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**Synthesis Report of Legal, Policy and
Science Approaches within the Frame of
CCA and DRR
(Global Report)**

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1 Introduction

Global demographic trends imply that more people are living in areas vulnerable to sudden-onset natural disasters. Scientists forecast that the frequency and intensity of these disasters are likely to increase as a result of the effects of climate change. These trends, coupled with recent, high-profile mega-disasters, are raising global awareness of the need to build the capacity of national governments, civil society organisations and international actors to prevent, respond to and recover from natural disasters (Ferris and Petz, 2013). There is growing recognition that the theory and practice of climate change adaptation (CCA) and disaster risk reduction (DRR) are converging, and there is increasing interplay between the two fields (Solecki et al., 2011). The key aim of DRR is to reduce the damage caused by natural hazards through a culture of prevention. As such, DRR includes the, “Systematic development and application of policies, strategies and practices to avoid (prevention) or limit (mitigation and preparedness) the adverse effects of hazards” (UNISDR, 2010a). DRR initiatives have the potential to reduce the negative impact of hazards and would lead to sustainable development (World Bank, 2011). Thus, it is important to reduce and prevent the impact of disasters with the proper adoption of disaster risk reduction strategies. As global climate change rises, the risk of climate related disasters increases. According to IPCC (2012), CCA is the, “Process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.” As CCA also has similar aims to DRR, it is important that CCA and DRR communities work together in addressing the underlying cause of risks. Accordingly, there is a need for a systematic linkage between CCA and DRR to advance sustainable development ((Birkmann and von Teichman, 2010).

Whether it is CCA or DRR, legal, policy and science approaches play a key role in tackling their related challenges. Legal and policy approaches act as the backbone for effective CCA and DRR. Palliyaguru et al. (2010) describe how it is extremely important to integrate DRR policies into the development process. As they specify, risk-management policies, relevant guidelines, standards and legal frameworks should be directly integrated into national level strategies. Similarly, Burton et al. (2006) state that CCA must be guided and supported by national policies and strategies and for some countries, these in turn, need to be facilitated through international measures. In this context, the Sendai Framework for DRR and the Paris Agreement for Climate Change have become important global agreements.

Accordingly, this report reviews the existing legal, policy and science approaches globally. It identifies the available legal, policy and science approaches that address climate change and natural hazards, and reviews the key issues that prevent more effective integration. The findings of this report are relevant to global and national decision makers who are responsible for the development and implementation of CCA and DRR strategies.

1.1 ESPREsSO Project

This report is an output of the ESPREsSO project (Enhancing Synergies for Disaster Prevention in the European Union) that aims to contribute to a new, strategic vision for natural risk reduction and CCA, thereby opening new frontiers for research and policymaking. To achieve this goal, the project focuses on three main challenges:

- To create more coherent national and European approaches on CCA, DRR and resilience strengthening
- To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries
- To improve the management of trans-boundary disasters

The main final products of ESPREsSO will be the Guidelines on Risk Management Capability and a Vision Paper on future research strategies in order to better define the research priorities following the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030.

This synthesis report is a key deliverable of the project, and it reviews the existing legal, policy and science approaches globally in relation to CCA and DRR.

This 30 month project is co-ordinated by the AMRA Centre, Italy, with the participation of six other key institutions from France, Germany, Switzerland, the UK and Denmark.

Further information about the project can be found at www.espressoproject.eu.

1.2 Horizon 2020

Horizon 2020 is the biggest EU Research and Innovation programme ever, with nearly €80 billion of funding available over seven years (2014 to 2020), in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure that Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

1.3 Structure of the Report

The remainder of the report is structured as follows:

Section 2 provides a synthesis of existing legal/policy and science approaches in relation to CCA and DRR. It addresses global and regional perspectives.

Section 3 summarises the methodology adopted in conducting this research. Sections 4 and 5 identify some of the key issues and challenges associated with legal/policy and science approaches in CCA and DRR, including those which may hinder more effective integration and their ability to reduce disaster risk.

Section 6 summarises and brings together the main areas covered in the report and discusses some of the emerging issues.

2 Existing Legal/Policy and Science Approaches

Disasters, either natural or man-made, cause widespread damage and losses around the world every year. Worldwide, an increased intensity in disasters has been observed over the past two decades resulting in a higher number of mortalities, economic and social losses. In particular, there is an increasing exposure of economic assets in hazard prone areas which increases disaster risk (UNISDR, 2015b). According to new calculations, natural disasters around the globe have resulted in economic losses of approximately \$7 trillion since 1900 (Amos, 2016). Meeting the cost related to natural disasters has increased from US\$ 50 billion a year in the 1980s to US\$200 billion a year in the last decade (Georgieva, 2014). As such, the annual losses of disasters are staggering. Over the 1900-2015 period, around 40% of economic losses were due to flooding, 25% were due to earthquakes, 20% were due to storms, 12% were due to drought, 2% to wildfire, and under 1% to volcanic eruptions (Amos, 2016). Nevertheless, there is a dramatic reduction in disaster mortality in selected countries and regions during the last decade (UNISDR, 2015b).

China, the United States, India, the Philippines and Indonesia together constitute the top five countries which have been most frequently hit by natural disasters over the last decade (Guha-Sapir et al., 2016). Asia accounted for the highest number of disaster victims (2005-2014 decade average of 80.6%) followed by Africa, which accounted for 2005-2014 decade average of 13.1%.

According to the Annual Disaster Statistical Review 2015, hydrological disasters represented the largest share in natural disaster occurrence in 2015 (46.5%), followed by meteorological disasters (33.8%) (Guha-Sapir et al., 2016). Given the adverse effects of climate change, it is more likely that the frequency and intensity of hydro-meteorological extreme events have increased (Dominey-Howes, 2015). It was evident that human induced climate change had resulted in 14 of 28 storms, droughts and other 2014 extreme weather events investigated by global scientists (Loftis, 2015). More widely, climate change is expected to increase the intensity and frequency of existing hazards (World Bank, 2015). In contrast, according to trends, geophysical events have remained stable (Leaning and Guha-Sapir, 2013).

Over the last decade, the scale and impact of disasters have increased as a result of increased urbanisation, deforestation and environmental degradation, and intensifying climate variables such as higher temperatures, extreme precipitation and more violent wind and water storms (Leaning and Guha-Sapir, 2013). As such, climate change mitigation, adaptation and DRR have been identified as some of the methods needed to mitigate the risks and adverse impacts of disasters, and to increase society's resilience.

2.1 Key Global Policies

Global policies are needed to unify different parts of the world. There are three main global policies that address DRR and CCA which are analysed in this report: the Sendai Framework for Disaster Reduction 2015-30 (SFDRR); the Sustainable Development Goals (SDGs) and the Paris Climate Agreement.

2.1.1 Sendai Framework for Disaster Risk Reduction (SFDRR)

The SFDRR was introduced at the third United Nations World Conference on DRR, held in Sendai, Japan in 2015. This provides a concise, focused, forward-looking and action-oriented, post-2015 framework for DRR. This framework complements and replaces the Hyogo Framework for Action, while identifying the gaps and challenges to be further addressed. As an action-oriented framework, it can be implemented by governments and stakeholders in a complementary manner. The framework highlights the importance of disaster governance, stakeholder participation and disaster preparedness against future disasters (UNISDR, 2015a). It further emphasises the impact of climate change and its effects on disasters. The SFDRR focuses on a strategy of a multi-hazard approach, covering disaster losses between 2015 and 2030. The aim of the framework is to achieve a substantial reduction in disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. This will be achieved through four priority areas (UNISDR, 2015a):

- Priority 1: Understanding disaster risk
- Priority 2: Strengthening disaster risk governance to manage disaster risk
- Priority 3: Investing in DRR for resilience
- Priority 4: Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction

Within the aforementioned priority areas, seven global targets have been presented:

- Substantially reduce global disaster mortality by 2030, compared to 2005-2015
- Substantially reduce the number of affected people globally by 2030, compared to 2005-2015
- Reduce direct disaster economic loss by 2030
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services (health and educational facilities) through improving resilience by 2030
- Substantially increase the number of countries with national and local DRR strategies by 2020
- Substantially enhance international co-operation to developing countries to support their national actions by 2030
- Substantially increase the availability of, and access to, multi-hazard, early warning systems and disaster risk information and assessments to the people by 2030

This framework is applicable to both small-scale and large-scale, frequent and infrequent, sudden and slow-onset, man-made or natural disasters. It highlights the importance of national and federal state governments, along with local authorities and local communities, in the allocation of resources, incentives and decision-making powers. The framework emphasises the importance of the science-policy interface through dialogues and co-operation among scientific communities, other relevant stakeholders and policymakers. They propose to clearly define roles and responsibilities of both the private and public sectors through providing incentives, enhancing disaster risk transparency and establishing proper organisational structures.

2.1.2 Sustainable Development Goals (SDGs)

The SDGs, otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 Goals build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among the other priorities. The goals are interconnected, often the key to success; one will involve tackling issues more commonly associated with another. The goals and targets became effective on 1st January, 2016 for a 15 year time period (UNDP, 2016).

The 17 goals emphasise the importance of having a global partnership for successful implementation. This partnership will benefit the poorest and most vulnerable societies by bringing together governments, the private sector, civil society, the United Nations and other relevant actors with available resources. In addition, they promote the mainstreaming of gender perspectives in the implementation of the agenda. This is to ensure gender equity and empowerment of women and girls as an important element towards achieving goals and targets.

The role of public finance is also emphasised by the agenda for mobilisation of public resources domestically. This includes the developed countries' official provision of 0.7% of their gross national income for official development assistance (ODA) to developing countries, and 0.15% - 0.2% of ODA to the least developed countries. The agreement highlights the importance of national parliaments (for legislative and budgetary allocations) and their roles of accountability for effective implementation.

Climate Action is the 13th development goal. The goal aims to mobilise \$100 billion annually by 2020 to address the needs of developing countries and help to mitigate climate-related disasters. It aims to help more vulnerable regions, such as land locked countries and island states, to adapt to climate change. This goal suggests integrating disaster risk measures into national strategies (UNDP, 2016). Similarly, the 13th goal proposes to strengthen resilience and adaptive capacity to climate related hazards and disasters in all countries. More importantly, they propose to integrate climate change measures into national policies, strategies and planning. The need to enhance human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning are all highlighted in the goal. They further aim at enhancing capacities among the least developed countries and small island developing countries with more focus on women, youth and local and marginalised communities towards effective climate management. The goal emphasises the support of international financial institutions for developing countries. In addition, they recommit to enhancing the voice and participation of developing countries in international, economic decision-making, norm-setting and global, economic governance.

Goal 11 deals with sustainable cities and communities. This is to ensure cities and human settlements are safe, resilient and sustainable. Accordingly, this goal aims to overcome the challenges faced by cities and to support them to continue thriving and growing, while improving resource use and reducing pollution and poverty. It focuses on areas such as adequate, safe and affordable housing and basic services, sustainable transport systems, inclusive and sustainable urbanization, participatory, integrated and sustainable human settlement planning, inclusive and accessible green and public spaces and cultural and natural heritage. It also emphasises the importance of reducing the economic losses of disasters, including water-related disasters, with a focus on protecting the poor in vulnerable situations. It further aims to reduce the environmental impact of cities and improve social and

environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

The framework of Global Partnership for Sustainable Development is proposed as the way of implementing the SDGs with the support of policies and actions outlined in the Addis Ababa Action Agenda which set out a global, financing framework for the post-2015 development agenda. This is an integral part of the 2030 Agenda for Sustainable Development. It deals with domestic public resources, domestic and international private business and finance, an international development corporation, international trade, debt, addressing systematic issues of science, technology, innovation and capacity building, data, monitoring and follow-up.

2.1.3 Paris Agreement

At the Paris Climate Conference in December 2015, 195 countries adopted the first ever, universal, legally binding, global climate deal. This agreement operates within the United Nations Framework Convention on Climate Change (UNFCCC). This was signed by 197 UNFCCC members and ratified by 126 members as of December 2016. The Paris Agreement will come into force on the 30th day after the date on which at least 55 parties to the Convention [accounting in total for at least an estimated 55% of the total global greenhouse gas emissions (GHG)] have deposited their instruments of ratification, acceptance, approval or accession with the depositary. The first of these thresholds was achieved on 22nd September, 2016.

According to Article 2 of the Agreement, its objectives are:

- To maintain global average temperatures to below 20C when compared to pre-industrial levels and to limit the temperature rises to 1.50C above pre-industrial levels
- To increase the ability of adaptation to climate change, to improve climate resilience and reduce GHG emissions without any threats to food production
- Make available financial sources for low GHG emissions and climate resilient development

One of the main features of the Paris Agreement is its 'bottom up' structure. As it emphasises consensus building among members, it accepts voluntary and nationally determined targets. Hence, their climate goals are politically supported rather than legislative requirements. This agreement makes all parties submit to emission reduction plans. Their plans are based on the principle of 'Common but Differentiated Responsibility' due to differences between capacities and duties to climate action among nations. Further, there is no specific treatment between developed and developing nations.

According to Article 3 of the Agreement, the contribution of each member should be set individually by considering the principle of ambition, represent a progression over time and with a view to achieve the ultimate purpose of the Agreement. These are known as 'Nationally Determined Contributions'.

The Agreement contains collective, long-term adaptation goals. According to Article 7 of the Agreement, parties establish the global goal on adaptation towards enhancing adaptive capacity, strengthening resilience and reducing vulnerability. They identify adaptation as a global challenge and developing countries require immediate actions since they are more vulnerable to climate change. Similarly, the adaptation actions should be country driven, gender responsive, participatory and transparent approaches, based on available scientific knowledge, traditional knowledge, knowledge of indigenous people and local knowledge when integrating adaptation into other policies and actions (UNFCCC, 2015).

2.1.4 Role of the Global Policy Frameworks in integrating CCA and DRR and facilitating trans-boundary Crisis Management

2.1.4.1 Integration of CCA and DRR

The SFDRR is a 15-year, non-binding agreement, which advocates the state's role of reducing disaster risk while sharing the responsibility with other stakeholders including local government, the private

sector and others. The Framework aims to substantially reduce disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries (UNISDR, 2015a). It recognises that many disasters are exacerbated by climate change and calls for dedicated action focusing on underlying disaster risk drivers such as climate change and variability. Climate change is considered as one of the drivers of disaster risk and the framework recognises the importance of respecting the mandate of the United Nations Framework Convention on Climate Change. It calls for coherence between development, strengthening and implementation of relevant policies, plans, practices and mechanisms across climate change and variability. It also recognises that effective DRR contributes to sustainable development. While recognising that disasters undermine the efforts to achieve sustainable development, it recalled the outcome document of the United Nations Conference on Sustainable Development, held in 2012, which called for a renewed sense of urgency in the context of sustainable development to be integrated at all levels. The Framework calls for coherence between development, strengthening and implementation of relevant policies, plans, practices and mechanisms across sustainable development and growth.

The new SDGs, which were adopted on 25th September 2015, consist of a set of goals to end poverty, protect the planet and ensure prosperity for all. For the goals to be reached in the 15 year period, everyone must do their part including government, the private sector, civil society and people (UN, 2015). Of the 17 goals, some are specifically linked to disaster risk reduction and climate change. For example, goal no. 11, 'Sustainable Cities and Communities', is specifically linked with disaster risk reduction. It aims to make cities inclusive, safe, resilient and sustainable. This goal has specific reference to SFDRR and highlights the importance of holistic disaster risk management in line with the Sendai Framework for Disaster Risk Reduction. As such, it is clear that SDGs have tried to create some coherence between the sustainable development agenda and the Sendai Framework.

Similarly, there is a specific goal for climate action, which aims to combat climate change and its impacts. It recognises the Paris Agreement and that all countries agreed to work together to limit global temperature rises to well below 2 degrees Celsius, above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius (UNFCCC, 2015). The SDGs recognise the importance of implementing the Paris Agreement for the achievement of the SDGs and provide a roadmap for climate actions that will reduce emissions and build climate resilience (UN, 2015). Similarly, the Paris Agreement has a number of references to sustainable development. It has tried to look at climate change in the context of sustainable development and tries to promote sustainable development and environmental integrity. However, within the agreement, there is no specific reference to SFDRR and SDGs.

2.1.4.2 Trans-boundary Crisis Management

Across global policies, a high prominence has been given to trans-boundary co-operation and crisis management.

The SFDRR recognises the pivotal role of international, regional, subregional and trans-boundary co-operation in supporting the efforts of states, their national and local authorities, as well as communities and businesses, to reduce disaster risk. It highlights that each state has the primary responsibility to prevent and reduce disaster risk, including through international, regional, subregional, trans-boundary and bilateral co-operation. It guides actions at national and local levels, as well as regional and international levels, in order to foster more efficient planning, create common information systems and exchange good practices and programmes for co-operation and capacity development, in particular, to address common and trans-boundary disaster risks. As such, the Framework recognises the trans-boundary nature of disaster risk and guides action at the regional level through agreed regional and subregional strategies and mechanisms for co-operation. Moreover, the importance of trans-boundary co-operation is also recognised in relation to ecosystem-based approaches with regard to shared resources, to build resilience and reduce disaster risk, including epidemic and displacement risk, and the Framework highlights the importance of promoting trans-boundary co-operation to enable policy and planning for the implementation.

Similarly, the Paris Agreement advocates global and regional co-operation and views climate change and adaptation in a global dimension. It brings all nations to a common cause to combat climate change and adapt to its effects, with enhanced support to assist developing countries (UNFCCC, 2015). The Agreement recognises adaptation as a global challenge with local, subnational, national, regional and international dimensions, and a special emphasis has been given to enhancing the capacities of developing countries to implement this, including through regional, bilateral and multilateral approaches. Likewise, the SDGs have a dedicated goal to revitalise global partnerships for sustainable development which recognise the trans-boundary nature of the problem and the importance of trans-boundary co-operation. Accordingly, this goal highlights the essential role of partnerships at the global, regional, national and local level. Hence, it will enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the SDGs in all countries, and in particular, developing countries (UN, 2015).

2.1.4.3 Coherence Across Policies

These global policy frameworks have created a significant opportunity to build coherence across overlapping policy areas (Murray et al., 2016). It is expected that these global agreements will provide a foundation for a shared aim of making development sustainable, resilient and safe (Wahlström, 2015). However, a large number of agreements has created challenges, especially in terms of implementation and monitoring. As such, how the policy commitments are put into practice is less straightforward (Carnwath, 2016). According to (Kelman, 2015), whilst they are trying to connect and follow each other closely, they are not coming together fully. For example, the SFDRR lacks an appropriate framing of climate change. Although climate change has been identified as one of the risk drivers, it has not been given adequate prominence. The primary focus was on tackling root causes of disaster risks, such as vulnerability, which undermines climate change.

In order to achieve the goals of the global agreements it is important that we integrate them. According to (Velasquez, 2017), working in separation prevents a holistic perspective and can lead to resource problems. Murray et al. (2016) emphasise that none of the frameworks engage with a full range of risk drivers. They highlight the importance of a systematic view of risks in order to bring frameworks together. Therefore, there is the potential to design finance mechanisms, policies and programmes that can deliver more than one set of frameworks (Peters et al., 2016). This will help to achieve the objectives of the frameworks effectively, efficiently and sustainably.

Murray et al. (2016) highlight the importance of identifying the synergies between policies, programmes and institutions in order to align the actions. They propose seven recommendations in building coherence between the agreements and global agendas. These recommendations include: raising awareness on how the different frameworks align, facilitating key partnerships to work across agreements, instituting clear governance arrangements for collective action and accountability, developing consistent definitions, promoting science and technology involvement, joined up monitoring processes and ensuring national ownership and leadership on all the frameworks. Moreover, a successful DRR depends on better use of science and technology and the way in which science and technology can provide evidence for policy. According to (Carabine, 2015), science is included as a core element of the SFDRR. However, implementation in practice is still unclear.

