



BNPB

— SYNTHESIS REPORT —

RESILIENCE REIMAGINED

LESSONS FROM 20 YEARS OF TRANSFORMATION

— 2004 - 2024 —

Synthesised Version of a Study on Disaster Management and Sustainable Resilience
Marking the 20th Commemoration of the 2004 Indian Ocean Tsunami

NOVEMBER 2024



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FOREWORD



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As the Deputy System and Strategy of BNPB Indonesia, it is my honour to present this comprehensive study on “The Evolution of Sustainable Resilience: Applying the Lessons Learned 2004-2024” This document represents our collective efforts and unwavering commitment to promoting “Sustainable Resilience” to our international partners. The findings and recommendations outlined herein are the result of extensive research, consultation, and dedication from our team and partners.

In an era where the frequency and intensity of disasters are escalating, it is imperative that we adopt a proactive and holistic approach to disaster risk management, climate change and sustainable development. This report delves into innovative methodologies and best practices that not only mitigate risks but also enhance the adaptive capacities of our communities. By integrating cutting-edge technology and local knowledge, we aim to build a resilient future that can withstand the disaster risks posed by natural and human-induced hazards.

Our journey towards sustainable resilience is a testament to the power of collaboration. I extend my heartfelt gratitude to all our stakeholders, including government agencies, non-governmental organisations, and community leaders, for their invaluable contributions. Their insights and support have been instrumental in shaping the strategies and recommendations presented in this report. Together, we have laid the groundwork for a safer and more resilient future.

As we move forward, it is crucial that we continue to prioritise resilience in our policies, planning, and practices. This report serves as a guiding framework for decision-makers, practitioners, and communities alike. It is my hope that the findings and recommendations will inspire action and drive meaningful change at all levels. Let us embrace the principles of “Sustainable Resilience” as we work towards a future where our communities can thrive in the face of adversities.

In conclusion, I would like to reiterate our commitment to building a resilient and sustainable future. The journey ahead may be challenging amidst all uncertainty, but with collective effort and unwavering determination, we can achieve our goals. I invite you to explore the insights and strategies outlined in this report and join us in our mission to create a sustainable resilient world for generations to come.

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ACRONYMS

ACSCC-DRFI	ASEAN Cross-Sectoral Coordination Committee on Disaster Risk Financing and Insurance
AI	Artificial Intelligence
APBN	Anggaran Pendapatan dan Belanja Negara (Indonesian State Budget)
ASEAN	Association of Southeast Asian Nations
BAPPENAS	Badan Perencanaan Pembangunan Nasional (Ministry of National Development Planning)
BASARNAS	National Search and Rescue Agency
BMKG	Badan Meteorologi, Klimatologi, dan Geofisika (Meteorology, Climatology, and Geophysics Agency)
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Agency)
BPDLH	Badan Pengelola Dana Lingkungan Hidup (Environmental Fund Management Agency)
BRI	Bank Rakyat Indonesia
BRIN	Badan Riset dan Inovasi Nasional (National Research and Innovation Agency)
CSR	Corporate Social Responsibility
DEMs	Digital Elevation Models
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
G20	Group of Twenty
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
InaBuoy	Tsunami Early Warning Buoy Detection System
InaRISK	Indonesia Disaster Risk Map Platform
InaTEWS	Indonesia Tsunami Early Warning System
IoT	Internet of Things
JICA	Japan International Cooperation Agency
KUR	Kredit Usaha Rakyat (People's Business Loans)
LPDP	Lembaga Pengelola Dana Pendidikan (Education Fund Management Institute)
MDMC	Muhammadiyah Disaster Management Centre
MSMEs	Micro, Small, and Medium Enterprises
NbS	Nature-based Solutions

NDCs	Nationally Determined Contributions
OCHA	United Nations Office for Coordination of Humanitarian Affairs
PARI	Platform for Agricultural Commodity Ecosystem
PARB	Penanggulangan Ancaman Risiko Bencana (Disaster Risk Financing and Insurance Strategy)
PENA	Nusantara Economic Heroes Program
PEKA	Predictive AI Tsunami Early Warning System
PFB	Disaster Pooling Fund (Pooling Fund Bencana)
PKH	Program Keluarga Harapan (Family Hope Program)
PLN	Perusahaan Listrik Negara (Indonesian State Electricity Company)
PPP	Public-Private Partnership
PVMBG	Pusat Vulkanologi dan Mitigasi Bencana Geologi (Centre for Volcanology and Geological Disaster Mitigation)
RAN-GRK	Rencana Aksi Nasional Gas Rumah Kaca (National Action Plan for Greenhouse Gas Emission Reduction)
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik (Electricity Supply Business Plan)
SCDF	Singapore Civil Defence Force
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SISKMOMNAS PMPB	Sistem Komunikasi Nasional untuk Pelindungan Masyarakat dan Penanggulangan Bencana (National Communication System for Community Protection and Disaster Management)
SJP	Sistem Jaringan Pemulihan (Recovery Network System)
SJM	Sistem Jaringan Mitigasi (Monitoring Network System)
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UN-Habitat	United Nations Human Settlements Programme
YKAN	Yayasan Konservasi Alam Nusantara (Nature Conservation Foundation)

OBJECTIVES

The 20th anniversary of the Indian Ocean Tsunami (IOT20) offers a sombre moment to reflect on the catastrophic event of 26 December 2004 and its profound impact on the global disaster management landscape. Over the past two decades, the concept of sustainable resilience has evolved as a central tenet in disaster management, combining long-term preparedness with adaptability to future challenges. This study is not only a retrospective analysis but also a forward-looking exercise, harnessing lessons learned, applied and, in some cases, reapplied over the past two decades to build a stronger foundation for sustainable resilience in the face of growing climate change impacts, urbanisation and other risks to planetary and human health. Thus, the objectives of the study are as follows:

1. **Mapping Progress:** The study documents advancements in disaster preparedness, response, and recovery, with a focus on Indonesia and the Indo-Pacific. It evaluates progress in global commitments like the SFDRR, the role of science and technology in disaster resilience, infrastructure investments, and the impact of financial mechanisms and technology transfer on vulnerable communities.
2. **Identifying Challenges and Opportunities:** The report explores governance, innovation, and community engagement as critical areas for integrating disaster management with the SDGs and climate adaptation efforts, emphasising their role in embedding sustainable resilience.
3. **Scenario Development:** Ideal future scenarios are outlined to position Indonesia as a regional leader in disaster risk management, supporting policy recommendations that advance resilience-building efforts.
4. **Policy Recommendations:** Actionable proposals are provided to guide Indonesia and ASEAN towards leadership in disaster resilience, shaping policies that extend beyond the 2030 Agenda and align with emerging global frameworks like the post-Paris Agreement and post-Sendai arrangements. Sustainable resilience remains central to addressing immediate and long-term risks.

This synthesis report presents background information and analysis, key findings and policy recommendations. For the full report please visit <https://bit.ly/IOT20Book>.

METHODOLOGY

The study employs an interdisciplinary methodology to explore the evolution of sustainable resilience from the 2004 Indian Ocean tsunami to 2024. By combining qualitative and quantitative methods, it synthesises data from a wide range of sources to provide a comprehensive analysis.

