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CENTRE FOR DISASTER MANAGEMENT AND PUBLIC SAFETY

A BLUEPRINT FOR DISASTER MANAGEMENT RD&D SUPPORTING THE SDGS

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We acknowledge the Traditional Owners of the lands on which the University of Melbourne's campuses are situated. We pay our respects to their Elders both past and present and extend that respect to all Aboriginal and Torres Strait Islander Australians who have made a contribution to the life of the University community.

A Blueprint for Disaster Management RD&D Supporting the Sustainable Development Goals

Centre for Disaster Management and Public Safety, the University of Melbourne

With the support of
Centre for Spatial Data Infrastructures and Land Administration (CSDILA), the University of Melbourne
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CONTENTS

List of Abbreviations

CDMPS	Centre for Disaster Management and Public Safety
DFAT	Department of Foreign Affairs and Trade, Australia
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FAO	The Food and Agriculture Organisation
GFDRR	Global Facility for Disaster Reduction and Recovery
ICSU	International Council for Science
IDSS	Intelligent Decision Support System
IPCC	Intergovernmental Panel on Climate Change
NDCs	Nationally Determined Contributions
RD&D	Research, Development and Demonstration
RPA	Research Priority Area
SDGs	Sustainable Development Goals
SEI	Stockholm Environment Institute
SDSN	Sustainable Development Solutions Network
UN	United Nations
UNCSW	United Nations Commission on the Status of Women
UN DESA	United Nations Department of Economic and Social Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UN-GGIM	United Nations Global Geospatial Information Management
UNISDR	United Nations International Strategy for Disaster Reduction
UNU-INWEH	United Nations University Institute for Water, Environment and Health
WCED	World Commission on Environment and Development
WEF	World Economic Forum
WHO	World Health Organisation

Photo: (previous) Aerial Photograph. *Photo by Deva Darshan, Pexels Stock.*

EXECUTIVE SUMMARY

The global adoption of the United Nations (UN) Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction, as well as the establishment of their general inter-relationship, has brought greater awareness to the critical significance of prioritising disaster preparedness and resilience to support countries and communities in their efforts to support sustainable development. With evolving hazard landscapes, including the intensification of disaster frequency and global impact, progressing sustainability is dependent on defining the specific linkages between priority research areas in disaster management and the individual SDGs.

This Blueprint presents the Sustainable Disaster Management Framework that establishes the detailed relationship between disaster management and the SDGs to guide future research, policy and innovation for sustainable development and disaster risk reduction. The framework outlines the steps necessary to answer the question "How can we translate our research into consistent and executable strategies that overcome disaster risks and sustainable development challenges cohesively?" In addition, the framework encourages effective partnerships and guides researchers to a comprehensive integration of the SDGs in disaster-research initiatives.

Building on the research and engagement endeavours of the Centre for Disaster Management and Public Safety (CDMPS) to improve the whole-system response and resilience of community, infrastructure and institutions to extreme events, the Blueprint focuses on key interlinkages between disaster management priority research areas and the SDGs to enhance the practical impacts of the former for the latter. These research priority areas (RPAs) include the following:


RPA1 Understanding and mitigating extreme events and critical incidents

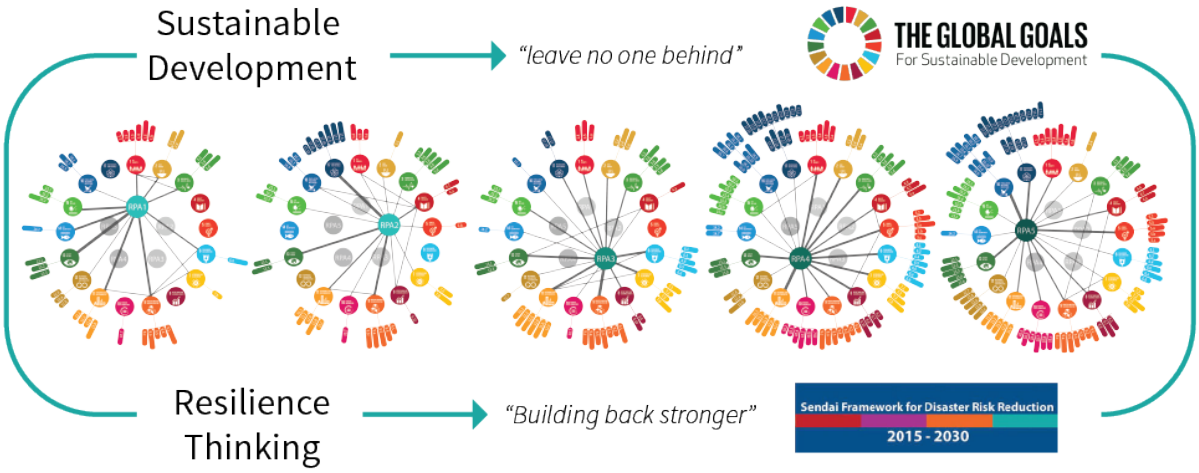

RPA2 Enabling technology, informatics and analytics


RPA3 Improving whole-life infrastructure system performance and resilience


RPA4 Strengthening organisational, institutional and community resilience


RPA5 Enhancing policy and decision making

The nature and the strength of the linkages between the RPAs and the 17 SDGs and targets discussed in this report are illustrated below. The RPAs in the inner layer of each circle figure are encircled by the 17 SDGs and the rays emitted from each Goal are the relevant SDG targets.



Understanding the SDG-disaster management interactions across different scales, domains and sectors is fundamental to creating new opportunities in the long-term for various locations, diverse populations, and different geo-political circumstances. Our proposed framework utilises this knowledge, with awareness of the dynamic nature of these interactions, to describe possible avenues for transdisciplinary and transformative change. In addition to prompting more integrative and holistic approaches to research, our work aims to engage stakeholders and communities in the process of addressing and overcoming the impact of disasters.

Our analysis of the linkages and their integration in the research framework highlights the importance of resilience, sustainability and inclusivity in planning for the mitigation, preparedness, prevention, response, and recovery phases of disaster management. The Blueprint underlines the potential contribution of such analysis to the wider knowledge base and platforms that supports policy makers, first responders, government practitioners, industry stakeholders and community members to strengthen resilience to future disasters. The path to a sustainable and resilient future is paved by the decisions we make today.

1. Global Action for Disaster Risk Reduction and Sustainable Development

The year 2015 set the global scene for critical agreements on how to respond to growing social, economic, and environmental risks through the introduction of long-term development plans aimed to be achieved over the next few decades. In March 2015, the Sendai Framework for Disaster Risk Reduction 2015-2030 was the first of three global agreements to be adopted that year. With seven targets and four priorities for action (Figure 1), the Sendai Framework provides a set of guiding principles and targets for governments, the private sector, and other stakeholders to reduce disaster risks and losses in health, economic, physical, social, and environmental assets (UNISDR, 2015b). The environmental, social and economic factors of disaster risk reduction (DRR) will strengthen the pillars of the United Nations Sustainable Development Goals (SDGs), otherwise known as the 2030 Agenda or Global Goals.

In September 2015, UN Member States adopted the 17 Sustainable Development Goals and their associated 169 targets outlined in Transforming our World: the 2030 Agenda for Sustainable Development, vowing to leave no one behind in the process. The SDGs provide a transformative agenda to shift the world towards a more sustainable and resilient course of action. The call to improve the quality of life for every individual holds the global community responsible for building a sustainable future that is inclusive of all populations in all localities. The 2030 Agenda is "global in nature and universally applicable, taking into account different national realities, capacities and levels of development and respecting national policies and priorities" (United Nations, 2015). The SDGs, therefore, aim to mobilise everyone to overcome the cumulative effects of social, economic, and environmental challenges. At the end of 2015, the world witnessed global leaders come together at the third monumental gathering in December to put the Paris Agreement on Climate Change into action.

> Strengthen knowledge of the relationship between disaster management and the SDGs to guide future disaster-related research towards impactful contribution to sustainable development research.

The frequency and intensity of natural disasters and extreme climate-related events is on the rise. Catastrophic impacts have reached soaring heights and pose severe socio-economic and environmental risks at a global level (WEF, 2017). Enhancing disaster management infrastructures

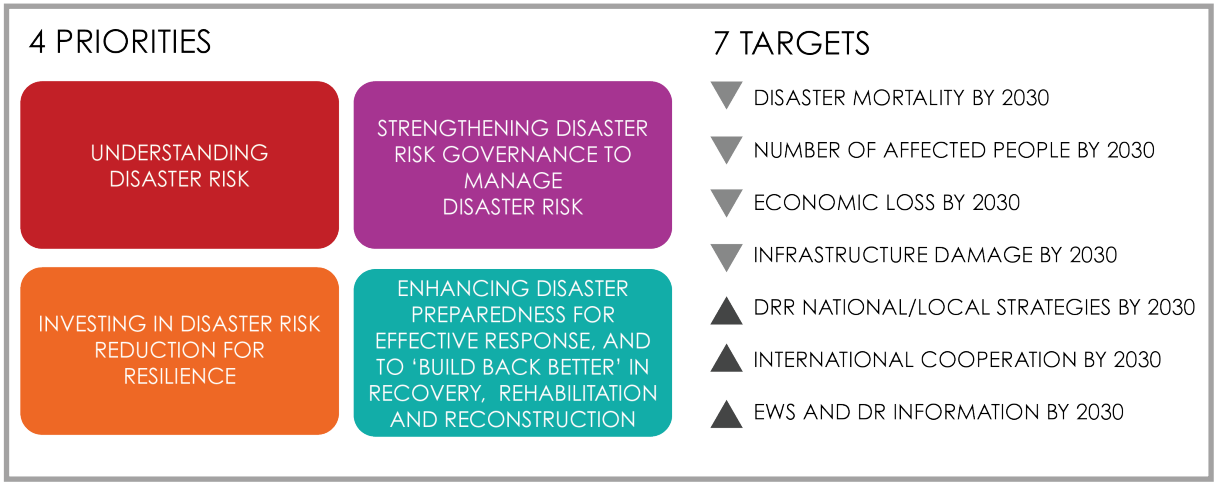


Figure 1. Sendai Framework Targets and Priorities for Action

Photo: (previous) Typhoon Mangkhut, 12 Sept 2018. *Source: NASA Earth Observatory image by Lauren Dauphin, using VIIRS data from the Suomi National Polar-orbiting Partnership.*

and approaches can strengthen social, economic, environmental, and governance resilience, which in turn contributes to achieving the three major frameworks. The UN affirms that disaster risk reduction plays a significant role in the advancement of the SDGs (UNISDR, 2015a). Communities and regions that suffer from drastic setbacks from disasters and extreme events, at times occurring in regular time intervals, will not be able to meet the SDGs at the same pace if risks are not substantially reduced. Therefore, the aspiration for many communities is not merely to improve disaster resilience and their adaptive capacity, but to 'bounce back stronger' or to reconfigure their communities (physical, social, economic and environmental systems) in such a way that increases their capacity to adapt to disaster-induced changes and chronic stress, thus, improve their chances of achieving the SDGs.

This Blueprint aims to strengthen knowledge of the relationship between disaster management and the SDGs to guide future disaster-related research towards impactful contribution to sustainable development research. A preliminary exploration of the linkages between the SDGs and disaster risk reduction was conducted by the UNISDR and the findings highlight 13 SDG targets that contribute to Sendai Framework objectives (Figure 2). While the Sendai Framework is focused on disaster risk reduction, the SDGs focus on a broader range of social, economic, environmental and governance challenges. Mapping the connections between various global frameworks is a necessary step towards identifying and overcoming the challenges of our natural, human-built and socio-economic complex systems that require a transformative approach to disaster management; disasters can occur at any time, in any location, and their impacts supersede through location and time.

The key objective of this Blueprint is to instigate sustainable and resilience focused action plans that result from the Sustainable Disaster Management Framework proposed in this document. 'Sustainable' and 'resilience' are the

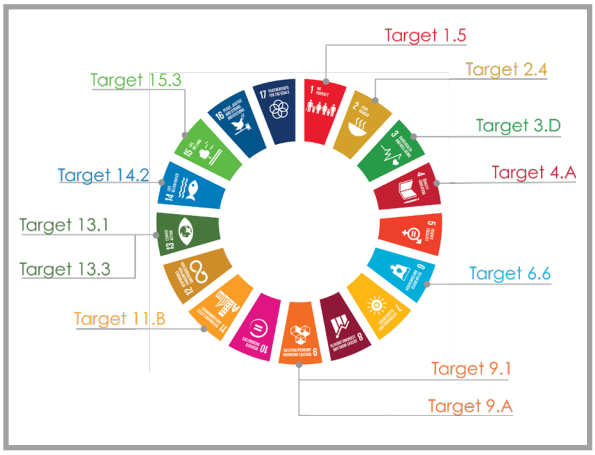
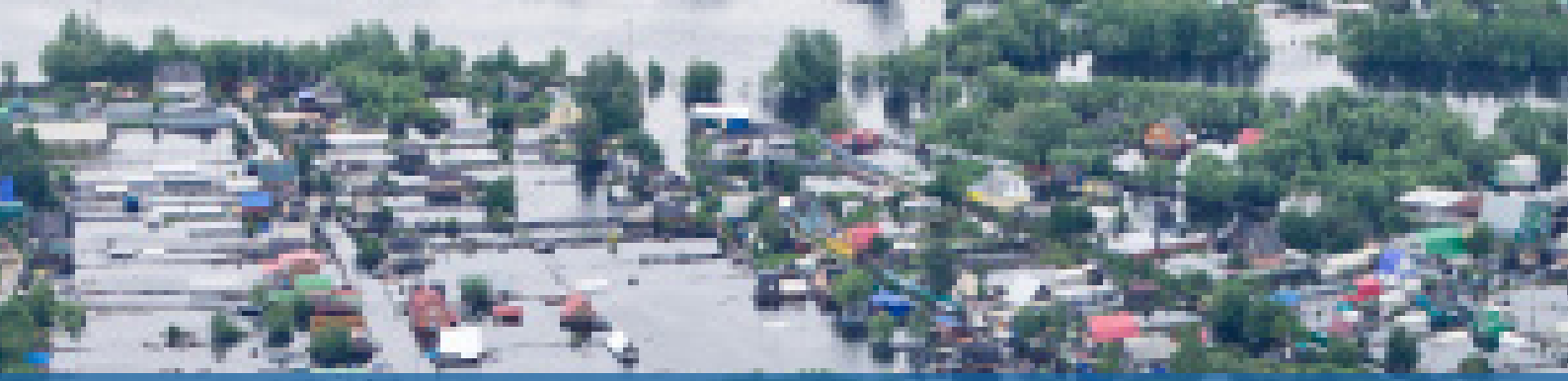


Figure 2. The SDG Targets that Contribute to the Sendai Framework, identified by UNISDR

key driving forces of this research agenda. The sustainability factor develops synergies between social, economic, environmental, and governance interactions—from local to global levels—to pave the way for inclusive "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The resilience factor consolidates a cycle of transformative measures that enhances ''the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure" (UNISDR, 2005). The transformative attribute of resilience prompts new development pathways for our changing circumstances. The Blueprint aims to prompt research that transcends academic silos and mobilises transformative action through the integration of interactions and relations across different challenges, sectors, domains, and scales.

Photo: (next) Flooding. *Source: Adobe Stock.*



2. What is the Blueprint for Disaster Management RD&D Supporting the SDGs?

The Blueprint provides a framework on how to identify the key challenges and research gaps, and guide research towards outcomes that enable sustainable development and disaster risk reduction to be achieved more rapidly and effectively. By examining the intra- and inter-connectivity between the SDGs and associated targets, the Sendai Framework targets, and the whole-system preparedness and response components, this Blueprint shapes a comprehensive understanding of the connectivity and complexity of real-world problems and enables advancements that are resilient beyond the location and time of disasters and extreme events. Figure 3 demonstrates an overview of the different levels of interconnectivity that will be analysed in the following sections.

The document promotes transdisciplinary research that draws from a wide range of skills and expertise across various domains, incorporates input from communities, businesses, governments and non-governmental organisations, and aims to generate practical adoption and impact methods. Traditional academic research has focused on developing or experimenting with new ideas, and oftentimes with clear lines of practical application(s) — traditionally labeled 'R&D.' However, the path to real-world impacts requires a comprehensive process of discovery and implantation of new principles and techniques to enable key actors across different sectors and disciplines and communities to collectively learn how to act on addressing sustainability challenges and opportunities (Foliente, Kearns, Maheepala, Bai, & Barnett, 2007). Therefore, this holistic process should be viewed as a natural part of the knowledge discovery and management life cycle, and thus, embedded in research innovation, development, and demonstration (RD&D).

The research framework and the analysis of linkages discussed throughout the Blueprint were determined by qualitative measures including gathering expert judgement via surveys, focus groups, as well as brainstorming sessions and review of existing literature. The experts consisted of a group of professors, practitioners, researchers and industry advisors. The analysis of SDG interactions for disaster management-related research was conducted at two levels: the general connection with each of the 17 SDGs (Section 5) and a more detailed discussion on the links between each of the whole-system preparedness and response components and specific SDG targets (Section 6). The research framework presented in Section 4 facilitates the integration of complex interactions in research projects to support short-term and long-term social, economic, and environmental requirements: working to fulfill our future needs, and effectively respond to the changing circumstances of our communities and the planet.