2.2 Other Global and Regional Policies: Examples

2.2.1 Addis Ababa Action Agenda

In July 2015, the Heads of State and Government with delegates gathered in Addis Ababa to set a global framework for financing development, post-2015. Their tasks aimed: 1. To follow up on commitments and assess the progress made in the implementation of the Monterrey Consensus and the Doha Declaration; 2. To further strengthen the framework to finance sustainable development and the

means of implementation for the universal, post-2015 development agenda; 3. To reinvigorate and strengthen the financing for the development follow-up process to ensure that the actions to which they commit are implemented and reviewed in an appropriate, inclusive, timely and transparent manner. Having understood the challenges of environmental degradation and climate change, along with unmet monetary agendas, specifically among developing countries, the importance of the lack of financing for achieving sustainable development goals are emphasized. The agenda aims to support national and local capacities for prevention, adaptation and mitigation of external shocks and risk management.

Furthermore, they commit to strengthening investments of national and local actors to manage and finance disaster risk, as part of sustainable development strategies to get international assistance at the necessary time. They highlight a recommitment of 0.7% of gross national income to aid by the developing countries.

2.2.2 SDG Climate Nexus Facility (Ali, 2017)

In order to integrate CCA-DRR approaches, a new SDG Climate Nexus Facility was introduced in the Arab region. This is a regional initiative between the League of Arab States, the Arab Water Council, UNDP, UNEP, UNISDR and WFP, to help countries integrate disaster and climate resilience into development and humanitarian interventions (Ali, 2017). Enhancing the capacities of taking an integrated approach will help achieve the global agreements – the SFDRR, the Paris Agreement to Combat Climate Change and the SDGs - in a more integrated manner.

The aim of the initiative is to develop local capacities for risk-informed development through integrated CCA-DRR approaches and to bring greater coherence in implementation of the Arab Action Plan on Climate Change and the Arab DRR Strategy (Ali, 2017). Accordingly, it is expected that this initiative will enhance the use of science for decision-making and expand early warning systems and social protection mechanisms, and enhance the resilience of agriculture and water systems to more severe droughts and floods.

This new initiative will bring together the UN's leading development and humanitarian agencies to promote an integrated approach to adaptation as a means to:

- Protect the capacities and assets from impacts of climatic disasters
- Prepare communities and institutions to cope with and mitigate the impacts of climatic shocks and disasters
- Strengthen communities' ability to recover and reconstruct from conflicts in a way that ensures their resilience to future climatic disasters (Ali, 2017)

2.2.3 New Urban Agenda (HABITAT 3)

The New Urban Agenda is the outcome document agreed upon at the Habitat 3 conference held in Quito, Ecuador in October 2016. This begins with the Quito Declaration on Sustainable Cities and Human Settlements for All. The New Urban Agenda guides the initiatives around urbanization for the next 20 years with a range of key actors: nation states, city and regional leaders, international development funders, UN programmes and civil society (Citiscoppe, 2015). Accordingly, it is expected to address both the challenges and opportunities of urbanization through planning, design, finance, development, governance and management, guided by the New Urban Agenda.

The New Urban Agenda has taken full account of the global agreements made in the course of the year 2015, in particular, the 2030 Agenda for Sustainable Development, including the Sustainable Development Goals (SDGs), and the Addis Ababa Action Agenda of the Third International Conference on Financing for Development, the Paris Agreement adopted under the United Nations Framework Convention on Climate Change (UNFCCC), the Sendai Framework for Disaster Risk Reduction 2015-2030, the Vienna Programme of Action for Landlocked Developing Countries for the Decade 2014-2024,

the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway and the Istanbul Programme of Action for the Least Developed Countries for the Decade 2011-2020. The New Urban Agenda also included the Rio Declaration on Environment and Development, the World Summit on Sustainable Development, the World Summit for Social Development, the International Conference on Population and Development Programme of Action, the Beijing Platform for Action, and the United Nations Conference on Sustainable Development, and the follow up to these conferences (Habitat 3, 2016).

Accordingly, the New Urban Agenda has tried to integrate disaster risk reduction and climate change adaptation into age- and gender-responsive urban and territorial development and planning processes. This includes greenhouse gas emissions, resilience-based and climate-effective design of spaces, buildings and constructions, services and infrastructure and nature-based solutions. It also includes promoting co-operation and co-ordination across sectors, as well as building the capacity of local authorities to develop and implement disaster risk reduction and response plans and formulate adequate contingency and evacuation procedures (Habitat 3, 2016).

It envisages cities and human settlements that adopt and implement disaster risk reduction and management, reduce vulnerability, build resilience and responsiveness to natural and man-made hazards and foster mitigation and adaptation to climate change. It also advocates environmental sustainability by promoting clean energy and sustainable use of land and resources in urban development as well as protecting ecosystems and biodiversity, including adopting healthy lifestyles in harmony with nature, promoting sustainable consumption and production patterns, building urban resilience, reducing disaster risks and mitigating and adapting to climate change (Habitat 3, 2016).

2.2.4 Ten Essentials for Making Cities Resilient

The 'Making Cities Resilient' campaign was launched in May, 2010 to address the issues of local governance and urban risk. The campaign was initiated to support the implementation of the Hyogo Framework for Action (HFA) at local level. Building on the Sendai Framework, the second phase of the campaign started in 2016 and will shift its focus to implementation support, partners' engagement, investment co-operation opportunities, local action planning and monitoring of progress and it is expected to carry on at least until 2020 (UNISDR, 2015b). The campaign is led by the UNISDR. However, it is self-motivating, partnership and city-driven, with the aim to raise the profile of resilience and disaster risk reduction among local governments and urban communities worldwide (UNISDR, 2015b).

The campaign has developed ten 'Essentials' to enable local governments to make their cities more disaster resilient and they are listed below:

- Essential 1: Organise for disaster resilience
- Essential 2: Identify, understand and use current and future risk scenarios
- Essential 3: Strengthen financial capacity for resilience
- Essential 4: Pursue resilient urban development and design
- Essential 5: Safeguard natural buffers to enhance ecosystems' protective functions
- Essential 6: Strengthen institutional capacity for resilience
- Essential 7: Understand and strengthen societal capacity for resilience
- Essential 8: Increase infrastructure resilience
- Essential 9: Ensure effective disaster response
- Essential 10: Expedite recovery and build back better
(UNISDR, 2015b)

Some of the Essentials have clearly acknowledged the climate change impacts and the 10 Essentials have tried to incorporate CCA and DRR to some extent. For example, Essential 1 highlights the importance of engaging and learning from other city networks and initiatives, such as city-to-city learning programmes, promoting climate change and resilience initiatives. Similarly, Essential 2 considers how hazards might change over time, given the impact of factors such as urbanization and climate change. Likewise, Essential 5 highlights the importance of anticipating changes from climate

trends, urbanization and planning, to enable ecosystem services to withstand these. Essential 6 specifically highlights the importance of integrating disaster and climate risk considerations in project evaluation and design.

2.2.5 Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017–2030 (SPC et al., 2016)

At the Pacific Island Forum Leaders' meeting in 2012, it was agreed to develop a single, integrated regional framework on climate change and disaster risk management, to succeed the two separate regional frameworks on climate change and disaster risk management after their expiry in 2015 (SPC et al., 2016). This decision was operationalized by a roadmap document, outlining the process for the development of this new framework. The substantive work on the formulation of the new framework was initiated after the first Joint Meeting of the Pacific Climate Change Roundtable and Pacific Platform for Disaster Risk Management in 2013. The FRDP was developed, firstly, on the basis of reviews of the two previous regional frameworks, so that it incorporates lessons learned from their implementation. Secondly, the document was developed through an extensive and inclusive engagement process with stakeholders, from national and communities to regional and international levels (SPC et al., 2016).

3 Research Methodology

The aim of this study was to review the existing, legal/policy and science approaches in relation to the three ESPREsO challenges as described in Section 1.3:

- To create more coherent national and European approaches on CCA, DRR and resilience strengthening
- To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries
- To improve the management of trans-boundary disasters

At the initial stage, a literature review was conducted to identify the key challenges and gaps related to the three key ESPREsO challenges. Thereafter, based on the initial findings, a conceptual framework was developed which is depicted in Figure 1. This led to identifying the key themes for the study. Once the key themes were finalised, the data collection instruments and the reporting template were developed.

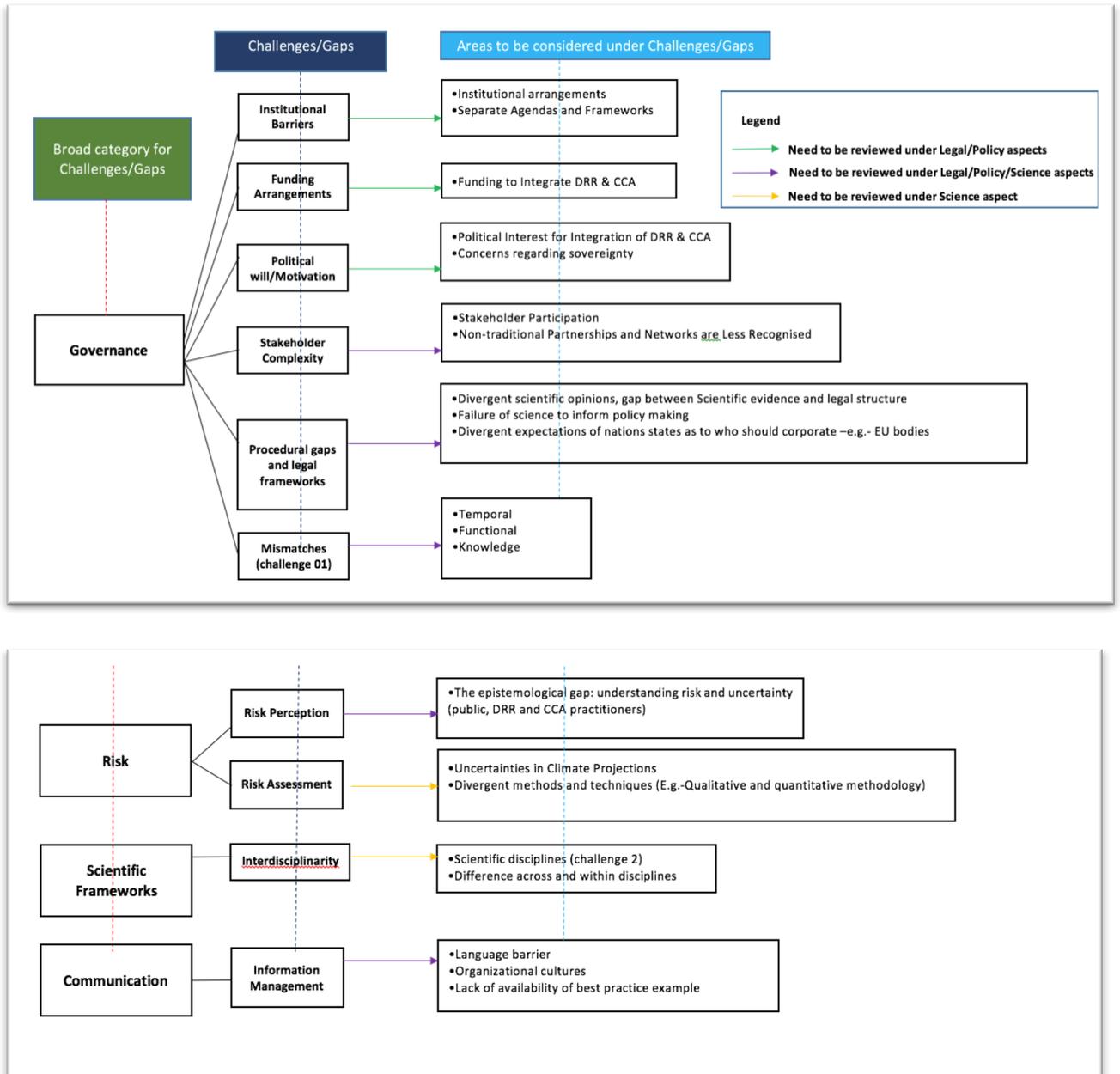


Figure 1- Espresso conceptual framework

The key data collection instruments are the desk-based literature review, semi-structured expert interviews and a questionnaire survey. The desk-based study had two purposes; one was to identify the legal/policy and science approaches. Secondly, the desk-based literature review identified the existing issues and critically reviewed the legal, policy and science approaches. A desk-based literature review was the ideal data collection method to initiate the study.

After completing the desk-based literature review, the research team conducted a number of semi-structured, expert interviews and focus group expert discussions to identify the key challenges and issues in the existing legal/policy and science approaches from a global perspective. Accordingly, 10 interviews were conducted with disaster resilience and climate change adaptation experts across the globe, mainly covering regions and countries such as Asia, Africa, USA, Canada and Australia. The sample represented academics, practitioners, NGOs, representatives from government bodies and so forth. In addition to semi-structured expert interviews, the research team also conducted three focus group discussions with five to six participants in each. Once the data was collected, it was qualitatively

analysed by using QSR-NVivo version 11 and thereafter, based on the identified key themes, mind maps were developed to understand the context for each and every issue and to identify the influence of the existing legal/policy and science approaches.

Finally, to gain a wider perspective on the key challenges and issues in the existing legal/policy and science approaches from a global perspective, an online questionnaire was developed. The survey was mainly designed to rate answers on a Likert scale, which allows participants to specify their level of agreement on a five-point scale, 1 being 'strongly disagree' and 5 being 'strongly agree'. The questionnaire was filled out by 140 highly experienced disaster resilience and climate change adaptation experts across the globe representing academia and research, national and central governments, local governments, NGOs, private sector and international organisations. The respondents represent various regions such as Asia (78), America (8), Africa (7), Oceania (10) and Europe (37). The collected data was mainly analysed through the Relative Importance Index (RII) method where 'W' is the weightage given to each factor, 'A' is the highest weight and 'N' is the number of respondents.

$$RII = \frac{\sum W}{A \times N} \quad (0 \leq RII \leq 1)$$

The analysis comprised ranking the associated challenges and issues according to the relative importance indices globally and regionally and revealed the key challenges and issues in the existing legal/policy and science approaches from a global perspective.

4 Qualitative Analysis and Findings

This section critically reviews the issues/gaps in implementing the key global policies in the global context, under the key challenges/gaps identified. The analysis and findings are based on the literature synthesis as well as based on the interview findings. Further, the existing legal/policy and science approaches are reviewed by taking examples from the following disaster types: floods, droughts, winter-storms, landslides, earthquakes, volcanic eruptions and tsunamis.

4.1 Challenges and Gaps associated with Governance Arrangements

4.1.1 Institutional Arrangements

Institutional barriers are identified as a key challenge which hinders the process of successful integration of CCA into DRR (Gero et al., 2010; Schipper and Pelling, 2006; Sperling and Szekely, 2005). For example, climate change policies and decisions are made by ministries and organizations related to the environment, whereas disaster management and reduction decisions are made by ministries related to infrastructure development. This institutional structure disturbs the communication process, which generates an information barrier among institutions (Schipper and Pelling, 2006; Sperling and Szekely, 2005). The situation is further aggravated by lack of simple methods, practical tools, lack of an enabling environment and institutional frameworks (Kato, 2010 #520).

Since CCA and DRR efforts are handled by two sets of organizations, their inherited cultures prevent or reduce effective integration (Schipper and Pelling, 2006; UNISDR and UNDP, 2012). In order to overcome institutional barriers among CCA and DRR, a common institutional structure is recommended (Mitchell and van Aalst, 2008). Nevertheless, some institutions, which are considered as effective and efficient, take a long time over climate change adaptation measures due to the time taken for negotiations and consultations with interrelated parties. Vedwan et al. (2008) explains this situation in his study related to lake management in Florida. According to Coppola (2015), one of the significant obstacles for integrating CCA and DRR activities within Pacific Island Countries and Territories is, "Government institutional structures that silo CCA and DRR." As a result, CCA and DRR are often compromised by poor collaboration and co-ordination among the communities of practice around

disasters, climate change and development (Hay, 2009). As such, a low level of integration is observed within the Pacific regions. However, Tonga is a leading example of integration of DRR and CCA in the region, having developed an integrated plan for Disaster Risk Management and climate change, including the reduction of greenhouse gas emissions (UNISDR and UNDP, 2012). Based on a study conducted by UNISDR and UNDP (2012), key barriers for integration in the Pacific are:

- Capacity constraints of Pacific Island countries (related to lack of co-ordination, communication, political will, insufficient funds and absence of expertise)
- Separate global and regional frameworks for CCA and DRR
- Perceptions of development practitioners that DRR and CCA are not valuable
- Difficulty quantifying the benefits of DRR and CCA

Similarly, within Small Island Developing States, the most common governance barrier reported was weak linkages and poor co-ordination between the tiers of government (Kuruppu and Willie, 2015). This resulted in inadequate engagement between formal national adaptation efforts and communities or Local Government, and poor communication between communities and government. Likewise, Jordan's institutional arrangement is fragmented where responsibility for Climate Change Adaptation lies with the Ministry of Environment while Disaster Risk Reduction lies primarily with Civil Defense which limits institutional co-ordination between different sectors (UNDP and IUCN, 2012).

Likewise, when considering the Central American region, CCA is being mainly managed by environmental institutions. For example, in Nicaragua, The National Strategy on climate change is managed by a top-down structure, where the decision-making process has three levels: the creation of legislation by the National Assembly, its implementation by the ministries and their territorial delegations and its management by the Ministry of Environment and Natural Resources (Rivera, 2014). On the other hand, the governmental body in charge of co-ordinating all DRR actions is the National System for Disaster Management and Prevention and this has been identified as a constraint for further integration (Rivera, 2014).

As discussed above, institutional barriers are one of the main factors affecting successful CCA and DRR procedures as well as integration of both CCA and DRR. Institutional barriers can also be identified in terms of the structure of institutions (Sperling and Szekely, 2005). For example, lack of institutional capacity among Bhutan CCA programmes hinders the adaptation capacity. This is further complicated by the lack of adequate experts and labourers in operating Bhutan's adaptive practices (Meenawat and Sovacool, 2011 #516). Moreover, within South Africa, the lack of capacity, high turnover of staff within government departments, limited understanding of and expertise in tackling climate-related issues, the positioning of climate change as an environmental issue rather than as a developmental issue, conservative financial management practices and poor communication and co-ordination between departments and between different levels of government, were all identified as barriers to addressing climate change across a range of South African studies (Ziervogel et al., 2014).

Similarly, according to Mukheibir et al. (2013), cited in Kuruppu and Willie (2015), Local Government in Australia face governance and resource limitations (that is, human, technical and financial) which includes competing priorities due to limited operational resourcing, poor communication and co-ordination between various tiers of government and poor understanding of climate risks due to challenges in understanding what information was required, where to find it, and how to effectively use it.

Based on the semi-structured interviews, it was evident that there are diverse policies, strategies and budgetary allocations for implementing disaster risk reduction and climate change adaptation in the African region. As a result, the implementation modalities are different from country to country. 37 out of 54 countries in Africa have a national platform in place for DRR. The climate change community doesn't have a very strong presence on the national platform. In general, the higher political profile of the institutions are responsible for climate change, compared to the institutions responsible for disaster reduction, which has implications for monetary allocations. Co-ordination challenges are also common in the region and dialogue between the DRR and the CCA communities is not present which results in huge duplications. One of the interviewees mentioned that, "They don't really talk to each other and

the institutions don't talk to each other, so there are obvious monetary and implementation duplications across these two sets of activities at a national level.” Another key challenge is the sectoral implementation of development activities. As DRR and CCA run across different sectors, emphasis on these is somewhat low within the sectoral implementation. For example, Ethiopia has two sets of policies and strategies; one is a national policy and strategy on disaster risk management, which has an investment framework attached to it, and then there is a climate resilient and green economy policy, which is on the climate change side of things. The two sets of policies are implemented by two sets of institutions and both have sectoral implementation activities. Figure 2 summarises the key findings of the African region.