- The qualitative component examines how policies, technology, infrastructure, and funding have shaped sustainable resilience. Drawing on stakeholder discussions, a literature review, and in-depth case studies, it evaluates the role of digital innovation, local initiatives, and global frameworks in Indonesia's resilience journey. A case study of Berbak Sembilang National Park illustrates how global concepts are adapted to local needs, offering practical insights into implementation challenges and successes.
- The quantitative analysis complements this by using statistics and indicators from government, international organisations, and research to evaluate Indonesia's progress. By identifying achievements, gaps, and opportunities, it provides a data-driven perspective on disaster risk management, sustainable development, and climate change mitigation.
- A robust analytical framework integrates policy alignment, localisation strategies, and impact evaluation, ensuring that national policies address local needs while meeting global commitments. Primary data from the Second Global Forum on Sustainable Resilience and thematic seminars on localisation, innovation, infrastructure, and financing is triangulated with secondary sources to ensure reliability.
- Reflective analysis adds a temporal, spatial, and social lens, examining milestones and regional variations to offer actionable recommendations. This interdisciplinary approach provides a roadmap for enhancing resilience, building on lessons from the past two decades to guide future efforts.

SUMMARY OF CONCLUSIONS AND POLICY RECOMMENDATIONS

Two decades after the 2004 Indian Ocean Tsunami, Indonesia has made significant progress in building sustainable resilience to disasters. This world-shaking event was a turning point that has driven a significant transformation in the approach to disaster risk management in Indonesia. This journey has been marked by a variety of valuable achievements, and some considerable challenges and learnings that have shaped the country's disaster resilience landscape.

The evolution of sustainable resilience in Indonesia reflects a paradigm shift from a reactive to a proactive approach in dealing with disasters. The establishment of a more systematic legal and policy framework, through key events and actions such as the passage of the Disaster Management Law in 2007 and the establishment of the National Disaster Management Agency (BNPB), marks Indonesia's commitment to strengthening disaster risk governance. The integration of various global initiatives such as the Sustainable Development Goals (SDGs), the Hyogo Framework for Action (2005-2015) and its successor, the Sendai Framework for Disaster Risk Reduction (SFDRR), and the Paris Agreement on Climate Change into national and local policies also demonstrates awareness of the importance of a holistic approach to building resilience.

Incorporating a Gender, Disabilities, and Social Inclusion (GEDSI) perspective, Indonesia's journey towards resilience also emphasises the need to address the unique vulnerabilities and capacities of all community members. Efforts to ensure that disaster preparedness and response strategies are inclusive and equitable are crucial. This includes recognising the specific needs of women, people with disabilities, and marginalised groups, and ensuring their full participation in disaster risk management processes.

This journey has not been without challenges. Indonesia has invested heavily in narrowing the capacity gaps between central and regional governments, diversifying resources, and reducing bureaucratic complexity by streamlining cross-sectoral policies. In addition, Indonesia also recognises and continues to address the unique challenges related to its geographical and socio-cultural diversity, which require an approach tailored to the local context.

This summary presents conclusions from the results of the study contained in the following chapters, as well as policy recommendations that, if prioritised, may help to strengthen sustainable resilience in the future.

Key Takeaways Chapter 2: Commitment to Global Agreements: Chapter 2 highlights Indonesia's commitment in implementing global agreements such as the SDGs, the SFDRR, and the Paris Agreement. Although these agreements differ in focus, their integration is key for achieving sustainable resilience. The biggest challenge is ensuring that these global commitments are translated into policies and actions at the local level.

Recommendations:

1. **Policy Integration:** Building on the considerable body of disaster risk management policy and regulatory work already done, Indonesia can confidently continue its efforts to strengthen mechanisms that integrate global and local commitments, particularly by facilitating regulatory harmonisation processes that address both disaster risk mitigation and climate change.
2. **Community Empowerment:** Active community participation in decision-making related to disaster risk and climate change should be increased through education programs and public awareness campaigns, with particular attention given to women, children and vulnerable groups.

Key Takeaways Chapter 3: Investing in Science, Technology, and Innovation: Chapter 3 underlines the important role of technology in disaster risk mitigation, highlighting the development of the Indonesia Tsunami Early Warning System (InaTEWS) as a key achievement. However, to meet “last mile” challenges, deploying technology to remote areas remains a priority, as does overcoming telecommunication infrastructure and human resource limitations.

Recommendations:

1. **Technological Infrastructure Improvement:** Increased multi-stakeholder investment in technological infrastructure, especially in disaster-prone areas with limited access to technology would improve disaster risk management. Special attention should be given to enabling access to information for women, children and people in vulnerable situations.
2. **Multi-Sector Collaboration:** Public-private-academic partnerships are essential for driving innovation in disaster risk management technology.

Key Takeaways Chapter 4: Building Resilient Infrastructure: Chapter 4 underscores the importance of resilient infrastructure in mitigating disaster impacts. Projects like construction of Jakarta’s seawall and improved drainage systems in major cities have protected vulnerable communities. A continued focus on improving governance and institutional coordination for infrastructure development will further enhance local level resilience.

Recommendations:

1. There is an opportunity to strengthen disaster risk management coordination, including the mechanisms between agencies, so that all infrastructure projects are resilient. Creating incentives to support this enhanced coordination should be considered.
2. **Use of Advanced Technology:** Expanding the use of AI, big data, and the Internet of Things (IoT) can better support disaster monitoring and response.

Key Takeaways Chapter 5: Access to Technology Financing and Transfer: Building on the success of existing mechanisms, such as the Disaster Pooling Fund, further exploration and innovation for disaster risk financing should be explored to address resource constraints and coordination challenges. A focus on diversification of funding sources and leveraging advanced technologies would be useful.

Recommendations:

1. **Diversification of Funding Sources:** The government should develop innovative financial instruments such as disaster insurance and crowdfunding, to enhance financing flexibility particularly for people in vulnerable situations.
2. **Increased Access to Technology:** Technology transfer should prioritise vulnerable areas and populations, with private sector and international institutional involvement to provide broader solutions.

SUMMARY OF POLICY RECOMMENDATIONS

1. Integration of Global and Local Commitments

Indonesia must continue ongoing efforts to ensure that global commitments (SDGs, the SFDRR, Paris Agreement) are integrated into local policies through a contextual and adaptive approach.

2. Sustainable Investment in Technology and Innovation

Increased investment in technological infrastructure, especially in disaster-prone areas, is crucial. This includes telecommunication networks that support early warning systems.

