



Towards a Contemporary Maritime Civilization: Long Term Flood Risk Reduction Transformation Strategy



Part 1: Unraveling Complex Problems

Urban development and increasing environmental risks are two sides of the same coin. Encouraging large-scale development which is characterized by the conversion of built-up land also means increasing the risk of environmental danger or damage. Spaces that were previously spaces for conservation and biodiversity are being reduced. Consequently, the carrying capacity and capacity of the environment is also decreasing, which makes disasters both extreme and sudden, such as floods, increase. This can also be exacerbated by environmental disasters that occur slowly, such as climate change and land subsidence. Not only that, changes in this order also have the potential for social conflict. All of these things are just a few among *wicked problems*¹ which is happening now and has the potential to become worse in the future.

The northern coastal region of Java Island is one of the areas facing these wicked problems. This area, which is dominated by lowlands, is prone to experiencing complex flood events due to land subsidence (*land subsidence*)². The northern coastal region is very vulnerable to tidal floods and the central region of Java Island, which is a lowland area, is often affected by river floods. In 2010, the north coast of Central Java, apart from being home to 41% of its population with very rapid regional development, was also an area with quite high levels of flooding and drought³. Flood incidents continue to increase from around 80 incidents in 2009, to more than 180 incidents in 2018⁴. This increase mainly occurred in various regions in Central Java, especially in lowland coastal areas⁵, such as Pekalongan Greater Regency Area, Semarang Greater Area⁶, and Jepara Regency^{7,8}.

1 Environmental, economic, and social problems are complex and remain unresolved.

2 Deltares. (2019). *Risk Assessment North Coast Java*.

3 Rudiarto, I., Handayani, W., & Setyono, J. S. (2018). A Regional Perspective on Urbanization and Climate-Related Disasters in the Northern Coastal Region of Central Java, Indonesia. *Land*, 7(1), 34–34.

4 Putri, I. H. S. (2021). A Preliminary Study of Land Use Change and Hydro-meteorological Disaster in The North Coast of Central Java. *IOP Conference Series: Earth and Environmental Science*, 750(1), 012035.

5 *Ibid.* p. 8.

6 Buchori, I., Pramasari, A., Sugiri, A., Maryono, M., Basuki, Y., & Sejati, A. W. (2018). Adaptation to coastal flooding and inundation: Mitigations and migration pattern in Semarang City, Indonesia. *Ocean & Coastal Management*, 163, 445–455.

7 Aji, A. (2015). Kesiapsiagaan Masyarakat dalam Menghadapi Bencana Banjir Bandang di Kecamatan Welahan Kabupaten Jepara. *Indonesian Journal of Conservation*, 4(1). [Bahasa]

8 Shani, Rhobi. (2023). *Sungai Serang Welahan Meluap, Ribuan KK Desa Dorang Jepara Terendam Banjir*. Medcom. [Bahasa]

Damage to water infrastructure is one of the most discussed causes of flood cases^{9,10}. This shows that although within a certain period of time hard infrastructure can provide protection, beyond that, it can also become vulnerable to flood¹¹. However, coastal flooding can also be caused by more complex problems such as sea level rise, increased extreme rainfall, urban land use change, poor drainage management, shoreline change (abrasion), and land subsidence. It is important to note that these issues are not limited to any specific sector or development activity. Additionally, cross-regional coastal development dynamics can also contribute to the sinking or loss of an area. One example of this is seen in the dynamics of the Semarang-Demak coastal area, which are complex^{12,13}. If appropriate handling policies are not implemented soon, this situation will worsen.

Several studies have estimated the increasing severity of land subsidence and flooding in the northern part of Java Island. Over the next 10 years, land subsidence is expected to reach up to 0.5-1 metre, while the flood-affected areas are predicted to increase by 3.7 times¹⁴. In Greater Pekalongan, Mercy Corps Indonesia¹⁵ estimates that the risk of flooding could almost double by 2035 compared to 2020, and several villages are at risk of permanent flooding¹⁶. In Semarang City, it is predicted that nearly all coastal areas will experience tidal flooding, with 36% of the area facing permanent flooding by 2031¹⁷.