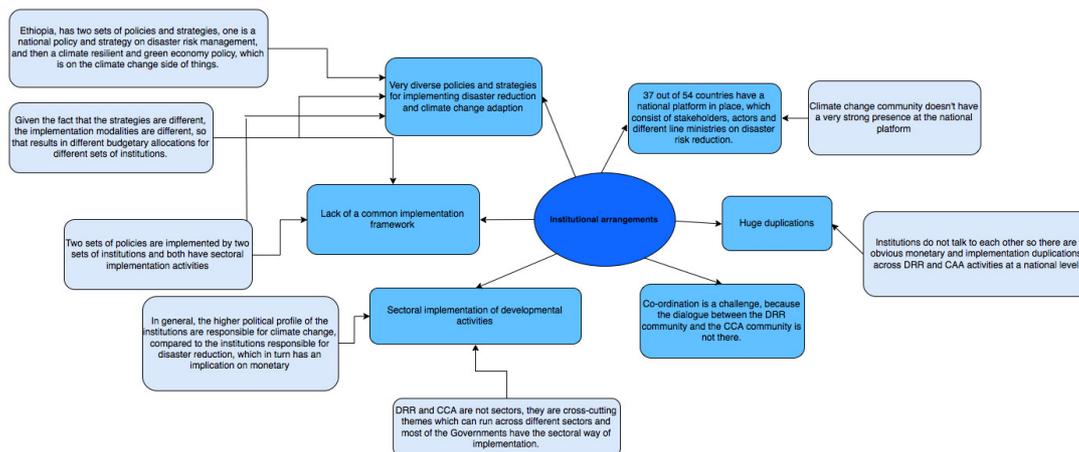


Figure 2- Institutional arrangements towards CCA and DRR – Africa

Similar to Africa, Australia also has divergent government structures for managing DRR and CCA. Local governments have a fair amount of responsibility where environmental management is at the local government level and areas such as natural resources management is at the state government level. When it comes to DRR, the primary responsibility is with the state government with some responsibilities devolved down to the local government level. As such, some conflict is present between the three layers of government and also some areas of responsibility are not very clearly defined. One of the interviewees mentioned that, “We don’t have a unified policy for climate change and disaster risk. I mean, they are two completely different things and that’s how it’s treated here.” Figure 3 summarises the key findings of the Australian region.

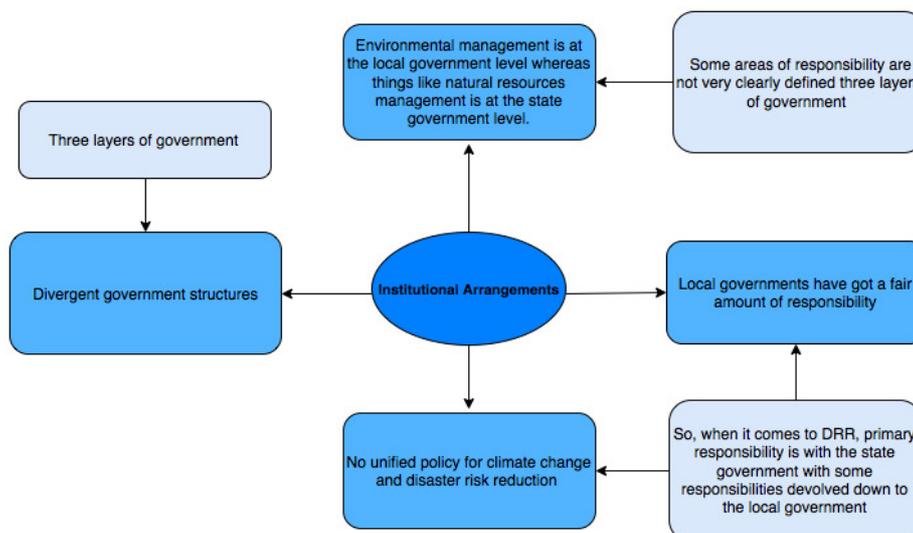


Figure 3- Institutional arrangements towards CCA and DRR – Australia

In Canada, the municipal level is actually responsible for implementing CCA and DRR with the assistance of provincial and the federal levels. However, municipalities are not placing climate change at the top of their list of priorities as they have so many other things to deal with more immediately. Therefore, it is more of a peripheral agenda as opposed to something that is integrated across all planning policies. There are also officials at the provincial and federal levels who have titles related to climate change adaptation or environmental protection and so forth. However, one of the interviewees stated that, “They’re ready to help municipalities deal with their problem.” Figure 4 summarises the key findings of the Canadian region.

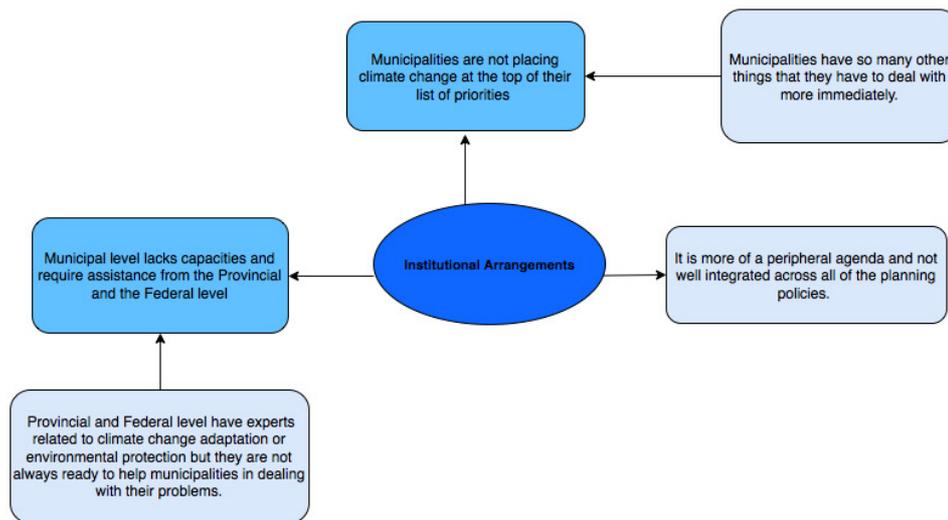


Figure 4- Institutional arrangements towards CCA and DRR – Canada

In the USA, CCA was managed by executive orders and not legislative acts, which can be easily made and are now being easily undone by the current administration. Therefore, at the moment, there is a very volatile kind of policy structure to deal with long-term problems like climate change. As such, CCA and DRR are not well integrated within the state, local and federal level activities. Even within the federal level, disaster risk reduction and climate change responsibilities may lie within different agencies. For example, departments such as The United States Environmental Protection Agency, Department of Homeland Security, The Department of Defence, Department of Energy and so on have some responsibility so it is very fragmented and lacks a unified approach to either of the issues. Figure 5 summarises the key findings of the American region.

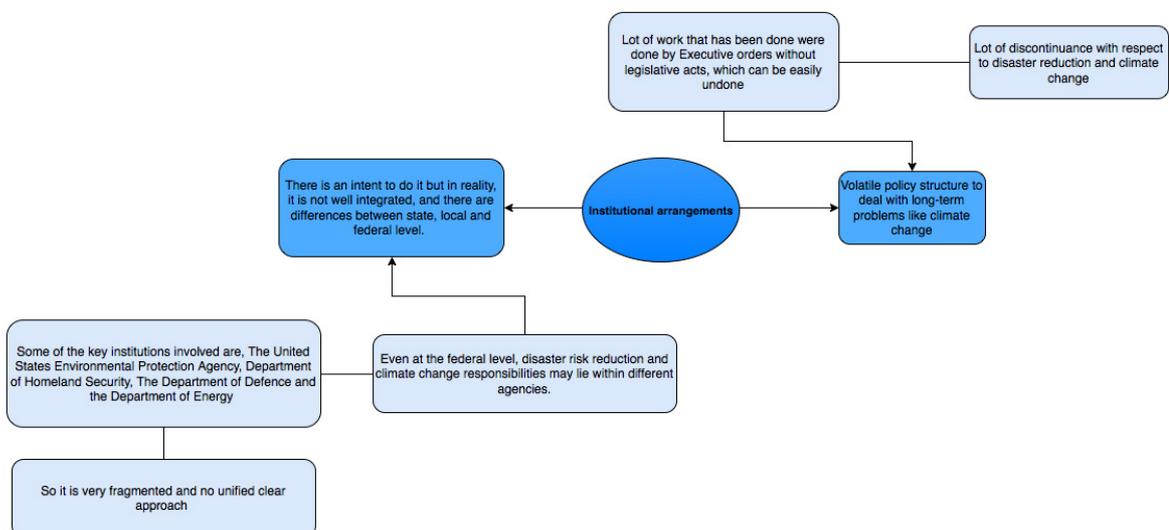


Figure 5- Institutional arrangements towards CCA and DRR – USA

In most of the Asian countries, CCA and DRR are separate portfolios operated by different ministries and they are not keen to change their agendas to integrate CCA and DRR. Basically, agencies on CCA and DRR want to work in their space, so there is less room for integration. Theoretically, they should co-operate but they are competing with each other to achieve certain goals. Perceptual difference is a reason for this separation as CCA is believed to be more advanced and strong, whereas DRR is considered as non-scientific. DRR typically sits with emergency response. Longer term DRR is not considered very much. However, post-2015, the Sendai Framework is a key tool for Asian countries to widen their thinking on CCA and DRR. Currently, the global and regional communities are trying to force countries to follow it. Figure 6 summarises the key findings of the Asian region.

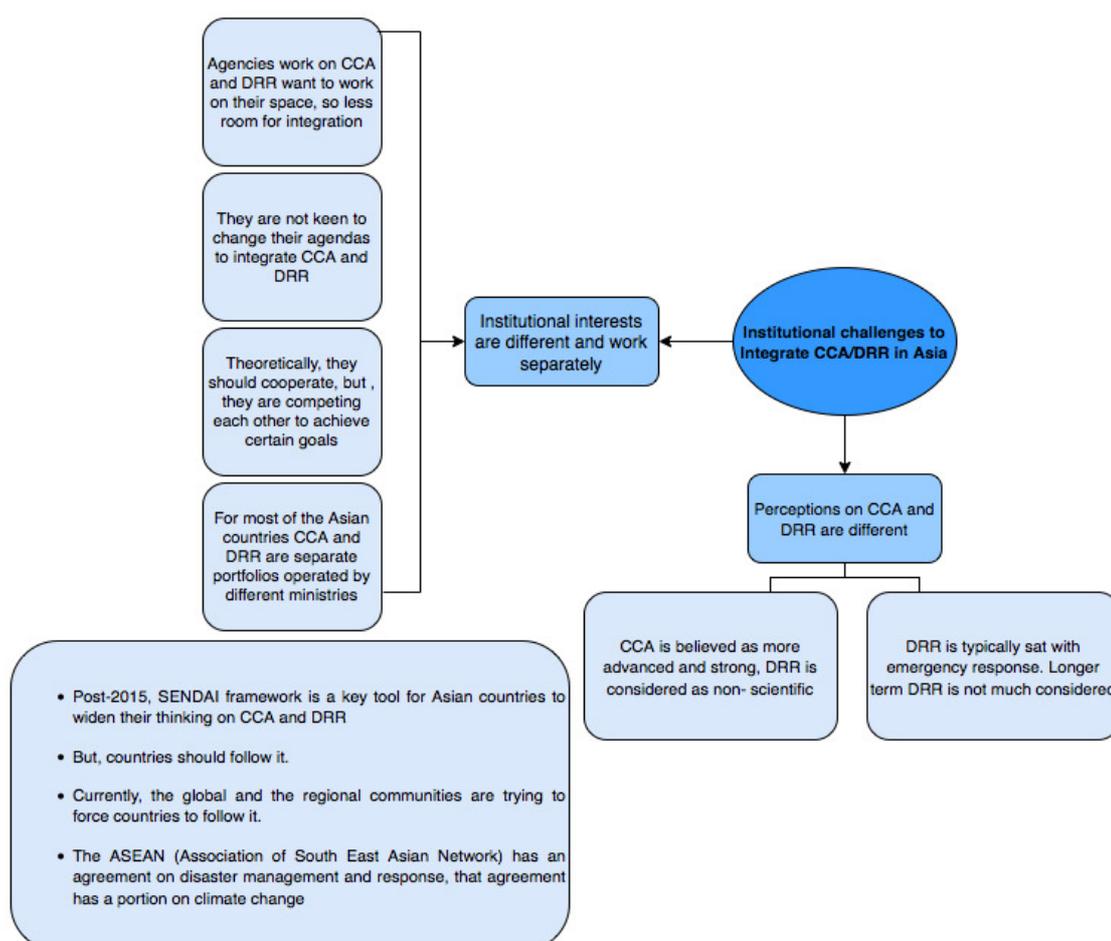


Figure 6- Institutional arrangements towards CCA and DRR – Asia

4.1.2 Funding Arrangements

This section reviews the barriers to the funding arrangements in the context of the existing legal/policy situation.

Financial matters hinder climate change adaptive measures (O'Brien, 2006 #270) and DRR efforts. As such, funding is a common barrier to the integration of CCA with DRR (UNISDR and UNDP, 2012; Biesbroek et al., 2010; Sperling and Szekely, 2005; ,EFDRR, 2013; Urwin and Jordan, 2008). However, it is important to note that, as per the Paris Agreement on Climate Change, there is an obligation for developed countries to take the responsibility of providing funding to developing countries to address climate change (SPC et al., 2016).

There are different funding systems for DRR and CCA at global, regional and national levels, leading to policy and institutional separation (UNISDR and UNDP, 2012). For example, one of the key funding sources for DRR is the Global Facility for Disaster Reduction and Recovery (GFDRR) which provides

technical and financial assistance to high risk, low income countries. GFDRR traditionally had a DRM focus and increasingly, incorporates climate change aspects (UNISDR and UNDP, 2012). The Global Environment Facility and Pilot Program for Climate Resilience (PPCR) is one of the funding sources for climate change within the Pacific region (UNISDR and UNDP, 2012). In addition, donor funding usually encourages isolation of specific hazards or issues and therefore, it is one of the obstacles faced by Pacific Island Countries and Territories in integrating CCA and DRR (Coppola, 2015). Separation of funding schemes in the region acts as a barrier to integrating CCA with DRR. As such, the creation of co-ordinated actions between CCA and DRR would avoid the duplication of effort and ensure better use of human and financial resources (Rivera, 2014). Agreeing with this, Calliari and Mysiak (2013) highlighted the importance of combining all of the funding instruments by enhancing coherence within the post-2015 development agenda. The Framework for Resilient Development in the Pacific (2017-2030) advocates the adoption of integrated approaches in managing climate change and disaster risks, to ensure more efficient use of resources, to rationalise multiple sources of funding which address similar needs and for more effective mainstreaming of risks into development planning and budgets (SPC et al., 2016). This is a welcome initiative within the Pacific region to integrate DRR and CCA.

On the other hand, some regions, like Africa, are extremely deficient in funding. For example, in South Africa, small municipalities have no capacity to act on climate change while larger metros seek external assistance (Ziervogel et al., 2014). Furthermore, international adaptation funding modalities did little to address root causes of vulnerability in African and Caribbean Small Island Developing States (Kuruppu and Willie, 2015). These funds were geared at supporting sectoral level adaptation for vulnerable, natural resource sectors such as water, biodiversity and coastal zones. Similarly, according to Mukheibir et al. (2013), cited in Kuruppu and Willie (2015), Local Government in Australia face financial resource limitations which includes competing priorities due to limited operational resourcing.

In Jordan, the funding gap is one of the key barriers for greater integration (UNDP and IUCN, 2012). At the same time, as explained before, the institutional approach is fragmented as the primary responsibility for Climate Change Adaptation lies with the Ministry of Environment while Disaster Risk Reduction lies primarily with Civil Defense (UNDP and IUCN, 2012). These two governmental institutions manage parallel structures of co-ordination, different national budgets, different strategies and different sources of external funding which limit the institutional co-ordination (UNDP and IUCN, 2012).

Even within disaster risk reduction, as UNISDR and UNDP (2012) points out, funding is not equally allocated between relief, reconstruction and prevention. For example, for every \$100 spent on disasters and risks, \$96 is spent on emergency relief and reconstruction. This highlights the poor financial arrangement for disaster reduction as a preventive measure. As such, many DRR programmes are funded by humanitarian budgets, whereas CCA programmes are funded by environmental departments (Mitchell et al., 2010). Funding for DRR is ad-hoc and insufficient because humanitarian assistance fails to provide less allocation for DRR whereas funding for CCA is sizeable and increasing (Mitchell and van Aalst, 2008). For example, in Nicaragua, CCA is more attractive for obtaining technical and financial support from international aid agencies (Rivera, 2014) compared to DRR.

Most adaptation strategies do not have commitments towards financial resources due to lack of knowledge on the cost of adaptation (Birkmann and von Teichman, 2010). It is therefore proposed to integrate preventive measures into development plans rather than establishing different funding for prevention (Sperling and Szekely, 2005). There would be complex and expensive overlaps within financial commitments in disaster relief programmes. Funding organisations for climate change may be reluctant to integrate funding in DRR programmes, since their primary concern is on climate change rather than climate variability (Mitchell and van Aalst, 2008). Also, lack of knowledge on disaster risk transfer mechanisms, such as knowledge on financing DRR, would limit the effectiveness of adaptive measures (Kato, 2010 #520). In contrast, when funding is available, there will be issues for allocating resources among priorities. For example, in Bhutan, the issue of prioritizing resources among projects is identified as a limitation in the existing legal/policy background (Meenawat and Sovacool, 2011 #516).

Based on the findings of the semi-structured interviews, it was evident that, in the African region, it is somewhat difficult to differentiate between the funding for DRR and CCA. As a result, the same project proposals are submitted to DRR and CCA funding streams while activities remain the same. Moreover, the funding allocations are not regular for both DRR and CCA. Donor funding has a major role apart from the national budgets for DRR and CCA, where policies and strategies for implementation result in different budgetary allocations. Figure 7 summarises the key findings of the African region.

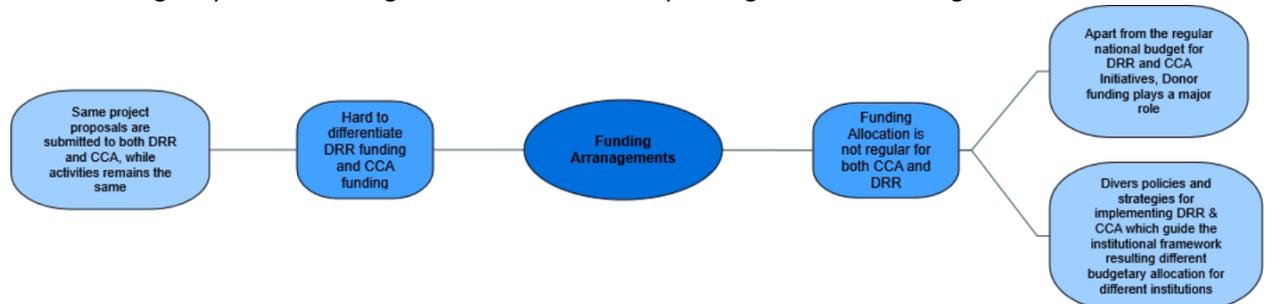


Figure 7- Funding arrangements for CCA and DRR – Africa

In the USA, funding is fragmented for both DRR and CCA. There are multiple funding streams for local governments and individuals. However, funding is limited, especially for DRR. However, there is funding for DRR which can be used only if a disaster happens. Funding for CCA is largely dependent on political will and whether the authoritative body is from a state which believes in climate change; then the funding will be available. Also, coastal states believe CCA is needed compared to central states and as a result, comparatively more funding is available for coastal states. Figure 8 summarises the key findings of the American region.