By examining the intra- and inter-connectivity between the SDGs and associated targets, the Sendai Framework targets, and the whole-system preparedness and response components, this document shapes a comprehensive understanding of the connectivity and complexity of real-world problems and enables advancements that are resilient beyond the location and time of disasters and extreme events

The Blueprint for Disaster Management RD&D Supporting the SDGs covers a wide range of topics related to disaster management and sustainable development and is applicable to research conducted at local, national, and international levels; however, it does not include all possible linkages between the SDGs and disaster management. This document will examine three main questions:

- What are the interactions between the SDGs and disaster management?
- How are the interactions integrated into

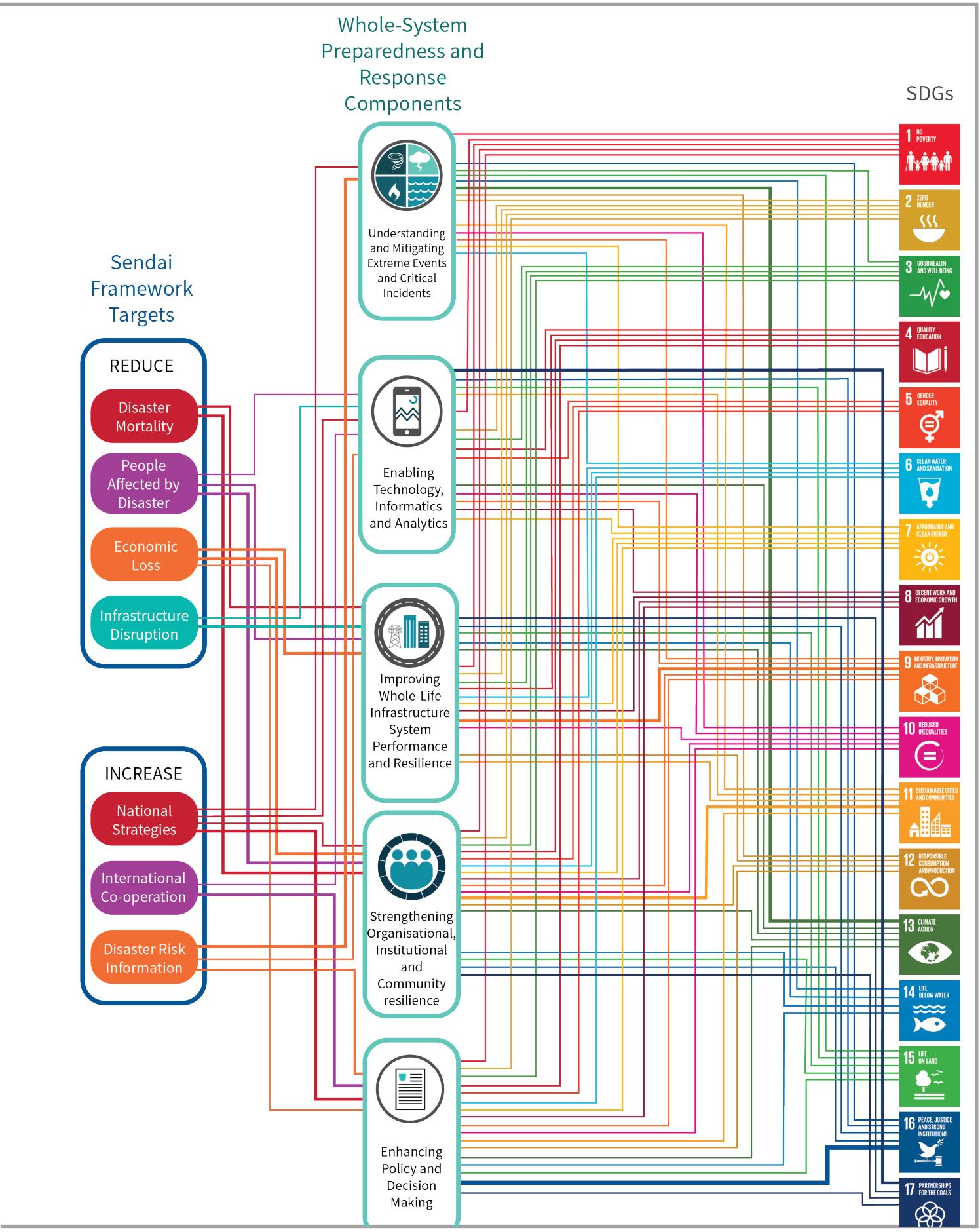


Figure 3: Linkages Between Sendai Framework Targets, Whole-system Preparedness and Response Components, and the SDGs*

**The weight of the lines connecting the three groups of goals and targets indicate the relative strength of connectivity.*

search and practice?
- What is the outcome of putting the interactions into action?

A whole-systems approach to disaster management strengthens the synergies between technologies, infrastructures, institutions and communities for the SDGs. Stakeholders could participate and contribute in all aspects of planning, implementation and improvements – a whole-of-society approach. Holistic and interdisciplinary knowledge is required to minimise the impacts of disasters before an event (i.e. improving adaptive capacity and overall preparedness) and enhance recovery after an event. Focusing on the capabilities of physical infrastructure systems, social institutions (both formal and informal), and individuals (e.g. first responders, professionals and the general public) will determine our ability to 'build back better', and ensure that we leave no one behind in the process. Responding to different disturbances effectively requires close collaboration between academic, organisations and relevant stakeholders. The proposed approach facilitates transformative development that enables sustainable solutions by means of transdisciplinary arrangements and collaborative partnerships.

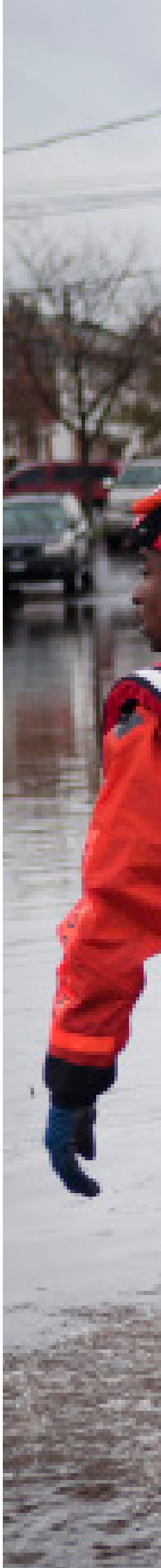


Photo: (next) Rescue workers after Hurricane Sandy, New York, 2012. *Source: Victori J. Blue. Bloomberg via Getty Images*

The intensification of disaster impact, and the interconnected nature of systems that produce patterns of operation which change over time (Meadows, 2008), set back efforts towards sustainable development and increase the complexity of our interactions. The emergence of new technologies, growing global markets, and increased mobility are generating new relational configurations in which interconnectivity between people, data, environment, governance, socio-political events, and economies are becoming more complex across different locations, sectors, and scales. Disasters and climate change, however, are forces that put human-environmental relations in peril, exacerbating vulnerability among the economically poor, increasing environmental degradation, and disrupting infrastructure and service delivery, among other socio-economic and physical ramifications.

The escalation of disaster-related loss, damage, and negative long-term impacts in recent decades underlines the need for research and action to move beyond a system's adaptive capabilities to transformative measures that identify the root cause and improve the approach to changed circumstances. Thus, a transformative approach to disaster management and achieving the SDGs involves changing the dynamics of disaster management phases: mitigation, prevention, preparedness, response, and recovery (Figure 4). The ability to operate beyond the reduction of risks and forced adjustments, while strengthening synergies between social, economic, environmental, and governance components of systems, rely on an interdisciplinary understanding of the three sustainable disaster management building blocks:

> Disaster risk reduction and management is a fundamental pillar of sustainable development.

contextual dependencies, comprehensive system analysis, and long-term strategising for change.

Understanding Contextual Dependencies

A thorough understanding of historic and current relations and interactions is conducive to constructing a framework that persistently and sustainably supports communities, infrastructures, and institutions when a disaster unfolds. In this respect, the Stockholm Environment Institute (SEI) has identified three opportunities (Figure 5) that enable transformation in the relationship between development and disaster risk. The SEI opportunities focus attention on the importance of cohesion between development decisions and risk reduction, equity and social justice,

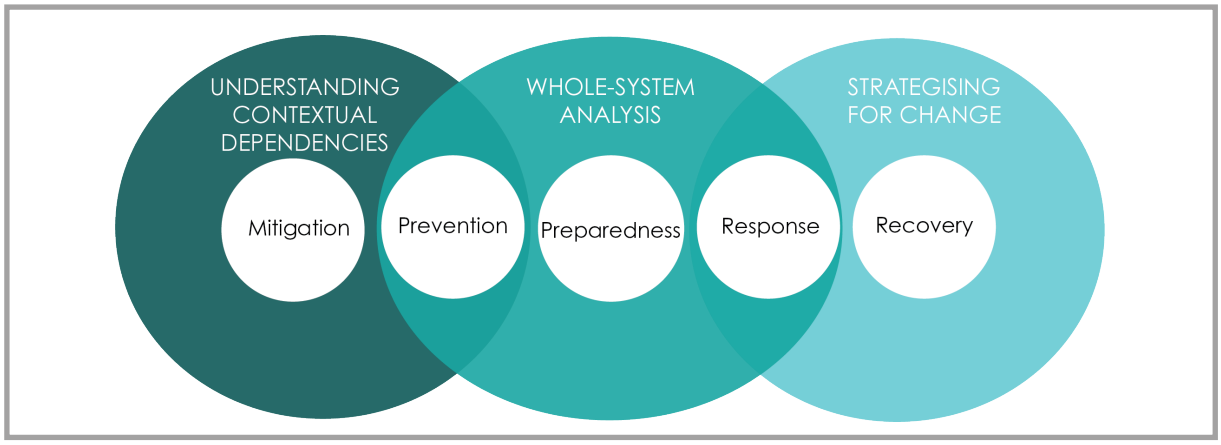


Figure 4. Transformative Measures for Disaster Management

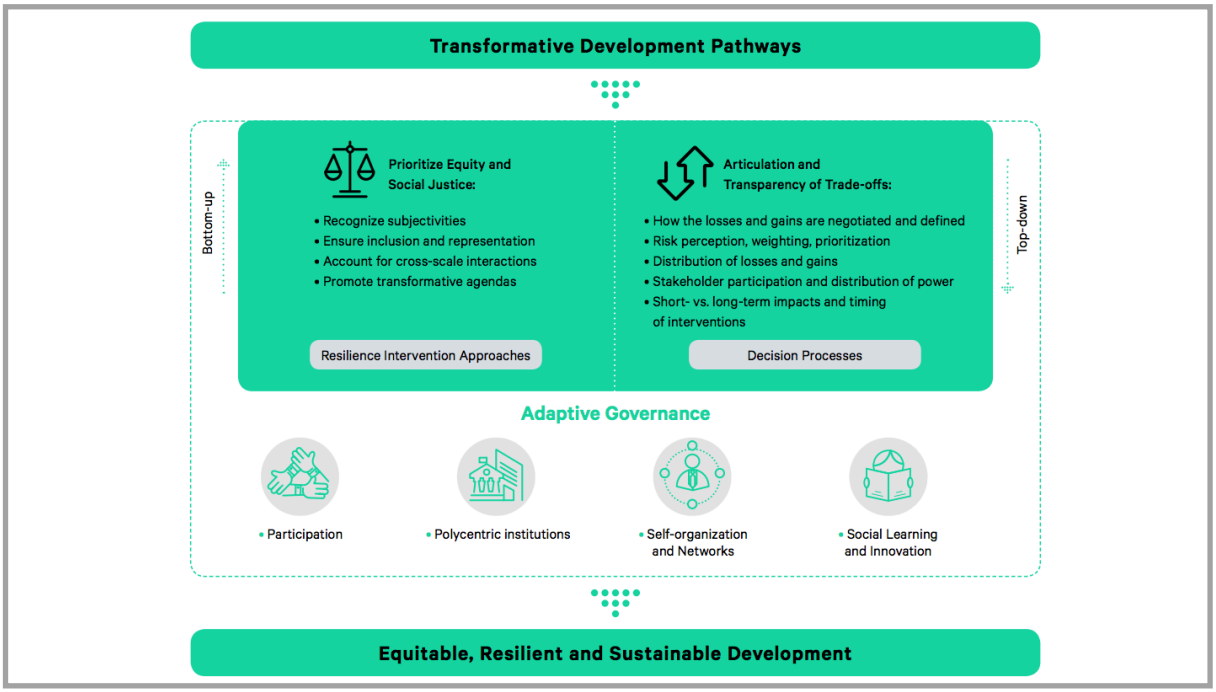


Figure 5. SEI Conceptual Framework of Three Opportunities for Transformation. *Source: Boyland et al., 2018*

and adaptive governance, with the goal to achieve transformation in practice (Boyland et al., 2018). Understanding the social, economic, and environmental characteristics of disaster-affected people and environments is vital to risk assessment and decision-making by enhancing knowledge of local risks and vulnerabilities. This level of understanding equips stakeholders and practitioners with the information and tools required to widen their impact to reach more people and sectors. Furthermore, it enables effective governance by introducing training programs, standards, and tangible action plans applicable to the situation. The proposed framework in Section 4 utilises such opportunities to assess risks and the complexity of emerging challenges.

Whole-System Analysis

Contextualising risk assessment helps prepare for future disasters and improve infrastructure, community, and institutional performance during and after a disaster occurs. The availability of a holistic data ecosystem can enhance physical and social capacities in disaster management and prompt sustainable development to adopt more resilient approaches to disaster risk reduction. Data and analytics play an important role in all phases of disaster management by enabling the production of real-time feedback loops to assist with developing effective evacuation and rescue plans.

The role of geospatial information in sustainable development has been particularly empahsised in hazard and risk assessment and policy-making (Scott & Rajabifard, 2017). Thus, the United Nations Global Geospatial Information Management (UN-GGIM) presents five disaster management priorities: governance and policies, awareness raising and capacity building, data management, common infrastructure and services, and resource mobilisation (Figure 6) in the Framework on Geospatial Information and Services for Disaster Management (UN-GGIM, 2017). The UN-GGIM priorities can be extended to all data, services, and infrastructures

to support evidence-based decision making, capacity assessment, and coordination among stakeholders, first responders, and community members.

The UN-GGIM and World Bank Integrated Geospatial Information Framework further underpins the role of efficiently using geospatial data to generate integrative solutions for disaster management, infrastructure development, land administration and other elements of the SDGs (UN-GGIM, 2018). The integration of such priorities is essential to enhancing technologies and performance analysis models, in addition to improving whole-life infrastructure, community, and institutional resilience. System interdependencies can trigger a sequence of disruptive events to different systems and sectors. Therefore, the availability and accessibility of data, and a whole-system approach to disaster management, can contribute to minimising and controlling the physical and social impact of disasters and reinforce inclusive and adequate prevention and recovery measures.

Strategising for Change

A whole-system approach intends to strategically manage disaster risk and improve the capacity and resilience of infrastructures and communities to sustainably operate before, during, and after disasters. The World Bank's Disaster Risk Management (DRM) Framework introduces five pillars of risk identification, risk reduction, preparedness, financial protection, and resilience reconstruction (Ghesquiere & Reid, 2012) that can assist with protecting citizens, governments, and other systems from the negative impacts of disasters (Figure 7). The DRM Framework implies that the empowerment of people, institutions, and other fractions of society is a continuous effort from the mitigation to recovery phases. However, some complications and negative ramifications come to light after the occurrence of a disaster.

As a result, the burden is on response and recovery operations to minimise short-term and long-term impacts. The success of post-disaster reconstruction and rehabilitation can be determined by the ability to continue sustainable development when responding to change and disturbances. The Disaster Recovery Framework Guide published by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) offers six modules (Figure 8) to "assist governments and partners in planning for resilient post-disaster recovery that will lead to sustainable development" (World Bank, 2015). Planning for damage and needs assessment, policy and strategy-setting, effective institutional structures, financing, and the implementation of recovery systems in local and national governance is a process that determines the operational

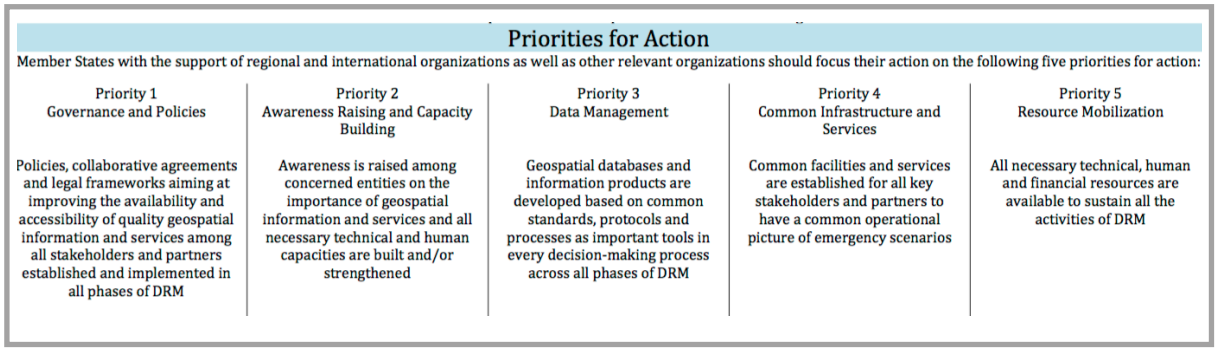


Figure 6. Strategic Framework on Geospatial Information and Services for Disasters Priorities for Action (UN-GGIM, 2017)

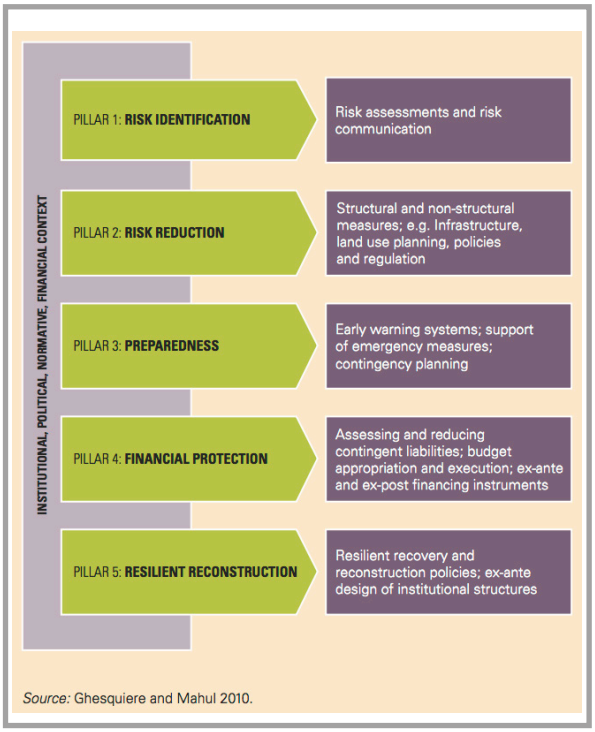


Figure 7. World Bank DRM Framework. *Source: Ghesquiere & Reid, 2012*

principles and aid impact assessment in order to enhance performance with each disaster or shock. Risk reduction begins before a disaster occurs, therefore efficient and effective recovery requires a framework that involves all stakeholders and members of society and input from different disciplines.