3. Strengthening Local Capacity

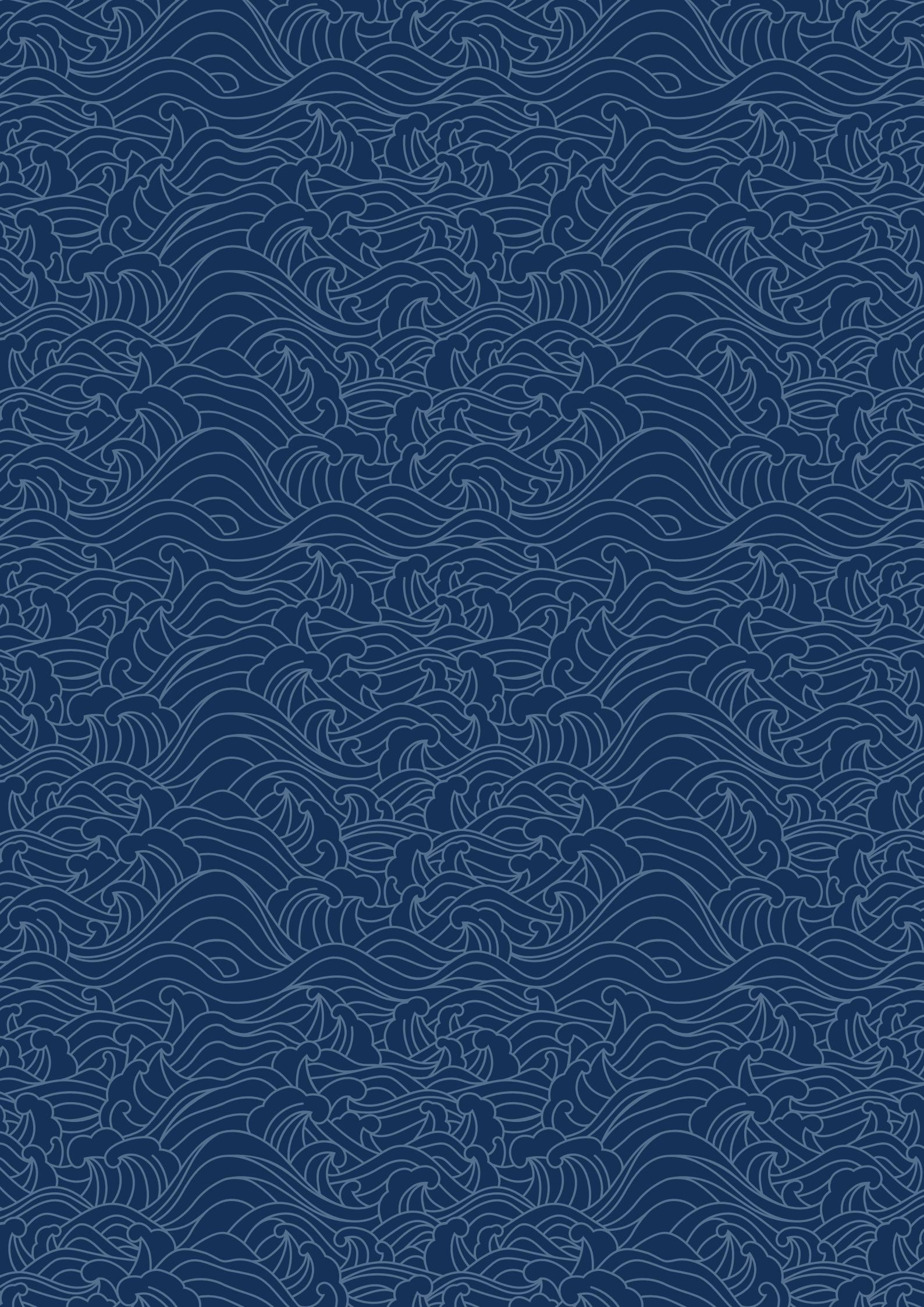
Empowering local communities particularly women, children and people in vulnerable situations in decision-making related to disaster risk through education and training on climate change mitigation and adaptation is essential.

4. Diversification of Funding Sources

Innovative financial instruments are needed to address complex disasters. Relying on the state budget alone will not suffice.

5. Cross-Sector Collaboration

Governments, the private sector, and civil society must collaborate to ensure that DRR efforts are supported by adequate resources and effective coordination.



CHAPTER 1

INTRODUCTION

Background to Sustainable Resilience

Sustainable resilience has become an essential framework for addressing the interconnected challenges of disaster risk, climate change, and sustainable development. Events such as the 2004 Indian Ocean Tsunami, the 2006 Jogjakarta earthquake, Cyclone Nargis in 2008, and Typhoon Haiyan in 2013 have demonstrated the increasing frequency and intensity of disasters, exacerbated by climate change. These experiences, compounded by the global impacts of the Covid-19 pandemic emerging climate-related risks and threats and other emerging

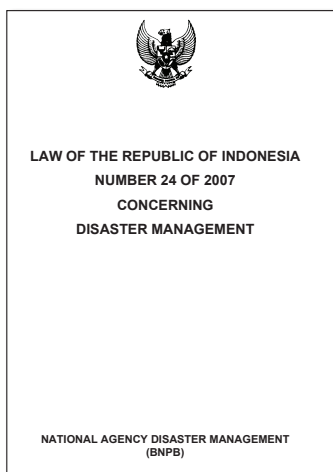
global challenges, highlight the urgent need for robust, integrated disaster risk management strategies.

In the aftermath of the 2004 tsunami, Indonesia—one of the worst-affected nations—undertook significant reforms to strengthen its disaster management capabilities. The 2007 Disaster Management Act and the establishment of the National Agency for Disaster Management (BNPB) were critical milestones in this transformation, marking a shift from reactive disaster response to a more proactive and integrated approach to disaster risk reduction (DRR).

The global community also recognised the need to enhance coordinated efforts, adopting the Hyogo Framework for Action (HFA) in 2005 to build the resilience of nations and communities. A decade later, the Sendai Framework for Disaster Risk Reduction (SFDRR) succeeded the HFA, introducing a more comprehensive approach to managing disaster risk and addressing the escalating threats to human and planetary security posed by climate change. Indonesia has since played a pivotal role in advancing sustainable resilience, exemplified by its leadership during the 2022 Global Platform for Disaster Risk Reduction (GPDRR) in Bali. The resulting “Bali Agenda for Resilience,” introduced by President Joko Widodo, outlined a vision that integrates disaster risk governance, investments in science and technology, community empowerment, and enhanced international cooperation.

Indonesia’s Journey Towards Sustainable Resilience

Indonesia’s transformation into a global leader in sustainable resilience began with the tsunami, which exposed vulnerabilities in its disaster preparedness and response systems. The magnitude of destruction prompted the government to implement significant reforms aimed at strengthening disaster management. The establishment of BNPB in 2008 provided a central authority to coordinate national efforts, including preparedness, mitigation, response, and recovery.



The 2007 Disaster Management Act further laid the groundwork for a systematic approach to DRR. The Act decentralised disaster management, empowering local governments to address region-specific risks. It also prioritised community-based disaster risk reduction, recognising the importance of local knowledge and active engagement in resilience-building. Additionally, the integration of DRR into development planning ensured that resilience measures became an integral part of infrastructure development, land use policies, and environmental management.

In the years following these reforms, Indonesia fostered a culture of resilience across the nation. Public awareness campaigns educated citizens on disaster risks and preparedness, often in collaboration with NGOs and international agencies. These efforts encouraged proactive behaviours, such as creating emergency plans and participating in drills, and emphasised the inclusion of women, children, and other vulnerable groups. Meanwhile, the incorporation of DRR into the national education curriculum equipped younger generations with the knowledge and skills necessary to respond effectively to disasters. Substantial investments in early warning systems further enhanced the country's ability to anticipate and mitigate the impacts of hazards such as tsunamis, earthquakes, and floods.

Sustainable Resilience, Development and Climate Change

Indonesia's approach to resilience is closely aligned with its broader development goals, including the Sustainable Development Goals (SDGs). The government's commitment to sustainable development is evident in its efforts to integrate disaster risk management with economic, social, and environmental policies. Resilience-building measures have been incorporated into infrastructure projects, social protection programs, and land-use planning.