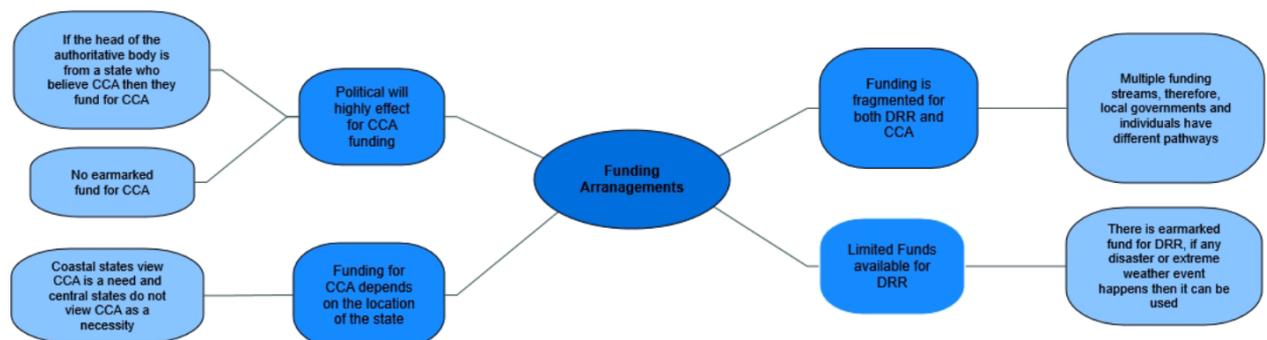


Figure 8- Funding arrangements for CCA and DRR – USA

In Australia, one of the major issues is that there is no unified approach for CCA at a federal level and therefore, the availability of funding is highly dependent on the political party in power at the state government level. However, in relation to DRR, the pool of funding is available for DRR activities and the state government can apply for this funding and issue it to local governments for implementation. Figure 9 summarises the key findings of the Australian region.

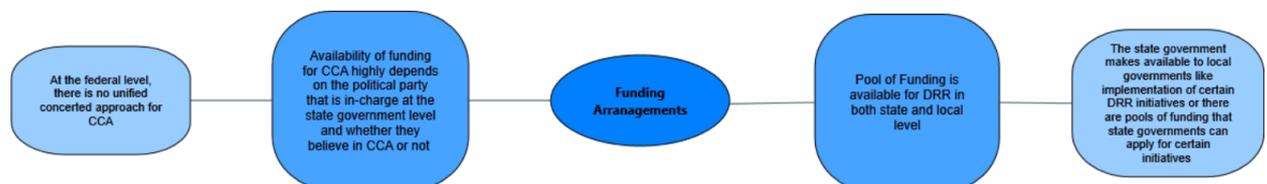


Figure 9- Funding arrangements for CCA and DRR – Australia

In contrast, funding for DRR is not a priority in Canada’s municipal levels. As such, funding for DRR is mostly available for post-disaster activities when there has been a disaster. On the other hand, there is no funding for CCA as it is not recognised or prioritised. Most of the communities and council members do not believe in climate change as a concept or a phenomenon. Figure 10 summarises the key findings of the Canadian region.

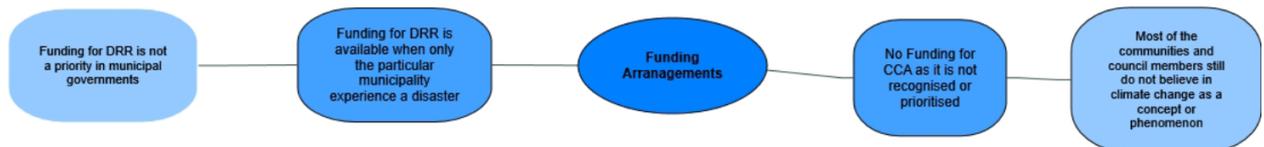


Figure 10- Funding arrangements for CCA and DRR – Canada

There are diverse funding allocations in Asia. The donor perspective is based more on science and evidence based approaches than applied approaches. As a result, CCA gets more funding, as CCA is science based and evidence based. This scenario is common among the global funding bodies which support Asia. DRR has less funding as it is mainly seen from the humanitarian angle, but, not from the development angle. One of the major issues in Asia is that some major international funds are not suitable for the real needs at ground level. Therefore, in order to access funding, authorities need to follow guidelines which are not the exact requirement. Figure 11 summarises the key findings of the Asian region.

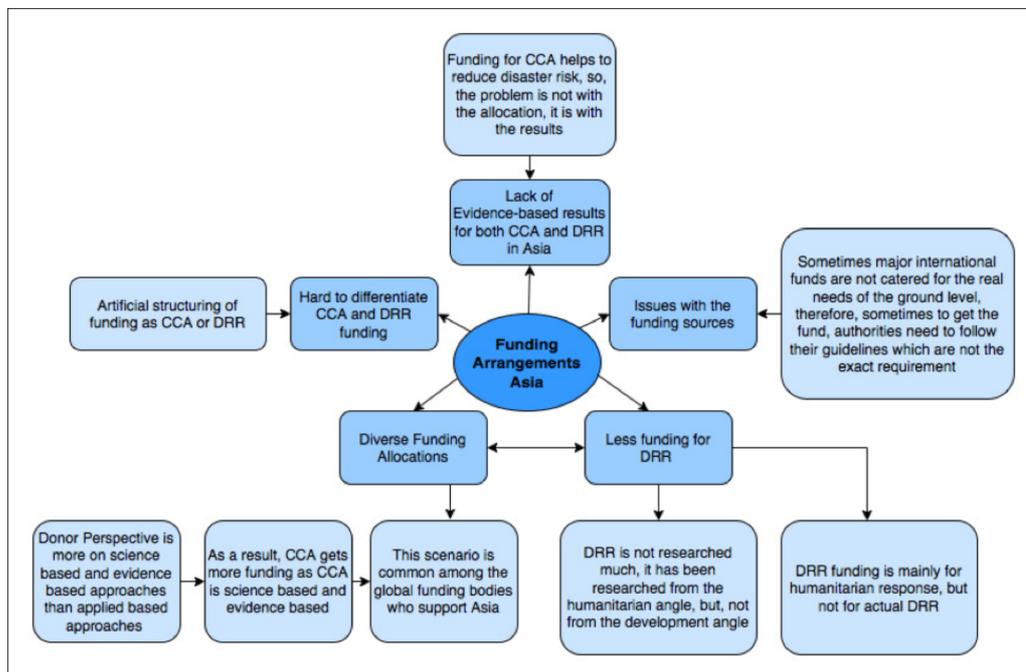


Figure 11- Funding arrangements for CCA and DRR – Asia

4.1.3 Political Will and Motivation

This section critically reviews the political will and motivation in integrating CCA and DRR within the global context. There is widespread recognition of the importance of integrating DRR and CCA within the academic community and practitioners (Rivera, 2014). Political will and motivation are of paramount importance in integrating CCA and DRR at the national level. A key challenge to integrating DRR and CCA is low political will in favour of integration (Gero et al., 2011; UNISDR, 2010b; UNISDR and UNDP, 2012). Dupuis (2011) highlights that, irrespective of developed or developing countries, low political interest to integrate will remain a key challenge. There is weak political recognition for DRR when compared to CCA (Mitchell and van Aalst, 2008; Venton and Trobe, 2008). In order to create an enabling environment to integrate CCA and DRR, political commitment should be increased by high-level political authorities (UNISDR, 2010b).

Political motivations diverge between countries in varying degrees. According to a study conducted by Rivera (2014) in relation to Nicaragua, many aspects of CCA are integrated into the DRR frameworks at national and regional levels in Central America. This was achieved through the approval of the 'Policy on Comprehensive Disaster Risk Management in Central America' in 2010, with a specific focus on CCA; through the 'National Policy of Disaster Risk Reduction' to be approved by the National Assembly with

a chapter on CCA and by way of modifying DRR plans at local level with CCA aspects (Rivera, 2014). This shows the political will and motivation within Central America towards integrating CCA and DRR.

However, according to Coppola (2015), one of the obstacles for integrating CCA and DRR in Pacific Island Countries and Territories is the lack of clear indicators and accountability measures to ensure the implementation of CCA and DRR measures. This is aggravated by the weak partnerships between institutions responsible for CCA and DRR (Coppola, 2015). Moreover, climate change adaptation and disaster risk reduction initiatives in Pacific Island Countries are frequently undermined by a lack of political will, insufficient funds or the absence of expertise and guidance (Hay, 2009). However, in the Pacific, there is more political will for climate change adaptation compared to DRR (UNISDR and UNDP, 2012). As such, it is evident that there is limited political will among those in the disaster management and environmental communities to integrate CCA and DRR mandates (Coppola, 2015).

Even within the field of disasters, political will varies depending on the requirements. In dealing with disasters, political will or support is a major determinant. Lack of political support hinders the disaster risk reduction efforts (Nabi and Khan, 2014 #518). Political culture and governance norms impact effective DRR in Jordan (Al-Nammari and Alzaghhal, 2015 #246). For example, political interest in natural hazards is at its highest during, and shortly after, a disaster. Although a commitment to “build back better” can help salvage some of the lost opportunities, funding for prevention measures and preparedness is hard to come by when there has not been a devastating natural disaster (UNDP and IUCN, 2012). In South Africa, the silo approach of government departments does not support an integrated approach to addressing climate change adaptation (Ziervogel et al., 2014). Although policy is changing, authors have identified the importance of altering the political and bureaucratic infrastructure to support more integrated, cross-sectoral responses. In African and Caribbean Small Island Developing States, the lack of focus of Local Government or Island Councils and communities on the adaptive capacity needs was a key barrier to ensuring the success of adaptation interventions (Kuruppu and Willie, 2015). The capacity of government officials further limits the engagement in climate diplomacy at the international level.

Similarly, according to Mukheibir et al. (2013), Local Government in Australia faces governance and resource limitations (that is, human, technical and financial) which includes competing priorities due to limited operational resourcing, poor communication and co-ordination between various tiers of government and poor understanding of climate risks due to challenges in understanding what information was required, where to find it, and how to effectively use it.

Based on the results of the semi-structured interviews, it was evident that political will towards CCA and DRR is limited in the African region. Although it is present in very few countries, political will towards integrating CCA and DRR is limited. One reason for this is lack of understanding of the importance of CCA, DRR and their integration. For example, one of the interviewees stated, “The right level of understanding is not yet there in the political class or the decision makers.” Political leaders often consider DRR as equivalent to emergency response and as a result, less emphasis is given to DRR activities. Figure 12 summarises the key findings of the African region.

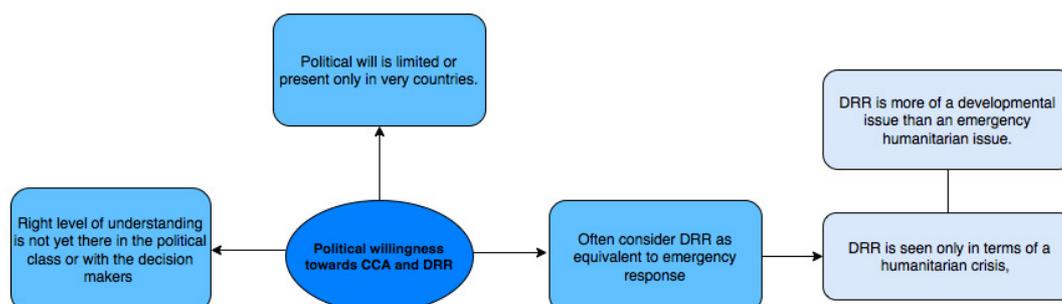


Figure 12- Political willingness towards CCA and DRR - Africa

Similar to the African region, emphasis on climate change is somewhat less in Australia. Some of the political leaders assume that climate change is not an immediate disaster and the political will is dependent on the party in power. One of the interviewees mentioned, “Lots of climate change deniers are in power.” As such, the political willingness, especially towards CCA, depends on which party is in power. Figure 13 summarises the key findings of the Australian region.

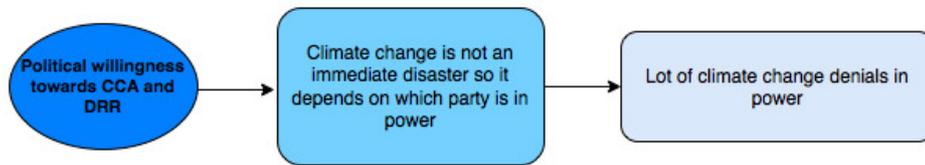


Figure 13- Political willingness towards CCA and DRR - Australia

In contrast, according to interviewees, political willingness towards CCA and DRR in Canada depends on the cost of the actions. All actions are dependent on councils, community and the private sector buy-in. Figure 14 summarises the key findings of the Canadian region.

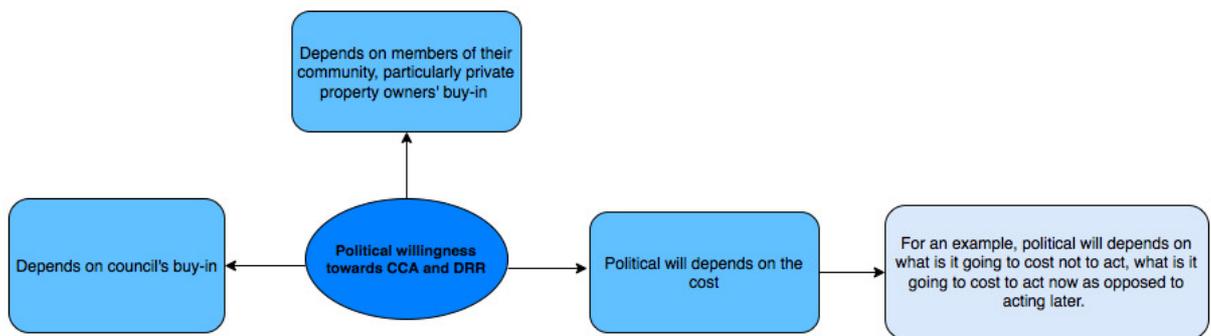


Figure 14- Political willingness towards CCA and DRR - Canada

In the USA, the concept of DRR is more acceptable at a political level compared to CCA. As such, the political will for humanitarian aid and for mitigation aid against disasters is a little more positive than it is for climate change, unless the risk and the disaster are in some way associated with an extraction industry: coal or oil. Political will to deal with things like fracking is much less than it is for dealing with things like wildfires which are less tied to a strong economic sector. As most of the issues related to climate change and risk reduction are long-term issues, unless politicians see a short-term gain from it, they are not willing to invest. With the current political climate, at the federal level, interviewees believed that there is no strong push for looking at climate change. Figure 15 summarises the key findings of the American region.

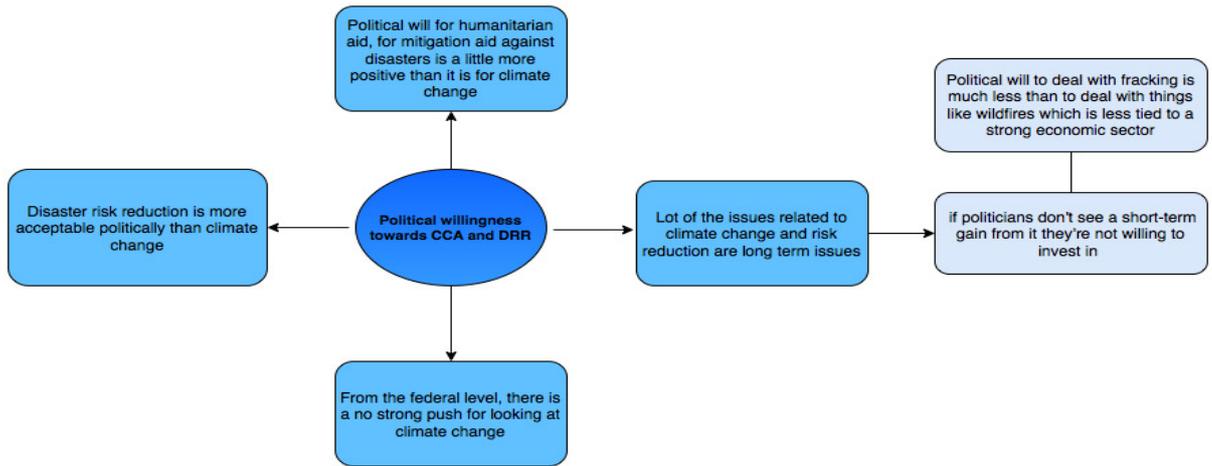


Figure 15- Political willingness towards CCA and DRR – USA

In Asia, since many Asian countries are still developing, politicians are more keen on socio-economic development than DRR or CCA; the strategy is aimed more towards disaster response than disaster management. In many cases, communities in Asia expect socio-economic development rather than CCA or DRR. Within this context, there is a lack of political will for integration which is an institutional issue in Asia. In many countries, since CCA and DRR are under different institutions, there is a lack of political will, as politicians tend to consider matters only within their own ministry. However, political bodies in some Asian countries have shown some interest to integrate CCA and DRR. The Philippines have shown the highest level of political confidence by bringing two legislative orders for both the domains to come together. In Sri Lanka, the Department of Meteorology and the Disaster Management Centre are under one ministry.

It was revealed that at the state level, CCA has much more attention than DRR. CCA has more political attention than DRR in Asia as a result of two key global agreements. Since the Paris Agreement is a global agenda, agreed by the head of states, it has become legally binding, whereas the Sendai Framework is mainly within Disaster Management ministries and not necessarily legally binding. Therefore, CCA has received state level attention whereas DRR has only ministry level attention. However, for local political bodies in Asia, DRR is much more important than CCA as local political bodies are in direct contact with the people. Therefore, they are more interested in DRR as they need to respond to the queries of the public. CCA is generally future oriented, therefore, local politicians cannot gain political points from CCA. Figure 16 summarises the key findings of the Asian region.

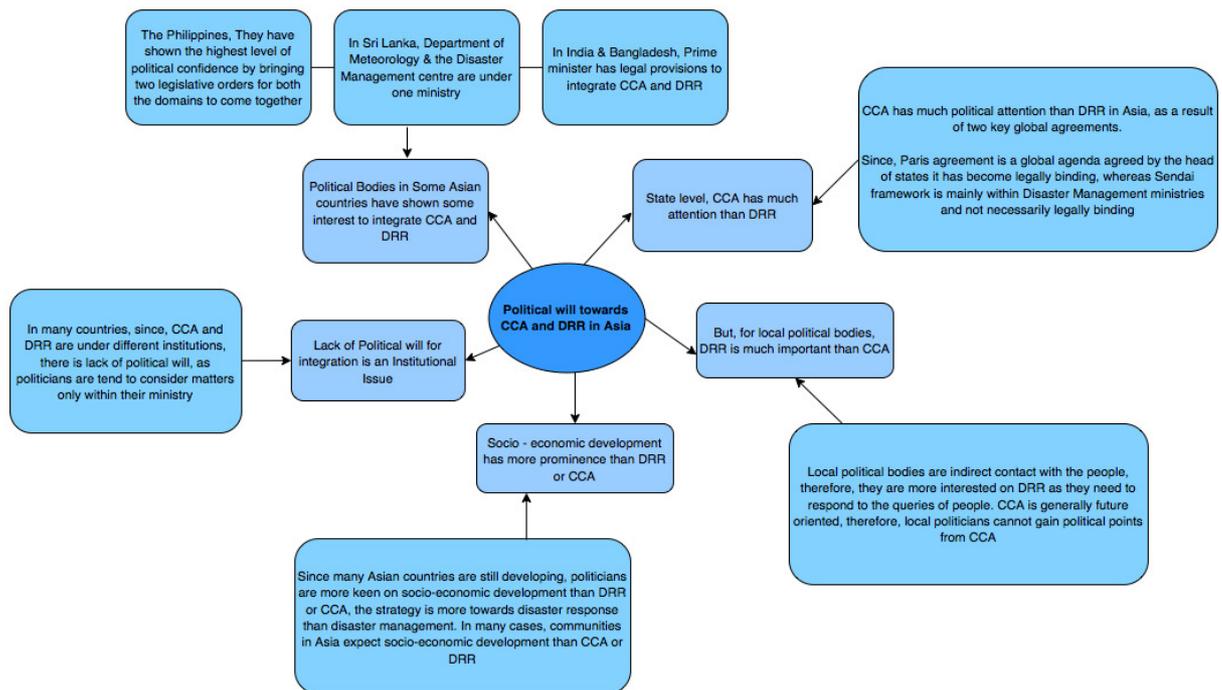


Figure 16- Political willingness towards CCA and DRR – Asia

4.1.4 Stakeholder Complexity

This section reviews the challenges/gaps under stakeholder complexity in the context of implementing existing legal/policy and science approaches across the globe.