Disaster risk reduction and management is a fundamental pillar of sustainable development. In their efforts to contribute to the implementation of the SDGs by 2030, the disaster management and public safety community is subject to the challenge of managing imminent natural and human-induced disasters and critical incidents at the local, national, and global levels. Therefore, the Sustainable Disaster Management Framework for Research, in the next section, intends to provide a holistic approach to a long-lasting chain of actions that aims to build resilience and increase sustainability with every pushback.

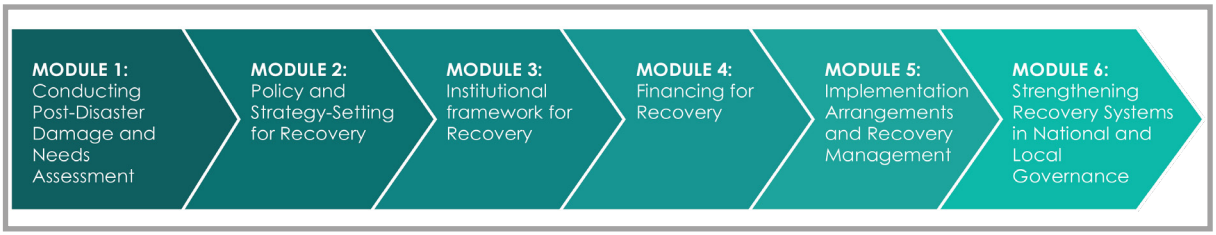


Figure 8. Disaster Recovery Framework Guide Modules (GFDRR, 2015)

4. The Sustainable Disaster Management Framework for Research

A comprehensive analysis of interlinkages between the 17 SDGs is vital for the inclusive implementation of the Global Goals for all populations and locations. The study of the SDG interactions conducted by the International Council for Science (ICSU) concluded that a science-informed study of SDG interactions can enhance decision making and the monitoring of progress in sustainability (ICSU, 2017). In the same way, understanding the impact of the Goals on one another and their link to disaster risk reduction is critical to progress, however, it is important to extend the key interactions analysis between the SDGs in disaster-related research to enable efficacious change. Therefore, we have developed a framework to identify high impact steps required for efficiently addressing the SDGs and disaster management practices.

The proposed framework guides researchers to a comprehensive integration of the SDGs in research initiatives. The confluence of disaster risk reduction planning and sustainable development pillars in research can result in resilient and impactful outcomes, a fact also recognised by UNISDR (Gall, Cutter, & Nguyen, 2014). The Sustainable Disaster Management Framework for Research (Figure 9) was formed on the basis of critical SDG-DRR interactions that determine the design and implementation of measures that strengthen community and infrastructure resilience by enabling the capacity of 'bouncing back better' from disasters and supporting the aspiration of 'leaving no one behind' in sustainable development.

> the monitoring shifts to outcomes and impacts, and in order to achieve the fundamental goals of 'bouncing back better' and 'leaving no one behind,' the various stages and steps discussed in this framework must fall into a continuous loop of research, action and evaluation.

The framework consists of three core building blocks: (A) Understanding Contextual Dependencies: Risk Assessment, (B) Whole-System Analysis and Planning: Community, Infrastructure, and Institutional Resilience, and (C) Strategising for Change: Decision-making and Implementation. Each building block outlines the steps necessary to answer the question "How can we translate our research into consistent and executable strategies that overcome disaster risks and sustainable development challenges cohesively?" Each building block transitions through Dynamic Steps 1 – 4, which act by means of the Principal Steps (A.1, B.1, etc.) and Connectivity Steps (1.1, 2.1, etc.). It's important to note that the framework is not a series of sequential steps and, although all sections are connected, the order of action is not contingent on the proposed numerical order.

A. Understanding Contextual Dependencies: Risk Assessment

The first building block of integrating SDG objectives in disaster-related research is to localise the assessment of risks and challenges that impact people and the planet. In order that the intended project encompasses all relevant domains, Dynamic Step 1 establishes focus areas and maps challenges that are related to ongoing or future research topics. Lessons from the past not only inform future plans, but provide the necessary context required to understand future interactions. Mapping previous research and its connection to current research topics can provide a concentrated starting point for research (SDSN Australia/Pacific, 2017). Dynamic Step 1 prompts researchers to undertake two essential sub-steps:

- understand extreme events and critical incidents, their historic frequencies and intensities, (Principal Step A.1); and
- take a sustainable approach to studying disasters and the economic, social, environmental, and governance impacts, in

Photo: (previous) Engineered metal structure *Source: Pexels Stock.*

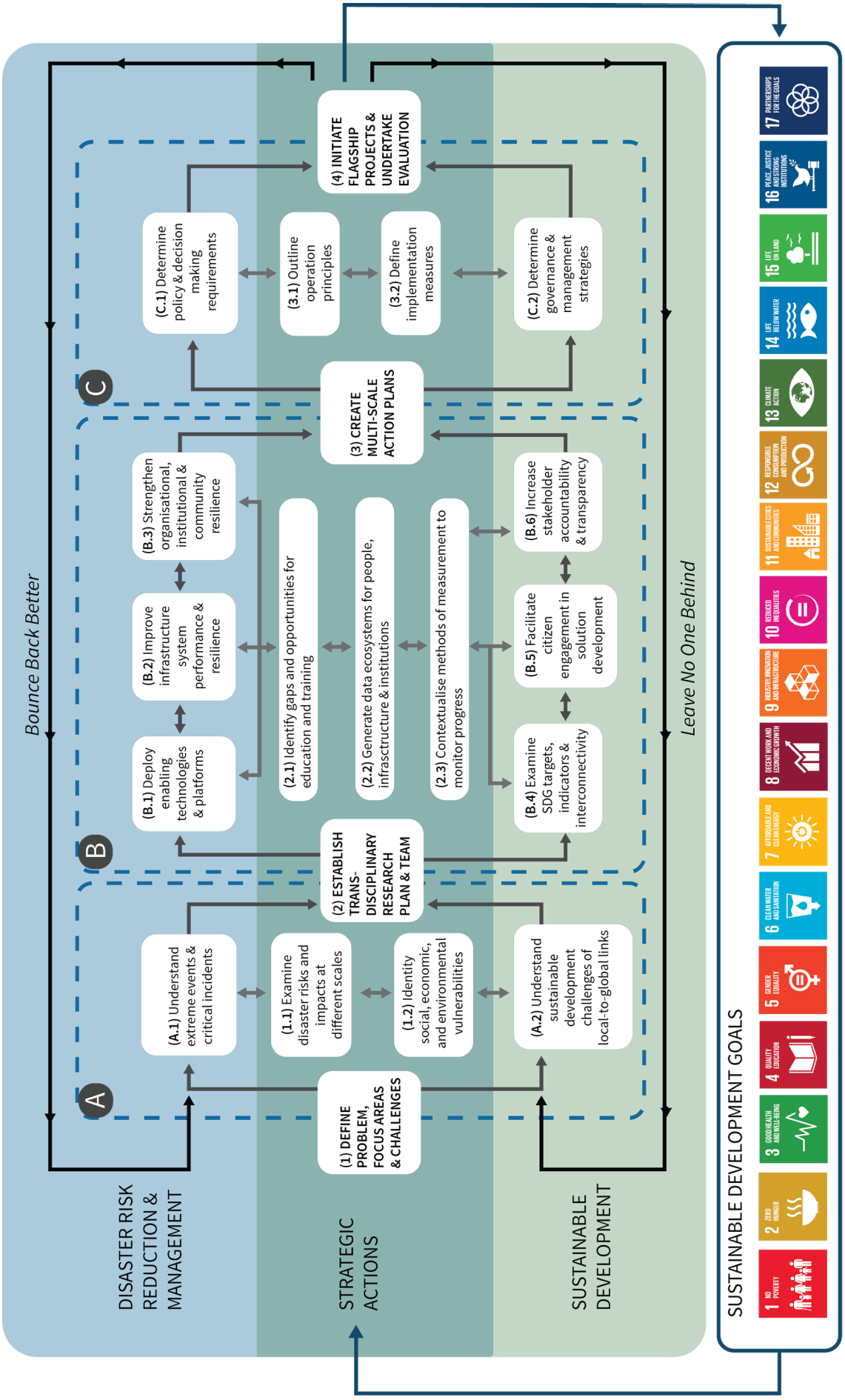


Figure 9. Sustainable Disaster Management Framework for Research. Building Blocks A, B and C transition through Dynamic Steps 1– 4, which act by means of the Principal Steps (A.1, B.1, etc.) and Connectivity Steps (1.1, 2.1, etc.).

addition to their interlinkages between local, national, regional, and global levels (Principal Step A.2).

Therefore, examining sustainable development challenges and their interconnected complexities across different domains and locales is the premise of research and its long-term impact. Knowledge of the links between the SDGs will direct research towards action, innovation, and implementation strategies. The Principal Steps mentioned above can be achieved via two specific tasks:

- study the social, economic, and environmental impacts of a specific event, their contextual dependencies and how a changing climate and environmental hazard landscape will influence resilience planning (Connectivity Step 1.1;) and
- identify the relation between social, economic, and environmental challenges and context-specific vulnerabilities of disaster-affected populations and regions, with the objective to reduce exposure to trauma, death, destruction of infrastructures, and other socio-economic losses (Connectivity Step 1.2)

This stage of the framework aims to instil a multi-dimensional approach to disaster-related research, which requires the establishment of a transdisciplinary team of researchers and key stakeholders who can work together to provide a 'holistic assessment' (urged by the Sendai Framework) of disasters and sustainable development from research to planning to implementation.

B. Whole-System Analysis and Planning: Community, Infrastructure, and Institutional Resilience

The second building block of this framework takes a multi-dimensional approach to the intended research project. Disasters impact a wide range of social, economic, physical, political, and other aspects of society. Therefore, a holistic understanding of the problem and its solution requires a multi-disciplinary and multi-stakeholder team in order to increase the applicability and inclusivity of the research outcomes. Following the formation of a transdisciplinary research team in Dynamic Step 2, a comprehensive systems analysis and planning conducted by the team will require the team to identify means to:

- deploy enabling technologies platforms including hardware and software technologies that enhance the collection, analysis, and dissemination of data, and support effective mission critical infrastructures (Principal Step B.1);
- improve infrastructure system performance and resilience, vital to disaster preparedness for effective response, recovery, rehabilitation, and recovery (Principal Step B.2);
- strengthen organisational, institutional, and community resilience to reduce severe setbacks and enhance the recovery process (Principal Step B.3);
- examine relevant SDG targets and indicators and their interconnected nature at local, national, regional, and global levels—in the context of the defined research project (Principal Step B.4);
- facilitate citizen engagement in the development of multi-dimensional solutions. The inclusion of local experts, practitioners and members ensure that social, economic, and environmental innovations cater to local demands and requirements (Principal Step B.5); and
- increase stakeholder accountability and transparency. Development processes will not be productive or inclusive if progress is not measured (Principal Step B.6).

The above subsets can be achieved if the team:

- examine the gaps and opportunities for training and education programs and identify implementation requirements (Connectivity Step 2.1);

- create open data ecosystems for the collection, sharing, management, and analysis of data for sustainable development and disaster resilience (Connectivity Step 2.2); and
- contextualise methods of measuring progress against local-to-global agendas (Connectivity Step 2.3).

This phase places emphasis on improving all aspects of our systems in the context of their interconnected complexities. The framework intends to ensure that research is inclusive of all populations when forming policies and implementing action work plans.

C. Strategising for Change: Decision-making and Implementation

Establishing multi-scale action work plans (Dynamic Step 3) is fundamental to the third building block of this framework. The implementation of the SDGs and disaster risk reduction strategies will bring about equitable change if the research project understands the process from local-to-global and global-to-local perspectives, which can potentially narrow the gap between ambitious global agendas and urgent local needs. Therefore, at this stage, the team must determine two crucial sub-steps:

- decision-making requirements, given relevant political processes, and potential impacts (Principal Step C.1); and
- appropriate and tangible governance and management strategies (Principal Step C.2).

Both Principal Steps require reliable data for informed decision making and implementation phases. Decisions can be made by the public, government, private sector, or other stakeholders, however, how and why these decisions are made can enhance or disrupt the management of sustainable development endeavours and to what extent they reduce disaster risks. This framework aims to enhance these processes by:

- outlining detailed operational principles (Connectivity Step 3.1); and
- defining explicit implementation measures for populations in different locations (Connectivity Step 3.2).

At this stage, researchers are prepared to carry out the implementation of their work in real-world settings and closely observe and analyse the impact of their work by initiating flagship projects and undertaking evaluation procedures (Dynamic Step 4). This stage encourages the team to modify implementation strategies to fit the needs and demands of particular locations, stakeholders and population. The ultimate goal is to bring about an evolving concept for more effective resilient response/capacity from BAU to a "whole-of-government" approach to a "whole-of-community" approach to a "whole-of society" approach.

A Forward-Feedback Loop

Monitoring and measuring the progress of a research project encourages the development of real-world solutions to our complex problems. In these latter stages, the monitoring shifts to outcomes and impacts, and in order to achieve the fundamental goals of 'bouncing back better' and 'leaving no one behind,' the various stages and steps discussed in this framework must fall into a continuous loop of research, action and evaluation. This creates a forward-feedback loop that evolves in productivity and accuracy, while promoting a consistent plan from research to practice. In doing so, and considering all 17 SDGs and their complex web of connectivity/interactions each time, the applicability and effectiveness of academic research in strengthening community resilience, combating devastating impacts of disaster, and advancing societies to build a sustainable future for all are enhanced.

Photo: (next) Aerial shot *Source: Pexels stock image.*

5. SDGS and Disaster Management Linkages

Disaster management and public safety is critical for achieving the economic, social, and environmental objectives of the SDGs, as well as strengthening community and infrastructure resilience. The Sendai Framework recognises the fundamental relationship between sustainable development and disaster risk reduction (DRR), where effective DRR contributes to sustainable development by increasing resilience to natural hazards, reducing disaster risk and vulnerabilities, and protecting natural resources and the environment (UNISDR, 2015b).

Complementing the Sendai Framework, Article 8 of the Paris Agreement states, "the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage" (UNFCCC, 2015). The formation of comprehensive policies, capacity building, and innovative measures for mitigation, prevention, preparedness, response, and recovery against incidents across the all-hazards spectrum of disaster management will immensely benefit from the disaster management-SDGs linkages.

The interrelationship between the SDGs and disaster management, identified in Table 1, is twofold: the interactions may be of an enabling or disrupting nature. Disasters engender serious setback to the sustainable development process (pushing vulnerable populations deeper into poverty, damaging infrastructures, halting economic growth, etc.) At the same time, the achievement the SDGs can significantly strengthen disaster resilience across different sectors and scales. Table 1 identifies the direct connection between the SDGs, its affiliated targets, and disaster management.

The formation of comprehensive policies, capacity building, and innovative measures for mitigation, prevention, preparedness, response, and recovery against incidents across the all-hazards spectrum of disaster management will immensely benefit from the disaster management-SDGs linkages.

Table 1. Links Between Disaster Management and the SDGs

SDG	Target	Links Between Disaster Management and the SDGs
	1.1 1.2 1.3 1.4 1.5* 1.a 1.b	**SDG 1 No Poverty** Disasters have disproportionate effects on the livelihood of economically vulnerable populations, which exacerbate poverty and obstruct the ability (and pace) to achieve economic recovery. Poverty contributes to the adverse outcomes of a disaster by aggravating the long-term impact and risks of disasters, in which vulnerable communities may not be able to bounce back from and improve their socio-economic conditions. The World Bank estimates that every year, disasters drive an estimated 26 million people into extreme poverty in developing countries [20]. Strengthening the resilience of the economically poor and investing in disaster risk reduction strategies can contribute to eradicating poverty if such measures reduce the impact of natural hazards and extreme events that push the vulnerable deeper into poverty.
	2.1 2.4* 2.a	**SDG 2 Zero Hunger** The impact of natural disasters on the agriculture sector directly threatens food and nutritional security. The livelihood of many communities depends directly on agricultural land and infrastructures, in addition to other food production systems. Integrating sustainable measures and climate adoption strategies in agricultural practices can reduce the severity of disaster risk and impact on land and systems. The Food and Agriculture Organisation (FAO) states that from 2003 to 2013, 22 percent of damages and losses caused by disasters affected the agriculture sector in developing countries [1]. Improving disaster response and recovery and the incorporation of enabling technologies can reduce agricultural damage and losses, which in turn contribute to ending hunger, achieving food security, and promoting sustainable agriculture.
	3.3 3.4 3.6 3.8 3.9 3.d*	**SDG 3 Good Health and Well-Being** The World Health Organisation (WHO) found that emergencies and disaster account for a large percentage of disease outbreaks, illnesses and disabilities (WHO, 2016). WHO reported that in 2015 natural disasters caused 22,662 deaths and affected 90.2 million people globally (WHO, 2016). Disasters can inflict trauma and other harmful health consequences, impairing the mental and physical health and overall wellbeing of the affected population by damaging healthcare facilities, delaying medical services and catalysing the spread of diseases. Preventative medical measures and enhanced health infrastructures can enable preparedness, response, and recovery procedures that build the resilience of communities. Reducing disaster related deaths and injuries can promote wellbeing and healthy lives for all.

