices surged, and shortages and gasoline lines were reported in parts of South Carolina, North Dakota, South Dakota, Arkansas and Kentucky. ● As for Wal-Mart which caught media's attention for its immediate response (detail discussed in "7. Response") , 120 to 140 stores were closed after the disaster, and approximately 40 stores were still not open as of September 1. ● P&G was reported by the media for its fast recovery (detail discussed in "7. Response"). However, access routes to its major coffee-producing facility which sits on high ground and was built to withstand winds of up to 140 mph, was completely blocked by the floods, and for many days, the only access to the facility was by helicopter (This coffee plant suffered more than $10 million of damage). Also, even though P&G had prepared for disaster situations based on its BCP, complete failure of the local phone system made useless of a carefully rehearsed employee call-in procedure, and it took 27 days until all local employees had been safely accounted for. ● The operation of the factory of The J.M. Smucker Company which produces coffee for P&G, was interrupted for approximately two months.
7. Response	● Provided a total of $16.7 billion in Federal funds under the U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grants (CDBG) program to help

	rebuild damaged housing and other infrastructure (Largest single housing recovery program in U.S. history). ● The U.S. Army Corps of Engineers (Corps) repaired and restored 220 miles of floodwalls and levees, improving storm and flood protection infrastructure to a 100-year protection level. ● USDA authorized $250 million to help hurricane-impacted farmers. ● It was widely reported by the media that Wal-Mart arrived to the disaster site before the Federal Emergency Management Agency (FEMA), and launched relief activities by utilizing its vast logistics network ($20 million in cash donations, 1,500 truckloads of free merchandise, food for 100,000 meals). In Mississippi where Wal-Mart operates a vast distribution center, the company had 45 trucks full of goods loaded ready for delivery before Katrina made landfall. To keep operating near capacity, Wal-Mart secured a special line at nearby gas station. Lee Scott, the president and CEO of Wal-Mart said in September, that current challenges include such matters as how to pay Gulf Coast Wal-Mart employees suddenly scattered across the country. ● P&G which operates four major coffee producing facilities in the area had detailed business continuity plan, designed for each facility and rehearsed annually. Due to such preparedness, P&G was said to be the first business back in operation following Katrina. Satellite communications were installed at all sites within a couple of weeks, and in order to respond to the demands of the upcoming holiday season, specially appointed teams were given the ability to sign contracts with new suppliers. As a result, the supply line was established in less than a month, but P&G was still short of needed production capacity. It took around 25 days to start the first production line in New Orleans. With local water supplies cut off, P&G drilled a well which continues to provide water at lower rates. By mid-October, the plants were at full capacity. As a result, the post-hurricane coffee sales increased 6%.
8. Lessons learned	● Disaster Risk: It can be presumed that levee and floodwall of the area did not have sufficient strength to withstand the level of storm strength that could have been expected to come. It is important to understand the level of design criteria that was applied when disaster prevention facilities to protect the industrial agglomerated area were built. Also, while warning system is effective upon wind and flood damage such as hurricanes, it is important that the citizens and companies take appropriate response measures when they receive the warning. ● Infrastructure: Roads, communications and water supply are essential infrastructures for the operation of industrial agglomerated area. From the case of Katrina, we learned that recovery of electricity may take more than one month even in developed countries, and that early recovery of electricity is a vital factor for Area BCP. ● Government Response: Restoration works and price stabilization measures (oil fuel) led by the government are important issues for Area BCP. ● BCP: Securing alternative infrastructures, payment of salaries to employees, establishment of coordination team among related parties are important matters for BCP. Also, regular rehearsal of BCP procedures during ordinary circumstances is essential in order to secure the effectiveness of BCP.

8) 2004 Typhoon Muifa/Unding (Philippines)[5]

Items	Contents
1. Time of occurrence	November 13 – 21, 2004
2. Place of occurrence	Muifa (Typhoon No. 25) developed into a tropical storm on Nov. 14 over the sea near east Philippines. Muifa gained strength over the sea east of Luzon Island, and after making a circular track, developed into a typhoon on Nov. 17. On Nov. 19, Muifa made landfall near Naga City located on Bicol at the south end of Luzon island. After it crossed Luzon island toward west, it weakened into a tropical storm, but later developed into a typhoon again in the South China Sea and headed toward Vietnam and Thailand. Provinces of Oriental Mindoro, Palawan and Camarines Sur (where Naga city is located) were damaged by the typhoon.
3. State and scale of the disaster	● Maximum sustained wind: 80kt (Recorded on Nov. 18)
4. Economic damage	● Total damage estimated at 852 million PHP. (1USD≒43.38PHP) (Overview of Damage: Agriculture 405 million PHP; Fisheries 76 million PHP; Infrastructure 971 million PHP)
5. Human damage	● Number of death : 71 ● Number of people injured : 169 ● Number of people missing : 69
6. Impacts on supply chain and business activities	● Roads were blocked by landslides and floodwaters on Catanduanes Island. Floods have also swept through four nearby provinces with extensive power cuts. Nearly 3,000 commuters were stranded at ferry crossings between the Bicol peninsula and the central islands after the coastguard restricted the operation. ● Estimated cost of damages on transmission lines and substation facilities due to Muifa amounted to 26.58 million PHP. Also, Ten towers were broken, and 267 transmission line structures and accessories were damaged in Luzon and Visayas. ● Due to mudflow and debris brought by the typhoons in late November, Umiray-Angat tunnel was severely damaged and Metro Manila suffered loss of about 30% of the water supply.
7. Response	● President Arroyo released a total of 4 million PHP as assistance from the national government for the victims of Muifa in Oriental Mindoro. ● Total aids received from national governments, international organizations, etc. for flood damages caused by the typhoons and tropical depressions in December 2004 amounted to 8,582,536 USD[5].
8. Lessons learned	● Infrastructure: Electricity and water supply are important for the continuity of business in industrial agglomerated area. Electricity and water supply systems in developing countries are vulnerable to disasters and it is necessary to exercise great caution. Also, public transportation is important for commuting, and early recovery from disaster is desired.

[5] http://fts.unocha.org/reports/daily/ocha_R10c_C169_Y2004_asof___1307080204.pdf

9) 2010 Eruptions of Eyjafjallajökull (Iceland)

Items	Contents
1. Time of occurrence	March 20 – October, 2010
2. Place of occurrence	Seismic activities began in late 2009, and on March 20, 2010, first eruption occurred at Fimmvörðuháls near Eyjafjallajökull glacier. After a brief stop, Eyjafjallajökull erupted on April 14 for the second time, this time in the center of the ice cap. Tephra ejected by this second eruption caused massive disruption to transportation network in Europe. The volcanic activity which started on April 14, seemed to stopped around May 23, and in October, Ármann Höskuldsson, scientist at the University of Iceland Institute of Earth Science declared the eruption at Eyjafjallajökull "over".
3. State and scale of the disaster	The scale of eruption was estimated to be between VEI (Volcanic Explosivity Index) 2-3. Extensive air travel disruption was caused by ash cloud from the second eruption on April 14, with massive cancellation of commercial flights occurring throughout Europe. This air travel disruption interfered with social activities. On April 17, it was reported that at least 26 countries in Europe closed parts of their airspace in Europe to avoid accidents that could be caused by engine troubles from volcanic ash.
4. Economic damage	● Total financial impact to airlines was estimated at 1.8 billion in lost revenue. ● The Association of German Chambers of Industry and Commerce (DIHK) calculated the impact of closing of airspace on the German economy, and estimated that the losses throughout the German economy will amount to 1 billion euro a day.
5. Human damage	● No Deaths ● Upon the eruption on March 20, 600 people living in the surrounding area were evacuated, and on April 15, 800 people were ordered to evacuate (there was a threat of flood being caused by melted glacier).
6. Impacts on supply chain and business activities	● The eruption on April 14 led to closure of the majority of European airspace in Europe for six days (and some temporary closures in different parts thereafter). It is reported by the International Air Transport Association (IATA) that during this six days period, some 10 million passengers and 100,000 flights were affected, and that lost revenue suffered by the airline industry amounted to 1.8 billion USD. ● It was estimated that the loss to the logistics industry will amount to few billion yen per day. Transportation companies switched from air freight to truck-based distribution. Impact on logistics industry in Europe was relatively small since freights are usually transported by trucks among European countries. However, trade between Japan was significantly affected by the closure of major hub airport in Europe. ● Transportation of fresh products such as food and flowers and medicines and garments which are usually transported by air, were hindered: ➢ It is estimated that African economies lost $65 million in exports of time-sensitive perishable goods such as fresh food and flower. ➢ Hotels and restaurants in Hong Kong were facing shortages of imported food and fresh-cut flowers. ● Supply chain suffered extreme disruptions. There are many Japanese automotive companies and electrical/electronic manufacturers operating in Central and Eastern Europe, and since these companies utilize airports such as Amsterdam airport and

	Frankfurt airport as their air freight hubs, parts supply was significantly disrupted by the prolonged airport closure: ➢ Nissan Motor Co. shut down three auto assembly lines in Japan because the factories had run out of tire-pressure sensors that were supposed to be delivered from a supplier in Ireland. ➢ Jaguar Land Rover Japan Limited postponed the debut of its new Jaguar XJ due to delay in the delivery of parts. ➢ At a BMW plant in South Carolina, USA, work was slowed after transmissions could not be delivered from Germany due to cancellation of flight. ➢ In South Korea, Samsung and LG said they were unable to air-freight more than 20% of their daily electronic exports.
7. Response	● In response to the eruption of Eyjafjallajökull, House of Commons Science and Technology Committee in UK recommended in its report on the use of science in national emergencies, that the government involve scientists more in planning for emergencies. ● EU established a new guideline to respond to volcanic ashes. Instead of one-size-fits-all solution, new guideline provides a graduated response to ash based on the following steps: (1) airlines submit safety risk assessments for their operations; (2) member state safety authorities can then give permission (or not) to operate, based on the safety risk assessments submitted. ● As for air freight to Japan, Southern route (via Singapore or South Korea) has been considered as an alternative route to respond to the closure of hub airports such as Paris and Frankfurt. However, the capacity of such route was limited and sufficient services were not available to respond to the situation. Japanese courier companies which used Brussels as their hub airport, stopped their distribution services during the airport closure. Although delays in deliveries occurred, American courier companies continued their services by utilizing other available airports in Europe. ● Volvo considered exporting their Japanese products to other parts of European countries with accessible airports, and delivering to other countries in Europe via land route. Sony Ericsson also considered the possibility of switching air freight to other method of transportation. ● The new EU guideline prepared after the eruption of Eyjafjallajökull, was applied when another eruption occurred at Grimsvötn in Iceland next year. While it is true that the situation for the Grimsvötn volcano has been very different, only 900 flights were cancelled during the Grimsvötn crisis, and this was mostly due to the more precise risk assessment adopted under the new guideline which allowed for a much more graduated response.
8. Lessons learned	● Disaster risk: Because volcanic eruption can affect a wide geographical area, industrial agglomerated area must take into consideration such possibility upon reviewing its business continuity. ● Infrastructure: In the case of eruption of Eyjafjallajökull, large number of flights was cancelled and it had a huge impact on the industry. If a business in the industrial agglomerated area relies on air-freight services, it should conduct risk assessments with respect to volcanic eruption, and measures such as securing alternative routes should be reviewed.