This alignment is particularly visible in Indonesia's focus on SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Climate-resilient infrastructure, such as flood defences and earthquake-resistant buildings, has been prioritised to safeguard communities against future risks. Social protection programs have been expanded to include disaster risk reduction measures, providing financial assistance to affected households and supporting community-led resilience initiatives.

The country's commitments under the 2016 Paris Agreement further demonstrate its dedication to sustainable resilience. Indonesia has integrated climate risk assessments into national and local development plans, conducted vulnerability assessments, and prioritised resilience-building in areas most at risk. Sustainable land-use practices, including reforestation and climate-smart agriculture, have been promoted to reduce vulnerability to climate change while protecting critical ecosystems such as mangroves and forests. By supporting diverse livelihoods and alternative income sources, Indonesia has also enhanced the resilience of communities heavily reliant on natural resources.

Global Leadership in Resilience

Indonesia's proactive approach to sustainable resilience has positioned it as a leader on the global stage. Hosting the 2022 Global Platform for Disaster Risk Reduction (GPDRR) in Bali marked a significant milestone, with the Bali Agenda for Resilience advocating an integrated approach to disaster risk reduction, climate change adaptation, and sustainable development. This agenda resonated with global leaders and practitioners, further cementing Indonesia's influence in shaping international resilience frameworks.



The country's leadership extended to its 2023 chairmanship of ASEAN, where it spearheaded the adoption of the ASEAN Leaders' Declaration on Sustainable Resilience during the 43rd ASEAN Summit in Jakarta. This declaration reflected Indonesia's vision, calling for enhanced regional cooperation, alignment with global frameworks like the SFDRR and Paris Agreement, and greater investment in science, technology, and community empowerment.

Indonesia's contributions to the Sendai Framework Midterm Review (MTR) and its advocacy during the 2023 G20 DRR Working Group further highlighted its commitment to integrating DRR with climate adaptation and sustainable development. These efforts reinforced Indonesia's reputation as a regional and global influencer in resilience-building.

Global Forums 1 and 2 on Sustainable Resilience

In March 2023, Indonesia hosted the inaugural Global Forum for Sustainable Resilience (GFSR), bringing together stakeholders from government, academia, international organisations, and civil society. The forum underscored the interconnected nature of disaster risks and the importance of integrated solutions. Discussions highlighted the need for increased investment in resilience, with a focus on innovative financing mechanisms and community-based approaches.

Participants emphasised the role of diplomacy, technology, and local engagement in driving the sustainable resilience agenda. The forum concluded with a commitment to ongoing dialogue, collaboration, and innovation, establishing GFSR as an annual platform for advancing resilience efforts.

The second forum, held in September 2024, commemorated the 20th anniversary of the 2004 tsunami. It assessed progress over two decades and validated insights from domestic seminars on the four pillars of sustainable resilience. Key outcomes included recognition of the critical role of international cooperation, technological integration, and resilience as a foundational element of all development strategies. Participants also stressed the importance of fostering a culture of prevention, particularly among younger generations, to build a more resilient society.

The forum's discussions highlighted the urgent need for transformative action in response to escalating disasters and systemic risks. Indonesia's leadership in organising these forums reinforced its commitment to shaping the global resilience agenda, leveraging its experiences to inspire and inform efforts worldwide.

Conclusion

Indonesia's journey towards sustainable resilience serves as a model for integrating disaster risk reduction, climate adaptation, and sustainable development. Through comprehensive reforms, international leadership, and sustained advocacy, the country has demonstrated how resilience can be prioritised to ensure a safer and more sustainable future for all.

CHAPTER 2

COMMITMENT TO GLOBAL AGREEMENTS

Taken together, global frameworks such as the Sustainable Development Goals (SDGs), the Sendai Framework for Disaster Risk Reduction (SFDRR), and the Paris Agreement offer comprehensive approaches to addressing the intertwined challenges of sustainable development, disaster resilience, and climate change. Each framework presents distinct yet complementary objectives that guide countries towards reducing vulnerabilities, building resilience, and promoting equitable development. Indonesia’s proactive engagement with these frameworks reflects its recognition of their importance in ensuring sustainable growth while managing risks associated with disasters and climate change.

Progress on the Sustainable Development Goals¹



Adopted by 193 UN Member States in 2015, the SDGs aim to tackle global challenges in poverty, inequality, climate change, and environmental degradation, while fostering peace and justice. Indonesia has formalised its commitment to the SDGs through Presidential Regulation Number 59 of 2017, integrating global priorities into its national development agenda. The National Action Plan for the SDGs (RAN-SDGs) serves as a comprehensive framework that aligns Indonesia’s socio-economic and environmental goals with the global agenda.

Since their adoption, the SDGs have significantly influenced Indonesia’s policy landscape. Guided by the principle of leaving no one behind, Indonesia has implemented wide-ranging programs to reduce poverty, improve access to healthcare and education, and promote gender equality. Social protection schemes, such as the Family Hope Program (PKH) and Smart Indonesia Card, have contributed to a steady decline in the national poverty rate, reaching its lowest level in over a decade.

Health and education outcomes have improved through targeted investments in infrastructure and human resources. The expansion of universal health coverage has enhanced access to healthcare services, while curriculum reforms and teacher training programs have strengthened the education system. Renewable energy initiatives, including solar and geothermal projects, have diversified the energy mix, aligning with Indonesia’s commitment to SDG 7 (Affordable and Clean Energy). Investments in disaster-resilient infrastructure and urban planning have further advanced sustainable development while reducing vulnerabilities to climate-related risks.

¹ For further detail on Indonesia’s progress in achieving the SDGs refer to the 2023 Report on Implementation of the Sustainable Development Goals issued by the Ministry of Development Planning (BAPPENAS): <https://sdgs.bappenas.go.id/website/wp-content/uploads/2023/11/Laporan-tahunan-SDGs-2023.pdf>

However, regional disparities remain a challenge. Access to essential services such as clean water, sanitation, and quality education varies between urban and rural areas. Remote regions often face infrastructure and resource constraints, exacerbating inequalities. Women and marginalised groups continue to encounter barriers to economic opportunities and social inclusion, despite progress in legislative and policy reforms.

To address these disparities, Indonesia has prioritised localisation of the SDGs, ensuring strategies are tailored to the diverse needs of its regions. Community-driven initiatives and participatory planning processes, such as Musrenbang, have empowered local governments and stakeholders to implement development projects that resonate with their unique contexts. Partnerships with civil society, private sectors, and international organisations have further amplified these efforts, fostering innovation and resource mobilisation for sustainable development.

Integration of the Sendai Framework

Adopted in 2015, the Sendai Framework for Disaster Risk Reduction (SFDRR) focuses on reducing disaster risks through four priorities: understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction for resilience, and enhancing disaster preparedness to “build back better” after crises. Indonesia has actively aligned its policies with the SFDRR, such as its National Action Plan for Disaster Management (2019–2024) and regional disaster management initiatives. These efforts have improved disaster resilience through mitigation plans, resilient infrastructure, and community empowerment. However, challenges such as resource limitations, capacity gaps, and policy harmonisation persist, requiring continuous collaboration, resource allocation, and capacity-building.