Photo: (previous) Ice Storm hits Kentucky, USA, January 2009. *Source: NASA image courtesy the MODIS Rapid Response Team at NASA GSFC.*

4.4
4.7
4.a*

SDG 4 Quality Education Education is essential to strengthening community resilience and DRR, as well as promoting sustainability in different aspects of life. The destruction of educational facilities and the displacement of teachers and students caused by disasters not only postpones the attainment of education for the affected population but also cause the loss of many lives. The UN Educational, Scientific and Cultural Organisation (UNESCO) reports that the impediment to education progress can increase disaster-related fatalities by 20 percent per decade [11]. Raising awareness about preparedness, response, and recovery procedures in educational curricula and incorporating disaster risk reduction policies to education infrastructures can facilitate equitable and quality education for all.

5.2
5.5
5.a
5.b
5.c

SDG 5 Gender Equality Girls and women are more vulnerable to disasters and suffer more in the aftermath. Gender inequalities amplify the socio-economic losses for girls and women, as they do not always exercise equal rights or equal access to recourses and services after a disaster or extreme event. According to the UN Commission on the Status of Women (UNCSW)every year, more women and girls are killed in disasters every year due to structural gender inequalities [7]. Moreover, violence against girls and women increases in the wake of a disaster. The promotion of equal rights for all genders and enhancing accessibility to education and services for risk reduction can increase the number of girls and women involved in capacity building and preparedness, contributing to the empowerment of women and, therefore, accelerating the efforts to achieve gender equality by reducing the gender specific consequences of natural disasters.

6.1
6.2
6.4
6.5
6.6*
6.a
6.b

SDG 6 Clean Water and Sanitation Access to clean water and sanitation is of vital importance during disasters and hazards when water sources are disrupted or contaminated. Water scarcity affects more than 40 percent of the world population and an approximately 386 million people were affected by droughts in 2016, reported by the United Nations University Institute for Water, Environment and Health (UNU-INWEH) [17]. Water is an integral part of a community's livelihood, agricultural activities, health, safe living settlements, and other needs which are severely threatened in disaster prone areas. Building resilient water infrastructures and sanitation systems that incorporate disaster risk reduction strategies can reduce water-related risks of a disaster and increase the availability of and access to clean water and sanitation for all.

7.1 7.2 7.3 7.a 7.b **SDG 7 Affordable and Clean Energy** Damage to energy resources and infrastructure have harmful impact on people and the environment and without access to energy services recovery and response efforts are hampered. UNISDR pledged $90 trillion towards urban-land-use and energy systems to reduce disaster risk and enhance sustainable development between 2015 and 2030 [15]. The disruption of essential services that depend on energy threaten the survival and livelihood of the affected population. The construction of resilient energy infrastructures, the implementation of clean energy technologies, and resource management systems can reduce energy-related risks and increase access to affordable and reliable energy in times of disasters.

8.3 8.7 8.8 8.10 **SDG 8 Decent Work and Economic Growth** Natural disasters and extreme events have adverse consequences for economic growth and increase the risk of financial losses, especially for the more vulnerable population. The economic loss from natural disasters is $250-$300 billion annually according to the UN [14]. Economic stability, sustainable economic growth, and the protection of financial assets is compromised when the means of financial income are brought to halt as a result of disasters. The integration of disaster risk reduction mechanisms in all aspects of soft and hard infrastructures and providing training in recovery measures can assist with reducing the devastating economic impact of disasters on the affected population and the countries and regions in which they hold financial ties. Productive employment, decent work, and inclusive economic activates can reduce the mass adversities cause by a disaster.

9.1* 9.2 9.3 9.4 9.5 9.a* 9.c **SDG 9 Industry, Innovation and Infrastructures** Soft and hard infrastructures are essential to the most important functions of every society. One of the most immediate effects of a natural disaster is damage to different levels of infrastructures, which suspends or delays health, financial, education, energy, emergency communication, water, and other necessary services to community members. Findings from the World Bank reveal that the cost of building safer infrastructures after a disaster is 50 percent higher than it would be to build resilient infrastructures before a disaster [19]. The resilience of infrastructures can be reinforced by the integration of up-to-date disaster risk management technologies and strategies to promote inclusive and sustainable industrialisation and foster innovation that would reduce vulnerability to natural disasters and extreme events.

10.2 10.3 10.4 10.7 10.b 10.c **SDG 10 Reduced Inequalities** UN Department of Economic and Social Affairs (UN DESA) reports that social inclusion and equality can decrease the negative impact of disasters on vulnerable populations and reduce the risk of civil unrest and conflict [8]. Socio-economic inequalities increase in the face of disasters and widen gender, income, health, and other social gaps. The implementation of inclusive disaster risk management measures, disaster preparedness and management programs, and the promotion of inclusive policies can reduce various forms of inequalities, increase community engagement, and strengthen the resilience of all populations within and among countries.

11.1 11.2 11.3 11.5* 11.6 11.b* 11.c **SDG 11 Sustainable Cities and Communities** With the rapid growth of urban populations, disasters can cause significant losses at national and global levels, since the risk exposure is highest there and with major economic and social activities centered in cities. The World Bank reveals that by 2050, the largest coastal cities could suffer from a combined loss of $1 trillion caused by natural disasters [19]. Strengthening the resilience of urban populations and urban infrastructures in addition to the incorporation of disaster risk management in urban planning and policies can significantly reduce the negative impact of disasters on cities and urban communities and ensure inclusive, safe, resilient, and sustainable cities and human settlements for all.

12.7 12.8 12.a 12.b **SDG12 Responsible Consumption and Production** Sustainable consumption and production can minimise disaster risk and reduce the vulnerability of ecosystems and natural recourses. UNISDR reports that sustainable consumption and distribution patterns, such as careful waste management processes, have a direct impact on reducing disaster risk [15]. Improper waste management can increase the emission of toxic or hazardous chemicals and put a community's health and the environmental at serious risk in the aftermath of natural disasters. Implementing sustainable infrastructures and effective disaster risk reduction strategies can minimise hazardous consequences and improve sustainable consumption and production.

13.1* 13.2 13.3* 13.a 13.b **SDG 13 Climate Action** The intrinsic connection between climate change and natural disasters generates an interdependent cause and effect relationship where they exacerbate the severity of one another. According to the World Bank, 90 percent of disasters were caused by weather-related events between 1995 and 2015 and in the future, climate change will continue to increase the occurrence of climate-related disasters [19]. Climate change effects exacerbate the risk of losses in economy, infrastructure, agriculture, health, and other components of a society's

livelihood across the globe. Climate change adaptation, strengthening disaster risk modeling, early warning systems, local risk reduction implantation, and enhancing disaster preparedness can reduce the risk of disasters caused by climate change and their impacts on communities.

14.2*
14.7

SDG 14 Life Below Water Disasters can be the cause of disruption and pollution of waterbodies, life under water, and marine resources. FAO point out that an estimated 5.5 percent of natural disaster impact falls on fisheries [1]. Coastal communities depend on marine resources as a primary means of livelihood, which can be interrupted as a result of natural disasters and extreme events. National and international economies that also heavily depend on marine and costal ecosystems experience the negative impacts of disasters on a larger scale. The incorporation of disaster management to reduce disaster risk factors of marine and costal ecosystems can prevent environmental damage, which would foster the conservation and sustainable use of oceans, seas, and marine resources.

15.1
15.2
15.3*
15.4
15.9
15.b
15.c

SDG 15 Life on Land FAO establishes that forests increase nature's defense capacity against disasters and can prevent the $2-$3.5 billion annual cost of disaster damage restoration of forest ecosystems [1]. Deforestation, unsustainable land use and management, and desertification can intensify disaster risks. The sustainable use and management of terrestrial ecosystems and the implementation of disaster risk reduction solutions can contribute to strengthening environmental resilience and its preservation in the case of a disaster, which in turn assists with sustainably protecting and restoring terrestrial ecosystems.

16.1
16.2
16.3
16.6
16.7
16.9
16.10
16.a
16.b

SDG 16 Peace, Justice and Strong Institutions The World Bank have shown that disaster impacts are higher in countries with a lower GDP, more inequality, and less democracy [20]. Disasters exacerbate the socio-economic conditions of the vulnerable and increase inequalities, which subsequently compromise peace and justice at different levels of society. The lack of accountability and inclusivity of institutions causes ineffective response measures in the event of a natural disaster, and results in the reduction of public safety, social security, and other forms of protection for the people. Equal access to preparedness and recovery services, fair participation in decision-making processes, and developing inclusive disaster risk reduction platforms minimises the risk of conflict, health risks, and food insecurity while strengthening the resilience of communities.

17.1 **SDG 17 Partnerships for the Goals** In the Sendai Framework, nine of the fifty paragraphs emphasise on the importance of partnership development for disaster risk reduction [12]. Natural disasters and extreme events are not confined to national borders. Developing countries, in particular, are faced with harsher and more devastating impacts of disasters. Global partnerships, aid, and a network of shared knowledge and technologies can combat disasters and reduce its impact by supporting communities in need of assistance, capacity building. Aiding other countries to strengthen the means of implementing disaster preparedness and recovery strengthens the resilience of communities and countries while advancing sustainable development.

* According to the United Nations Office for Disaster Risk Reduction, these targets are directly or indirectly related to disaster risk reduction and will contribute to achieving the goal of the Sendai Framework. www.unisdr.org/files/50438_implementingthesendaiframeworktoach.pdf

Photo: (next) Heavy sediment along the Queensland coast after 2011 floods *Source: NASA Earth Observatory image by Joshua Stevens, using Landsat data from the U.S. Geological Survey. Flickr Creative Commons.*

6. CDMPS Research Priority Areas Supporting the SDGs

The sustainability of our social, economic, environmental, and governance systems in the face of disasters depends on how we manage the interlinkages and impact of relational changes that occur. For this reason, the Centre for Disaster Management and Public Safety (CDMPS) takes a whole-system approach to research, focusing on themes associated with preparing for, responding to, recovering from, and mitigating against incidents across the all-hazards spectrum of disaster management. One of the key objectives of research at CDMPS is to utilise an interdisciplinary method to create a knowledge base that can be used to support further research activity, training and education programs worldwide. In this framing, CDMPS has identified five major Research Priority Areas (RPAs) to address whole-system response and resilience of infrastructures, institutions, and communities (Figure 10).

The CDMPS Research Priority Areas were strategically defined to comprehensively encompass key areas of research needed to overcome the barriers identified in the Sendai Framework and the SDGs.

The sustainability of our social, economic, environmental, and governance systems in the face of disasters depends on how we manage the interlinkages and impact of relational changes that occur.

In the Australian context, CDMPS is identifying links between the RPAs and the country's efforts to build the disaster resilience of systems both nationally and internationally (DFAT, 2018) and reach the SDGs. CDMPS is working towards the global vision of a future world where everyone, everywhere enjoys the benefits of the SDGs, in the face of discontinuities or disturbances caused by human-induced and natural disasters and extreme events. Table 2 lists the SDGs that have direct links to each of the RPAs.

In a detailed account of the interactions between SDG targets and the RPAs, each of the following sections provide a holistic assessment of the

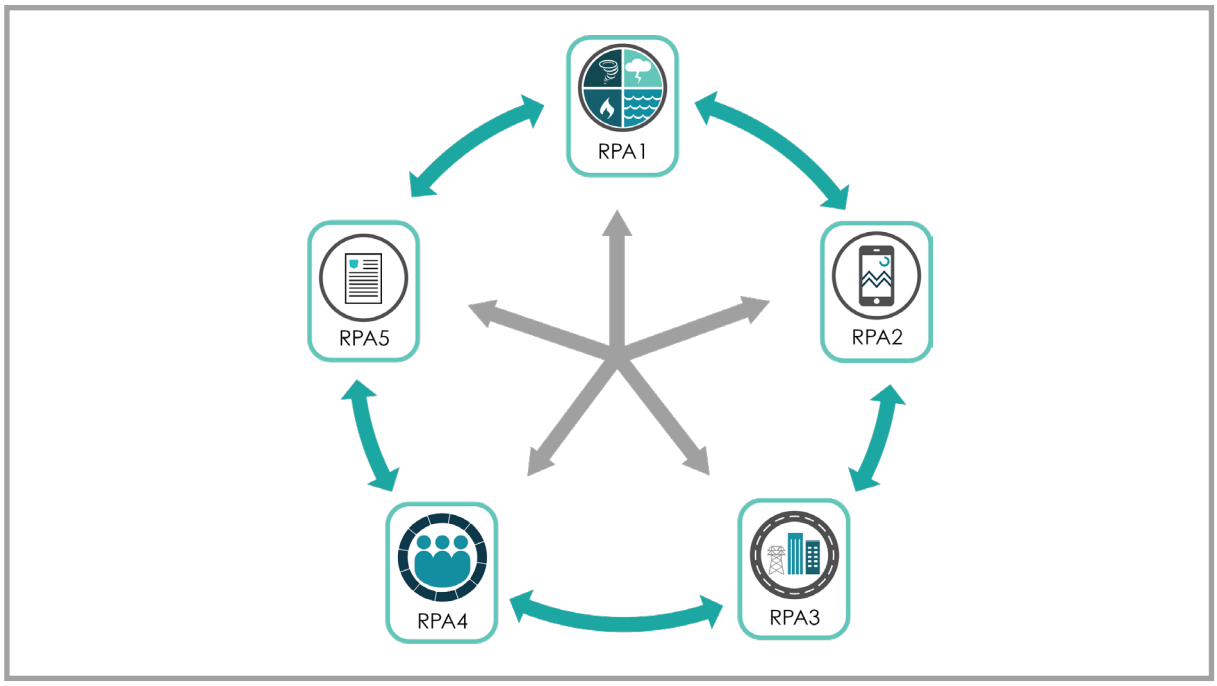
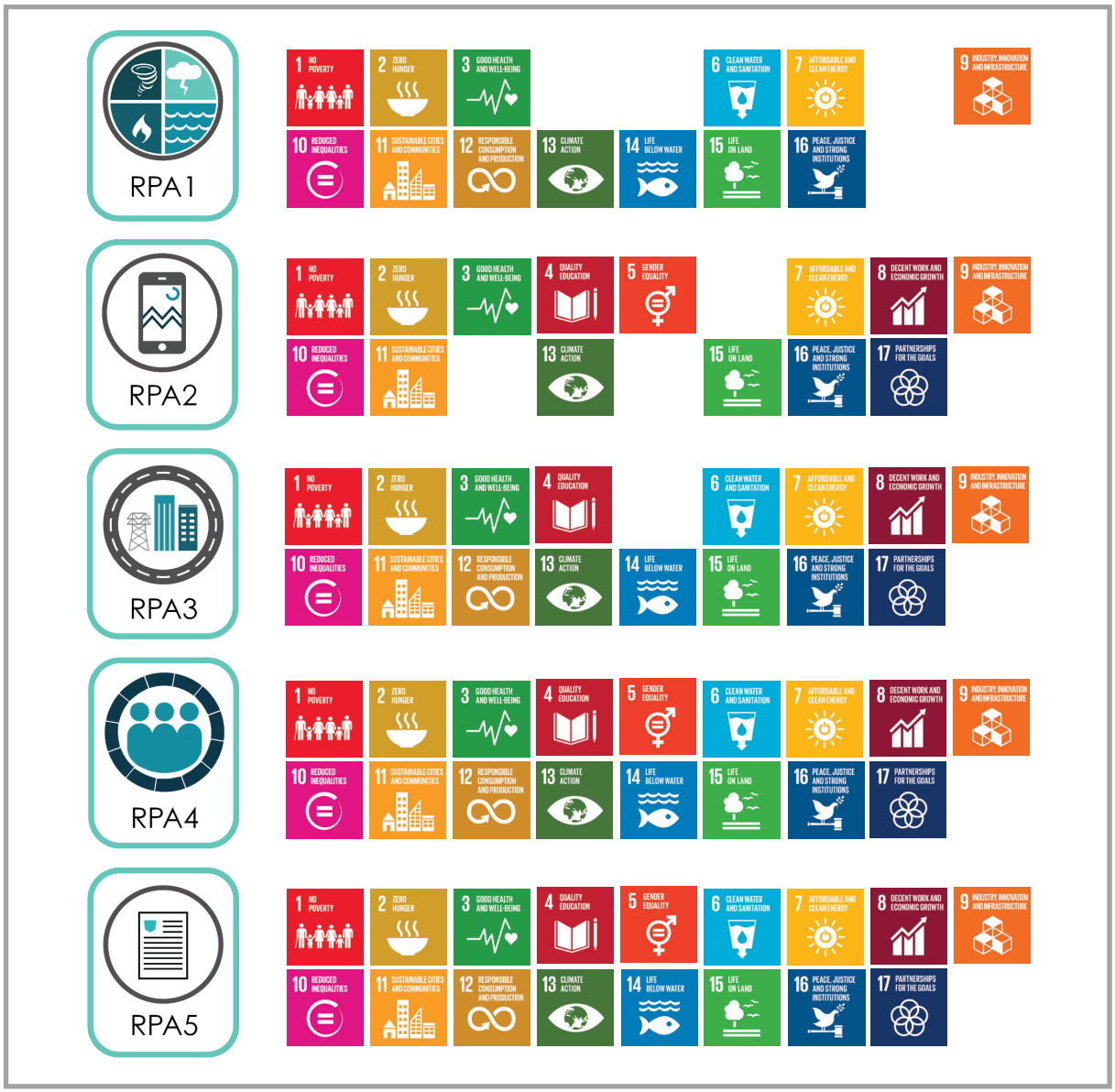


Figure 10. Synergies and Inter-relationships between CDMPS Research Priority Areas

Table 2. How CDMPS Research Priority Areas are Connected to the SDGs



most pertinent SDG targets—as well as the inter-relationship between the targets—in the context of different disaster-related themes. The numbers throughout the text refer to the relevant SDG targets, which are highlighted in the color of the associated SDG. While the inter-connectivity of the SDGs is complex, the figures display the major links between the SDGs relevant to each RPA by means of different line weights. The size of the SDG target rays (emitted from each SDG icon) displays the level of direct connectivity between the SDG targets and RPAs; where the smaller SDG target ray is an indication of weak connectivity (+), the medium-sized SDG target ray illustrates moderate connectivity (++), and the larger SDG target ray displays strong connectivity (+++). The strength of connectivity demonstrated in the following figures were determined by senior industry advisors, professors, experts and researchers at CDMPS.