The impact of flooding is directly associated with the increasing size of the inundated area, as well as the more people, sectors and administrative areas are affected. It is estimated that in the next decade, over 2 million individuals residing on the north coast of Java will be affected by flooding¹⁸. In Pekalongan alone, the economic loss caused by flooding is estimated to increase up to 20 times from IDR 1.55 trillion/year to IDR 31.28 trillion/year between 2020 and 2035¹⁹. The impact of flooding is directly linked to the size of the flooded area and the number of people, sectors, and administrative areas affected. It is estimated that over 2 million individuals residing on the north coast of Java will be affected by flooding in the next decade. In Pekalongan alone, the economic loss caused by flooding is estimated to increase up to 20 times from IDR 1.55 trillion/year to IDR 31.28 trillion/year between 2020 and 2035. These losses include material losses, such as reduced asset value and loss of income sources, as well as additional costs for basic services such as clean water, food, energy and waste management, and non-material losses, such as mental health disorders and reduced land productivity and ecosystem services^{20,21}. Flood management in the Java Island region, particularly in Central Java, is still partially fragmented across cities/regency, resulting in a lack of integrated management, which has significant impacts and becomes a cumulative problem across administrative areas.

9 *Ibid.*

10 Aji., *op cit.* p. 7.

11 Deltares., *op cit.*, p. 1.

12 Dewi, R. S., & Bijker, W. (2020). Dynamics of shoreline changes in the coastal region of Sayung, Indonesia. *The Egyptian Journal of Remote Sensing and Space Science*, 23(2), 181–193.

13 Marfai, M. A. (2014). Impact of sea level rise to coastal ecology: A case study on the northern part of Java Island, Indonesia. *Quaestiones Geographicae*, 33(1), 107–114.

14 Deltares., *op cit.*, p. 7.

15 Syam, D. A., Wengi, K. R. L., & Gandapurnama, A. (2021). *Climate Risk and Impact Assessment of Pekalongan, Indonesia (Technical Working Report)*. Mercy Corps Indonesia.

16 *Ibid.* In 2020, flooding affected 24 villages in the Kupang watershed area. It is projected that by 2035, the number of villages at high risk of flooding will increase to 42, with an estimated inundation area of 5,700 hectares.

17 Buchori, dkk., *op cit.*, p. 450.

18 Deltares, *op cit.*, p 7.

19 Syam, dkk., *op cit.* p 19.

20 *Ibid.*, p. 19.

21 Marfai, *op cit.*, p. 111.

In addition to tidal flooding, flooding in Central Java can be due to rainfall or overflowing rivers. During the wet season, extreme precipitation often causes rivers to overflow as they are unable to hold and distribute water runoff. Damage to the ecosystem upstream and around the watershed area is often the cause. Flooding caused by river overflow can exacerbate the effects of tidal flooding on coastal areas by increasing the flow of water in the affected area. Consequently, losses from both tidal and pluvial flooding can be even greater when they occur simultaneously.

Flooding problems caused by multi-sectoral activities and impacting multiple regions require urgent development of transformative flood management efforts. These efforts must involve collective and collaborative actions from various actors, including the government, academics, communities, and non-governmental organisations. As almost all areas in the northern part of Central Java experience this problem, these efforts must be carried out throughout the region. Efforts to manage floods should not be limited to coastal areas but also extended to the middle and upstream areas of the watershed. This will help to maximise flood management efforts and reduce the impact of large losses when a flood disaster occurs.



Part 2: Closing the Policy Gaps

In May 2023, Mercy Corps Indonesia together with the Association of Planning Expert/Ikatan Ahli Perencanaan (IAP) chapter Central Java Province, Bintari Foundation, Integrated Coastal Zone Management (ICZM) Center Undip, Association of Indonesian Landscape Architects/Ikatan Arsitek Lansekap Indonesia (IALI) chapter Central Java Province, Kemitraan Foundation and Lembaga Gerak Pemberdayaan conducted a series of Policy Dialogues to address the upstream and downstream flooding problems in Pekalongan and Pantura, Central Java²². The activities have highlighted the need to bridge the gap between policy and practice, which has not yet been achieved by the stakeholders. The issue of flooding is often only addressed when the phenomenon of flooding is felt. However, the perversity is that the phenomenon of flooding in Pekalongan and Pantura Java is now timeless, and reactive responses to events are no longer effective.

