4.3.6 Identified Challenges on Floods

4.3.6.1 Overall Issues related to Four Fields in SFDRR

Based on the current situation on floods in Indonesia as identified in the previous section, the following eight (8) issues were revealed under the four (4) fields (four priorities for action) on "understanding disaster risk", "disaster risk governance", "investment in DRR" and "disaster preparedness enhancement and Build Back Better (BBB)"endorsed by the United Nations in SFDRR, 2015.

Table 4-41 Overall Issues on Floods under Four Fields in SFDRR

Field in SFDRR	Issues Revealed
Disaster information (Understanding Disaster Risknajd Share Information)	a. Increase of disaster risk in river basin b. Insufficient maintenance for FFEWS and visual monitoring on flood information during flood
Governance (Strengthen Governance for Disaster Risk Management)	c. Inadequate collaboration and correspondence among ministries and agencies that are in charge of flood management d. Disaster mitigation measures are project-oriented, lacking the viewpoint of disaster prevention. e. Insufficient DRR activities in communities and local governmental agencies
Disaster Risk Reduction (DRR Investment for Resilience)	f. Priority is given on water resources development, insufficient progress is being made for the flood control project. g. Insufficient investment in flood DRR
Disaster Preparedness and BBB	h. Response and preparation for disasters beyond design scale (excess disaster) are not sufficient.

The above issues in Table 4-41are explained as follows.

(1) Disaster information (Understand Disaster Risk and Share Information

«Challenge1» Increase of disaster risk in river basin

In the urbanization areas, due to changes in land use, forest areas have decreased and water-holding capacity by forest has also decreased, so the arrival time of the flood becomes smaller and the runoff volume also tends to increase. Furthermore, in urban areas, the area of asphalt pavement has increased, and rainwater flows into the drainage channel in a short period of time, so that it is impossible to sufficiently drain the water in the drainage channel. As the forest area decreases, the yield of soil and sand increases, causing riverbed to rise due to sediment discharge from the basin which lead to a remarkable shortage of flow capacity in the river. This increased the disaster risks of the river basin.

«Challenge2» Inadequate maintenance for FEWS and visual monitoring on flood information during flood

The Flood Early Warning System (FEWS) is introduced in two rivers namely; the Bengawan Solo River and the Citarum River. Dissemination on flood information system is done free of charge as smartphone applications.

In the project implemented areas, there are situations where the underlying hydrological monitoring facilities are not properly maintained and managed, and even if monitoring stopped process of identifying the cause of the problem is quite weak. There are small number of censors in “Tech 4Water” system by PUPR. Regarding the flood forecasting and warning system introduced with the JICA loans, as far as confirmed by BWS Sumatera I in Aceh, it is not operating at the present time. The causes of the lack of operation resulted in difficulties in maintenance of rain gauges and river water level recorders. Although the system could be maintained for 2 - 3 years after the commencement of the project but the budgets for updating the equipment could not be secured, and therefore the system could not be operated.

Regarding flood monitoring, water level information is the most fundamental and important aspect of monitoring. Monitoring by automatic water level recorder is still many, real time water level monitoring is limited in Indonesia. Therefore, in many cases, it is not possible to obtain real-time water level information at the necessary reference points at the time of flood. In the telemetered monitoring station, examples are reported in which water is submerged during large scale floods and the function is lost. As these causes, (1) the area to which the office is responsible is very wide, it takes much time and expense to travel by car, so it is difficult to maintain and manage with a limited budget, (2) difficulty in the use of electronic equipment in events of failure due to maintenance difficulty., So it is more appropriate to manage with "analog equipment" which can be easier to maintained even by office staff.

(2) Governance (Strengthen Governance for Disaster Risk Management)

«Challenge3» Inadequate collaboration and correspondence among ministries and agencies that are in charge of flood management

Collaboration and response activities among government agencies such as BNPB, PUPR, BPBD, BBWS and BMKG that are responsible for flood management during flood are not sufficient. Regarding floods, PUPR monitors the river water level and transmits the information to BNPB at central level and BPBD at province and district level, but the delegation of role is not clear and there is confusion among stakeholders including the communities.

The preliminary preparedness including structural measures and nonstructural measures also shows lack of cooperation, for example, the results of risk management and risk assessment in BNPB are not reflected in long-term river improvement plan in PUPR

«Challenge4» Disaster response activities are prioritized post-flood activities, and the viewpoint of disaster prevention is lacking.

Disaster management is prioritized on post-flood measures such as emergency response and rehabilitation in Indonesia's activities, and it is not prioritized preparedness activities. From the viewpoint of disaster prevention, priority should be given on embankment construction, establishment of basin storage facilities, construction of dams and retarding basins, preparation of hazard maps, flood drills, and installation of forecasting and warning systems.

«Challenge5» Insufficient DRR activities in communities and local governmental agencies

Although there is successful example on community based flood mitigation at Klaten in the upper reach of the Solo River, community based disaster mitigation activities in Indonesia are inadequate generally because local agencies and communities for disaster countermeasures are not adequately well-trained. Regional mitigation activities related to flood information transmission are not sufficient even in rivers where the flood forecasting and warning system was introduced.

(3) Disaster Risk Reduction (DRR Investment for Resilience)

«Challenge6» Development of water resources facilities is given priority, construction of flood-responsive facilities has low priority

According to the current presidential policy, priority projects at the Directorate General of Water Resources (DGWR) are concentrated in water resources development, and a lot of budget is allocated to dam projects related to these. The number of dams completed by 2015 was 15 dams (source from PUPR), the number of dams started in 2015 was 13 dams, the number of dams started in 2016 was 8 dams, and the number of dams was 9 dams started in 2017. In 2018, the construction of 11 dams was planned. In this way, emphasis was

placed on water resource development, and not on situations where budget related to structural measures such as embankment construction to reduce flood risk can be sufficiently secured.

«Challenge7» Insufficient investment in flood DRR

Flood is the most severe disaster with the large number of death tolls, disaster victims and affected areas, but the budget allocation is small and falls short of the required amount for preparation of disaster risk. The World Bank (WB) supports Dam Operational Improvement and Jakarta Urgent Flood Protection, and the Asian Development Bank (ADB) supports BBWS 3Ci's in Banten Province for flood mitigation Cidanau - Ciunjung - Cidurian River Basin Territory (WS), but the number of projects/programs is not many. Further investment is needed based on the concern of increased risk on flood disasters.

(4) Disaster Preparedness and BBB

«Challenge8» Response and preparation for disasters beyond design scale (excess disaster) are not sufficient.

Emergency rehabilitation measures after disasters are designed and focused on preventing similar scale occurrence of disaster. Therefore, there seems to be no project adopting the design scale exceeding the scale of occurred disaster or designated scale based on the design guidelines of PUPR.

However, due to climate change and the progress of urbanization, the occurrences of floods exceeding the designated scale of probability are also expected in the future. Measures such as structures (river planning), non-structural measures including warning and evacuation plans, installation of evacuation facilities, construction of disaster information transmission system, implementation of community based evacuation drills and hazard mapping to deal with these are not sufficiently taken in Indonesia.

4.3.6.2 Identified Challenges on Localities

«Challenge1» Aceh City, Aceh Province

Regarding the floodway of the Krueng Aceh River which is carried out with JICA loans, sedimentation has progressed, and survey analysis and design including cost estimate was carried out. According to the analysis result "A Study on Sediment Distribution Pattern of Krueng Aceh River Floodway", in the case of the 5-year design discharge (854 m3/sec), due to the river shape near the estuary and the setting of Jetty, sedimentations on the right bank side near the estuary cannot flush to the sea. For the sedimentation in the floodway, a dredging project is scheduled. The dredging volume is t 1.6 million cubic meters, and the project cost is estimated at 250 billion Rupiah.

The current situation and issues in flood risk reduction in Aceh Province are summarized as follows.

a. The sedimentation in the floodway of the Krueng Ace (River) constructed with the JICA loan is progressing, and flow capacity has decreased and is insufficient. BWS Sumatera I are planning the dredging project for this countermeasure.
b. The flood forecasting and warning system introduced in the above loan is currently not in operation. The monitoring of hydrological information such as rainfall, river water level is carried out by BWS Sumatera I. At the time of flooding, flood information is provided to related organizations by monitoring of river water level. There are few observation stations in real time, and it is necessary to expand in the future.
c. In year 2000, a flood with discharge 2,000m3/sec exceeding the planned scale (1,350m3/s) occurred in the Krueng Aceh River, causing major damages. It is necessary to reexamine the present design scale (1/5).
d. Three regencies such as Aceh Timur, Langsa and Aceh Tamiang were selected as Regency to prioritize Flood Damage Response (ZPPBA in Indonesian) in Aceh Province. Countermeasures for floods are planned and designed in these selected rivers.

«Challenge2» Manado City, North Sulawesi Province

Regarding the current situation and issue on flood risk reduction in and around Manado City are summarized as follows.

a. Large scaled flood occurred in January 2014 and made severe damages with damage amount of Rp 1,440 Billion to the regional economy. BNPB dispatched headquarters staff, and in command of the teams, estimated the damage amount and plan, and designed reconstruction and recovery plan.
b. The river normalization plan of the main river Tondano River is implemented with the JICA loan in the downstream section. The design scale of the plan is 1/5 (Q = 650 m3/sec). As of May 2018, the construction works are in progress. In addition, the master plan and feasibility study (design scale 1/25, Tondano River Q = 1,220 m3/sec) for reducing flood damage in the Manado area were implemented with the JICA loans in 2016 in five rivers.
c. Possible disaster area by flood is already prepared, and the risks in the downstream area in the river and in the vicinity of Lake Tondano are high. The areas where landslides occur are uniformly situated in the whole basin.
d. Housing complex (Pandu area, 10 ha, 2,054 houses) for residents who resettled in the river project was prepared and relocation was made. In the case of river projects in urban areas, the time and cost to prepare for relocation are high.
e. With regard to flood risk, although the risk is reduced in the current design scale with 1/5, as the design scale is not so high for disaster reduction, further projects with increasing design scale such as 1/25 are necessary.
f. With regard to BPBD Sulawesi, in response to flood in 2014, enough equipment and facilities are prepared.
g. With regard to BWS Sulawesi I, monitoring system on hydrological information is not sufficient, monitoring of rainfall and river water level is carried out by assistance of equipment supplied by JICA.
h. The plan concerning river projects is implemented on the basis of the past disaster, but the budgetary limitation is also large, so that only small scale projects can be implemented as projects.

«Challenge3» Surakarta City, Central Java Province

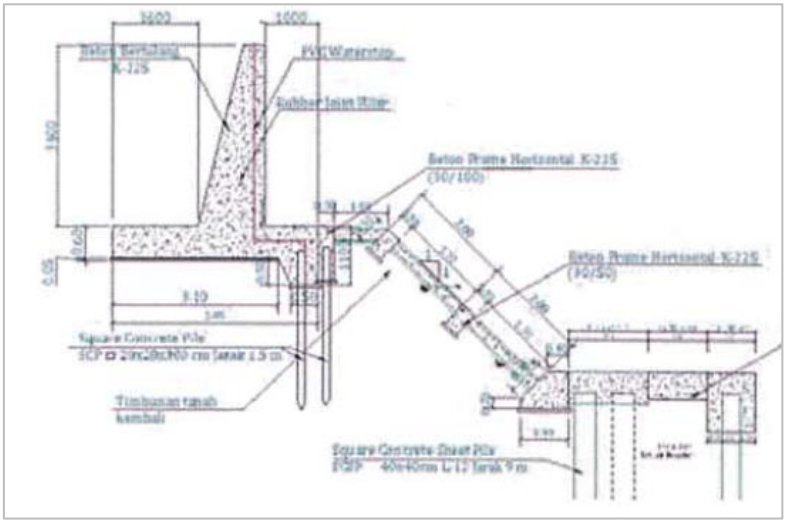
Regarding the current situation, issues on flood risk reduction in Surakarta City are summarized as follows.

a. Since the areas in the Kali Pepe (River) affected by floods from 2013 to 2016, BBWS Bengawan Solo decided to implement improvement works. For river improvement works, weirs for intake water were constructed and pumps for inland water drainage were installed at eight sites. (It seems there was a generous budgetary assistance because it was located at the hometown of the incumbent president Joco Widodo's)
b. For the river improvement (normalization) works of Kali Pepe (River), community leaders took the initiative to dialogue with the residents, although settlements existed in the upstream part of the weir and difficulties in relocation negotiations were expected. Regarding the relocation candidate sites, the city authorities also proposed to negotiate with residents not only in the city (Kota Surakarta), but also on the conditions that they would accept the relocation to the outside of the city as well as on the condition that no sealing was set for the acquisition price. Furthermore, even if they did not accept the proposed conditions, city authorities proposed acceptance by construction of the apartments. In the case of the river project, there is also a success example as described above under the condition that acquisition of land does not progress easily due to the opposition by residents. According to BPBD staffs, the recognition that the leadership of staff and local leaders was important

Source: Penaganan Banjir Kota Surakarta (Solo 2016-2018, BBWS Bengawan Solo)

Figure 4-77 Target Areas for Relocation by River Works in Kali Pepe

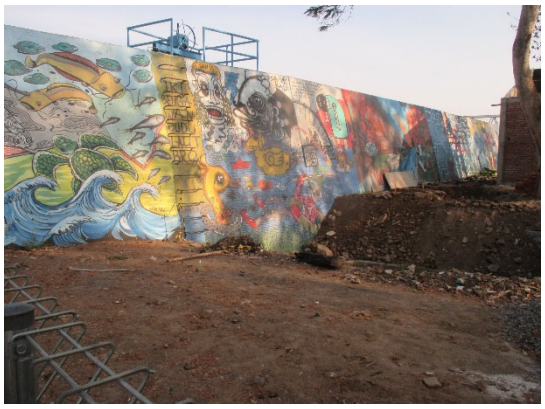
c. Upon the improvement works in Bengawan Solo, levee construction with many parapet structures is being carried out in relation to space of margin with existing infrastructures. In the Government Ordinance for Structural Standard for River Facilities of Japan, there are restrictive conditions such as restriction of heights and limitations on its application conditions to rivers flowing in urban areas, but in Indonesia the applicable conditions are considerably loose compared with Japan. In the case shown in the pictures (figures) above and the following design example in the Bengawan Solo, there are examples adopting from 3m to 4m in height. As measures to prevent falling due to earthquakes and overflows, fixed countermeasures such as anchors are designed in Japan, but as for the case of Indonesia, consideration has not been made as far as design examples are concerned. In the future, further examination should be made.



Source: Penaganan Banjir Kota Surakarta (Solo 2016-2018, BBWS Bengawan Solo)

Figure 4-78 Typical Cross Section for Parapet Facility in Bengawan Sola

d. In Manado and Aceh City which conducted the survey, BPBD was established in accordance with the establishment of BNPB based on the enforcement of disaster prevention law, but in Solo case it was founded in 2013 and the actual activities are commenced in 2014. Depending on new establishments, there is lack of both personnel and budget. As of 2018, BPBD Solo are constructing a new office and plans to increase personnel and budget accordingly. Formulation of SOP and disaster management plan (DM plan) as well as creation of hazard maps are made.



Parapet at Jurug (Landside, B. Solo)

Parapet at Jurug (River side, B. Solo)

Source: The Survey Team (13 September, 2018)

Figure 4-79 Parapet Facilities in Bengawan Solo

4.3.7 Identified Challenges on Landslides

Based on the current situations on landslides identified in the previous section, the following six (6) issues were revealed under the four (4) fields endorsed by the United Nations in SFDRR, 2015.

Table 4-42 Overall Issues on Landslides under Four Fields in SFDRR

Fields in SFDRR	Issues Revealed
Disaster information (Understanding Disaster Risknajd Share Information)	a. Many houses remain in the landslide hazard area. b. Insufficient maintenance for LEWS
Governance (Strengthen Governance for Disaster Risk Management)	c. Susceptibility map is not utilized in land use planning and development plan. d. Disaster mitigation education on landslide disasters is not implemented in schools.
Disaster Risk Reduction (DRR Investment for Resilience)	e. Insufficient investment on landslide disasters
Disaster Preparedness and BBB	f. Insufficient preparedness for frequent landslide disasters

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(1) Disaster information (Understand Disaster Risk and Share Information

«Challenge1» Many houses remain in the landslide hazard area.

In Indonesia, there are many cases where forest areas are developed for vegetables and tobacco cultivation. As the cultivated land area expands, forest area decreases. In the cultivated land, rainfall easily penetrates into the underground and soil moisture is saturated, causing landslides. These areas are designated as landslide hazard zones. The report by Asian Disaster Reduction Center (ADRC) reveals that there are still many houses and cultivated areas in the "high risk area" to “medium risk area” indicated in the susceptiblity map. Under such conditions, as the residents' activities are being carried out, the landslide disaster does not decrease easily.

«Challenge2» Insufficient maintenance for LEWS

According to BNPB's report (Emergency Management at Banjarnegara Landslide, APEC Emergency Preparedness Working Group Meetings, Philippine 2015), the Landslide Early Warning System (LEWS) was set up in Banjarnagara, Bogor and Karanganyar for monitoring the landslide movement. There are many cases that the system is not functioning due to lack of financial support, not being incorporated into the management system in the local community and periodic inspection activities. In the field survey conducted by the JICA Team in Manado, devices installed by UGM (University of Gajah Mada) are left without being maintained.

Installation of Wire Censor for Landslide

Battery for Wire Censor and Data Transfer

Source: The JICA Survey Team

Figure 4-80 Landslide Warning System Installed by UGM in Manado

Under the conditions of perfect monitoring control, there is good practice of successful warning issued in Central Java Province as mentioned above, but in many cases, many of the systems are in place under insufficient maintenance after installation. Since the landslide early warning system (LEWS) is the only means to prevent the occurrence of human damages caused by landslides, it is needed to make it function as an early warning system by incorporating the maintenance and operation system in community based disaster management.

(2) Governance (Strengthen Governance for Disaster Risk Management)

«Challenge3» Susceptibility Map is not utilized in land use planning and regional development plan

According to PVBGM, the hazard map and the susceptibility map on landslides are distributed to many local governments, and it is supposed that sediment-related disaster mitigation measures are implemented based on these. However, as mentioned above, there are houses in hazard areas in the susceptibility map, and activities of residents are being carried out in cultivated land. In addition, there are actual conditions that these maps are not utilized in the land use plan in the spatial planning and the regional development plan. These situations make the cause more severe.

«Challenge4» Disaster mitigation education on landslide disasters is not implemented in schools.

Disaster mitigation education in the community is being implemented as part of the relief activities of landslide disasters in Indonesia. On the other hand, PVBGM points out that disaster mitigation education is not carried out at school. It is necessary to incorporate disaster management on landslides into the curriculum of school education.

(3) Disaster Risk Reduction (DRR Investment for Resilience)

«Challenge5» Insufficient investment on landslide disasters

The characteristic of landslide damage is that although the affected area is small, the damage when it happens is severe. It is a characteristic of landslide damage that the death toll is high. As measures to mitigate landslide disasters in Indonesia, structural measures such as piling works, anchor works, retaining wall works and groundwater lowering works are not adopted, but as described above, non-structural measures such as creating hazard maps, building early warning systems and awareness of disaster mitigation for residents are main measures. In the future, based on the survey result on disaster risk susceptibility for landslide in densely populated areas, investment for structural measures is also needed.

(4) Disaster Preparedness and BBB

«Challenge6» Insufficient preparedness for frequent landslide disasters

The occurrence of landslide which greatly exceeds the scale of the previous disasters due to change in land use and devastation of forests as well as progress of urbanization and climate change is expected in the future. Large sediment disasters assumed in connection with landslide disasters include the formation of river natural dam due to the occurrence of landslides occurred in Way Ela River in 2013 and the occurrence of mudflow disasters caused by slope failures in Langkat District in 2003 in North Sumatra Province, and "Banjir Bandang" (Flash Flood) disaster occurred in Jembel District, Eastern Java Province in 2006.

Since these large collapses are phenomenon such as collapse or the surface slip of large soil and rocks, there are forerunning phenomenon such as cracks, muddy water spills, abnormal rise of well water level and ground vibration. In addition, landslide damage frequently occurs repeatedly in areas where topography and geological characteristics resemble. For example, in Banjaneraga District in Central Java, similar landslide disasters were occurred in Sijuruk in 2006 with death toll of 240 people and in Jemblug in 2014 with death toll of 93 people. These are adjacent watersheds, with similar topography, geological characteristics and land use.

After the disaster, although the rebuilding of infrastructures, construction of houses and restoration of public civil facilities are carried out under the budget of the local government, there are many cases that preparedness for disaster are not implemented. Therefore, preparedness against the upcoming disaster is necessary in areas that have affected severe damages in the past. In particular, as preparedness measures, an evacuation center to minimize the occurrence of deaths and develop landslide early warning system (LEWS) to predict occurrence are required. Similarly, regarding areas and villages that are judged to be dangerous for landslide, relocation should also be taken.

4.4 Coastal Disasters (Storm surge and Coastal Erosion)

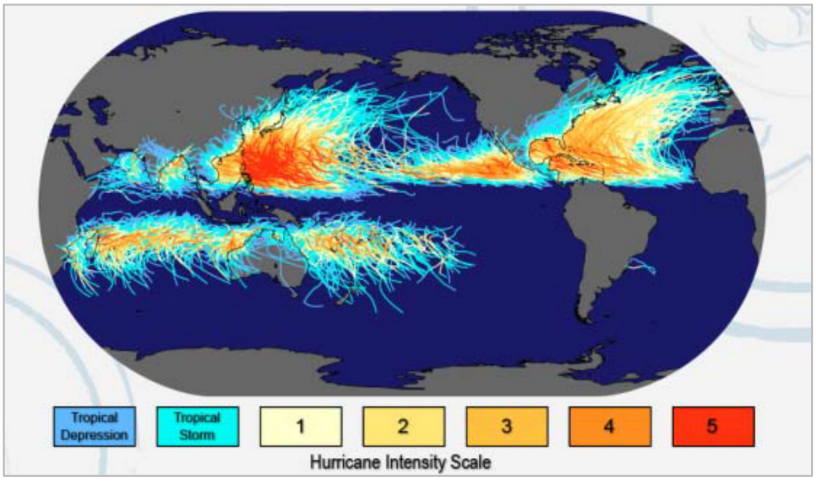
4.4.1 Characteristics of Recent Storm Surge and Coastal Erosion

4.4.1.1 Occurrence of Storm surge

Storm surge is caused by typhoon or cyclone into which tropical low pressure area developed. Typhoon is generated above the sea of which latitude isabout 10 to 20 degree north. After generation, it moves towards northwest while developing and turns to northeast direction. Cyclone, which is generated at 10 to 20 degree south, does not develop as much as typhoon. Cyclone moves towards southwest while developing and then turns to southeast.

Indonesia is located between 10 degree north and 10 degree south, so both typhoon and cyclone do not pass as shown in Figure 4-81Figure 4-81 Trace of Typhoon and Cyclone Occurrence (1945-2006)In exception, cyclones occurred in 1973 and 2009 which were generated around 5 degree south caused tremendous damages in Indonesia. Frequency of storm surge due to these tropical low pressures is low. However, the generation and development of typhoon and cyclone cause impacts from remote area by climate fluctuation. This causes torrential rainfall and/or wind wave at coastal areas. [126]

[126] BMKG HP (http://web.meteo.bmkg.go.id/en/component/content/category/36-tropical-cyclone)



Source: United States Environmental Protection Agency[127]

Figure 4-81 Trace of Typhoon and Cyclone Occurrence (1945-2006)

4.4.1.2 Coastal Erosion

Indonesia consists of a total of 17,508 islands including the main islands such as Java, Sumatera, Kalimantan, Sulawesi and Papua islands. Total length of coastal lines isabout 81,000 km, corresponding to the 3rd longest in the world. (The total length of coastal lines in Japan is 33,000km, corresponding to the 6th longest.). Coastal erosion was firstly observed in the northern coast of Java Island which was caused by landuse change from mangrove forest to prawn farm. Erosion had been progressing in this area due to lack of governmental management/control. Such erosion has also occurred in Lampun, Northeast Sumatera, Kalimantan, West Sumatera (Padang), Nusa Tenggara, Papua, South Sulawesi and Bali. According to the data from Ministry of Public Works and Housing, coastal erosion has occurred at 30,000 km of coastal lines which is equivalent to 40% of the total length of coastal line in the nation (Ministry of Public Works and Housing, September,2007). These coastal erosions has been caused by the following reasons. (Gegar Prasetya) [128][129]

- Waves and Winds
- Reduction of sediment supply from rivers due to dam construction and/or river channel improvement works
- Disturbance of sediment movement along coast due to construction of ports/piers
- Sand and/or coral mining, and
- Degradation of wave power dispersion effect by deforestation of coastal vegetation

4.4.2 Efforts by the Government of Indonesia

4.4.2.1 Storm Surge

Countermeasures against storm surge is merely conducted in Indonesia except the area suffering land subsidence such as Jakarta due to low frequency as mentioned above.