6.1 Understanding and Mitigating Extreme Events and Critical Incidents

Understanding the evolving nature and frequency of extreme events and critical incidents is a vital step towards risk reduction and management. These disturbances come in different shapes and sizes (Hasan & Foliente, 2015), some types allow us very little or no warning time while others allow short, medium or long windows of time to prepare (Figure 11). For instance, the increase in sea level rise from the previous IPCC 0.6m estimate to an approximate 1.0m rise by 2050 (Carlson et al., 2008), will have unintended consequences that are not predictable across time or intensity.

Regardless of the disturbance, the perspective of classifying events and shocks as either "natural" or "man-made" disasters can be changed. Extreme events in nature need to be better understood but do not occur independently from human influence. When humans and institutions fail to understand hazards and relevant preparedness plans, they become an element of that disaster. Thus, disaster management must shift its centre of attention from the source type (natural or human-induced) to the responsibility to be prepared for any type of disturbance. To equip society and responsible institutions for this purpose, the collection, analysis, and real-time access to reliable data for effective preparedness and response is an important requirement.

The Sendai Framework acknowledges that disaster knowledge is essential for pre-disaster risk assessment, prevention and mitigation, and the development and implementation

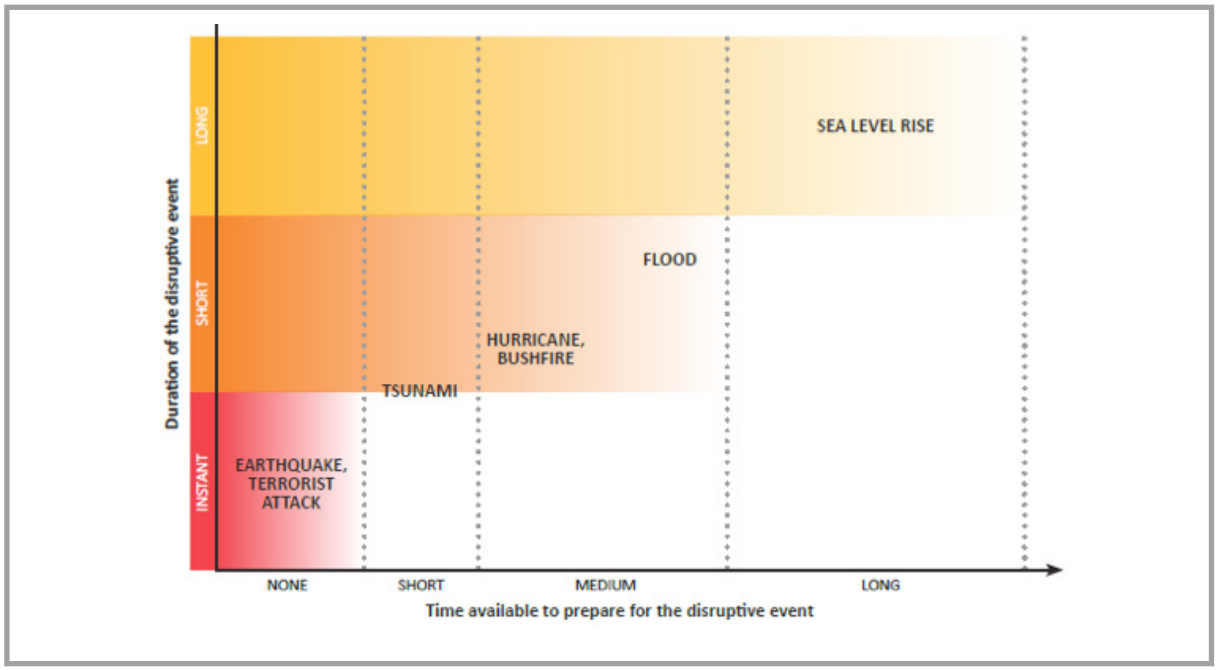


Figure 11. Classification of disruptive events, considering the time available to prepare for the event (x-axis) and the event duration (y-axis). *Source: Hasan & Foliente, 2015*

of responses to disasters (UNISDR, 2015b). Particularly with climate-related events, a better understanding of the changing hazard landscapes and disaster-specific factors is needed. Thus, Research Priority Area 1 aims to facilitate research that provides a greater understanding of extreme events through a better understanding of causes or driving mechanisms and examining their historic frequencies and social, economic, and environmental impacts.

The escalation of disaster risks worldwide calls for strengthening resilience and adaptive capacity to climate-related disasters across all countries (13.1). These risks need to be assessed in their contextual circumstances. A thorough examination of disasters and the geo-political, socio-economic, and environmental conditions of the affected population is fundamental to collecting comprehensive data on disaster loss, and utilising relevant data to minimise the implications of future incidents, as well as improve education, awareness (12.8), and human and institutional capacity on mitigation, adaptation, impact reduction and early warning (13.3) systems.

> Extreme events in nature need to be better understood but do not occur independent from human influence. When humans and institutions fail to understand hazards and relevant preparedness plans, they become an element of that disaster.

The SDGs were developed for people and the planet. Ecosystems can suffer from the negative impact of disasters or be the cause of great risk for humans when extreme events occur. Understanding the complexities of their roles in different types of disasters in local contexts can advance the development of preventative and recovery plans. The restoration of land affected by natural disasters (15.3) cannot be achieved without understanding the role of land-use planning and restrictions in mitigating extreme events. Similarly, management of marine and costal ecosystems (14.2) is critical to mitigating disasters and building the resilience of costal populations to natural disasters. Approximately 60 percent of the world's population will live in cities by 2030 (UN DESA, 2016b). Therefore, knowledge of disasters and risks can significantly reduce the adverse per capita environmental impact of cities (11.6) and strengthen their resilience to disasters (11.b).

Understanding various dimensions of disaster risks can reinforce the development of mitigation strategies, which in effect contribute to the enhancement of infrastructure resilience (9.1), reduction of financial losses, especially for economically vulnerable populations (1.5), decrease in disaster related deaths (3.9, 13.1), and an increase in food accessibility (2.4), water and sanitation (6.6), and clean energy (7.b). Moreover, it can promote responsive, inclusive, participatory and representative decision-making (16.7) and facilitate safe migration and mobility of people (10.7) affected by disasters.

Preventing or minimising any form of loss and damage in a disaster is a principal goal of risk reduction and understanding and mitigating disasters contributes to improving pre- and post-disaster management strategies. We have identified 36 SDG targets in direct correlation with understanding and mitigating extreme events and critical incidents. Figure 12 highlights the fundamental linkages between these SDG targets and the degree of connectivity between each SDG target in the context of Research Priority Area 1.

Figure 12. Interaction between SDGs in the Context of Understanding and Mitigating Extreme Events and Critical Incidents

6.2 Enabling Technology, Informatics and Analytics

The advent of a new generation of powerful computers, new materials and sensors, Information and Communication Technology (ICT) systems, coupled with the latest advances in predictive modelling, cloud computing, informatics, and analytics, have provided academics and experts in the field with a myriad of opportunities to disrupt or transform various aspects of disaster management and public safety. Emphasis on technology development in the Sendai Framework to enhance the collection, analysis, and dissemination of data (UNISDR, 2015b) affirms the Centre's work on real time access to reliable data, GIS, multi-hazard and solution-driven research in disaster risk management to address gaps, obstacles and complex system interdependencies. In order to utilise enabling technologies more effectively and prevent, prepare for, respond to, and recover from disasters, CDMPS conducts research on the application of the latest hardware, including sensors and Internet of Things (IoT) devices, and software technologies, including new generation machine learning, across all areas of disaster management and public safety. Research Priority Area 2 aims to examine and explore the impact of new and emerging technologies and their applications in mission critical communications and infrastructure, and community resilience.

The advent of a new generation of powerful computers, new materials and sensors, Information and Communication Technology (ICT) systems, coupled with the latest advances in predictive modelling, cloud computing, informatics, and analytics, have provided academics and experts in the field with a myriad of opportunities to disrupt or transform various aspects of disaster management and public safety.

Technology and innovation capacity-building mechanisms, in particular using ICTs, are critical to the implementation of the 17 SDGs (17.8). The Global Goals address challenges that are shared worldwide and the achievement of any goal in any location must take a collective approach; the SDGs cannot be achieved in isolation. Therefore, enabling technologies foster connectivity across different sectors and locations, and increase the capacity to exchange and share knowledge and data at a global level (17.6). Fundamentally, more emphasis needs to be placed on collaborations with developing countries to incorporate environmentally sound technologies (17.7) and ensure that no country is left behind. Developing countries are some of the most vulnerable areas to natural disasters and climate change, and they experience more prolonged periods of recovery. Enabling technologies and their applications can strengthen disaster mitigation by contributing to the improvement of education, awareness-raising and human and institutional capacity on disaster risk reduction, climate change mitigation, adaptation and early warning (13.3, 11.b). For example, in the 2016 Nepal flood, the affected community believe that the use of mobile SMS/text alerts saved thousands of lives (Karki, 2018).

The international community must emphasise on enabling technologies, informatics and analysis in institutions responsible for providing financial, basic, and social services to increase

access to basic services, economic resources, and control and ownership over land (1.4). Increasing access to services, before and after disasters, can prevent vulnerable populations from falling into further hardships and poverty. Food security and health care are the most vital services that need to be readily available in the aftermath of a disaster. Innovative processing technologies for food production and storage, resource (e.g. water) management, and soil nutrition, such as UAV remote sensing, can contribute to the implementation of resilient agricultural practices (2.4). Furthermore, digital access to health providers decreases health risks that result from disaster and increases universal health coverage (3.8) by reaching more patients, using remote monitoring tools, and focusing on prevention.

Emerging technologies also play a vital role in ensuring access to safe housing (11.1), enhancing air quality and waste management (11.6), and supporting the least developed countries in building sustainable and resilient buildings (11.c). One of the more critical components of safe and sustainable cities is infrastructures. Innovative construction and GIS technologies for risk assessment significantly advance the impact of disaster mitigation. Therefore, enhancing scientific research, upgrading technological capabilities (9.5), and providing technological and technical support to developing countries (9.a) will significantly strengthen infrastructure resilience and foster innovation. Energy infrastructures power hospitals, homes, agriculture systems, etc. and therefore, require updated technologies to supply modern and sustainable energy for all (7.b).

Prevention and preparedness planning significantly reduce disaster impact. ICTs and digital learning tools provide long-term benefits for preparedness and prevention of disaster and increasing sustainable development, namely in enhancing early warning and risk reduction strategies (3.d). Mapping and the analysis of educational requirements for disaster prevention , as well as knowledge and skills needed to promote sustainable development (4.7) can be achieved by enabling technologies, informatics, and analytics. In post-disaster situations, technologies can facilitate logistics of supplies, and safe migration (10.7) by enhancing the tracking and management means of migratory movements inflicted by disasters, while facilitating legal identity registration (16.9) and an easier transition for those forced into migration.

There are further social, economic and environmental implications of enabling technologies, which include increasing the engagement of women in all aspects of society and empowering their voice in decision making processes (5.b), strengthening the capacity of financial institutions (8.10), and combating desertification, deforestation, and degradation of land and soil (15.3).

Technologies, informatics, and analytics influence the way communities and institutions prepare for and respond to disasters. We have identified 41 SDG targets in direct correlation with enabling technology, informatics and analytics. Figure 13 highlights the fundamental linkages between the SDGs and demonstrates the degree of connectivity between each SDG target in the context of Research Priority Area 2.

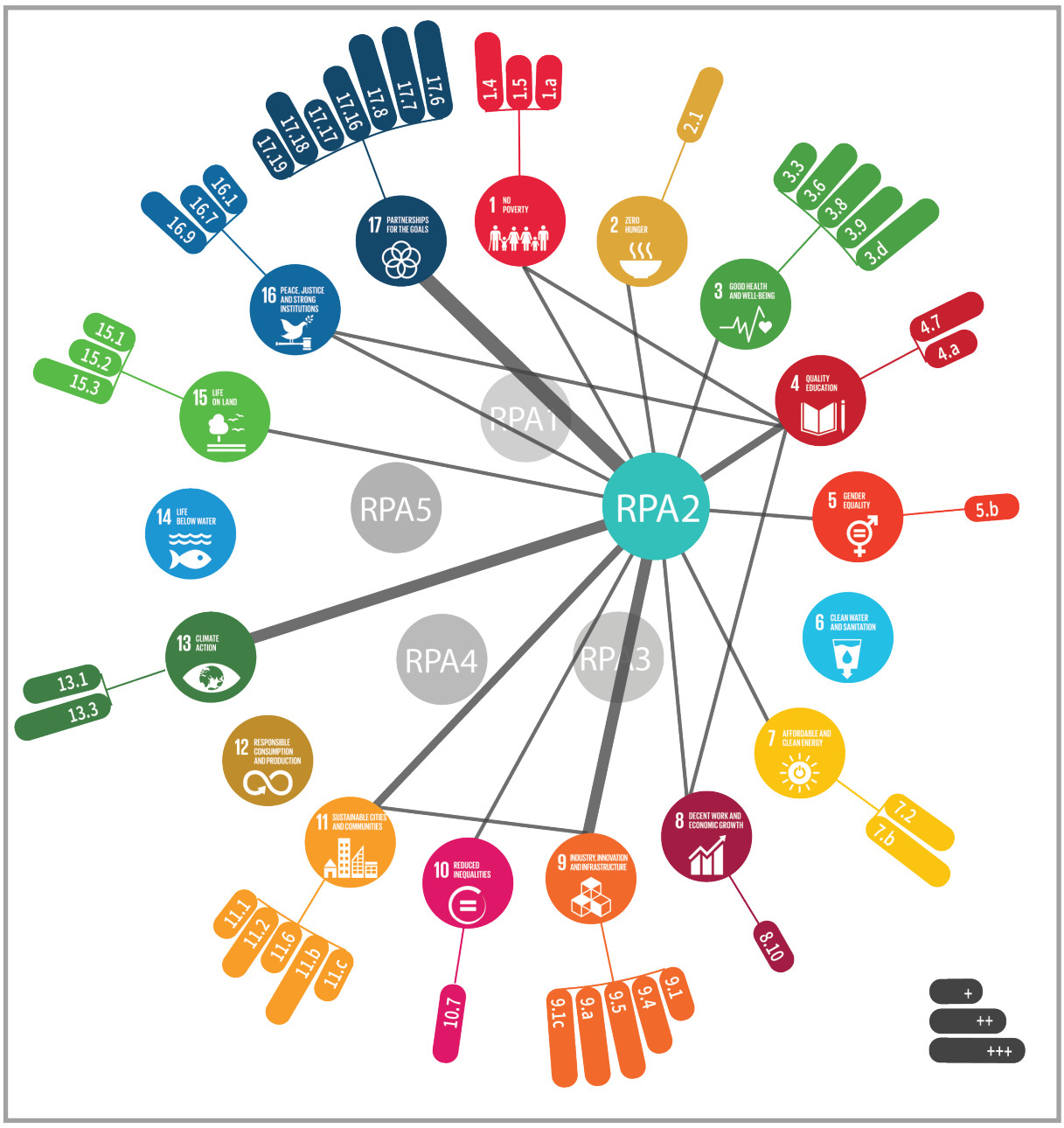


Figure 13. Interaction between SDGs in the Context of Enabling Technology, Informatics and Analytics

6.3 Improving Whole-Life Infrastructure System Performance and Resilience

The performance of physical infrastructure systems, such as buildings, transport, telecommunications, and power and water systems under extreme events has long been studied. Popular areas of investigation have focused on new materials, technologies and design and/or performance analysis models. The Sendai Framework asserts the vitality of the resilience of new and existing critical infrastructures in order to provide essential services in the face of a disaster (UNISDR, 2015b). System interdependencies can trigger a sequence of disruptive events to different systems and sectors, raising concerns about the largely unknown extent of potential cascading system failures. At CDMPS, we study the physical damage or failure of infrastructures and their broader socio-economic impacts. The Centre's research focuses on service life design with material science and digital manufacturing, time-dependent system reliability and vulnerability assessment, system interdependencies, impacts of cascading failures, and disaster economics (first and second order impacts). Research Priority Area 3 examines the immediate and long-term technical and social impacts of an infrastructure, where disruption due to disasters and extreme events attacks first.

System interdependencies can trigger a sequence of disruptive events to different systems and sectors, raising concerns about the largely unknown extent of potential cascading system failures.

Engineering and physical infrastructures are an integral part of building disaster resilience and reducing the negative impacts of damage caused by extreme events, which compromise the functionality of different sectors within society. Thus, there is now increasing interests in infrastructure system interdependencies (Hasan & Foliente, 2015) and the potential for cascading failures. The types of problems associated with infrastructure systems are illustrated in Figure 14, showing the potential impacts of failure in the electric power system in California, USA – effects to the immediate local environment, and to other systems and economic sectors (2nd and 3rd order effects).