The response mechanisms currently in place for flooding and inundation have been ineffective in minimizing the impact of flooding in Greater Pekalongan and the Central Java Coast. This indicates that flood risk and impact management have not been approached from a holistic perspective. A gap still exists between the disaster sector and the development sector, as well as other interrelated sectors. Effective flood management requires collaboration between various development sectors, including forestry, spatial planning, basic infrastructure, public housing, health, human resources, and the economic sector, etc. By working together, these sectors can address problems and root causes more efficiently.

Despite the coastal flooding phenomenon caused by coastal dynamics and sea level rise due to climate change, the aspects of adaptation and mitigation have not been adequately addressed. Additionally, urgent tactical handling is required, particularly in areas experiencing a significant increase in flood inundation and intensity. Therefore, policies, strategies, and program plans must be transformed gradually, depending on the level of urgency.

Current flood management policies have not adequately addressed the complexity of the issues and the systemic recovery that is necessary for Greater Pekalongan and the Central Java Coast. A comprehensive roadmap for flood and inundation management, including short, medium, and long-term programs, needs to be formulated that is more comprehensive (not partial) and implementable (according to a stepwise approach). The spectrum that can contribute to this comprehensive policy construction process is the spectrum of sectoral planning and regional planning.

The flood management sector is unique in that it has been “auto-piloted” through various tasks and functions of official institutions or ministries/institutions, including: The Disaster Management Agency, Development Planning Agency, Public Works and Housing Agency,

²² Atho, M.A., (2023). Mercy Corps Indonesia Ajak Pemda di Kawasan Pesisir Rumuskan Strategi Teknis Adaptasi Perubahan Iklim. *Berita*. Radar Pekalongan. Online: <https://radarpekalongan.id/mercy-corps-indonesia-rumuskan-strategi/> [Bahasa]



Environment Agency, Marine and Fisheries Agency, Spatial Planning Agency, Housing and Settlement Agency, Meteorology Climatology and Geophysics Agency, Watershed and Protected Forest Management Agency, River Basin Centre, and the Coordinating Ministry for Maritime and Investment Affairs. In addition, each regional government also tries to protect itself from the effects of flooding and inundation by using its regulatory and budgetary capacity. However, regional governments' efforts are often limited by administrative boundaries, resulting in a lack of alignment in optimizing flood management programs. In some cases, programs in one area may even have a counterproductive impact on flood management in other areas. Therefore, we recommend a policy umbrella in the form of a roadmap for flood and inundation management that is cross-sectoral and cross-administrative area-based, both horizontally and at higher administrative levels^{23,24}.

Flood management demands a landscape management perspective because water and its ecological systems do not recognize administrative boundaries. For instance, the Brengi-Meduri River Basin, which spans Pekalongan City and Regency, requires better coordination beyond the Loji-Banger System. To prioritize the principle of benefits and streamline bureaucratic processes, one way is to reform ecoregion-based governance through coordination mechanisms within an institution (ad hoc) or across institutions (e.g., in the form of forums, councils, or the like). The stakeholders also need to include various elements of society interested in solving flood problems, such as NGOs, academics, business, communities, and religious leaders.

Efforts to reduce flood risk cannot rely solely on short-term hard structures like sea walls, dams, long-storage, and pump houses. A more comprehensive plan is necessary, including medium- to long-term initiatives aimed at developing a more sustainable flood resilience system. For instance, planning for a five-year period (medium-term) allows for

23 Smajgl, A., Ward, J. R., Foran, T., Dore, J., & Larson, S. (2015). Visions, beliefs, and transformation: exploring cross-sector and transboundary dynamics in the wider Mekong region. *Ecology and Society*, 20(2). <http://www.jstor.org/stable/26270187>

24 The Energy and Resources Institute (TERI). (2016). State Level Engagement for Mainstreaming Urban Climate Resilience Policy Goa and Uttarakhand. *Working Paper*. TERI as part of Asian Cities Climate Change Resilience Network.

the exploration of anticipatory measures in areas that are not yet permanently inundated, increasing their resilience. In the long-term (20 years), policy changes based on research promoting resilient actions are essential to transform areas that were previously at high risk of flooding into resilience laboratories.