10) The eruption of Mt. Pinatubo in 1991 (Philippines)

Items	Contents
1 Time of occurrence	June, 1991
2 Place of occurrence	Located on the border of Zanbales, Bataan and Pampanga provinces in the western part of Luzon, Commonwealth of the Philippines (Approx. 95 km from Manila, the capital of Philippines)
3 State and scale of the disaster	● In Mount Pinatubo, phreatic eruption started around April, 1991, and magma eruption occurred on June 9, 1991. Although the eruptive activity itself ended in about one week, the surrounding area suffered from volcanic mudflow which is a mix of rain water and volcanic sediment that moves fast, in addition to a pyroclastic flow and volcanic ashes. These mudflows inundated farmlands, villages and towns and destroyed thousands of houses in five neighboring provinces. Furthermore, such mudflows are occurring every year since the eruption. ● Also, a lot of air aerosol particles were emitted to the stratosphere by the eruption, and sulfate aerosol layer remained for several months. Thereby, the average temperature of the earth fell by about 0.5 ℃, and it is said that depletion of the ozone layer increased significantly.
4. Economic damage	● While the Gross Regional Product (GRP) of the area surrounding Mount Pinatubo was growing steadily at the rate of 5% every year before the eruption, it fell 3% or more for the period between 1990-1991. ● Infrastructures such as roads and transportations in the vicinity of the volcano were damaged by pyroclastic flows and volcanic mudflows, and the costs incurred for rehabilitation is estimated to be 3,800 million pesos. Also, great expense was required to construct embankments and dams to control mudflow floods. ● Several cases of troubles with aircraft engines caused by volcanic ashes were reported, and the amount of damage was estimated to exceed 100 million USD. ● In addition, it is reported that 800 square kilometers of rice fields were damaged and 800,000 livestock were killed in the disaster. The amount of damage in agriculture sector is estimated to be about 1,500 million pesos.
5. Human damage	● This eruption is said to be the largest scale in the 20th century. However, since the peak of the eruption was predicted in advance, the government was able to evacuate tens of thousands of residents in the vicinity, and this reduced the number of loss of lives. ● Approx. 900 people are estimated to be dead and the missing due to the eruption. Many deaths were due to collapse of houses, caused by heavy mud-rain containing pumice stone and volcanic ashes piling up on the roof. The damage was exacerbated by rains brought by the typhoon, which added weight to the accumulated volcanic ash. ● The total number of victims affected by the eruption is estimated to be about 1.2 million.
6. Impacts on supply chain and business activities	● The manufacturing subsector, and consequently the exporting subsector, was heavily damaged. Lost assets for 559 firms totaled 851 million pesos. Foregone production losses for 1991 were reported to be about 45 percent of the potential sales for the year 1991, or 454

	million pesos, and 424 million pesos of capital investment was destroyed at 306 firms. The furniture industry was hardest hit, with damage of 156.5 million in 108 firms. The processed food sector suffered 97 million pesos of loss in 18 firms. ● The Department of Public Works and Highways (DPWH) Regional Office III estimated damage to public infrastructure amounting to 3.8 billion peso. The breakdown of the estimated damage is as follows: transportation infrastructure, 11.5 billion peso; communications infrastructure, 13 million peso; electricity related infrastructure, 55 million peso; water resource management infrastructure, 1.57 billion peso; other social infrastructure (e.g. schools) 1.05 billion peso. Through these data, we can observe that the gravest destruction was on irrigation and flood control systems, roads and bridges, and school buildings. Additional damage of at least 1 billion pesos was done to roads and bridges by lahars of 1992. ● There was no report/information of significant damage suffered directly by major foreign companies, including Japanese companies, or of major interruption of supply chain thereof, caused by the eruption of Mount Pinatubo. ● U.S. Clark Air Base in the Province of Pampanga was severely damaged by the pyroclastic flow from the eruption. The U.S. military withdrew from Clark, and returned the base to the government of Philippines. In 1993, the former Clark Air Base was reopened as the Clark Special Economic Zone (CSEZ). Several Japanese companies including Yokohama Tire Japan Co., Ltd., are conducting business in CSEZ.
7. Responses	● Evacuation of the population at risk had been the concern of local authorities as early as April 1991 when the Philippine Institute of Volcanology and Seismology (PHIVOLCS) declared a 6-mile-radius danger zone around the volcano. PHIVOLCS, jointly with the U.S. Geological Survey (USGS), had conducted intensive studies and monitoring of the volcano's activity from which it forecast and declared an imminent eruption and issued early warnings to the communities at risk. This early warning was counted as a successful case. ● In the immediate aftermath of the eruption, the National Disaster Coordinating Council mobilized civilian and military resources to respond to the evacuation, rescue and relief requirements of the affected populations. Government agencies mobilized their respective facilities (hospitals, schools, etc.) and personnel (medical, social workers, teachers, etc.) to provide the necessary basic services in designated evacuation centers. The Department of Social Welfare and Development was in the forefront of providing emergency relief assistance to displaced families and victims in evacuation centers. The Department of Health led in the provision of medical care and public health services at evacuation centers, including disease surveillance. Heath advisories were also issued and broadcast to guide the public in coping with the ashfall as health hazard since the fine volcanic particles could cause sore eyes or trigger asthma. Later on, a host of countries extended humanitarian relief assistance to the Philippine Government and its support NGOs, including the Philippine National Red Cross. These countries included Australia, Japan, U.S.A. and etc. International organizations such as WHO, UNDP, UNICEF, UNDRO and WFP also extended humanitarian relief assistance. ● The government of Philippines identified the following as the pillars of its rehabilitation/development plans to recover from the aftermath of eruption, and stated that it will implement specific measures for

	each area: Resettlement; Livelihood, Social Services, Infrastructure; Land use and environmental management; and Science and Technology. ● As can be seen from the above description, the measures adopted by the government of Philippines mainly focused on the support/rescue of the residents affected by the disaster, and the restoration of infrastructure. On the other hand, Government's reference to the issue of continuity and recovery of business activities of the companies was relatively limited, and it can be assumed that the issue of business continuity was not regarded as an important theme at that time.
8. Lessons Learned	● Although there was little influence on the business activities and supply chains of Japanese companies, the case shows that once a volcanic eruption occurs, it can cause extensive damage to vast areas, and depending on the surrounding conditions, rehabilitation itself may be difficult or may require substantial cost and time. Therefore, it can be pointed out that companies should be extremely cautious when deciding on starting their business in areas where risk of volcanic eruption exists. ● Even when a company does not have its operational base near the volcano, domestic and international logistics services may be disrupted due to damages to transport infrastructures such as highways and railroads, or possible danger to airplanes caused by volcanic ashes. In preparation for such situation, it is necessary to discuss and arrange for alternative means of transportation and substitute suppliers beforehand.

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Tool 4 Samples of Lesson Learned Report

Report of Response to the 2013 Typhoon No. 5 in Haiphong, Vietnam: Tropical Storm JEBI and other Typhoon, AHA Centre and JICA, December 2013, AHA Centre and JICA

The Impact of January & February 2014 Jakarta Flood to the Industrial Park in Jakarta and Bekashi, AHA Centre and JICA, February 2014

Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region

Report of Response to the 2013 Typhoon No. 5 in Haiphong, Vietnam: Tropical Storm JEBI and other Typhoon

December 2013

AHA CENTRE
Japan International Cooperation Agency

OYO International Corporation
Mitsubishi Research Institute, Inc.
CTI Engineering International Co., Ltd.

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1 Introduction

During the 3rd mission from July 28th to August 10th, 2013, Typhoon No. 5 : Tropical Sotrm JEBI (August 2013) and Typhoon No. 6 : Tropical Storm MANGKHUT (August 2013) have occured. The City of Hai Phong established Hai Phong Committee for Flood and Storm Control (Hai Phong CFF&SC) to respond flood and typhoon by advising proactive measures and evacuation advisories, providing typhoon information and conducting damage investigations. In this report,the Sutdy Team summarized 1) specification of each Tyhoon, and 2) disaster prevension measures applied by Hai Phong CFF&SC, public sectors, private sectors and industrial estates. Target Typhoons are JEBI, MANGKHUT, as well as the past typhoons which brought severe damages to Hai Phong, namely Typhoon No. 2 : BEBINCA (June 2013) and Typhoon No. 8 : SON TIHN (October 2012).

2 Specification of Typhoon No. 5 : JEBI (2013)

On July 29th, 2013, Typhoon No. 5 occured as a tropical storm in the South Chian Sea. It moved toward northwest direction with increasing its strength, then the tropical strom became typhoon on July 31st. From August 2nd noon to 3rd early morning, Typhoon JEBI reached to the maximum wind speed of 25 m/s. After landing in the City of Hai Phong, it weekend into a tropical cyclone before disappearing on the 4th. The route and specification of Typhoon No. 5 are summarized below.

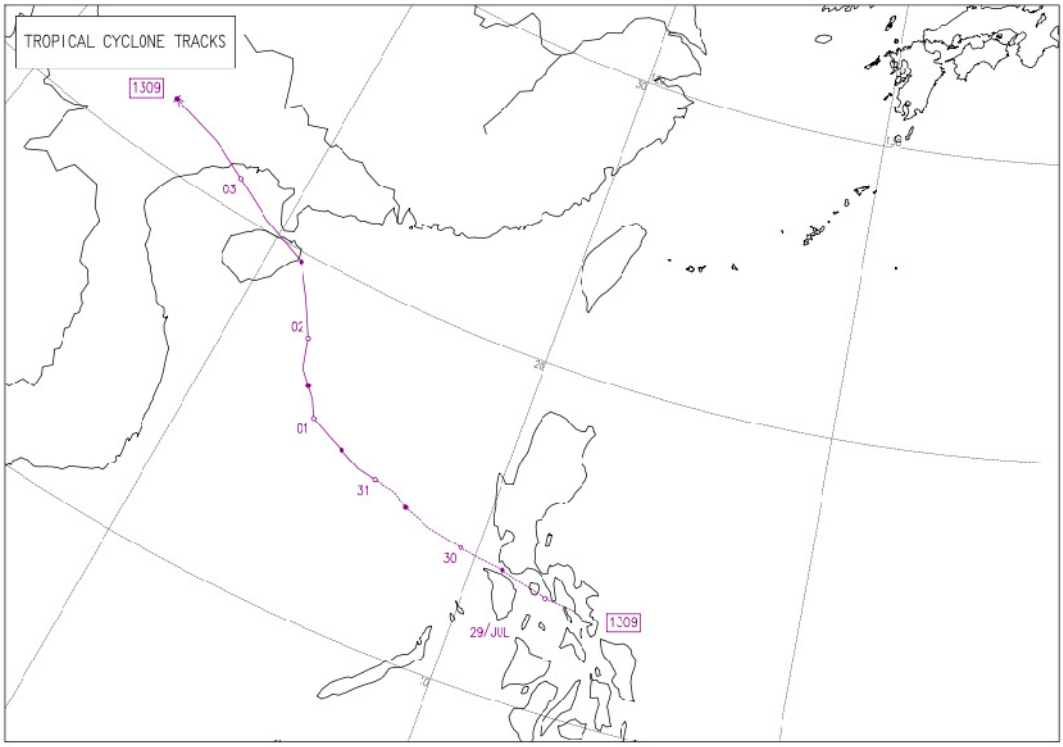


Figure 2.1 Route of Typhoon No. 5 : JEBI

Reference : Japan Meteorological Agency **http://www.jma.go.jp/jma/indexe.html**

Table 2.1 Location Chart of Typhoon No. 5 [*1] : JEBI

Date/Time (Japan)			Position Centre		Central Pressure	Max sustained Wind Speed	Strom Area (radius)	Strong Wind Area (radius)	Size	Strength
M	D	T	N	E	hPa	m/s	km	km		
7	29	03	13.1 N	123.3 E	1006	--	---	---	Tropical Cyclone Developped	
		09	13.2	122.4	1008	--	---	---		
		15	13.4	121.6	1006	--	---	---		
		21	13.6	120.9	1006	--	---	---		
	30	03	13.7	120.1	1004	--	---	---		
		09	13.8	119.5	1004	--	---	---		
		15	14.0	118.4	1002	--	---	---		
		21	14.3	117.5	1002	--	---	---		
	31	03	14.6	117.0	1002	--	---	---		
		09	14.7	116.3	1000	18	---	220	---	---
		15	14.8	115.7	998	18	---	220	---	---
		21	15.1	115.0	994	18	---	330	---	---
8	1	03	15.3	114.5	994	18	---	SE: 460 NW: 280	---	---
		09	15.6	113.8	994	18	---	SE: 460 NW: 280	---	---
		15	16.1	113.5	994	18	---	SE: 460 NW: 280	---	---
		21	16.4	113.2	992	20	---	SE: 460 NW: 280	---	---
	2	03	16.8	112.8	990	20	---	SE: 460 NW: 280	---	---
		09	17.7	112.5	990	20	---	SE: 330 NW: 220	---	---
		15	18.8	111.8	985	25	---	SE: 330 NW: 220	---	---
		21	19.7	111.1	985	25	---	SE: 330 NW: 220	---	---
	3	03	20.3	109.4	985	25	---	SE: 330 NW: 190	---	---
		09	21.0	107.9	985	25	---	E: 330 W: 190	---	---
		15	21.6	106.5	990	20	---	E: 280 W: 170	---	---
		21	22.0	104.5	998	---	---	---	Cahged to Tropical Cyclone	
	4	03							Disappear	

*1: Japan Meteorological Agency named as Typhoon No. 9

Reference : Japan Meteorological Agency http://www.jma.go.jp/jma/indexe.html

3 Observation Record in the City of Hai Phong: Typhoon No. 5 JEBI (2013)

According to Hai Phong CFF&SC (Hai Phong CFF&SC, August 2013) , at 4:00 AM on August 3rd, the center of Typhoon No. 5 was located at 20.6°N ; 108.7°E 180 km east-southeast from Quang Ninh-Nam Dinh coast with the maximum wind speed of Level 10 (24.5 - 28.4 m/s). Coastal areas from Auang Ninh province to Nam Dinh were warned for rising sea levels combined with high tides.

