IJCCSM
17,1

Received 15 November 2024
Revised 9 April 2025
Accepted 20 June 2025

Investigating the relationship between climate change adaptation and disaster risk reduction: the Asia-Pacific region's path towards SFDRR targets

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Abstract

Purpose – This paper aims to characterise the suggestions for and implement disaster risk reduction (DRR) and National Climate Change Adaptation (CCA) initiatives, as well as to revisit and evaluate a range of disaster risks tackled in regional programs. Studying the theoretical background of DRR and CCA, as well as the possible impact of project consequences on the Sendai Framework on Disaster Risk Reduction (SFDRR) and its relationship with the sustainable development goals (SDGs), this research was driven by the project execution experiences of 24 expert professionals.

Design/methodology/approach – Local governments ought to establish DRR as a top priority, and researchers should do their part to raise awareness of the scientific methods that decision-makers can use in the lead-up to disasters. By doing its CCA Framework and the primary field of risk reduction and resilience, which includes CCA and DRR, the Asia-Pacific Network for Global Change Research has been promoting research and capacity-building activities, in line with its strategic objectives of generating scientific proof data and encouraging research efforts that contribute to currently available comprehension on climate, risks and disasters.

Findings – The findings outline the risks in different regions, the methods and strategies for DRR and community capacity building, and the lessons learnt in relation to the SFDRR Target 5, which is to increase disaster risk mitigation efforts at the national and regional levels by 2022.

Originality/value – Several factors, such as poverty, diverse geological and topographical characteristics, a rapidly expanding population and heavy reliance on natural resources for financial development, make the Asia-Pacific region particularly vulnerable to the worst effects of climate change and associated disasters.

Keywords Climate change adaptation (CCA), Risk mitigation, Disaster risk reduction (DRR), Sustainable development, Disaster management

Paper type Research paper

International Journal of Climate Change Strategies and Management
Vol. 17 No. 1, 2025
pp. 1056-1078
Emerald Publishing Limited
1756-8692
DOI 10.1108/IJCCSM-11-2024-0202

1. Introduction

Developing nations, in particular, are seeing increased susceptibility to risks of all kinds as a consequence of population growth and urbanisation (Casartelli *et al.*, 2025). Extreme weather, heat waves, water shortages, diseases transmitted by insects and other widely reported threats are becoming even more severe as a result of climate change (Bernados and Ocampo, 2024). All levels of government at the federal, state and regional levels, as well as all levels of local government, businesses and individuals, must increase their funding for disaster risk reduction (DRR) and climate change adaptation (CCA). Established in 2015, the Sendai Structure for Disaster Risk Reduction emphasises that saving lives, mitigating economic damage and investing in proactive DRR measures can save the cost of post-disaster rebuilding (Abdeen *et al.*, 2021) and (Do *et al.*, 2023). The Third Asia-Pacific Area Water Conference revised "The Yangon Declaration: The Journey Forward" in late November 2017. An important statement made at this Conference was to improve water availability in Asia-Pacific countries and to increase funding to tackle catastrophes related to water (He *et al.*, 2022). According to a historic resolution passed by the UN in December 1989, the International Decade for Natural Disaster Reduction (IDNDR) was scheduled to begin on February 1, 1990 (Kebede *et al.*, 2025). For over 30 years after that, there has been a marked increase in global efforts to lessen the impact of disasters. More than 30 years have passed since the world began taking action to adapt to and mitigate the effects of climate change (Sanson and Masten, 2024). The IPCC was formed in November 1988 by a joint effort between the World Astronomical Organisation and the United Nations Environment Agency. In the April 2019 Outcome Documentation, the UN Security Council and the World Bank advised tripling funding for water-related DRR over the next five years (Wang *et al.*, 2024). Investment priorities should include (i) making structural and non-structural expenditures to bring risk down to an adequate level and (ii) preparing for disasters through warning mechanisms and funding relief and post-disaster rebuilding efforts (Versaillot and Honda, 2024).

A growing body of literature (Liu *et al.*, 2024) recognise the importance of studying the relationships and synergies between DRR and climate change modification. A number of earlier works have posited that CCA is both an element of and a process within DRR. This is not necessarily so; however, there is a lot of overlap between the goals of CCA and DRR, and the strategies that are used in both are rather similar. Thus, numerous studies have proposed that tackling DRR and CCA simultaneously might lead to better results (Imperiale and Vanclay, 2024). Several studies have investigated the advantages and disadvantages of combining the two approaches, as well as the steps necessary to mainstream both into advancement (Moore, 2025). According to Qian *et al.* (2024), and a few others, there has been a growing need to combine these two areas of study in the past decade, particularly in the discipline of international growth. However, this approach has yet to be successful, particularly on a national or even a local level. There needs to be more direction on how to combine catastrophe risk reduction with adapting to climate change, despite pleas for doing so, because the connection between the two disciplines continues to be not well understood. Take, for instance, the argument that DRR should be considered as a sector or intersecting theme within modification, as well as the argument that climate change adaption should be integrated into DRR (Ishiwatari and Sasaki, 2021). Beyond that, the conceptual and cultural foundations, methodologies, policy structures and institutions that support the two domains could not be more different.

A "greater collaboration among a community of policymakers, professionals and researchers" is necessary to integrate DRR and climate change adaption (de Lima *et al.*, 2022). Furthermore, according to de Lima *et al.* (2022), integration could be seen as a

coordinated effort by the government to limit policy trade-offs, enhance resource utilisation and foster better communication and collaboration among all parties involved (Brauers *et al.*, 2021). At the same time, according to Moriarty and Honnery (2021), seven mainstreaming techniques must be implemented in order for planning and theory to be integrated into planning systems. Only then will integration be possible, at least from these viewpoints. There should be an emphasis on three areas in these plans:

(1) putting measures in place to lessen the likelihood of climate and disasters;

(2) changing the way different organisations do things, like their management, policies, and organisational frameworks, so that programs are better coordinated and have fewer unintended consequences; and

(3) teaching people how to adapt to climate change and reduce the probability of disasters (Beylot *et al.*, 2019).