An effective integration of CCA with DRR requires the participation of a wide range of stakeholders: policy makers, private firms, scientists, NGOs and educators (IPCC, 2012; UNISDR, 2009a). Multi-stakeholders and multi-sectoral processes are vital in building common understanding, commitment and consensus (UNISDR, 2009b). However, co-ordination of these different stakeholders with different interests is one of the challenges to integration due to the inability of arriving at consensus on specific adaptation measures (Lei and Wang, 2014). Furthermore, weak co-ordination between stakeholders, lack of know-how and poor communication between stakeholders, especially between government and local communities, were some of the key challenges faced by Jordan (UNDP and IUCN, 2012). Similar challenges were observed by Coppola (2015) in Pacific Island Countries and Territories and the key obstacles were poor communication between stakeholders and different levels of government, weak partnerships between institutions responsible for supporting DRR and CCA and power struggles between stakeholders responsible for DRR and CCA. On the other hand, Sovacool (2011 #517) observed that experts and the community may not come to an agreement with hard and soft climate change adaptation measures in the Maldives. This leads to a divergence among policy makers and planners in CCA towards two different paths due to the complexity of stakeholders (Sovacool, 2011 #517).

Moreover, decision makers are interested in scientific information on climate change to support decisions regarding adaptation (Mastrandrea et al., 2010). Most top-down approaches are used in climate impact assessment, whereas bottom-up approaches are applicable in acquiring knowledge of vulnerabilities at the decision-making level. Accordingly, developing an integrated approach to inform decision-making has become a difficult task (Mastrandrea et al., 2010; Thomalla et al., 2006). Furthermore, effective integration of CCA into practice requires inter-sectoral and participative work which includes stakeholders and practitioners at national and local levels and related monitoring and learning mechanisms (Rivera, 2014).

In Africa, key stakeholders at the inter-governmental level are the African Union and the Regional Economic Communities. The key role of these organisations is to ensure inter-governmental co-ordination and political co-ordination across the continent and across the regions of Africa. The member states play a very important role and they share the key stakeholders in terms of implementation of CCA and DRR. However, given the lack of resources across the continent, the development partners, in particular the donors, United Nations, the NGOs and the community based organisations, play a very important role in the implementation of roles and responsibilities on CCA and DRR. The role of the developing partners is mainly twofold: resource allocation and working with the member states and key actors on the inter-governmental side for implementation.

However, as the national policies and strategies are different, the institutional structures of the Government on DRR and climate change vary across the region. The stakeholders have to talk to two sets of institutions for CCA and DRR, which complicates matters because then it doesn't really address the issue of the overlaps and gaps between the two sets of actions. So, the different sets of stakeholders, even sometimes a common set of stakeholders, have to talk to two different institutional structures in the Government for their respective domains of CCA and DRR. Figure 17 summarises the key findings of the African region.

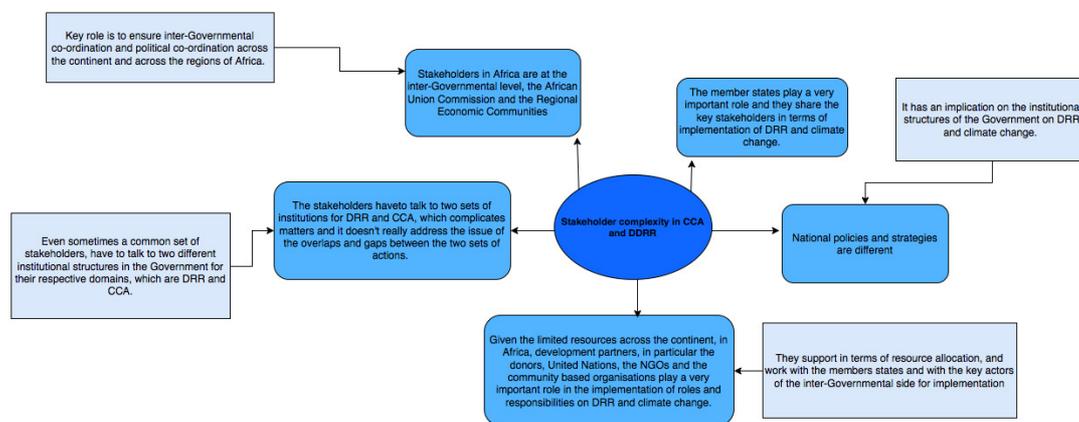


Figure 17- Stakeholder complexity in CCA and DRR – Africa

In the USA, the key stakeholders are the various government levels, the private sector and the scientific community. For example, in the oil industry, the carbon industries represent major stakeholders. There are also lots of non-profit organisations such as the Rockefeller Foundation and many environmental non-profit groups working on CCA and DRR. Political parties are also major stakeholders when it comes to CCA and DRR. For particular projects, legal frameworks and policies require bringing together all the stakeholders. For example, if a new coal burning power plant needs to be built, regulations now require a great deal of input from different groups. It requires filing an environmental impact statement, ergonomic impact statements and consideration of the public health aspects. All those things are required so in that sense, it will literally bring all groups together around specific projects, whether it is a dam or a pipeline or a nuclear power plant. Figure 18 summarises the key findings of the American region.

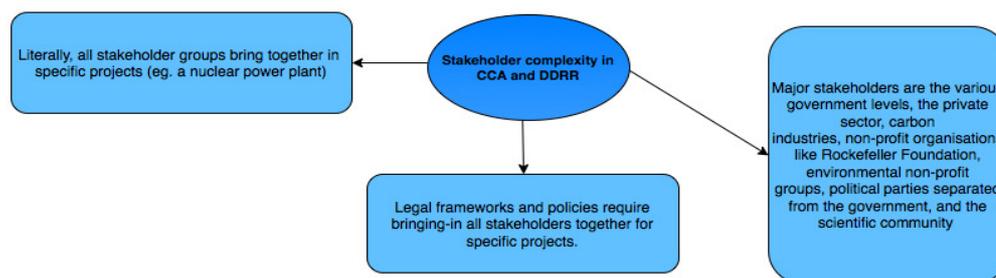


Figure 18- Stakeholder complexity in CCA and DRR – USA

It was evident that, in Australia, stakeholder engagement is minimal in terms of CCA. The main reason is that the political will to engage with the community is not there. However, in terms of DRR, there is a significant emphasis on stakeholder engagement and there is a great deal of community engagement. A lot of information is also being provided. Moreover, there is much engagement during disasters, and also post-disasters, with the community and other stakeholders. Figure 19 summarises the key findings of the Australian region.

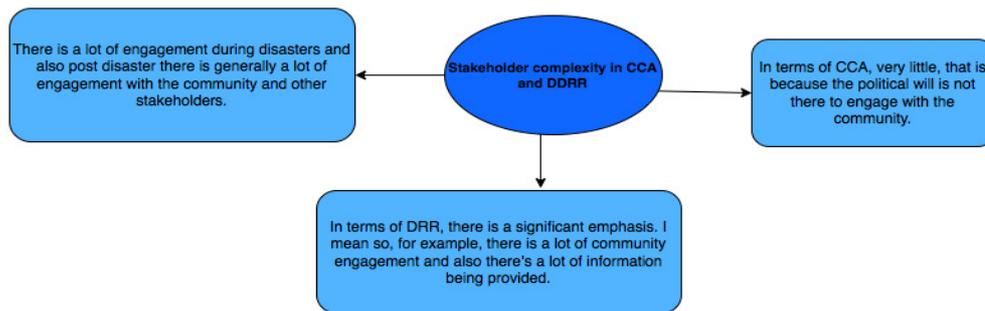


Figure 19- Stakeholder complexity in CCA and DRR – Australia

The role of stakeholders is not clearly defined in Canada compared to other countries in Europe. As such, it is important to identify who the stakeholders are and what their role actually should be. Even at the municipal level, the municipal staff, the civic body itself, even internally, do not know which staff should be working on the problems of climate change and risk reduction. Figure 20 summarises the key findings of the Canadian region.



Figure 20- Stakeholder complexity in CCA and DRR – Canada

In Asia, stakeholder management is complex at the state or sub-state level. In some Asian countries, stakeholder responsibilities are not clearly defined and there is no guidance or policy framework for stakeholder management. However, there are positive regional stakeholder engagement programmes in Asia, for example, the Asian Disaster Preparedness Centre organizes the Regional Consultative Committee on Disaster Management, which is a platform for stakeholder engagement in Asia.

Post-2015, the global agenda has provided a platform for CCA and DRR stakeholders. Before the Sendai Framework, there was a great separation between CCA and DRR stakeholders. For example, CCA stakeholders did not even want to attend DRR conferences. However, now things are changing for the better in Asia as a whole. In addition, politicians in Asia are now keen to attend both CCA and DRR activities after implementing the Sendai Framework. Similarly, donors are participating with interest in both CCA and DRR. Figure 21 summarises the key findings of the Asian region.

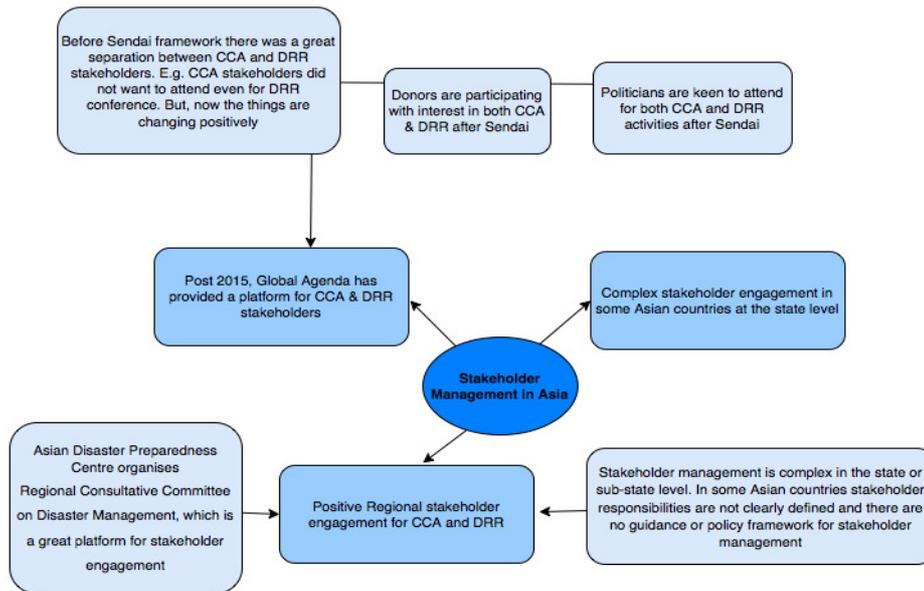


Figure 21- Stakeholder complexity in CCA and DRR – Asia

4.2 Challenges and Gaps related to Communication

This section reviews the communication and information gaps in the context of implementing existing legal/policy and science approaches across the globe.

According to IFRC (2008), climate information in the form of trends and forecasts, with tried and tested DRR measures, assist in anticipating disasters before they happen. As such, when developing appropriate strategies to respond to or reduce disaster risk and adapt to climate change, sound information is required (Birkmann and Pardoe, 2014). There are many sources of climate information. Practitioners working in the field of climate change, including academics and scientists, provide valuable information to enhance understanding of climate variability and change (IFRC, 2008). Furthermore, community knowledge is indeed important for better understanding of climate change and disaster risks (IFRC, 2008). According to IFRC (2008), this information needs to be provided in forms that are sector specific and translated into practical risk reduction measures. There are many good examples of adapting, responding and reacting to natural hazards, including climate change, throughout history. However, they have not been sufficiently explored and documented (Garcia-Acosta, 2017) which is one of the major challenges.

As such, a lack of information on the importance of adapting to climate change and lack of knowledge about available options are some of the barriers in CCA (O'Brien et al., 2006 #270; Measham et al., 2011 #515). According to Manoj and Baker (2007 #519), the 9/11 attack and Hurricane Katrina have shown good examples of communication which prevails during the disaster reduction efforts. He explains three types of communication challenges: technological challenges, sociological challenges and organizational challenges. He further emphasizes the importance of these three types of communication in creating an effective disaster communication system. Technological challenges are a result of scientific contribution or background. For example, in a post-disaster situation, maintenance of proper communication, as well as development of a new communication system, is very difficult. In terms of sociological concerns, the trustworthiness of information, ethical considerations and security are the challenges. Organizational challenges arise when dealing with the number of groups that belong to hierarchical decision-making which prevent or hinder decision-making in an ad-hoc, dynamic and flatter environment. The organizational challenge of communication can be considered as a result of the legal/policy basis.

Furthermore, according to the Adaptation Knowledge Platform (2010), the challenge lies in how information can be interpreted for decision-makers which is essential for long-term planning and to boost understanding of CCA. As such, it is important to improve communication strategies to interpret data and information for decision-makers to conduct long-term planning and knowledge-based solutions (Adaptation Knowledge Platform, 2010).

In Africa, gaps exist in communication between academia and practitioners as well as between practitioners and the general public. Most practitioners follow global, practice-based documents rather than academic publications. As a result, most of the works of the academic community do not fully reach the practitioners. On the other hand, there is a huge gap in transferring practitioners' knowledge to the general public. One reason for this is a lack of awareness by the general public on the work that CCA and DRR practitioners are conducting. There are lots of community awareness campaigns in the region. However, these do not reach the general public and there is a need to improve this. Figure 22 summarises the key findings of the African region.

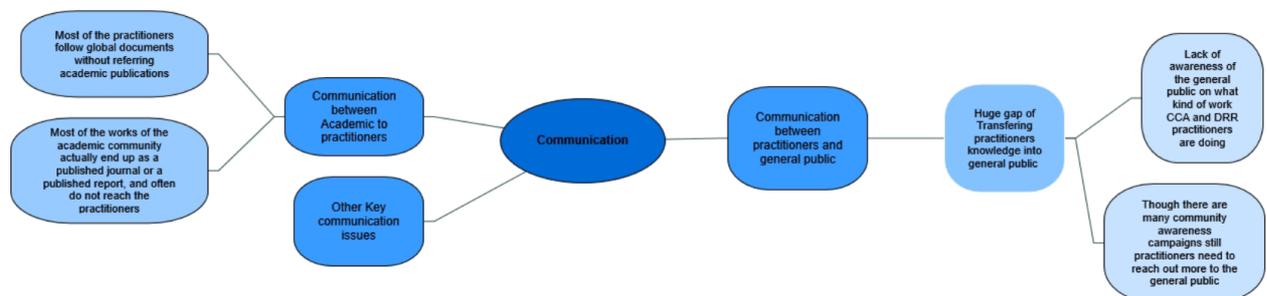


Figure 22- Challenges and gaps related to communication– Africa

In the USA, the communication between academia and practitioners differs depending on different practitioners. For example, it depends on different government levels; at the federal level, it is much easier to communicate compared to the local level as they are not as knowledgeable. It is also easy to communicate with research groups, as they comprise academics and practitioners. Communication between practitioners and the general public is mostly supported by the World Wide Web, as most of the information is available and accessible online. Figure 23 summarises the key findings of the American region.

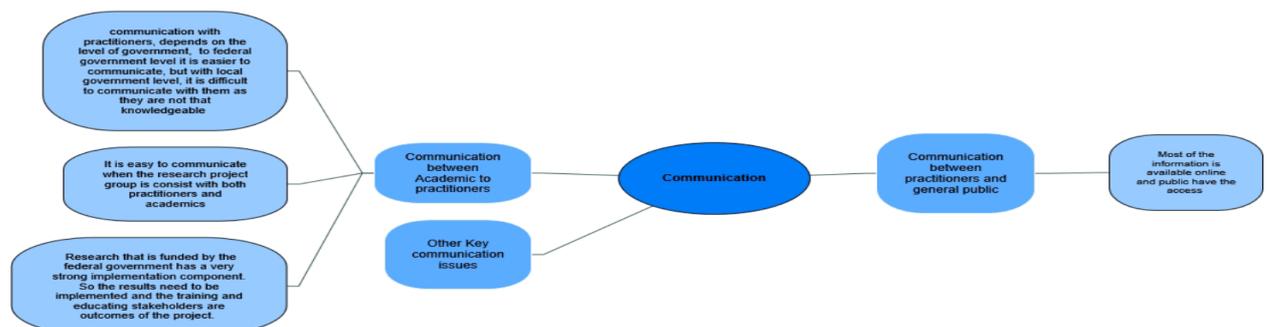


Figure 23- Challenges and gaps related to communication – USA

In Australia, there is very little communication between DRR and CCA communities and as a result, there is no established information flow between the two fields. In DRR, communication sometimes becomes challenging when people in the areas are from multi-cultural nationalities. Therefore, it is important to identify the most suitable communication channels for each stage of the disaster management cycle, for example, in the preparedness phase, social media plays a huge role. When looking at the communication between practitioners and the general public, institutions do not directly communicate with the public unless a local authority funds the project or the project outcomes need to be shared with the community. Figure 24 summarises the key findings of the Australian region.

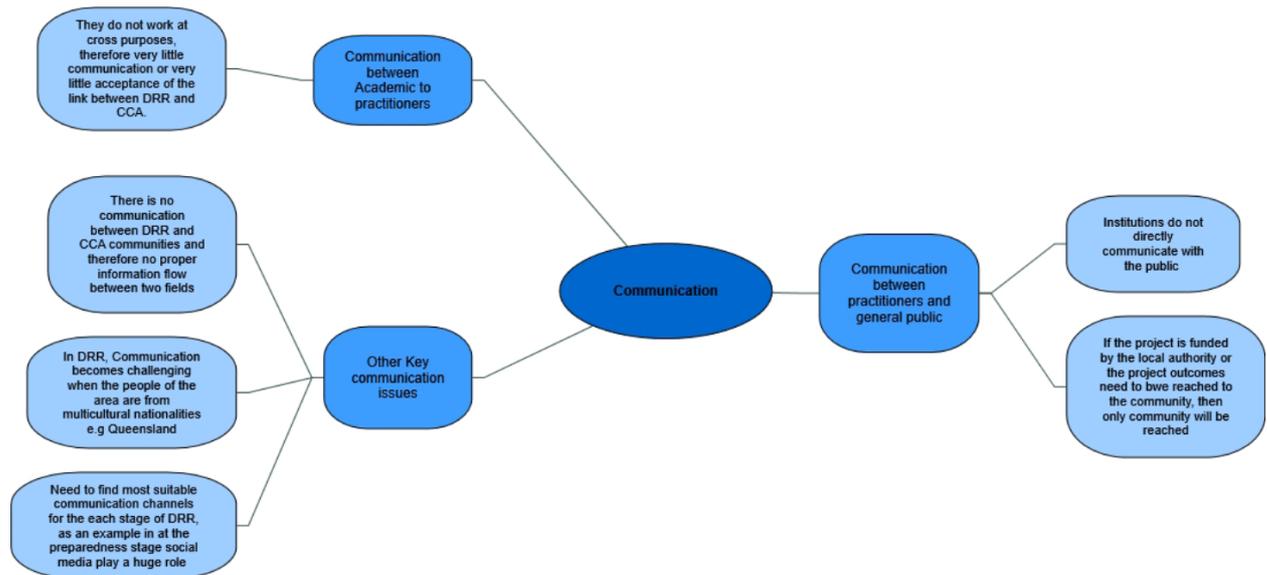


Figure 24- Challenges and gaps related to communication – Australia

In contrast, communication between academics and practitioners is easy in Canada as both parties are trained and the level of understanding is high. However, communication between practitioners and the general public is challenging, as the level of understanding is not the same. There are consultant firms which handle the communication between councils and the community. Most of the time, the problem is not with the quality of communication but whether the community wants to accept the issues that practitioners want to communicate. Figure 25 summarises the key findings of the Canadian region.