4 Recorded Damages in the City of Hai Phong: Typhoon No.5 JEBI (2013)

There was no report on accident, inundation and casualty due to Typhoon No.5. The main damage among records is a breakage and damage of infrastructure facilities, including the roof damage to the office and residence, fire caused by electrical problems and agriculture-aquaculture damages. The recorded damages were over a wide area from the coast to inland. Hai Phong CFF&SC (Hai

Phong CFF&SC, August 2013) summarized damages caused by Typhoon No. 5 as shown in Table 4.2

Table 4.1 Accident and Inundation Damages

Item	Condition	Remarks
Accident	None	None
Inundation	No Major Inundation	None

Reference: Hai Phong CFF&SC, August 2013

Table 4.2 Other Damages

Item	Condition/Location	Remarks
Human Life	No Casualty	None
Dyke・Irrigation Structure	No Major Damage	− Erosion: Part of dyke (Vinh Bao) along No.17 Road
Residence	Kien An Area	− 30m^2: Roof damaged − 150m^2：Fire by electrical problem
	An Duong	− 100m^2：Office roof damaged
	Cat Hai	− Roof damaged
Agriculture・Aquaculture	An Duon and Cat Hai	− Farmland damaged: Approx. 50 hectors
	Cat Hai	− Aquaculture cage damaged
Infrastructure	Cat Ba	− Damages along No.356 Road − Balcony damaged at Cat Ba Road Station, fallen tree（35 trees）, dyke damaged（15m）
	—	− Sidewalk surface loosened：30m^2 − Road depression：20m^2 − Road Sign collapse：2 signs
	Beach Long Vy	− VHF antenna broken
	Long Phu Commune	− 35KV line cut
	Hien Hao	− Transformer line cut

	Commune, Cat Hai	

Reference: Hai Phong CFF&SC, August 2013

5 Response to Typhoon No. 5: JEBI (2013)

Data collection was conducted on the responses of each stakeholder including governmental agencies, private companies and locals to typhoon. The methodologies are (1) governmental official report (Hai Phong CFF&SC, August 2013) and (2) interviews with locals. The governmental official report described the responses of the central government and the City of Hai Phong (CFF&SC) to the Typhoon No.5. From the report, the method and timing of official orders/instructions are organized in chronological sequence in Table 5.1. The interviews were conducted with people of commercial facilities and Nomura Hai Phong Industrial Park Management office and tenants.

According to Hai Phong CFF&SC report, on August 1st (2 days before the Typhoon landed in the City of Hai Phong), the central government sent emergency telegram (No.05/CD-CT) to related agencies and units requesting for the implementation of prevention measures. In response to the telegrams, the local government, Hai Phong CFF&SC, sent a telegram (No. 07/CD-CFF&SC) to local public agencies and units in order to convey the national government's order on implementation of prevention measures.

The local reported during the hearing investigation at Do Son area that, on August 1st (on the same day the telegrams were sent out), they also received the typhoon information and warnings from the local government. The prevention measures implemented by locals are moving boats to safer places, removal of lantern decorations at Cat Ba area, removal of large signs of restaurants/hotels at coastal areas and covering windows and entrance facing the sea by using plywood at Do Son Area.

As for the activities of central and local government, officials held meetings and field investigation for gathering supplemental information, and issued evacuation order and offshore fishing ban. The local government also ordered the military mobilization (100 members) for placing a prevention measure to the coast line at Do Son Tourist Park which was severely eroded by previous typhoons (CFF&SC supplied reinforced material).

On the other hand, on August 2nd, the tenants of industrial park, particularly foreign-affiliated companies received typhoon information and warnings from the embassy of their country and the Industrial Park management office. With the information, they conducted internal discussion on prevention measures. It must be noted that throughout the typhoon period, they did not receive information from the central and local government agencies. It is recommended that the current system or means for transmitting information/warning on natural disaster must be improved to provide accurate and timely warnings to stakeholder including private companies.

Table 5.1 Response by Public Sectors and Stakeholders

Date	Central Government*1	The City of Hai Phong*1	Private Sector	Industrial Estate
1-Aug	Unknown	14:30	Unknown (interviewed info at Do Son Area on August 3):	
	− Emergency Telegraph (ET) (No.05/CD-CT): requested sectors and units to implement prevention measures.	− CFF&SC ET (No.07/CD-CFF&SC): Direct sectors to monitor conditions, gather information, limit the vessel operation, prohibit offshore boats activities, keep regular contact with boat owners, implement safety plan to protect dykes, irrigation, drainage system, agriculture, livestock, fisheries and manufacturing facilities, warehouse and docks, order maintenance and rescue as required.	− Local people at Do Son area received typhoon information from local government.	
	PM − Hai Phong CFF&FC mtg. (chairman: Chairman of People's Committee (PC): assigned CFF & SC members to inspect			
	− Delegates inspected prevention measures at Cat hai, Do Son, Duong Kinh, Kien Thuy, Thuy Nguyen, Tien Lang, Vinh			
2-Aug	AM	17:00	Unknown (interviewed info at Do Son Area on August 3):	Unknown (interviewed info at Nomura Hai Phong IZ on August 5)
	− Chairman of PC inspected prevention measures at major regions.	− Hai Phong CFF&SC prohibited the offshore fishing and operated rescue vessels CN09.		
		17:30	− Start moving boats to safe place.	− Obtained Typhoon Information (weather map) from the Embassy of Japan and the management office of Nomura Hai Phong IZ.
		− HPai Phong CFF&SC ET (No.09/CD-PCLB&TKCN): ordered to implement ETs No.05/CD-CT and No.06/TB-PCLB&TKCN.	− Removal of lantern decorations at Cat Ba area. Removal of large signs of restaurants and hotels at coastal areas. Begin to cover windows and entrance facing the sea by using plywood at Do Son area.	
		− Determined to evacuate entire residents at warning area (outside the dykes, critical area, aquaculture are) before 7 am on August 3, 2013, ordered to implement measures to agriculture lowland.		
		−		
	Unknown	Inspected safety of operation of tide and sewer system.		
	− The Ministry of Military Commander mobilized 100 officers and Hai Phong CFF&SC supplied 500 steel gabion, 1200 m^3 riprap, 50 kg steel wire, 50 pliers to reinforced embankment at Do Son tourist area.			
		Typhoon No. 5 landed in the City of Hai Phong		
August 3	Morning: Chairman of PC and CFF&SC members site visit (Do Son)			

Reference: *1 Hai Phong Committee for Flood and Storm Control (Hai Phong CFF&SC), "REPORT: Prevention and control and recover works response to Tropical Storm JEBI", People's Committee of Hai Phong, No.: /BC-PCLB&TKCN, August 2013

6 Results of Field Survey on Typhoon No. 5: JEBI (2013)

The Study Team conducted a two day field survey: 1) on August 2nd before typhoon and 2) August 3rd after typhoon. The survey on August 2nd included the investigation of evacuation situation and preventative measures within the City of Hai Phong and at the Cat Bi Airport. The survey after typhoon on August 3rd focused on a damage investigation within the City of Hai Phong and at the Do Son Area. The main survey points are shown in Figure 6.1.

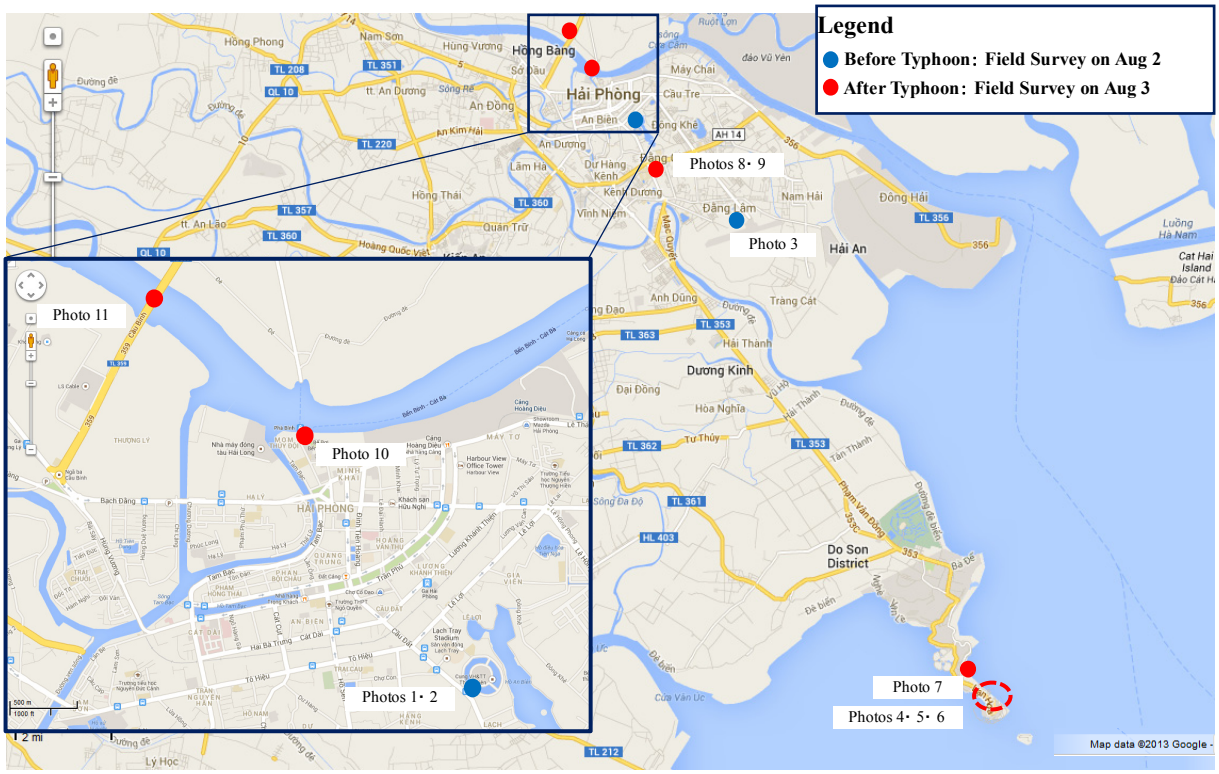


Figure 6.1 Location Map of Field Survey

6.1 Before Typhoon: August 2nd Afternoon

In the City of Hai Phong, most of shops were already closed and there was less traffic as compared to the usual condition. It was noted that the preparation to typhoon was underway.

Photo 6.1 Looking at the City of Hai Phong

Photo 6.2 Street in front of Nam Cuong Hotel in the City of Hai Phong before arrival of typhoon. Much fewer traffic as compared to the usual condition.

Photo 6.3 Hai Phong Cat Bi Airport

6.2 After Typhoon: August 3rd Afternoon

The observed damages at Do Son area include coastal dyke damages at few locations (unknown if they were caused by Typhoon No. 5). In the afternoon of August 3rd, people were out cleaning the aftermath of the typhoon and removing plywood which was used to protect the commercial facilities (restaurants and hotels) located along a road facing the South China Sea. At a dock, as a typhoon measures, boats were tied to trees along embankment.

Within the city of Hai Phong, inundations caused by inland water were recorded, especially along major roads and lowlands (university campus). However, the investigation from the Bin Bridge across the Cam River indicated that there was no damage along the river.