In the aftermath of HFA, the Sendai Framework for Disaster Risk Reduction (SFDRR) was put in place with a timeframe of 2015–2030 for implementation. It has four action objectives and seven goals (Table 1). Through an analysis of risk features and the presentation of relevant measures and methods, this paper aims to improve the evaluation of the SFDRR's performance in the Asia-Pacific area, which is bearing the heavy burden of climate change and a wide range of disasters. In addition, we analyse project-based measures carried out by appropriate stakeholders, such as authorities and non-profit organisations, to determine the interconnections between DRR and CCA. This is done in light of the idea that DRR and CCA need to be aligned with the SDGs and other world development agenda goals. Using the analysis's findings as a foundation, we explain why DRR and CCA integration is crucial and provide a series of suggestions that improve both during and after disasters.

Like DRR, CCA is multi-faceted; the degree to which processes and activities are coordinated, integrated and synergized is determined by the national or global policy level. Research by Li *et al.* (2022) and Liang (2022) shows that, with a handful of significant exceptions, national authorities in South Asian countries typically direct separate departments to handle the respective crises. While both DRR and CCA have had an impact on global development policy, they have consistently operated independently and have only recently begun to collaborate. Nevertheless, numerous nations continue to be in the

Table 1. An overview of seven SFDRR targets

1	In contrast to the years 2007–2017, the average global death rate per 100,000 people from disasters significantly decreased during 2022 and 2030
2	Decrease in the number of affected individuals worldwide by 2030, with the goal of achieving a lower average global figure per 100,000 from 2022 to 2030 compared with 2007–2017
3	Decrease in the economic impact of disasters on the world's gross domestic product by the year 2030
4	Strengthening the resilience of these sectors will help minimise the impact of natural disasters on essential services and infrastructure, particularly educational institutions and hospitals, by 2030
5	Reach a significantly higher level of national and regional disaster risk reduction strategy implementation by 2022 in all nations
6	Improve global relationships with developing nations by 2030 by providing them with sufficient and long-term support to supplement their national efforts to implement the framework
7	By 2030, warning networks for multiple hazards, evaluations of disaster risk and their accessibility to the general public should be promoted more

Source(s): Authors' own work

beginning stages of incorporating DRR and CCA, and there are numerous obstacles to overcome. According to Chen *et al.* (2024), who examined the worldwide development of the DRR idea from 1986 to 2017, the connections between DRR and CCA have been recognised but need to be adequately represented.

The purpose of this study is to analyse the DRR and CCA projects that APNs financed. APNs determine how much of an influence the project results had on the integration and organisations of DRR governance. This report details building capacities and research initiatives in the Asia-Pacific area that focused on DRR and preparations (DRR and CCA) and concluded between 2017 and 2022. These initiatives have either directly or indirectly aided the region's efforts to execute SFDRR. Through an analysis of the main results of these DRR and CCA initiatives, we seek to understand (1) what are the commonalities and challenges of DRR and CCA and (2) what kinds of DRR and CCA measures were developed or implemented as a result of these initiatives. (3) How these projects may have contributed to the advancement of relevant global agendas, like the SFDRR and the sustainable development goals (SDGs), according to the experts who worked on them and (4) how well residents, government officials and other decision-makers comprehended the data and expertise that has been made available to them.

2. Aim and structure of the research paper

Combating the growing number and severity of climate-related disasters (e.g. floods, storms, droughts, landslides) is a focus of common ground between DRR and CCA. In light of this, the primary goal of this research is to examine the measures taken by DRR and CCA, as well as their related components, and to contribute to a greater awareness of the current state of integration in the Asia-Pacific regions where the initiatives were carried out (Eze and Siegmund, 2024). In addition, we investigate how the evaluated projects pertain to SFDRR and the value they have added to the development of SFDRR. This study provides new perspectives on the efficacy of DRR and CCA initiatives across various Asia-Pacific regions. It thoroughly analyses practical methodology, policies and strategies used in various socioeconomic and environmental contexts compared with conceptual studies. More precisely, the following goals were pursued:

- Search the APN Publication Database for relevant projects finished between 2017 and 2021 concerning DRR and CCA in the Asia-Pacific area, and then review these initiatives and their capacity-strengthening efforts (Amighini *et al.*, 2022). By conducting this empirical review, the research addresses significant gaps in understanding policy and governance and shows how CCA and DRR methods can be suitable for global sustainability goals.
- Determine the methods and approaches to DRR and community capacity building (DRR and CCA), as well as the specific methods and approaches developed by each project, while keeping in mind any commonalities;
- Perform an online survey between the expert professionals who oversaw the chosen projects to determine regional characteristics, challenges and deficiencies in DRR and CCA project implementation.
- This study helps to enhance comprehensive disaster risk governance frameworks by giving researchers, practitioners and politician's practical suggestions. This study adds to the body of literature by demonstrating how important it is to address both disaster risk and climate adaptation simultaneously if we are to build resilient and sustainable communities over the long run. Evaluate the chosen projects' impact on the SFDRR according to the survey results and document any connections or relationships with the SDGs that were found.