4.4.2.2 Coastal Erosion

The Sub-directorate of Coastal, Directorate of River and Coastal, DGWR, PUPR is responsible for countermeasures against coastal erosion.
The structural measures taken by the government consists of the construction of coastal dike, breakwater,

[127] United States Environmental Protection Agency | US EPA, Climate Change - A Student's Guide to Global Climate Change | US EPA, All tropical storms 1945-2006
[128] Gegar Prasetya, The role of coastal forests and trees inprotecting against coastal erosion, Regional Technical Workshop, 28-31 August 2006, Khaolak, Thailand Coastal Protection in the aftermath of the Indian Ocean tsunami: What role of coastal forest and trees?
[129] Gegar Prasetya, CHAPTER 4 PROTECTION FROM COASTAL EROSION, Thematic paper: The role of coastal forests and trees in protecting against coastal erosion,FAO, 2007

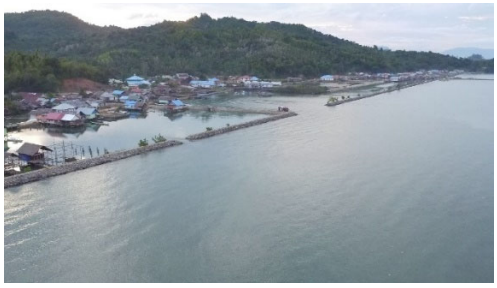
revetment, jetty, T-shape jetty, offshore breakwater and so on. Materials used are bolder, concrete, concrete block and so son. As a structure, revetment is dominant because of its cost and flexibility of design. It is noted that design wave is smaller than that applied in Japan because most of the coastal line does not face the open ocean but surrounded by other islands. As the results, the structure of protection woks is smaller and cheaper than in Japan. (J. Manu et al., 2011)[130]. For examination of protected areas, various aspects shall be considered such as cost, environment, social aspects (traditional villages, mosques etc.) and so on, however, economically important area is prioritized due to cost constrain.[131]. Coastal protection works consisting construction of jetties and beach nourishment had been conducted during 1996 and 2004 funded by Japanese ODA loan as protection of tourist attractions. Importance of coastal protection was recognized when Tsunami disaster happened in Sumatera Island in 2004, and budget for coastal protection works has increased since then.

As a non-structural measure, Ministry of Foretry and Environment conducts afforestation in the coastal areas (Risk, 2016) [132]

1) Plantation of Mangrove Trees
2) Maintenance of Existing Mangrove and Other Forests
3) Development of Coastal Forest

An NGO named Wetland International conducts a hybrid coastal protection works consisting mangrove and wood structures as shown below. [133]

Source: PUPR



Source: PUPR

Figure 4-82 Breakwater with cobble stones Pantai Tanjun Bunga, Kabupaten Konawe Utara

Figure 4-83 Concrete Steps Revetment[134] Desa TukadMungga, Bali North

Figure 4-84 Concret Blocks Revetment[135] Desa TukadMungga, Bali North

130 Julianti Manu・Julianti Manu, Ryuichiro Nishi, Kazunori Hosoya Kazunri: Typical Shore Protection Structures in Indonesia, Journal of Ocean Development, Vol. 27, 2011

131 BMKG HP （http://web.meteo.bmkg.go.id/en/component/content/category/36-tropical-cyclone）

132 BNPB, RBI（Risk Bencana Indonesia）, Dec. 2016

133 Gegar Prasetya, *The role of coastal forests and trees inprotecting against coastal erosion,* Regional Technical Workshop, 28-31 August 2006, Khaolak, Thailand Coastal Protection in the aftermath of the Indian Ocean tsunami: What role of coastal forest and trees?

134 Huda Bachtiar, Coastal protection and beach nourishment in Indonesia, International symposium on beach erosion management in East Asia, 1st Nov. 2018

135 Huda Bachtiar, Coastal protection and beach nourishment in Indonesia, International symposium on beach erosion management in East Asia, 1st Nov. 2018

Figure 4-85 Cobble Stones Revetment[136]Morotai Is., North Maluku

Figure 4-86 Natural Stone Revetment Pengaman Pantai Pulau Rupat Kab.Bengkalis BWS SUMATERA III RIAU, 2011

Figure 4-87 Concrete Beach Embankment Pantai Wameo, Kabupaten Bau-Bau, PUPR

Figure 4-88 Concrete Blocks Revetment Pantai Banding BBWS Mesuji Sekampung

Figure 4-89Offshore Breakwater Pantai Bahari, Kanupaten Buton Selatan (*source: PUPR*)

Note: This project was implemented by "Wetland International" with the support of PUPR and the Ministry of Marine and Fisheries.

Figure 4-90 Mangrove restoration permeable structure (Hybrid engineering permeable structurek at Demak, Semaran)"Building with Nature" by NGO Wetland International

136 Huda Bachtiar, Coastal protection and beach nourishment in Indonesia, International symposium on beach erosion management in East Asia, 1st Nov. 2018

However, reforestation of mangrove is difficult in the coastal area where once erosion has occurred. Currently, cutting of coastal woods is prohibited by the law.

4.4.3 Cooperation by Donors

The coastal erosion has occurred in many places in Indonesia. In Bali Island, severe coastal erosion occurred due to overexploitation of coals and effect of winds and waves. It has an adverse effect upon living environment of who works in tourism or fishery. A Japanese ODA loan project of which components were beach nourishment, construction of jetty, submerged breakwater, offshore breakwater was conducted in southern Bali Island such as Sabnur, Kuta, Nusa Dua and Tanarot areas. The summary of loan is as follows.[137][138]

- Type of Assistance : Soft Loan
- Year of L/A : 1996
- Loan Amount : JPY 9.506 billion

Figure 4-91 Aerial view of changes after sand nourishment, case of Sanur Beach, Bali

4.4.4 Actions of Private Sectors[139]

Coastal protection works is also conducted by private sectors to protect their assets and lives within the limits of human and budgetary resources, such as small wooden breakwaters and revetment works using sand bags.

4.4.5 Evaluation of Disaster Risks and Identified Challenges

Until now, no major storm surge countermeasure has taken in Indonesia. However, risk of storm surge will increase due to enlargement of scale of tropical low pressure area induced by climate change. To prepare such situation, enhancement and improvement of storm surge monitoring, forecasting and warning system shall be discussed. Monitoring and warning are conducted by the TCWC (Tropical Cyclone Warning Center) under BMKG. PUPR is responsible for structural measures. Coordination among the relevant agencies including BNPB is important. For construction of coastal protection structure, the following procedure is required.

1. Local government submit a proposal to central government
2. Central government review the proposal
3. National budget and technical assistance are given for the project implementation

Knowledge and technologies on coastal protection works are accumulated in PUPR. These knowledge and technologies shall be organized and developed. Besides, periodical inspection and maintenance are important because coastal protection structures are exposed to natural external force. Enhancement of organization and budget system for this operation and maintenance is also important.

[137] JICA, ODA MIERU-KA site, Bali Beach Conservation Project (https://www.jica.go.jp/oda/project/IP-475/index.html)
[138] JICA, External evaluation of Bali Beach Conservation Project, 2010
[139] Julianti Manu, Ryuichiro Nishi, Kazunori Hosoya Kazunri: Typical Shore Protection Structures in Indonesia, Journal of Ocean Development, Vol. 27, 2011

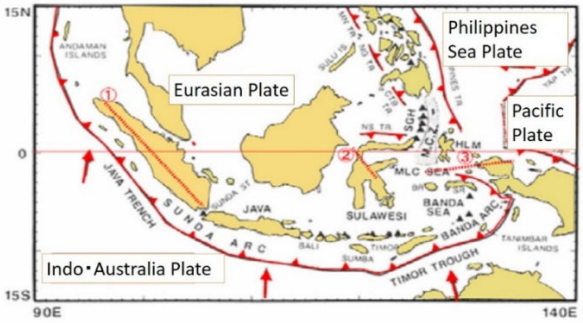
While local technologies on coastal protection works are well applied, there is room for improvement (Jakarta Shinbun, Web Site of MOFA , Japan)[140][141]. It is expected that necessity of coastal protection works will be recognized along with the increase of recognition of disaster risk management in Indonesia. Potential for Japan's cooperation to Indonesia in both technical and budgetary aspects is high.

4.5 Volcanic Eruptions

4.5.1 Characteristics of Recent Volcanic Disasters

4.5.1.1 Volcanic Activities in Indonesia

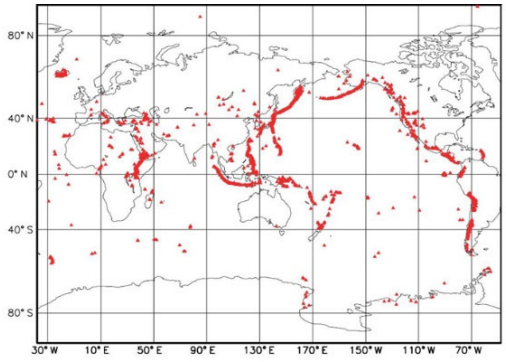
In Indonesia, two plates pass between the islands, and there is risks that volcanic disasters occur in 80% of the land areas due to movement of the plates (see the figure).



Source: Sabo in Indonesia (2002,yec)

Figure 4-92 Location of Plates and Major Volcanoes around Indonesia

There are 127 active volcanoes in Indonesia. Among them, there are 77 volcanoes that recorded actual eruption in the history. There are about 1,500 active volcanoes in the world, and in Indonesia there are about 10% of them (there are 110 active volcanoes in Japan). Those that recorded major eruption are Mt. Merapi (central Java), Mt. Kule (eastern Java), Mt. Semeru (same), Mt. Agung (Bari) and Mt. Sibun (Sumatra). Among these, Mt. Merapi has caused eruption that occurs once every five years, and volcano-sabo projects have been implemented with Japanese loan assistance.



Note: Active volcanoes are defined as "volcanoes that have erupted in about 10,000 years and that are performing fumarolic activity" by Volcano Eruption Liaison Committee. Most of them are distributed in the Pacific Rim. (Cabinet Office of Japan HP)

Figure 4-93 Distribution of Volcanoes in the World[142]

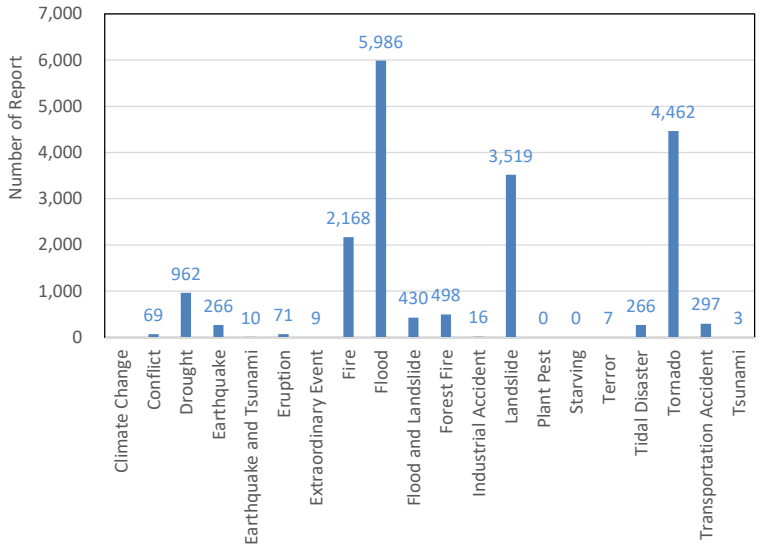
[140] The Daily Jalarta Shimbun 2013/10/05 (https://www.jakartashimbun.com/free/detail/13821.html)

[141] Ministry of Foreign Affairs of Japan, ODA Private monitor report 2007 (https://www.mofa.go.jp/mofaj/gaiko/oda/shimin/monitor/19m_hokoku/indonesia/opinion/opinion_9.html)

[142] Office of Cabinet HP (http://www.bousai.go.jp/kazan/taisaku/k101.htm)

4.5.1.2 Characteristics of Recent Volcanic Disasters

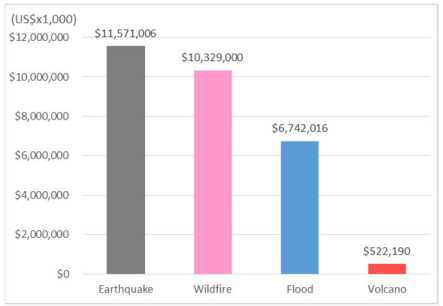
Based on BNPB's disaster database (DIBI) ten-year data from 2007 to 2016, the number of events caused by volcanic eruptions was only 71 cases as per disaster type, and the number of occurrences is significantly less than other disasters.

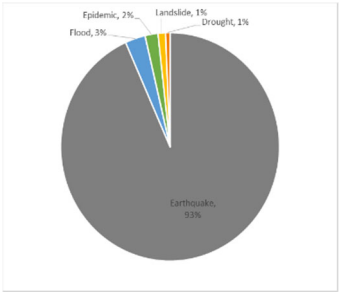


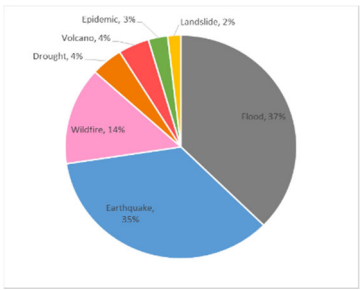
Source: BNPB, DIBI

Figure 4-94 Disaster Occurrences by Type over 10 years

According to data from the 1980 to 2017 statistics of EM-DAT disaster list, the impact of volcanic disasters is shown in Figure 4-37. The economic loss due to volcanic disaster is estimated at over US $ 520 million. In terms of affected population by disaster type, volcanic disaster is relatively small, but regarding the number of deaths, volcanic disasters are is 5th among disaster types.







Economic Losses	Affected People	Death Toll

Source: EM-DAT (1980-2017)

Figure 4-95 Disaster Characteristics on Volcanic Eruption by Type

Based on the record of the historic volcanic eruptions by PVMBG, the date of eruption occurrence, the date of cessation, volcanic characteristics and Volcanic Explosively Index (VEI) as well as the death toll are summarized below. The VEI is classified by the amount of volcanic ejecta, there are indices from VEI = 0 to VEI = 8, withVEI = 8 the largest. Mt. Merapi volcanic eruption in 2010 was VEI = 4.

Table 4-43 Major Volcanic Eruptions in Indonesia

Eruption date	Volcanoes	Cessation date	VEI	Characteristics	Death Toll
13 February 2014	Kelut	25 February 2014	4	cv,cl,pf,lm	7
3 November 2010	Merapi	8 November 2010	4	cv,pf,ld,lm	353
10 February 1990	Kelut	March 1990	4	cv,cl,pf,ph,ld,lm	35
18 July 1983	Colo	December 1983	4	cv,pf,ph	0
5 April 1982	Galunggung	8 January 1983	4	cv,pf,lf,lm	68
6 October 1972	Merapi	March 1985	2	cv,pf,lf,ld,lm	29
26 April 1966	Kelut	27 April 1966	4	cv,cl,pf,lm	212
17 March 1963	Agung	27 January 1964	5	cv,pf,lf,lm	1,148
31 August 1951	Kelut	31 August 1951	4	cv,cl,pf,lm	7
25 November 1930	Merapi	September 1931	3	cv,rf,pf,lf,ld,lm	1,369
19 May 1919	Kelut	20 May 1919	4	cv,cl,pf,lm	5,110
7 June 1892	Awu	12 June 1892	3	cv,pf,lm	1,532
26 August 1883	Krakatoa	February 1884	6	cv,se,pf,fa,lm,cc	36,600
15 April 1872	Merapi	21 April 1872	4	cv,pf	200
2 March 1856	Awu	17 March 1856	3	cv,pf,lm	2,806
8 October 1822	Galunggung	December 1822	5	cv,pf,ld,lm	4,011
10 April 1815	Mount Tambora	15 July 1815	7	cv,pf,cc	71,000+
6 August 1812	Awu	8 August 1812	4	cv,pf,lm	963
12 August 1772	Papandayan	12 August 1772	3	cv,ph	2,957
4 August 1672	Merapi	unknown	3	cv,pf,lm	3,000
1586	Kelut	unknown	5	cf,cl,lm	10,000
September 1257	Samalas	unknown	7		

Notes: VEI: Volcanic Explosively Index *Source: PVMBG*

Characteristics: cv=central vent eruption, pf=pyroclastic flows, lf=lava flows, lm=lahar mudflows, cl=crater lake eruption, ph=phreatic eruption, ld=lava dome extrusion, cc=caldera collapse, se=submarine eruption, fa=fumarole activity, rf=radial fissure eruption.

4.5.2 Efforts by the Government of Indonesia

PVMBG under the umbrella of Ministry of Mineral Resources and Energy (ESDM, Energi dan Sumber Daya Mineral) conducts the monitoring of volcanic activities and has the following mandates.

a. Research and monitoring of volcanic activities
b. Volcanic eruption disaster early warning
c. Determination of volcanic disaster prone area
d. Formation of emergency response teams
e. Socialization to local governments and communities, evacuation training and spatial planning arrangement

As mentioned above, it is characterized by conducting research with total management on volcanoes, creating hazard maps, monitoring of volcanoes and issuance of warnings. In the event of volcanic activity becoming active, PVMBG dispatches staff from the headquarters to strengthen the monitoring system, and explains to BPBD along with local governments including residents the volcanic activity.

According to the meeting results from the seismic section of PVMBG, it is usually visual and device monitoring. Regarding monitoring by devices, they record earthquake activities, stress forces and geophysical items (eruption gas and plume). Regarding volcanoes that are most likely to erupt, PVMBG installs seismographs at four sites and stress meters at two sites. Monitoring posts are placed at active volcanoes and monitoring is carried out by observers.

PVMBG classifies volcanoes into three types based on the history of volcanic activities in the past (after 1600 AD) and monitors them.

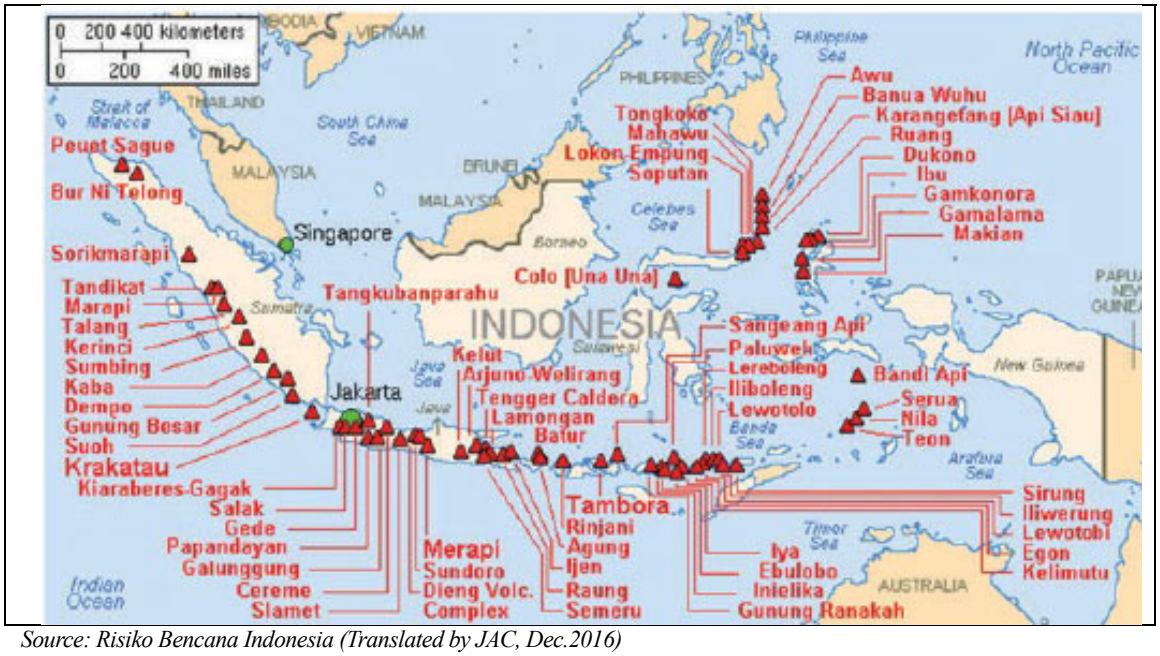
Table 4-44 Classification on Volcanic Types in Indonesia

SN	Volcanoes Area	Type A	Type B	Type C	Total
1	Sumatera	13	11	6	30
2	Jawa	19	10	5	34
3	Lombok	1			1
4	Bali	2			2
5	Sumbawa	2			2
6	Flores	17	3	5	25
7	Laut Banda	7	2		9
8	Sulawesi	6	2	5	13
9	Kepulauan Sangir	5			5
10	Halmahera	5	1		6
Total (Type)		77	29	21	127

Notes: Type A: Experienced an eruption at least one time after 1600 AD
TypeB: Not experienced a magmatic eruption after 1600AD, but still exhibit signs of activity
TypeC: Eruption is not known in human history.

Source: RNPB 2015-2019, Prioritas Nasional Penanggulangan Bencana

Locations of "Type A" (erupted at least one time after 1600 AD) volcanoes are shown below.

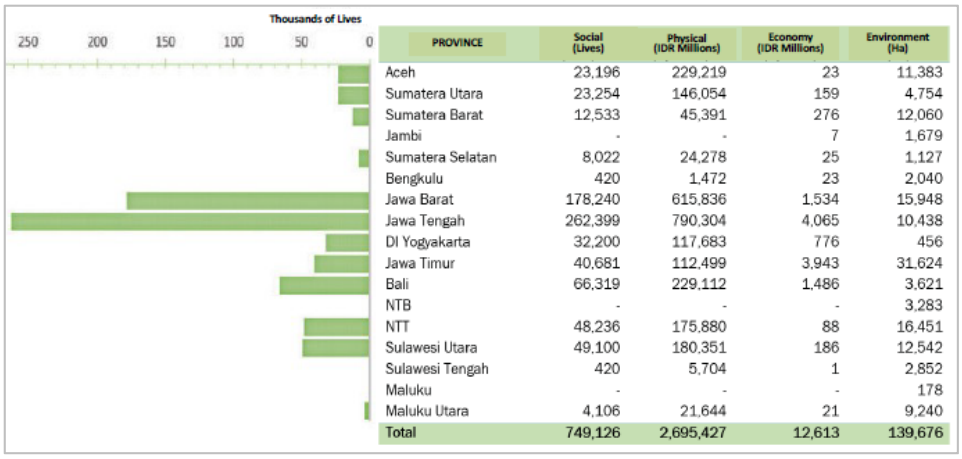


Source: Risiko Bencana Indonesia (Translated by JAC, Dec.2016)

Figure 4-96 Location Map for Type A Volcanoes

In Figure above, it was shown major historical eruptions such as Mt. Merapi (2010, VEI = 4, death toll 353, 1931, VEI = 3, death toll: 1,369), Mt. Kelut (1966, VEI = 4, 212 deaths) , 1819, VEI = 4, death toll 5,110), Mt. Agung (1964, VEI = 5, 1,148 dead), Mt. Krakatau (Krakatoa) (1884, VEI = 6, dead 36,600), Mt. Awu (1892, VEI = 3, 1,532 deaths, 1856, VEI = 3, the number of deaths 2,806), and Mt. Tambora (1815, VEI = 7, death toll: over 71,000 people).

The risk assessment results of volcanic eruptions by Province made by PVMBG in 2015 is shown in Figure. Volcanoes with the above-mentioned major disasters are concentrated in Java (West, Central), Bali and North Sumatra.

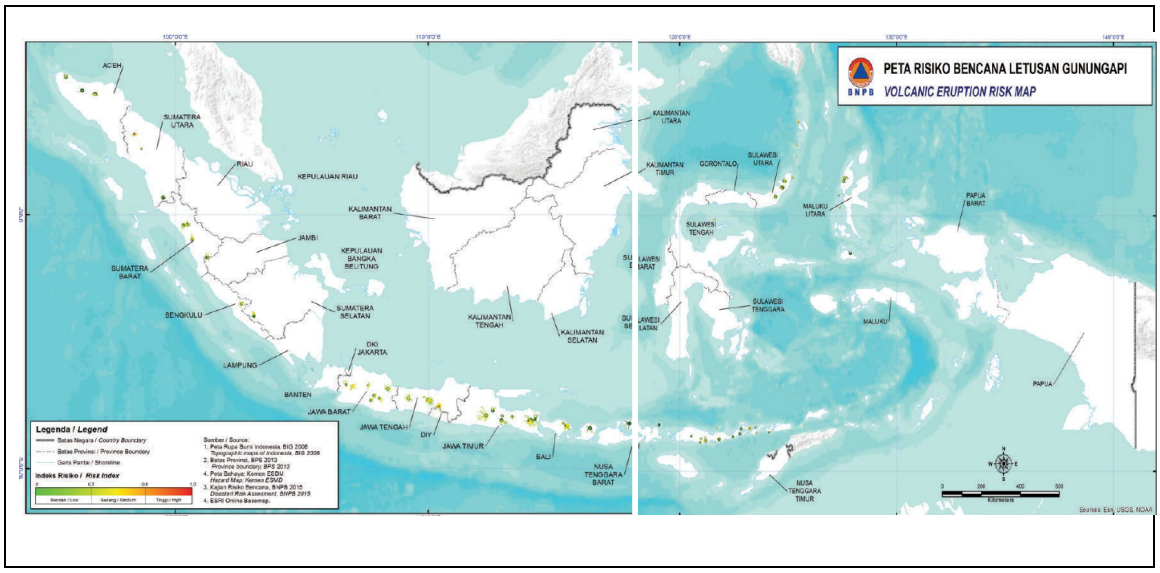


PROVINCE	Social (Lives)	Physical (IDR Millions)	Economy (IDR Millions)	Environment (Ha)
Aceh	23,196	229,219	23	11,383
Sumatera Utara	23,254	146,054	159	4,754
Sumatera Barat	12,533	45,391	276	12,060
Jambi	-	-	7	1,679
Sumatera Selatan	8,022	24,278	25	1,127
Bengkulu	420	1,472	23	2,040
Jawa Barat	178,240	615,836	1,534	15,948
Jawa Tengah	262,399	790,304	4,065	10,438
DI Yogyakarta	32,200	117,683	776	456
Jawa Timur	40,681	112,499	3,943	31,624
Bali	66,319	229,112	1,486	3,621
NTB	-	-	-	3,283
NTT	48,236	175,880	88	16,451
Sulawesi Utara	49,100	180,351	186	12,542
Sulawesi Tengah	420	5,704	1	2,852
Maluku	-	-	-	178
Maluku Utara	4,106	21,644	21	9,240
Total	**749,126**	**2,695,427**	**12,613**	**139,676**

Source: Risiko Bencana Indonesia (Translated by JAC, Dec.2016)

Figure 4-97 Risk Assessment by Province on Volcanic Eruptions

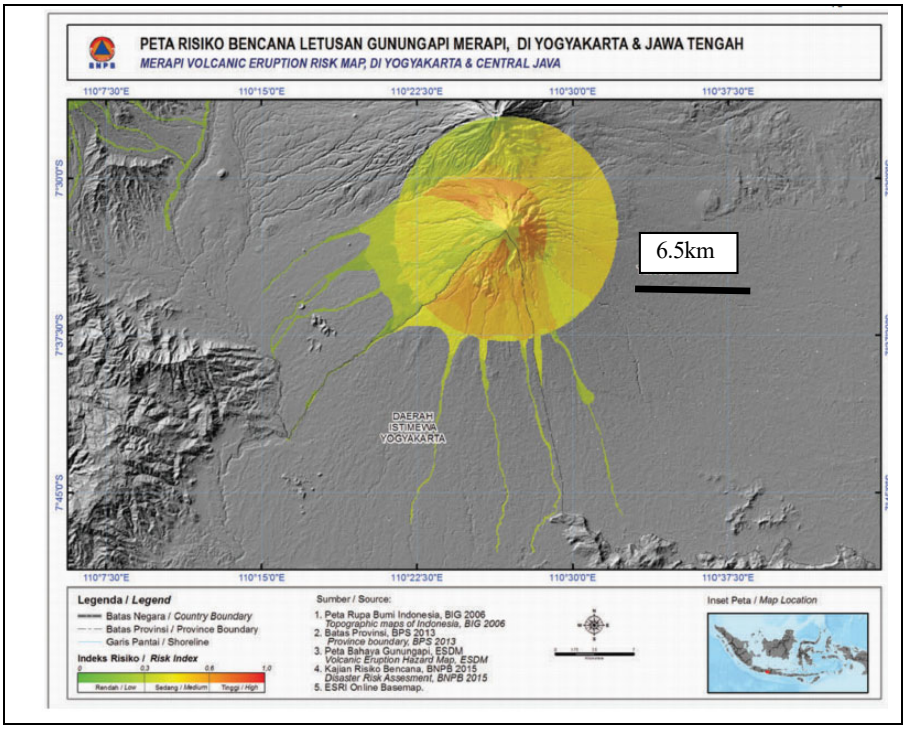
Risk map updated by PVMBG is shown below in Figure 4-98.



