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POLICY BRIEF
Climate and Disaster Resilient Infrastructure

Key Highlight

- *Infrastructure resilience is of utmost importance with the nature of disasters in Indonesia and the increasing threat of climate change.*
- *Mainstreaming infrastructure resilience to local governments and increasing their capacity towards the issue is important.*
- *Financing is a key issue in infrastructure resilience and thus developing innovative financing means is essential.*
- *Improving reliable and real-time databases is essential to support the process risk assessments, monitoring, and evaluation of infrastructure resilience issues.*
- *Indonesia could learn from infrastructure resilience policies that are successfully conducted in other countries, two examples of which are the case of Japan and Chile.*

Climate and Disaster-Resilient Infrastructure in Indonesia: Have We Done Enough?

Introduction

In the first regime of the Jokowi administration (2015-2019), the Government of Indonesia (GoI) sets a progressive plan for infrastructure development to improve interregional connectivity, boost economic growth, and enhance national competitiveness. The government spending on infrastructure rose significantly from IDR 154.6tn (USD 13bn) in 2014 to IDR 394.1tn (USD 27.2bn) in 2019 or approximately multiplied by 254.9%. The budget size straightforwardly represents Indonesia's high ambition for infrastructure expansion which includes among others: 3,432 km national roads, 1,852 km highways, 65 dams, 41,1 km bridges, 38,431 hectares of urban slum revitalization, 559,660 units of public housing equipped with a drinking water system, 27 seaports, and 10 international airports.

Amid the increasing number of infrastructures built every year, there is growing exposure to certain environmental risks faced by those physical assets, particularly from disasters and climate change. Located in the Pacific Ring of Fire with 127 active volcanoes, Indonesia is included in the list of the most exposed countries to disaster and climate change impacts (World Bank, 2019). This condition could potentially bring substantial consequences on the resilient of existing, ongoing, and planned infrastructure assets. In turn, it could affect the livability and prosperity of society across the country. During the 2014-2019 period, it is estimated that Indonesia has suffered an average annual loss of more than USD 20bn due to disasters (UNESCAP, 2019).

As natural disasters pose risk to Indonesia's infrastructure, developing resilient infrastructure is crucial to reduce vulnerability to natural disasters and climatic change variability. With slightly higher initial costs[1], building a more resilient infrastructure could reduce the repairs and maintenance required in the long run, hence will bring economic benefit (Hallegatte et al., 2019). Moreover, resilient infrastructure offers more reliable services and impact reductions on people and economies in the event of natural disasters.

[1] Hallegatte et al. (2019) estimates that the extra cost for building resilient infrastructure is only 3% of overall investment needs

This policy brief will discuss several problems and challenges faced by Indonesia in developing resilient infrastructure that includes: 1) planning and regulation, 2) mainstreaming[2], 3) financing, and 4) monitoring and evaluation. Two case studies in developed and developing countries are provided regarding their experience in developing resilient infrastructure.

Issue #1: Current Arrangement of Resilient Infrastructure in Indonesia

In Indonesia, the development of climate-resilient infrastructure is based on the 2014 – 2025 National Action Plan for Climate Change Adaption (*Rencana Aksi Nasional Adaptasi Perubahan Iklim*, RAN-API)[3] created by the Ministry of National Development Planning (Bappenas). According to the plan, existing and planned infrastructure must adapt to climate change through adjustments in structure, components, design, and location. The 2020 - 2024 National Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional*, RPJMN) has also made resilient infrastructure, both construction and rehabilitation, a key project. Moreover, the Ministry of Public Works and Public Housing (MoPH) have established a National Action Plan for Climate Change Mitigation and Adaptation (*Rencana Aksi Nasional Mitigasi dan Adaptasi Perubahan Iklim*, RAN-MAPI) in 2012 that explicitly address resiliency in water facilities, roads and bridges, engineering, and spatial planning. These documents set up climate- and disaster-resilient infrastructure planning and development in Indonesia[4].

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Although climate change adaptation and mitigation have been incorporated in the national planning, the infrastructure sector specifically still lacks a thorough specification and standards. Only several regulations have been created on this matter, such as green buildings and sustainable construction. More clarification on technical specifications and climate adjustments for infrastructure development is necessary. A comprehensive analysis of infrastructure proposals, such as analysis on asset lifecycle and climate risk assessment and forecast, similar to those in the European Union's infrastructure guideline (European Commission, 2013), is also essential to increase resiliency.