The SFDRR complements the Sustainable Development Goals (SDGs) and climate action by integrating disaster risk reduction (DRR) into broader sustainable development efforts. It does this through understanding disaster risk where enhanced knowledge of these risks supports targeted policies to protect communities, aligning with SDG 11 (Resilient Cities) and SDG 13 (Climate Action). A focus on strengthening governance aims to foster collaboration across stakeholders, ensuring DRR integration into national and local strategies, enhancing sustainability and efficiency. Investments in resilience mean prioritising resilient infrastructure and early warning systems and so promoting long-term preparedness, aligned with SDG 9 (Infrastructure) and SDG 13. And building back better ensures communities rebound stronger after disasters, reducing long-term vulnerabilities.

An integrated approach to sustainable resilience is at the core of the SFDRR. This involves embedding climate change adaptation and mitigation into DRR strategies to promote social, economic, and environmental sustainability. Localisation is vital, as adapting policies to regional contexts enables tailored responses to unique risks. Collaboration among local governments, civil society, private sectors, and communities ensures inclusive and sustainable resilience.

Despite progress, challenges such as limited resources and challenges to inter-agency coordination at local levels hinder implementation. Continuous efforts to address these gaps are needed to align resilience-building with sustainability principles. The SFDRR underscores that sustainable resilience is not only a goal but must underpin all development decisions to create thriving, disaster-resilient communities.

Addressing Climate Change under the Paris Agreement

Adopted at COP 21 in 2015, the Paris Agreement aims to limit global temperature rise to below 2°C above pre-industrial levels, with a target of 1.5°C. Central to the agreement are Nationally Determined Contributions (NDCs), where countries outline plans to reduce greenhouse gas emissions and adapt to climate impacts through, for example, nature-based solutions, green infrastructure, and resilience-building.

Indonesia demonstrated its commitment through Law No. 16 of 2016, setting ambitious goals to cut emissions by 29 percent domestically and 41 percent with international aid by 2030. The law encompasses climate governance, community participation, resource mobilisation, and innovation, supported by regulations such as the National Action Plan for Reducing Greenhouse Gas Emissions and renewable energy policies.

The 2023 Global Stocktake reveals mixed progress globally. Mitigation and adaptation efforts have advanced but remain insufficient for the 1.5°C target. While NDCs show improvement, higher ambition and policy integration are needed. Local governments increasingly prepare climate action plans, aligning with specific regional challenges, but financial and technical limitations hinder implementation.

Integration between national and local policies is critical to ensure actions are context-specific and impactful. Localisation mirrors the Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction (SFDRR), allowing for tailored responses to regional needs. In Indonesia, some regions have adopted sustainable resource management and green infrastructure to address climate challenges.

The Berbak-Sembilang National Park in Sumatra exemplifies how the Paris Agreement, SDGs, and SFDRR converge at the local level. This UNESCO Biosphere Reserve absorbs carbon, shields coasts, and fosters biodiversity. Community-led efforts in nearby Sungsang IV Village demonstrate transformative approaches through the SMART (Sungsang Mangrove Restoration and Ecotourism) program, which restored mangroves and boosted ecotourism. Innovative initiatives include producing natural resource-based goods and planting rare mangrove species. These efforts integrate climate change mitigation, disaster risk reduction, and sustainable development, inspiring other regions in Indonesia and beyond.

Localising the Paris Agreement involves several strategies. Firstly, climate-oriented policies, where regional governments should align climate action plans with emission reduction and resilience-building goals, supported by digital monitoring tools. Secondly, community engagement where public awareness and participation are essential for long-term success. Education and digital campaigns can enhance understanding and support for climate initiatives. Thirdly, a stronger push for cross-sector collaboration where partnerships among public, private, and non-profit sectors foster resource sharing, innovation, and collective solutions. Digital platforms can enhance collaboration.

Indonesia's climate law underscores the importance of mitigation and adaptation across all governance levels. Engaging local communities in planning and implementation ensures policies meet specific needs and enhances their effectiveness. Empowerment through education and training builds resilience and supports equitable development. By prioritising localised, inclusive strategies, implementing the Paris Agreement strengthens resilience, fosters sustainable progress, and unites communities in combating climate change.

Integration of Global Agreements for Sustainable Resilience at the Local Level

Integrating the Sustainable Development Goals (SDGs), the Sendai Framework for Disaster Risk Reduction (SFDRR), and the Paris Agreement is crucial for achieving sustainable resilience. This holistic approach enables stakeholders to develop adaptive strategies tailored to specific local risks. By aligning with the principles of these frameworks, stakeholders can strengthen disaster risk management, mitigate climate change impacts, and promote inclusive development.

In Indonesia, climate change holds the highest legal priority, reflected in the 2016 climate law. While the SDGs are supported by Presidential Regulations, they do not carry the same legal weight. The SFDRR, referenced in the Disaster Management Master Plan, lacks dedicated legislation, highlighting the need for better integration among these frameworks. Aligning their implementation provides several benefits including integrated policies where alignment of the principles of the SDGs, SFDRR, and Paris Agreement enables the creation of comprehensive policies. Linking disaster risk reduction (DRR) with climate action and development ensures cohesive, impactful strategies. Improved preparedness, which involves integrating disaster and climate risk considerations, means that stakeholders can design more resilient infrastructure and response mechanisms, addressing both immediate and long-term challenges. And, by optimising resources, coordinated efforts allow countries to efficiently use those resources and tap into international funding for projects that enhance disaster resilience while advancing the SDGs.

Together, these frameworks create synergies to build community resilience, linking sustainable development, disaster risk reduction, and urgent climate action. Coordinated implementation not only addresses climate and disaster challenges but also fosters equitable, sustainable development, paving the way for sustainably resilient societies.

Localisation Strategies for Global Agreements

Localising global agreements like the SDGs, SFDRR, and Paris Agreement is vital for tailoring their implementation to regional contexts. Effective localisation enhances resilience by strengthening local capacity, encouraging participation, ensuring equitable resource allocation, and fostering partnerships. It also promotes a sense of ownership, empowering communities to tackle climate and disaster challenges. Key strategies include:

- **Building Local Capacity:** Investing in capacity-building for local governments, civil society organisations, and communities ensures effective implementation and understanding of global frameworks.
- **Active Participation:** Engaging local actors in planning, implementation, and evaluation fosters relevance and ownership of resilience and adaptation initiatives.
- **Resource Allocation:** Channelling financial and technical resources to local organisations supports resilience programs and amplifies their impact.
- **Equal Partnerships:** Collaboration between international, national, and local actors on an equal footing ensures that global agreements reflect local needs and contexts.
- **Participatory Monitoring:** Developing monitoring systems that involve communities enhances accountability and supports continuous learning for refining strategies.

By adapting global policies to local realities, localisation ensures the effectiveness and sustainability of resilience efforts. This approach not only strengthens local ownership but also equips communities to manage climate and disaster risks, contributing to the broader goals of sustainable development.

Policy Recommendations

To advance the SDGs, SFDRR, and Paris Agreement while fostering resilience and inclusive growth at the local level, a continued focus on the following priorities will help to ensure progress on Indonesia's sustainable resilience goals.