Dealing with the phenomenon of flooding and inundation, which has a major impact on urban spaces, ecosystems and the people who live in them, requires an extraordinary effort. Some of the approaches that need to be taken are as follows:



» **Explore opportunities for land uses affected by flooding and at risk of flooding.**

The risk of being affected by flooding varies from region to region. Spatial management and use strategies also vary according to the risks faced. Areas with permanent flood risks and impacts require direct government intervention (local and central), with the main mission to save every resident in the area. On the other hand, areas with the risk of tidal inundation require the intervention of various parties, including research institutions, to formulate the best anticipatory steps to deal with future problems.

» **Restoring environmental support and capacity.**

In the case of Greater Pekalongan, soil, water and air quality continue to deteriorate. This process is likely to become more severe if restoration efforts are not undertaken. Nature-based solutions such as the development of reservoirs, infiltration ponds, and river and coastal boundaries can be a solution to improve the quality of the environment.

» **Strengthening the capacity of flood-affected communities and institutions.**

The process of community adaptation to a more resilient social order will be a long process, but that does not mean it is difficult and endless. The urgency is to find an adaptation model that can be carried out in accordance with the socio-cultural and economic characteristics of coastal communities, both in terms of livelihoods, settlement patterns, land management, and so on.

Unless governance, policies, and actions are changed, Pekalongan and the Central Java coastline cannot be depended upon to function optimally as the economic engine of Central Java in the future. Flooding can be addressed through reactive measures such as raising roads, elevating houses, and rebuilding drainage and sanitation systems. But the cycle repeats itself, and these efforts are not comprehensive enough to address the complexity of flood causes and impacts. If institutions continue to look at the problem in the same way, more opportunities will be lost for a region that has great potential to move forward.

Part 3: Operational Framework for Policy Transformation

In order to fill the policy gap in flood management, this policy paper attempts to offer alternative solutions that are divided into different recommended actions, collaborations, and levels of government. Transformative flood management efforts are organized around three main principles: (1) cross-regional and cross-sector stakeholder engagement; (2) science-based policy development; and (3) development of innovative financing strategies. These three principles underlie the operational framework in the table below. The formulation of new operational rules of the game plays a critical role in optimizing the match between available resources and needs.

The main actors in this framework are not just one or delegated institutions, but stakeholders across sectors and regions. The roles and functions of different institutions are expected to embody the need for multisectoral cooperation based on output. In addition, the authority of central and regional institutions (multi-level) has its own important role, supporting each other. It is also interesting that regional agglomeration is also one of the levels of authority mentioned in this framework. This underlines the interconnectedness of urban systems, not only in terms of socio-economic systems, but also in terms of environmental risks and impacts²⁵.

The next step is to adopt a more comprehensive approach to the flood management problem. The current approach to water management has many facets, including surface water (watershed), groundwater (groundwater basin), coastal cell²⁶, and seawater. In order to comprehensively integrate them, it is necessary to develop an integrated database or

²⁵ Zhang, W., Liu, G., Gonella, F., Xu, L., & Yang, Z. (2022). Research on collaborative management and optimization of ecological risks in urban agglomeration. *Journal of Cleaner Production*, 372, 133735. <https://doi.org/10.1016/j.jclepro.2022.133735>

²⁶ Coastal cell is an ecological delineation based on the intertwined land and sea within a coastal dynamics. The definition as mentioned before is according to: Susilowati, Y., Nur, W. H., Sulaiman, A., & Kumoro, Y. (2022). Study of dynamics of coastal sediment cell boundary in Cirebon coastal area based on integrated shoreline Montecarlo model and remote sensing data. *Regional Studies in Marine Science*, 52, 102268. <https://doi.org/10.1016/j.rsm.2022.102268>

system of coordination and cooperation between related sectors (e.g., environment, energy, and mineral resources, marine and fisheries). These efforts must operationalize the concept of integrated water resources management²⁷. The concept also emphasizes the implementation of the concept of ecosystem-based infrastructure planning and land use management. This may be embodied in changes to the delineation of planning and development areas. In operationalizing the concept, the role of government at the national level is quite important to develop a strong regulatory basis. In addition, contributions from the international level can also be harnessed in terms of the capacity building of relevant stakeholders.