By focusing at the suggestions of finished initiatives that are important to the SFDRR's adoption, we shed light on what professionals have found about how some countries and areas are dealing with disaster risk and how DRR and community capacity assessment are being built into development strategies. Additionally, this helps in pinpointing areas that need improvement when it comes to disaster crisis preparedness and climate change mitigation, as well as when it comes to attaining general strategy coherence, which could pave the way for a more resilient and economically viable future (Richards *et al.*, 2021) and (Bohdanowicz *et al.*, 2023). To determine the most effective methods for reducing disaster risks, the study compares and contrasts structural and non-structural approaches. There are policy suggestions to improve disaster preparedness, develop resilience and multi-stakeholder collaboration, and it takes an in-depth look at governance structures to show how national policies do not always match up with local implementation. In addition, it clarifies how DRR efforts support SDGs, especially SDGs 13 (climate resilience), 11 (sustainable community) and 1 (poverty reduction). This study provides a better understanding of how to incorporate DRR into sustainable development initiatives by describing the benefits and drawbacks of implementing DRR within larger development frameworks. After the 2030 SDGs were made, DRR was mostly seen in conjunction with climate action (SDG 13.1), building community resilience (SDG 11.5, SDG 11.b), making it easier for low-income and vulnerable groups to adapt to extreme weather events and other social, economic and environmental disasters and shocks (SDG 1.5), and making it easier for all countries, especially developing ones, to find and reduce national and international health risks (SDG) . In light of this, we created and applied the theoretical model shown in Figure 1.

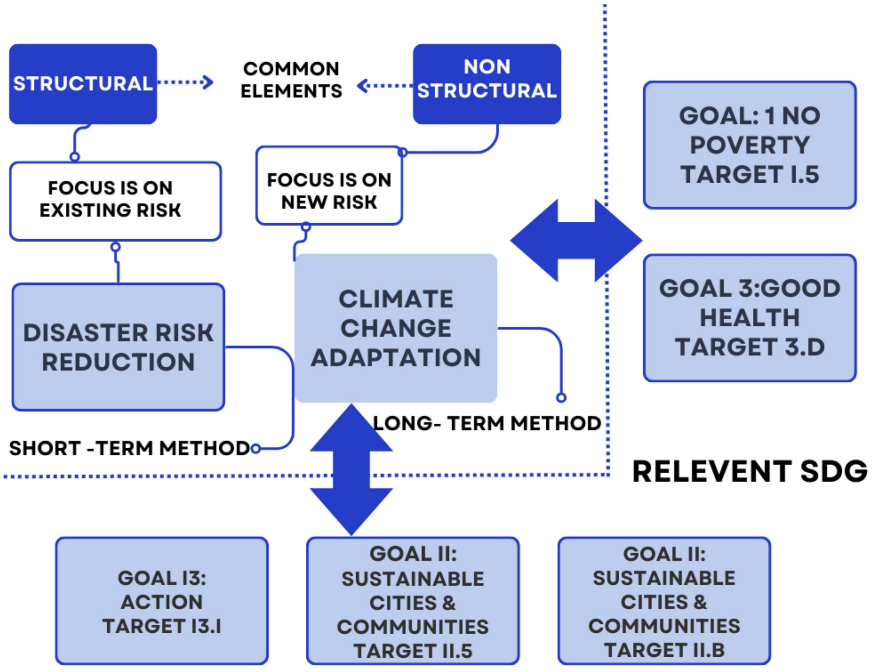

Figure 1. Overview of study framework
Source: Authors' own work

3. Methods

Both DRR and CCA programs in the Asia-Pacific area are assessed in this study using a systematic methodology. The SDGs offer a more comprehensive socioeconomic and environmental perspective to evaluate the interventions' effects on sustainability and resilience in the long run, while the SFDRR provides a framework for assessing the efficacy of DRR initiatives in the short term. Data Collecting and Project Evaluation: Studying climate change, catastrophe risk reduction and sustainable development in the Asia-Pacific area is the focus of the Asia-Pacific Network for Global Change Research (APN), an intergovernmental network that provides funding for such research. APN projects are a great way to evaluate DRR and CCA initiatives because they are tailored to deal with climate-related catastrophes, resilience tactics and sustainability. To facilitate organised comparisons across various sub-regions, APN provides comprehensive project reports that include techniques, results and effect evaluations. Organisations like the SFDRR and the SDGs are among the worldwide frameworks that APN supports when it comes to scientific research and capacity-building programs. A total of 24 projects, all supported by APN for Global Change Research and ending in 2022, were thoroughly examined. Projects related to DRR and CCA were located through search terms conducted in the APN Publication Database. Disasters caused by climate change, mitigation initiatives and strategies to enhance resilience in various sub-regions were given priority during the selection process. By conducting an online poll from December 2022 to January 2023, we were able to gather more detailed information. The purpose of the survey was to collect viewpoints from project professionals regarding the execution of DRR and CCA, difficulties encountered and contributions made to SFDRR and SDG targets from those participating in the chosen projects. Detailed examination of expert viewpoints was made possible by the survey's combination of organised multiple-choice questions and broad replies. Figure 2 shows the reversed pyramidal structure, which

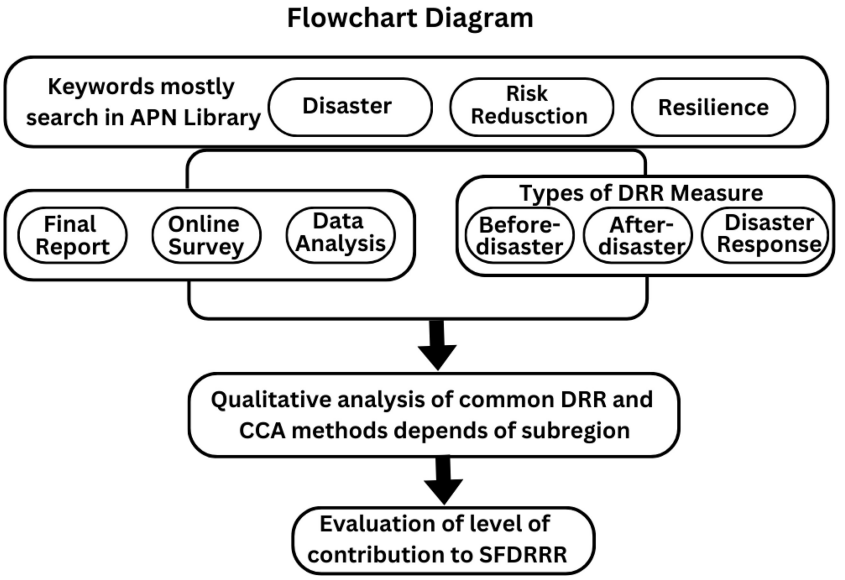

Figure 2. The authors have provided a methodological roadmap
Source: Authors' own work