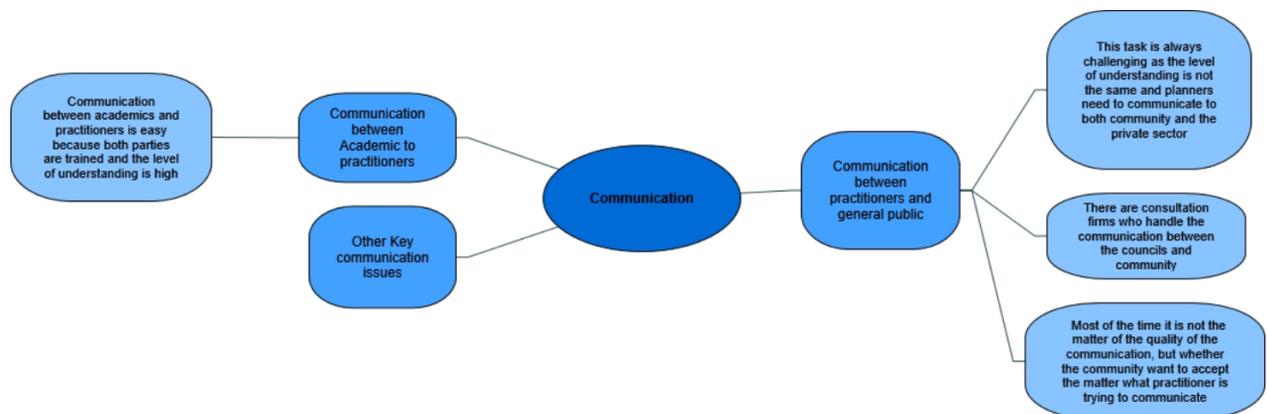


Figure 25- Challenges and gaps related to communication – Canada

In Asia, one of the key issues, with regard to communication between the academic community and practitioners, is that academic research is not continuous and stops at the pilot stage. Further, new tools and techniques from academic research are not generally transferred to practice. In most cases, new tools and techniques for CCA and DRR are tried and evaluated only for academic research. They are not transferred to practitioners. When practitioners need to address issues related to CCA and DRR, they have to use the same old tools and techniques.

Furthermore, in some Asian countries, people are not aware of common terminology related to CCA and DRR, for example, in Thailand, there is no specific word for DRR. So, communicating this concept to the general public has become difficult. Further, it was highlighted that complex scientific information related to CCA and DRR should be transferred to common practice. However, there are issues with the information flow to the general public in Asia. Basically, there are some mechanisms to communicate with the general public at the state level but, when it comes to the local or community level, the information is not transferred properly due to various reasons such as language issues. In

addition, there are issues with the mode of communication. Generally, there are no specific guidelines to address the special needs of communities such as communicating information to blind and deaf people and information sharing with people who are illiterate. One of the major issues is that additional information is not shared with the general public. In most of the Asian countries, people are given only general information but not specific, or additional, information, for example, in flood prone areas, people are informed that there is a flood risk and information, such as an evacuation strategy, is not provided. So, people are not that interested in the general information provided.

In addition to that, there are major issues with the information management related to CCA and DRR. Many relevant government bodies in several countries of Asia do not keep a good record of data, therefore, they cannot issue information when needed. Countries have legal provisions for the right to information, such as India, but not to collect information. Therefore, obtaining information from the government bodies is extremely difficult. Figure 26 summarises the key findings of the Asian region.

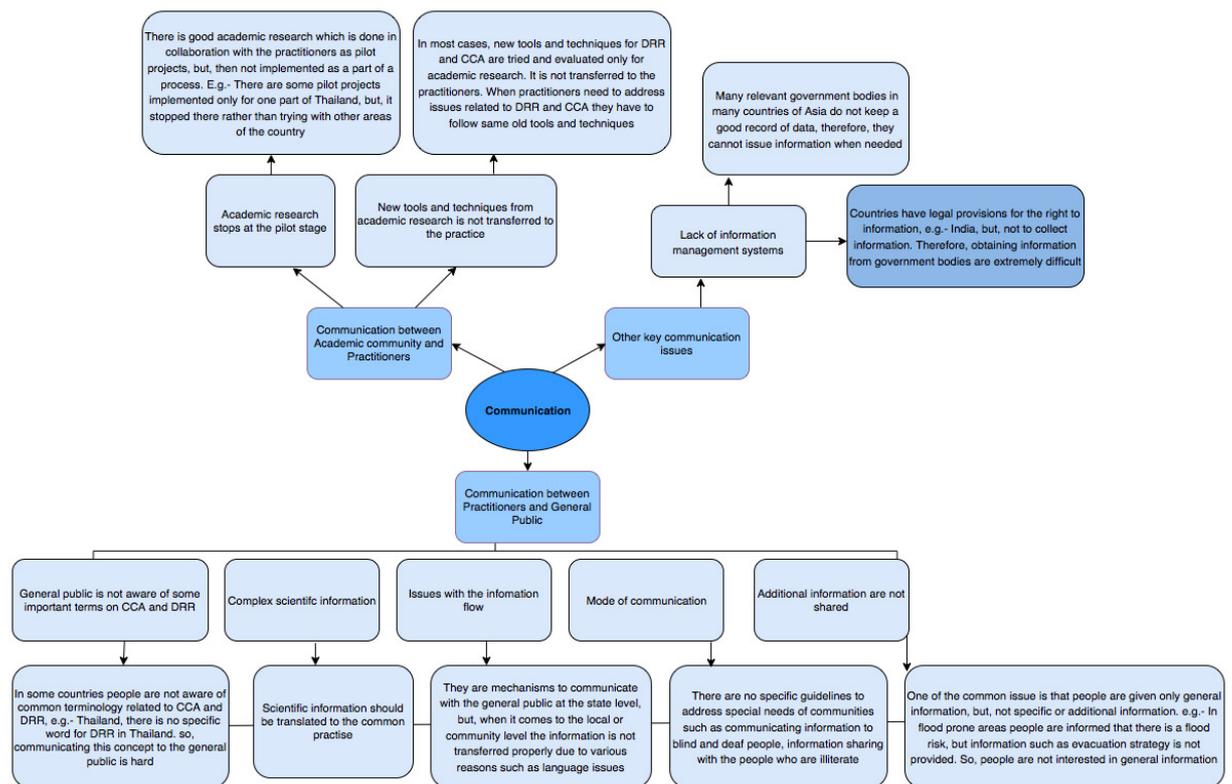


Figure 26- Challenges and gaps related to communication – Asia

4.3 Challenges and Gaps related to Scientific Innovations

This section critically reviews the challenges/gaps associated with scientific innovations in the context of the existing legal/policy situation.

One of the key gaps for the integration of CCA and DRR is the unrecognised link between community initiatives and scientific knowledge. Traditional/indigenous knowledge at the community level is the basis for DRR, whereas traditional/indigenous knowledge is insufficient for CCA. CCA needs scientific innovation in order to understand the future disaster risk and to make the appropriate predictions.

Communities are frequently involved in the management of a range of cultures and identities and these cultures and identities are an outcome of their past experience, local knowledge and cultural memory. According to Gaillard and Mercer (2013), this knowledge has an impact on the creation of scientific

knowledge. Accordingly, this local knowledge should be gained through participatory mapping by interacting with local and scientific stakeholders. This will enable the integration of local knowledge with scientific innovations (Gaillard and Mercer, 2013; O'Brien et al., 2008). As such, traditional knowledge gained through DRR practices should be linked to scientific knowledge, but currently, this need for integration has not been recognised by both DRR and CCA communities (Gero et al., 2011; Venton and Trobe, 2008; Xu and Grumbine, 2014).

Furthermore, the importance of integrating local knowledge with national decision-making has been well recognized and therefore, national action plans for climate change adaptation should incorporate the knowledge of scientific theory as well as knowledge gained from the communities (O'Brien et al., 2006; Xu and Grumbine, 2014). From the academic perspective, CCA is often considered as a subset of DRR, and DRR is considered as a subset of development (DasGupta and Shaw, 2017). Despite this, CCA and DRR have not been integrated at national and international levels due to political and governance reasons. At the international level, parallel platforms exist to manage DRR and CCA which are governed by parallel frameworks. To achieve a more inclusive DRR, including CCA, and integrating with development goals, requires co-production and sharing of knowledge (Cadag, 2017). The use of participatory approaches, while engaging all actors including the most marginalized communities in society, will be a powerful mechanism to recognize the different issues surrounding CCA, DRR and development (Cadag, 2017).

Another key challenge for scientific innovation is the mismatch between CCA and DRR approaches. Birkmann and von Teichman (2010) describe mismatches under three subheadings namely: spatial scale mismatches, temporal scale mismatches and functional scale mismatches. Spatial scale refers to the context where CCA and DRR measures are applied. Accordingly, it has been identified that CCA issues are primarily analysed on a global scale whereas DRR measures are applied in the respective regions and localities. Further, climate scientists have mostly designed global models and predicted global trends, striving for universal laws, whereas the DRR community focuses primarily on local vulnerabilities and risks of specific areas, hazards and groups of people potentially, or actually, affected (Birkmann and von Teichman, 2010).

In terms of temporal scale mismatches, it has been revealed that DRR measures and funding schemes are available only for the short-term aftermath of disasters instead of having long-term sustainable disaster measures and funding schemes. In contrast, CCA strategies require long-term commitment, which goes far beyond a political election period. Accordingly, CCA and DRR communities tend to work separately as the scales are mismatched in terms of the scope and funding availability in both disciplines (Birkmann and von Teichman, 2010).

Thirdly, functional scale mismatch can also be identified as a key issue for successful integration. In most countries, climate change issues have been tackled by the environment ministries and meteorological services, whereas disaster risk management often lies within the responsibility of the ministry of the interior, defence or development. Existing funding schemes, which are structured according to the objectives of the issuing institution, do not allow for the integration of measures that are inconsistent with its respective scope of responsibility; clear evidence of this incoherent search for solutions. Differences in their respective mandates, programmes and sets of measures on how to deal with climate change issues on the one hand, and DRR on the other hand, create great difficulties when developing a coherent and integrative strategy (Birkmann and von Teichman, 2010; Djalante, 2012).

Mismatched knowledge is also a key gap in integrating CCA and DRR. This is the knowledge required to take decisions under conditions of uncertainty and possible surprise (Birkmann and von Teichman, 2010; EFD, 2013). In an uncertain environment, both CCA and DRR communities should be properly aware of their knowledge bases and boundaries and how that knowledge can be used in decision-making. However, currently, both CCA and DRR communities have not identified the boundaries of their knowledge bases. As a result, the CCA and DRR communities are in real competition in generating knowledge for CCA and DRR (Rivera, 2014; EFD, 2013). This competitive knowledge gaining process between the CCA and DRR communities has hindered straightforward communication, collaboration and joint programming across larger governance networks (Birkmann and von Teichman, 2010; EFD, 2013).

2013). For example, socio-economic data on vulnerable communities derived from DRR initiatives is not communicated to CCA communities and therefore, vulnerability assessments become difficult and accordingly, proper adaptation strategies are not correctly in place (EFDRR, 2013). On the other hand, Anderson (2012) states technical experts do not accommodate local knowledge derived from DRR initiatives in their climate change adaptation strategies due to the inability of assessing such knowledge.

Furthermore, it is essential to understand both CCA and DRR alongside the Sustainable Development Goals, as many of the targets overlap (DasGupta and Shaw, 2017). As such, in reality it is exceptionally challenging to segregate issues of climate change and DRR, as communities do not feel the impact of natural hazards and climate change separately. This requires practitioners and policy makers to consider both the issues coherently (DasGupta and Shaw, 2017). According to Velasquez (2017), despite target 11.b of SDGs calling for integration in planning, there is still a lot of confusion among CCA and DRR professionals about what it means to integrate CCA and DRR into development. However, some countries have already taken steps to integrate CCA and DRR into development. For example, in India, while recognizing the increasing risks, the Government has made intensive efforts for CCA and DRR and to integrate DRR into development (Copde et al., 2016).

Another key issue hindering scientific innovations is the segregation of global frameworks for CCA and DRR. There are separate global and regional frameworks available for CCA and DRR (Sperling and Szekely, 2005; UNISDR and UNDP, 2012). For example, Sperling and Szekely (2005) identify two separate frameworks available for CCA and DRR in the Pacific region. As a result, integration of the two concepts is not generally accepted and hence, operate separately (Gero et al., 2011). Different institutions, coming from different organisational cultures, manage CCA and DRR and that organisational culture influences the generation of separate agendas and frameworks. These different cultures hinder the integration of CCA and DRR (Forino et al., 2015).

Similarly, in Central America, separate laws exist for management of DRR and CCA. For example, the Nicaraguan Government passed Law 337, which created the National System for Disaster Management and Prevention - the governmental body in charge of co-ordinating all DRR actions in the country - and the National Strategy on climate change which is managed by the Ministry of Environment and Natural Resources for CCA (Rivera, 2014). A study conducted by Rivera (2014) revealed the importance of creating co-ordinated actions between CCA and DRR which would avoid the duplication of effort and ensure better use of human and financial resources.

4.4 Challenges and Gaps related to trans-boundary Crisis Management

This section reviews the challenges/gaps associated with trans-boundary crisis management in the context of the existing legal/policy situation.

In recent years, an increasing number of devastating trans-boundary threats were witnessed around the globe (Ansell et al., 2010; Boin and Rhinard, 2008; Olsson, 2015). A trans-boundary threat is where there is a potential to cross geographical and functional boundaries (Boin and Rhinard, 2008). Thus, it demands a joint response which requires actors at various administrative and geographical levels (Olsson, 2015). As such, according to Ansell et al. (2010), it creates an interdependence among actors involved, requires extreme adaptation and unprecedented co-operation as the response is distributed across multiple organizations and jurisdictions. However, according to Olsson (2015), establishing a network for trans-boundary crisis management is challenged by ambiguity, complexity and uncertainty in terms of responsibility, co-operation and mandates.

In October 2015, the Nansen Initiative presented the agenda for the protection of cross-border displaced persons in the context of disasters and climate change which was endorsed by 109 governments (Mc Adam, 2016); one good example of a trans-boundary initiative. Furthermore, the

Sendai Framework calls for the promotion of trans-boundary co-operation to build resilience and disaster risks (Mc Adam, 2016). It guides actions at national and local levels, as well as regional and international levels, to foster more efficient planning, create common information systems and exchange good practice and programmes for co-operation and capacity development, in particular, to address common and trans-boundary disaster risks. As such, the framework recognises the trans-boundary nature of disaster risk and guides action at the regional level through agreed regional and subregional strategies and mechanisms for co-operation. Similarly, the Paris Agreement brings all nations into a common cause to combat climate change and adapt to its effects, with enhanced support to assist developing countries (UNFCCC, 2015). The Agreement recognises adaptation as a global challenge with local, subnational, national, regional and international dimensions, and a special emphasis has been given to enhancing the capacities of developing countries to implement this, including through regional, bilateral and multilateral approaches. Likewise, the SDGs have a dedicated goal on revitalising global partnerships for sustainable development which recognises the trans-boundary nature of the problem and the importance of trans-boundary co-operation.

According to Hart and Tindall (no date), “Trans-boundary crisis management demands that multiple actors in distinct jurisdictions, in coherent ways, jointly handle the shared crisis and aftershocks.” Thus, it is necessary to create tight collaborations with network partners, not only during the crisis, but also at the pre-crisis stage (Bakker et al., 2016). Among others, crisis leadership is of paramount importance to balance information and expert recommendations with other, equally important perspectives (Hart and Tindall, no date). Further, Ansell et al. (2010) argued that the response to a trans-boundary crisis requires a specific set of organizational and procedural tools and, according to Boin and Rhinard (2008), the institutional challenge is a key barrier to build effective trans-boundary systems for managing the complex threats.

Most of the trans-boundary crises in Africa are less political in nature and more clan based or tribal conflict based crises, which, in turn, are determined by the conflict over natural resources. Rulers, or the administrators of the political boundaries, have very little control over the clans which often clash, resulting in a trans-boundary crisis. Political actions are therefore hampered by clan based conflicts, which are mostly autonomous or independent of the political parties.

Africa has one of the most structured, inter-governmental organisations called the African Union. In addition to the African Union and to ensure trans-boundary co-operation, particularly across borders, there is an institutional mechanism called Regional Economic Communities. Regional Economic Communities is duly recognised by the United Nations and the African Union. They play a key role in ensuring that there is political action for trans-boundary risk and crisis management. All the countries in Africa are members of the African Union and Regional Economic Communities. However, lack of capacity with the inter-governmental organisations to influence their national counterparts is a key challenge. The East African Community Disaster Risk Reduction and Management Act of 2013 is a very good example that inter-governmental organisations have adopted, with acceptance by the member states of that inter-governmental organisation, a document which focuses mostly on trans-boundary crises as well as risk management. Similar policies also exist in Central Africa and in West Africa and the Southern African community has also recently adopted a preparedness strategy with all the member states of the Southern African Developmental Community in Southern Africa. So, these are some of the key policy documents, some of which have legal backing to ensure trans-boundary management.

In addition, there are many inter-governmental mechanisms where most of the member states or the nation states participate and cross-exchange their information, ideas, approaches and experiences. For example, one of the respondents stated, “We have just organised a regional Pan-Africa platform on disaster risk reduction in Mauritius, 47 African countries participated. So that gives a, kind of, an opportunity for the countries to cross-exchange and share their experience.” Figure 27 summarises the key findings of the African region.

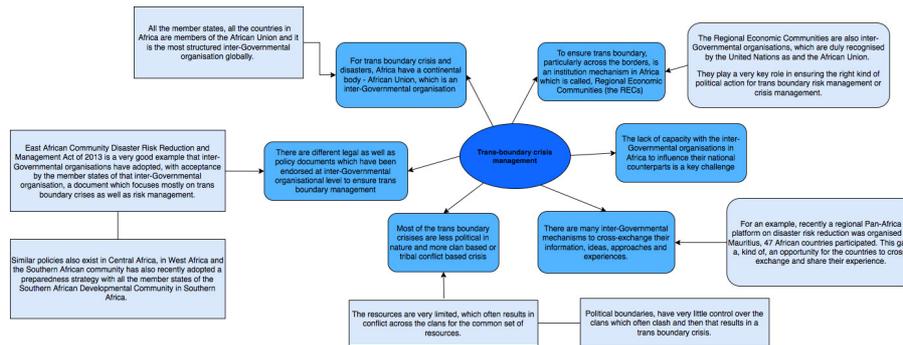


Figure 27- Challenges and gaps related to trans-boundary crisis management – Africa

Trans-boundary issues are not much discussed in relation to Australia and Canada. One of the respondents associated with Australia stated, “We are an island so we don’t have a trans-boundary problem. I mean we could have issues between states, but we really don’t have trans-boundary problems as such as it would happen in Europe or US.”

In terms of America, the present administration leans more towards a nationalist approach and therefore, one of the respondents stated, “Issues of a transnational kind of collaboration and co-operation are in jeopardy I would argue.” However, scientific and professional networks carry out a lot of trans-boundary work although there are no legal requirements to do so. As a country, the USA has historically been heavily engaged in humanitarian aid outside the country and will engage in that kind of humanitarian effort. Figure 28 summarises the key findings of the American region.

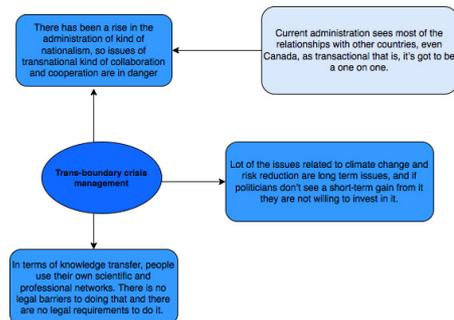


Figure 28- Challenges and gaps related to trans-boundary crisis management – America

4.5 Challenges and Gaps related to Risk

This section critically reviews the risk perception and its associated challenges/gaps in the context of the existing legal/policy situation.