In addition, a transformation in leading sectors is also needed to address and respond to floods in a more anticipatory and adaptive as well as disaster risk and climate change-oriented manner. Environment, infrastructure, disaster, spatial planning, regional administration, and marine can become leading sectors to collaborate and lead the transformation of flood management. The main point is that the current flood conditions, issues, and trends require an integrated approach because the complexity of the floods that occur today is very difficult to separate based on the causal factors, whether they are caused by human activities/anthropogenic or natural conditions/climate change. Not only that, but current flood management is also exceedingly difficult to separate based on the disaster timeline, namely before (pre), during and after (post).

It is necessary to update the most appropriate policies to address flooding problems that are not only limited to rapid onset events, but also recognize that disasters are a destructive process that occurs slowly (slow onset). This can be undertaken based on iterative evidence gathering efforts at the site, city, and district levels to be synergized with policies at the provincial and national levels. Reliable and up-to-date data or evidence is one of the key factors in the implementation of such policies, also known as proactive disaster management policies²⁸.

Scientific evidence-based policy development is the next building block in efforts to develop more transformative flood management development policies²⁹. In particular, studies of the risks and impacts of climate change on various development assets and urban activities, such as land that may be permanently lost due to erosion or flooding, decreasing land values, or the dynamics of soil emergence in the presence of sediment dynamics. This analysis needs to be done not only within an administrative area, but also within an ecological area. Ecological delineation is important to see the impact of change as a whole system.

The analysis of community resilience as a basis for designing a climate-resilient civilization is also a critical component of flood policy efforts that are more transformative. These efforts must be bottom-up, with the active participation of the people, businesses, communities, and organizations that will be at risk from climate-induced hazards³⁰. Moreover, this process is important because they are on the frontlines of direct experience of loss and damage from climate hazards, including floods. Therefore, efforts to increase the community's resilience

27 Zurich Flood Resilience Alliance. (2022). *Foundations for Change: How the Zurich Flood Resilience Alliance is Building Ecosystems for Advocacy*. Available online: <https://floodresilience.net/resources/item/foundations-for-change-how-the-zurich-flood-resilience-alliance-is-building-ecosystems-for-advocacy/>

28 Kusuma-Atmadja, M., Purwaka, T.H., 1996. Legal and institutional aspects of coastal zone management in Indonesia. *Marine Policy* 20, 63–86. [https://doi.org/10.1016/0308-597X\(95\)00034-4](https://doi.org/10.1016/0308-597X(95)00034-4)