1. Policy Integration

- Harmonise national and local policies to align the SDGs, SFDRR, and Paris Agreement.
- Establish a central body to oversee framework implementation across sectors and regions.
- Revise regulations to eliminate overlaps and encourage cross-sector collaboration.

2. Local Capacity Building

- Invest in training local governments in disaster preparedness, climate adaptation, and resource management.
- Develop regional action plans with community input and tailored to local challenges.
- Foster peer-to-peer learning and promote locally driven solutions.

3. Resource Allocation

- Direct financial and technical resources to vulnerable regions, prioritising resilient infrastructure and renewable energy.
- Attract international donor and institutional support for sustainable development projects.
- Focus on long-term financing commitments to maximise impact in targeted communities.

4. Public-Private Partnerships (PPP)

- Collaborate with the private sector to mobilise resources for green infrastructure and community-based adaptation.
- Incentivise businesses to invest in climate resilience and renewable energy initiatives.
- Engage non-traditional donors through CSR, pooled funds, and venture capital.

5. Localisation of Frameworks

- Adapt global frameworks to Indonesia's diverse regional needs, tailoring initiatives to specific socio-economic and environmental conditions.
- Empower communities to participate in climate mitigation and disaster risk reduction efforts.
- Implementing these actions will help Indonesia achieve its commitments while promoting sustainable resilience and inclusive growth at all levels.

Conclusion

Indonesia's commitment to global agreements such as the SDGs, SFDRR, and Paris Agreement underscores its dedication to building a sustainable and resilient future. The country's achievements in poverty reduction, disaster risk management, and climate action reflect the transformative potential of aligning global principles with local realities. However, the road ahead requires sustained effort, innovation, and collaboration.

CHAPTER 3

INVESTING IN SCIENCE, TECHNOLOGY AND INNOVATION

Background

Advances in science, technology, and innovation are revolutionising disaster risk management globally, with Indonesia—a nation facing significant disaster risks—leading in leveraging these advancements. Sustained investment in technology is crucial to enhancing resilience while supporting sustainable development.

Since the 2004 tsunami, Indonesia has significantly improved its disaster preparedness, exemplified by the Indonesia Tsunami Early Warning System (InaTEWS). Providing alerts within five minutes of earthquakes, InaTEWS integrates advanced tools like seismometers, GPS, and tide gauges. According to BMKG's 2023 report, InaTEWS has successfully warned against 95 percent of tsunamis since its launch. Components such as INA-BUOY, INA-CBT, and INA-CAT monitor seismic activity and wave patterns, while the AI-powered PEKA Tsunami system predicts tsunami characteristics, ensuring swift responses in collaboration with agencies like BNPB and Basarnas.

GIS and remote sensing technologies also play a pivotal role. BNPB's InaRISK platform combines spatial and non-spatial data to create detailed disaster maps, aiding decision-makers and communities. By 2024, over 10 million users had downloaded the app, highlighting its role in mitigation planning. Projects like PATRIOT-Net leverage the Internet of Things (IoT) to monitor disasters, and AI analyses vast datasets to enhance prediction and mitigation. High-resolution digital elevation models (DEMs) improve volcanic hazard planning, with a 2023 study showing 90 percent accuracy in lava flow predictions.

Integrating traditional knowledge with technology further strengthens resilience. In Simeulue, the culturally rooted “smong” tsunami warning system complements modern early warning systems, improving community responsiveness by 95 percent. Digital tools like the SIAGA app and Village Information System enhance local disaster coordination and planning. Indonesia's innovative approach to disaster management demonstrates how combining cutting-edge technology with local practices can build resilience and save lives.

Effective communication systems are crucial during disasters, yet gaps in integration remain a challenge in Indonesia. The Disaster Information Delivery System, Emergency Call Number Service, and Radio Communication System are not yet fully harmonised across central and regional agencies. To address this, the government is developing the National Communication System for Community Protection and Disaster Management (SISKOMNAS PMPB). This integrated system aims to improve coordination and ensure seamless information flow during emergencies.

Investment in human resource development is equally vital. Training programs are essential to equip practitioners and decision-makers with the skills to operate advanced technologies and interpret data effectively. Building technical capacity ensures that technological advancements translate into practical benefits for disaster-prone communities.

Key Findings

Decentralisation and Policy Alignment: Indonesia's decentralised governance structure has enhanced regional disaster response, offering flexibility to address local challenges. Greater alignment between central and regional policies presents an opportunity to further strengthen disaster risk management. Integrated frameworks that balance national consistency with regional relevance can support more effective and locally tailored disaster mitigation programs.

Strengthening Expert Participation: Engaging experts and academia more extensively in disaster planning offers a pathway to leveraging the latest scientific knowledge. Encouraging multi-stakeholder collaboration, including governments, academia, the private sector, media, and civil society, can foster innovation and ensure policies are grounded in comprehensive research and local needs.

Enhancing Access to Technology: Urban areas often have better access to disaster management technologies than rural regions. Expanding digital infrastructure and communication networks, particularly in remote areas, can help ensure that all communities benefit from advanced technological solutions, enhancing resilience nationwide.

Building Local Capacity: Investments in education and training programs for local governments can empower regional authorities to integrate modern technologies and disaster risk management policies more effectively. Capacity-building initiatives can strengthen local governments' ability to respond to disasters quickly and efficiently.

Promoting Innovation in Disaster Financing: Encouraging innovation in disaster risk financing, such as supporting start-ups and small enterprises developing disaster technologies, offers an opportunity to enhance resilience. Policies that incentivise the use of innovative financial instruments can contribute to more robust disaster risk management systems.

Incorporating Local Knowledge and Community Engagement: Local knowledge and active community involvement play a key role in disaster preparedness. Integrating traditional practices, such as the "smong" tsunami warning system, with modern technologies ensures culturally relevant and effective disaster risk solutions. Expanding community-based initiatives, like Disaster Preparedness Schools, can enhance grassroots resilience.

Advancing Technological Solutions Inclusively: Indonesia has made significant progress in adopting advanced technologies such as AI and IoT for disaster management. Addressing disparities in access by investing in connectivity and digital literacy ensures these advancements benefit all communities equally.

Fostering Local Participation: Strengthening the role of local leaders and adopting innovative engagement methods can increase community involvement in disaster risk reduction. Approaches like virtual and augmented reality training can inspire greater participation and preparedness at the grassroots level.

Collaborative Efforts in Technology and Policy: Collaboration among governments, private sector, and academia remains vital for advancing disaster resilience. Building partnerships and maintaining long-term investments will ensure inclusive access to cutting-edge technologies and enhance preparedness across all regions.

Policy Recommendations

To strengthen disaster resilience through science, technology, and innovation, the following actions are recommended:

1. Invest in Infrastructure

- Expand broadband internet access in remote and disaster-prone areas.
- Establish regional data centres for disaster information storage and analysis.
- Deploy IoT-based environmental monitoring systems.

2. Enhance Human Capacity

- Develop training programs for local governments and community leaders.
- Launch a national digital literacy campaign to improve technology adoption.
- Establish certification programs for disaster risk management professionals.

3. Promote Collaboration

- Foster partnerships between government, academia, private sector, and civil society.
- Create innovation hubs for disaster technology research and development.
- Incentivise private sector investment in disaster risk management solutions.