Source: RNPB 2015-2019, Prioritas Nasional Penanggulangan Bencan

Figure 4-98 Updated Risk Map on Volcanic Eruption Disasters

The risk map of Mt. Merapi where volcanic activities have become active in recent years is as follows. According to this Figure, the risk index (RI) is roughly divided into three categories, RI = 0.0-0.3 is Low (low risk), RI = 0.3-0.6 (medium risk), RI = 0.6-1.0 (High risk). The area within the circle with a radius of approximately 6.5 Km from the crater is designated as" medium danger zone".



Source: Risiko Bencana Indonesia (Translated by JAC, Dec.2016)

Figure 4-99 Risk Map on Volcanic Eruption Disasters at Mt. Merapi

The level of volcanic alert defined by the PVMBG is in four levels, the outline of these are as follows.

Table 4-45 Classification on Volcanic Alert Levels in Indonesia

Alert	Color of Code/Activity	Explanation
Level I	Green/ Active Normal	No activity based on monitoring visual seismicity and other events. No eruptions in the foreseeable future.
Level II	Yellow/ Danger/Waspada	Increased seismicity and other volcanic events such as gases; visual changes around the crater and magmatic, tectonic or hydrothermal disturbances. Eruption is not imminent. however due to the increased danger, local officials should prepare for a disaster
Level III	Orange/ Ready to erupt/Siaga	Rapid rise in seismicity accompanied by obvious visual changes in the crater. Large eruption possible within one-to-two weeks, depending on data analysis.
Level IV	Red/ Active danger/Awas	Begin evacuation due to small eruptions and/or potential for a large eruption spewing ash, lava and gases. A major eruption is imminent, possibly within 24 hours

Source: Disaster Management Reference Handbook (Indonesia, 2015)

From the article on the website "Badan Geologi, Berita Gunungapi (volcano news)" in PVMBG, the results of timing (date) of the warning issuance and its classification at Mt. Agung volcano erupted in 2017 in Bali are shown in Table 4-46.

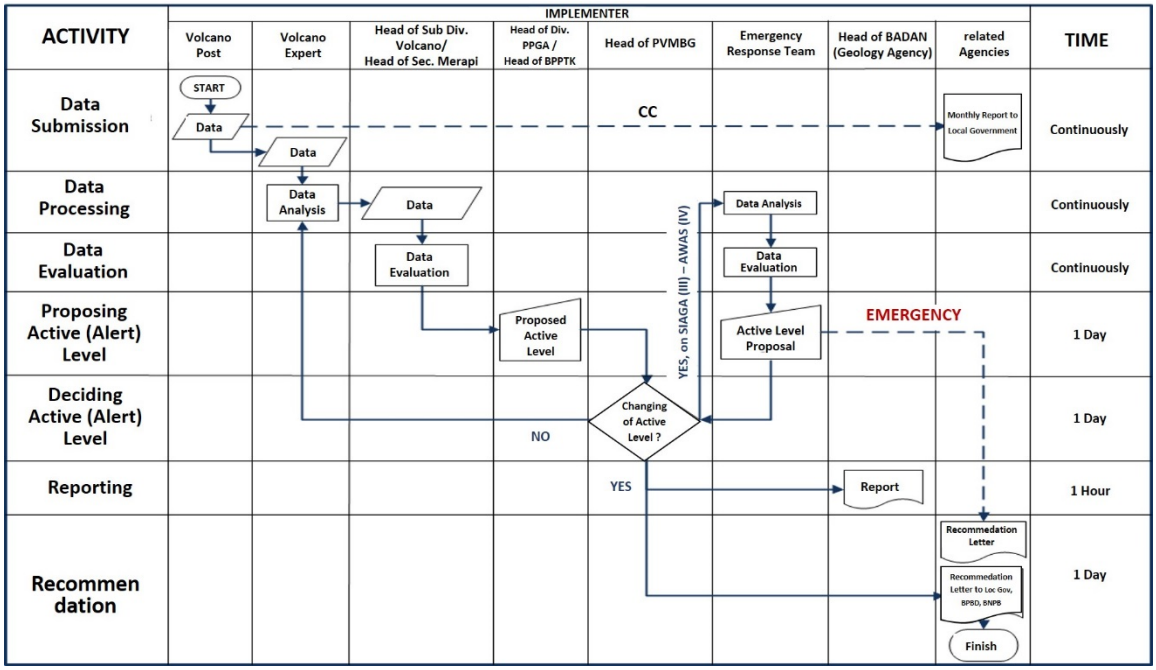
In the event of a volcanic disaster, BPBD takes the initiative in managing disaster response, and BNPB supports the expenses of the activities such as procurement of materials. In the case of a large-scale disaster, BNPB directly takes the initiative and manages disaster response. PVMBG provides technical and professional advice. Even if the residents are evacuated at the level of volcanic alerts for eruption and even if volcano did not erupt, expenses for evacuation are borne by BNPB and minimum compensations necessary for daily living are paid.

Table 4-46 Status of Issuing on Volcanic Alert Levels at Mt. Agung

Announcement Day for Alert	Mt. Agung Activities	Alert Level
10 August 2017	Observation of volcanic seismic movement	No Alert (I:NORMAL)
14 September 2017		I → II (WASPADA)
18		II → III (SIAGA)
22		II → IV (AWAS)
29 October		IV→ III
21 November	First Eruption was observed, Smoke height:700m	
25	Second Eruption: Smoke height:2,000m	
26 November		III
27	Eruption of Mt. Agung Smoke height:3400m	III → IV
10 February 2018		IV → III
July 2018		III

Source: PVMBG Badang Geologi (Website)

Information flow among the related agencies concerning disaster response on volcanic eruption, in case of Mt. Merapi, is shown as follows.



Source: PVMBG, Badang Geologi

Figure 4-100 Information Flow among the Related Agencies on Disaster Response

The legal system on sediment disasters including volcanic eruptions are shown below.

Table 4-47 Legal System on Sediment Disasters including Volcanic Eruptions

Classification	Laws/Decrees/Regulations (Year)	Name/Title
Law	Law No. 24/2007	Disaster Management
	Law No. 26/2007	Spatial Planning
Presidential Decree	Presidential Decree No. 8/2008	National Disaster Management Agency (BNPB)
Government Regulation	Government Regulation No. 21/2008	Implementation of Disaster Management
	Government Regulation No. 22/2008	Finance and Management of Aid for Disaster
	Government Regulation No. 23/2008	Participation of International Institutions and Foreign Non-Governmental Institutions in the Mitigation of Disaster
Ministry Decree	Ministry of ESDM Regulation No.18/2010	Organization and Administration of the Ministry of Energy and Mineral Resources
	Ministry of ESDM Regulation No.15/2011	Guidelines for Geological hazard Mitigation including Volcanic Eruption, Landslide, Earthquake and Tsunamis
	Ministry of Internal Affairs Decree No.46/2008	Disaster Countermeasures
	Ministry of Public Works Regulation No.4/PRT/M/2008	Guideline for Establishment of Water Resources Council in Province, Regency/City and River Basin Levels

Source: Geological Agency and websites

Regarding structural measures on the volcanic eruption, it is under the management of the Ministry of Public Works and Housing (PUPR). The works also implemented by each BBWS (or BWS) as a volcanic sediment control (SABO) project.

4.5.3 Cooperation by JICA

The history of cooperation process on volcanic eruptions by JICA and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan is shown below. Volcanic eruption related matters are dealt as "Sabo Project" by MLIT, and its technical cooperation began with dispatch of JICA experts in 1969.

At that time in Indonesia, they were struggling with the treatment of volcanic ejecta and mudflow deposits by eruptions such as Mt. Agung volcano in 1963, Mt. Kelut volcano in 1966, Mt. Merapi volcano in 1969 and so on. As an opportunity of Mt. Merapi volcano eruption in 1969, the government of Indonesia designated as their top priority area for the National Disaster Management Program. Based on the Mt. Merapi Volcano Disaster Prevention Basic Plan (Master Plan) formulated under the cooperation of JICA, sediment management plan was formulated and structural measures for disaster mitigation were designed.

From the 1980s to the 1990s, in the areas with high risk of large-scale volcanic disasters and landslides as well as giving large social impact, Volcanic Lahar Control Project (VLCP) under the direct management control of PU (PR) was carried out for the purpose of sediment control in small and medium river basins in five (5) volcanic areas. Of these, technical cooperation schemes under JICA and grant aids (former Overseas Economic Cooperation Fund: OECF) on “Volcanic SABO” projects were implemented at Mt. Merapi, Mt. Kelut, Mt. Semeru and Mt. Galunggung volcano areas. On the other hand, Mt. Agung volcano sediment management control project was carried out by Indonesian government's budget. From 1982 to 1992, the five (5) major projects implemented for volcanic sediment management on “Volcanic SABO project” are shown in Table 4-26 below.

Table 4-48 Major Projects Implementing on "Volcanic SABO Projects"

Volcanoes	Location	Plan and Countermeasures
Merapi	Yogyakarta, Central Java	Sabo works was implemented in 1969/70 in order to protect mountain settlements located from southwest to southeast for large debris deposited and debris flow caused by heavy rain in the hillside of the mountain. Many Sabo facilities were constructed with six double wall type dams, two consolidation dams and channel works with length of 12 km. (1989/90 to 1992/93 years)
Kelut (Kelud)	East Java	Numerous Sabo works such as sand pocket and sabo dam have been constructed since 1969/70 for the purpose of preventing villages located in the northern and southern areas of the volcano from debris flow. It was also done for prevention of flooding by rising riverbed of the Brantas River as well as prevention of sedimentation of multipurpose dam reservoirs.
Agung	Bali	In order to protect the settlements located in the northern and southern part of Mt. Agung volcano from debris flow and sediment disasters, Sabo works were implemented since 1969/70, and erosion control dam, sand pocket and river channel construction were carried out as mud flow countermeasures. At the same time, regional infrastructure developments such as irrigation and intake works, bridges, restoration of roads were also implemented.
Semeru	East Java	Pyroclastic flows often occurred in the southwestern part in the Mt. Semeru volcano. Numerous erosion control works have been carried out since 1977/78 in order to protect the settlements of these areas from debris flow and to prevent flooding due to river bed rising. Channel works and Sabo dams were constructed. The OECF loan with 34 billion yen was funded from 1988/89.
Galunggung	West Java	Sabo works have been implemented since 1982/83 in order to protect the village located in southern part of Mt. Galunggun volcano from floods and debris flows, sediment-related disasters due to riverbed rising in Cikunir River and Cirose River. The main Sabo facilities were sand pockets and erosion control dams such as consolidation dam. In 1982, a mud flow warning and warning system were introduced from grant aid.

Source: Comprehensive Disaster Prevention Project in Volcanic Areas in Indonesia (Project Document, JICA,2001)

In addition to the implementation of the project, Volcanic SABO Technical Center (VSTC) was established in 1982 at Jogjakarta. In 1992, in addition to sediment-related disasters caused by volcanic activities, sediment-related disasters in areas without volcanoes were also involved and reformed to Sabo Technical Center (STC). In these institutions, sediment control technology contributed not only protects people's lives and properties but also expanding to local benefits and welfares such as by conjunction use of SABO facilities as multipurpose dam with functions for crossing road and water intake. Sand mining business by sediment excavation in the rivers was also implemented in order to increase the income of local residents by selling as construction materials. After that, Integrated Sediment Disaster Management (ISDM) projects started in the 2000s. Implementation projects for the master plan formulation by JICA is shown in Table 4-27.

Table 4-49 Master Plan Study on Sediment Disaster Mitigation Projects Implemented by JICA

Volcano/Coast	Location	Implementation Period	Purpose of Master Plan
Merapi	Yogyakarta, Central Java	1977-1980	Prevention for land erosion and sediment control for debris flow
Semeru	East Java	1975-1980	Prevention of land erosion and sediment control for debris flow/pyroclastic flow
Galunggung	West Java	1986-1990	Sediment control for debris and pyroclastic flow/ Sediment management in sand pocket
Bali Coast	Bali	1987-1991	Prevention for coastal erosion

Source: Comprehensive Disaster Prevention Project in Volcanic Areas in Indonesia (Project Document, JICA,2001)

Volcanic sediment control ("SABO" including coastal disaster prevention) projects implemented by JICA in the past are listed as follows.

Table 4-50 Major Volcanic SABO Projects Implemented by JICA

SN	Province	Major Projects Implemented by JICA	Implementation Period
1	West Java	Mt. Galunggung Disaster Prevention Project	1987-1988
2	Yogyakarta & Central Java	Capacity Development Project for SABO, VSTC, STV, ISDM	1982-2006
3		Mt. Merapi and Mt. Semeru Volcanic Disaster Countermeasures Project	1987-2001
4		Mt. Merapi, Progo River Basin Urgent Disaster Reduction Project	2005-2014
5		Mt. Merapi Urgent Disaster Reduction Project	2014-2018
6	Central Java & East Java	Mt. Merapi and Mt. Semeru Volcanic Disaster Countermeasures Project	1986-2001
7	East Java	Mt. Kelut Urgent Volcanic Disaster Mitigation Project	1992-1996
8		Water Resources Existing Facilities Rehabilitation and Capacity Development Improvement Project (Tributaries of K. Brantas)	2003-2011
9		Natural Disasters Reduction Project (Banjir Bandang)	2007-2009
10		"Banjir Bandang" Integrated Disaster Mitigation Management Project	2008-2011
11	Bali	Bali beach conservation project	1988-2008
12	South Sulawesi	Mt. Bawakaraeng Urgent Disaster Reduction Project	2005-2014

Source: JICA

According to PVMBG, two projects are being implemented by SATREPS (Science and Technology Research Partnership for Sustainable Development) of Japan as shown below. At the time of this survey, integrated study on multi-disasters caused by volcanic ejection has been conducted

Table 4-51 SATREPS Projects Implemented by JICA-JCT

Period	Type of the Project	Implementing Agencies	Project Name
2009-2012	SATREPS	LIPI, PVMBG	Multi-disciplinary Hazard Reduction from Earthquakes and Volcanos in Indonesia
2014-2019	SATREPS	PVMBG	Project for Integrated Study on Mitigation of Multimodal Disasters caused by Ejection of Volcanic Products

Note: LIPI: Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Science *Source: PVMBG*

PVMBG: Pesat Vulkanologi dan Mitigasi Bencana Geologi, PVMBG, Center for Volcanology & Geological Hazard Mitigation, CVGHM,

4.5.4 Cooperation by Other Donors

Cooperation programs by international donors concerning volcanic eruption are as follows. There were cooperations from Singapore, the United States, Australia and France.

Table 4-52 Cooperation Programs by International Donors

Period	Donors	Implementing Agencies	Project Name
2011-2018	Earth Observatory of Singapore (EOS)	PVMBG	Assessment and Mitigation of Geological Hazards
2008-2018	USAID	PVMBG	Volcano Monitoring and Hazard Assessment
2009-2018	Geological Agency of Australia	PVMBG, BNPB	Volcanic Ash Simulation and InaSAFE Real-time for Volcanic Ash
2013-2018	IRD France	PVMBG	Risk Assessment and Mitigation of Volcanic

Period	Donors	Implementing Agencies	Project Name
			Hazards in Indonesia
2015-2017	World Food Program	BPBD DI Jogjakarta	Formulation of Humanitarian Logistics Master Plan
2012-	USAID	BPBD DI Jogjakarta	Incident Command System

Note: IRD: Institute of Research and Development, France, *Source: PVMBG, BPBD DI Jogjakarta*

4.5.5 Evaluation of Disaster Risks and Identified Challenges

4.5.5.1 Identified Changes on Volcanic Eruption

Based on the current situations on volcanic eruptions identified in the previous sub-section, the following six (6) issues were revealed under the four (4) fields endorsed by the United Nations in SFDRR, 2015.

Table 4-53 Overall Issues on Volcanic Eruptions under Four Fields in SFDRR

Fields in SFDRR	Issues Revealed
Disaster information (Understanding Disaster Risknajd Share Information)	a. Inadequate understanding of disaster risk in the hazard area
Governance (Strengthen Governance for Disaster Risk Management)	b. Insufficient capacity for evacuation centers c. Need for continuous volcanic activity monitoring
Disaster Risk Reduction (DRR Investment for Resilience)	d. Shortage of budgets for improvement of aging facilities and new facility construction e. Need for investment in volcanic activity monitoring devices
Disaster Preparedness and BBB	f. Necessity for damage response and disaster preparedness assuming large-scale refugees

(1) Disaster information (Understand Disaster Risk and Share Information

«Challenge1» Inadequate understanding of disaster risk in the hazard area

In Mt. Merapi area, hazard maps have already been prepared and formulated in hazard areas as described above, and explanation to residents has also been made based on these materials. According to the disaster risk mitigation adviser of the Catholic Aid Agency for UK and Wales, there are people carrying out evacuation activities based on hazard maps and evacuation maps in the event of volcanic disaster, while there are people who believe in traditional and customary preventive methods. In the latter case, because some people make supernatural events such as volcanic eruption sedative by rituals, individual communities cannot believe warning based on scientific observation and do not evacuate therefore, remain in the hazard area. "The community has an early warning system based on tradition and natural signs, and it is difficult to believe in scientific monitoring," the NGO adviser said. (Report by Humanitarian NGO Caritas) In the case of Mt. Kelud volcanic eruption in February 2014 (7 death toll, 15 missing, 201,200 evacuees at the time pf eruption, 99,000 the final evacuees), there was a case where there were residents staying in the hazard area without evacuation. Similar cases have been reported in the eruption of Mt. Merapi volcano in November 2010.

The volcanic ejecta is very fertile, and this makes a pull factor that the farmers remain in the hazard area. Since the farmers recognize that the fertile soil is suitable for cultivation, they remain in the erupted areas and cultivate their farms after eruption. While recognizing risks, the fact that many farmers and livestock remain in the hazard area is the cause of repeated damage in the event of eruption disasters. In these cases, many farmers keep livestock, and since this is their only property to raise their livestock, , so even while the volcanic eruption continues, they go to the farm to feed the livestock. Their activities during eruption put their lives at

risk. To respond to this dilemma, the government have incorporated livestock evacuation by truck into several district contingency plans. Eventually, the government have built evacuation centers with foods and water for livestock.

The indigenous people living in the foot of Mt. Merapi have evacuated on the basis of traditional own warning signals on volcanic eruption. These warning signals include gas clouds from the summit crater of Mt. Merapi volcano, small earthquake motions, movement of monkeys living at the foot of the mountain and thunderstorms.

At the time of the 2010 eruption, cases of refused evacuation have been reported. The government authorities had recommended evacuation despite the fact that such a warning signal for evacuation had not been seen(Website: Reducing the volcano risk in Indonesia, Jakarta, 1 May 2014). Despite early warning from government agencies, local traditional leaders and community leaders were confident that they were safe because they did not want to evacuate. In Mt. Merapi, some communities strongly believed “Muba Maridjan”, designated as the "gatekeeper" of the mountain by the Sultan of Jogjakarta, a powerful regional religious politician. According to the local reports, Maridjan refused to evacuate after the eruption, saying "Die on the volcano", and was caught up in a pyroclastic flow with the residents who persuaded his evacuation. As a countermeasure to this, the government decided to develop and foster “the volcanic heroes”, leaders whose social position can influence the behavior of the community. They try to fight old "nonscientific warning signal" based on scientific monitoring and analysis.

By conducting analysis based on the scientific monitoring, warning signals are issued based on these results. It is required to formulate countermeasures leading to evacuation activities for people in the volcanic areas.

(2) Governance (Strengthen Governance for Disaster Risk Management)

«Challenge2» Insufficient capacity of evacuation centers

As mentioned above, the population within 15 km of the hazard area organized by BPBD JogJakarta, the capacity of people able to accommodate at evacuation centers, and the number of deficient people are shown in the table below. The target population to be evacuated is more than 56,400 people, and that shows only 9% of satisfaction rate, for the nine (9) evacuation centers with capacity of 5,300 people in total. The fact that there are many residents in the hazard area is a problem, but also the fact that there is a huge shortage of accommodation for evacuees at the evacuation center is big problem.

Regarding evacuation for volcanic disasters, evacuation to other than designated centers is also possible because the possibility of simultaneous occurrence of disaster in all rivers is low, but the problem is the overall evacuation capacity is insufficient. In order to prevent disasters, the provincial government plans to relocate 700 households living in the highest hazard area (KRB 3), and in 2018, the relocation of 30 households has been completed. In 2019, the provincial government plans to relocate 40 households. In addition, the PUPR also carries out the construction of evacuation shelters and plans to continue in the future, but the response is not sufficient.

Table 4-54 Overview of Evacuation Center (Capacity, Target Population for Evacuation)

SN	Name of Evacuation Centre	Target Population to be Evacuated	Capacity	Balance
1	Barak Lumbungrejo	4,837	300	-4,537
2	Barak Pondokerejo	5,063	500	-4,563
3	Barak Sleman	4,837	300	-4,537
4	Barak Ull	12,796	2,000	-10,796
5	Barak Umbulmartani	12,796	500	-12,296
6	Barak Kuwang	5,757	500	-5,257
7	Barak Bimomertani	3,056	400	-2,656
8	Balai Desa Sindumartani	4,684	300	-4,384
9	Barak Koripan	2,552	500	-2,052
Total		**56,378**	**5,300**	**-51,078**

Source: Evacuation Map within Radius of 15km (BPBD DI Jogjakarta)

«Challenge3» Needs for continuous volcano activity monitoring

Regarding the volcanic monitoring of Mt. Merapi, PVMBG (Volcanic Geological Disaster Mitigation Center) supervises the monitoring of Indonesia as a whole. According to a person in charge of PVMBG, monitoring of volcanic activity is usually visual and monitoring by devices. Monitoring items are carrying out earthquakes, stresses and geophysical items (eruption gas and plume). Regarding the volcano where there is a high risk of eruption classified as "PP1 volcano", seismographs are installed in 4 places and stress meters are set in 2 places. Furthermore, for PP2, there are two seismographs, for PP3, one seismograph is set in one (1) place. For active volcanoes such as Mt. Merapi volcano, monitoring post is placed and monitoring is carried out by personnel. As for the monitoring data, data is sent to the nearest monitoring center (or observatory unit) and then forwarded from the monitoring center to PVMBG headquarters.

Based on the survey on Mt. Sinabung and Mt. Merapi volcanoes, volcanologists at Kyoto University, Disaster Prevention Research Institute, have pointed out the following. (*Source: Learn from 2010 Eruptions at Merapi and Sinabun Volcanoes in Indonesia: Annuals of Disasters Prevention Research Institute, Kyoto Univ. 2011*)

a. Evaluation of the long-term dormancy eruption activity like Mt. Sinabun volcano is difficult. Quick response to obtain data is important to compensate the gap from the last eruption.

Prediction of eruption activity which the top of the volcano under the condition of open-conduit system like Mt. Merapi is difficult. Under such circumstances, high sensitivity ground deformation monitoring by using high sensitive ground deformation and chemical analysis of material for pyroclastic material and volcanic gas called quick geochemical analysis are required.

Regarding active volcanoes, it is necessary to continuously monitoring and design of countermeasures that covers wider areas. On the other hand, regarding long-term dormancy type volcano, quick monitoring is important to predict the volcanic explosion.