[2] Mainstreaming is the integration of climate change adaptation or mitigation into related government policies or in relevant sectors, it is also referred to as "climate policy integration" (Climate Policy Info Hub, 2016)
[3] RAN-API is the continuation of the 2009 Indonesia Climate Change Sectoral Roadmap (ICCSR)
[4] See Appendix 1 for institutional arrangements

Issue #2: Mainstreaming Resilient Infrastructure to Regional Governments

Mainstreaming the concept of climate-resiliency in local infrastructure development plans is crucial for Indonesia. Through a decentralized system, regional governments can play a role in infrastructure provision, such as roads and schools, separate from the national government. Unfortunately, there are two main issues in mainstreaming a climate perspective to policies: political will and capacity limitations in local governments. Local governments perceive disaster preparedness as a trivial matter requiring minimal attention (Vermonte et al., 2020). With many competing issues such as poverty, improving local revenue, and growth, disaster management is less of a priority as is not a main key performance indicator for local governments (Djalante et al., 2012). Not to mention, local departments work according to the current leader's interest, and a new leader may have different priorities, leaving old programs discontinued or changed (Lassa, 2019). Moreover, adopting a new concept, such as climate resiliency, in current planning requires intensive executive and legislative support and political lobbying (Ministry of the Environment Government of Japan, 2015). Hence, improved environmental awareness and strong public support of climate policies would be able to catalyze the mainstreaming process (Besley & Persson, 2019)

"…there are two main issues in mainstreaming a climate perspective to policies: political will and capacity limitations in local governments"

From the human resources capacity, not all provincial governments have qualified personnel who are aware of climate-resilient infrastructure (Djalante et al., 2012), and those who do tend to have a high turnover rate (Lassa, 2019). Besides, policymakers are detached from experts due to the lack of advocacy and publication for individual climate-resiliency researches. Furthermore, data regarding climate change and disasters are neither integrated nor easily accessed. Since the data are also not disaggregated at the regional level, the vulnerability assessment and resilient strategies tend to be outdated with no resources to amend them (Vermonte et al., 2020; Lassa, 2019). Lastly, coordination and cooperation between related sectoral agencies are insufficient (Djalante et al., 2012), partly caused by an absence of leadership. The Local Development Planning Agency (*Badan Perencanaan Pembangunan Daerah*, Bappeda), which is supposed to mainstream climate resiliency, is mostly inconsequential because all programs must be approved by the local legislators (Lassa, 2019). The limited capacity available means most technical progress only occurs in previously-stricken areas (i.e., Aceh, Padang, Yogyakarta) because they receive major support for rebuilding and reconstruction (Djalante et al., 2012). As a result of these issues, less than 5% of Indonesian districts have adopted the Regional Action Plan for Climate Change Adaptation (*Rencana Aksi Daerah Adaptasi Perubahan Iklim*, RAD-API).

Issue #3: Financing Resilient Infrastructure

In its efforts to develop climate- and disaster-resilient infrastructure, Indonesia still faces obstacles in terms of financing options available. Relying in full on the tax revenues is simply not a preferable way to start the construction stage in the first place. The MoPH claimed that the GoI requires USD 140bn to realize the infrastructure project plans during 2020-2024, with a planned state budget contribution of "only" USD 42.38bn (or about 30%)[5]. Considering what the COVID-19 pandemic has raised the cost to the national economy, it will require additional efforts to finance the planned infrastructure projects and even more resilient infrastructure development due to its cost characteristics. A report from the World Bank (2019) suggests that there will be an extra cost of building resilience into infrastructure systems by approximately 3% of overall investment needs. The portion comes from the extra interventions to build assets that can withstand bigger shocks. Such interventions come in the form of using alternative materials, digging deeper foundations, building flood protection around the asset, elevating assets, and adding redundant components.