Therefore, developing quality, reliable, sustainable and resilient infrastructure to support economic development and human well-being can provide affordable and equitable access for all (9.1), most critically, in the face of a disaster. Asia and the Pacific are the regions most affected by disasters (ESCAP, 2017). Facilitating sustainable and resilient infrastructure development in developing countries (9.a) can reduce infrastructure damage that disrupts the livelihood of people in this region. With rapid urbanisation, planned urban infrastructure development can bring long-term resilience to natural disasters and hazards, where infrastructure upgrading should significantly reduce the number of deaths and number of people affected by disasters due to infrastructure deficiencies (11.5).

Risk and vulnerability assessment, infrastructure modelling and protection, structural health monitoring, advanced protective materials, and systems for producing innovative solutions are crucial means of strengthening infrastructures. In turn, these can build the resilience of the poor (1.5) and food production systems (2.4), especially in rural areas (2.a), as well as improve transpiration safety (11.2) while reducing deaths from road traffic incidents (3.6) in the aftermath of

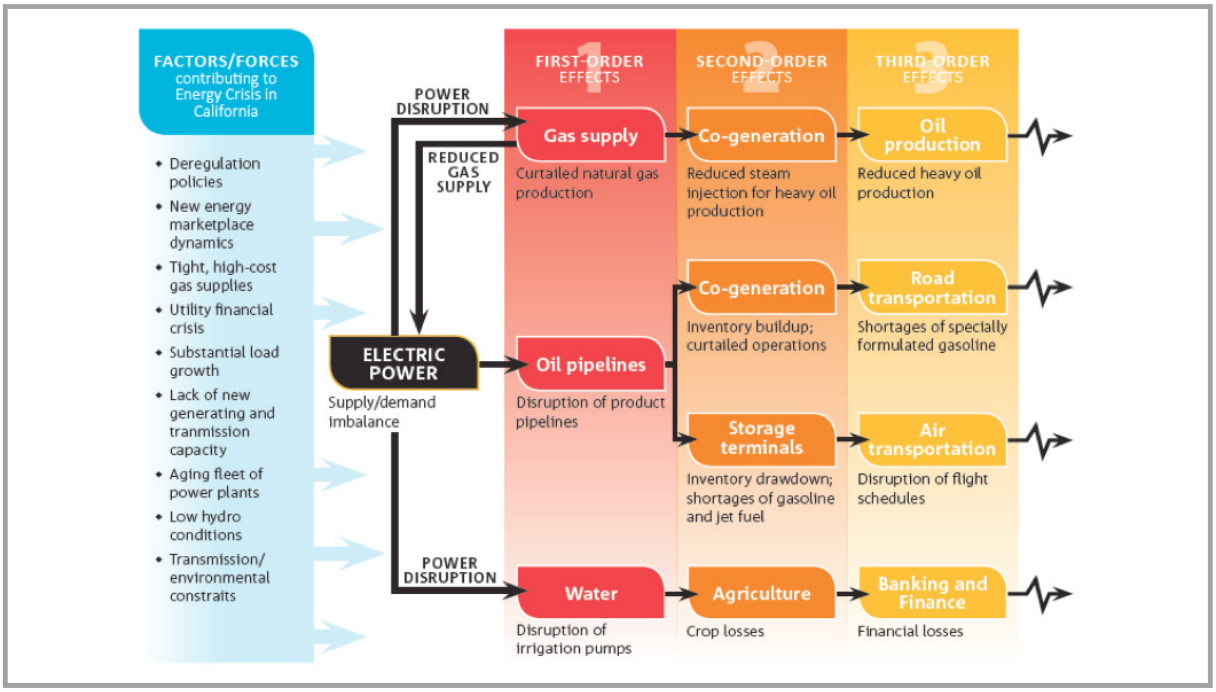


Figure 14. Order of Disruptive Effects – in the context of California, USA. *Source: Rinaldi et al. (2001).*

disasters and environmental shocks. In addition, integrating such expertise in infrastructure resilience can enhance access to crucial resources such as water resource management (6.5), sustainable energy services, financial services (8.10), and migration and mobility management (10.7). It can also contribute to strengthening adaptive capacity to disasters (13.1), protect marine and costal ecosystems (14.2), and reduce land degradation (15.3).

Infrastructure upgrading will require effective public, public-private, and civil society partnerships (17.17) that can increase public safety (16.1), as well as provide safe, non-violent, inclusive and effective learning environments for all (4.a), promote public procurement practices that are sustainable (12.7), and improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning (13.3). Damage to soft and hard infrastructure imperils the social, economic, and environmental conditions of communities and cities at peril, and therefore, improving whole-life infrastructure systems by advancing design, performance and resilience, is a fundamental need for any sustainable development initiative. Quality evidence-based research can provide the justification that may be required to support the financial implications within a comprehensive public-private partnership model and the potential assistance this may provide to governmental decisions in future disaster aid packages. Furthermore, the promotion of inclusive public-private and educational information sharing within existing sector networks would complement these decisions.

Improving infrastructure system performance in disasters contributes to long-term resilience during the post-disaster recovery process. We have identified 49 SDG targets in direct correlation with improving whole-life infrastructure system performance and resilience. Figure 15 highlights the fundamental linkages between the SDGs and the degree of connectivity between each SDG target in the context of Research Priority Area 3.

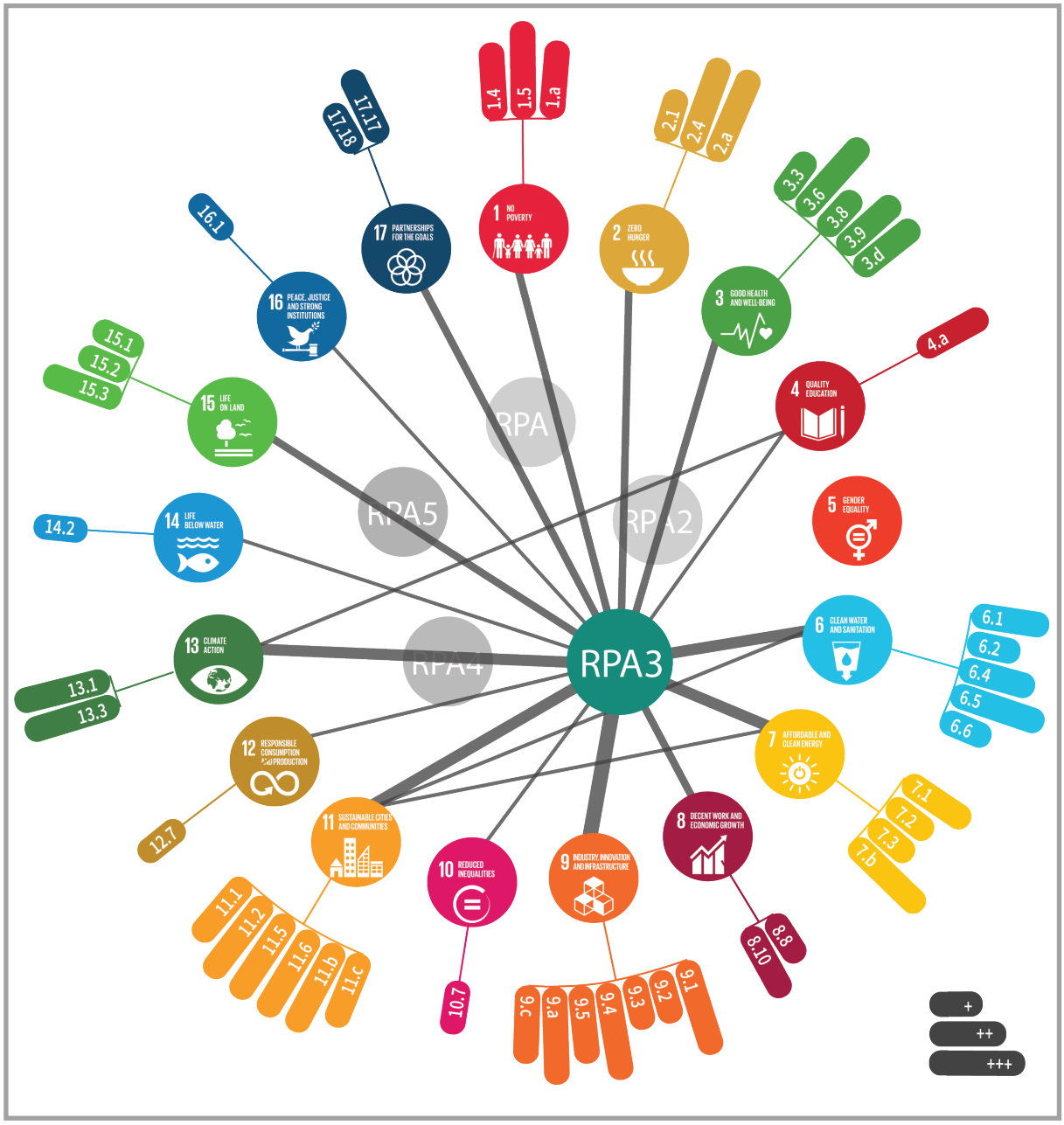


Figure 15. Interaction between SDGs in the Context of Improving Whole-Life Infrastructure System Performance and Resilience

6.4 Strengthening Organisational, Institutional and Community Resilience

Community, especially its vulnerable members, is the focal point of disaster management and public safety policies and practices. Public and private organisations routinely assess the potential risks (both local and global, traditional and emerging) to their investments and operations. In some cases, insufficient disaster preparedness and/or lack of institutional and organisational resilience have an exacerbating effect on communities and individuals. The Sendai Framework stresses the importance of resilient communities and inclusive disaster risk management in strengthening synergies across all groups involved as a crucial aspect of enhancing disaster preparedness for effective response, recovery, rehabilitation, and recovery (UNISDR, 2015b). CDMPS aims to undertake a systematic approach to understanding the complex relationship between the socio-economic impacts of natural disasters and extreme events with institutional and organisational resilience. The Centre's research revolves around emergency and disaster preparedness, psychology of acceptable risks, connections between individual, community and institutional resilience, and disaster economics (second-order and nth order impacts). Research Priority Area 4 aims to hasten the recovery process from any setback and identifies pathways towards improved community, organisational, and institutional resilience. The relationship between individual resilience, particularly of the vulnerable, and community resilience (Figure 16) can inform how public policy could support this objective and assist with identifying required systems and services. Furthermore, they are significant research questions to address in Research Priority Area 4.

> insufficient disaster preparedness and/or lack of institutional and organisational resilience have an exacerbating effect on communities and individuals.

Pre and post-disaster planning should primarily focus on measures that reduce disaster impact on vulnerable communities. The adverse impacts on communities are exacerbated when they do not have the resources to recover and bounce back. In order to increase community resilience to natural disasters, governments must first and foremost reduce the exposure and vulnerability of the poor to climate-related extreme events and disasters (1.5, 15.9) by ensuring access to safe and affordable housing and basic services (11.1). Integrating preventative measures at local and national levels ensure effective response and recovery capabilities that enhance the adaptation of food production system to environmental shocks (2.4), expand access to banking, insurance and financial services (8.10), strengthen the participation of local communities in improving water and sanitation management (6.b), and increase access to modern and sustainable energy services (7.b). Access to basic needs for survival and recovery is essential to strengthening community resilience.

The adverse impacts of disasters can exacerbate post-disaster circumstances when communities lack adequate information and awareness of sustainable and resilient methods of preparedness and recovery. Strengthening education facility infrastructures (4.a) and increasing access to ITCs and the Internet (9.c) improves education and awareness about mitigation, adaptation and impact reduction (13.3), in addition to reducing the risk of disrupting education after

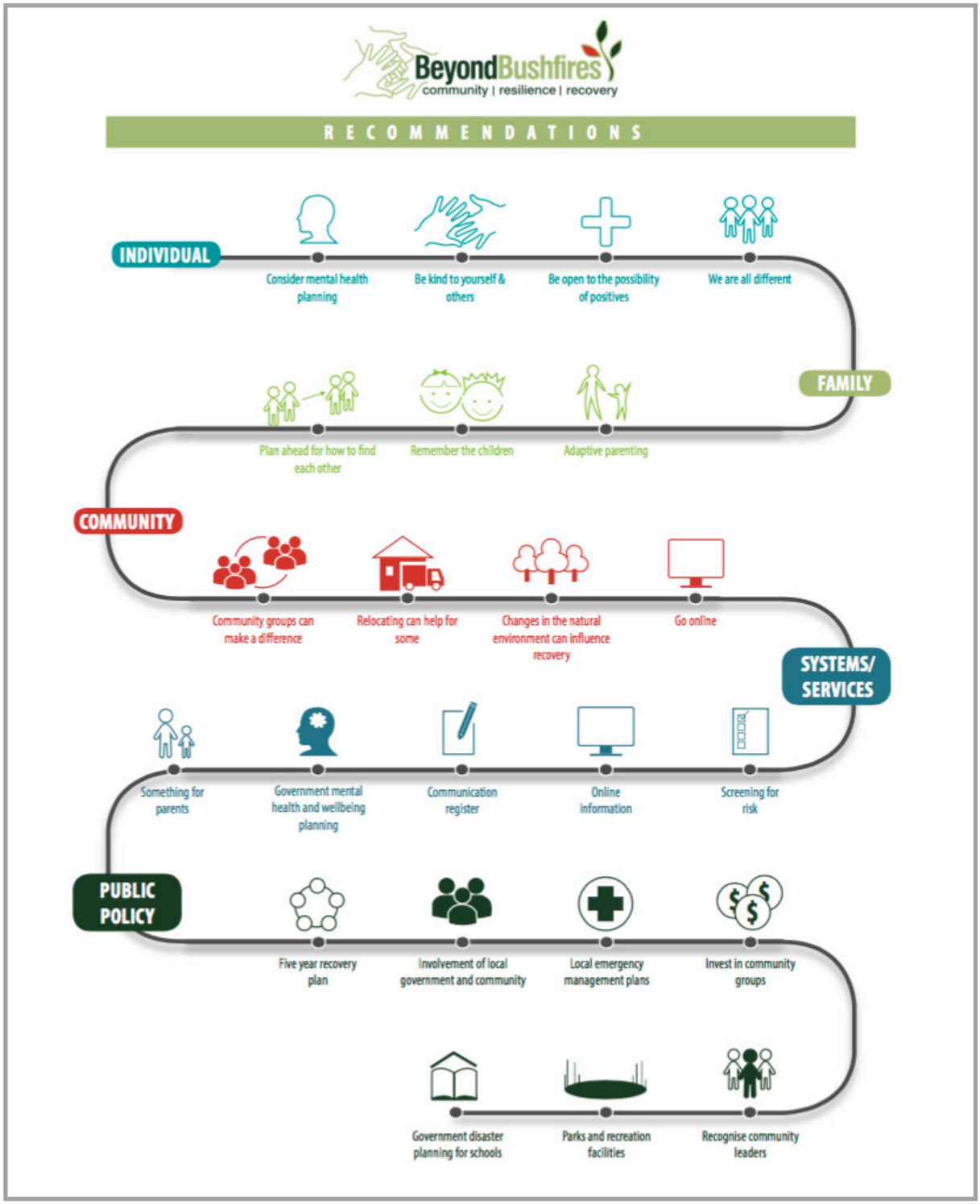


Figure 16. Recommendations for Community Resilience summarised from the Beyond Bushfires. *Source: Professor Lisa Gibbs, University of Melbourne*.

the occurrence of a disaster. Such awareness encourages reform to give women equal rights to various resources (5.a) and services, effectively increasing the resilience of all members of the affected community.

Institutional resilience is equally critical to support community resilience. Strengthening human and institutional capacity on climate change mitigation, adaptation, impact reduction, early warning (11.b, 13.3) and health risk reduction (3.d) will provide communities with high-level guidance on disaster management. Community and institutional resilience are particularly important for developing countries, where disaster impact is more disruptive. Enhancing capacity-building support to developing countries by increasing availability of high-quality, timely, and reliable data disaggregated (17.18) can assist with a wide range of measures from providing legal identity for all (16.9), facilitating orderly, safe, regular and responsible migration and mobility (10.7), to increasing the economic benefits of communities that rely on marine resources and coastal tourism (14.7) or local culture and products (12.b).

Building the resilience and sustainability of institutions and communities will ensure that all levels of society will survive and thrive under harsh circumstance. We have identified 93 SDG targets in direct correlation with strengthening organisational, institutional and community resilience. Figure 17 highlights the fundamental linkages between the SDGs and the degree of connectivity between each SDG target in the context of Research Priority Area 4.