Lack of awareness of climate risk is a major challenge in most climate change adaptation mechanisms (O'Brien, 2006 #270). Since CCA strategies focus on future risks (Mitchell and van Aalst, 2008; Venton and Trobe, 2008), risk assessment is considered a vital part in adaptation strategies (Thomalla et al., 2006). However, due to the uncertain nature of climate change, policy makers adopt a ‘wait and see’ approach to most of the climate change incidents (Sperling and Szekely, 2005). This uncertainty limits the weighting of future risks and hence, it hinders the incorporation of adaptation strategies with risk reduction strategies (Conway and Schipper, 2011). In addition, high levels of uncertainty in climate projections disturb their understanding of the future risks and actions necessary for managing climate change (Conway and Schipper, 2011). This is further complicated by the limited availability of tools and techniques for CCA when compared to the full range of well-established tools for DRR (Mitchell and van Aalst, 2008). A study conducted in the Pacific Islands also revealed that proper climate data and modelling affect the adaptation response. According to them, this is a major concern in integrating CCA with DRR (Hay, 2009). Also, there is a lack of technical capacity to understand the limits and

uncertainties related to climate data used for models and scenario development which reduces the accuracy of risk assessment and thereby, impacts effective adaptive planning (Kato, 2010 #520).

In terms of the perception of risk, it was evident that there are many differences between the two communities, CCA and DRR. The DRR community works on all kinds of hazards. The CCA community sees themselves relevant only to climate related hazards. For example, earthquake is a considerable hazard for most countries, and the DRR community sees earthquakes as part of risk but it is not part of the agenda of the climate change community. Further, the communities who deal with DRR, sometimes have to tackle broader issues beyond natural hazards, for example, pandemics, terrorism or security issues. As such, it is a far larger domain and one of the respondents stated, "That's the reason that the CCA communities are, kind of, focused on, specific hazards like floods, landslides, wet landslides, typhoons, cyclones and heat waves." Furthermore, when looking at the origin of the two phenomena, the DRR community's origin is in humanitarian issues and disasters which have already happened, and the climate change community is largely engaged in the scientific theories and projections. While the DRR community talks largely about existing risks, the climate change community is more futuristic and they like to see into the future: what new risks might come up in the future based on long-term projections.

Moreover, one of the interviewees stated, "Disaster risk community talks more about the short-term actions, which is usually not beyond five to ten years, the climate change community talks up to 50 to 100 years." As such, it was evident that there are a number of differences as to how the two communities perceive risk in their disciplines. However, the global frameworks, for example, the Sendai Framework, has tried to bring these two perceptions together, or at least, closer. The Sendai Framework has introduced a term on new risks, or the prevention of new risks, which is actually much closer to the climate change dimension of risk because it makes the DRR community become more futuristic.

In terms of risk assessment, one of the key challenges faced by both CCA and DRR communities is the monitoring of disasters. The monitoring data has not been there for a historical period of time and as a result, CCA and DRR communities have less data which results in poor projections. As such, a lack of information has been a key barrier, especially for regions such as Africa. The community based information, which is a very important set of information for implementation, is also very limited and there is a lack of connection between the information available at the national level and at the community level. Accordingly, one of the respondents stated, "I think the most important requirement for doing any kind of risk assessment is the data needs, and that in itself is a big challenge." Agreeing with this, another respondent, representing the Asian region, stated, "The biggest challenge is that we really do not keep systematic data in the country. Now, data is not only by the meteorological department or disaster relief, each of the ministries - they really don't have the procedure. They generate a lot of data but they don't really keep that information from an angle that will help understand which kind of risks they are going to have." Another important issue is information sharing. For example, some of the ministries and institutions have done several studies but those studies are not available in public domains. Furthermore, a lot of information on climate and climatic models are done but those are still at the research level and not available for district planning, community planning or local planning processes.

5 Quantitative Analysis and Findings

5.1 Institutional Arrangements

Based on the results of the survey, barriers associated with existing institutional arrangements in dealing with DRR and CCA were ranked based on the Relative Importance Index (RII). As shown in Table 1, 'poor communication between organisations' is ranked as the key barrier in dealing with DRR while 'unclear roles and responsibilities' is ranked as the key barrier in dealing with CCA. Among the pre-identified barriers, 'lack of qualified staff' is ranked last in both categories. As shown in Table 1, a large

majority of the respondents either 'agreed' or 'strongly agreed' with the institutional barriers listed within the questionnaire. 50.71% of participants strongly agreed that poor communication between organisations is a barrier when dealing with DRR. Within the domain of the DRR, the second key barrier was reported as 'unclear roles and responsibilities' where a large majority of the respondents, 89.44%, agreed or strongly agreed. In addition to what has been listed, respondents also noted that insufficient time to concentrate on DRR was a barrier, as staff are often busy with too many other priorities. Among others, lack of funding to the local institutions, lack of authorities, poor knowledge and knowledge management systems, lack of political will and access to data also emerged as barriers.

In terms of CCA, a large majority of the respondents, 82.01%, agreed or strongly agreed that unclear roles and responsibilities are a barrier. The second key barrier was reported as 'poor communication between organisations' where a large majority of the respondents, 81.43%, agreed or strongly agreed. In addition to what has been listed, lack of institutional will, lack of political will and disregard of local adaptation strategies also emerged as barriers.

Table 1 : Barriers in existing institutional arrangements

Factors	DRR				CCA			
	RII	Rank	Modal Opinion	Combined Majority ¹	RII	Rank	Modal Opinion	Combined Majority ¹
Poor communication between organisations	0.8671	1	Strongly agree (50.71%)	86.43%	0.8300	2	Agree (42.14%)	81.43%
Unclear roles and responsibilities	0.8366	2	Agree (52.82%)	89.44%	0.8345	1	Strongly agree (41.73%)	82.01%
Poor data management systems	0.8269	3	Agree (45.39%)	83.69%	0.8100	5	Strongly agree (39.29%)	75.00%
Divergent governance structures	0.8056	4	Agree (52.11%)	83.10%	0.8158	3	Agree (47.48%)	80.55%
Lack of stakeholder participation	0.7690	5	Agree (52.82%)	74.65%	0.8129	4	Agree (43.88%)	77.70%
Lack of qualified staff	0.7396	6	Agree (46.76%)	66.91%	0.7435	6	Agree (38.41%)	64.49%

¹Total percentage of 'agree' and 'strongly agree'

Survey results were then analysed based on the regions and ranked based on the RII (Table 2 and Table 3). In terms of DRR, 'poor communication between organisations' was ranked as the key barrier in Europe, America and Asia while divergent governance structures and unclear roles and responsibilities were ranked as key barriers in Oceania. In contrast, the most prevailing barrier in Africa was 'lack of stakeholder participation'. CCA results somewhat differ with DRR results except for the Asian and African regions where 'poor communication between organisations' was the key barrier in Asia while 'lack of stakeholder participation' was the key barrier in Africa. Similar to Africa, 'lack of stakeholder participation' is ranked as the primary barrier in Oceania. In contrast, 'divergent governance structures' was ranked as the key barrier in America while 'unclear roles and responsibilities' was ranked as the key barrier in Europe.

Respondents also emphasised that it is difficult to agree on common barriers at the EU level since the economic situation varies largely over the continent. The same may apply with other regions, for example, the Asian region includes a wide range of countries with varied political and economic conditions.

Table 2 : Barriers in existing institutional arrangements when dealing with DRR - RII score

Factors	Europe		Asia		Oceania		Africa		America	
	RII	Rank								
Divergent governance structures	0.78919	2	0.81026	4	0.88000	1	0.74286	6	0.77500	5
Unclear roles and responsibilities	0.76757	3	0.86154	2	0.88000	1	0.85714	3	0.82500	3
Poor communication between organisations	0.84444	1	0.87013	1	0.86000	3	0.82857	5	0.97500	1
Lack of stakeholder participation	0.72973	5	0.76923	6	0.80000	5	0.91429	1	0.80000	4
Poor data management systems	0.75135	4	0.85455	3	0.82000	4	0.88571	2	0.85000	2
Lack of qualified staff	0.64324	6	0.77632	5	0.74000	6	0.83333	4	0.75000	6

Table 3 : Barriers in existing institutional arrangements when dealing with CCA - RII score

Factors	Europe		Asia		Oceania		Africa		America	
	RII	Rank								
Divergent governance structures	0.77778	2	0.82564	4	0.82000	3	0.80000	6	0.92500	1
Unclear roles and responsibilities	0.78857	1	0.85897	2	0.80000	4	0.85714	2	0.85000	3
Poor communication between organisations	0.75000	4	0.86923	1	0.80000	4	0.82857	4	0.87500	2
Lack of stakeholder participation	0.77714	3	0.81538	5	0.88000	1	0.91429	1	0.80000	5
Poor data management systems	0.73333	5	0.83590	3	0.86000	2	0.82857	4	0.85000	3
Lack of qualified staff	0.61714	6	0.78442	6	0.76000	6	0.85714	2	0.80000	5

After analysing the institutional barriers for DRR and CCA, respondents were asked to rank the institutional barriers in integrating DRR and CCA. Survey results are summarised in Table 4 with the order of importance. As shown in Table 4, 'lack of political will' ranked as the most prevailing barrier for integration. It was also evident that existing legal frameworks and policies do not fully support the integration and, as a result, it was ranked as the second most important barrier. Thirdly, it was evident that separate funding sources exist for DRR and CCA and this too has been widely mentioned within the survey as a barrier for integrating DRR and CCA. In addition to what was listed in Table 4, lack of co-ordination between government institutions and lack of data availability were also identified as barriers for integrating DRR and CCA.

Table 4 : Barriers in existing institutional arrangements when integrating DRR and CCA

Institutional barriers for integrating DRR and CCA	Total Count	Rank	Mean
Lack of political will	99	1	39.34%
Legal frameworks and policies	106	2	18.87%
Separate funding sources and allocations	102	3	16.67%
Institutions are not ready	91	3	14.29%
Unclear roles and responsibilities	103	4	22.33%
Divergent governance structures	107	5	15.89%
Poor communication between organisations	112	6	16.96%
Lack of stakeholder participation	110	8	15.46%
Poor data management systems	110	9	20.91%
Lack of qualified staff	125	10	22.40%

Results were also analysed regionally and the 'lack of political will' was ranked as the key barrier in all five regions: Europe, Asia, Oceania, Africa and America.

5.2 Funding Arrangements

In terms of funding arrangements, it was evident that the highest component of funding for DRR is coming from national/central governments followed by international grants. For CCA, the highest components of funding are coming from international grants, followed by donor funding (international) and regional grants. In addition to what is listed in Table 5, respondents also highlighted other funding sources such as crowd-source funding. It was also evident that, for DRR, it is mostly the continuation/extension of funding allocations from the emergency response period and very little funding is available purely for DRR without an initial disaster.

Table 5 : Funding available for DRR and CCA initiatives

Funding sources	DRR		CCA	
	Count	%	Count	%
International grants	75	16.24	70	19.39
EU or regional grants	59	12.77	60	16.62
Donor funding (international)	66	14.29	61	16.90
Donor funding (national)	50	10.82	35	9.70
National/central government	90	19.48	55	15.24
Local government	54	11.69	27	7.48
Private sector	33	7.14	24	6.65
Public private partnerships	35	7.58	29	8.03

When analysing the regional results, it was evident that DRR funding for Europe is mainly coming from EU or regional grants followed by international grants and national/central government. CCA funding is mainly coming from EU or regional grants followed by international grants. It was also noted that the national/central government funding for CCA is comparatively low compared to DRR. In Asia and America, the main funding source for DRR is national/central government funding. Many respondents have also voted for donor funding (international) and international grants. CCA funding for Asia mainly comes from donor funding (international) and international grants while national/central government funding was ranked first in America. In Oceania, more respondents voted for the accessibility of national/central government funding and national donor funding for DRR and national/central government funding and international grants for CCA. African results were somewhat different to other regions and many respondents have not identified national/central government funding as a major funding source for both DRR and CCA. The funding mainly comes from international grants, regional grants and donor funding (international) for both DRR and CCA. The results are depicted in Table 6 and Table 7.

Table 6 : Funding available for DRR initiatives

Funding sources	Europe		Asia		Oceania		Africa		America	
	Count	%	Count	%	Count	%	Count	%	Count	%
International grants	19	17.92	46	15.65	4	12.50	3	21.43	3	18.75
EU or regional grants	23	21.70	28	9.52	3	9.38	4	28.57	1	6.25
Donor funding (international)	10	9.43	48	16.33	4	12.50	3	21.43	1	6.25
Donor funding (national)	11	10.38	31	10.54	6	18.75	0	-	2	12.5
National/central government	19	17.92	58	19.73	6	18.75	2	14.29	5	31.25
Local government	11	10.38	35	11.90	5	15.63	1	7.14	2	12.5
Private sector	6	5.66	23	7.82	2	6.25	1	7.14	1	6.25
Public private partnerships	7	6.60	25	8.50	2	6.25	0	21.43	1	6.25

Table 7 : Funding available for CCA initiatives

Funding sources	Europe		Asia		Oceania		Africa		America	
	Count	%	Count	%	Count	%	Count	%	Count	%
International grants	17	18.68	43	20.77	5	16.67	2	15.38	3	15.00
EU or regional grants	19	20.88	31	14.98	4	13.33	4	30.77	2	10.00
Donor funding (international)	11	12.09	40	19.32	4	13.33	4	30.77	2	10.00
Donor funding (national)	8	8.79	20	9.66	3	10.00	2	15.38	2	10.00
National/central government	11	12.09	35	16.91	5	16.67	0	-	4	20.00
Local government	10	10.99	12	5.80	3	10.00	0	-	2	10.00
Private sector	5	5.49	13	6.28	3	10.00	1	7.69	2	10.00
Public private partnerships	10	10.99	13	6.28	3	10.00	0	-	3	15.00

5.3 Stakeholder Integration

Based on the survey results, key stakeholders involved in DRR and CCA were identified. It was evident that all stakeholders listed in Table 8, are engaged in DRR and CCA initiatives at various levels. National/central government and ministries, international organisations, regional organisations and academia and research emerged as the highest engaged stakeholders for both DRR and CCA while low engagement was observed from private sector and charitable organisations. In addition to the stakeholders listed in Table 8, some respondents also highlighted the importance of the media.

Table 8 : Stakeholders involved in DRR and CCA initiatives

Stakeholders	DRR		CCA	
	Count	%	Count	%
International organisations	85	10.28	77	11.61
Regional organisations	76	9.19	70	10.56
National/central government and ministries	91	11.00	80	12.07
Local governments	81	9.79	54	8.14
International NGOs	73	8.83	66	9.95
NGOs	72	8.71	60	9.05
Private sector	52	6.29	43	6.49
Community based organisations	75	9.07	49	7.39
Charitable organisations	59	7.13	36	5.43
Community	72	8.71	42	6.33
Academia and research	91	11.00	86	12.97

When analysing the regional results for DRR, it was evident that the engagement of international organisations in Asia and Oceania is somewhat lower than that of other regions. On the other hand, participation of regional organisations is comparatively higher in Africa compared to other regions. Furthermore, involvement of national/central government is comparatively higher in all regions except for America. Further, national and international NGO presence is comparatively low in Oceania and the participation of the private sector is comparatively low in all regions. Charitable organisations are also somewhat low in Europe and Asia. Regional results of DRR are summarized in Table 9.

When analyzing the regional results of CCA, participation of international organisations in America and Asia is somewhat lower than the other regions. Similar to DRR, Africa has more presence of regional organisations than other regions. Involvement of local government in CCA is somewhat low in all regions compared with DRR and the involvement of private sector, community, community based organisations and charitable organisations is comparatively lower than that of other stakeholders. Regional results of CCA are summarized in Table 10.

Table 9 : Stakeholders involved in DRR initiatives

Stakeholders	Europe		Asia		Oceania		Africa		America	
	Count	%	Count	%	Count	%	Count	%	Count	%
International organisations	21	11.48	48	9.84	4	7.84	4	11.43	6	12.50
Regional organisations	17	9.29	45	9.22	5	9.80	4	11.43	3	6.25
National/central government and ministries	21	11.48	54	11.07	6	11.76	4	11.43	4	8.33
Local governments	16	8.74	49	10.04	6	11.76	3	8.57	5	10.42
International NGOs	17	9.29	44	9.02	2	3.92	4	11.43	4	8.33
NGOs	14	7.65	45	9.22	3	5.88	4	11.43	4	8.33
Private sector	12	6.56	33	6.76	2	3.92	1	2.86	2	4.17
Community based organisations	15	8.20	44	9.02	6	11.76	2	5.71	6	12.50
Charitable organisations	10	5.46	33	6.76	6	11.76	3	8.57	5	10.42
Community	17	9.29	40	8.20	6	11.76	3	8.57	4	8.33
Academia and research	23	12.57	53	10.86	5	9.80	3	8.57	5	10.42

Table 10 : Stakeholders involved in CCA initiatives

Stakeholders	Europe		Asia		Oceania		Africa		America	
	Count	%	Count	%	Count	%	Count	%	Count	%
International organisations	22	13.02	40	10.90	6	13.95	4	15.38	4	10.00
Regional organisations	18	10.65	39	10.63	4	9.30	4	15.38	3	7.50
National/central government and ministries	21	12.43	45	12.26	5	11.63	3	11.54	4	10.00
Local governments	16	9.47	31	8.45	2	4.65	2	7.69	2	5.00
International NGOs	16	9.47	37	10.08	4	9.30	3	11.54	4	10.00
NGOs	15	8.88	34	9.26	2	4.65	2	7.69	5	12.50
Private sector	11	6.51	23	6.27	4	9.30	1	3.85	2	5.00
Community based organisations	10	5.92	28	7.63	4	9.30	1	3.85	4	10.00
Charitable organisations	6	3.55	21	5.72	3	6.98	2	7.69	3	7.50
Community	10	5.92	24	6.54	3	6.98	1	3.85	3	7.50
Academia and research	24	14.20	45	12.26	6	13.95	3	11.54	6	15.00

After analysing the stakeholder participation for DRR and CCA, respondents were asked to rank the barriers for stakeholder participation. Survey results are summarised in Table 11 with the order of importance (modal rank). As shown in Table 11, ‘lack of interest’ and ‘lack of political will’ ranked as the most prevailing barriers for both DRR and CCA. It was also evident that ‘lack of funding’ is the next most important barrier for DRR and ‘legal frameworks and policies’ for CCA. Also ‘competing priorities’ ranked 5th for DRR and 11th for CCA.

Table 11 : Barriers for stakeholder participation - DRR

Barriers for stakeholder participation	DRR			CCA		
	Total Count	Modal Rank	Mean	Total Count	Modal Rank	Mean
Lack of interest	70	1	15.71	64	1	23.08
Lack of political will	73	1	24.66	73	1	21.92
Lack of funding	73	2	17.82	67	4	23.88
Lack of stakeholder engagement	73	4	20.55	72	6	15.28
Competing priorities	91	5	16.05	76	11	14.47
Legal frameworks and policies	72	5	15.28	73	3	20.55
Divergent governance structures	78	6	15.38	66	5/6	18.18
Unclear roles and responsibilities	78	7	16.67	74	5	17.57
Poor communication between organisations	78	8	20.51	72	7/8	18.06
Lack of qualified staff	86	9	16.28	74	8	21.62
Lack of opportunities to participate	77	9/10	19.48	74	9	18.92

When analyzing the regional results of DRR, ‘lack of interest’, ‘lack of stakeholder engagement’ and ‘lack of political will’ emerged as the key barriers in Europe while it was ‘lack of political will’ and ‘lack of funding’ in America. ‘Lack of political will’ also emerged as the key barrier for stakeholder participation in Asia. In contrast, ‘lack of interest’ and ‘competing priorities’ were the key barriers for Africa while ‘lack of funding’, ‘legal frameworks and policies’ and ‘competing priorities’ emerged as the key barriers for Oceania.