(3) Disaster Risk Reduction (DRR Investment for Resilience)

«Challenge4» Shortage of budget for improvement of aging facilities and new facility construction

In the JICA project implementation areas in Mt. Merapi, there are needs for improvement and renewal of Sabo facilities implemented in the 1980s. Specific events showed a decrease in the sediment control capacity of Sabo dam and sand pocket, and the fact that parts of Sabo structures (dam body, revetments of embankment) are becoming eroded and broken. During the field survey by the JICA Survey Team, there were damages on the Sabo dam caused by the disaster in 2010. The aggregates used for the dam also caused problem, but deterioration is mainly due to aging after more than 30 years have passed.

	
Sabo Dam Damaged by 2010 Eruption	Inside of Sabo Dam (Aggregate)

Source: The JICA Survey Team

Figure 4-101 Situation of Sabo Dam broken by Debris Flow in 2010

Regarding the above situation, the project office has requested PUPR to secure the budget for improvement and renewal of facilities, but at current situation the budget cannot be secured.

«Challenge5» Continuous investment in monitoring devices for volcanic activities

The monitoring of volcanic activity is carried out by PVMBG. Regarding volcanoes with active volcanic activity, it is necessary to install devices for continuous monitoring. Regarding the volcanic eruption after a long-term dormancy (without volcanic activity), installation of emergency monitoring devices is necessary. Continuous investment to install and expand monitoring devices for volcanic activities is necessary.

(4) Disaster Risk Reduction (DRR Investment for Resilience)

«Challenge6» Necessity for damage response and disaster preparedness assuming large-scale refugees

Regarding the volcanic eruption, it is necessary to assume "occurrence of disaster beyond design scale". Even during the period of the JICA data collection survey, Mt. Agung volcano in Bali, Mt. Melapi volcano in Java and Mt. Soputan volcano in Sulawesi have erupted or indicated signs of eruption. According to BNPB volcano monitoring information (Status Gunung Api), as of October 2018, Mt. Agung and Mt. Soputan volcanoes show Level III (Siaga) and Mt. Merapi Volcano shows Level II (Waspada). No major disasters have occurred at the time of erupting of Mt. Soputan and Agung volcanoes. Even if the eruption is large in these area, there are few residents living in the vicinity, so the death toll is assumed to be low.

On the other hand, in Mt. Merapi volcano erupted in 2010, it is reported that the death toll has reached 275 people. It has also been reported that it took 5-7 days to evacuate the population of 320,000 people. (*Source: Earthquake report, January 2012*). In Mt. Kelud volcano in the eastern part of Java Island erupted in 2014, there were 7 deaths and 15 missing, and it was reported that evacuees reached 201,200 people at the time of eruption. In the case of the Mt. Kelud volcano, evacuees living near Mt. Kelud volcanoes reached in 35 villages (Desa) of Blitar, Kediri and Malang Districts (Kabpaten). (*Source: WHO Emergency Situation Report (ESR-2), Mt. Kelud Volcano Eruption*) The evacuees initially reached 201,200 people, but as the eruption activity declined, eventually, 99,000 people became evacuation target.

In the case of large-scale volcanic eruption, it is necessary not only to respond to evacuees, but also to simultaneously carry out disaster rehabilitation activities, improvement of infrastructure facilities and securing of community in a short period. In response to the disaster at the time of the 2014 eruption of Mt. Kelud volcano, as described above, response agencies were classified into categories for refugee, local safety and restoration. All orders were made from the reports sent by relevant departments based on coordinate meetings in the "Provincial command post".

Regarding response to large-scale refugees, the role and direction of BNBD, BPBD and PCP are important, as it is necessary to simultaneously deal with various disaster responses at the same time in a short period of time. It is important to build mechanism that allows each line organization to facilitate disaster response.

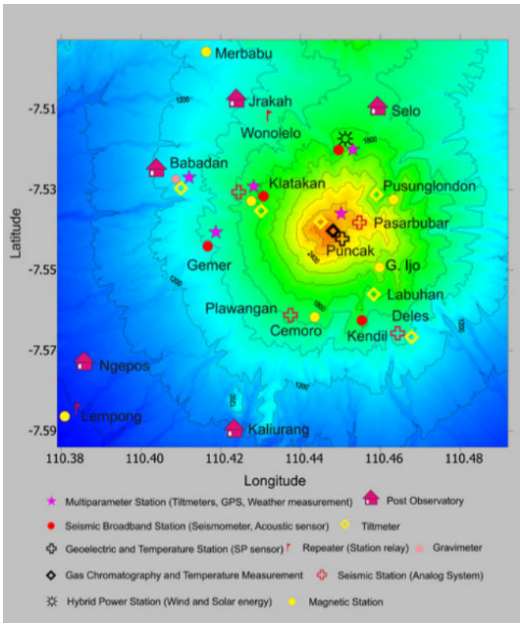
4.5.5.2 Identified Challenges on Localities

(1) DRR Activities on Mt. Merapi Volcanic Eruption

With respect to volcanic SABO (volcanic eruption countermeasure) projects, as described above, detailed activities for monitoring situation, disaster countermeasures and implementation projects in Mt. Merapi volcano triggered by the start of Japan's cooperation project.

1) Volcanic Eruption of Mt.Merapi

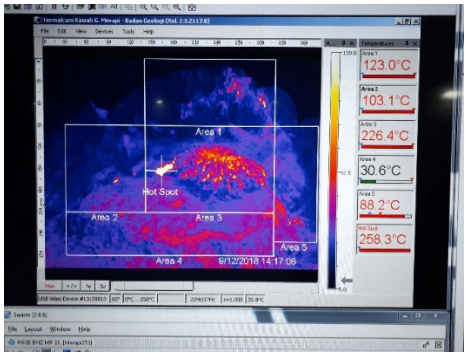
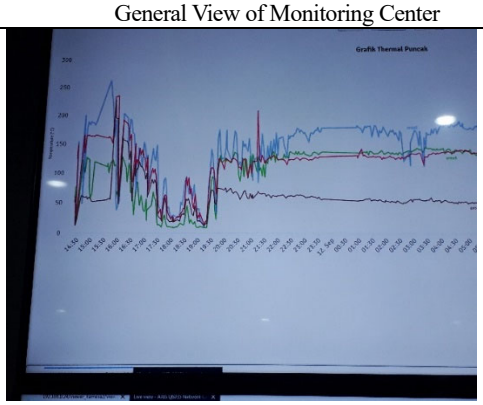
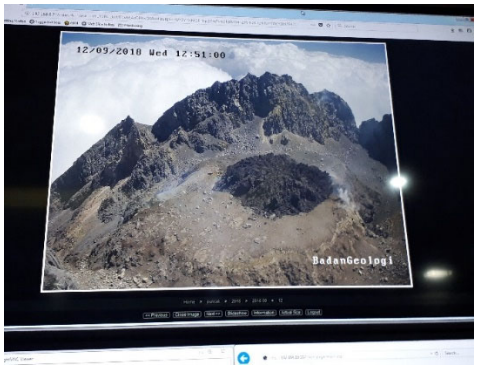
BBPTKG (Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi, Unit for Research and Development of Technology for Geological Disasters) located in JogJakarta, which is the under institution of PVMBG, was originally founded in 1945 for the Mt. Merapi Volcano Monitoring Post. The institution was reformed in 2013, and it became "Geological Disaster Research Unit". In addition to monitoring the eruption activity in Mt. Merapi volcano, this unit is also investigating and analyzing volcanic geology, surveying and analyzing nationwide landslides. The activity of Mt. Merapi volcano is monitored by monitoring post with seismometer, tiltmeters, CCTVs installed in 5 places. The locations of the monitoring devices are shown below



Source: BBPTKB (Unit for Research and Development of Technology for Geological Disasters)

Figure 4-102 Monitoring Post and Location of Monitoring Devices for Mt. Merapi

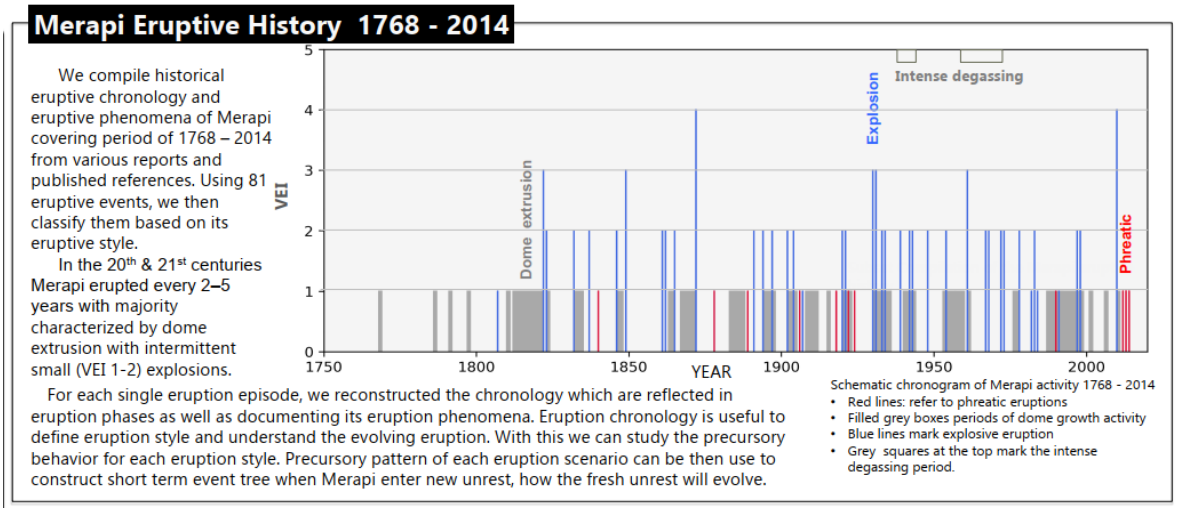
Monitoring data is sent to the monitoring center at BBPTKG, and monitoring by the personnel is continued for 24 hours. (See below pictures). The growth situation of the volcanic crater, the temperature near the crater, and the record of the seismograph are constantly monitored. Beside these, at the time of eruption, analysis of eruption gas and ejections is also carried out in this unit.

	
General View of Monitoring Center	Temperature in each Monitoring Area
	
Records of Temperature around the Crater	Monitoring Image for New Cinder Cone in CCTV
	
Records of Seismometer	Records of Seismometer in Eruption Event of 2010

Source: The JICA Survey Team (September 2018)

Figure 4-103 Monitoring Volcanic Activities at BBPTKG for Mt. Merapi

The eruption record of Mt. Merapi volcano arranged by BBPTKG and the University of Gajah Mada (UGM) is shown below. According to the analysis results from 1768 to 2014, the eruption frequency from the 20th century to the 21st century has been evaluated “once every 2 to 5 years”.



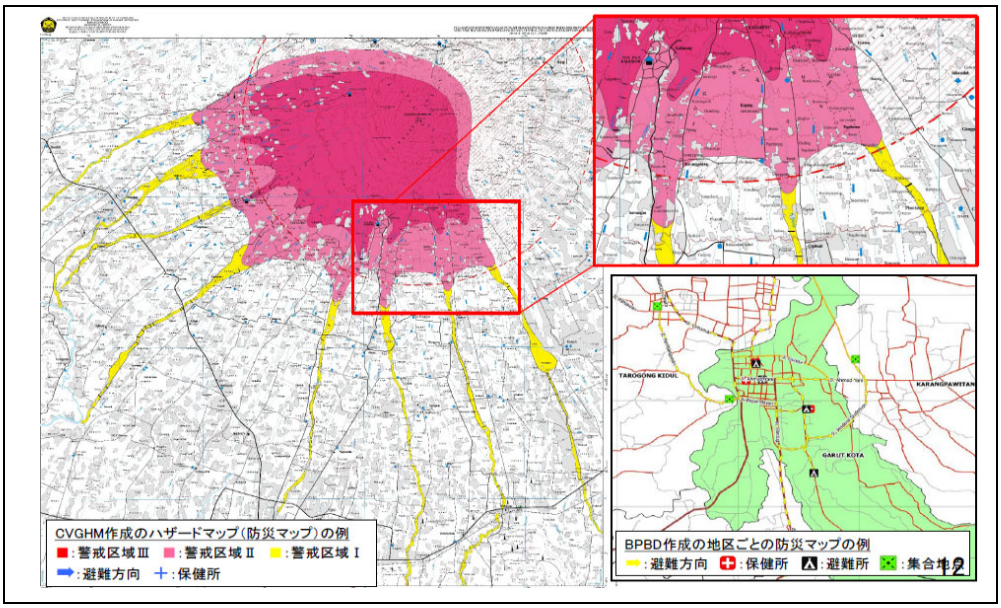
Source: Application of Long-Term event Tree analysis for volcanic hazard assessment at Merapi Volcano, Indonesia (BPPTKG, UGM & Earth Observatory of Singapore).

Figure 4-104 Historical Eruption Record of Mt. Merapi (BBPTKG, UGA)

2) Countermeasures for Mt. Merapi Eruption

Volcano eruption countermeasures are responsibility of BPBD DI Jogjakarta. Regarding the eruption information situation, information from the above-mentioned BBPTKG is contained to BPBD in real time. Using information system "WhatApp", BBPTKG informs volcanic information to stakeholders and local communities. Information exchange between BPBD and BBTKG is very good. Regarding the 2010 volcanic eruption event, in addition to BPBD DI Jogjakarta, four (4) Kabpatens (Sleman, Magelang, Boyolali, Klaten) locationsin the eruption area were working together.

Disaster hazard map showing evacuation routes, hospital locations and related information created in Mt. Merapi volcano is shown below. Updates are made every five years considering the population increase, road construction and so on.



Source: Disaster Prevention System in Overseas(Indonesia、Cabinet Office, Japan.2017.3)

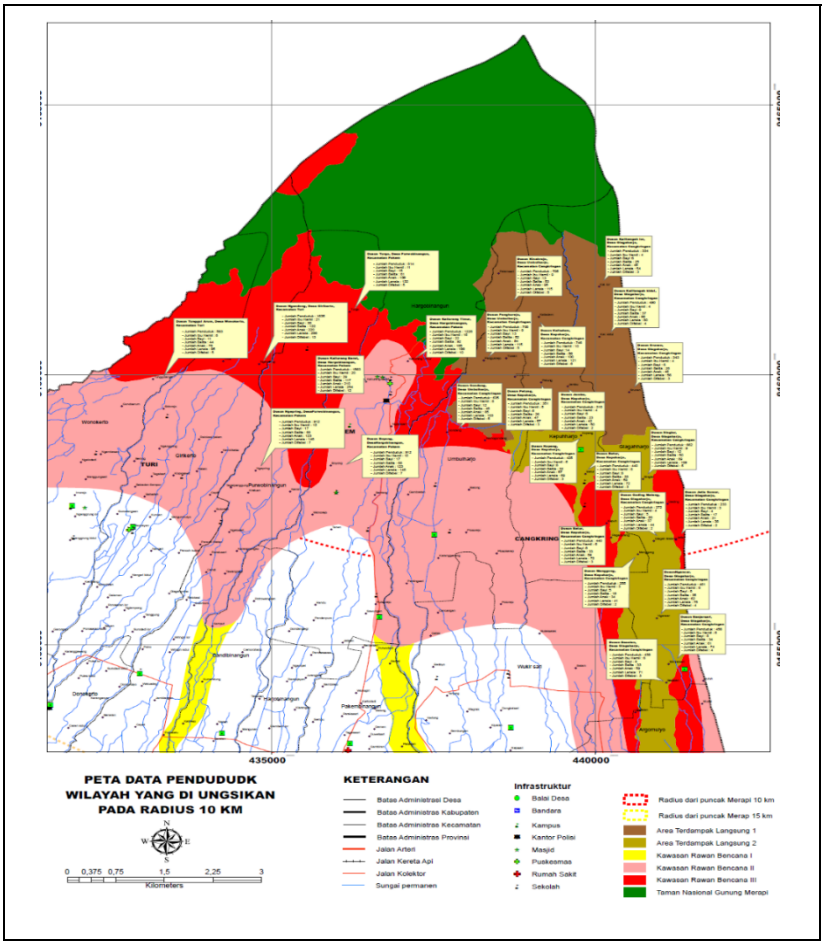
Figure 4-105 Disaster Hazard Map in Mt. Merapi

The following figure shows the target population by survey result for each hamlet (dusan in Indonesian) assumed at the time of evacuation within the radius of 10 km from the crater prepared by DI Jogjakarta BPBD. In figure, the total population in hamlet, the population of pregnant women, infants, aged people and so on are shown

Dusun Turgo, Desa Purwobinangun, Kecamatan Pakem - Jumlah Penduduk : 814 - Jumlah Ibu Hamil : 11 - Jumlah Bayi : 15 - Jumlah Balita : 61 - Jumlah Anak : 109 - Jumlah Lansia : 132 - Jumlah Difabel : 5	Dusun Turgo, Desa Purwobinangun, Kecamantan Pakem **-Total population: 814** **-Population of pregnants: 11** **-Population of babies: 15** **-Population of toddlers: 61** **-Population of childeren: 109** **-Population of aged people: 132** **-Population of disable people: 5**

Source: Evacuation Map within Radius of 10km (BPBD DI Jogjakarta)

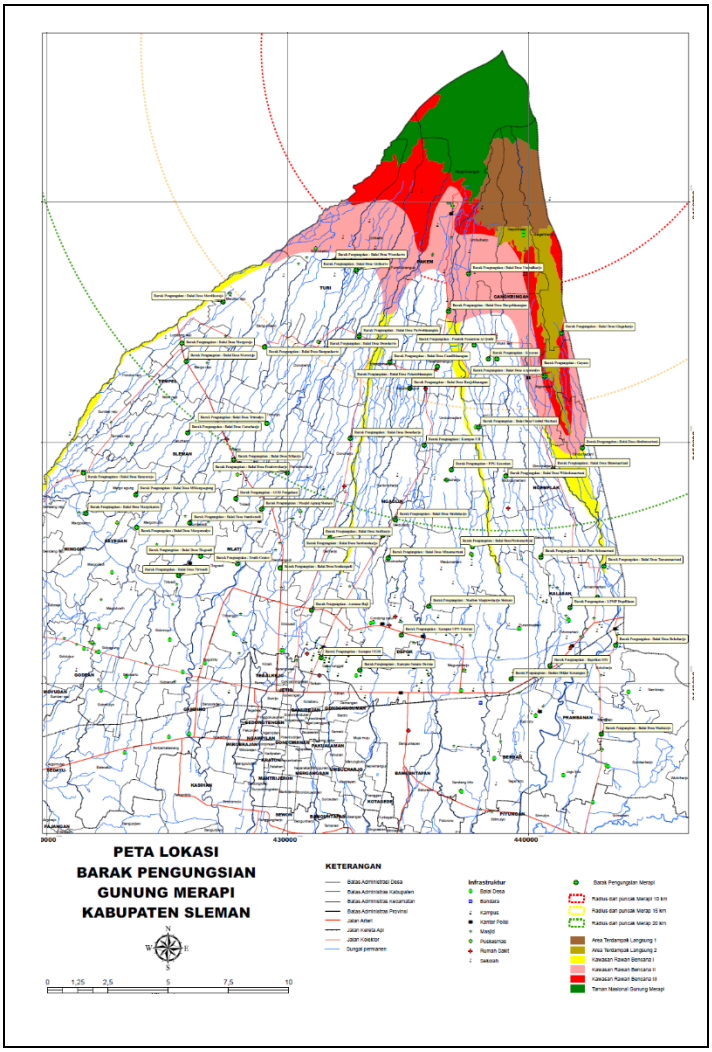
Figure 4-106Target Population for Evacuation for Each Hamlet



Source: Evacuation Map within Radius of 10km (BPBD DI Jogjakarta)

Figure 4-107 Target Population for Each Hamlet in Evacuation Area within 10 km from the Crater

In addition to the above, the figure showing the location of the evacuation centers for each evacuation designated area is shown below.



Source: Evacuation Map within Radius of 10km (BPBD DI Jogjakarta)

Figure 4-108 Location of the Evacuation Centers for Each Evacuation Designated Area (Kab. Sleman)

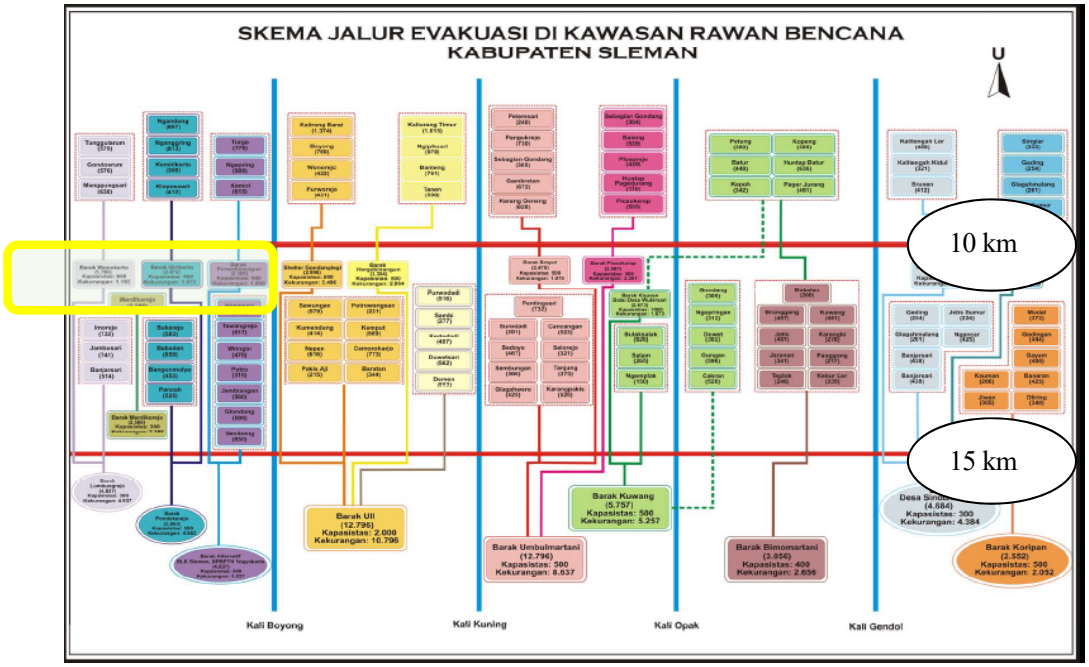
A current situations of the evacuation center in Desa (village) Kepuhatjo are shown below. This center functions normally as an exercise and ceremonial facility, and functions as an evacuation center (shelter) during volcanic eruption.

	
Evacuation Center (Desa Kepuharjo)	Evacuation Center Ground (Desa Kepuharjo)

Source: The JICA Survey Team (September 2018)

Figure 4-109 Evacuation Center in Desa Kepuharjo (Mt. Merapi Area)

Figure below shows the target population for evacuation for each distance of 10 km, 15 km from the crater of Mt. Merapi in Kabpaten Sleman. This figure also shows the capacity of evacuation center and deficiency (shortage) of population comparing with the capacity.



Source: Evacuation Map within Radius of 15km (BPBD DI Jogjakarta)

Figure 4-110 Target Population for Evacuation, Capacity of Evacuation Center and Deficiency of Population for the Capacity (Desa Kepuharjo)

From the above Figure, the extracted items on target population, capacity of evacuation center and deficiency of population for the capacity at each shelter are shown below.

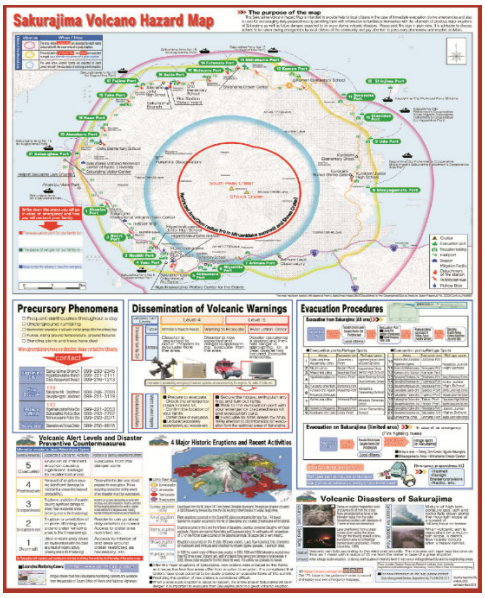
Figure 4-111 Target Population, Capacity of Evacuation Center and Deficiency of Population for the Capacity at each Shelter (Extracted from Figure Above)

According to the above figure, the target population of the evacuation center Barak Wanokerto is 1,763, the capacity of center is 600, and 1,193 people are short of the capacity. Many evacuation centers are short of capacity, but at times of volcanic disaster, there are people who can remain at home or move to other areas. Regarding shortage, although it is possible to accept a certain population with flexibility, in general, there is a shortage of the evacuation capacity.

In order to mitigate death toll by volcanic disasters, the provincial government planned to relocate about 700 households living in a hazard areas called “Highest Hazard Area, KRB 3”, and in 2018, the relocation with supplying housing of 30 households was completed. In 2019, the government plans to relocate 40 households. In addition, PUPR is adding shelter in view of the shortage of the evacuation shelter mentioned above

Regarding community based disaster prevention, BPBD have completed the program (Disaster Resilient School Program) at 70 schools of 1,906 schools in total, and at the village level 176 villages (301 villages in total) have already implemented similar programs.

As a request for assistance from JICA, BPBD would like to create a comprehensive hazard map as created in "Sakura-jima", Japan in the future. In addition, BPBD wanted to introduce radio alarm information system as well.



Source: Kagoshima City, Japan

Figure 4-112 Volcanic Eruption Hazard Map in Sakurajimam Japan

3) Volcanic Sabo Projects and Rehabilitation Works after 2010 Mt.Merapi Eruption

The following is a summary of JICA's implementation of the Mt. Merapi Volcano SABO project.