"Given the limited fiscal space, the GoI needs to collaborate with the private sector to finance resilient infrastructure projects"

Given the limited fiscal space, the GoI needs to collaborate with the private sector to finance resilient infrastructure projects. However, financing a resilient infrastructure tends to be less appealing given its nature of higher costs. Besides, infrastructure specially made to mitigate climate change (e.g., dams and seawalls) tends to lack a clear revenue stream and "only" generate indirect benefits in the long run. To solve this issue, the GoI may try to promote the usage of Public-Private Partnerships (PPP) through Viability Gap Funds (VGF) and Availability Payment (AP) schemes, accompanied by the strengthening of de-risking instruments, such as guarantees and public equity co-investments. The GoI may also try to tap funding from other sources such as Multilateral Development Banks (MDBs) and international climate funds which provide co-financing loans with relatively lower interest rates, grants, and even technical assistance for project developers which could improve the quality of infrastructure.

Besides relying on the private sector, the GoI needs and has already started to utilize alternative financing options. In early 2018, the GoI was successfully issued a USD 1.25bn green sovereign sukuk to finance low-carbon and climate-resilient projects across ministries. To date, Indonesia has issued 6 green bonds and green sukuk to the value of USD 3.7bn. These range from a USD 15m distributed solar generation

[5] Statement of the Minister of MoPH, Basuki Hadimuljono
https://www.kompas.com/properti/read/2020/12/14/151007421/investasi-infrastruktur-2020-2024-tembus-rp-2058-triliun-ini-rinciannya

plant to the USD 6bn Jakarta-Bandung High-Speed Rail, from investments in bonds issued by the State-Owned Enterprises (SOEs) in the transportation sector to equity as private electricity companies/Independent Power Producers (IPPs) or a stake in a government's public-private partnership (PPP). Key green sectors for current opportunities include:

- Transportation – increased rail and Bus Rapid Transit (BRT) development as well as electric vehicle generation and sustainable waterborne transport
- Energy –expanding hydro and geothermal power generation
- Water and waste – the provision of clean drinking water

In addition, the GoI has just authorized the establishment of a Sovereign Wealth Fund (SWF) under the name Indonesia Investment Authority (INA). The SWF will manage investment funds from outside and inside the country with infrastructure development lies at the core of their mandate. As of January 2021, INA has received an injection of funding from the GoI as much as IDR 30 trillion and has also received interest from various investors around the world.

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Issue #4: Databases, Monitoring, and Evaluation

Monitoring and evaluation are crucial to ensure that the climate-resilience plan is implemented properly. For RAN-API, the planning, monitoring, and evaluation are done by local governments and line ministries reported to the Bappenas. Meanwhile, the monitoring and evaluation activities for the RAN-MAPI are conducted by MoPH's RAN-MAPI team.

Bappenas relies on some existing databases, such as climate data from the Indonesian Agency for Meteorology, Climatology, and Geophysics (*Badan Meteorologi Klimatologi Geofisik*a, BMKG) and vulnerability assessment data from the Ministry of Environment and Forestry (MoEF). These databases are used to monitor climate-resiliency activities, such as PEP (*Pemantauan, Evaluasi dan Pelaporan*) RAN/RAD which monitors programs and estimate each contribution to lowering GHG, SRN (*Sistem Registri Nasional*) which monitors the program, budget, and estimation of GHG reduction, and KRISNA (*Kolaborasi Perencanaan dan Informasi Kinerja Anggaran*) which monitors the program and budget.

While several measures have been done for monitoring and evaluation purposes, there have been limited official documents explicitly explaining the methods and outcomes utilized for the monitoring and evaluation of the RAN-API or RAN-MAPI. Moreover, the utilized database is not integrated into one data, causing some climate-resiliency programs recorded on one database and not on others—as some databases are only for specific ministries. Each ministry also has its own methods for calculating the mitigation impacts which further should be integrated.

Infrastructure Resilience in Japan: A Developed-Country Case

Japan is already well-known to be one of the most vulnerable countries to suffer from disasters due to its natural conditions (Hayashi, 2010). Disasters, both geophysical and climate-change-induced, are affecting Japan drastically each year. Climate change has particularly posed a greater risk to Japan because it has contributed to the increased frequency and intensity of extreme weather events (Case & Tidwell, 2017). Anticipating those, Japan has managed to build "high-quality infrastructure". How are they doing that?