6.3 September 3, 2013

Photo 6.4 Coastal dyke damaged at Do Son Area (Unknown if the damage caused by Typhoon No. 5 JEBI:JEBI(2013))

Photo 6.5 People cleaning the aftermath of typhoon and removing plywood used to protect doors and windows.

Photo 6.6 Coastal dyke damaged at Do Son Area (Unknown if the damage caused by Typhoon No. 5 JEBI:JEBI(2013))

Photo 6.7 Prevention measures to protect boats by strapping to trees along embankment at Do Son area

Photo 6.8 Inundation in the City of Hai Phong

Photo 6.9 University Campus Inundated in the City of Hai Phong

Photo 6.10 Looking downstream from a commercial port (tour boats for Catba island) located on right bank of Cam River

Photo 6.11 Looking downstream of the Cam River from the Bin Bridge

6.4 Summary of Typhoon No. 6: MANGKHUT (2013)

On August 5th, 2013, Typhoon No. 6 occurred as a tropical storm in the South China Sea. It moved toward northwest direction with increasing its strength, and then on the 6th the tropical storm became Typhoon. From August 7th morning to evening, Typhoon MANGKHUT reached to the maximum wind speed of 20 m/s. After landing in Northern Viet Nam, it weakened into a tropical cyclone before disappearing on the 8th morning. According to reports by local media, there was no significant damage caused by the Typhoon MANGKHUT. The route and specification of Typhoon No. 6 are summarized below.

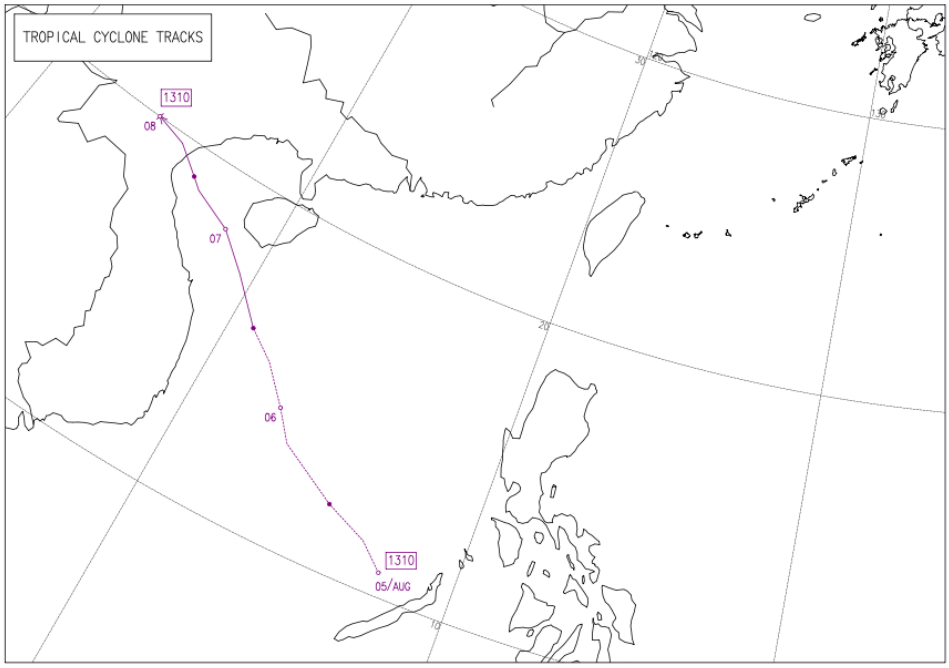


Figure 6.2 Route of Typhoon No. 6 : MANGKHUT

Reference : Japan Meteorological Agency http://www.jma.go.jp/jma/indexe.html

Table 6.1 Location Chart of Typhoon No. 6 *2 : MANGKHUT

Date/Time (Japan)	Position Centre		Central Pressure	Max sustained Wind Speed	Strom Area (radius)	Strong Wind Area (radius)	Size	Strength
M D T	N	E	hPa	m/s	km	km		
8 5 09	10.7 N	117.7 E	1006	--	---	---	Tropical Cyclone Developpe	
15	11.4	116.9	1004	--	---	---		
21	12.0	115.5	1004	--	---	---		
6 03	13.1	113.5	1004	--	---	---		
09	14.0	112.8	1002	--	---	---		
15	15.1	111.8	1002	--	---	---		
21	15.8	110.8	998	18	---	220	---	---
7 03	17.1	109.5	996	18	---	220	---	---
09	18.1	108.3	994	20	---	220	---	---
15	18.7	106.8	992	20	---	220	---	---
21	19.0	106.4	994	20	---	220	---	---
8 03	19.7	105.4	996	18	---	E: 220 W: 150	---	---
09	20.0	104.2	1000	--	---	---	Changed to Tropical Cyclon	
15							Disappear	

*2: Japan Meteorological Agency named as Typhoon No. 10

Reference : Japan Meteorological Agency http://www.jma.go.jp/jma/indexe.html

7 Summary of Typhoon No. 2 : BEBINCA (2013)

On June 20th, 2013, Typhoon No. 2 occurred as a tropical storm in the South China Sea. It moved toward northwest direction with increasing its strength, and then changed to typhoon on the 21st. From June 22nd morning to 23rd dawn, Typhoon BEBINCA reached to the maximum wind speed of 20 m/s. After landing in Northern Viet Nam on the 23rd midnight, it weakened into a tropical cyclone on the 24th noon before disappearing. The route and specification of Typhoon No. 2 are summarized below.

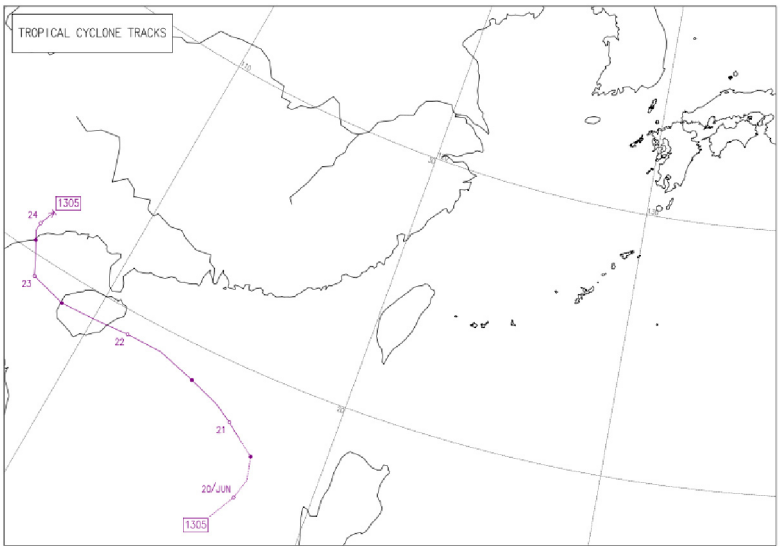


Figure 7.1 Route of Typhoon No. 2 : BEBINCA

Reference：Japan Meteorological Agency **http://www.jma.go.jp/jma/indexe.html**

Table 7.1 Location Chart of Typhoon No. 2 [*3] : BEBINCA

Date/Time (Japan)	Position Centre		Central Pressure	Max sustained Wind Speed	Strom Area (radius)	Strong Wind Area (radius)	Size	Strength
M D T	N	E	hPa	m/s	km	km		
6 20 03	14.8 N	116.9 E	1002	--	---	---	Tropical Cyclone Developpe	
09	15.7	117.4	1002	--	---	---		
15	16.4	117.6	1000	--	---	---		
21	7.2	117.4	1000	--	---	---		
21 03	17.6	116.8	998	18	---	E: 220 W: 190	---	---
09	18.0	116.2	998	18	---	E: 220 W: 190	---	---
15	18.4	115.5	996	18	---	E: 280 W: 220	---	---
21	18.8	114.3	996	18	---	E: 280 W: 220	---	---
22 03	19.2	112.8	994	18	---	E: 280 W: 220	---	---
09	19.2	111.4	990	20	---	E: 280 W: 220	---	---
15	19.1	110.2	990	20	---	E: 280 W: 220	---	---
21	19.0	108.7	990	20	---	SE: 280 NW: 220	---	---
23 03	19.2	107.8	992	20	---	E: 280 W: 220	---	---
09	19.3	107.3	992	18	---	220	---	---
15	19.8	107.0	994	18	---	220	---	---
21	20.4	106.6	994	18	---	220	---	---
24 03	20.7	106.4	996	18	---	220	---	---
09	21.0	106.4	998	18	---	190	---	---
15	21.6	106.6	1000	--	---	---	Changed to Tropical Cyclon	
21							Disappear	

*3: Japan Meteorological Agency named as Typhoon No. 5

Reference：Japan Meteorological Agency **http://www.jma.go.jp/jma/indexe.html**

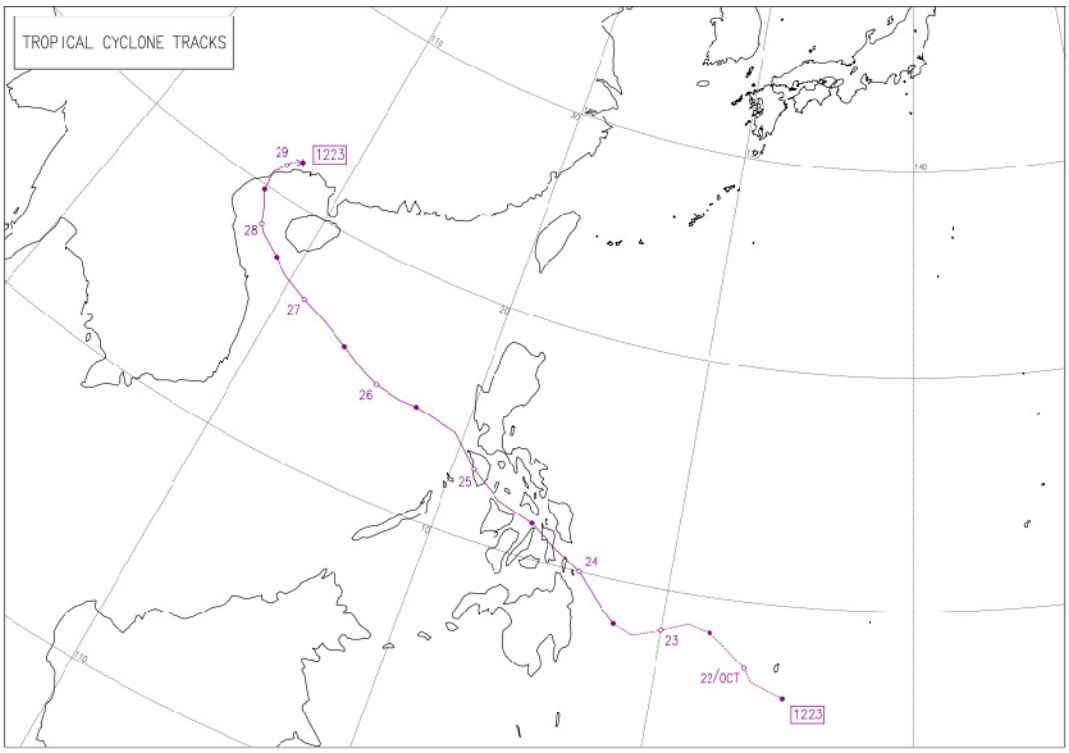
According to Hai Phong CFF&SC (Hai Phong CCF&SC, June 2013), at the evening of June 23rd, Typhoon No. 2 landed Hai Phong-Thai Binh with strong wind speeds at the level 8 (17.2-20.7 m/s). High tide on June 23rd (at 5:5 PM: 3.6 m) with strong winds caused rising water level over 4m at Do Son and Cat Hai.

Financial loss caused by Typhoon No. 2 (Hai Phong CCF&SC, June 2013) was estimated approximately 395,71 billion VND. The main loss and damages are evacuation (more than 1,800 people from Cat Hai Area, Do Son Area and other Area), Inundated house (1,500 houses at Do Son area), house collapsed and swept away (4 houses), livestock mortality (cattle: 180 cattle, other : 2,650 livestock), salt damage of farmland and grazing land, dyke and embankment damage (4,048m), slid embankment at Cat Ba (167m), slide coast dyke and area at Do Son tourist area (433,65m^3), national highways, provincial and rural roads damaged/inundate, and electrical poles/lines/substation damaged.