4. Strengthen Policies

- Simplify regulatory processes for adopting new disaster technologies.
- Establish national standards for AI and big data use in disaster risk analysis.
- Support local technology developers through grants and incentives.

5. Empower Communities

- Integrate local knowledge with modern technology in disaster management programs.
- Develop mobile apps tailored to local languages and cultural contexts.
- Involve communities in data collection and disaster risk monitoring.

Conclusion

Indonesia's investment in science, technology, and innovation has transformed its disaster risk management landscape, saved lives and reduced economic losses. By continuing to prioritise technological advancements, capacity building, and inclusive approaches, Indonesia can strengthen its disaster resilience and achieve broader development goals.

Long-term commitment, sustained funding, and collaboration among stakeholders are essential to overcoming challenges and ensuring that these technologies benefit all communities. Through a comprehensive and integrated approach, Indonesia can set a global example of how innovation can build a safer, more resilient future.

CHAPTER 4

DEVELOPMENT OF RESILIENT INFRASTRUCTURE

Background

Resilient infrastructure is a cornerstone of sustainable development, particularly for disaster-prone countries like Indonesia. Located at the convergence of three tectonic plates (Indo-Australian, Eurasian, and Pacific), Indonesia is vulnerable to earthquakes, tsunamis, floods, landslides, and the effects of climate change. Over the past two decades, the country has made significant strides in building infrastructure that reduces disaster risks and enhances resilience.

Indonesia has prioritised the development of physical and green infrastructure to mitigate disaster risks. The Indonesian Tsunami Early Warning System (InaTEWS), discussed in Chapter 3, exemplifies the country's commitment to technological advancements in disaster response. Complementing this are extensive efforts in building disaster-resistant physical infrastructure, such as embankments, drainage systems, and earthquake-resistant buildings. The Jakarta Seawall, part of the National Capital Integrated Coastal Development (NCICD) project, protects 12,000 hectares from flooding, preventing an estimated annual economic loss of IDR 26 trillion (USD 1.6 billion).

In disaster-prone areas, over 60 percent of roads have been constructed or upgraded with disaster-resilient designs, materials, and drainage systems, according to the Ministry of Transportation (2023). These roads and bridges ensure uninterrupted transportation during disasters, facilitating emergency response and economic recovery.

Indonesia's energy infrastructure has also been enhanced for resilience. The State Electricity Company (PLN) has equipped power plants with independent operational systems to function during emergencies. Resilient power grids, combined with a focus on renewable energy under the 2021-2030 Electricity Supply Business Plan (RUPTL), further support disaster preparedness and sustainability.

Green infrastructure initiatives, such as mangrove rehabilitation, complement physical infrastructure by leveraging natural ecosystems for disaster mitigation. Since 2015, more than 500,000 hectares of mangroves have been rehabilitated, reducing coastal vulnerability by up to 40 percent in some areas while enhancing carbon sequestration to support Indonesia's emission reduction targets.

Other NbS, like urban wetland parks, provide flood control, carbon sequestration, and biodiversity conservation. For example, Surabaya's wetland pilot project cut flood risk by 40 percent and absorbed 500 tons of CO₂ annually, demonstrating how ecological solutions can address urban challenges. Integrating NbS into infrastructure projects fosters sustainability, social inclusion, and long-term economic benefits. Community participation in mangrove restoration, for instance, has improved livelihoods through ecotourism and fisheries, showcasing the socio-economic potential of NbS.

Key Findings

Regulatory Alignment and Institutional Synergies: Aligning policies across levels of government will help to streamline implementation and enhance disaster-resilient infrastructure development. For instance, Government Regulation No. 5 of 2021 promotes risk-sensitive development, but its application can face challenges in high-risk areas. Strengthening collaboration among stakeholders can improve enforcement of disaster mitigation protocols.

Technical Capacity and Resources: Many regions require additional technical support to integrate disaster risk assessments into infrastructure planning. Reports from the Asian Development Bank underscore the need for investments in quality infrastructure and capacity-building initiatives to strengthen local disaster management capabilities.

Partnerships and Coordination: Enhanced coordination between central and regional governments, coupled with investments in local training, can help to reduce regulatory fragmentation and improve disaster risk considerations in planning. Incentives for private sector engagement and public-private partnerships can promote innovation and resource-sharing for sustainable infrastructure. International collaboration also offers opportunities for technical assistance and knowledge transfer to adapt global best practices to Indonesia's unique context.

Community Engagement: Sustained community participation in planning, management, and monitoring of disaster-resilient infrastructure is linked to better access to information and stronger local leadership. Improving disaster literacy and strengthening communication between governments and communities can help to promote long-term involvement.

Building on Existing Programs: Promoting community involvement through initiatives like the Village Information System (SID) can enhance local ownership and sustainability. Strengthening local leadership and incorporating disaster risk education can empower communities to actively participate in infrastructure planning and maintenance, ensuring contextually relevant solutions.

Technology Barriers: Integrating advanced technologies in infrastructure projects faces challenges such as funding gaps, limited expertise, and insufficient regulatory support, particularly in remote areas. Coordination between sectors and agencies will help to improve effective technology adoption.

Policy Support: With policy support and inter-agency collaboration, technology can significantly enhance infrastructure resilience. Investments in technology infrastructure in underserved regions can close the digital divide, while partnerships among governments, private sectors, and academia can ensure the relevance and effectiveness of technological solutions. Modern tools like AI and IoT can improve planning, implementation, and maintenance of resilient infrastructure.

By addressing these findings, Indonesia can strengthen governance for disaster-resilient infrastructure, building a foundation for sustainable and inclusive development across the country.

Policy Recommendations

To enhance infrastructure resilience, Indonesia should adopt the following strategies:

1. Improve Governance and Coordination

- Streamline regulatory frameworks to align with disaster resilience goals.
- Strengthen coordination mechanisms between central and regional governments.

2. Empower Communities

- Engage communities in planning and maintaining resilient infrastructure.
- Provide disaster literacy and capacity-building programs for local leaders and residents.

3. Leverage Advanced Technologies

- Integrate AI, big data, and NbS into infrastructure development.
- Expand digital infrastructure in remote areas to bridge the digital divide.

4. Promote Sustainable Investments

- Incentivise private sector participation in renewable energy and disaster-resilient projects.
- Prioritise investments that consider long-term climate risks.

5. Foster Multi-Sector Collaboration

- Facilitate dialogue between government, private sector, academia, and communities.
- Establish innovation hubs for research on resilient infrastructure solutions.

Conclusion

Resilient infrastructure is essential for safeguarding Indonesia against disaster risks while promoting sustainable development. By investing in advanced technologies, NbS, and collaborative approaches, Indonesia can enhance its infrastructure resilience, reduce vulnerabilities, and accelerate recovery efforts. With continued commitment and multi-stakeholder cooperation, Indonesia can set an example of how resilient infrastructure development supports a safer, more sustainable future for all.

CHAPTER 5

ACCESS TO DISASTER RISK MANAGEMENT TECHNOLOGY, FINANCING AND TRANSFER

Background

As the world's largest archipelagic nation, Indonesia faces significant disaster risks, with 40 percent of its population living in vulnerable areas and annual economic losses exceeding IDR 22 trillion. Events like the 2018 Lombok and Sulawesi disasters underline the socio-economic impacts of these challenges. In response, Indonesia has adopted innovative approaches to financing and technology integration to enhance disaster resilience.