represents the four stages of the review methods. Two stages of screening made up the first step. Projects are first screened at the first stage through keyword searches (e.g. "risk elimination" OR "resilience" OR "catastrophe" OR "risk" OR "diminution"; OR, since the Boolean algorithm combines keywords so that every result obtained incorporates at least one of the phrases) in the APN Works Library. In the next round of screening, we look over the first list and pick out the finished projects (we do not include ongoing ones) and those that were carried out in the Asia-Pacific region. Step 2 will read the entire concluded report and take an online survey to gain a better grasp of the project's findings and the expertise of the practitioners involved. Professionals involved in certain projects were asked to fill out a survey. The third step involved analysing the responses through textual evaluation for the broad enquiries and determining the frequency of the multiple-choice questions. Also, to show how the words in the free-form answers were related to one another, an associated network was created. In Step 4, we will assess the projects' industrial emphasis, determine the disaster phase and perceive their significance to global strategies to ascertain their direct and indirect value to the SFDRR. Furthermore, within this research's theoretical framework, we delineated the narrative links between the SFDRR objectives and the relevant SDGs addressed in the projects.

The studies follow arrays of steps (Figure 2) to synthesis important messages and provide suggestions for how to integrate governance for DRR, CCA and sustainable growth. The suggestions provided will be based on specific instances of approaches.

4. Results and discussion

From December 2022 through January 2023, we interviewed 24 professionals in the field via online survey. The survey included 16 questions covering topics such as the meaning of DRR, the industry that they work for, the main challenges in executing DRR and the specific stage of a disaster that their projects were centred around.

We assume that every initiative under consideration has CCA features because they are all authorised under APN funding programs, which are known to focus on climate change-related initiatives planned and executed by prominent regional experts and researchers. From our point of view, projects vary with regard to goals, associated DRR targets in regard to hazard types, execution scale (both geographical and temporal) and timeline. Projects are anticipated to take on disaster risks arising from climate change as a condition or funding requirement. The level of strategies (execution efforts) could differ among sites.

4.1 Project results synopsis

A comprehensive analysis of disaster risks and mitigation measures across Southeast Asia, South Asia, the Pacific and Temperate East Asia is presented in this paper. DRR and CCA strategies differ greatly among regions due to wide variations in topography, climatic vulnerability and socioeconomic variables. An emphasis on early warning systems, community resilience development and the development of local governance capacities is necessary since hydrometeorological events, such as typhoons and floods, disproportionately affect Southeast Asia. Realising the importance of a multi-sectoral strategy for disaster management, nations engaged in this area have made DRR a top priority in their urban design and infrastructure resilience initiatives. In contrast, South Asia's structural and non-structural adaptation initiatives have been pushed by the region's high climatic unpredictability, which includes regular heat waves, droughts and flooding. Important interventions, including flood defensive infrastructure, agricultural adaption strategies and ecosystem-based strategies, are needed to improve long-term resilience (Kandel *et al.*, 2024). The Pacific area has implemented a variety of adaptation techniques, including coastal

reinforcement, community-based approaches based on traditional wisdom and relocation plans, in response to the region's increased vulnerability to tropical storms and increasing sea levels. Improving regional collaboration and utilising nature-based solutions have been the primary goals of numerous small island governments in their efforts to deal with long-term climate challenges. Extreme weather events like typhoons, extreme temperatures and severe winters have become more common in East Asia due to rising industrialisation and urbanisation. Hence, there has been a focus on making cities more resilient. To lessen the impact of climate change, countries in this area have instituted integrated disaster management strategies, conducted ecosystem risk evaluations and used innovative flood modelling techniques. Localised policies are needed to address the unique risk profile, socioeconomic circumstances and institutional capacity of each location, as seen by the different methods taken throughout these regions.

4.1.1 Allocation of the project. The allocation of the APN initiative amongst countries in the Asia-Pacific area is shown in Figure 3. Singapore, Thailand, the Philippines and Cambodia were the primary locations for the projects, although other Southeast Asian (SEA) nations also had some involvement. Countries in Southeast Asia are proactively striving for improvement in their DRR and CCA functions, which makes sense given that that area is one of the quickest-growing ones and that catastrophic events are becoming more intense and frequent. Other South Asian (SA) nations where projects were carried out include Nepal, Sri Lanka, Bangladesh and India. Such nations are vulnerable to a wide range of hydro meteorological risks, many of which cross international borders. Fascinatingly, initiatives also reached out to Pacific island nations like Micronesia and Fiji, where DRR and CCA inclusion is only just beginning to gain traction. Some examples of DRR initiatives in Temperate East Asia (TEA) nations are stormwater collection for CCA, ecological risk