8 Summary of Typhoon No. 8 : SON TINH (2012)

On October 21st, 2012, Typhoon No. 8 occurred as a tropical storm in the South China Sea. It moved toward northwest direction with increasing its strength, and then changed to typhoon on the 23rd. Typhoon No.8 recorded the maximum wind speed at 45 m/s on the 27th. After landing in

Northern Viet Nam on the 28th noon, it weakened into a tropical cyclone before disappearing. The route and specification of Typhoon No. 8 are summarized below.



Reference：Japan Meteorological Agency **http://www.jma.go.jp/jma/indexe.html**

Figure 8.1　Route of Typhoon No. 8：SON TINH

Table 8.1 Location Chart of Typhoon No. 8 [*4] : SON TINH

Date/Time (Japan)	Position Centre		Central Pressure	Max sustained Wind Speed	Strom Area (radius)	Strong Wind Area (radius)	Size	Strength
M D T	N	E	hPa	m/s	km	km		
10 21 21	6.4 N	135.0 E	1008	--	---	---	Tropical Cyclone Developped	
22 03	6.9	133.7	1004	--	---	---		
09	7.4	133.4	1006	--	---	---		
15	8.0	132.7	1004	--	---	---		
21	8.6	131.9	1004	--	---	---		
23 03	8.8	131.0	1004	--	---	---		
09	8.4	130.0	1004	--	---	---		
15	8.0	128.9	1000	--	---	---		
21	8.3	128.1	1000	18	---	280	---	---
24 03	8.8	127.5	998	18	---	280	---	---
09	10.0	126.3	998	18	---	280	---	---
15	10.8	124.9	996	18	---	280	---	---
21	11.4	123.9	998	18	---	280	---	---
25 03	11.9	122.3	996	20	---	390	---	---
09	12.8	120.9	998	20	---	390	---	---
15	14.0	119.6	998	20	---	390	---	---
21	14.4	117.6	998	20	---	390	---	---
26 03	14.4	116.8	996	20	---	390	---	---
09	14.6	115.6	990	23	---	390	---	---
15	14.9	114.8	980	30	90	390	---	---
21	15.5	113.6	980	30	90	390	---	---
27 03	16.1	112.2	975	30	90	390	---	---
09	16.5	111.0	975	30	90	390	---	---
15	17.0	109.7	965	35	110	390	---	Strong
21	17.5	108.9	945	45	110	390	---	Very Strong
28 03	18.1	107.8	955	40	110	390	---	Strong
09	18.4	107.5	955	40	110	390	---	Strong
15	19.2	107.1	970	35	110	330	---	Strong
21	19.8	106.7	980	30	110	280	---	---
29 03	20.7	106.6	990	23	---	280	---	---
09	21.3	107.0	1004	18	---	220	---	---
15	21.5	107.1	1008	--	---	---	Cahged to Tropical Cyclone	
21	21.8	107.6	1008	--	---	---		
30 03							Disappear	

*4: Japan Meteorological Agency named as Typhoon No. 23

Reference : Japan Meteorological Agency http://www.jma.go.jp/jma/indexe.html

Hai Phong CFF&SC (Hai Phong CCF&SC, November 2012) reported that Typhoon No. 8 had strong intensity, and landed in Hai Phong from evening of the 28th to dawn of the 29th. It recorded the strong wind speeds at the level 11 (24.5-28.4 m/s) – Level 12(28.5-32.6 m/s), caused heavy rain at whole city with total rainfall from 300 to 350 mm.

The total value of damaged assets (Hai Phong CCF&SC, November 2012) was estimated to 997,395 billion VND. Major damages and losses are victims (2 deaths, 9 injured), rescued victims (56 people), house collapsed (136 house), lost roof (house: 10,621, business building: 125, farm: 1,584, temporary housing: 536), agriculture damage (rice field: 8,433ha, crops damaged: 5,604ha,

aquaculture areas: 3,943ha), livestock mortality (cattle/chicken: 202,937 head), tree collapsed (209,976 tree), electric poles broke (863 poles), electric line cut (83line), port damaged (4 ports), bridge/gauging station damage (8 stations), dyke damage (Cat Hai Dyke, Thai Binh Right Dyke, Thai Binh Left Dyke, Van Uc Left Dyke, Luoc River Right Dyke), and coast dyke eroded at Do Son tourist area (1,200m).

9 Conclusion

During the 3rd mission, Typhoon No. 5: Tropical Storm JEBI (August 2013) and Typhoon No. 6: Tropical Storm MANGKHUT (August 2013) occurred. JICA Study Team conducted field survey and gathered related information to investigate the damages and losses caused by Typhoon No. 5 and summarized the general description of each typhoon and the prevention measures and responses taken by the related agencies. As for other past typhoons which caused severe damages and losses to the city of Hai Phong, the Study Team gathered information through the relevant government agencies and summarized specifications, route and damages of each typhoon.

It was found that, all four typhoons (JEBI, MANGKHUT, BEBINCA and SON TINH) demonstrated a number of similarities that (1) it appeared in Pacific Ocean or the South China Sea located southeast of the City of Hai Phong, and (2) It reached the maximum wind speed before landing in the city of Hai Phong or in the Northern Viet Na, then soon weakened into a tropical cyclone and disappeared. Typhoon No. 8 SON TINH in 2012 was the largest among the investigated typhoons in terms of the total value of damaged assets, wind speed, and radius of strong wind zone.

In response to the investigation through the governmental official report (Hai Phong CFF&SC, August 2013) and hearing investigation with locals, it was found that the local residents received telegrams issued by central and local government and are informed regarding the description of the typhoon and actions to be taken in a timely manner. On the other hand, the source of typhoon information and warnings for the tenants of industrial park, particularly foreign-affiliated companies, was mainly the embassy of their country and the Industrial Park management office; they did not receive information from the central and local government agencies. It is recommended that the current system or means for transmitting information/warning on natural disaster must be improved to provide accurate and timely warnings to every stakeholder including private companies.

In addition, the field survey confirmed that damages and loses caused by typhoons were not only regionally but also spread through a wide area. At the coast, coast dykes were severely damaged and collapsed, whereas the city life was interrupted by inland inundation at lowland and collapsed trees along major roads. In addition, the City of Hai Phong has many major infrastructures (ports, station, airport and highways) located within the city, regional inundation or collapsed trees could temporarily suspend or cut the important distribution network and roads which may lead large

economic loss. Therefore, even when the abnormal condition that affects the entire region occurs, it is important to maintain and early recovery of function particularly in the industrial areas.

It is recommended that local governments, infrastructure providers and private companies within the region to develop and have disaster prevention measures as well as BPC. Also the findings of the investigation reveal the importance of development of Area-BCP which can be used for understanding and sharing important information among every stakeholder at timely manner. Area-BCP could be also beneficial for strengthening the capacity of means for transmitting information between local government and private companies.

References:

1) Hai Phong Committee for Flood and Storm Control (Hai Phong CFF & SC), "REPORT: Prevention and control and recover works response to Tropical Storm JEBI", People's Committee of Hai Phong, No.: /BC-PCLB&TKCN, August 2013
2) Hai Phong Committee for Flood and Storm Control (Hai Phong CFF & SC), "REPORT: Prevention and control and remediation to Storm No.2", People's Committee of Hai Phong, No.: /BC-PCLB&TKCN, June 2013
3) Hai Phong Committee for Flood and Storm Control (Hai Phong CFF & SC), "REPORT: Prevention and control and remediation to Storm No.8", People's Committee of Hai Phong, No.: /BC-PCLB&TKCN, November 2012

AHA CENTRE
ASEAN Coordinating Centre for Humanitarian Assistance on disaster management

JICA

FLOOD SURVEY REPORT

The Impact of January & February 2014 Jakarta Flood to the Industrial Park in Jakarta and Bekasi

February, 2014

Prepared by:
Dr. Krishna S. Pribadi
Aria Mariany

This report is developed with participation of:

1. Anin Utami
2. Bayu Novianto
3. Gery Andrika
4. In In Wahdiny
5. Mona Foralisa
6. Nimas Maninggar
7. Rienna Oktarina

SUMMARY

The January and February, 2014 flood that occurred in Jakarta has affected many sectors, including industry, both production process and supply chain. Flood that inundated North Jakarta has impacted the logistic distribution through Tanjung Priok. It has caused billions rupiah losses. The flood in Jakarta affected industries not only in Jakarta but also in the surrounding area, such as in West Java, where Tanjung Priok is the distribution hub of the industrial logistics. Head of APINDO West Java mentioned that the losses of industries in West Java are about IDR 200 million per day because the road to Tanjung Priok is flooded. The case shows that even though the industrial area is not flooded, if the distribution infrastructure (such as roads, harbor, etc) are affected, the industrial process will be disturbed. Additionally, if the residential areas where industrial workers live are affected, the industry will also be disturbed.

To cope with the disaster, each industry should have its own business continuity plan (BCP). But it is also important to prepare how industry will manage the emergency situation, in case the disaster does not affect the industrial area itself, but affect the logistic routes outside of their premises, where they cannot do anything. Therefore, an Area BCP, which is a new method, is necessary to integrate the emergency management among various stakeholders, including industry, industrial parks, government, infrastructure and utility operators.

Appropriate input regarding disaster risk information is important in developing the Area BCP. Therefore, 2014 Jakarta flood survey was conducted to recognize the impact of flood disaster, especially to the industry.

The finding from the field shows that even though the industrial parks were not inundated, the production process can still be disrupted since the logistic routes were flooded and the houses of industrial workers were inundated.

TABLE OF CONTENT

I. INTRODUCTION

The January and February, 2014 Flood that occurred in Jakarta has affected many sectors, including industry, both production process and supply chain. Flood that inundated North Jakarta has impacted the logistic distribution through Tanjung Priok. It has causedbillion rupiah losses (Antara, 2014). The flood in Jakarta affected industries not only in Jakarta but also in the surrounding area, such as in West Java, where Tanjung Priok is the distribution hub of industrial logistic. Head of APINDO West Java mentioned that the losses of industries in West Java is about IDR 200 million per day because the road to Tanjung Priok is flooded (Sanjaya & Samariansyah, 2014). The case shows that even though the industrial area is not flooded, when the distribution infrastructure (such as roads, harbor, etc) are affected, the industrial process will still be disturbed. Additionally, if the residential areas where industrial workers live are affected, the industry will also be disturbed.

Currently, JICA in collaboration with AHA Center is conducting the study on Area Business Continuity Plan for industrial area in facing the disaster. 2nd Workshop will be held on the first week of March 2014. In the 2nd Workshop, there will be an exercise regarding the development of ABCP in an industrial area,where there are industrial parks, for certain hazards (based on scenario). The January and February, 2014 flood in Jakarta and Bekasi will be used as input to develop the flood disaster scenario that is needed in developing the ABCP in the case study area. Therefore, flood survey was conducted in order to gather information regarding flood impact, especially to the industry.

The objective of the survey is to gather information regarding flood impact that occurred in Jakarta and Bekasi in January 2014 especially to the industry, both process and transportation of goods and material.

II. METHODOLOGYOF SURVEY

The survey was conducted through secondary and primary. Secondary survey was conducted to collect preliminary information regarding the January and February, 2014 Jakarta flood including its magnitude and impact. Meanwhile, primary survey was conducted to collect information regarding the impact of the 2014 Jakarta flood, especially to the infrastructure and the industries. The method used in primary survey was interview with the stakeholders and collect secondary data, if possible. Primary survey was conducted in Jakarta and Bekasi to the following institutions:

1. Local government agency (BPBD/Local Disaster Management Agency, Bina Marga/Public Works)
2. Infrastructure Operator (Tanjung Priok, Jasa Marga)
3. Utility Operator (Telkom, PDAM, PLN)
4. Industrial park
5. Industry tenant
6. Infrastructure Operator: Tanjung Priok operator
7. Cargo company
8. Workers

III. REPORTING

The survey result will be reported as the following outline:

1. A glimpse of 2014 Jakarta Flood. It will describe the current condition of 2014 Jakarta Flood, which was occurred in January and early February 2014.
2. Impact of 2014 Jakarta Flood. It will describe the impact of 2014 Jakarta Flood to the community, industries, and infrastructures. It will be based on the result of both primary and secondary survey.
3. Annexes. Annexes will contain the result of primary survey both in Jakarta and Bekasi. Flood map will also be provided in the annexes.