Table 4-55 Summary of Volcanic SABO Projects in Mt. Merapi

Implementation Period	Type of the Project	Project Name
1977-1980	Technical Cooperation	Master Plan for Land Erosion and Volcanic Debris Control in the Area of Mt. Merapi
1985-1993	JICA Loan LA:October,1983	Urgent Disaster Reduction Project for Mount Merapi
1995-2001	LA:December 1995	Mt. Merapi and Mt. Semeru Volcanic Disaster Countermeasures (2)
2000-2006	Technical Cooperation	Integrated Sediment-related Disaster Management
2006-2014	JICA Loan LA:March 2005	Urgent Disaster Reduction Project for Mt. Merapi, Progo Basin
2009-2012	Technical Cooperation	Multi-disciplinary Hazard Reduction from Earthquakes and Volcanoes in Indonesia
2014-2019	Technical Cooperation	Project for Integrated study on mitigation of multimodal disasters caused by ejection of volcanic products
2014-2019	JICA Loan LA: February 2014	Urgent Disaster Reduction Project for Mt. Merapi 2

Among the above, Urgent Disaster Reduction Project for Mt. Merapi, Progo Basin, started in 2006 shown as follows. This loan also includes rehabilitation works after the 2010 eruption of Mt. Merapi.

Table 4-1 Outline of Urgent Disaster Reduction Project for Mt. Merapi, Progo Basin

Items		Main Outputs
(a) Countermeasure against debris flow	Structural Countermeasures	● Construction of sabo facilities (30 units)
	Non-structural Countermeasures	● Installation of debris flow monitoring, forecasting and early warning systems (Rainfall observation station: 6 locations, Master station: 1 location, Control station: 1 location, Monitoring station: 3 locations) ● Evacuation shelter (3 units), Evacuation roads (5.82 km) ● Development of GIS system for volcanic disaster ● Procurement of heavy equipment for disaster recovery works, maintenance structure ● Assistance for capacity strengthening of regional disaster prevention ● Dissemination and education of disaster prevention knowledge in cooperation with educational institutions ● Evacuation drills (Note)
(b) Progo riverbed stabilization		● Construction of consolidation dam (2 units)
(c) Sand mining management		● Preparation of sand mining management plan ● Implementation of community-driven monitoring activities
(d) Regional development at the mountain foot		● Rehabilitation of irrigation facilities (14 units) ● Construction of consolidation dam (1 unit)
(e) Urgent disaster countermeasures for 2006 earthquake and eruption		● Construction of sabo facilities (6 units) ● Rehabilitation of irrigation facilities (35 locations) ● Rehabilitation of water source facilities (20 locations)
(f) Urgent disaster countermeasures for 2010 eruption		● Rehabilitation of sabo dam (5 units) ● Embankment, construction of training dykes (2 units)

Note: Participatory community activities, evacuation drills and preparation of disaster prevention manual were conducted.
Source: FY 2016 Ex-post evaluation of Japanese ODA Loan Project

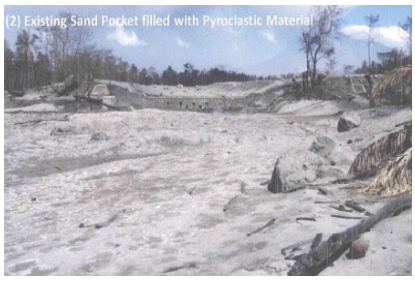
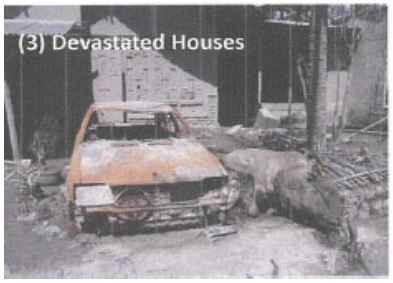
The occurrence conditions of debris flow at the eruption of Mt. Merapi volcano in 2010 (5 - 9 November 2010) are shown in the following Figures. The pyroclastic flow occurred in K. Gendol on November 5 2010.

K. Putih PU-C2

K. Bebeng BE-C7

K. Kuning KU-C5

K. Gendor GE-C

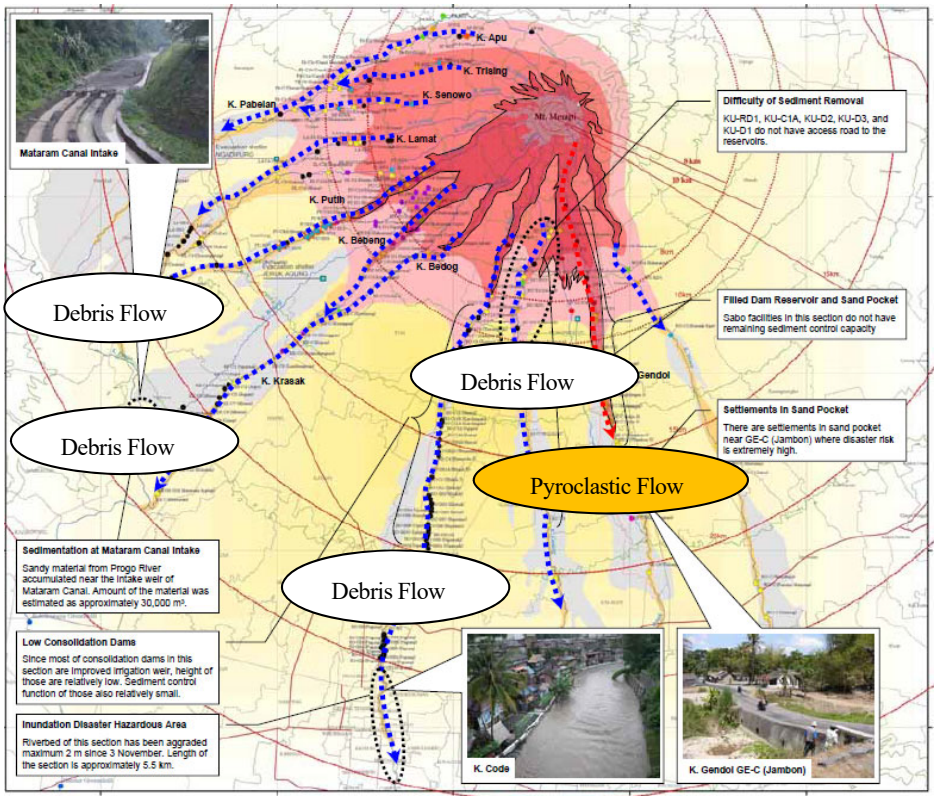
	
K. Code	K. Boyong BO-C10
	
Sand Pocket filled with Pyroclastic Flow Materials (K.Gendol)	Devastated Houses and Car (K. Gendol)

Source: Loan Project Team on Mt. Merapi

Figure 4-113 Debris Flows by Erupted Materials at Mt. Merapi in 2010 Event

The profile of damages caused by volcanic eruption in 2010 is as follows. The amount of sediment yield is estimated at 140 million m3 (Kyoto University: Annual Report on Disaster Prevention Research, No. 55, 2012), and sediment damage profiles at the southwestern slope basins (Kali Paberan, Kali Putih and Kali Bebeng) are different from southern slope basins. Volcanic ashes flowed out and pyroclastic flow occurred in the south-western slope basins, whereas pyroclastic flow occurred in southern slope basins such as Gendol River (Kali Gendol) and its tip portion reached nearly 15 km from the crater.

Debris flow occurred in other rivers, especially in K. Boyong, it reached within 30 km from the crater. Sediment discharge to the intake facility and rising of the riverbed were also observed in the river of southwest basins. In the southern slope where the pyroclastic flow occurred, washing away of bridges, decreasing sediment storing capacity of Sabo dams and sand pockets were revealed.



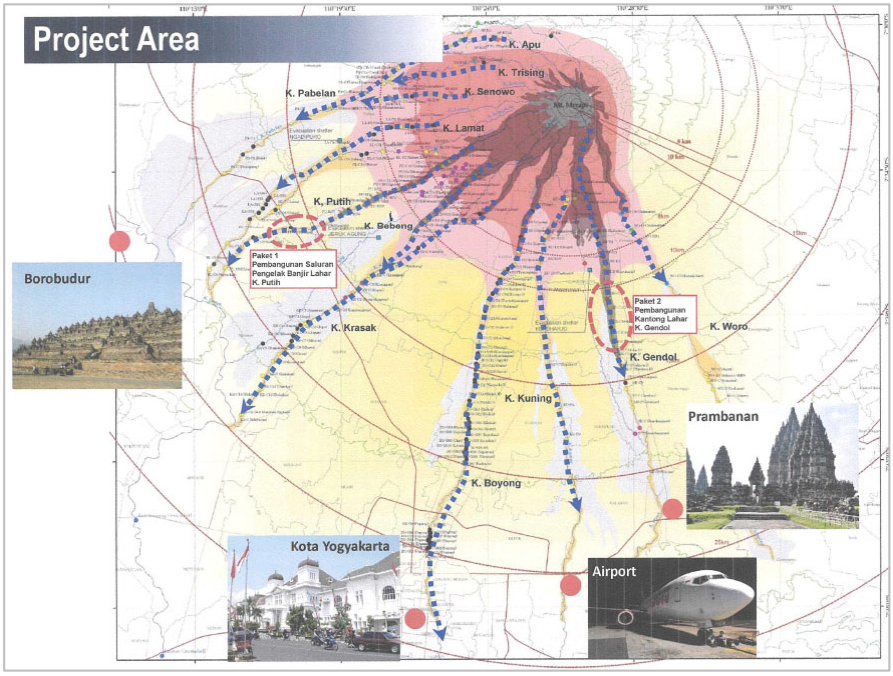
Source: Loan Project Team on Mt. Merapi

Figure 4-114 Debris Flows and Pyroclastic Flow Occurrences in the Basins of Mt. Merapi

4) Outline of Urgent Disaster Reduction Project for Mt. Merapi, Progo River Basin

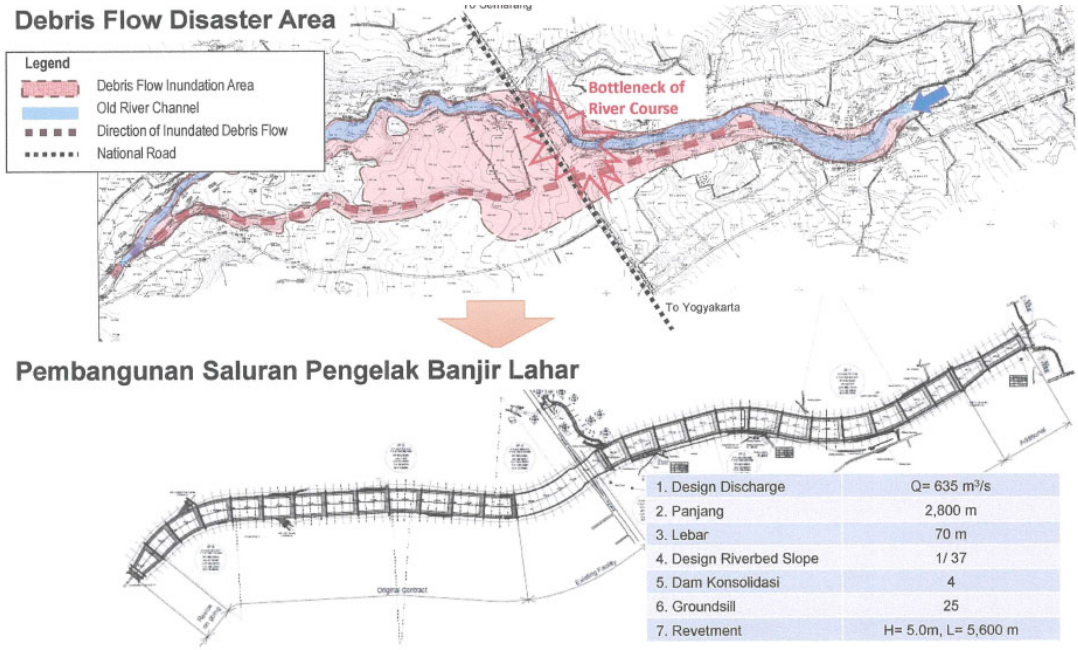
This project was started in response to volcanic eruption in 2010 and is being implemented in the construction period of 5 years from June 2014 to June 2021. The total loan amount is 5.1 billion JPY in terms of currency conversion to Japanese Yen (JPY) (construction cost 4.36 billion yen, consulting service 530 million yen and contingency cost 2.2 billion yen). Construction target areas are the construction of the diversion channel in the Putih River and construction of the sand pockets including the improvement of existing SABO facilities in the Gendol River.

For the Petih River, it was intended to widen and normalize the river by increasing the flow capacity of the river damaged by the debris flow and sedimentation. In addition, diversion channel connecting with the existing river aim at supplying irrigation water to irrigated areas were designed and constructed.



Source: The Project Team on Urgent Disaster Reduction Project for Mount Merapi and Lower Progo River Area II (IP-566)

Figure 4-115 Outline of Urgent Disaster Reduction Project for Mount Merepi



Source: The JICA Surveyt Team on Urgent Disaster Reduction Project for Mount Merapi and Lower Progo River Area II (IP-566)

Figure 4-116 River Works in Putih River (Normalization and Diversion Channel)

Pictures after completion of works for diversion channel are shown below in Figure 4-117.

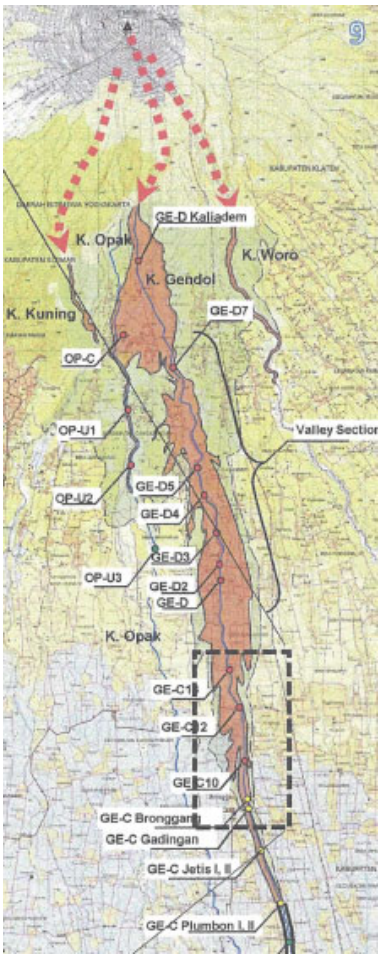
Diversion Channel

Old Putih River Channel after Improvement

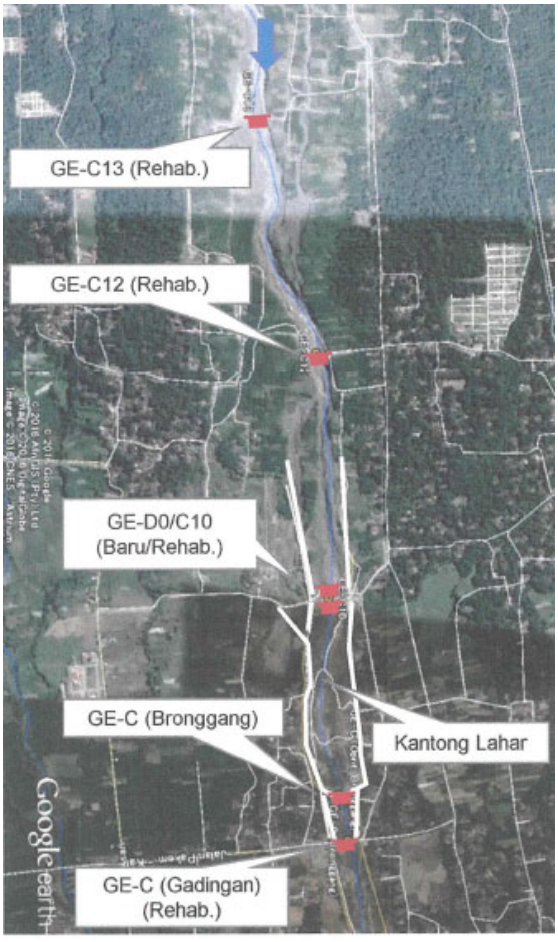
Source: The Project Team on Urgent Disaster Reduction Project for Mount Merapi and Lower Progo River Area II (IP-566)

Figure 4-117 River Works for Diversion Channel in the Putih River

For the Gendol River, since there are many sediments caused by pyroclastic flows, in order to increase the sediment control capacity, new sand pockets and rehabilitation of existing sand pockets were planned and works were done. The number of targeted sand pockets are five, and it ranges from GE - C 13 in the upstream side to GE - C in the most downstream side.



Location of Works



Location of Five (5) Sand pockets

Source: The Project Team on Urgent Disaster Reduction Project for Mount Merapi and Lower Progo River Area II (IP-566)

Figure 4-118 Sand Pocket Works in the Gendol River

The current situations of sand pocket facilities in the vicinity of the most downstream GE-C is as follows.

	
Sand pocket GC-C(Broggang)	Sand pocket GC-C (Gadingan)

Source: The Survey Team

Figure 4-119 Sand Pocket Works in downstream of the Gendol River

5) Review of the Master Plan and SABO Facility Planning (2017)

Based on the 2010 eruption event and SABO facility rehabilitation works, a review of the current master plan formulated in 2001 was made in 2017, and facility plan (draft) was formulated. The outline is as follows.

a. Regarding sediment control volume, follow the policy of the current master plan.
b. For rivers where the sediment control ratio exceeds 60%, construction works are undertaken to improve the SABO facilities and stabilize the river bed.
c. For rivers where sediment runoff is small, execute debris flow countermeasure works.

Among the above, for rivers where the sediment control ratio exceeds 60%, it was decided to adopt open type SABO dam.

Source: Review Master Plan (2017)

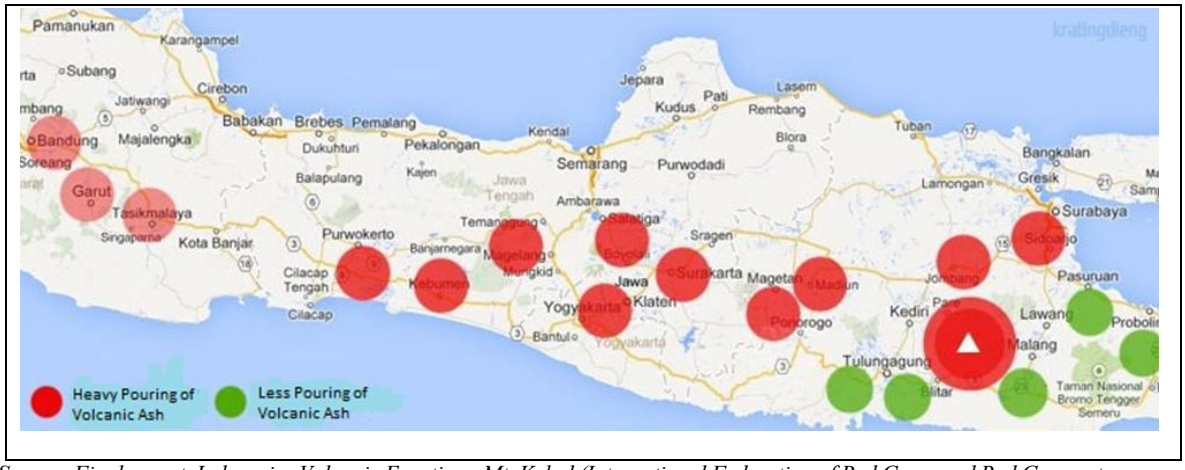
Figure 4-120 Construction Example of Open Type SABO Dam

(2) DRR Activities on Mt. Kelud Vilcanic Eruption

Among the cooperation projects mentioned above, Mt. Kelud volcano located in East Java province erupted on February 13, 2014. Disaster mitigation activities accompanying the eruption are organized as follows.

1) Disaster Profiles

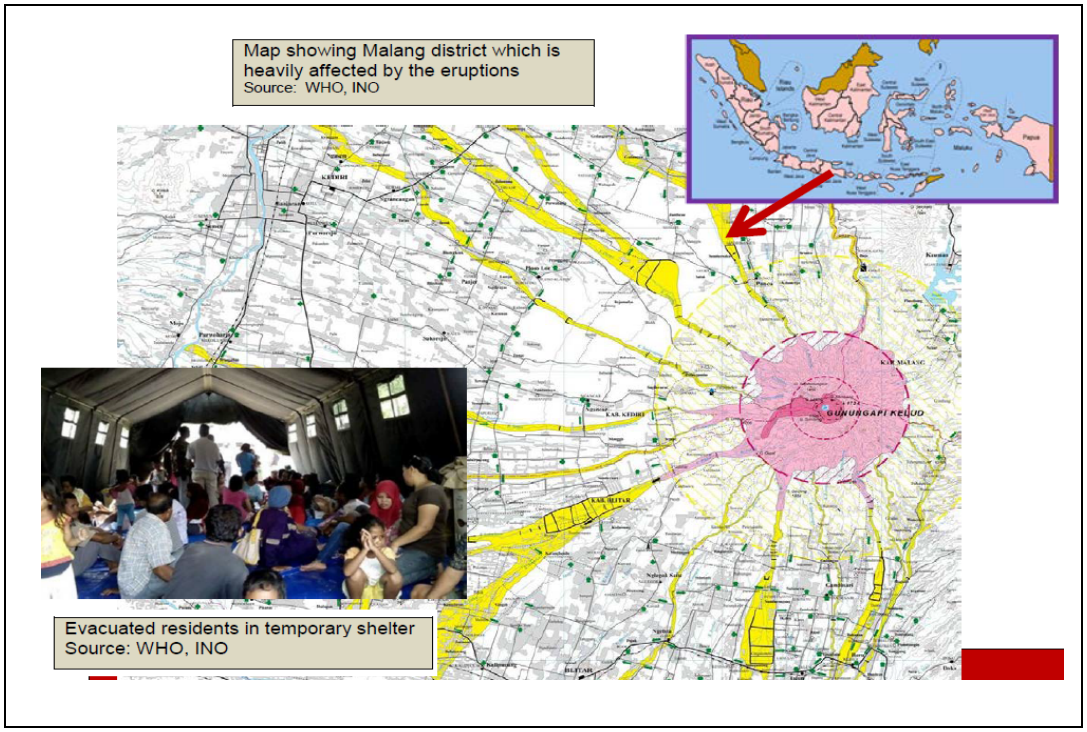
PVMBG issued an alert on Level II, “Danger” for Mt. Kelud volcano on 2 February 2014. This alert was switched to Level III (ready to erupt) on 10 February, and on 13 February, a warning of Level IV (Active dander) was issued. Volcanic eruption occurred 2 hours after issuing an alarm, and after that, active eruption activity continued for about a week. On 20 February, the warning level was lowered to Level III, but disaster prevention and restoration activities were carried out until the end of April. Major disasters affected the three districts of Kediri, Blitar and Malang, but the impact of the ash pouring drops in the range of 250 km, so that seven airports such as Surabaya, Solo, Jogjakarta were closed.



Source: Final report, Indonesia: Volcanic Eruption –Mt. Kelud (International Federation of Red Cross and Red Crescent Societies, IFRC)

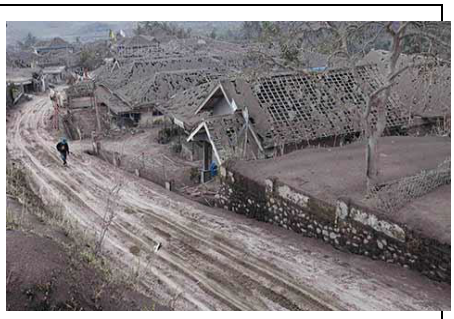
Figure 4-121 Ash Pouring of Volcanic Ash by Mt. Kelud Eruption

Hazard area on Mt. Kelud and disaster profiles area show below.



Source: Mt. Kelud Volcano Eruption, Kediri-Blitar-Malang District, East Java Province (WHO ESR-2, 2014)

Figure 4-122Hazard Areas of Mt. Kelud and Its Location

Damage Conditions on the Roofs by Ash Falls in Kediri

Source: Final report, Indonesia: Volcanic Eruption –Mt. Kelud (International Federation of Red Cross and Red Crescent Societies, IFRC)

Figure 4-123 Houses Damaged by Eruptions

Details of the damage summary are shown below. The death toll was seven (7) and the missing person was 15. Displaced peoples reached 100 thousand in total.

Table 4-56 Damage Summary of Mt. Kelud Eruption (2014)

Item	Kediri	Malang	Blitar	Total
Death Toll				7
Missing				15
No. of Displaced Person	66,319	28,970	3,610	98,899
No. Camps	25	63	14	102
Heavily Damage for Houses and Public Facilities	8,622	1,514	957	11,093
Moderately Damage for Houses and Public Facilities	5,426	1,066	878	7,370
Minor Damage for Houses and Public Facilities	5,088	1,378	1,578	8,044

Source: Final report, Indonesia: Volcanic Eruption –Mt. Kelud (IFRC, July 2014)

2) Response by Related Agencies

As a disaster response at the time of the 2014 eruption in Mt. Kelud volcano, response among the agencies were classified as follows:

a. Refugee response: Vice Governor of East Java, East Java Province
b. Secure local safety: East Java Chief of Police
c. Restoration and improvement of housing, infrastructure and public facilities:
East Java Commander of Military Region

As a mechanism to respond to the disaster of Mt. Kelud volcanic disaster, under the support of BNPB, BPBD and BASARNAS (National Research and Rescue Agency) were mainly involved, military and police also joined. Furthermore, local organization, political organization, NGO and Red Cross (PMI) responded. The coordination mechanism including the response was taken. All orders were made on a daily basis from the reports sent by relevant departments based on a coordinated meeting in the "Provincial Command Post (PCP)" of the Government Department established near the place of the disaster. Information on evacuated people was made by Emergency Operation Center via telephone or wireless. District level command post was founded in Kediri and Malang City under the PCP. (*Source: the PMI report*)

Responding to the eruption of Mt. Kelud volcano by International Federation of Red Cross and Red Crescent Societies (IFRC), drinking water supply to 3,400 families and 16,500 people in three districts over about two (2) months, placing water supply piping system, medical services, equipment and materials supply for measures against water related diseases and rescue activities were made. The main activities are as follows.