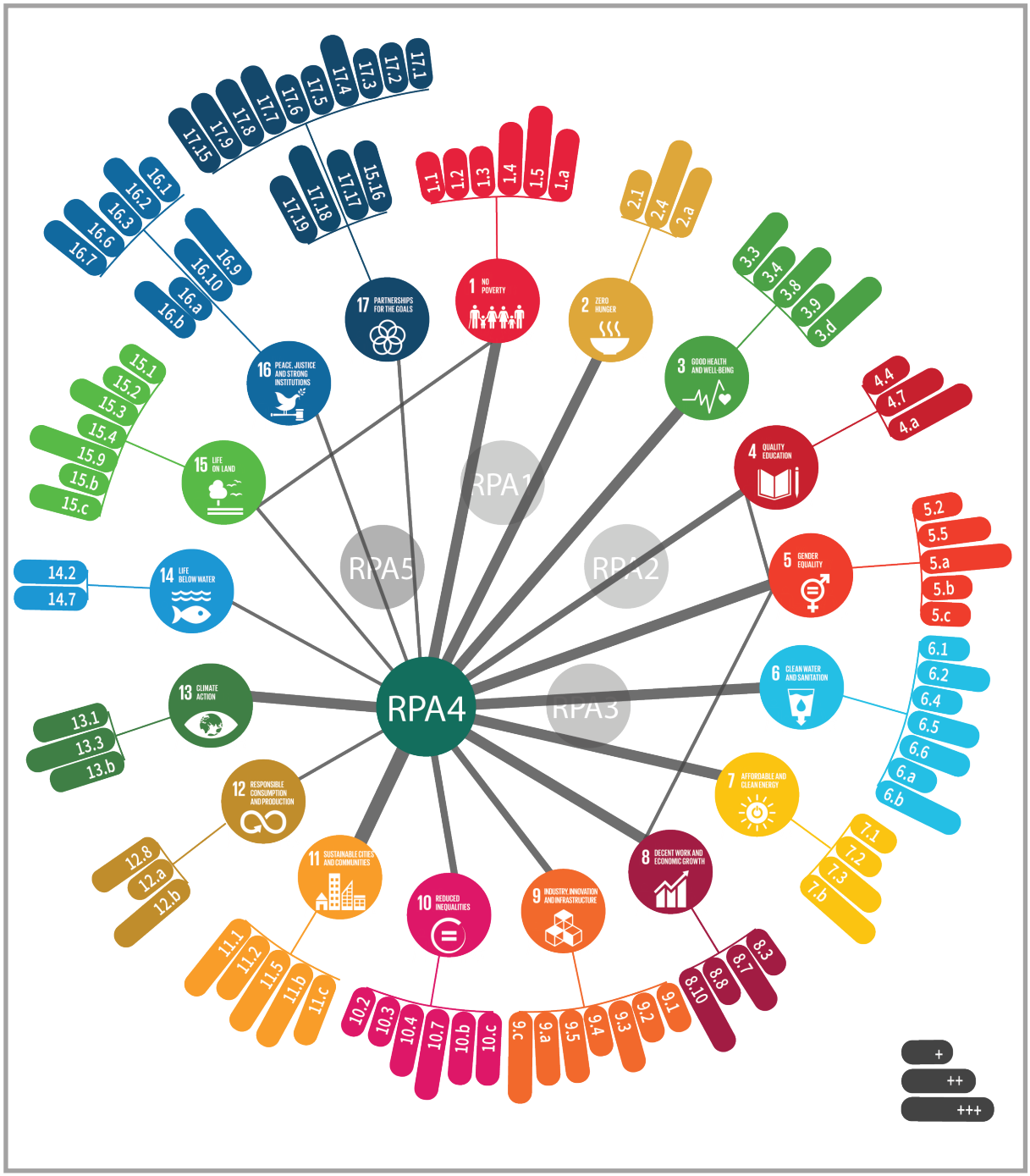


Figure 17. Interaction between SDGs in the context of Strengthening Organisational, Institutional and Community Resilience

6.5 Enhancing Policy and Decision-Making

The task of planning and responding to disasters is an urgent and challenging one for governments and public safety officials. Different stakeholders , and their varying concerns and roles in mitigating disaster damage and/or responding to critical incidents, determines their primary objectives and the underlying decision-making contexts, which affect the different knowledge base, methods, tools or technologies that can best support decision makers in their respective roles (Figure 17). The choice of an appropriate decision-support tool or scenario modelling approach, for example, should be based on specific roles and decision-making contexts. The Sendai Framework urges scientific and technological communities to facilitate a science-policy interface for effective decision-making (UNISDR, 2015b). Therefore, policies that are designed to prevent and reduce the effect of disasters must stand on accurate information and sound evidence. CDMPS research focuses on decision-making under uncertainty and/or stress, technology-assisted or data-driven strategic policy development, and operational decision-making, including crowd-based or nearest neighbors/individuals as first responders. Research Priority Area 5 focuses on improving our knowledge base and tools that can be used as critical resources by different stakeholders and decision-makers (Figure 18) before, during and after a disruptive event, and in the development of comprehensive, effective, and evidence-based disaster management policies.

Disaster management policies should make sustainable means of prevention, preparedness, and response a core objective to achieve at all levels of society. As climate change has significant impact on the frequency and severity of disasters, integrating climate change measures into national policies (13.2) to enhance disaster management will significantly reduce disaster risks. Providing public access to information (16.10) will prompt the establishment of adequate and locally applicable measures to reduce disaster impact and strengthen the resilience of economic systems, infrastructures, communities, and the environment. For these policies to reach all members of communities worldwide, governments and international agencies will have to improve policy coherence for sustainable development (17.17) across different countries and sectors, with the full and effective participation of women at all levels of decision-making (5.5).

Different stakeholders and their varying concerns and roles in mitigating disaster damage and/or responding to critical incidents determines their primary objectives and the underlying decision-making contexts, which effect the different knowledge base, methods, tools or technologies that can best support decision makers in their respective roles

Policies that support the enhancement of disaster risk reduction must place great emphasis on human and institutional capacity building to engage and prepare everyone for disaster management. Policies that enhance the resilience of infrastructures contribute to strengthening the resilience of communities. Therefore, facilitating infrastructure development, especially in developing countries (9.a) and implementing strategic urban plans to enhance urban resilience (11.b), require decision-making processes that expand local, national, and international cooperation to improve water and sanitation management (6.a), sustainable energy

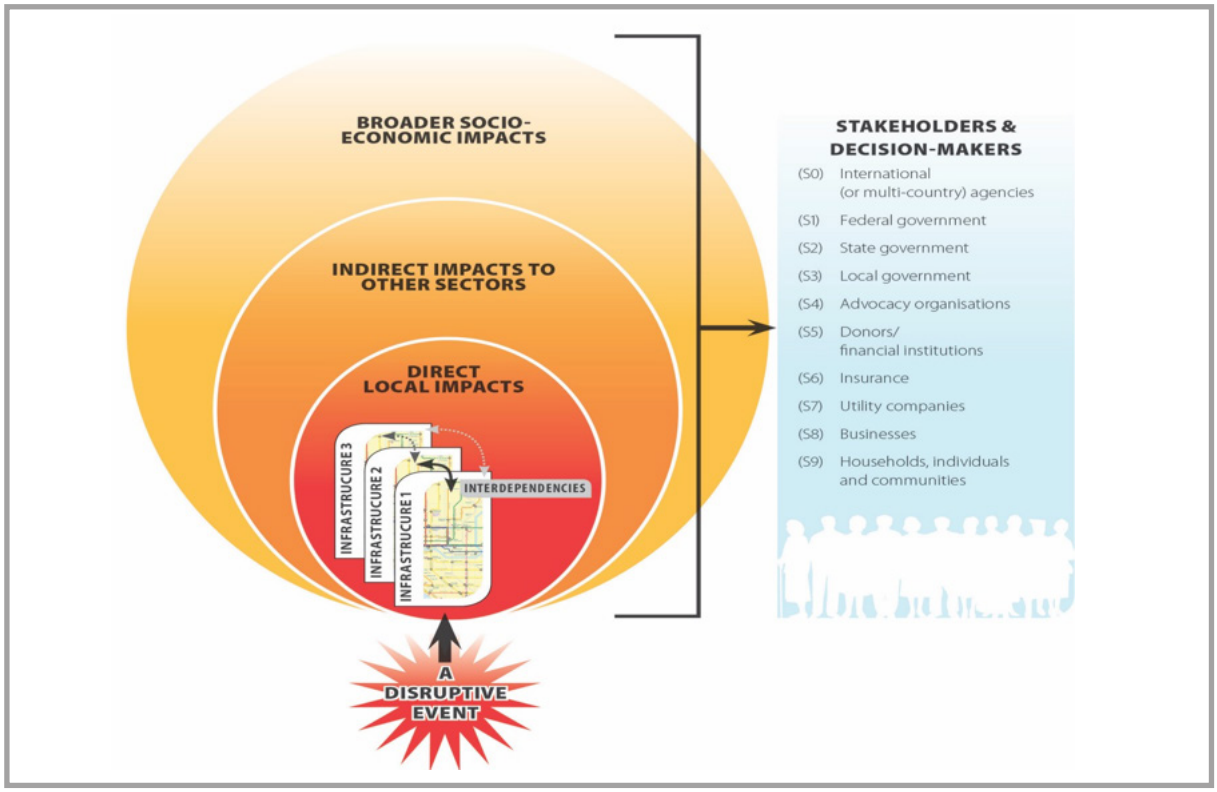


Figure 18. Types of stakeholders and decision-makers whose decisions before, during and after a disruptive event could determine the scope of impacts. *Source: Hasan & Foliente, 2015*

efficiency (7.3), sustainable public procurement practices (12.7) health care accessibility, and early warning systems (3.d) for all.

Following the occurrence of a disaster, policies must also protect the rights and livelihood of communities. The pre- and post-disaster decision making processes will be more effective when communities are educated about their rights (4.7), and ensuring that no one is pushed into forced labour (8.7) due to the dire circumstances community members face after an extreme event. Informed and technology-assisted policies can prevent vulnerable communities from experiencing extreme poverty (1.b) conditions or suffering from food insecurity (2.4). In the case of migration resulting from a disaster, having access to accurate population and environmental data will result in a more sustainable and secure management of mobility (10.7). In this context, policies are utilised to spur institutions into community-centric action.

The environmental impact of disasters, intertwined with community and infrastructure impact, requires much attention in the development of policies regarding marine and terrestrial ecosystems. National and international policies can regulate marine and terrestrial related activities so that marine life (14.2) and biodiversity (15.4) are not threatened by disasters or do not exacerbate the risk and impact of disasters.

Policies and development plans play an important role in disaster mitigation, infrastructure and community resilience, and effective response and recovery. We have identified 94 SDG targets in direct correlation with enhancing policy

and decision-making. Figure 19 highlights the fundamental linkages between the SDGs and the degree of connectivity between each SDG target in the context of Research Priority Area 5.

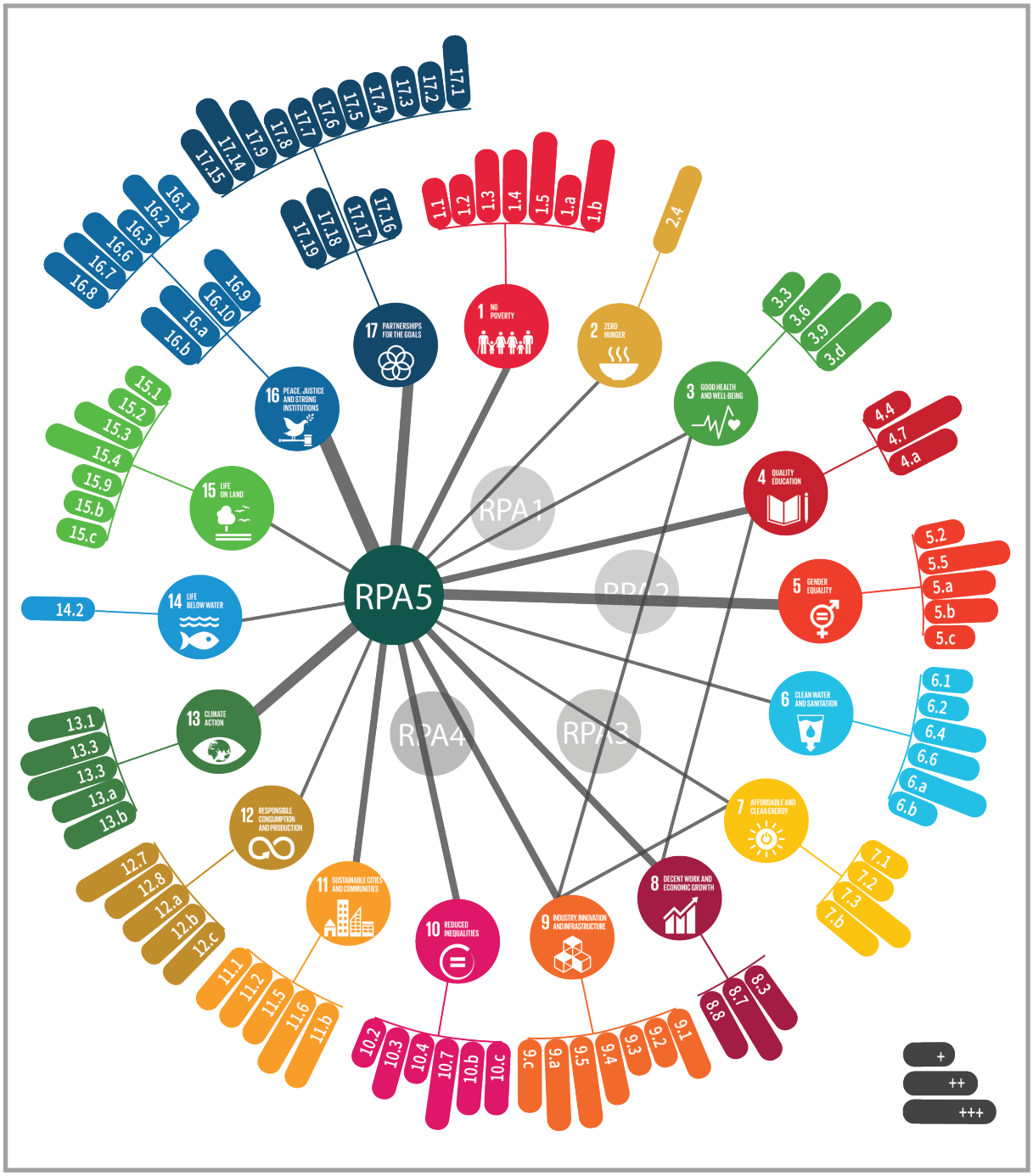
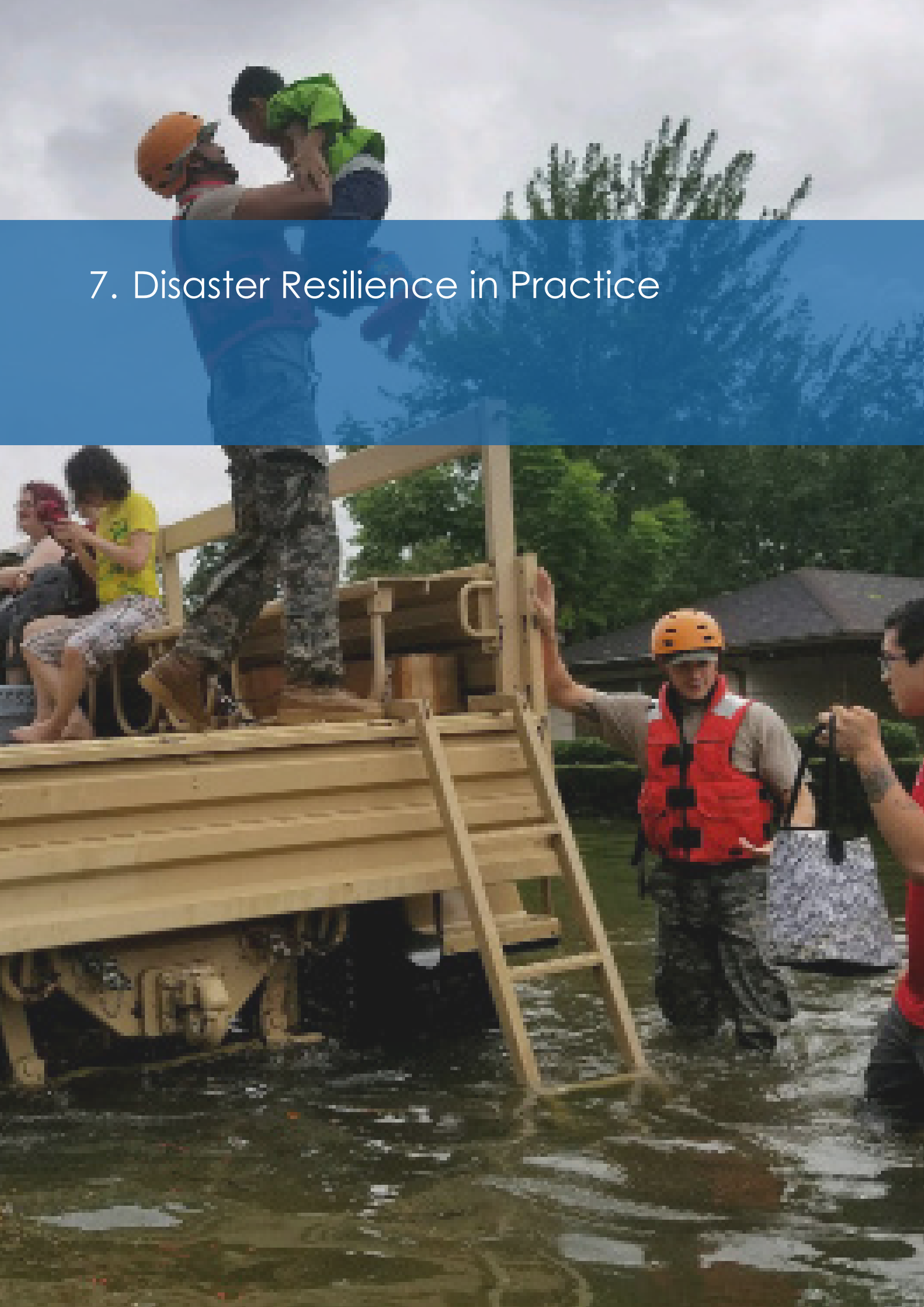


Figure 19. Interaction between SDGs in the context of Strengthening Organisational, Institutional and Community Resilience

7. Disaster Resilience in Practice



Inclusive progress and effective evaluation of sustainable development is most vulnerable to various forms of disasters and extreme events. Thus far, the Blueprint has corroborated the significance of examining and integrating the connections and complexities of social, economic, environmental, and governance systems in disaster management research to help with strengthening the resilience of disaster-affected populations and regions. This outlook to research incorporates elements of 'resilience thinking,' which considers social and ecological systems to be intertwined and acknowledges that complex interactions come with a level of uncertainty. Resilience thinking and practice can contribute to holistic and dynamic change needed to transform our world to sustainability (Sellberg, Ryan, Borgström, Norström, & Peterson, 2018). However, the current state of disaster management research and practices require academics, stakeholders, and practitioners to instigate research projects that provide the means for the application of resilience thinking in real-world situations.