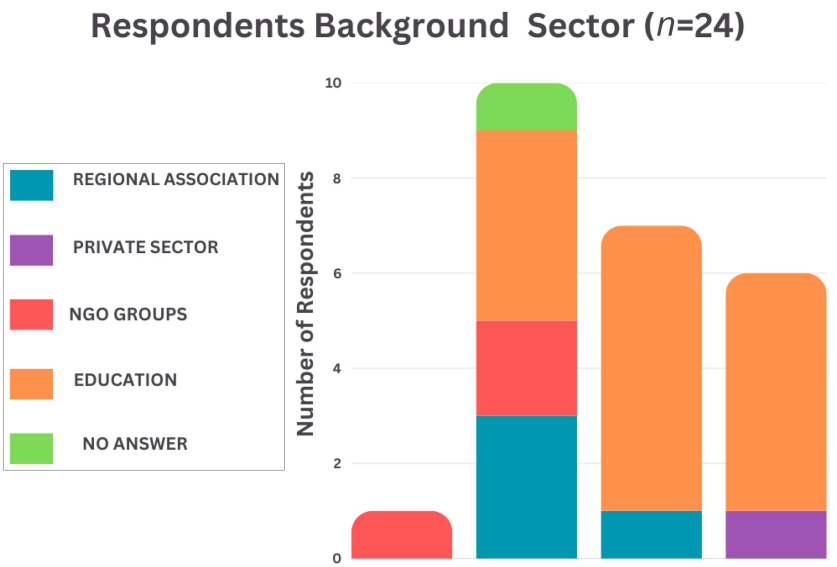

Figure 3. The survey respondents' profiles, which provide valuable insights into the distribution of professionals across different government levels and their involvement in international collaborations
Source: Authors' own work

assessment and a cohesive structure for urban resilience analysis. These countries include Brazil, China and Germany.

4.1.2 Combining reported outputs from specified DRR and CCA projects. The majority of the DRR and CCA initiatives that received funding engaged in local studies (70.85%), while a small percentage pursued capacity-building initiatives (29.18%). There are some things that all subdivisions have in common that can be seen as similarities between DRR and CCA. These include techniques that try to find sustainable economic action and improve the welfare of communities facing financial growth and environmental challenges, such as making communities more resilient in the face of unpredictable global environmental changes. Although the majority of catastrophic hazards and threats are natural, uncontrolled exposure may have unintended consequences for vulnerable groups. Figure 4 shows the various hazards. These hazards include natural disasters like landslides and tsunamis, as well as man-made ones like pandemics and outbreaks. The effects of these threats can be devastating: they can cause death, injury or additional health problems; destruction of property; change of income and services; socioeconomic crisis; and environmental degradation. In the components that follow, we will go over the features of regional hazards and risks using qualitative evaluations of project reports and the DRR and CCA strategies used or suggested by the projects (Figure 5).

4.1.2.1 The Southeast Asia. Given the frequency and severity of disasters in this region, particularly floods brought on by typhoons, torrential rain and tropical storms, the majority of initiatives chose floods as their primary disaster target. Disaster risk management financing in Southeast Asian nations primarily goes towards raising public and institutional knowledge of the issue, as well as improving readiness for and ability to respond to disasters (Nawaz *et al.*, 2021). From this study, we learnt that most APN projects in Southeast Asia used non-structural methods to help the local government, such as creating capacity structures, instructions, adaptation strategies, indices, and simulation models. A functioning LCCAP of a municipal-level authority is one of the important outcomes of the initiative in the Philippines. As pointed out by Benz-Saliasi (2020), this result emphasises the value of

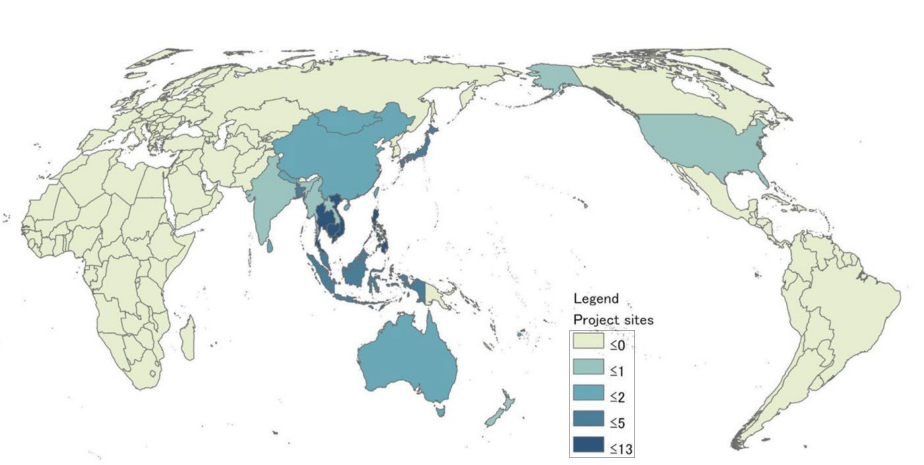

Figure 4. APNA initiative locations
Source: Authors' own work

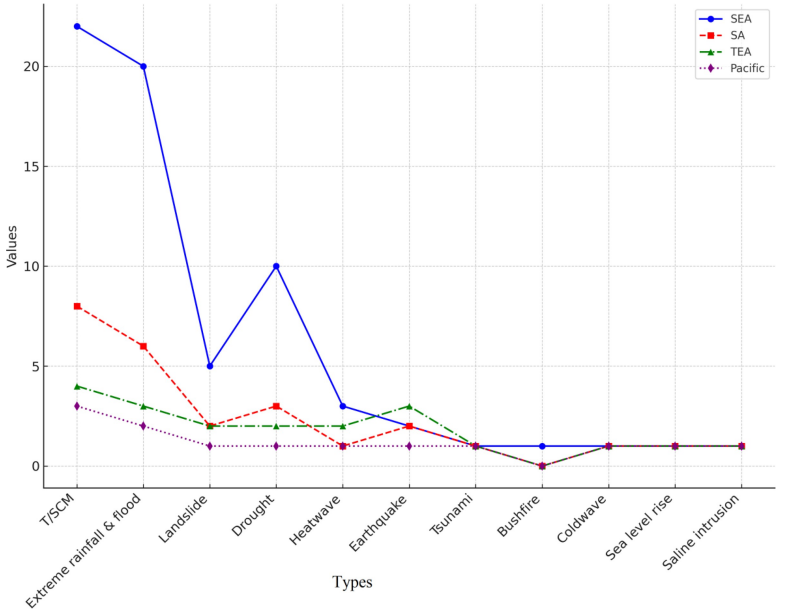

Figure 5. APNA initiative hazards and risks
Source: Authors' own work

capacity creation and the effectiveness of combining human capital from DRR and CCA. The initiatives also included typhoons, landslides and flood disasters. Importantly, projects addressed the development of slow-onset disasters, including heat waves, drought, salinity intrusion and rising sea levels.