Table 4-57 Urgent Aids by IFRC for Mt. Kelud Eruption (2014)

SN	Activities, Operations	Outputs
1	Shelter and household items	3,400 tarpaulins and shovels were distributed。
2	Food security	Cooked meals were provided through mobile kitchen services
3	Water sanitation and hygiene promotion	Water supply with 1.6 million m3 by truck, Distributed jerry cans with 3,400 and clean up equipment and tools, Conduct cleanup for wells and water sources
4	Health and care	Provide health service by mobile clinic to displaced population, Provide affected people with personal protective equipment.

Source: Final report, Indonesia: Volcanic Eruption –Mt. Kelud (IFRC)

Among the above activities, there were medical activities by mobile clinic as representative as support activities after eruption. At the time of the eruption of the Mt. Kelud volcano, daily medical activities were made through the Indonesian Red Cross (PMI) ambulance. Mobile clinics also provide psychological support for infants who have suffered mental damage due to disasters. These activities were carried out under the management responsibility of the Ministry of Health. Regarding the water supply, there was restoration activity of 14 km of water supply pipes in Malang province. In the restoration of the buried pipe damaged by the volcanic eruption, PMI provided funds for purchasing pipes, the residents restored based on this, and the local governments implemented connection of the pipes to each house. Furthermore, accompanied by supplying water to households, water supply to livestock was made, and cleaning-up activities for wells, roads, and drainage channels covered with ashes and debris were conducted.

These activities were implemented by funds from Disaster Relief Emergency Fund (DREF) of the IFRC (CHF 240, 127 (equivalent to JPY: 27,400 thousand yen) in 2 months). As a lesson from disaster at this time, the IFRC recommends implementing Cash Transfer Programming (CTP) for food and relief items. With appropriate implementation of CTP, beneficiaries (displaced people) can choose aid based on their needs and make better use of resources, stimulating the regional economy, and saving time and effort on distribution and warehousing.

4.6 Forest and Peatland Fire

4.6.1 Characteristics of Recent Forest and Peatland Fire

Problems in Indonesia's lowland areas are forest and peat fires. They are caused by loss of water from the peat in the forest's roots that develop in tropical and wetlands such as mangroves and burning in the dry area. One of the reasons for the forest and peat fire is residents. They put fire on the forest aiming for obtaining lands for planting lucrative crops such as perm trees or just weeding.

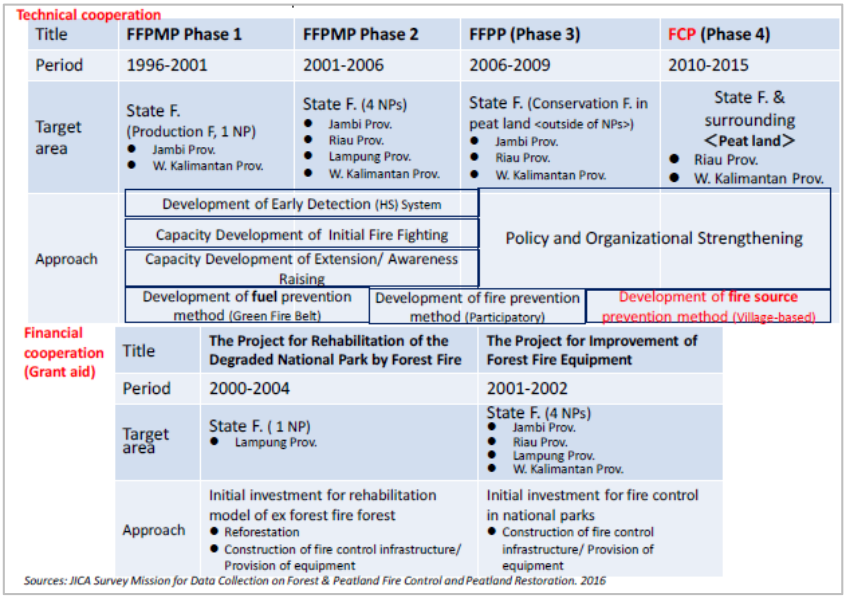
Tropical peatlands accumulate a large number of carbons. Most of the tropical peatlands in Indonesia are located in lowland areas. However, as the consequence of establishing the large scale of channels and logging in tropical peatland forests at the end of the 20th century, carbon emissions from peatland has increased because of fire outbreaks and decomposition by microbes. In addition to the difficulties of extinguishing the fire in peatland, the extension of the fire causes further carbon emissions. Moreover, when the peat burns, a large amount of carbon dioxide is generated as the fire spreads, and a haze is generated, and the fume spreads to neighboring countries. In fact, El Niño has caused a large-scale forest and peat fire in 2015 due to a large amount of GHG emission equivalent to the emission in Germany in one year and increased respiratory diseases and cancellation of flights due to haze and diffusion of haze to the neighboring countries. In the neighboring countries, there is a damage caused by the occurrence of respiratory diseases and the cancellation

of aircraft. Thus, forest and peat fire control in Indonesia is important for protecting the interests of not only its own country but also neighboring countries.

Once a fire occurs, it is difficult to extinguish the fire, and particularly in forest and peat fires, disaster prevention method is important, such as re-wetting peatlands, prevention of burning by residents, early detection of HS, etc.

4.6.2 Cooperation by JICA

Under these circumstances, JICA has implemented the 3 phases of technical cooperation for forest fire control since 1996. The project outputs include supporting the development of the system by formulating ministerial and director general's decrees, building early warning system utilizing satellites, developing fire extent control focusing on national parks and fire prevention system. Moreover, the five-years technical cooperation until July 2015 "Program of Community Development of Fires Control in Peatland Area (hereafter referred to as "FCP")" was implemented. The results in the targeted provinces by applying village-based fire prevention activities by village facilitation team (Tim Pendamping Desa/ TPD) composed of fire brigade (Manggala Agni/MA) and community groups in Riau and West Kalimantan Provinces showed the decreased numbers of burning by community residents resulting in the reduction of hotspots.



Source: Information Collection Survey on Forest and Peat Fire in Indonesia JICA mission. 2016

Figure 4-124 Outline of Past MoEF-JICA Corporation on Forest and Peatland Fire Control

In addition, as a solution to the problem for forest and peatlands firecontrol, JICA implemented Science and Technology Research Partnership for Sustainable Development (SATREPS) with Hokkaido University from 2009 to 2015, and peat forest management method by "Fire and carbon management project in peat and forest in Indonesia". The project created the construction of fire detection system and carbon evaluation mode

Chapter 5. Direction of Problem Solving on DRR

5.1 Outline of Problem Solving on DRR

5.1.1 Problem Solving on DRR

Current situations and problems in DRR field are organized based on following items;

- Law／Standard, Guideline
- Organization, Inter-organizational Cooperation／Enhancement of Talent and Ability
- Planning and DRR Policy
- Budget related to DRR
- Local Area

Table 5-1 Challenges of DRR in Indonesia

(1) Law／Standard, Guideline	① BNPB ragards preparedness as a non-structural countermeasure before disaster occurance. It includes early warning system, evacuation, stockpiling, etc. On the other hand, structural measures by dams and river structures have not been included in the concepts of preparedness, mitigation nor prevention. This is attributed to the fact that BNPB is not directly involved in the construction of structural measures, and its effects have not been fully recognized. In government ordinance No.21, BNPB is stipulated to be responsible for preparedness, but preparedness is not clearly defined in it. Due to the background, BNPB has low perceptions and responsibilities for DRR infrastructure investment. Investment on DRR infrastructure is not fully recognized as integral countermeasures. Recognition of integrality of DRR infrastructures and its reflection on national DRR plans are critical ② The responsibility of organizations for each of DRR tasks has not been systematically specified in details. The laws do not clearly stipulate measures against tsunami. For this reason, disaster prevention efforts are being implemented by the ministries and agencies without collaboration. It is necessary to systematically coordinate the works of each of the organization. ③ KEMENDAGRI which supervises BPBD is responsible for formulating a system to conduct DRR activity by local governments. BPBD actually carries out disaster prevention activities uneder local governments. Recently, Minimum Standard Service is stipulated and DRR activity items, more detailed technical guideline in the form of Minister of Home Affairs Regulation, are prescribed for the internal mandate of disaster management. This is planned to promote specifications consisting of more than 100 items according to the rules of the province of KEMENDAGRI. Its contents are expected, planned as June 2018, to be completed at the soonest timing.
(2) Organization, Inter-organizational Cooperation ／ Enhancement of Talent and Ability	④ As a current situation, cooperation and communication among organizations taking part in DRR such as BNPB and PUPR aren't sufficient. The activities defined by laws are only conducted by each of the organizations almost independantly. Each organization doesn't interfere other's activities. BNPB construct IDMMP so that it consists of only what BNPB is responsible for as stipulated in laws and doesn't include projects

	implemented by PUPR. ⑤ It is reaffirmed that cooperation isn't enough even among the central government. Information is not shared well among BNPB and others. During the second survey in this study, interview surveys to BMKG and PUPR were conducted to get information about implemented projects. Early Warning System issued by BMKG is almost simply a weather forecast. It is only delivering predicted weather 3 days in advance. But it doesn't predict river flooding nor inundation area on hourly basis. Flood Prone Map simply lays rainfall information over topographical information. It is not based on any flood analysis. PUPR doesn't analysis inundation simulation to make a plan even in large scale river basins like BBWS Bengawan Solo. Outcome which indicates benefits from a river improvement project is based on past projects' results, e.g.) 1 km embankment length benefits 10 ha protection area. These situations have to be improved. it is integral that ministries and agencies improve their capacity, while collaboration is enhanced among related organizations with BNPB. ⑥ In Line ministries such as PUPR, there is a gap in the ability of hazard analysis between central and local staff. Gaps can be also seen among local staff. It is necessary to develop the capacity of relevant organizations, staffs' DRR skills, and technology.
(3)Planning and DRR Policy	⑦ The next National Disaster Mitigation Master Plan (IDMMP) is being developed through 2019, and its contents are policies rather than plans. No concrete description has been found and it has remained a general description. The main administrator of IDMMP is BNPB. The responsibilities of the administrative organizations in Indonesia are regulated by laws and regulations pertaining to each organization. Organizational independence and longitudinal systems are strong. Therefore, the content of IDMMP tends to be biased toward what is to be dealt with and what can be done by BNPB. Descriptions of contents other than BNPB's jurisdiction, such as disaster prevention infrastructure investment, are thin. Importance of the investment on DRR infrastructure have to be clarified in the implementation plan of each of organizations responsible for DRR infrastructure development. ⑧ Value of Risk Index (R=H*V/C) is identified as degree of achievement level of IDMMP so that evaluation and reduction of value become important and issue politically. However, this Risk Index focuses on the capacity improvement that BNPB can perform. Therefore, the development of the DRR infrastructure, which is in charge of PUPR, shows little effect on reducing the Risk Index compared with the amount of its investment. There are items that are not based on scientific basisabout H, V, C evaluation methods, and this is to be improved. Although the revision of the Risk Index can not be resolved immediately, investment in DRR infrastructure is important and effective. Along with the advancement of the Risk Index, its importance and necessity need to be continuously advocated. BNPB's Deputy I: Prevention and Preparedness's Deputy (Sub) Director for Disaster Mitigation, suggests that there are problems that structural measures have not been properly reflected on risk indexes, evaluation based on scientific evidence is necessary, and that these are challenges to be tackled in future.

	⑨ The line ministries also conduct hazard analysis and evaluation on the effect of structural measures without scientific mthods nor data. This is to be improved. Improvement of methods of hazard analysis is an urgent issue because proper understanding of risks is the basis of countermeasures. ⑩ BNPB understands the significant importance of "investment on DRR infrastructures" as jurisdiction and coordination organization of disaster management. As a matter of fact, PUPR is using half of DRR related national budget to construct DRR infrastructure. There is no major discrepancy in the direction that both parties are heading for. ⑪ The damage from earthquakes, tsunamis and volcanic eruptions is enormous. The main countermeasures against the disasters is how to escape to save lives. Non-structural measures are the major solution. On the other hand, major solutions for flood control are structural measures. Because floods occur frequently all over the country, they tend to be regarded as local challenges rather than central government's issues. Since it is called "disaster prevention infrastructure" or "structural measures", it may be regarded as one of the solutions in local areas. In addition, because the structural measures are not in charge of the BNPB, in the past IDMMP s (drafts), the structural measures were not clealy identified. However, IDMMP 2015-2045 (latest version, May 2019) mentions needs and importance of DRR infrastructure investment.
(4) Budget related to DRR	⑫ Disaster prevention investment in Indonesia has been increasing gradually . It has reached almost 1% of the national budget. While investment in DRR infrastructure is almost half of that, there is a large increase in non-structural measures. In that respect, BAPPENAS and BNPB have a large contribution. In general, as the capacity of the national disaster management agency is strengthened, its emphasis will be expanded from emergency response to disaster prevention. Disaster prevention is a cross-sectoral social development issue. In Indonesia as well, it is necessary to allocate budgets for disaster prevention and DRR investment.
(5)Local	⑬ The survey on local governments (Manado and Aceh) surveyed the current situation of disaster prevention in the local areas. It has become clear that there are various issues (organization, budget, ability) on the sites. These are: there is a difference in awarenessabout disaster prevention activities and disaster prevention among related parties. There is a gap in awareness and activities of DRR between the central government (BNPB, PUPR) and local governments. . ⑭ Manado's BPBD (Kota) took close contact with the local people at the time of the disaster. It is the major activities by BPBD (Kota) to deal with residents at the time of disasters. In the event of a disasters, BPBD dispatches its own staff to the sites. On the other hand, although weather information is obtained from BMKG, EW that contributes to evacuation activities is not provided by BMKG. BWS Sulawesi I has been linked on a project basis and an event basis.The outcome as from the central government (PUSAIR) cannot be expected from the BWS. BWS's own analysis on floods or economic benefit (B / C) has not been conducted. Its office scale is small. Its major work on a daily basis is the construction supervision. Master plan formulation and large-scale projects that require engineering analysis are not conducted. DRR investment on infrastructure

	for flood control, or economic evaluation on scientific basis has not been formulated. ⑮ Due to the support of many donors in Aceh, it looked advanced in disaster prevention. The necessity of DRR investment and regulation were mentioned in the meeting with BPBD (Kota), and The importance and necessity of DRR investment, the effectiveness and necessity of structural measures, the necessity of sufficient substantive DRR Action Plan, necessity of local hazard information and etc. were discussed in the meeting with BPBA (Prov.). According to an opinion of the Chief (DR.IR.Muhammad Dirhamsyah) belonging to Disaster Management Advisory Board, Risk index is biased toward social issues and it is important to emphasize investment on DRR. Expectation from BPBA to Japan was very large. It seemed to ask for support in various aspects concerning DRR. Tsunami and inundation simulation was conducted by TDMRC (Tsunami & Disaster Mitigation Center) in Aceh. The effects of road embankment (ring road surrounding Banda Aceh) have been verified as structural measures. BWS Sumatera I explained the actual situation of flood administration in Aceh. Although BWS staff members know the contents of hydraulic analysis and flooding analysis, making of guidelines and standards are contracted to consultants. On the other hand, the importance and necessity of structural measures and the current problems such as sediment deposition were recognized. Although there is an advanced attitude towards disaster prevention, there is a reality that concrete practices and measures are still insufficient.

5.1.2 Summary of Problems Solving on DRR

As mentioned above, various challenges have been tackled in DRR of Indonesia, however, they have not been conducted systematically based on optimal hazard and risk evaluation. It is also a problem that these measures are conducted under the administrative system of vertical line. There are some cases that the measures are not implemented efficiently nor effectively due to lack of coordination among organizations between the central and the local governments or within central governments. Following are confirmed as the critical problems of DRR in Indonesia.

1. Enhancement of understanding disaster risks and hazards
2. Promotion of Increasing investment on DRR
3. Facilitation of collaboration / coordination between related agencies

BNPB, the principle organization for DRR, focuses on improvement of preparedness through the experiences of the earthquake disaster in Bali and Lombok (August, 2018) and the earthquake and tsunami disaster in central Sulawesi (September, 2018). Preparedness is the concepts including EWS and contingency plan. Several types of disasters such as earthquake, tsunami and volcanic eruption is hard for prediction and the large scale disaster cannot be prevented by structural measures only. To save lives, preparedness such as accuracy of warning issuance and contingency plan based on proper risk scenario is inevitable.

Currently, recovery and reconstruction works are on-going in the damaged areas by earthquake and tsunami in South Sulawesi with the concept of Build Back Better (BBB). Although a spatial plan is under preparation by BAPPENAS and ATR, there are some issues arisen such as related agencies including donors insist on their policies, concepts of recovery and reconstruction are not shared. BNPB cannot be involved with their own initiative. The disaster management in Indonesia is in transition from disaster response dominant to

preparedness dominant. System enhancement for recovery and reconstruction and coordination system of related agencies are required as a preparation of possible future disasters.

For solving the problems mentioned above, the mainstreaming of disaster management is inevitable as a fundamental viewpoint.

5.2 Direction for Problem Solving in Disaster Management

5.2.1 International Targets and Indonesian Goals

As an international trend in disaster management sector, SDGs were announced. SDGs aims for 2030 with the 17 Goals and 169 Targets. The goals and targets related to disaster management are included. The related targets to disaster management in SDGs are shown in Table 5-2.

Table 5-2 Targets related to Disaster Management in SDGs

No.	Contents	Year
1.5	Build the resilience and reduce exposure and vulnerability to disasters	2030
2.4	Ensure sustainable food production systems that strengthen capacity for adaptation to disasters	2030
11.5	Significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses caused by disasters with a focus on protecting the poor and people in vulnerable situations	2030
11.b	Substantially increase the no. of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	2020
11.c	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	-
13.1	Take urgent action, strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	-

In the World Conference on Disaster Risk Reduction held in 2015, the following year of SDGs announcement, 4 Priorities for Actions and 7 Global Targets as shown below were agreed as the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR).

Table 5-3 Priorities for Actions and Global Targets under Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR)

No.	Contents	Year
Priority for Action 1	Understanding disaster risk	-
Priority for Action 2	Strengthening disaster risk governance to manage disaster risk	-
Priority for Action 3	Investing in disaster risk reduction for resilience	-
Priority for Action 4	Enhancing disaster preparedness for effective response, and to “Build Back Better” in recovery, rehabilitation and reconstruction	-
Global Target (a)	Substantially reduce global disaster mortality by 2030.	-
Global Target (b)	Substantially reduce the number of affected people globally by 2030.	2030
Global Target (c)	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.	2030
Global Target (d)	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.	2030

Global Target (e)	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.	2020
Global Target (f)	Substantially enhance international cooperation with developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030.	2030
Global Target (g)	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments for the people by 2030.	2030

Indonesian Government formulated the IDMMP 2015-2045 (Final Version (May 2019)) which has the vision "Establishing a Disaster Resilient Indonesia for Sustainable Development" and the missions shown in Table 5-3. The IDMMP was formulated based on the problems in disaster management sector in Indonesia, and focuses on DRR investment, understanding of disaster risks and disaster risk governance. It corresponds to the SFDRR.

Table 5-4 Vision and Mission for Disaster Management Year 2015-2045 (Final Version (May 2019))

Vision	Establishing a Disaster Resilient Indonesia for Sustainable Development
Mission	1. Strengthen the regulatory and policy frameworks, as well as institutional integrity in disaster preparedness and DRR that responsive to current development. 2. Increasing the investment for DRR & Preparedness. 3. Realizing rapid and reliable emergency response. 4. Conducting recovery of disaster affected areas and communities for building a better life. 5. Realizing management support and disaster management governance that professional, transparent and accountable.

Source: The Survey Team based on Disaster Management Master Plan 2015-2045: Kementerian PPN/Bappenas, BNPB Jakarta, December 2018

5.2.2 Basic Concepts for Problem Solving in Disaster Management Sector

The basic concepts for problem solving in disaster management sector is summarized in this section. As mentioned above, the following 3 concepts will be pillars for solving the problems.

- Understanding of Disaster Risk and Hazard
- Increase of Investment on DRR
- Enhancement of Coordination of Related Agencies

These are corresponding to the Priority for Action 1: Understanding Disaster Risk, Priority Action 3: Investing in Disaster Risk Reduction for Resilience and Priority for Action 2: Strengthening Disaster Risk Governance to Manage Disaster Risk, respectively. Based on these pillars, necessary activities will be implemented for solving the problems considering the international trends such as SDGs and SFDRR.

In addition, the mainstreaming of disaster management is inevitable as the fundamental viewpoint and the efforts for acceleration is required. Besides, the recent efforts of BNPB to improve prepared ness is also considered.

As the results, the following 5 concepts are the pillars for solving the problems. It is noted that the issues in the recovery/reconstruction stage which were revealed in the Central Sulawesi Earthquake Disaster are included in DRR investment as preparedness for possible future disaster.

1) Mainstreaming of Disaster Management (Fundamental Viewpoint, Priority for Action 2 under SFDRR)
2) Understanding of Disaster Risk and Hazard (Priority for Action 1)
3) Acceleration of Investment on DRR (Priority for Action 3)
4) Enhancement of Preparedness (Recent Trend of BNPB, Priority for Action 4)
5) Enhancement of Coordination of Related Agencies (Priority for Action 2)

5.2.3 Recommendations for RPJMP and NDMP (Efforts needed for DRR)

In this section, the necessary approaches in the field of disaster management in Indonesia in respect with RPJMP and NDMP are explained from each of the five viewpoints described above. The presentation materials given to concerned Indonesia institutes are attached to Appendix-3.

5.2.3.1 Promotion of Mainstreaming DRR

Consideration for disaster risks and hazards and awareness of future risk are insufficient at working and decision maker stages, such as insufficient budget for disaster management and lack of coordination. This concept is the fundamental viewpoint for cross-sectoral disaster management and inevitable for taking measures positively and comprehensively. The necessary efforts are as follow.

- Establishment of legal system to promote mainstreaming DRR and monitoring implementation status
- Setting common goals among organizations for disaster risk reduction
- Reflecting common goals and disaster risk / hazard assessment results for disaster risk reduction in each development plan and policy decision (national and local levels)
- Capacity building of related agencies

5.2.3.2 Understanding of Disaster Risk and Hazard

In Indonesia, evaluation of hazards are conducted by the line ministries while risk are taken care of by BNPB. Evaluation methods, contents and accuracies vary depending on the agencies. Some of them have no scientific analysis with correct data. There are lack of disaster risk analysis nor hazard analysis for some disaster types and regions. It is important to analyze the probability of hazards and disaster risks with scientific manners. It is also integral to evaluate effect / efficiency of investment quantitatively for acceleration of DRR. . The necessary works are as follows.

- Information and data collection on disaster risk and hazard. Analysis on current disaster risk, hazard evaluation methods, contents and accuracies
- Standardization and improvement of evaluation methods of disaster risks and hazards. Examination of utilization of evaluation results
- Institutional development for acceleration of disaster risks evaluation, hazards evaluation, and preparation of road map for future improvement
- Capacity building on disaster risks evaluationm, hazards evaluation and its utilization

5.2.3.3 Acceleration of Investment on DRR

Most of disaster prone countries including developing countries tend to spend much budget for post disaster activities. Likewise, most of the budget for DRR is allocated to emergency response, recovery and reconstruction in Indonesia. There are some cases that the investment does not contribute to sustainable development such as reduction of death by EWS without comprehensive disaster management with structural measures.

DRR is not only a humanitarian problem but a national development issue. In SFRDD, reduction of direct economic loss, important infrastructure damages including medical and educational facilities and disruption of basic public service are included in the global target as well as reduction of the victims and the affected. To protect assets which is the basis of development as well as human life, shifting from post-disaster response to preparedness is important. The necessary works are as follows.

- Evaluation of disaster investment effect based on scientific evaluation of disaster risks and hazards. Review of current evaluation methods and improvement.
- Reflection of investment on risk reduction to DRR plans and related plans such as development plans.
- Implementation of a project to invest in disaster prevention.
- Evaluation of project effects, pre and post.

- Reflection of project effects to disaster risk assessment and feedback to DRR and other plans.
- Capacity building on evaluation of investment effects.

5.2.3.4 Enhancement of Preparedness (BNPB's latest trends)

In Indonesia, non-structural measures in pre to during disaster stage such as monitoring, warning, evacuation, reserve, emergency response is recognized as Preparedness. Formulation of contingency plans and development of EWS are conducted with initiative of BNPB. However, there is a strong needs for precious EWS based on scientific background. Establishment of disaster scenario is also required for contingency planning. Currently, BNPB focuses on establishment of EWS and MHEWS. It also focuses on formulation and review of contingency plans including estimation of disaster scenario. The necessary works are as follow.

- Information and data collection on disaster risk and hazard. Analysis of current disaster risk and hazard evaluation methods, contents and accuracies.
- Standardization and improvement of evaluation methods of disaster risks and hazards. Setting of disaster scenario.
- Formulation and improvement of emergency response plans.
- Establishment and improvement of EWS for each disaster type. Its development to MHEWS.
- Capacity building on preparedness.

5.2.3.5 Promotion of BBB

A wide variety of natural disasters occur every year in Indonesia. It is necessary to continue to improve preparations for recovery, reconstruction, reconstruction and domestic coordination. Furthermore, it is necessary to promote "Build Back Better" in the recovery and build back phase after a disaster. Based on these, the following efforts will be made.