29 *Ibid.*

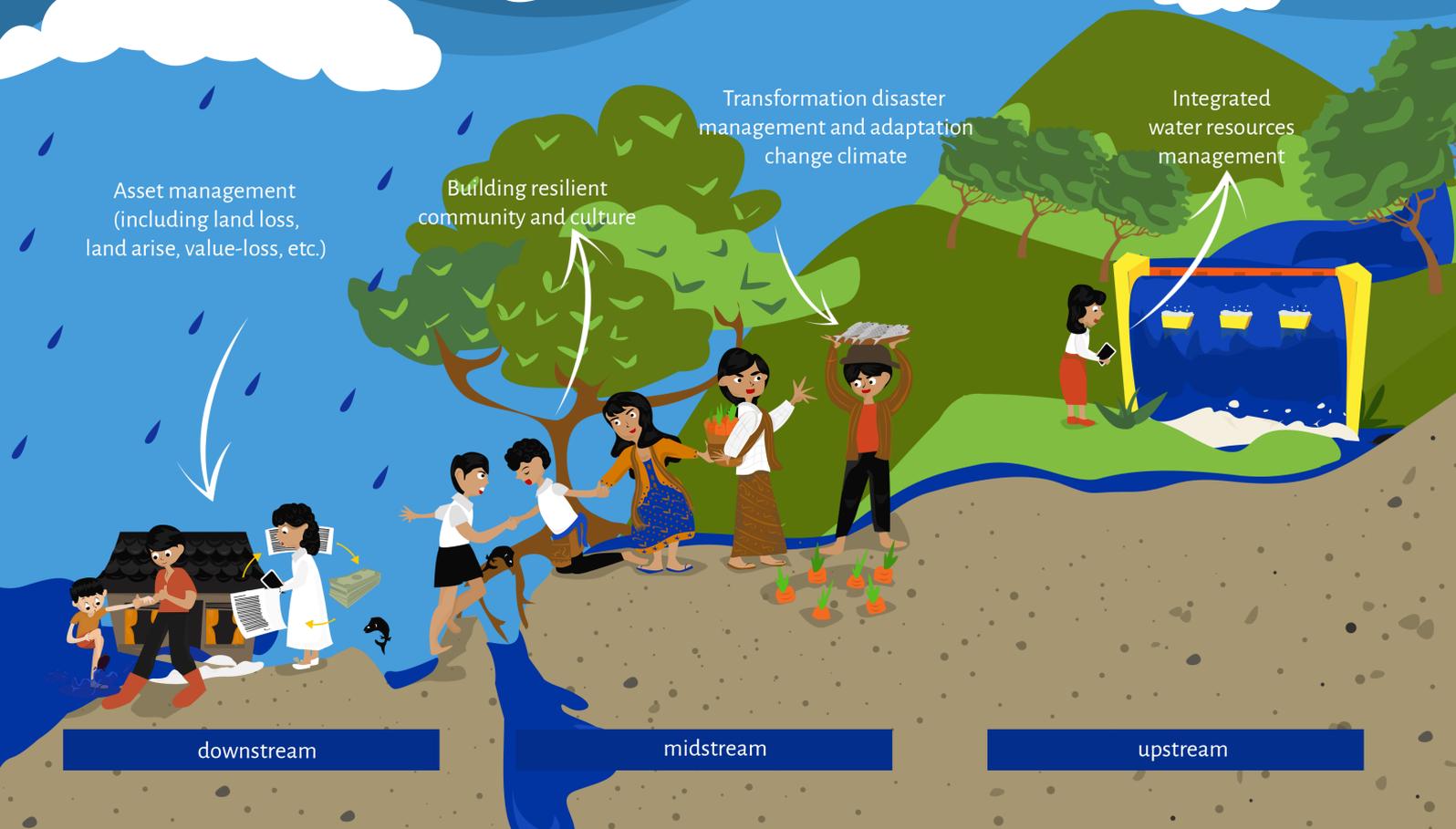
30 This analysis could be conducted based on the Flood Resilience Management for Communities analysis framework as developed by the Flood Resilience Alliance (2022).

to the impact of loss and damage are very important. In many cases, the lack of standardized mechanisms and the lack of knowledge about the phenomenon of losses necessitates the development of innovative financing.

Innovative financing includes, but is not limited to, options and financing mechanisms beyond the usual schemes. In other words, innovative finance requires new breakthroughs. In terms of building climate-resilient communities, there are two main concerns that need to be addressed in innovative financing breakthroughs. The first concern is how to focus existing sources of finance on loss and damage. This will require a tagging process to ensure that the various budget expenditures made can effectively have a positive impact on increasing community resilience on a regular basis. An innovation that can also be developed is the process of monitoring and evaluating the outcomes of a program or policy through an empirical research process. The second concern is how inclusiveness and equitable access to alternative sources of financing can create opportunities for developing community resilience based on fiscal independence. The second approach requires a process of developing a framework for thinking about solving the problem of loss and damage and how this issue can be institutionalized into the social structure of a region. This approach requires the strength of a narrative about changes in community resilience systems, coupled with channelization to accredited entities that can access environmental funding related to climate change, such as the Environmental Fund Management Agency (Badan Pengelola Dana Lingkungan Hidup /BPDLH), Adaptation Fund (AF), and Green Climate Fund (GCF). Above all, there is a need for empirical evidence that is able to place the urgency of developing community resilience in the actual context at the local level.