4.1.2.2 South Asia. Various initiatives have developed construction and engineering techniques and non-structural resources, such as manuals and toolkits, in the South Asian regions. Hydro meteorological risks are the primary disaster concerns in this area because of its extreme climatic and geographical differences, long coastlines and elevated mountains. The studies highlight timely, accessible and trustworthy information as a non-structural strategy for implementing DRR in the agricultural sector. For instance, national and sub-national policy initiatives aim to improve agroecosystem functionality and services (Ivanovski and Marinucci, 2021). This is also very useful for agricultural disaster response and effect mitigation. Another case in point in South Asia is the use of economic simulations and data from satellite imagery for flood evaluation and mapping (Dafermos *et al.*, 2021).

4.1.2.3 Pacific. Projects primarily focus on flood disasters and rising sea levels in the Asia-Pacific region. Risk maps, indices and frameworks are examples of non-structural measurements. Since most Pacific nations are geographically isolated and their populations have evolved unique responses to climate change, this strategy is considered optimal (Jiskani *et al.*, 2022). Adaptation methods should be based on historical circumstances and identity management, and risk and vulnerability evaluations should be prioritised according to the projects. Adaptation techniques in relation to social and cultural principles ranged from spiritual preparation methods and coping cultures to labour mobility and coastal relocation, as shown in one Fijian project. This made it even clearer how hard it is to make decisions

about migration caused by and related to climate change and how important it is to know how communities feel about changes in the natural environment.

4.1.2.4 A temperate region in East Asia. Typhoons, floods, heat waves, harsh winters and droughts all have a financial and social effect in the temperate East Asian location, which is why these projects sought to address those impacts. Rural areas were also mentioned in the actual case studies, particularly in relation to ecosystem risk and the possible loss of livelihoods, even though the case studies primarily focused on urban populations. According to a study conducted in a Brazil coastal community and referenced by Li *et al.* (2024), NELD, or non-economic destruction and loss, can occur as a result of both fast- and slow-onset catastrophic climate events. This includes losses to health, cultural assets and natural resources. DRR strategy and execution, disaster damages and shelter regulation are all NELD-related practices that the project uncovered. As a result, the municipal government and the communities were able to agree on these policy suggestions, which the community highly values.

4.2 Analysis of the survey data

The survey's results, based on responses from 24 experts, shed light on the benefits, drawbacks and geographical differences of DRR and CCA adoption. Different regional approaches to disaster risk management are evident in the responses, which can be attributed to variations in governance frameworks, financial resources and climate vulnerability. When it comes to addressing extreme weather events, Southeast Asian countries are more concerned with flood preparedness and organisational capacity building, whereas South Asian countries are more focused on agricultural resiliency and ecosystem-based adaptation. In response to the existential risks posed by rising sea levels, the Pacific area has put a greater emphasis on coastal reinforcing tactics, solutions rooted in nature and community-driven adaptation. Urban resilience frameworks that incorporate technology advancements like flood modelling and enhanced risk assessment tools have been adopted by temperate East Asia.

4.2.1 Responses' profiles. The expert professionals whose answers were included in the survey are shown in Figure 6. Most of the participants originated from educational institutions, including research centres and colleges in TEA (Brazil, China and Germany), accounting for 25%, SEA (Malaysia, Thailand and Singapore) for 18% and the Pacific

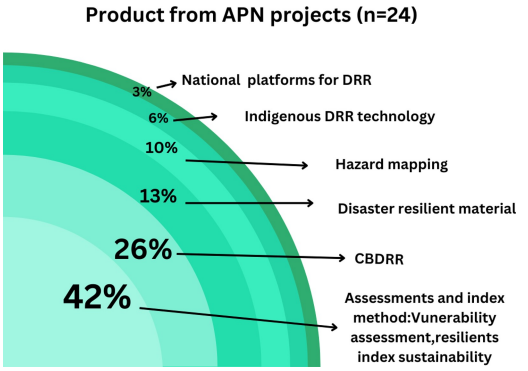

Figure 6. The DRR regards innovation as the result of projects
Source: Authors' own work

Islands region (Australia, Tonga) for 22%. Respondents come from a variety of backgrounds: some work for regional or global organisations based in South Africa (14%), others for TEA (5%) and still a small number from SEA (9%), SA (5%) and India (5%). In the Pacific region, 4% work for private companies, while the remaining 4% in Southeast Asia did not specify their industry.

While 23% of people work for regional governments, global governments use 44% of the population. Fourteen percent of those who reported working with foreign governments are involved in collaboration between nations. Just 8% are involved in regional affairs, while 17% chose not to answer.

4.2.2 According to respondents, which sectors are most affected by climatic disasters? Among the professional practitioners surveyed, 42% said that catastrophic weather occurrences in the previous five years had the greatest impact on the agriculture and food businesses. This might be associated with the increased frequency and severity of natural disasters like typhoons and storms, which wiped out entire fields and flocks of cattle. In underdeveloped countries, the agricultural industry is particularly vulnerable due to its scale and fragility (Datta and Kairy, 2024). This should come as no surprise. Among these, 25% go to the water sector, 21% to the environmental area, 8% to the health sector and 4% to industrial and other sectors. These findings indicate that there is a relationship between natural catastrophes and a lack of food, with the latter having a bigger impact on people's capacity to make a living after a natural disaster has occurred. This suggests that, in the future, while investing in the agricultural sector with capital, authorities should typically examine all the potential risks.