- ・Building a legal system to promote Build Back Better
- ・Strengthen management at the recovery and reconstruction stage
- ・Development of recovery / reconstruction plan
- ・Development of disaster damage data collection mechanizm and formulation of PDNA for each disaster type
- ・Capacity improvement and human resource development of each organization related to BBB promotion

5.2.3.6 Enhancement of Coordination of Related Agencies

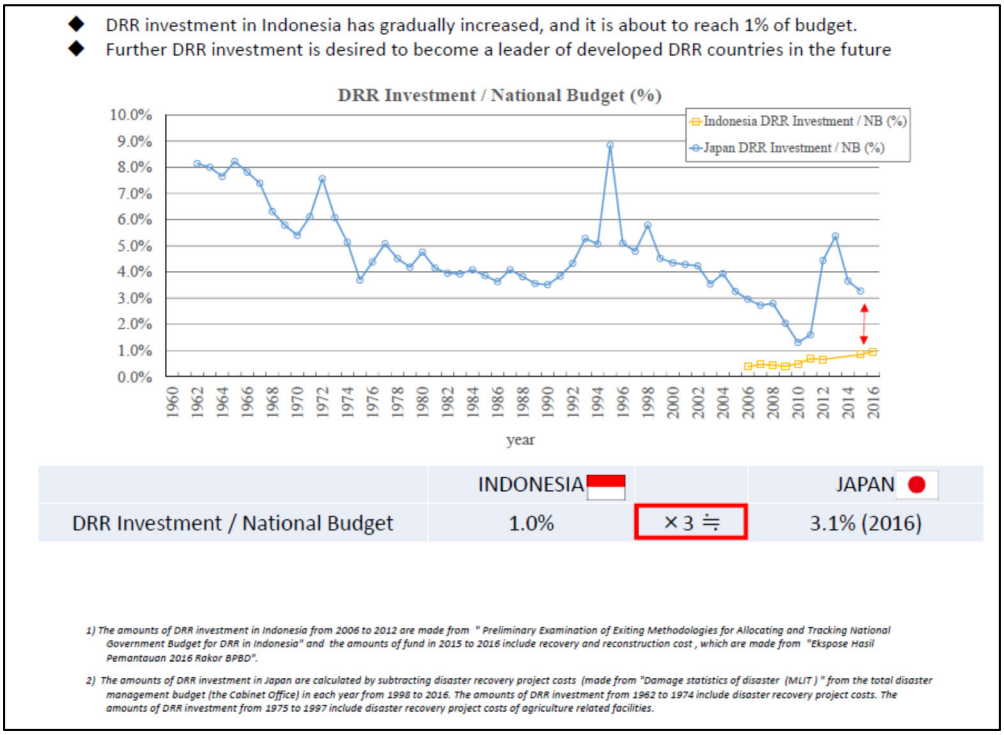
Coordination among related organizations is inevitable for solving problemsabove (1) to (4). Indonesian government has made efforts for enhancement of disaster governance and coordination of related agencies based on the current mandates of each organization. However, activities of agencies in central and regional government are regulated by parent organization's regulation and it causes lack of coordination between organizations and central-local offices. Unclear tasks among organizations and lack of capacities result in DRR measures ineffective. For instance, analysis of hazards are conducted by BMKG for earthquake and tsunami while PUPR for flood. These results of hazard analysis are not sufficiently reflected to risk assessment and EWS by BNPB. The necessary efforts are as follows.

- Establishment of national committee and working groups for acceleration of coordination
- Establishment of coordination system and setting of national targets for DRR
- Reflection of the national targets for DRR to the plans of each organization. Implementation of coordination and monitoring
- Capacity building on preparedness
- Improvement of public awareness

5.2.4 Necessary DRR Budget in Indonesia

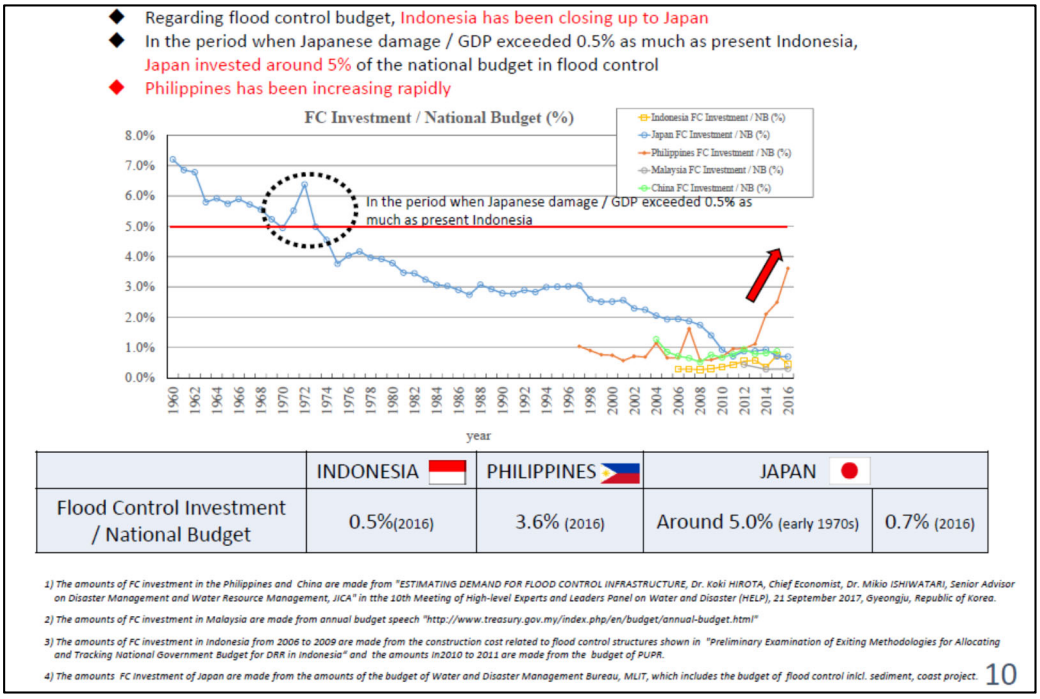
As mentioned earlier in 3.4.4, the disaster prevention budget in Indonesia is increasing year by year. It is about to reach 1% of the national budget. Estimation on the amount of DRR budget that Indonesia is recommended to secure in the short to medium term by 2030 is made here. It is by comparing Indonesia with Japan and other Asian countries in respect with the ratio of DRR budget to the whole national budget. The comparison between Japan and Indonesia is shown in the figure. In Japan, it accounted for 8% in 1960s and 3% in 2016. On the other hand, in Indonesia, the ratio is reaching 1% as mentioned above.

The figure shows the results of comparing Indonesia with Japan / some other Asian countries regarding the ratio of flood control budget to the national budget. In Japan, the proportion has fallen below 1% in recent years. In the Philippines, the figure is growing rapidly, reaching 4%. In Indonesia, it is 0.5% . Indonesia's disaster damage amount in 2016 was 0.5% of the national budget, which is comparable to Japan's 1970s situation. At that time, Japan invested in flood control on a scale close to 5% of the national budget. Based on the above, it is recommended that Indonesia invests 1% to 5% of the national budget on DRR in the short and medium term.



Source: JICA study team

Figure 5-1 Ratio of DRR Budget in the National Budget



Source: JICA study team

Figure 5-2 Ratio of Flood Control Budget in the National Budget

5.3 Japanese DRR Technologies Applicable to Indonesia

Japanese DRR technologies, which will contribute to Indonesia's economic development, is studied. In collecting and analyzing the information, the results of "Japan Technology Fair on DRR" (hereinafter referred to as the Japan Technology Fair) held in Jakarta in December 2018, co-sponsored by PUPR and the Ministry of Land, Infrastructure, Transport and Tourism of Japan are referred to. In the fair, there were discussions about Japanese technologies that could be used in the field of disaster prevention, matching the technologies with Indonesian needs, and future prospects. Indonesian needs for disaster prevention are wide ranging from understanding disaster risk, disaster risk governance, and pre-disaster investment. Under such circumstances, discussions on needs (technology that Indonesian side expects from Japan) and seeds (technology that Japan can apply) were made. The outline is shown in the table. As applicable Japanese technologies, real-time monitoring and information provision tools for EWS were proposed. Regarding dams, design / construction / regeneration and monitoring technologies were also proposed. As technologies that may contribute to DRR that contribute to economic development in Indonesia, the tsunami warning system and dam reclamation technologies were presented.

Table 5-5 Matching Indonesian needs with Japanese Seeds for in DRR

Needs	Challenges	Applicability of Japanese technology
Early warning system	<u>Accuracy improvement</u> There are many visual observation facilities for rainfall and river water level. However, there are problems with nighttime observation and accuracy <u>Maintenance of hydrological observation facilities</u> A certain budget for maintenance of hydrological observation facilities is secured. However, they manages a wide range with a limited budget and personnel. For this reason, in case of equipment that is sophisticated and expensive to repair, such as telemeters, the cost of repair cannot be generated. They are replaced with manual types and downgrading occurs.	<u>Real-time monitoring</u> ・ Real-time hydrological observation system with rain gauges, water level sensors and telemetry systems ・ Provision of detailed rainfall distribution information by X-band radar <u>Provision of information to disaster responders</u> Timely and appropriate river information provision technology (ICT, etc.) for organizations (BPBD) and the

Needs	Challenges	Applicability of Japanese technology
	Real-time information Telemeterized equipment has been introduced, but many basin management offices have not been able to collect real-time information during floods, as water level gauges submerged during large-scale floods. Information transduction ・There is no broadcasting station that plays a reliable role in the event of disasters like NHK in Japan. ・ In many cases, the information provision system for the leader who is the decision maker at the time of disasters is not well established. Real-time information is hardly transmitted to the leaders.	decision-makers during large-scale floods Provision of information to residents Development of information and communication means with: terrestrial digital broadcasting, DRR radios, SNS
Dam construction	Support for new dam construction Indonesia aims to construct 65 dams by 2019 under the direction of the president. Technical and financial support for this is needed. On the other hand, since Japan is reluctant to build dams using ODA, it is difficult to practice ODA projects. In Indonesia, training of engineers related to dam design and construction is conducted. Promotion of water resources development Indonesia has very few water resources per population compared to other countries. Therefore, there is a large demand for water resources development. Dam construction is also planned as a part of the policy. * For dam construction cost,APBN, Chinese loan (Jatigede Dam) and Korean loan (Karian Dam) are applied.	Japanese dam design and construction technologies ・Experience of building dams under various topography and geological conditions in Japan ・New technology for Japanese dams: trapezoidal CSG dam, flowing water dam Japanese dam regeneration technologies Achievements in advanced dam reclamation technology: Elevate existing dams, add spillway
Dam sediment prevention measures	Rehabilitation of dams with sedimentation progressed In Indonesia, at the design stage, there are many problems related to the estimation of sedimentation volumes. Rapid sedimentation due to unexpected events such as mountain collapse is one of major challenges. * Phase 2 of sediment control measures for Wonogiri Dam with the JICA ODA Loan has been under implementation. * Bilibili Dam Sediment Management Project is listed in the Blue Book. * In the co-financing project DOISP AF (2017-2022) with WB and AIIB, dam sediment control and prevention will be implemented..	Estimation of the appropriate amount of sediment during design Estimate the appropriate amount of sediment from the monitored data of existing dams. In Japan, design is based on accumulated data. Dam monitoring technology ・Survey of dam sedimentation ・3D survey using sonars ・ Use of monitoring results for maintenance Dam regeneration technology Dam reclamation technology such as a sand removal tunnels
Volcanic eruption measures	Response during eruption There are many volcanoes in Indonesia. Countermeasures during / post eruption are challenges. * Yen Loan Project Phase 2 for Merapi Volcano is underway	Volcanic sabo Volcanic countermeasures technology in areas where volcanos are a major threat to urban areas, such as Unzen Fugendake Unmanned construction Unmanned technology such as construction work in areas where human access is dangerous

Source: Report on Overseas disaster prevention problem resolution work utilizing disaster prevention collaboration dialogue, March 2019

The technologies introduced in Japan Technology Fair are shown in Appendix-4

Chapter 6. Development of the Tentative Cooperation Policy by JICA for Disaster Risk Reduction in Indonesia

The Japanese study team has developed a tentative cooperation policy by JICA in this chapter considering the required future approaches/measures in Indonesia mentioned in the previous chapters.

6.1 Overview

Japan and Indonesia have great disaster risks and are exposed to various risks of natural disasters, such as earthquake, volcanic eruption, flood, etc. since both are island nations located on the "Ring of Fire". Both countries have had numerous disaster damages historically. Earthquake and a volcanic eruption occur frequently and people are suffering from water-related disasters as well.

Implementation and strengthening of disaster-prevention measures are essential in order to protect the public from natural threats and to realize sustainable economic growth. Moreover, shifting from a disaster recovery / ex-post investment to a disaster prevention / prior investment is important in order to protect not only human life but also economic assets, which are the foundation of national development.

Economic damage by disaster is increasing in Indonesia due to the population concentration, economic centralization and disordered development caused by the rapid economic growth. The scale of disasters is increasing by the impact of climate change and by other various factors. Therefore, prior investment for disaster risk reduction is becoming integral.

JICA has been cooperating over the years in the field of disaster risk reduction especially in sediment disaster, river improvement/flood control, earthquake, emergency aid/relief after a disaster, development of disaster prevention system and capacity development and so on, as mentioned in Chapter 3. JICA has accomplished and complied a lot of outcomes in this field.

Therefore, mutual cooperation in the field of disaster risk reduction can be possible since Japan and Indonesia have similar geological and geographical conditions and are suffering from similar natural disasters. In fact, awareness of disaster recovery/reconstruction in Japan was enhanced by exchanging the reconstruction roadmap, the knowledge and the experience of disaster countermeasures among the affected areas of "2004 Indian Ocean earthquake and tsunami" and "2011 Tōhoku earthquake and tsunami". Japanese DRR policy on volcanic eruption received feedback from the case studies of a volcanic eruption in Indonesia. As a recent example, the knowledge and the experience of "2011 Tōhoku earthquake and tsunami" were shared and utilized for the disaster recovery/reconstruction in Sulawesi, which suffered serious damage by the earthquake, tsunami and landslides.

Thus, Japan and Indonesia have been establishing a mutually beneficial relationship in the field of DRR. It shifts to a new strategic partnership. Developing a tentative cooperation policy by JICA should pay attention to the two items below considering the development of bilateral relation.

1) The new policy will enhance the efforts on disaster risk reduction by Indonesia. Compiled knowledge and experience in cooperation in the field of DRR between Indonesia and JICA and the latest Japanese technology and experience shall be fully utilized.

2) The new policy should be consistent with not only the direction of Indonesian policy, development plan, and Vision 2045, but also international/regional frameworks for DRR. It shall contribute to lead the discussion on the whole concept of international/regional DRR aiming to compile the international/regional good practices regarding the DRR in Japan and Indonesia. It also needs to contribute to a mutually beneficial relationship and international cooperation.

6.2 The direction of Cooperation Policy

The JST developed the tentative cooperation policy, which consists of four items such as, goal, outcome, priority activity and the items to be taken into account, considering the above examination policy. It needs to be in line with the following policy/items for examining future projects in the field of DRR in Indonesia.

Goal: Establishing a Disaster Resilient Indonesia for Sustainable Development

Even though Indonesia has had a lot of natural disasters and the society and community suffered the damages, it recovered with resilience and sustainably. On the other hand, economic damage by disaster will increase due to the population concentration, economic centralization and disordered development caused by the rapid economic growth, and by increasing the scale of disasters by the impact of the climate change and other various factors. It requires nation, society, and community to recognize and manage various hazards and disaster risks properly and establish a resilient society, which is well-prepared against disasters and is able to recover even after suffering damages. Although Indonesia has been significantly establishing infrastructure due to its rapid economic growth, it is not following the seismic design standard properly. Therefore, establishing a safe infrastructure is needed as a part of the prior investment.

A goal of the tentative cooperation policy is set as **"**Establishing a Disaster Resilient Indonesia for Sustainable Development" aiming to establish safe/resilient society and to maintain sustainable development.

JICA has been aiming to "break out from the negative spiral of disaster and poverty" and to "enable sustainable development by reducing a disaster risk", mainstreaming DRR into development plan in the various sectors, and enhancing the cooperation on building a disaster-resilient society. Those approaches fit the above goal. Indonesia set the vision, "Establishing a Disaster Resilient Indonesia for Sustainable Development" and the missions shown in Table 6-1 in IDMMP2015-2045 Final version (May 2019). These are consistent with the goal.

Table 6-1 Vision and Mission for Disaster Management Year 2015-2045 (Final Version May 2019)

Vision	Establishing a Disaster Resilient Indonesia for Sustainable Development
Mission	1. Strengthen the regulatory and policy frameworks, as well as institutional integrity in disaster preparedness and DRR that responsive to current development. 2. Increasing the investment for DRR & Preparedness. 3. Realizing a rapid and reliable emergency response. 4. Conducting the recovery of disaster-affected areas and communities for building a better life. 5. Realizing management support and disaster management governance that professional, transparent and accountable.

Source: The JST organized based on the Disaster Management Master Plan 2015-2045: Kementerian PPN/Dappenas, BNPB Jakarta, December 2018

Non-structure measures for disaster, such as Early Warning System and so on, had been put much value internationally for cooperation on the DRR after setting up the "Hyogo Framework for Action 2005-2015 (HFA)" in 2005. However, it is confirmed that the structural measures including the prior investment, such as establishing safe economic and social infrastructure, are required for DRR in the "Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR)", which was adopted at the 3rd UN conference on DRR. Therefore, "Investing in disaster risk reduction for resilience" was set as the priority activity 3 in the framework. As a result, the enhancement of DRR by strengthening both structures and non-structure measures have been addressed internationally. The goal is consistent with such global tides of the cooperation on the DRR.

Outcome: Disaster risks and disaster damages on human lives, livelihood, health, economy, society, culture, environmental property, economic activity, and community are reduced.

"Human development and mastery of science and technology", "Sustainable economic development", "Equitable development" and "National resilience and governance" are set as a development pillar of Indonesia Vision 2045. JICA aims to realize the "Safe and Resilient Indonesia", which is set as the goal of the tentative cooperation policy, by developing cooperation on the DRR in Indonesia. It will contribute to further economic development and protection of the nation. It leads to the accomplishment of the Vision 2045. Therefore, "Disaster risks and disaster damages on human lives, livelihood, health, economy, society, culture, environmental property, economic activity, and community are reduced" is set as an outcome of the tentative cooperation policy of JICA aiming to accomplish the SFDRR in Indonesia.

Priority activity (Pillar)

Tentative cooperation policy for DRR is composed of six priority activities and three Items to be taken into account. Five priority activities explained below are consistent with the five main activity/policy directions in the IDMMP2015-2045. It will contribute to implementing DRR activities by the Indonesian government.

As mentioned in Chapter 5, "Enhancement of recognition of hazards/risks", "Increasing DRR investment" and "DRR cooperation and coordination" are the main activities in Indonesia. These are in line with the "Priority 1: Understanding disaster risk", "Priority 3: Investing in disaster risk reduction for resilience", and "Priority 2: Strengthening disaster risk governance to manage disaster risk" of the SFDRR. Therefore, these three main activities are set as the main pillar / central shaft of the tentative cooperation policy in the study, and the activities/projects in line with them are regarded as the main activity/project by JICA.

Relation among the tentative cooperation policies in this study, the IDMMP2015-2045(Final version (May 2019)), which is the long-term planning for DRR in Indonesia, and the SFDRR is shown in Table 6-2. As shown inTable 6-2, the priority activities in this study are mostly consistent with the IDMMP2015-2045(Final version (May 2019)).

Table 6-2 Relation among the Tentative Cooperation Policy in this Study, IDMMP2015-2045(Final Version (May 2019)) and SFDRR

Priority activity in the tentative cooperation policy in this study	IDMMP2015-2045 (Final version (May 2019)) Policy Direction	Priority activity in SFDRR
Priority activity 1: Mainstreaming DRR into development plans at central and regional levels	1.Strengthening regulatory and policy frameworks, as well as institutional integration in disaster preparedness and disaster risk reduction 5. Realizing professional, transparent and accountable management support and governance of disaster management.	Priority 2: Strengthening disaster risk governance to manage disaster risk
Priority activity 2: Enhancement of recognition of hazards/risks	1.Strengthening regulatory and policy frameworks, as well as institutional integration in disaster preparedness and disaster risk reduction 5. Realizing professional, transparent and accountable management support and governance of disaster management.	Priority 1: Understanding disaster risk
Priority activity 3: Increasing DRR investment	2.Increase budget allocation in the appropriate value for investment in disaster preparedness and risk reduction 5. Realizing professional, transparent and accountable management support	Priority 3: Investing in disaster risk reduction for resilience

	and governance of disaster management.	
Priority activity 4: Enhancement of Preparedness	1.Strengthening regulatory and policy frameworks, as well as institutional integration in disaster preparedness and disaster risk reduction 3. Realizing rapid and reliable implementation of disaster response. 5. Realizing professional, transparent and accountable management support and governance of disaster management.	Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction
Priority activity 5: Promoting BBB	4. Organaizing recovery of regional and affected communities to build a better life.	Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction
Priority activity 6: DRR cooperation and coordination	1.Strengthening regulatory and policy frameworks, as well as institutional integration in disaster preparedness and disaster risk reduction 5. Realizing professional, transparent and accountable management support and governance of disaster management.	Priority 2: Strengthening disaster risk governance to manage disaster risk

* This table above is explaining the general relation among priority activities of the three policies. It does not confine the relationship of each item to the items described above.

Priority activity 1 (Pillar 1): Mainstreaming DRR into development plans at central and regional levels

Disaster prevention / DRR is tending to be regarded as subsidiary measures, especially in the developing countries, since economic development is put higher priority. However, disaster prevention / DRR is an essential issue for sustainable development. It is also a cross-sectoral issue among different sectors. It is also integral in the viewpoint of "safety assurance for humanitarians". Therefore, disaster prevention / DRR should be set as a national priority. The viewpoint of disaster prevention / DRR should be considered/included in every type of development plan. It is important to promote prior investment for disaster prevention / DRR.

It is important to include the viewpoint of disaster prevention / DRR in every social and economic development sectors to promote DRR and to enhance the effectiveness of DRR approach by bi-directional/mutual cooperation and communication with other sectors under mainstreaming DRR. The approaches for DRR should be shared and implemented considering the mutual relationship among all governmental levels; central, local and community levels. Implementation of seamless disaster risk management from emergency response, rehabilitation/reconstruction and to post-disaster prevention is essential.

Budget for the DRR and mutual cooperation/coordination are insufficient in Indonesia. Awareness of considerations for hazard, disaster risk, and future risk is not sufficient at both practical and decision-making levels. Mainstreaming DRR is the fundamental viewpoint/approach in order to promote an active and comprehensive implementation of cross-sectoral DRR measures. Bappenas, PU and BMKG should be involved to realize mainstreaming DRR. The role of DRR for sustainable economic development shall be understood at the inner circle of government and the disaster prevention / DRR shall be discussed.

JICA will support on the establishment of legal provision and procedures, ensuring ministries to use a unified DRR target, incorporating DRR into development, policy decision and capacity development regarding mainstreaming DRR considering above.

Priority activity 2 (Pillar 2): Enhancement of recognition of hazards/risks

Recognition and evaluation of hazards/risk on a scientific basis is set as priority 1 in the SFDRR and it is necessary for effective implementation of DRR measures. Measures without scientific basis will be not only a useless investment, but also they might cause further disaster damage. It is important to show the value/effect of investment quantitatively in order to encourage investment in DRR, especially for prior investment. Therefore, evaluating hazards and the probability of disaster risks in an objective and scientific ways based on the appropriate disaster-related data and scientific basis are essential. The same is equally true for non-structure measures, such as land-use regulation, development of contingency plans, EWS and evacuation plans, which is also true for the structure measures such as establishment of riverbank, etc.. EWS can encourage the people to evacuate when it is difficult to mitigate/respond by the structure measures in case of tsunami or volcanic eruption. Implementation of non-structure measures based on the disaster scenarios without scientific basis might cause serious disaster damage.

Various hazards and disaster risks have been analyzed in Indonesia thanks to the efforts of related organizations. Hazard assessment is conducted by line ministries, which are in charge, and the BNPB takes a leading role in risk assessment. However, appropriate analysis with proper disaster data and scientific basis are not always implemented. Hazard and disaster risk analyses in specific disasters or specific areas are insufficient. Moreover, information sharing and organizational cooperation among the relevant organizations are not sufficient.

Considering above, JICA will extend their support on clarification of disaster information, construction/expansion of hazards/risks evaluation system, improvement of analysis accuracy, and capacity development for evaluation of hazards/risks.

Priority activity 3 (Pillar 3): Increasing DRR investment

Disaster prevention is not only a humanitarian issue but also an issue on national development. Not only reduction of death toll and number of afflicted people, but also reduction of direct economic loss, damage on major infrastructures including the health / the education facilities, and lifeline disruption are set as a global target in the SFDRR. In general, the leadership of national disaster-related organization will expand to the prior disaster prevention from the emergency response with the development of capacity. Shifting from a disaster recovery / ex-post investment to a disaster prevention / prior investment is important in order to protect not only human life but also economic assets, which are the foundation of national development. Prior investment is relatively effective compared with ex-post investment.

Same as the other affected countries, especially in developing countries, Indonesia had spent a lot of budget for emergency response and reconstruction/rehabilitation after the disaster. A relatively small amount of budget for disaster prevention is used for the prior investment. Annual disaster damage in Indonesia is estimated at approximately 30 Trillion IDR, and disaster damage as a percentage of GDP in Indonesia is approximately five times of Japan. However, the amount of investment in DRR is lower than Japan. For example, the amount of investment for flood protection in 2016 in Indonesia was approximately 0.5% of the national budget while the one in Japan was 0.7%, even though the river improvement condition is better than Indonesia.). Moreover, sufficient budget is not allocated to DRR especially in local government since there is neither clear evidence/reason to allocate a budget for DRR nor an appropriate legal system to define the public service to be provided by the local governments. Moreover, cooperation and coordination among relevant organizations (especially BNPB in charge of disaster prevention, and PUPR in charge of the establishment of infrastructure is limited especially in disaster risk assessment, the decision-making of DRR investment and project evaluation. There is little practical and technological exchange. Commitment by the other ministries to the National DRR plan, which is developed by the secretary of BNPB, is limited.