Recommendation Action	Transformation disaster management and adaptation change climate	Integrated water resources management	Asset management (including land loss, land arise, value-loss, etc.)	Building resilient community and culture
Leading sectors	Environment, Infrastructure, Disaster, Spatial Planning, Territoriality Administration, Marine	Marine, Water Resources, Human Settlements, Spatial Planning, Energy and Mineral Resources, Environment	Spatial Planning, Land, Housing and Settlement	Education, Agriculture, Fisheries, Social, Economy, Public Health, Tourism
Role distribution based on Government Authority Level				
Local (Region/ City)	Enhance the comprehensiveness and integration of the climate disaster response monitoring system database.	Establish a system of collaboration and communication across water ecosystem sectors, including surface water (watersheds), groundwater (groundwater basins), coastal cells (coastal waters), and seawater.	<ul style="list-style-type: none"> Analyze climate change risks and impacts, and mapping of affected areas. Develop asset management policies based on the risks and impacts of climate change. 	<ul style="list-style-type: none"> Enhance the community's ability to manage the risks and effects of climate change. Establishing a participatory (bottom-up) system for planning human resources and economic development³¹
Urban Agglomeration	Cross-regional coordination to integrate climate change adaptation measures	Establish inter-regional cooperation in monitoring groundwater quality and status, coastal and marine water dynamics, and surface water.	Analyze climate change risks and impacts across administrative boundaries and establish coordination with priority risk management principles.	Cross-regional cooperation for social, economic and health protection efforts for vulnerable communities and businesses affected by climate disasters.
Province	Establish an integrated system for mapping development impacts that may exacerbate climate-related disasters.	Integrate data and management systems for surface water, groundwater, and coastal cell and marine waters.	<ul style="list-style-type: none"> Build integrated open data for monitoring and analyzing climate change impacts across administrative boundaries. Coordinate climate impact assessments and asset management policies across administrative boundaries. 	<ul style="list-style-type: none"> Analyze potential changes in community livelihoods due to climate disasters. Prepare a protection system for social, economic, and health on communities vulnerable to disasters climate. Prepare social, economic and health protection systems for vulnerable communities against climate disasters. Develop a special working group to implement and control the financing of climate change resilience programs. x
National	Strengthen disaster management by incorporating a slow onset event paradigm.	<ul style="list-style-type: none"> Establish coastal cell-based governance bodies and systems Establish integrated water resources management regulations 	Establish a regulatory basis for analyzing the management of economic activities, assets and social activities affected by climate disasters.	<ul style="list-style-type: none"> Establish a regulatory basis for cross-administrative boundaries cooperation and cross-sector collaboration in order to build society resilience disaster climate. Develop innovative financing control mechanisms in order to ensure government expenses prioritize climate disaster risk mitigation or increase climate resilience.
International	Increase capacity to develop transformative disaster governance.	Support integrated water resource management governance implementation.	<ul style="list-style-type: none"> Support key stakeholders' capacity building in systemic thinking for deepening their knowledge of transboundary climate risks and impacts. Support in capacity building for innovative finance and asset-based risk management 	Support for inclusive financing alternative development and social security for communities, business owners, and organizations impacted by climate-induced hazards.

³¹ Bottom-up measures in transformative flood management is crucial in understanding a real challenges as faced by the climate-change impacted communities. This insights was mentioned in the learning on development policy advocacy process for a flood-responsive development by the Flood Resilience Alliance which was also published in their publication entitled "Foundations for Change: How the Zurich Flood Resilience Alliance is Building Ecosystem for Advocacy" in 2022.