IV. A GLIMPSE OF 2014 JAKARTA FLOOD

Flood in Jakarta is almost an annual occurence. The flood is caused bythe inadequate capacity of the river and surface water drainage system to evacuate surface run off caused by high intensity rain fall. Garbage clogging and siltation that caused by sedimentationin the upstream area exacerbate the situation. The intense change of land use (from vegetation into cultivation and settlement including residential areas) in the upstream part of the river basin areas in the past decades has increased the surface run off. The development of the Greater Jakarta area has also increased the surface impermeabilisation of the area and provoking higher peak flows and shorter time of concentration. Thenatural geological condition of Jakarta, which is in the flood plain areas of 13 river basins has contributed to the flood hazard, as well as land subsidence that occurred in the northern part of Jakarta, worsened by intense groundwater extraction . The social cultural activity of Jakarta urban community with low awareness of flood hazard has deteriorated the situation.

Regarding the 2104 Jakarta Flood, Local Disaster Management Agency (BPBD) of DKI Jakarta Province mentioned that the inundation was started on January 8, 2014. Initially flood inundated North and East Jakarta.. Figure 1 shows the flood inundation maps on January 8, 2008, which was published by BPBD of DKI Jakarta Province.

Figure 1a. Flood Inundation Area in North Jakarta on January 8, 2014

(Source: BPBD DKI Jakarta Province, 2014)

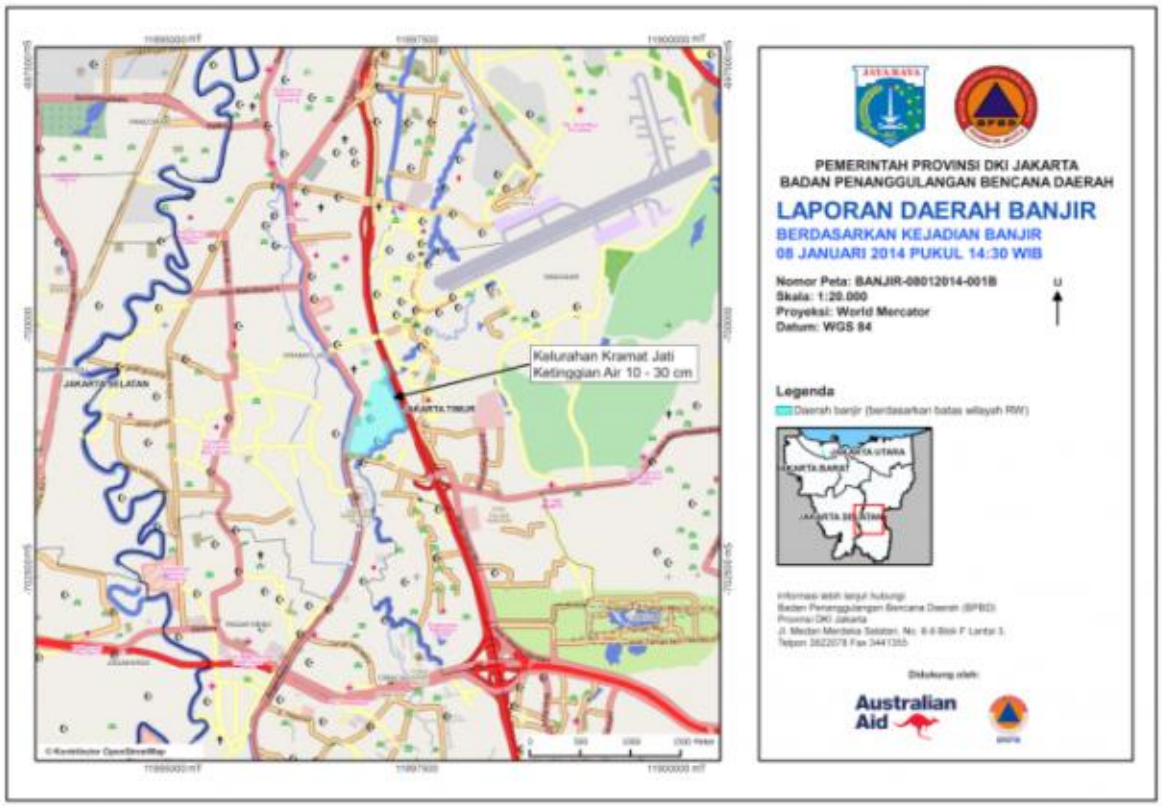


Figure 1b. Flood Inundation in East Jakarta Area on January 8, 2014

(Source: BPBD DKI Jakarta Province, 2014)

From the data of Meteorological, Climatological, and Geophysical Agency (BMKG), it was recognized that the flood on 12 January 2014 occurred after the heavy rainfall on 11-12 January 2014. On 17 January 2014 heavy to very heavy rainfall occurred in Jakarta area and also in the southern parts of the greater catchment area (upstream) , such as Puncak, Bogor, Cibereum and Ciawi areas. The rainfall duration in those areas was almost 12 hours. This caused inundation in the settlement and roads in Jakarta area, such as in Kelapa Gading, Condet, Kampung Pulo and Otista, and also in Bekasi.

The significant differences between rainfall on 17 January and 11-12 January 2014 is on the concentration area of the very heavy rainfall (the rainfall is above the 100mm/day[1]). The rainfall is distributed in the Eastern and Southern part of Jakarta and Bogor and Bekasi on 11-12 January 2014, meanwhile, on 17 January 2014 the rainfall was concentrated in the Central Jakarta and Bogor areas(BMKG, 2014). Table 1 shows the daily rainfall in Jakarta area.

[1]Rain fall in normal condition is about 20-50 mm/day. During flood disaster, the intensity of rain fall is 124 mm/day.

Table 1. Daily Rain Fall in January 2014 (BMKG, 2014)

AREA	DAILY RAINFALL JANUARY 2014 (in mm/day)									
	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th
Tanjung Priok	72	0	7	91	50	6	44	6	154	63
PIK	189	0	1	37,5	28	1,6	51,4	0,56	41,92	61,6
Kemayoran	121	0	12	31	79	17	28	5	118	148
Cengkareng	62	0	0	34	16	3	58	6	104	72
Kedoya	65	0	10	24,8	69,5	1,7	14,1	7,1	41,2	80
Pakubuwono	37	0	11	58	90	4	13	40	15	75
Ciledug	46,4	0	21	58	82	8	11,9	62,5	9	43
Ps. Minggu	39,5	0	9	29,5	100	6	9	55,5	23	65,5
Lebak Buluus	15,5	21,5	0	53	128	11,5	6,5	77,3	22,9	51
Halim PK	22	0	87	86	104,2	9,3	50,8	47,2	12,8	-
TMII	65,5	3,5	11,5	29,5	171	5	7	46	22,5	89
Mekarsari	8	0	97	26,5	132,5	5,5	2	29,5	9	48,5
Gunung Mas	1	0	19	25	120	4,5	18	7	29	152
Citeko	6	0	23,9	65	132	13	37	14	38	103
Dermaga	37	0	9	85	102	10	11	29,6	12	141
Jagorawi	26	0	20,5	72	124,5	14	3,5	34,5	5	29
Depok	36	0	0,1	65	147	20	0,01	56	16,5	78
Matoa	37,5	0	3,5	89,5	122	19	4	52	13,5	51,5

Remarks:

: Heavy to Very Heavy Rain

: Moderate Rain

: Light Rain

The peak of flood inundation occurred on 19-21 January 2014. During that time, flood inundated almost the whole area in DKI JakartaProvince. The average of flood height was about 10-70 cm and the worst flood height was more than 150 cm. Figure 2 shows the inundation map from 19-21 January 2014, which is published by BPBD of DKI Jakarta Province. The inundation maps from 8 January to 7 February 2014 are provided in Annex 3.

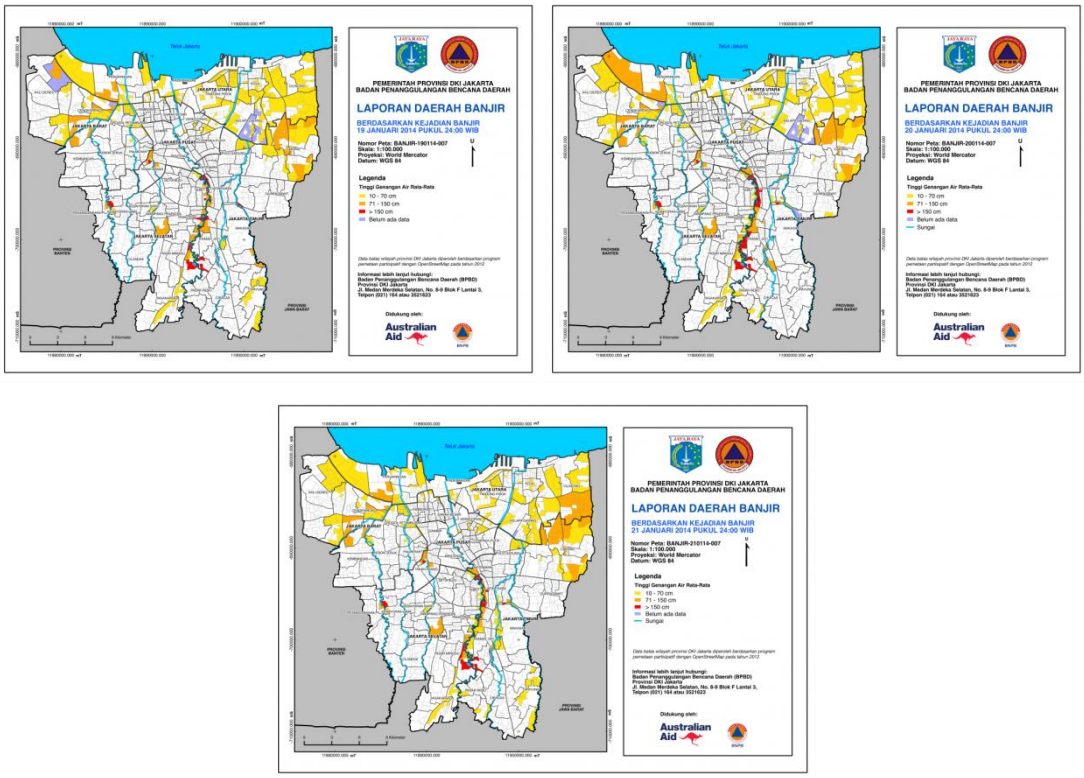


Figure 2.Flood Inundation Map from 19-21 January 2014 (Source: BPBD of DKI Jakarta Province, 2014)

The worst flooded areas in Jakarta during 2014 flood were Kampung Pulo Jakarta Timur, Kalibata Jakarta Selatan and Pasar Rebo Jakarta Timur.