4.2.3 Project-focused disaster stages. The majority of projects (48%) were concentrated on the pre-disaster phase, subsequently followed by the disaster response phase (31%) and the disaster phase (21%), according to the results of the poll's query about the process of catastrophe management. During the phase preceding a disaster, the majority of APN projects prioritised activities such as risk estimation, mitigation, detection, transfer and readiness. While some projects focused exclusively on structural tasks, others included non-structural tasks like alert systems and organising evacuations as part of their disaster response phase. In the wake of a disaster, there is a better opportunity to plan for a subsequent round of avoidance efforts by focusing on rapid post-disaster rebuilding, damage-loss evaluation, rehabilitation efforts and rehabilitation. To accomplish SFDRR Priority 1 and that is to comprehend disaster risk through consistent development of capacity and instruction on DRR throughout the phases, cross-sectoral integration and the execution of innovative scientific and technological advances, it is essential to assess, disseminate and communicate risk data (Nguyen *et al.*, 2021). The survey results also highlight important challenges for effective DRR and CCA initiatives. Limited funding prevents the execution of large-scale adaptation programs, which is an important issue throughout, but especially in developing nations. Furthermore, DRR policies are not productive due to governance weaknesses and insufficient coordination across local, national and regional organisations. As a result of DRR being seen as an independent sector instead of an issue that affects all areas of development, the lack of integration between DRR and CCA into larger development plans makes vulnerabilities worse. Many respondents also mentioned a lack of technical knowledge as an issue with using advanced techniques of risk assessment, prediction and resilience building.

4.2.4 DRR techniques used, both structural and non-structural. According to the survey results from the experts in the field, a balanced approach to DRR is preferred. Non-structural approaches make up the bulk of the strategies used in these projects (58.5%), whereas 4.4% are structurally focused. Approximately 37% of the strategies are a mix of the two, indicating

a comprehensive approach to DRR. This balance ensures that both structural and non-structural aspects of disaster risk are effectively addressed, leading to more robust DRR strategies.

Based on the percentages of both structural and non-structural improvements, a mix of the two is best. Investment in enhancing non-structural initiatives over time, such as developing sustainable capabilities and expertise and promoting collaborative efforts between communities at large, government agencies and other participants (i.e. non-profit organisations, private sector, etc.), is encouraged by SFDRR Priority 3 for the purpose to effectively decrease disaster-related casualties. Strategised co-creation and co-design of dependent-on-needs DRR and CCA strategies should be included in policymaking. Figure 3 shows the geographical distribution of the initiative sites; thus, it is reasonable to assume that DRR and CCA strategies will vary according to regional features and implementation scale. For example, it has been noted that most DRR approaches prioritise mitigation and prevention measures when conducted at the local level. In contrast, CCA approaches place a greater emphasis on enhancing capacity and shared knowledge.

4.2.5 Project-based DRR innovations. The SFDRR plays a significant role in promoting innovation in DRR and technological advancement in DRR (Kul *et al.*, 2020), serving as a link between technological advancement, science and policymaking. When asked, "What instance of DRR developments did you employ or create through your project?" most professional practitioners suggested and used evaluations of vulnerability, community-centred DRR (CBDRR) and disaster-resistant content. The complicated and lengthy processes required in developing a national framework for DRR may explain why they were not as frequently used (Figure 7). However, the SFDRR's emphasis on innovation and technological advancement encourages the use of advanced DRR methods and tools, leading to more effective DRR strategies.

The findings underscore the pivotal role of regional-based DRR in engaging diverse communities, particularly in participative community risk assessment and monitoring. This understanding is crucial, even in the face of recent DRR innovations such as models and technology (28%).

4.2.6 Respondents' perceptions of the relative importance of SFDRR objectives. The survey respondents' ranking of "improving disaster readiness for efficient response" and

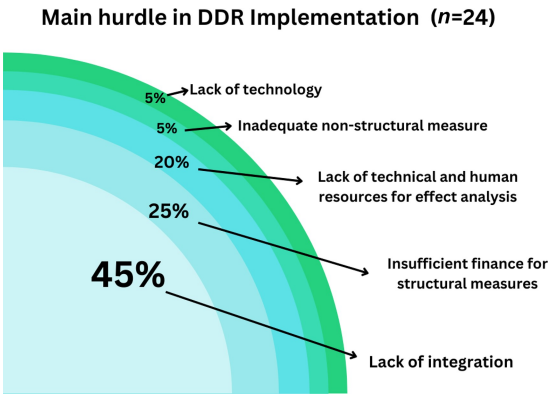

Figure 7. Obstacles experienced by participants in disaster risk reduction implementation
Source: Authors' own work

"building back better" as the most pressing SFDRR objectives underscores the urgent need for collaboration among regional, federal and international governments. This collaboration is essential to developing systems that empower communities to prepare for catastrophic weather and enhance opportunities for better rebuilding after such events.

4.2.7 Respondents' perceptions of the primary obstacles to SFDRR adoption. According to reports, there are a few factors that make it difficult to implement DRR. One of these is the need for integration or integration of DRR into the overall development planning procedure, which accounts for 45% of the obstacles. Another is the need for more financial resources, which accounts for 25% of the problems, and finally, there is a shortage of scientific and human resources, which accounts for 20% of the problems. Additionally, 5% of the time, issues like insufficient non-structural improvements and a need for more technological tools for forecasting and simulation come up. In general, strong institutional frameworks are to blame for these obstacles to DRR execution, as DRR is not considered a top priority. Findings also seem to point to a lack of governance capability as well as accessibility to resources (human, technological and economic) for executing and regulating DRR initiatives. There needs to be more connection between what is known and how building capacity for DRR is actually implemented, according to recent research (Warnken and Mosadeghi, 2018). This finding supports the idea that the complicated web of connections between cultures, organisations, power/governance and ecological systems has gotten surprisingly little attention, even though it needs to be understood to figure out how mitigation efforts, response strategies and stakeholder participation work together.