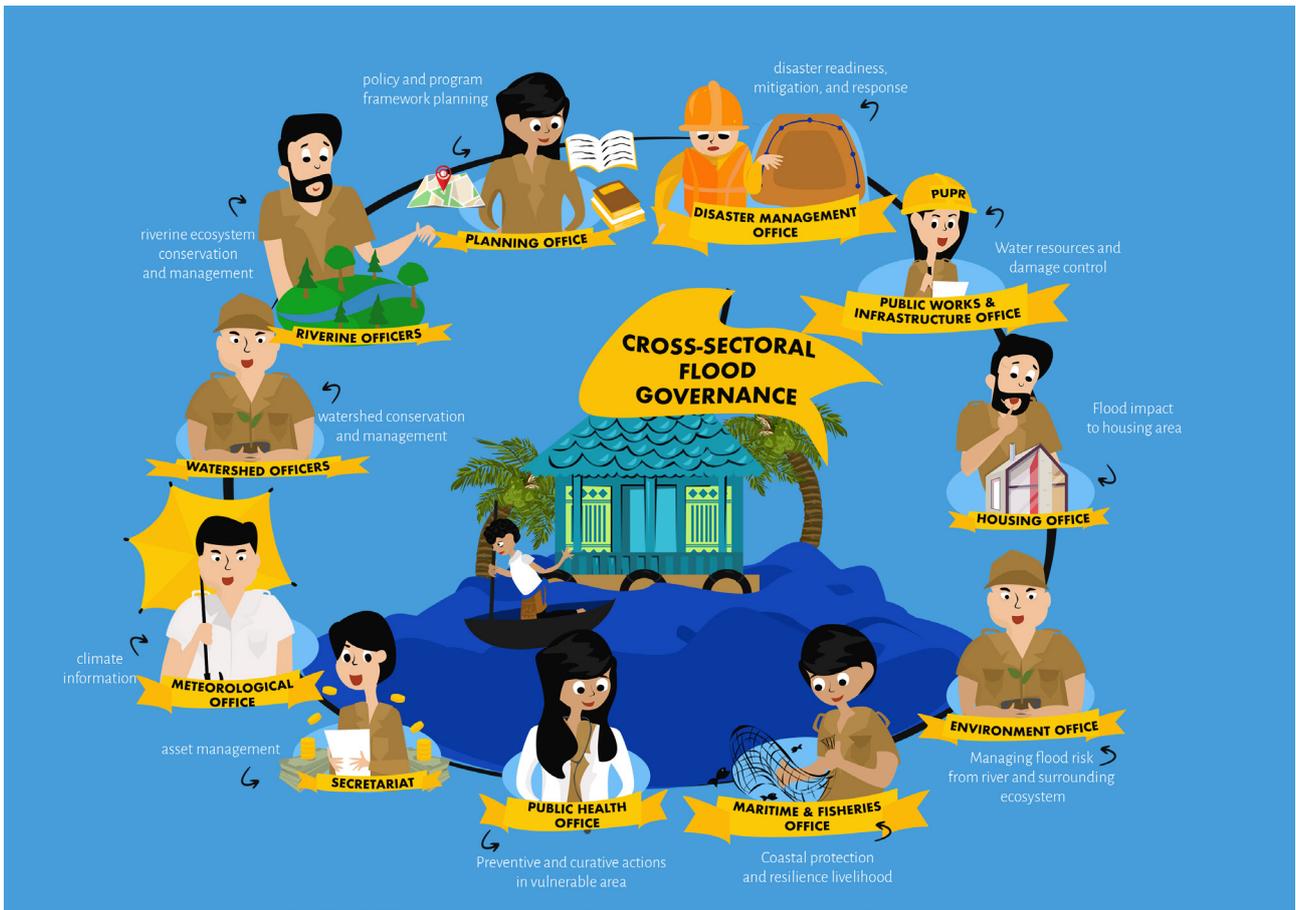


Part 4: Key take away

In the era of climate change and environmental degradation caused by human activities, development must be approached with caution, particularly in regard to disaster risk reduction. The complexity of these issues requires a governance system and policy-making paradigm that is not only reactive but also proactive and transformative. The development of disaster governance must now enter a new phase, implementing the knowledge and recommendations that have been built through collaborative work by various entities. The three pillars that need to be embodied in each policy maker are information openness, evidence-based policy, as well as participatory and collaborative policy making. The need for governance across administrative boundaries and authorities requires an institutional system that allows for sustainability.

Communities as the main entity should be more involved in the development process, including the production of climate risk knowledge in their area, not just in empowerment programmes. This involvement will increase acceptance and ownership of the transformative management policy and make its implementation more effective by directly addressing the community's needs and conditions.

Ultimately, the keys to achieving an effective disaster governance system are a willingness to continuously learning, openness to collaboration with various parties, including government agencies, communities, academics, international organizations, non-governmental organizations (NGOs), and the private sector. It is essential to prepare for more effective flood risk management not only in the short term but also to be systematically prepared to deal with the complexity and accumulation of impacts that may arise in an increasingly unpredictable future.



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