The key action from Japan's resilient infrastructure is learning from experience. Nearly all of its policies, technical, institutional, and community capacities are improved through accumulated lessons from every sizable disaster (Hori et al., 2017). First, in terms of geophysical disaster, the Japanese government has made continued renewals over the years to its building code created in 1924 as a response to the damage caused by the Great Kanto Earthquake (7.9 M_W). It is done by evaluating past earthquakes to test buildings' resilience to conform to more risky earthquakes in the future. This had come to fruition when the 2011 Great East Japan Earthquake (9.0 M_W) happened and only resulted in minimal damage to the buildings and infrastructures. For non-geophysical disasters, Japan also shows a great example of reducing urban flooding problems due to high rural-urban migration. The Japanese government enacted a more comprehensive approach that did not just treat the areas within river channels but also the whole river-basin area because they knew river channel treatment was not enough (Kundzewicz & Takeuchi, 1999). This approach then includes structural (i.e., widening river channels) and non-structural measures (i.e., hazard maps, early warning, evacuation routes). Further, the local government's role in Japan cannot be denied since they also partake in requiring private companies to construct water-catchment areas to compensate for their activities that disturb water penetration. All these efforts had resulted in a significant drop in flood damage in most metropolitan areas, even after more than 30 years since it was first initiated.

"While several measures have been done for monitoring and evaluation purposes, there have been limited official documents explicitly explaining the methods and outcomes utilized for the monitoring and evaluation of the RAN-API or RAN-MAPI."

All those approaches that have been practiced in Japan seem possible to be applied in Indonesia to improve the resiliency of its infrastructure. First, in terms of building code, Indonesia already has its own standard under the name of *Standar Nasional Indonesia* (SNI). Improvement in this aspect can be made in terms of updating the standard over time for the infrastructures to be able to face greater risks exposed by increased natural disaster occurrences as well as higher vulnerability due to climate change. Furthermore, Indonesia can also learn from Japan's comprehensive approach in dealing with flooding by not just considering the structural aspect of the

infrastructure itself, but also the non-structural aspect that completes the disaster mitigation efforts. For this matter, the local governments in Indonesia can strengthen the partnerships with other local governmental organizations, such as Dinas Lingkungan Hidup, to support the implementation of the aforementioned comprehensive approach as well as the enforcement of adequate land use permits that uphold the provisions as stipulated in *Analisis Mengenai Dampak Lingkungan* (AMDAL).

Infrastructure Resilience in Chile: A Developing-Country Case

Chile is considered the most exposed country to natural disasters, with 54% of its population and 12.9% of its territory exposed to three or more types of hazards (Dilley et al., 2005). Given the fact, Chile leads the OECD countries with the largest percentage of GDP spent in disaster losses with a figure of almost 1.2% or more than USD 2,800m per year (De La Llera et al., 2018). This condition is exacerbated by severe climate events ranging from flash floods and landslides to extreme cold waves with heavy snowfall.

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Chile responded to these issues very well. Since 1928, Chile has updated the construction rules after almost every notable disaster in its history, especially earthquakes, accompanied by a constitution and/or institutional changes. Recently, the Government of Chile created the National Commission of Research, Development, and Innovation (R&D+*i*) for Disaster Resilience (CREDEN). The goal was to develop a comprehensive *R&D+i* strategy by collaborating with more than 80 experts representing different stakeholders from the academia, public and private sectors, NGOs, and the armed forces. In 2016, CREDEN successfully translated the strategy into an R&D disaster resilience roadmap. The realization of such a strategy demands a lot of investment, amounting to USD 914m in 20 years. However, it is expected to have a benefit-cost ratio of 2.32 and annual savings of USD106 m (De La Llera et al., 2018). Such practice could be implemented in Indonesia as well. Currently, Indonesia already has a special agency that deals with disaster, the National Disaster Management Agency (*Badan Penanggulanan Bencana Nasional*/BNPB). In this regard, BNPB could act as an initiator in forming an *R&D+i* commission for various stakeholders to jointly design a comprehensive climate and disaster resilience roadmap. In terms of financing, the practices carried out by the Chilean government could also be emulated by the GoI. Chile's substantial financing needs for disaster resilience are matched by their robust PPP framework. Regarding this, The Economist Intelligence Unit (2019) has ranked Chile first in Latin America in the capacity to do public-private partnerships (PPP). Chile is also named the most attractive investment infrastructure market in Latin America by the Third Global

Infrastructure Investment Index (2017). The secret recipe for Chile's success in PPP is their regulatory framework in concession. They establish a clear, transparent, and fair concession process so that the private sector can know the criteria for evaluating the offer. The framework is also stable and predictable, providing certainty to private investors regarding the low risk of government expropriation and clearly stated compensation for any unilateral changes. In addition, policies in the investment and trade tax can also prevent foreign capital investment from leaving the country (Hill, 2012). Thanks to its good investment climate, as of 2020, Chile is able to absorb a total investment of USD 14,884m for its concession plan for the period 2019–2023 (Mansilla & Vassallo, 2020).