2014 Flood also affected the periphery area such as Bekasi. 23 sub-districts in Bekasi were inundated, and the worst flooded areas were Sub-district Babelan, Tarumajaya, Cabang Bungin and Muaragembong. The height of flood inundation varied from 10 to 150 cm and the duration was between 2 to 30 days. Beside those sub-districts, the other areas that were affected by flood in Bekasi are:

1. Muara Gembong: Pantai Bahagia, Pantai Sederhana, Pantai Mekar, Pantai Harapan, Pantai Bakti
2. Babelan: Ds. Buni Bakti, Urip Jaya, Pantai Hurip, Muara Bakti, Kedang Pengawas
3. Tarumajaya: Ds. Pusaka Rakyat, Setia Mulya, Samudra Jaya, Pahlawan Setia, Segara Makmur, Setia Asih, Pantai Makmur, Segera Jaya)
4. Tambun (Papan Mas, Mangun Jaya, Kitamani, Srianur, Srimahi, Srimukti, Karang Satria)
5. Cibitung (Wanasari, Wanajaya)
6. Cabang Bungin (Ds. Lenggah Jaya, Ds. Setia Laksana, Ds. Jaya Laksana)
7. Tambelang (Ds. Sukatenang, Ds. Sukamekar)
8. Sukatani (Ds. Sukajadi, Ds. Sukamakmur, Ds. Sukararsa)
9. Pebayuran (Ds. Kr. Segar, Ds. Kr. Harja, Ds. Sumber Hurip, Ds. Sumber Reja, Ds. Sumber Sari)
10. Kedung Waringin (Ds. Bojong Sari, Ds. Waringin Jaya, Ds. Kd. Waringin)
11. Cikarang TImur (Ds. Laban Sari, Ds. Cipayung, Ds. Sukakrsa)
12. Cikarang Pusat (Ds. Pasir Ranji, Ds. Pasir Tanjung)
13. Serang (Ds. Nagasari)

Figure 3. Photo of Distribution of Flood Prone Areas in Bekasi District

Regarding the 2014 Flood, the Governor of DKI Jakarta Province, Joko Widodo declared the letter Number 70 Year 2014 and stipulated the status of flood emergency alert situation since 13 January until 12 February 2014. This period of emergency alert situation was determined based on rainfall as predicted by BMKG. The peaks of rainfallswere predicted in the period from January to February 2014.

This is in contrast to what was found during the interview with the staff of BPBD DKI Jakarta Province. He mentioned that the governor eventually did not declare the status of flood emergency situation because the economy was considered not disturbed and the extreme weather would not continue (Annex 1).

V. IMPACT OF 2014 JAKARTA FLOOD

Description of 2014 Jakarta flood impact will be limited to impact to the community, impact to the industries(including freight forwarder industry), impact to the industry workers, impact to the utilities, and impact to the infrastructure (such as toll road and port).

5.1 Impact to the Community

During 19-21 January 2014 flood inundation, 134.662 people who live in 100 villages and 34 sub-districts in Jakarta were affected. Up to 21 January 2014, the fatality due to flood disaster is about 12 people, caused by electric shock, swept away, and illness (BPBD of DKI Jakarta Province-Annex 1). Table 2 shows the recapitulation of flood report until 21 January 2014 at 06.00 am.

Table 2. Recapitulation of Flood Report (Monday 20 – Tuesday 21 January 2014 until 06.00 am)

Temporary Data

No	Administrative Area	Average Height	Total								Location of evacuation	Notes
			Affected						Evacuees	Fatality		
			Sub-district	Villages	RW	RT	HH	People				
1	East Jakarta	20-350 cm	9	32	131	559	22.209	65.090	22.405	7	101	
2	South Jakarta	50-300 cm	8	16	40	171	7.557	29.969	16.354	1	44	
3	Central Jakarta	50-150 cm	2	9	25	56	250	10.392	3.426	0	17	
4	West Jakarta	10-150 cm	9	19	87	278	7.820	24.933	14.521	1	52	
5	North Jakarta	20-130 cm	6	24	161	163	836	4.278	6.113	3	39	
Total			**34**	**100**	**444**	**1.227**	**38.672**	**134.662**	**62.819**	**12**	**253**	

(Source: BPBD Prop. DKI Jakarta, 2014)

Last updated data on 5 February 2014 at 18.00, 2014 Jakarta Flood affected the 96.332 people who live in 24 villages and 14 sub-districts. Table 3 shows the recapitulation of flood report up to 5 February 2014 at 18.00.

Table 3. Recapitulation of Flood Report (5 February 2014 until 18.00 am)

Temporary Data

No	Administrative Area	Average Height	Total							Location of evacuation	Notes
			Affected						Evacuee		
			Sub-district	Villages	RW	RT	HH	People			
1	East Jakarta	0-200 cm	3	6	23	117	3.946	11.847	7.123	38	
2	South Jakarta	0-100 cm	4	5	14	105	2.770	11.467	522	2	
3	Central Jakarta	0-60 cm	1	1	4	16	1.518	8.461	464	0	
4	West Jakarta	0-90 cm	4	8	36	218	20.507	64.557	5.052	20	
5	North Jakarta	0-40 cm	2	4	28	0	0	0	0	0	
Total			**14**	**24**	**105**	**456**	**28.741**	**96.332**	**13.161**	**60**	

(Source: BPBD Prop. DKI Jakarta, 2014)

In Bekasi, 51.200 people were affected by the flood. The distribution of affected people is listed as follows:

- Kec Cibitung 1800 people
- Kec. Sukatani 1300 people
- Kec, Peboy 3000 people
- Kedung Wringin 1500 people
- Cikarang timur 4250 people
- Cikarang pusat 1600 people
- Menara Gembong 15000 people
- Taruna Jaya 6000 people
- Tambun Utara 6000 people
- Babelan 7000 people
- Sukawangi 750 people
- Tambun Selatan 1500 people
- Setu 1500 people

5.2 Impact to the Industries

Industrial Areas

Flood also affected the industrial parks, both directly and indirectly. Jakarta Industrial Estate Pulogadung (JIEP) was flooded on 18 and 19 January 2014. The flood height in the industrial park was up to 60 cm. Some machines in steel factories were flooded with height of about 40 cm, therefore the management stop the production process and all the workers were not coming to the factories (Tribunnews.com).

Beside JIEP industrial park, there were three more industrial parks visited by the surveyors, i.e. Jababeka and MM2100 industrial praks in Kabupaten Bekasi (District) and KBN Cakung in Jakarta. The visits were aimed to collect information directly from the stakeholders from industrial areas.

From the survey, it was found that both industrial parks in the Kabupaten Bekasi were not inundated by the flood. There was only temporary inundation, which lasted for 10 to 15 minutes and was caused by the overflow of Cilemah Abang, Cipegadungan, and Cikarang Rivers.

Some workers in the Bekasi industrial parks did not come to work during flood, but this did not cause disturbance to the production process inside the industrial parks. The production process disturbance was primarily caused by the disturbance of logistic, both incoming (material input to the industry)as well as outgoing (distribution of the products) because the area around the industrial areas was inundated.

The industrial parks in Bekasi also did not have any problem with electricity supply, since they are provided by private sectors, such as Cikarang Listrindo (a private power supplier) that guarantee that the electricity supply will not be shut down, event when there is outage from the state power company grid (PLN). The industries in industrial parks (both in Jababeka and MM2100) in Bekasi also use water that is processed through water treatment plant.

Industrial parks have also prepared the business continuity plan (BCP) to deal with emergency situation such as flood, fire, etc., such as provided by the MM2100 industrial park. Meanwhile, Jababeka industrial park has anticipated the flood by maintaining the rivers, providing catchment ponds, also making use of *biopori* (a system for improving water infiltration into the ground/percolation by drilling a series of holes on the ground, filled with pwervious organic materials), and developing 70 hectares of botanical garden that consists of 2530 species of plants and animals.

Some industrial parks, such as Jababeka, also have coordination with other stakeholders, such as Balai Besar Pengelola Wilayah Sungai (BBWS) Cisadane and Citarum, Geographic Information Agency (BIG), Meteorological, Climatological, and Geophysical Agency (BMKG), and TKSPDA to control the water flow from Jatiluhur Dam. It also has coordination with other industrial areas to overcome all the production problems, such as traffic jam and labor demonstration, which can disturb to the production process.

Different with industrial parks in Bekasi area, the visited industrial park in Jakarta (KBN Cakung) was inundated by 2014 Jakarta flood especially in the main gate area. The height of flood is about 50-60 cm, and in some areas the height of flood is about 50-80 cm (Figure 4). Figure 5 shows the inundation in KBN Cakung industrial park.

Figure 4. Map of KBN Cakung Industrial Park. The areas in red circle were inundated by 2014 Jakarta Flood (Source: KBN Cakung)

Figure 5. Flood Inundation in KBN CakungIndustrial Park(Source: KBN Cakung)

The flood did not inundate the industry buildings, but since the main gate and some of streets in KBN Cakung were inundated and some workers' houses were also inundated by flood, therefore, on Friday, 7 February 2014 some industries allowed the workers to go home. They also made one day off for the workers on Monday, 10 February 2014.

Flood inundation also disturbed the logistic of material and product distribution from KBN Cakung industrial park, due to the traffic jam cause by the inundation. (Figure 6).

Figure 6. Traffic Jam on Main Gate of KBN Cakung (Source: KBN Cakung)

The 2014 Jakarta flood did not much affect the production process in KBN Cakung industrial park. It was different with the 2007 Jakarta Flood, which caused the production off for a whole week. KBN Cakung gave rent discount for the industry tenants during that time.

From the past flood experiences (in 2007 and 2002), KBN Cakung also provides 10 water pumps and develops two ponds as catchment area to reduce the inundation areas if flood occurs. Besides, many industries have raised their building up and put vital assets to higher place (second floor).KBN Cakung also has Flood Response Team to cope with the problems due to a flood disaster.

Internally, KBN Cakung has also some strategies to respond to the problem of inundation on the main gate and on some streets within the industrial park for the industrial workers, such as providing rubber boat or other transportation means to bring the workers to the industry buildings (Figure 7).

Figure 7. PT.KBN Cakung provides transportation means inside the industrial areas to bring the workers to the industry buildings(Source: KBN Cakung)

According to the KBN Cakung management, the flood was caused by the development of toll road that caused the clogging of water channel around the area, and in addition to that, the drainage system (Cakung Drain) effectiveness was also reduced by squatter settlements in the area.

KBN Cakung recommends some solution to overcome the flood inundation, i.e.:

- Normalization of Cakung river, addition of water channel and water gates
- Bypass channel to the Cakung Drain
- Integrated flood management
- Development of dormitory for workers
- Address the squatter settlement problem

Industry Tenants

There were two industries in Jakarta and two industries in Bekasi, i.e. PT. KAHO and PT. IFI (KBN Cakung industrial park) in Jakarta, and PT. Bumimulia Indah Lestari (Jababeka industrial park) and PT. Seiwa Indonesia (MM2100 industrial park) in Bekasi that were visited during the survey

The flood did not inundate the industrial buildings, except in PT. IFI in KBN Cakung area. The height of inundated water inside PT. IFI is about 10-15 cm, meanwhile the inundation on the street outside the factory is about 20 cm.

The production process both in PT. KAHO and PT. IFI in KBN Cakung area was stopped for two days (on Friday,7th and Monday,10th) due to the flood inundation and the traffic jam in the access to the industrial area caused by the inundation. The wages for the workers were still paid, but they have to change their working day later. However, male workers came to the factory of PT. KAHO on Monday (10th February) to anticipate if the flood comes again, as was the case in 2007. Meanwhile, the male worker at PT. IFI came to the factory on Monday (10 February) to clean the buildings after flood inundated them.

Despite the disruption of the production process due to the flood which hampered the workers to come to the factory, the assets of the industry were not damaged as, learning from their experiences in 2002 and 2007 flood, they have put their valuable assets, such as machines, raw materials, and products, in the higher place. They also have water pump to pump out the water if there is flood in the factory building.

The industry in Bekasi was not directly impacted by flood. The internal production process in PT. Bumimulia Indah Lestari (in Jababeka industrial park) was not disrupted, even though 70% of workers cannot come to the factories for 1 to 2 days because their houses and the access to the factories were inundated. It is different in PT. Seiwa Indonesia (in MM2100 industrial park), where 20% of workers of PT. Seiwa Indonesia cannot come to the factory for about 1 to 5 days for the same reason with the workers before. The absence of the workers, especially machine operators has caused theinternal production process disruption for about one week.

The indirect impact to the industries in Bekasi is similar with the industries in Jakarta, i.e. the delayed material and products logistics, because the infrastructure and the access, such as the road to the port, the road to the main gate of industrial areas, etc., were inundated. This will cause losses to the industry. In addition to this, the absence of industrial workers will also cause the loss to the industry, as both industries in Bekasi used overtime policy for the workers who work more than their usual shift, and they have to pay overtime fee for the workers who have to work more to cover for those who could not come due to the flood.. Therefore, the industries may have to pay more expenses and may suffer additional loss.

Industrial Workers

There were three workers interviewed in Jakarta and Bekasi. The complete summaries of interview result are provided in the Annex 1 for Jakarta and Annex 2 for Bekasi.