Recognising the limitations of relying solely on traditional state budgets and international aid, Indonesia has implemented the Disaster Risk Financing and Insurance Strategy (PARB). A cornerstone of this strategy is the Disaster Pooling Fund (PFB), established under Presidential Regulation 75/2021. Managed by the Environmental Fund Management Agency (BPD LH), the PFB consolidates resources to ensure swift and adequate financial support for disaster management. With an initial allocation of IDR 7.3 trillion in 2023, it marks a significant step in disaster preparedness and recovery.

Regional and international collaborations further bolster Indonesia's capabilities. Platforms like the ASEAN Cross-Sectoral Coordination Committee on Disaster Risk Financing and Insurance (ACSCC-DRFI) and the Southeast Asia Disaster Risk Insurance Facility (SEADRIF) enable resource pooling and knowledge exchange, tailoring best practices to Indonesia's context.

Indonesia's climate commitments, reflected in its Nationally Determined Contribution (NDC) targets, aim to cut greenhouse gas emissions by 31.89 percent domestically and 43.20 percent with international support by 2030. Innovative financing mechanisms, such as the Green Sukuk, have raised USD 6.54 billion for renewable energy and low-carbon projects. Complementary efforts, including REDD+ payments and the launch of a carbon exchange in 2023, further support emission reductions and disaster resilience.

Technological innovation is pivotal to Indonesia's disaster management. Systems like the Indonesian Tsunami Early Warning System (InaTEWS), powered by AI and IoT, enhance real-time monitoring and response. Community-focused platforms like the Village Information System (SID) empower local populations, while initiatives supported by the Indonesian Venture Capital Association for Startups (Amvesindo) foster technological solutions to mitigate disaster risks.

Indonesia's Adaptive Social Protection (PSA) policy integrates social measures with disaster risk management, supporting programs such as Disaster Preparedness Villages and Social Barns. In 2024, the Ministry of Social Affairs allocated IDR 477.2 billion for PSA, aiding over 500,000 disaster victims and enhancing community resilience.

The private sector is integral to disaster resilience. Bank Rakyat Indonesia (BRI) empowers micro, small, and medium enterprises (MSMEs) through credit access and digital platforms like PARI, strengthening inclusive recovery efforts. Public-private partnerships further support resilient infrastructure, exemplified by the National Capital Integrated Coastal Development (NCICD) project, which combines government oversight with private innovation to safeguard vulnerable regions.

Through these strategies, Indonesia is charting a progressive path toward resilience, integrating financing, technology, and community-based approaches to mitigate disaster risks and promote sustainable development.

Key Findings

Resource Availability: Current investments in disaster risk reduction (DRR), while generous and ambitious, have not yet reached the ideal 0.3 percent of GDP target (IDR 62.7 trillion annually). This funding gap is a factor in challenging the government's ability to implement long-term, preventive DRR measures.

Coordination: Strengthening coordination between central and regional institutions can minimise overlapping programs, address funding imbalances, and streamline disaster responses. Flexible funding mechanisms, including proactive state budgets and international aid, could reduce delays and accelerate recovery.

State Budget: Reliance on the state budget constrains response capacity during large-scale disasters. Diversifying funding sources will help to enhance readiness.

Technology Gaps: Differential access to technology between urban and rural areas limits the effectiveness of early warning systems and disaster preparedness tools. Rural areas also face lower levels of financial and technological literacy, hindering their adoption of disaster management solutions.

Regulatory and Data Barriers: Regulatory and data access challenges impede the success and sustainability of DRR programs. Streamlining regulatory frameworks and improving data collection and analysis are critical to enhancing disaster resilience.

Innovative Financing: Instruments like green bonds, catastrophe bonds, and parametric insurance can diversify funding for disaster management. The Green Sukuk's success in raising USD 6.54 billion highlights the potential of such tools to fund DRR projects effectively.

Carbon Markets and Climate Finance: Indonesia's carbon exchange, launched in September 2023, provides new financing opportunities for emission reduction and climate adaptation projects, strengthening disaster resilience while advancing national climate targets.

Public-Private Partnerships (PPP): PPPs can attract private investment to develop disaster-resilient infrastructure and preparedness systems, leveraging resources and expertise from the private sector.

Leveraging Digital Technology: Technologies like AI, big data, and blockchain can optimise disaster risk management. Tools such as PARI have demonstrated efficiency in facilitating large-scale operations, and similar innovations can enhance data-driven decision-making and response efforts.

International Collaboration and Knowledge Sharing: International partnerships, such as those through the Green Climate Fund and ASEAN's ACSCC-DRFI, enable Indonesia to access global technologies, funding, and best practices, furthering its disaster resilience efforts.

Financial Literacy and Public Engagement: Improving financial literacy and public understanding of DRR tools, such as disaster insurance and early warning systems, can boost community involvement in disaster mitigation. Enhanced awareness encourages wider adoption of technologies and financial instruments, fostering local-level resilience.

Policy Recommendations

To enhance disaster resilience in Indonesia, a holistic, integrated approach involving government, private sector, communities, and international partners is essential. Key recommendations include:

1. Strengthen Institutional Coordination for Disaster Funds:

- Improve efficiency by clearly defining roles between central and regional agencies.
- Establish a task force under BNPB to synchronise policies, strengthen the Disaster Pooling Fund, and simplify fund distribution processes.

2. Foster Innovation in Disaster Financing:

- Create regulatory frameworks that harmonise national and regional regulations, incentivise innovative financial instruments, and support coordinated disaster management.

3. Diversify Funding Sources:

- Expand catastrophe bonds, green bonds, sukuk, and parametric insurance.
- Enhance global partnerships (e.g., Green Climate Fund) and encourage private sector involvement through PPP schemes.

4. Develop Technological Infrastructure:

- Invest in digital disaster information centres, promote international technology transfer, and train local communities in using advanced technologies like AI, IoT, and big data.

5. Enhance Community Engagement:

- Strengthen community-based programs, incentivise participation in disaster mitigation, improve financial and technological literacy, and engage private and international organisations in local disaster risk reduction (DRR).

6. Improve Data Management:

- Establish a National Disaster Risk Data Centre to integrate and analyse data for informed decision-making, including risk assessments and targeted mitigation strategies.

7. Boost Private Sector Collaboration:

- Encourage private investment in DRR technology, support CSR-driven innovation, and foster public-private partnerships to deploy advanced tools like AI and blockchain for disaster management.

Conclusion

Indonesia's comprehensive approach to disaster resilience demonstrates its commitment to safeguarding its people and economy against the growing risks of natural disasters. By integrating advanced financial mechanisms, cutting-edge technology, and community-based strategies, the nation has taken significant strides in building a robust disaster risk management framework.

Key initiatives, such as the Disaster Pooling Fund, the Green Sukuk, and the implementation of innovative technologies like AI and IoT, showcase Indonesia's proactive stance in addressing both immediate and long-term challenges. Furthermore, the emphasis on public-private partnerships, international collaboration, and community engagement ensures that resilience efforts are inclusive and sustainable.

With continued investment in coordination, technology transfer, and diversified funding sources, Indonesia is well-positioned to strengthen its disaster resilience and lead regional efforts in disaster risk management and climate adaptation.