Conclusion

"BNPB could act as an initiator in forming an R&D+i commission for various stakeholders to jointly design a comprehensive climate and disaster resilience roadmap."

Due to its nature and geographical position, Indonesia is at serious risk of natural disasters. With existing disaster risks as well as the evolving and more threatening harm of climate change, infrastructure resiliency is of utmost importance. We should see making infrastructures more resilient as an investment –not a cost– that yields a long-term benefit. In order to do so, there are four potential key improvement steps: (1) developing a proper definition of climate and disaster-resilient infrastructure and building a robust standardization for infrastructure development in Indonesia; (2) mainstreaming the concept of climate-resiliency for as well as the capacity of local government in developing local infrastructure; (3) developing innovative financing for climate and disaster resilient infrastructure, such as the promotion of PPP including VGF and AP schemes, the issuance of green bonds, SWF, and complemented by other supporting de-risking instruments; (4) improving reliable and real-time databases to support risk assessment as well as monitoring and evaluation.

Building back Infrastructure: A Case of Haiti Earthquake Recovery

On January 12, 2010, Haiti was struck by a 7.0 magnitude earthquake, one of the most devastating disasters in the recent history. Having a combination of overcrowded population and less organized urban planning, Haiti has never been able to anticipate the impacts of an earthquake before. Damage and losses were evaluated at US$7.8 billion (120% of Haiti's GDP) and reconstruction needs were estimated at USD 11.3bn.

Not long after that, Haiti started its big recovery by undertaking the Infrastructure and Institutions Emergency Recovery Project (IIERP). In collaboration with the World Bank, IIERP helped the Haitian government did the post-disaster sustainable recovery. The project was not only successful in undertaking urgent actions and rebuild key infrastructures, but also done an institutional strengthening through training, capacity building, and urban reconstruction planning.

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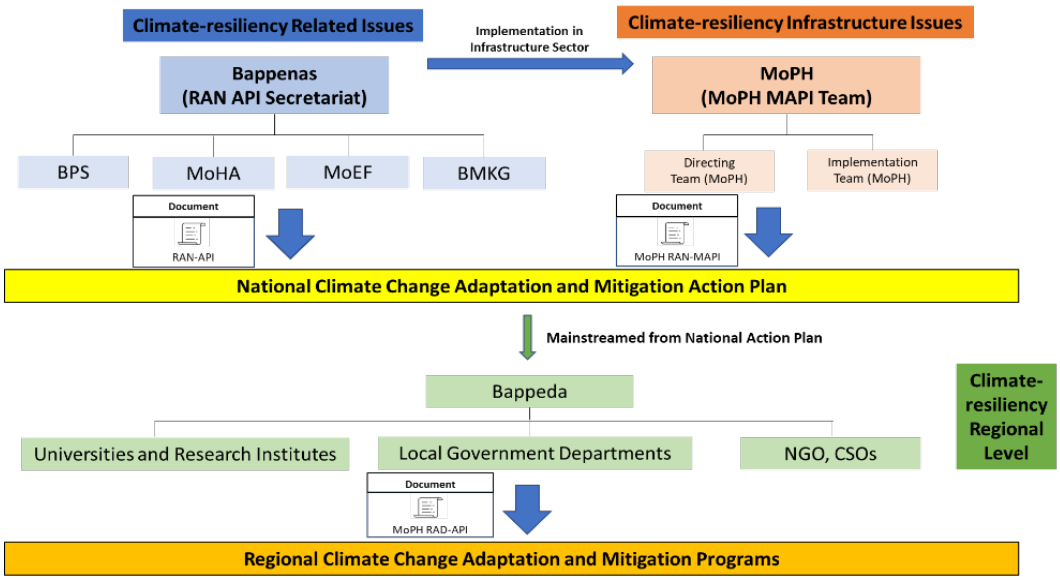
Appendix 1: Institutional Arrangement of National and Regional Climate-Resiliency Issues



Source: Adapted from Ministry of the Environment Government of Japan (2015)