The prior investment includes not only structure measures, such as the establishment of infrastructure to mitigate the disaster damage, but also non-structure measures, such as DRR planning and evacuation drill. Prior investment considering the combination of structure and non-structure measures is important, and the

challenge is how to encourage/realize the prior investment. Only the concept, such as "prior investment is important", cannot encourage/realize the actual, designed and continuous DRR investment. Investments in infrastructure development, food production, education, and health usually have a priority than disaster prevention since the occurrence of disaster is unpredicted and the disaster risk is unclear. Moreover, the effect of the prior DRR investment is unclear for the decision-makers and the stakeholders. Therefore, it tends to be considered as an additional cost, not as a future investment.

It is important to show concrete evidence, which can prove an economic benefit of prior investment in the DRR, such as cost-benefit of the DRR investment since there are various national priority projects under the budget limitation. Quantitative evaluation of the investment effect by the scientific and evidence-based risk assessment, including the evaluation of hazards and probability of disaster risks in an objective and scientific ways and reflection of evaluation results to the decision-making of DRR investment are required to increase DRR investment.

Considering above and the "Investing in disaster risk reduction for resilience" is set as priority 3 in the SFDRR, JICA will support on evaluation of projects (pre and post), and implementation of verification on effectiveness, evaluation of effectiveness of DRR investment, reflection of effectiveness of DRR investment into risk assessment, reflection of DRR investment in disaster management plans / development plans, planning and Implementation of DRR investment (grant aid / loan), and capacity development for evaluation of DRR investment.

Priority activity 4 (Pillar 4): Strengthen residual risk management capabilities

Non-structure measures just before and after the disaster, such as disaster prediction and alert, stockpiling, evacuation, emergency responders are regarded as "Preparedness" in Indonesia, and BNPB takes a leading role and develops the "Contingency Plan" and establish the EWS. On the other hand, the needs for a science-based precise EWS is high since the tsunami occurred after clearing of tsunami alert and caused serious damage in 2018 Sulawesi earthquake and tsunami. It might worsen the disaster situation and endanger citizen's safety if the EWS and a disaster alert are operated/issued without scientific basis if disaster information does not contribute to an appropriate evacuation action. Therefore, the relevant organization needs to operate the EWS / issue a disaster alert in order to lead the citizen to take an appropriate evacuation action.

Development of the various disaster scenarios in the Contingency Plan is important. The disaster scenario in the present Contingency Plan is not based on a scientific basis, and BNPB also recognizes a need for improvement of the plan. BNPB is now focusing on the development of EWS and MHEWS, revision and development of the Contingency Plan and its disaster scenarios considering above background.

Therefore, JICA will support an organization of relevant data and information related to the past / existing hazards/disaster risks, standardization of evaluation method of the hazards / disaster risks, development of disaster scenarios, development / revision of emergency response plan, examination of disaster information / alert to be transmitted and its transmission flow and protocol, and capacity development for enhancement of "Preparedness"

Priority activity 5 (Pillar 5): Promoting BBB

A wide variety of natural disasters occur every year in Indonesia. It is necessary to continue to improve preparations for recovery, reconstruction, reconstruction and domestic coordination. Furthermore, it is necessary to promote "Build Back Better" in the recovery and build back phase after a disaster.

During the recovery and reconstruction from the May 27, 2006, Central Java earthquake, through JICA's technical cooperation "Building Administrative Execution Capability Improvement Project (2007-2011, 2011-2014)" for non-engineered houses, materials that briefly describe structural specifications, called Key

Requirements, are attached to the requirements giving consideration to earthquake resistance of highly vulnerable buildings.

In addition, in the areas affected by the Central Sulawesi earthquake and tsunami (2018) that caused many victims, efforts were made for recovery and reconstruction based on the basic concept of BBB, Spatial plans for affected areas is being formulated by mainly BAPPENAS and ATR.

Based on these, JICA will support to develop policies and systems for promoting BBB, formulate recovery / reconstruction plans, develop disaster damage data collection mechanisms and protocols, improve the capacity of each organization for promoting PDNA and BBB, and develop human resources.

Priority activity 6 (Pillar 6): DRR cooperation and coordination

Organizational coordination and disaster governance have been strengthened based on the present division of duties of each organization in Indonesia. However, effective disaster prevention / DRR measures/approaches have not been implemented since cooperation and coordination between central and local governments and the approaches taken by each organization are based on each ministries' regulations. This results in a lack of communication among relevant organizations / central and local governments, unclear division of duties and insufficient capacity of relevant organization for implementation of the DRR. For example, while understanding and analyzing the hazards of earthquake and tsunami are implemented by the BMKG and the hazard of the flood is implemented by the PU, the analytical results are not properly shared with BNPB and not reflected on the risk assessment and the EWS. Also, BNPB developed the "Risk Index" to check/evaluate the progress of the DRR measures implemented by the central and local governments, however, the effects of the structure measures, such as the river banks and diversion channel established by PUPR, are not reflected in the index/evaluation measures appropriately. On the other hand, scientific-based measures for disaster risk assessment and evaluation of the DRR project effect by PUPR are not established well.

"Strengthening disaster risk governance to manage disaster risk" is set as the Priority 2 in the SFDRR. Strengthening disaster risk governance by the DRR cooperation and coordination among all relevant organizations, levels, and activities is required. Government agencies in Indonesia tend to be vertically divided and it causes insufficient organizational coordination. The whole government needs to promote organizational coordination under mainstreaming DRR.Considering above, JICA will support on the establishment of national-level committee for the arrangement of DRR cooperation and coordination, enhancement of regulations for DRR, capacity Development, and public awareness.

Items to be considered 1: Implantation of countermeasures considering the actual conditions of region and community

Regional disaster-resilience differs depending on local conditions, such as disaster characteristics, natural and terrain conditions, land-use, social and economic conditions. Therefore, the type and scale of required DRR investment vary depending on the region and community. It is essential to understand/consider the actual condition of each region and community for planning DRR.

Items to be considered 2: Gender

There is a variety of disaster damage situation. Its scale depends on sex, age, presence of disability, etc.. Death toll in women by the natural disaster is higher than men and the unemployment rate in post-disaster in women is also higher than men especially in the developing countries. Impact of disaster varies by people. Especially women, children, elderly people, disabled people and the people who are in a vulnerable situation tend to receive more severe impacts.[143] Human right and gender equality are highlighted in the SFDRR. Participation of women in the DRR is important for effective disaster risk management, development and

[143] UNISDR, UNDP. (2009) "Making Disaster Risk Reduction Gender Sensitive: Policy and Practical Guidelines."

implementation of policy/plan/ project of the DRR considering gender equality and financing. Moreover, sufficient approaches for capacity development for women empowerment regarding disaster prevention and for gaining/means of livelihood are required. Therefore, promoting / encouraging women participation/leadership, the approaches which have the viewpoints of gender/gender equality/diversity, and the approaches which can protect their safety / right considering the particular needs of women / diverse people, are required in the cooperation on the DRR in Indonesia.

Items to be considered 3: Climate change

Damage by the natural disaster tends to increase by the several factors, such as economic development, population growth, urbanization and increase of meteorological disasters due to climate change, etc.. Climate change is a global issue as well as in Japan and Indonesia, and drastic solution against climate change has not been found yet. Since Japan and Indonesia are island nations and are exposed to meteorological disasters under threats of water-related disasters, sharing the knowledge/experience/ data and cooperation between both countries will yield a profound effect on DRR. Moreover, knowledge and experience can be utilized internationally. Importance of the approach to prevent new/additional disaster risk by climate change is emphasized in the SFDRR. On the other hand, including the impact and uncertainty of climate change in planning is difficult. Therefore, not only mitigation but also adaptation measures including both structure and non-structure measures must be examined in planning. The DRR approach, which considers the impact of climate change, should be encouraged in order to reduce growing disaster damage which may arise.

Based on the cooperation policy (draft) up to the previous paragraph, priority action items (draft) are shown in Table 6-3. This is a time-series flowchart shown in Figure 6-1. The priority activity item is expressed as Pillar. Each Pillar is organized under the framework of the six missions listed in IDMMP2015-2045 (Final version (May 2019)), the long-term master plan for disaster prevention in Indonesia. The detailed contents and implementation schedule of each activity item are shown in Appendix-1.

Table 6-3 Contents of Tentative Priority Activity (Comprehensive DRR) (1/2)

Recommended Actions	**Mission1** Regulatory, Policy and Integrity in disaster preparedness and DRR	**Pillar 1**	**Mainstreaming DRR**
		P 1-I1	Analysis of the current situation and issues in mainstreaming of DRR
		P 1-S1	Enhancement of legal provisions and procedures for mainstreaming of DRR and setting unified DRR target
		P 1-S2	Ensuring ministries use risk assessment and unified DRR target in development planning and decision makings
		P 1-M1	Incorporating DRR into development planning in central and regional levels and Implementation of DRR activities
		P 1-L1	Implementation of DRR activities in development in central and regional levels by each ministry
		P 1-I2	Capacity Development for DRR of each organization
		Pillar 2	**Enhancing Recognition of Hazard/Risk**
		P 2-I1	Clarification of Disaster Information
		P 2-S1	Enhancement of legal provisions and procedures for recognition of hazard/risk
		P 2-S2, M1	Continuous improvement of hazard/risk evaluation accuracy based on scientific basis
		2-3-S2, M1- (1)	Hazard: continuous improvement of analytical methods by "Step-by-Step Process" proposed by JICA
		2-3-S2, M1- (2)	Vulnerability: improvement of evaluation accuracy and quality through betterment / enhancement of statistical and economic data
		2-3-S2, M1- (3)	Capaciy: clarification of evaluation criteria, improvemt the evaluation
		P 2-M2	Construction/Expansion of hazard/risk evaluation system and improvement of analysis accuracy
		P 2-L1	Continuous Implementation and Improvement of hazard/risk evaluation on scientific basis and reflection to DRM
		P 2-I2	Capacity Development for evaluation of hazard/risk
	Mission2 Investment for DRR & Preparedness	**Pillar 3**	**Increasing DRR Investment**
		P 3-I1	Analysis of the current situation and issues in DRR investment
		P 3-S1	Evaluation of effectiveness of DRR investment in central and regional level
		P 3-S2-(1)	Reflecting DRR investment in disaster management plans in central and regional level, and dissemination of regional disaster management plans
		P 3-S2-(2)	Reflecting DRR investment in each of central development plans and regional development plans
		P 3-M1-(1)	Planning and Implementation of DRR investment of structural measures
		P 3-M1-(2)	Planning and Implementation of DRR investment of non-structural measures
		P 3-M1-(3)	Evaluation of projects (pre and post), and implementation of verification on effectiveness
		P 3-M2	Reflection of effectiveness of DRR investment into risk assessment
		P 3-M3	Feedback DRR investment into DRR related plans and development plans in the next/future period both in central and regional level.
		P 3-L1	Continuous implementation of DRR investment and reduction of economic loss by disaster damage
		P 3-I2	Capacity Development for evaluation of DRR investment
	Mission3 Reliable Emergency Response	**Pillar 4**	**Strengthening Residual Risk Management**
		P 4-I1	Clarification of Disaster Information for Contingency Plan and EWS
		P 4-S1	Enhancement of legal provisions and procedures for preparedness
		P 4	Improvement of contingency plan/preparedness plan
		4-M1-(1)	Improvement of hazards/risks analysis
		4-M1-(2)	Risk scenario assumptions
		4-M1-(3)	Formulation of contingency plan (examination of response plans, systems, resources, information, etc., preparation and documentation of response procedures such as SOP and Timeline)
		4-M2	Dissemination of contingency plan,preparedness plan
		4-M3	Implementation and maintenance of contingency plan,preparedness plan (education, training, update,etc.)
		4-M4	Application to various disaster types, spread throughout the country
		4-L1	Continuous improvement of contingency plan/preparedness plan
		P 4	Improvement of Early Warning System incl. MHEWS
		4-S2-(1)	Definition of roles and responsibilities of related agencies in EWS
		4-S2-(2)	Conducting full scale study based on hazard/risk profiles for EWS
		4-M5	Reflection the results of the study to EWS, Improvement of EWS
		4-M6	Enhancement of dissemination of EWS, monitoring and review of EWS
		4-L1	Improvement of details of Multi Early Warning System
		P 4-I2	Capacity Development for preparedness
		P 4-I3	Enhancement of Emergency Response
		4-I3-(1)	Continuous enhancement of capacity of BNPB
		4-I3-(2)	Enhancement of capacity of disaster response in regional level

Table 6-4 Contents of Tentative Priority Activity (Comprehensive DRR) (2/2)

Recommended Actions	**Mission4** Recovery for better life	**Pillar 5**	**Promoting BBB**
		P 5-I1	Analysis of the current situation and issues in recovery and reconstruction
		P 5-S1	Enhancement of legal provisions and procedures for recovery and reconstruction
		P 5-S2	Enhancement of Post Disaster Management
		5-S2-(1)	Formulation and establishment of recovery and reconstruction system based on the concept of "Build Back Better (BBB)"
		P 5-S3	Formulation and Implementation of recovery and reconstruction plans, relocation plans and landuse plans based on disaster risk assessment
		P 5-S4	Enhancement of capacity of psot disaster activities in all levels including post disaster needs assessment (PDNA)
		5-S4-(1)	Development of mechanism to collect disaster and loss data and formulate post disaster needs assessment (PDNA) based on sectral needs.
		5-S4-(2)	Establishment of a mechanism to ensure timely and immediate recovery of essential services and livilihoods with BBB concept
		PA 5-M1	Implementation of recovery and reconstruction in disaster damaged area
		PA 5-L1	Continuous Implementation of recovery and reconstruction and preparation for future disaster
		PA 5-I2	Capacity Development for recovery and reconstruction
	Mission5 Management and Governance	**Pillar 6**	**DRR Cooperation and Coordination**
		P 6-I1	Establishment of national level committee for arrangement of DRR cooperation and coordination
		P 6-S1	Enhancement of regulations for DRR both in central and local governments
		6-S1-(1)	Enhancement of ministerial regulation for DRR considering risk evaluation
		6-S1-(2)	Enhancement of local government regulation for DRR considering risk evaluation
		P 6-S2	Setting of unified DRR target among ministries and reflection to DRR plans and development plans
		6-S2-(1)	Setting of unified DRR target among ministries, especially on DRR planning and implementation
		6-S2-(2)	Setting of unified DRR target in region, especially on DRR planning and implementation
		P 6-M1	Implementation and monitoring of cooperation/coordination both in central and local governments
		6-M1-(1)	Sharing of collected data, data analysis results, and risk evaluation results among organizations/agensies/ministries
		P 6-L1	Enhancement of inter-ministerial cooperation during policy/plan formulation in central and local governments
		P 6-I2	Capacity Development for DRR of each organization
		6-I2-(1)	Capacity development of each organization for inprovement of risk evaluation and DRR related activities
		P 6-I3	Public Awareness
		6-I3-(1)	Development/Improvement of awareness raising program/campaign for public incl. students
		6-I3-(2)	Conducting awareness raising program/campaign for public incl. students
		6-I3-(3)	Development/Improvement and conducting specific awareness raising program /campaign for government staff of relevant agencies
		6-I3-(4)	Incorporate DRR into curricular of schools, training institutes and universities

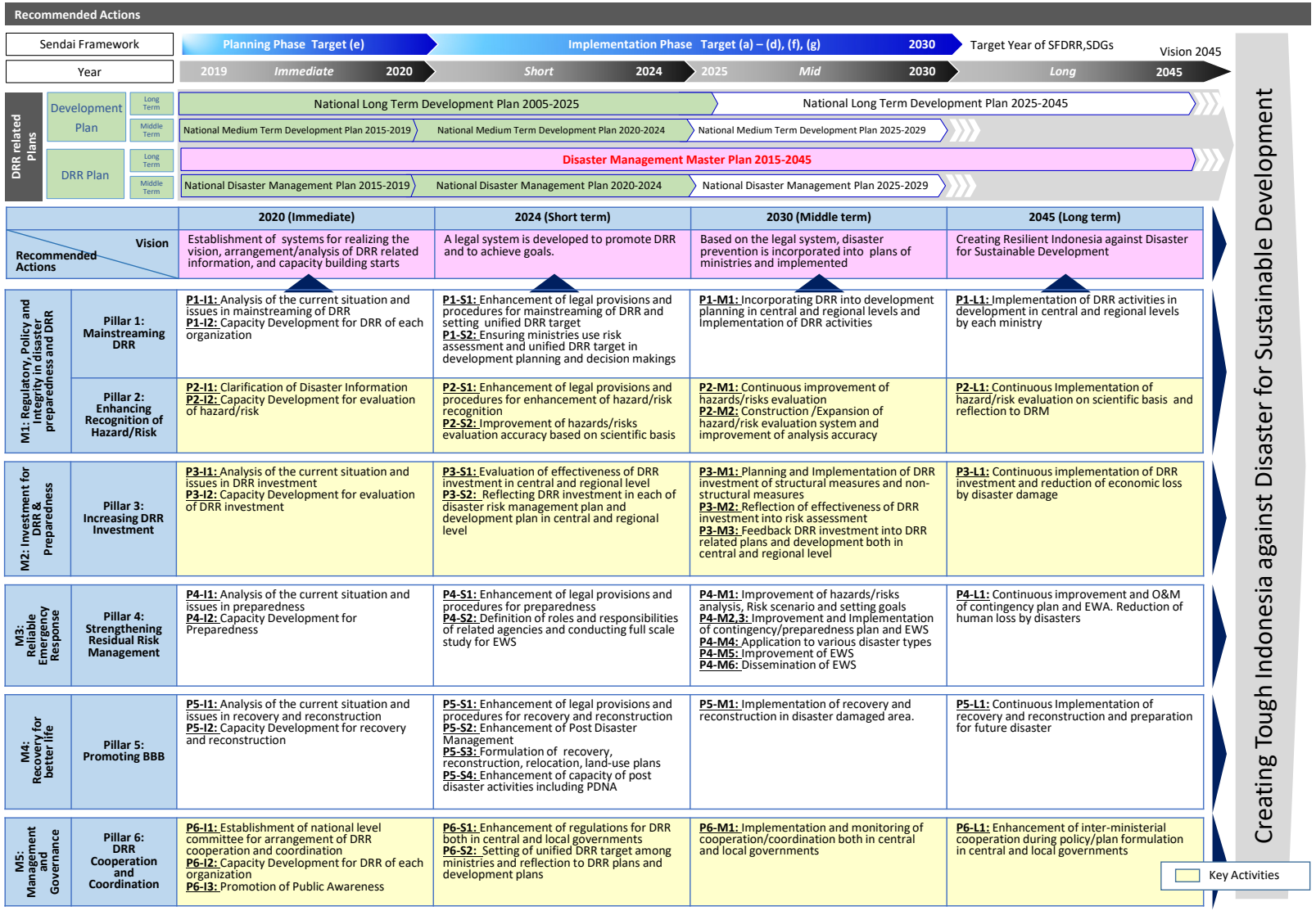


Figure 6-1 Flowchart and Relation among the Tentative Priority Activities

6.3 Tentative Cooperation Policy for the Solutions to the Challenges by Each Disaster Variety

Tentative cooperation policies for the solutions to the challenges in each specific field, such as earthquake and tsunami; climate and early warning system; water-related disaster including sediment disaster; coastal erosion; volcanic eruption; and forest/peatland fire, are organized as followings. It is classified into three categories / below priority activities, which are the main activity framework as previously mentioned.

Priority activity 2 (Pillar 2): Enhancement of recognition of hazards/risks
Priority activity 3 (Pillar 3): Increasing DRR investment
Priority activity 6 (Pillar 6): DRR cooperation and coordination

Relation among three main activity framework and priority activities are shown in Table 6-5.

Table 6-5 Priority Activity in Each Specific Field and in the Tentative Cooperation Policy

	Comprehensive disaster prevention / DRR	Disaster prevention of earthquake and tsunami	Disaster prevention regarding climate and early warning system	Disaster prevention of water-related disaster including sediment disaster	Disaster prevention regarding sea coast	Disaster prevention regarding volcano	Disaster prevention of forest fire and peatland fire
Priority activity 1: (Pillar 1) Mainstreaming DRR	1) Establishment of legal provisions and procedures for mainstreaming DRR into the development process 2) Ensuring ministries use risk assessment and unified DRR target in development planning and decision makings 3) Incorporating DRR into development planning in central and regional levels 4) Capacity Development for DRR of each organization	—	—	—	—	—	—
Priority activity 2: (Pillar 2) Enhancement of recognition of hazards/risks	1) Clarification of Disaster Information 2) Continuous improvement of hazards/risks evaluation accuracy based on a scientific basis 3) Construction/Expansion of hazards/risks evaluation system and improvement of analysis accuracy 4) Capacity Development for evaluation of hazards/risks	Promote Basic Research as National Strategy	Grasp disaster characteristics and establish effective EWS	1)Identification of flood risk and introduction of FFEWS 2)Identification of landslide risk and introduction of effective EWS	Evaluation of Storm Surge and Coastal Erosion Risks and Establishment of Storm Surge Warning System	Identification of volcanic eruption risk and introduction of effective disaster mitigation system	Focusing on community fire prevention to control the cause of fires by making use of past experiences and lessons
Priority activity 3: (Pillar 3) Increasing DRR investment	1) Promotion of DRR investment through mainstreaming and public awareness 2) Evaluation of the effectiveness of DRR investment in central and regional level 3) Reflecting DRR investment in disaster management plans in the central and regional level, and dissemination of regional disaster management plans 4) Reflecting DRR investment in each of central development plans and regional development plans 5) Planning and Implementation of DRR investment of structural measures 6) Planning and Implementation of DRR investment of non-structural measures 7) Evaluation of projects (pre and	1)Promote mainstreaming of earthquake and tsunami DRR in government policies ・Establish inter-agency DRR forum chaired by BNPB ・BNPB coordinates and integrate DRR policies for earthquake and tsunami ・All stakeholders agree on and implement DRR policies for earthquake and tsunami 2)Special Considerations: Use of advanced Japanese technologies ・ High quality and	1)Promotion of consideration for disaster management with EWS to various policies by mainstreaming DRR ・Preliminary survey to improve alarm accuracy ・Formulation of observation network development management plan ・Formulation of EWS establishment plan ・Human resource development and capacity building necessary for implementing weather analysis and early	1) Promoting investment in DRR ・Measures that focus on disaster prevention and implementation of projects ・Implementation of projects with implementation priorities from the standpoint of disaster prevention 2)Promoting Investment in DRR ・Promoting investment in DRR of landslide	1)Quality Improvement of structural measures by the establishment of design standards 2)Project Implementation with proper budgetary system and prioritization 3)All stakeholders agree on and implement DRR policies for earthquake and tsunami	1)Improvement and renewal for aging SABO facilities 2)Effective investment on monitoring devices for volcanic activities	1)Promotion of re-wetting peatlands 2)Promote recovery and monitoring of frequent fire areas and accelerate early warning and initial response for the disaster 3)Use of fire prevention methods which shows “no putting fires into the forest and peatland” is valuable

	Comprehensive disaster prevention / DRR	Disaster prevention of earthquake and tsunami	Disaster prevention regarding climate and early warning system	Disaster prevention of water-related disaster including sediment disaster	Disaster prevention regarding sea coast	Disaster prevention regarding volcano	Disaster prevention of forest fire and peatland fire
	post), and implementation of verification on the effectiveness 8) Reflection of the effectiveness of DRR investment into risk assessment 9) Feedback DRR investment into DRR related plans and development plans in the next/future period both in central and regional level 10) Capacity development for evaluation of DRR investment 11) Enhancement of mitigation 12) Enhancement of Emergency Response and Post-disaster management	advanced anti-seismic, base-isolation and vibration control technologies/ State-of-the-art tsunami evacuation tower with abundant experience all over the world /Advanced equipment and systems for earthquake and tsunami observation and early warning	warning				
Priority activity 4: (Pillar 4) Strengthening Residual Risk Management	1) Improvement of contingency plan/preparedness plan 2) Establishment of early warning system incl. MHEWS 3) Capacity Development for residual risk management	—	—	—	—	—	—
Priority activity 5: (Pillar 5) Promoting BBB	1) Establishment of legal provisions and procedures for promoting BBB 2) Formulation of recovery and reconstruction plan 3) Enhancement of capacity of psot disaster activities in all levels including post disaster needs assessment (PDNA) 4) Capacity Development for BBB	—	—	—	—	—	—
Priority activity 6: (Pillar 6) DRR Cooperation and Coordination	1) Establishment of national-level committee for the arrangement of DRR cooperation and coordination 2) Enhancement of regulations for DRR both in central and local governments 3) The setting of unified DRR target among ministries 4) Promotion and monitoring of cooperation/coordination both in central and local governments 5) Capacity development for DRR of each organization 6) Public awareness	1)Reflect research results to DRR policies and designate priority areas for earthquake and tsunami DRR 2)Develop DRR plans dedicated to earthquake and tsunami	Promotion of strengthening of disaster reduction capacity through a collaboration of early warning disaster management related organizations	Promoting the enhancement of disaster mitigation capability through cooperation among related agencies on flood.	Improvement of disaster management capability by a collaboration of related agencies	Promoting the enhancement of disaster mitigation capability through cooperation among related agencies on volcanic eruption	1)Strengthening of organization and system for forest and peatland fire control 2)Comprehensive capacity development of stakeholders on peatland restoration