CCA results were somewhat similar to DRR results. ‘Lack of interest’ and ‘lack of political will’ emerged as the key barriers for Europe and Asia while ‘lack of interest’, ‘lack of political will’, ‘lack of qualified staff’ and ‘lack of opportunities to participate’ emerged as key barriers in America. ‘Lack of interest’ and ‘competing priorities’ emerged as the key barriers for Oceania. Similar to DRR, ‘lack of interest’ and ‘competing priorities’ were the key barriers for Africa.

5.4 Barriers for integrating DRR and CCA Initiatives

Based on the results of the survey, barriers for integrating DRR and CCA initiatives were ranked based on the RII. As shown in Table 12, ‘poor communication between organisations’ emerged as the key barrier with a combined majority of 84.94% while ‘unclear roles and responsibilities’ emerged as the second key barrier with a combined majority of 83.52%. ‘Competition between DRR and CCA communities’ was ranked as the least dominant barrier with an RII of 0.672340 and a combined majority of 51.06%. As shown in Table 12, the majority of the respondents agreed with the barriers for integration listed within the questionnaire. As such, it was evident that all of the barriers listed within the questionnaire are in existence at varying degrees in various regions across the globe.

Table 12 : Barriers for integrating DRR and CCA initiatives

Factors	Total Count	RII	Rank	Modal Opinion	Combined Majority ¹
Poor communication between organisations	93	0.832258	1	Agree (49.46%)	84.94%
Unclear roles and responsibilities	91	0.815385	2	Agree (50.54%)	83.52%
Different perceptions on risk	93	0.808602	3	Agree (46.23%)	79.57%
Lack of political will	93	0.804301	4	Agree (51.61%)	80.65%
Institutional arrangements	93	0.797849	5	Agree (52.69%)	78.49%
Separate funding sources and allocations	90	0.793333	6	Agree (52.22%)	78.89%
Poor data management systems	93	0.791398	7	Agree (47.31%)	77.42%
Lack of dissemination of best practices	93	0.769892	8	Agree (45.61%)	70.97%
Divergent governance structures	92	0.767391	9	Agree (46.74%)	70.65%
Inadequate cooperation among DRR and CCA communities	94	0.765957	10	Agree (55.32%)	77.67%
Legal frameworks and policies	92	0.754348	11	Agree (44.57%)	69.56%
Lack of stakeholder participation	92	0.747826	12	Agree (48.91%)	68.48%
Functional mismatches	93	0.731183	13	Agree (52.69%)	68.82%
Temporal mismatches	90	0.715556	14	Agree (45.56%)	61.11%
Spatial mismatches	92	0.713043	15	Agree (42.39%)	60.87%
Competition between DRR and CCA communities	94	0.672340	16	Agree (31.91%)	51.06%

¹Total percentage of ‘agree’ and ‘strongly agree’

When looking at the regional results, ‘different perceptions of risk’ emerged as the key barrier in Europe with an RII of 0.833333 while ‘separate funding sources and allocations’ emerged as the second key barrier with an RII of 0.808696. Modal opinion for all barriers emerged as ‘agreed’ except for ‘different perceptions of risk’ where the modal barrier was ‘strongly agreed’ and ‘lack of dissemination of best practices’, where the modal barrier emerged as ‘neither agreed nor disagreed’.

When looking at the results of the American region, ‘lack of political will’ emerged as the key barrier with an RII of 0.96 while ‘poor communication between organisations’ emerged as the second key barrier with an RII of 0.92. Modal opinion for all barriers emerged as ‘agreed’ or ‘strongly agreed’ except for ‘temporal mismatches’, where the modal barrier was ‘neither agreed nor disagreed’.

The Asian region showed somewhat similar results to the American region, where ‘poor communication between organisations’ emerged as the key barrier with an RII of 0.864286 while ‘unclear roles and responsibilities’ emerged as the second key barrier with an RII of 0.855556. Modal opinion for all barriers emerged as ‘agree’. Similar results

were observed in the African region where ‘poor communication between organisations’ and ‘unclear roles and responsibilities’ with an RII of 0.866667 emerged as key barriers.

In contrast, ‘legal frameworks and policies’ and ‘divergent governance structures’ ranked as key barriers in Oceania with an RII of 0.9. Furthermore, modal opinion for ‘spatial mismatches’ emerged as ‘disagree’ and the modal opinion for ‘lack of dissemination of best practices’ emerged as ‘neither agreed nor disagreed’. The majority of respondents either agreed or strongly agreed with the rest of the barriers.

It is also important to note that, depending on each country’s or locality’s availability and quality of scientific communities/experts and bureaucrats, the DRR and CCA integration may vary. In supporting this argument, one of the respondents stated, “This is a very challenging process in the case of the Philippines, there seems to be a considerable difference in their popularity: where I am, CCA is hip, especially amongst the young, and DRR is largely ignored.”

In addition to what was ranked within the survey, respondents have also highlighted several other barriers. Accordingly, the importance of conceptualizing the risk, risk assessment and risk management became clear: crucial in DRR and CCA projects. When integrating, it is also important that DRR and CCA policy making and research are integrated. In general, the objectives of DRR are defined in legal frameworks. However, CCA initiatives are defined more in terms of strategies, which act as a barrier for integration. As such, the question is not whether the governance requires a coherent or divergent structure, but whether the necessary bonding and bridging mechanisms are present to make integration of DRR and CCA work and at the right level for giving meaningful results.

Some of the respondents also highlighted that integration requires skilled personnel to lead the way. It was also a challenge to define which aspects of DRR and CCA require integration as this can be in terms of risk assessments, data management or it can be in terms of policies. Furthermore, it is important to mainstream DRR and CCA into national development planning and policy, without which, integration will not happen. CCA and DRR should start from national policy as well as among regional countries, otherwise, it will be the last priority for the government's budget allocation. International organizations, such as the UN, can also play a major role in this process by encouraging and stimulating countries to set up a fund track for CCA, DRR and relevant research.

5.5 Barriers for trans-boundary Crisis Management

Based on the results of the survey, barriers for trans-boundary crisis management were ranked based on the RII. As shown in Table 13, ‘economic factors’ emerged as the key barrier with a combined majority of 82.42% while ‘differential priorities among nations’ emerged as the second key barrier with a combined majority of 86.96%. ‘language and communication barriers among nations’ was ranked as the least dominant barrier with an RII of 0.712088 and a combined majority of 62.64%. As shown in Table 13, the majority of the respondents ‘agreed’ or ‘strongly agreed’ with the barriers for trans-boundary crisis management listed within the questionnaire. As such, it was evident that all of the barriers listed within the questionnaire are in existence at varying degrees in various regions across the globe.

Table 13 : Barriers for trans-boundary crisis management

Factors	Total Count	RII	Rank	Modal Opinion	Combined Majority ¹
Economic factors	91	0.848352	1	Strongly Agree (42.86%)	82.42%
Differential priorities among nations	92	0.847826	2	Agree (48.91%)	86.96%
Inadequate legal frameworks and policies on transboundary crisis management	92	0.832609	3	Agree (43.48%)	82.61%
Lack of political will and support	93	0.832258	4	Agree (47.31%)	83.87%
Inadequate legal frameworks and policies on transboundary allocation of funding	91	0.830769	5	Agree (49.45%)	84.62%
Imbalanced support from countries	91	0.826374	6	Agree (42.86%)	80.22%
Procedural difference among nations in employing professionals in neighbouring countries	90	0.822222	7	Agree (46.67%)	81.11%
Lack of understanding between the nations	93	0.821505	8	Agree (50.54%)	82.80%
Procedural difference among nations in DRR and CCA priorities	91	0.813187	9	Agree (45.05%)	78.02%
Spatial mismatches	90	0.753333	10	Agree (44.44%)	64.44%
Functional mismatches	87	0.747126	11	Agree (42.53%)	62.07%
Lack of dissemination of best practices among nations	91	0.745055	12	Agree (39.56%)	65.93%
Temporal mismatches	89	0.730337	13	Agree (41.57%)	59.55%
Language and communication barriers among nations	91	0.712088	14	Agree (39.56%)	62.64%

¹Total percentage of ‘agree’ and ‘strongly agree’

When looking at the regional results, ‘inadequate legal frameworks and policies on trans-boundary crisis management’ emerged as the key barrier in Europe with an RII of 0.816667 while ‘inadequate legal frameworks and policies on trans-boundary allocation of funding’ emerged as the second key barrier with an RII of 0.816000. Modal opinion for all barriers emerged as ‘agreed’ except for ‘economic factors’ where the modal barrier was ‘strongly agreed’. Similar to Europe, ‘inadequate legal frameworks and policies on trans-boundary crisis management’ emerged as the key barrier in Africa with an RII of 0.933333. All barriers were in existence in Africa, where the modal opinion was either ‘agreed’ or ‘strongly agreed’ for all of the barriers.

When looking at the results of the American region, ‘lack of political will and support’ emerged as the key barrier with an RII of 0.96 while ‘economic factors’ emerged as the second key barrier with an RII of 0.92. Modal opinion for all barriers emerged as ‘agreed’ or ‘strongly agreed’, where a majority of respondents either agreed or strongly agreed with the barriers listed within the questionnaire.

In contrast, ‘differential priorities among nations’ and ‘economic factors’ ranked as key barriers in Oceania with an RII of 1.0 and 0.95 respectively. Furthermore, modal opinion for most of the barriers emerged as ‘strongly agreed’ while the modal opinion for ‘spatial, functional and temporal mismatches’ emerged as ‘neither agree nor disagree’. Similar results were observed within the Asian region, where ‘differential priorities among nations’ and ‘economic factors’ ranked as key barriers in Asia with an RII of 0.855556 and 0.851852 respectively. The modal opinion was ‘agreed’ or ‘strongly agreed’ and it was evident that all barriers were in existence in Asia.

In addition to what has been listed within the questionnaire, respondents also identified that absence, or lack of joint-scenario planning for trans-boundary crisis situations, were barriers to trans-boundary crisis management. In many cases, disasters and the climate change impacts are trans-boundary in nature. As such, the engagement of one country will not solve the issues related to CCA and DRR. So, it is vital to establish such collaboration towards a comprehensive disaster management and climate change adaptation. The AADMER of ASEAN is a good example of a legally-binding, regional agreement, which can manage a trans-boundary crisis. However, most of the countries/regions do not have such policies and frameworks to manage trans-boundary crises. Therefore, there is a need to identify and create the typology of trans-boundary crises, and subsequently find the appropriate regional bodies for managing those crises. The regional approach is essential in trans-boundary crisis management. The role of regional organisations in bringing about trans-boundary co-operation is very important but somehow, there is hardly any work taking place on this front. It is important to also consider the alignment of trans-boundary crisis management with other mechanisms, such as in the humanitarian field. Respondents also highlighted the importance of continuous interaction in trans-boundary crisis management, not limiting this to ‘one off’ situations.

5.6 Barriers for Scientific Innovations

Based on the results of the survey, barriers for scientific innovations were ranked based on the RII. As shown in Table 14, ‘lack of interdisciplinary approach’ emerged as the key barrier with a combined majority of 92.31% while ‘lack of integration of science and technology with DRR and CCA legal frameworks and policies’ emerged as the second key barrier with a combined majority of 83.52%. ‘Competition between DRR and CCA communities’ was ranked as the least dominant barrier with an RII of 0.694505 and a combined majority of 51.65%. As shown in Table 14, the majority of the respondents ‘agreed’ with the barriers for scientific innovations listed within the questionnaire. As such, it was evident that all of the barriers listed within the questionnaire are in existence at varying degrees in various regions across the globe.

Table 14 : Barriers for scientific innovations

Factors	Total Count	RII	Rank	Modal Opinion	Combined Majority ¹
Lack of interdisciplinary approach	91	0.859341	1	Agree (51.65%)	92.31%
Lack of integration of science and technology with DRR and CCA legal frameworks and policies	91	0.817582	2	Agree (52.75%)	83.52%
Different perceptions of risk	92	0.813043	3	Agree (51.09%)	82.61%
Lack of funding opportunities	92	0.806522	4	Agree (52.17%)	81.52%
Lack of dissemination of best practices	91	0.797802	5	Agree (56.04%)	80.22%
Lack of political will and support	94	0.787234	6	Agree (47.87%)	74.47%
Language and communication barriers among CCA and DRR communities in terms of concepts and terminology	91	0.775824	7	Agree (49.45%)	74.43%
Language and communication barriers among practitioners and general public	91	0.775824	7	Agree (49.45%)	75.82%
Inadequate cooperation among DRR and CCA communities	91	0.771429	9	Agree (45.05%)	71.43%
Lack of stakeholder participation	92	0.769565	10	Agree (52.17%)	75.00%

Language and communication barriers among academic community and practitioners	91	0.764835	11	Agree (42.86%)	72.53%
Legal frameworks and policies	92	0.754348	12	Agree (42.39%)	67.39%
Spatial mismatches	89	0.730337	13	Agree (42.70%)	60.67%
Functional mismatches	90	0.715556	14	Agree (51.11%)	61.11%
Temporal mismatches	91	0.709890	15	Agree (46.15%)	57.14%
Competition between DRR and CCA communities	91	0.694505	16	Agree (32.97%)	51.65%

¹Total percentage of 'agree' and 'strongly agree'

When looking at the regional results, 'lack of interdisciplinary approach' emerged as the key barrier in Europe with an RII of 0.852174 while 'language and communication barriers among practitioners and general public' emerged as the second key barrier with an RII of 0.843478. Modal opinion for all barriers emerged as 'agreed' except for 'language and communication barriers among academic community and practitioners' where the modal barrier was 'strongly agree' and 'competition between DRR and CCA communities' where the modal barrier was 'neither agree nor disagree'. Similar to Europe, 'language and communication barriers among practitioners and general public' and 'lack of interdisciplinary approach' emerged as the key barriers in Oceania with an RII of 0.90 and 0.85 respectively. 'Language and communication barriers among academic community and practitioners' also emerged as a key barrier in Oceania with an RII of 0.85. Similarly, 'language and communication barriers among practitioners and general public' and 'lack of interdisciplinary approach' emerged as key barriers in Africa, in addition to 'language and communication barriers among CCA and DRR communities in terms of concepts and terminology', all of which scored an RII of 0.9333333. The majority of the respondents either 'agreed' or 'strongly agreed' with the barriers listed within the questionnaire with the exception of one barrier, 'legal frameworks and policies', where the majority of the respondents disagreed. As such, it was evident that the legal frameworks and policies do not act as a major issue for scientific innovation in the African region.

When looking at the results of the American region, 'lack of funding opportunities', 'lack of interdisciplinary approach' and 'lack of integration of science and technology with DRR and CCA legal frameworks and policies' emerged as key barriers with an RII of 0.92. Modal opinion for all barriers emerged as either 'agreed' or 'strongly agreed' except for 'spatial mismatches', 'temporal mismatches' and 'competition between DRR and CCA communities' where a majority of respondents 'neither agreed nor disagreed'. Similarly, 'lack of interdisciplinary approach' and 'lack of funding opportunities' emerged as key barriers in Asia with RII scores of 0.8545455 and 0.8357143 respectively. The majority of the respondents agreed with the barriers listed within the questionnaire and the modal opinion for all barriers emerged as 'agreed'.

In addition to what has been listed within the questionnaire, respondents also highlighted the importance of clearly defining the responsibilities of different organizations in terms of scientific innovations and having a scientific basis for all DRR and CCA projects. Responders also emphasized that poor communication between policy makers and researchers acts as a hindrance for scientific innovations. The importance of integrating science and technology with legal frameworks and policies was particularly highlighted and it is science and technology which should be the basis for the policy development in future.

6 Conclusions

Whether its CCA or DRR, legal, policy and science approaches play a key role in tackling their related challenges. Accordingly, this report reviews the existing legal, policy and science approaches globally. It identifies the available legal, policy and science approaches that address climate change and natural hazards, and reviews the key issues that prevent more effective integration. The key data collection instruments were a desk-based literature review, semi-structured expert interviews and a questionnaire survey. Key findings are summarized under three headings: integrating CCA and DRR; trans-boundary crisis management and scientific innovations.

6.1 Integrating CCA and DRR

It was evident that a number of barriers prevent integrating CCA and DRR. 'Poor communication between organisations' emerged as the key barrier for integrating CCA and DRR while 'unclear roles and responsibilities' emerged as the second key barrier. As it stands, climate change policies and decisions are usually made by ministries and organizations related to the environment, whereas disaster management and reduction decisions are made by ministries related to infrastructure development. Since CCA and DRR efforts are handled by two sets of organizations, their inherited cultures prevent or reduce effective integration. Co-ordination challenges are also common and dialogue between the CCA and the DRR community is not necessarily present which results in huge duplications. Furthermore, there are different funding systems for CCA and DRR at global, regional and national levels, leading to policy and institutional separation. It was also evident that there is limited political will among those in the disaster management and environmental communities to integrate CCA and DRR mandates. One reason for this is lack of understanding of the importance of CCA, DRR and their integration. Furthermore, some of the political leaders assume that climate change is not an immediate disaster, and the political will is therefore sometimes dependent on the party in power. Besides, political willingness towards CCA and DRR in some countries depends on the cost of the actions. As most of the issues related to climate change and risk reduction are long-term issues, unless politicians see a short-term gain from it, they are not willing to invest.

Moreover, as the Paris Agreement is a global agenda agreed by the heads of state, it has become legally binding, whereas the Sendai Framework is mainly within Disaster Management ministries and not necessarily legally binding. Therefore, CCA has received state level attention whereas DRR has only ministry level attention. In addition, it was evident that a large number of agreements have created challenges, especially in terms of implementation and monitoring. As such, how the policy commitments can be put into practice has become less straightforward.

6.2 Trans-boundary Crisis Management

Trans-boundary crisis creates an interdependence among actors involved as the response is distributed across multiple organizations and jurisdictions. As such, a specific set of organizational and procedural tools are required to better manage the trans-boundary crisis. According to Olsson (2015), establishing a network for trans-boundary crisis management is challenged by ambiguity, complexity and uncertainty in terms of responsibility, co-operation and mandates. Across the global policies, a high prominence has been given to trans-boundary co-operation and crisis management and the post-2015 frameworks calls for the promotion of trans-boundary co-operation to build resilience and climate change adaptation. Based on the results of the survey, barriers for trans-boundary crisis management were ranked based on the RII. 'Economic factors' emerged as the key barrier while 'differential priorities among nations' emerged as the second key barrier. The majority of the respondents 'agreed' or 'strongly agreed' with the barriers for trans-boundary crisis management listed within the questionnaire. As such, it was evident that all of the barriers listed within the questionnaire are in existence at varying degrees in various regions across the globe.

6.3 Scientific Innovations

It was evident that a number of barriers affect scientific innovations in CCA and DRR. Based on the results of the survey, barriers for scientific innovations were ranked based on the RII and 'lack of interdisciplinary approach' emerged as the key barrier while 'lack of integration of science and technology with DRR and CCA legal frameworks and policies' emerged as the second key barrier. At the international level, parallel platforms exist to manage CCA

and DRR, governed by parallel frameworks. Therefore, to achieve a more inclusive DRR including CCA, and integrating it with development goals, requires co-production and sharing of knowledge.

Furthermore, based on the literature review and semi-structured interviews, it was evident that one of the key gaps for the integration of CCA and DRR is the unrecognised link between community initiatives and scientific knowledge. Traditional/indigenous knowledge at the community level is the basis for DRR whereas traditional/indigenous knowledge is insufficient for CCA. CCA needs scientific innovation in order to understand the future disaster risk and to make the appropriate predictions. Accordingly, this local knowledge should be gained through participatory mapping by interacting with local and scientific stakeholders. This will enable the integration of local knowledge and scientific innovations.

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