While many organisations have developed practical approaches to DMR, advancement in disaster resilience will require that all relevant stakeholders with diverse disciplinary, social, and economic backgrounds contribute to and share their knowledge and skills in order to meet the needs of different components of our societies.

Putting disaster reliance in practice presents opportunities for better disaster management, yet we are faced with limitations and obstacles that can hold back efficient progress. The Sustainable Disaster Management Framework for Research was developed with the aim to promote research that enables sustainability and resilience in practice. While many organisations have developed practical approaches to DMR, advancement in disaster resilience will require that all relevant stakeholders with diverse disciplinary, social, and economic backgrounds contribute to, and share their knowledge and skills in order to meet the needs of different components of our societies.

In an effort to realise the practical implications of the Blueprint in disaster management, Table 3 connects some of the key elements of disaster resilience stated in this document to the Sendai Framework priorities for action. New opportunities for enhancing disaster resilience are vast, however, insight into the obstacles and limitations of the process can serve as an opportunity to define realistic and tangible action plans for the future. The list of obstacles and limitations below will enhance practical approaches to the SDGs and disaster management:

Time: the SDGs and Sendai Framework have set a designated 15-year period for action, ending in 2030. Given the frequency and intensity of disasters and their negative impacts, the limited time frame is a considerable challenge.

Resources: with population growth on the rise and large-scale disasters disrupting economic growth, critical infrastructures, agriculture systems, etc., we are constrained by limited and unequal access to resources.

Uncertainty: natural and human-induced shocks and changes are followed by unpredictable consequences. Preparedness and response capacities at local and national levels cannot always anticipate the intensity or chain of events that follow disasters.

Data Gap: data unavailability, lack of open data sources and limitations in collecting and managing data create shortcomings in mitigation strategies, developing prediction models, and enabling transparency in decision making and implementing processes.

Scope: the wide scope of global frameworks makes it hard to align global goals with local needs and challenges. The chances of significantly narrowing the gap between global frameworks and diverse local circumstance are slim, given the time frame

Photo: (previous) Texas National Guard soldiers arrive in Houston, Texas to aid citizens in heavily flooded areas from the storms of Hurricane Harvey. Lt. Zachary West , 100th MPAD. *Source: Flickr Creative Commons. flickr.com/photos/texasmilitaryforces/36846391355*

and resources available.

With increasing interest in topics related to the SDGs and disaster management, a number of research centres around the globe are developing research activities that can overcome the obstacles and barriers mentioned above. The following section introduces a number of research projects conducted within academic settings that have demonstrated real-world impact and will play a vital role in advancing global frameworks.

Table 3. Connection between disaster resilience and the Sendai Framework Priorities for Action

Building Disaster Resilience	Sendai Framework Priorities for Action
Context • The local circumstances of populations and places at risk play a critical role in understanding current and future risks. • For whom and where are we striving to strengthen resilience?	**Sendai Priority Action 1** Understanding disaster risk
Risks and Shocks • The type of disaster and the different organisations, governing bodies, volunteers, etc. involved will determine our course of action before and after a disaster. • Who and where are the most vulnerable? • Who is involved in various phases of disaster management? • What are the short-term and long-term impacts?	**Sendai Priority Action 2** Strengthening disaster risk governance to manage disaster risk
Capacity Building • The ability to meet the needs of the affected population and transform our systems to respond to the changed circumstances are critical to building back better. • How well can our systems cope with disturbances? Can they help us bounce back better? • Are the adaptive capacities sustainable?	**Sendai Priority Action 3** Investing in disaster risk reduction for resilience
Response and Rehabilitation • In preparation for disasters, we must consider the requirements for immediate responses and long-term planning for future shocks. • How can we foster collaborative communication and response? • Who is involved and how will they be working together? • How can this process benefit from enabling technologies?	**Sendai Priority Action 4** Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Photo: (next) Network architecture. *Source: Pixabay Stock. Free Creative Commons*

8. Enabling Research in Platforms

Research and innovation must contribute to the wider knowledge base and sharing systems that support policy makers, first responders, government practitioners, industry stakeholders and community members to overcome disaster prevention and recovery challenges and encourage action on disaster risk reduction across different sectors and scales. Research initiatives are increasingly leveraging their research to advance data collection, modelling, and analytics in order to develop enabling platforms that enables transdisciplinary collaboration and contributes to strengthening infrastructure and community resilience. This section provides an overview of a number of notable initiatives and platforms developed by research groups around the world and their potential contribution to the SDGs.

Intelligent Decision Support System

One of the key challenges in disaster response is to ensure that timely information reaches government agencies and first responders before they make critical decisions. Making well-informed and timely decisions to maximise sustainable and effective rescue and rehabilitation efforts following a disaster requires access to timely information (CDMPS, 2014). Without timely information, rescuers lose significant time for important tasks such as evacuation, locating clusters of probable survivors and, more generally, the optimisation of response and recovery options. The Intelligent Disaster Decision Support System (IDDSS) for urban disasters, developed by CDMPS, integrates a smart geospatial platform with an advanced optimisation simulation engine. The smart geospatial platform performs real-time collection, management, analysis, distribution, and visualisation of information for enhanced situational awareness. The smart platform can visually display the disaster and its location accurately in real-time, hence users can more rapidly understand the disaster's distribution and predicted trajectory. This real-time stream of critical information populates the optimisation/ simulation engine which increases the cognitive abilities of decision makers when faced with an urban disaster of large magnitude and uncertainty.

Utilising a decision support system and smart platform increases the resilience of society by reducing disaster disruption costs incurred by governments, businesses and citizens, which contributes to a number of SDG targets (Figure 20). You can access IDSS here: apps.csdila.ie.unimelb.edu.au/iddss

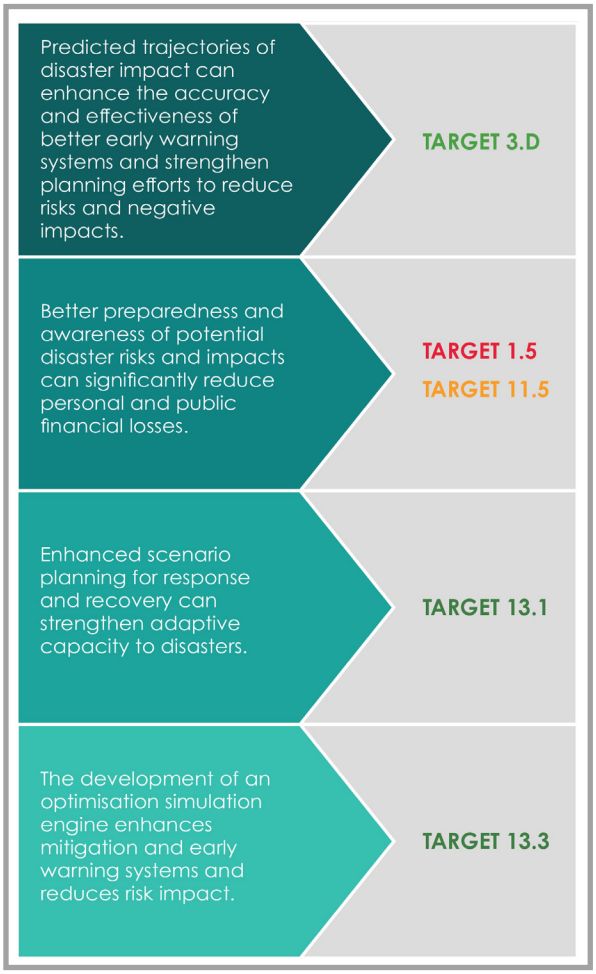


Figure 20. IDSS potential contribution to SDG targets

Urban Risk Map

Real-time information sharing and communication is vital for timely disaster response and recovery efforts. Access to localised and geo-referenced information about community and environmental circumstances shared via social media can enhance and expedite disaster response (Hung, 2016). Citizens affected by a disaster can be a source of localised data that reports on changing conditions, reduce response times, and enhance recovery measures. Tracking and responding to disasters requires citizen engagement in the process of post-disaster decision-making and rehabilitation.

The Urban Risk Map, developed by the Massachusetts Institute of Technology (MIT), enables citizens affected by disasters to add information to publicly available maps by submitting reports via direct messages from social media platforms (Twitter, Facebook, and Telegram) to a Risk Map chatbot. The chatbot then sends a one-time link to the user where they can upload information such as location, photos, and a description. The Risk Map connects citizens with emergency managers to reduce response time, map time-critical information, and visualise real-time sensor information. While the platform reports on flooding, the research at MIT Urban Risk Lab focuses on including different hazard types and developing custom decision support tools for governments.

The growing complexities of disaster impact on communities calls for an increased role of citizens in response and recovery efforts. Enabling citizen reporting and communication can improve community awareness in the face of disasters and enhance the assessment and prioritisation of emergency response and recovery while keeping government bodies and local communities informed (Figure 21). For more information about Risk Map, visit their website: riskmap.org

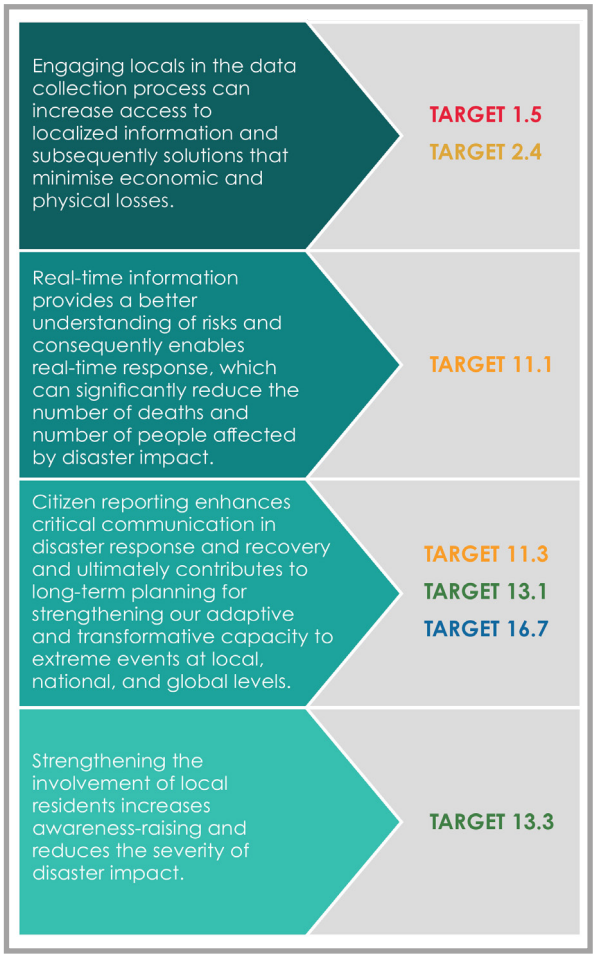


Figure 21. Risk Map potential contribution to the SDG targets

NDC-SDG Connections Tool

Climate change exacerbates disaster losses and impact, namely on urbanisation, economic losses, atmospheric concentrations of greenhouse gases and other socio-environmental conditions (IPCC, 2012). Climate change has also been identified as one of the top risks globally (WEF, 2018). The impact of climate change on economic loss, involuntary migration, environmental degradation, and other social, economic, and environmental challenges is an indication of the interconnected nature of risks and climate-related disasters. Coherent policies across different scales and synergy between

disaster risk reduction and climate change are required in order to reduce the risks and setbacks of climate change on communities, countries, institutions, and sustainable development as a whole.

The NDC-SDG Connections tool analyses, compares, and connects climate actions initiated by Nationally Determined Contributions (NDCs) to each of the SDGs. Developed by SEI and the German Development Institute the tool identifies interlinkages between climate-related plans submitted by the countries under the Paris Agreement—which are primarily about greenhouse gas emissions— and the SDGs at national and global levels. The online tool aims to provide decision makers and stakeholders how the Paris Agreement links to the SDGs. This research and visualisation project asserts that understanding the synergies and connections between the SDGs and Paris Agreement enables effective and inclusive national action to implement the SDGs.

The global struggle of climate adaption and the severity of social, economic, and environmental ramifications of climate-related disasters, particularly on vulnerable populations, necessitate partnership and collaboration between sectors and countries to combat the challenges outlined in the SDGs. Online tools such as the NDC-SDG Connections not only highlight the interdependencies of the SDGs, they also encourage and enhance cohesive action for the implementation of the SDGs and other development efforts (Figure 22). For more information about NDC-SDG Connections, visit their website: klimalog.die-gdi.de/ndc-sdg

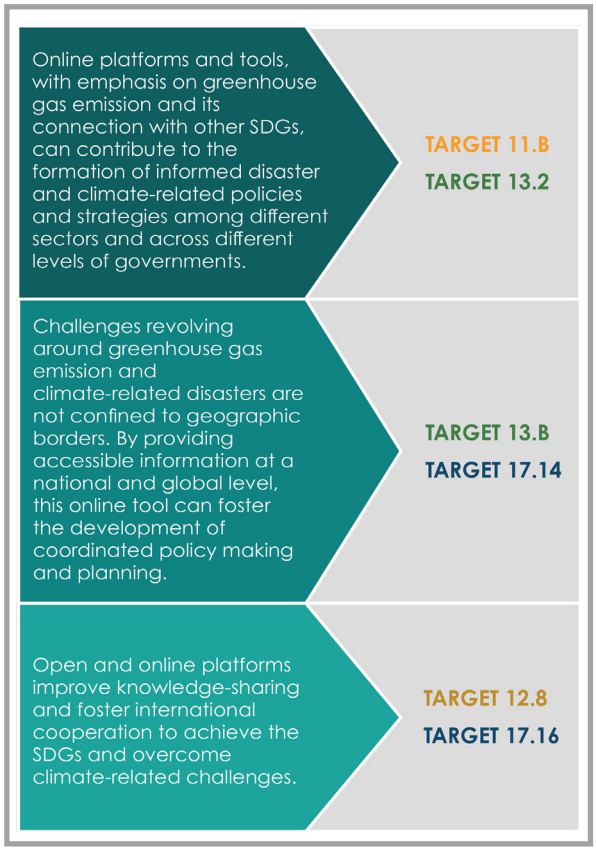


Figure 22. NDCs-SDGs Connection Tool potential contribution to the SDG targets

Photo (next): The fire destroyed around 100 houses during Hurricane Sandy in the flooded neighborhood at Breezy Point in Far Rockaway area on October 29; 2012 in New York City; NY *Source: Mishela, Adobe Stock.*

9. Future Research and Avenues for Progress

The path to a sustainable and resilient future is paved by the decisions we make today. The current pace of large-scale urbanisation, climate change, technological advancements, global market expansion and changes in human mobility have made social, economic, environmental and governance connections more complex. This level of connectivity puts many communities and countries around the world at higher risk of vulnerability to natural and human-induced disaster. Therefore, mapping and contextualising the interactions between the SDGs in the context of disaster management in this Blueprint will help accelerate progress and transformational processes starting today.

The Sustainable Disaster Management Framework utilises the key linkages between key disaster management Research Priority Areas and SDG targets in addition to connections between disaster resilience requirements and the Sendai Framework Priorities for Action to prompt future research that takes a transdisciplinary approach. This transdisciplinary and cross-sectoral approach to the Blueprint aims to provide integrative steps to address sustainable development principles in disaster management in the context of real-world problems. Understanding the SDG-disaster management interactions across different scales, domains and sectors is fundamental to creating new opportunities in the long-term for various locations, diverse populations, and different geo-political circumstances.

Understanding the SDG-disaster management interactions across different scales, domains and sectors is fundamental to creating new opportunities in the long-term for various locations, diverse populations, and different geo-political circumstances.

The severity and frequency of natural and human-induced disasters cause high levels of complexity and uncertainty and undermine our hard-earned efforts towards sustainable development. To tackle these challenges and limitations, stakeholders must take into consideration real-time and quality data and lessons learned from each disaster to support continued improvement and sustainability for all. The proposed framework stimulates a forward-feedback loop that aligns mitigation, prevention, preparedness, response and recovery phases of disaster management with sustainable development principles. Within this holistic outlook, the framework aims to strengthen community, infrastructure, and institutional resilience, foster informed decision-making, and enable the cohesive implementation of operations and governance strategies.

Committed to leaving no one behind and building back better, we encourage researchers, experts, entrepreneurs and business people, non-government organisation workers, policy makers and practitioners to work together and contextualise the various relations and interactions in sustainable development and disaster management to build a future that is safe, sustainable and resilient for everyone, everywhere.

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EST. 2014

Delivering world-class, interdisciplinary research and innovation to improve the whole-system response and resilience of infrastructure, institutions and communities against extreme events and critical incidents, and contribute to the UN Sustainable Development Goals

CDMPS is a hub for global expertise, analysis and innovation on emergency and disaster management. Our mission is to respond to the global challenges that disasters present through collaborative research with academic, industry and government institutions, nationally and internationally.

The core purpose of the Centre is to further our knowledge of disasters and to advance technology that improves the current practices and approaches to disaster management. We strive to make this work available and useful to the greater community.

The Centre has identified 5 Research Priority Areas of disaster management and public safety to focus our applied research:

RESEARCH PRIORITY AREAS

1. Understanding & mitigating extreme events & critical incidents
2. Enabling technology, informatics & analytics
3. Improving whole-life infrastructure system performance & resilience
4. Strengthening organisational, institutional & community resilience
5. Enhancing policy & decision making

CAPABILITIES

The Centre for Disaster Management and Public Safety provides a series of analytical tools, and visualisation and modelling platforms.

We welcome collaboration and offer services to meet the needs of both industry and government clients.

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Earthquake Resilience

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Mission Critical Communications

Food Security

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This blueprint shapes a comprehensive understanding of the connectivity and complexity of real-world problems and enables advancements that are resilient beyond the location and time of disasters and extreme events.

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