Based on the interview, we understand that the workers did not go to the factory because their houses were inundated and their access to the factory was disrupted.

The height of inundation in their houses was varying from 5 cm to 1-2 meters for 2 to 4 days. Their properties were damaged and they have to clean the house. Because of this situation, they were allowed to not to come to the factory as long as they have recommendation letter from the head of neighborhood unit (Ketua RT). The average days they did not go to the factory were about 1 to 2 days without wage cut.

Figure 8 shows the interview process with the industrial workers.

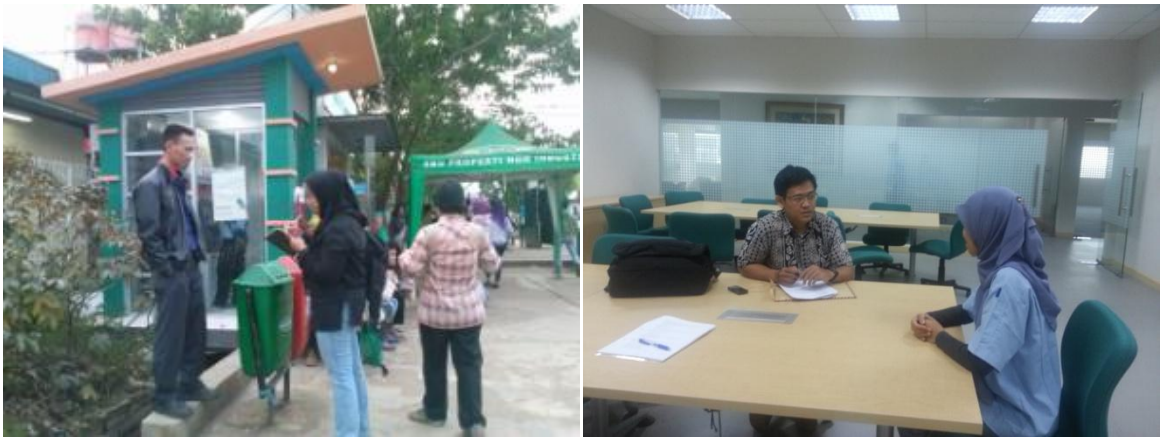


Figure 8. Interview with the Industrial Workers

Cargo Company

Two freight forwarder companies were interviewed to gather information on the impact of flood to their business, i.e. PT. Lookman Djaja and PT. Hokkindo Jaya Mandiri. The complete summary of interview result is provided in Annex 2.

From both cargo companies, only one company was impacted by flood, i.e. PT. Lookman Djaja. The access from Jakarta was inundated by flood and it caused disturbance to the delivery time which took longer than normal condition. Direct impact also felt on the vehicle, tires easily damaged and sometimes the engine stalled due to the flood. To respond to this problem, PT. Lookman Djaja had to replace the damaged parts and engine.

Meanwhile, PT. Hokkindo Jaya Mandiri is not impacted by flood both directly and indirectly because the access to the industrial area for the company was not inundated by flood.

5.3 Impact to the Utilities

Communication

2014 Jakarta Flood caused telecommunication utility disruption, mostly in West Jakarta, albeit it was less severe compared to the impact of 2002 and 2007 Flood, where the telecommunication utility was totally out of service, and the head office of PT. Telkom was inundated.

The disturbance of telecommunication utility was caused by the high humidity (due to rain) at the distribution points and connections, and this caused connection interference. Besides, the battery in the cable houses can have short-circuit and run out of power, when the power supply from PLN is disrupted.

PT. Telkom as one of telecommunication utility operator has preparedness measures to face the flood disaster, i.e. they put cable house in the safer place, they provide standby generators, and they put the switch, generator and battery in second floor in the head office where that place is safer from flood inundation. They also have Telkom Care during emergency situation. However, up to now they do not have any collaboration with the industrial parks manager .

Electricity

Electricity operators that were interviewed are PLN, Bekasi Power and Cikarang Listrindo. The last two electricity operators were private sector entities supplying electrical power to the industrial parks.

PT. PLN

During flood inundation, PT. PLN shut the power down to avoid the danger of electric shock. The electric utility was usually shut down for maximum two days. The electricity can be turned on if the situation is totally safe. The damages in electric utility were mostly on substation, cable, and broken connection.

In industrial areas, PT. PLN has built electrical substation in two methods. First, the substation is put in the basement, and second, the substation is put on the ground surface. The substation in the basement is more vulnerable towards flood disaster, so PT. PLN has moved some of the substation to the safer place.

The substation that is located on the ground surface is still lower than flood level. It is also lower than the industrial floor level, which have been raised above the flood level. PT. PLN has raised one substation building to mitigate the flood impact (Figure 9), but some of them are still not raised yet. The substations which are not raised yet are very vulnerable towards flood disaster. If the substation is inundated, the electric power can be shut down.

Figure 9. Substation building that has been raised (ASTRA Daihatsu Jl. Danau Sunter Utara)

PT. PLN has some standard procedures to cope with flood disaster. It has flood hazard map, which can be used as a reference to prioritize the electric substation to be handled. The management of electric substation in the flood prone area includes reducing the damage risk to the components in the substation and reducing the service disruption to the costumers. Asa mitigation effort, PT. PLN put the substation in the safer place that is higher than flood level. New substation was built by raising the flood to secure the cubical and switch from the inundation. PT. PLN also has motorcycles and 2 unit-cars that can be used by Emergency Response Unit during emergency situation.

Cikarang Listrindo

Cikarang Listrindo is a private electricity operator in Indonesia that was established in 1997. It is located in Jababeka industrial park, but it provides also electric supply for other industrial parks, such as MM2100, beside for Jababeka industrial park. The location of Cikarang Listrindo is not prone to flood inundation. Cikarang Listrindo guarantees the electric supply outage, otherwise, it will pay for the loss due to its fault. Figure 10 shows the area of Cikarang Listrindo.

Figure 10. Cikarang Listrindo

Bekasi Power

PT. Bekasi Power is under PT. Jababeka, Tbk. authority. It has completed the testing and commissioning of electric supply on January 5, 2013. It supplies the electricity needs to the PT. PLN. The location of PT. Bekasi Power is not prone to flood disaster, so it still can supply the electricity, even though the surrounding area is flooded.

5.4 Impact to the Infrastructure

Road

Flood disaster affects the roads, both express ways and roads. Express way is under PT. Jasa Marga responsibility, meanwhile, roads areunder public work agency responsibility. This sub-section will provide the impact of flood disaster to both express way (toll road) and other roads.

Express way

According to PT. Jasa Marga, generally, the express ways (toll roads)are not damaged by the flood inundation because they have been designed for 100 years flood. However, incidental inundation on toll roads occurs, caused by the failure of the adjacent drainage, such as the Cipinang River, which is spoiled by the development of squatter settlements on its river bank. The worst flood inundation occurred in 2007 that caused the closing of toll road to Cengkareng (Soekarno Hatta) airport.

PT. Jasa Marga does not have any specific management unit to cope with the flood disaster. If there is traffic problem caused by a disaster, PT. Jasa Marga will manage it through operational units in every branch office. These operational units do not only maintain traffic problem during disaster, but also maintain all traffic problems. Nonetheless, PT. Jasa Marga has prepared water pumps as emergency measures during the heavy rain fall season, i.e. January to February.

PT. Jasa Marga also collaborates with the local disaster management agency (BPBD) of DKI Jakarta, i.e. for evacuation, emergency posts, health posts, and pumps on several segments of toll road, for instance on Cengkareng Airport toll road..

Road

The Public Work Agency which is responsible for the road network (outside of toll roads) mentioned that the characteristics of flood in 2014 were different from that in 2007. In 2007, the flood inundation was much higher than that in 2014, but the duration was shorter than the one in 2014, meaning that the 2014 flood was not so high, but it took a longer duration compared to the previous flood inundations..

The floods caused road damage (potholes) in 6.300 points, the worst is in Daan Mogot Street, West and North Jakarta. The depth of the hole is about 40 cm.

Public Work Agency has already had a preparedness system to face flood disaster, such as early warning system in each area, standard operational procedure for flood emergency response, and 24 hours flood emergency posts. Potholes in roads are repaired by hot mix or cold mix asphalt within a maximum of 2X24 hours after damage identification.

The community can ask or report the situation and condition of flood in the flood emergency posts and the Jakarta Command Center. In the Command Center, community can also report the situation through online social media, such as twitter. There are also CCTV monitors in some road segments.

Public Work Agency at DKI Jakarta Province level has collaborated with KBN Cakung industrial park to maintain the roads in the industrial park in September to October 2013.

Port

The flood that occurred in January and February 2014 did not directly affect the Tanjung Priok (PT. PELINDO II) area, because the area was not inundated[2]. The indirect impact to the area is the delayed loading and unloading of cargo goods because the route to the port is inundated and caused the worst traffic jamThe container trucks were stuck on the traffic jam. Figure 11 shows the logistic route to and from Tanjung Priok Port.

[2]Tanjung Priok was not directly affected by the 2014 Flood, but it was inundated during the 2007 flood disaster. Tens of containers that were put on the storage area were inundated. The inundation height at that time was about 50 to 70 cm.

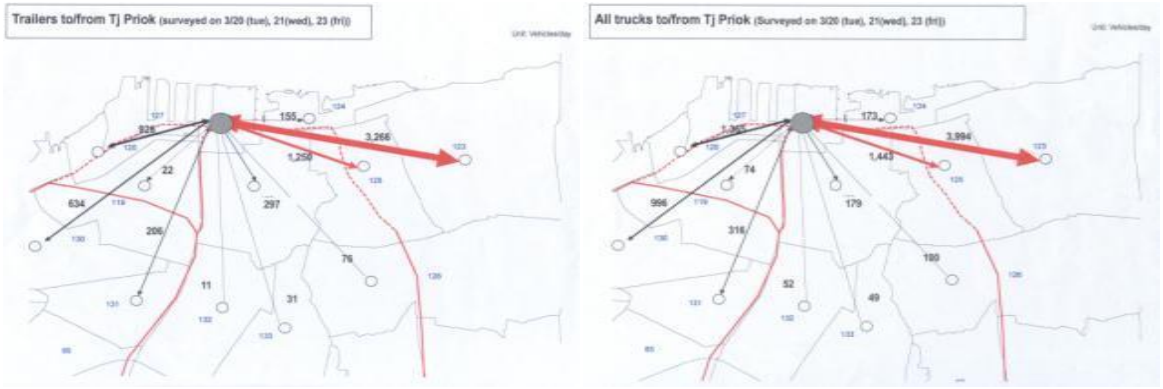


Figure 11. Logistic Route to and from Tanjung Priok Port (Source: KBN Cakung)

To overcome such situation, which was beyond PT. Pelindo capability to handle, there are some policies adopted by PT. Pelindo, such as:

- Prioritize the loading and unloading of goods that should be delivered immediately (those which are delayed for more than one day)
- Joint Slot Policy, i.e. if the goods are not loaded for one reason, they can join other ships to the same POD (Port of Destination).

The indirect impact caused by flood to the port operation process was the absence of workers. PT. Pelindo has more or less 900 permanent workers (for Tanjung Priok branch). 10-15% of the workers were affected by flood. Their houses were inundated and their access to the port was jammed due to flood inundation. So, most of them were not able to come to work from Friday to Monday (17 to 20 February 2014), but it did not affect the work productivity.

To overcome this problem, PT. PELINDO provided rubber boat and special transportation for the workers that were affected by the flood, to go to the work place.

PT.PELINDO II (IPC) is also planning the development of Chain of IPC Care to handle emergency situation in 12 ports in Indonesia. Specific to PT. PELINDO II Tanjung Priok, a unit for internal obedience control, emergency response and Port Facility Security Officer was established in the middle of 2012, with the support from BNPB (National Disaster Management Agency) and BASARNAS (National Search and Rescue Agency). During flood emergency situation, the unit coordinates with the Mayor's office, Police and the Public Work Department for improving access and goods traffic flow.

VI. ANNEXES

1. Primary Survey Result: Jakarta
2. Primary Survey Result: Bekasi
3. 2014 Jakarta Flood Maps
4. Disaster Maps of Bekasi District

VII. REFERENCESFOR SECONDARY INFORMATION

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