4.2.8 The most significant SFDRR objective and the project's estimated participation in SFDRR. The expert professionals' responses indicate that Target 2, which aims at minimising the number of affected people, is the most significant SFDRR objective. Nations are taking the issue seriously and taking more measures to lessen their risk, and vulnerable exposure is visible. The third objective is to lessen the financial impact of direct disasters. According to the respondents, local governments can benefit from a national DRR strategy and a system for managing and responding to climate-related and naturally related hazards. This will help keep local development in line with global priorities and prevent the arising of new risks. The participants also place a high value on Target 5, which seeks to increase the number of nations with national and regional DRR strategies by 2022. This goal is centre on the importance of promptly communicating risks through established policies and systems. To ensure effective risk governance structures, UNISDR (Abdeen *et al*., 2021) reports that, over the last 20 years, every member state of the United Nations has worked tirelessly to develop DRR plans and techniques at the national and regional levels to supplement existing policy structures. According to Colenbrander *et al.* (2023), in 2018, one hundred member states declared that their DRR strategies were in line with the SFDRR. This represents approximately half of the member states. Nevertheless, there needs to be extensive and adequate reporting of the efficacy and success of DRR initiatives at the national and regional levels. Expert professionals perceive Target 1 and 7 of the SFDRR as curiously low. This could be because their projects are typically small-scale, affecting only around 100 people on average, and have a negligible impact on mortality rates. On the other hand, Target 7 is more of a continuous process that involves gathering research results and data and making them available.

In terms of the projects' overall effect on the SFDRR goals, the expert professionals' responses show that the local initiatives mainly aimed at helping achieve Target 2, which is to significantly decrease the number of individuals impacted by disasters. The contribution addressed in this portion is seen as purely indicative and interpretive, based on the

respondents' perceptions, since Target 2 is measurable and necessitates a global benchmark and controlled evaluation.

The total contribution of these initiatives can be seen as focusing on the four SFDRR objectives (1–3), with a particular emphasis on Target 2, which aims to decrease the number of impacted people, and Target 3, which aims to lessen the direct economic damage caused by the disaster. A rise in disaster risk mitigation measures is associated with a decrease in disaster-related economic losses, a smaller number of impacted populations, and a lower mortality rate. Including relative values allows for more accurate inference of the actual impacts and extent of disasters. Therefore, the United Nations Global Evaluation Assessment on Disaster Risk Management (GAR) (He *et al.*, 2022) also found that the first four targets have been achieved.

By 2020, national and regional authorities are expected to have developed a DRR action strategy, such as a local adaption plan, at the national-level determined contributing (NDC), etc. according to Target 5 of the SFDRR. Given that the initiatives under consideration here are all collaborative and meant to aid in the formulation of policy, the majority of expert practitioners saw a significant impact from their respective projects on the development of a DRR strategy in their respective project areas. Among those who took the survey, just 7.4% said the project had no role in developing a DRR strategy.

4.3 Integrating CCA and DRR

The report, based on the assessed projects, identifies several significant best practices for improving DRR and CCA outcomes. In areas prone to flooding or typhoons, early warning systems (EWS) are especially important because they allow for the communication of real-time data and community preparation, which greatly reduces economic losses and casualties. Particularly effective in areas at risk of severe weather is the incorporation of sustainable infrastructure into DRR plans, like flood-prone areas' advanced roadways and climate-resilient residential designs.

4.3.1 Overview of DRR and CCA measures implemented via the projects. Nineteen types of DRR and CCA measures have been identified in the projects, each designed with adaptability in mind to mitigate CCR while also addressing fundamental well-being issues, including human, social, generated and financial resources. Categories of DRR and CCA measures utilised or generated through the Additional Material project. Table 2 enumerates examples of particular measures determined by the projects corresponding to the six categories of DRR and CCA measures: structural and non-structural mitigation, monitor potential hazards, coordination efforts, post-disaster rebuilding measures, governance measures and education and training. Table 3 presents a summary of results regarding the measures used and/or introduced for DRR and CCA, along with their regional distribution expressed in percentages. The findings emphasise that initiatives predominantly focus on the urban and rural fields, followed by multi-sectoral approaches, and that initiatives are specific to phases and locations, reflecting the integration of DRR and CCA.

4.3.2 Project-based examples of DRR and community capacity-building initiatives. Implementing catastrophe risk reduction (DRR) and CCA strategies is essential to making communities more resistant to climate-related disasters. A number of initiatives worldwide have implemented targeted plans to adapt to shifting weather patterns and reduce associated risks.

EWS established in at-risk areas are a prime illustration of this principle in action. In the event of a natural disaster, for example, a flood or a cyclone, these systems will sound a warning so that people in the area can take safety measures. A decrease in flood-related deaths and damages has been attributed to the substantial improvement of EWS in

Table 2. An overview of the initiatives' contributions to DRR and CCA metrics, broken down by group category and percentage of each contribution

Structural and non-structural mitigation	Monitor potential hazards	Coordination efforts
- Evaluation of potential dangers (for instance, AWIS) - Frameworks for assessing risk and building resilience - Climate- and disaster-resilient agriculture - The diversification of livelihoods - Database administration - Relocating and planning land uses - Methods used by rural or indigenous communities to adapt	- Institutional structures and policies - Scenario practice - Possible future outcomes	- "Risk assurance" and "risk transmission" - Activities related to human security and disaster relief - Procedures for financial and contingency planning
Post-disaster rebuilding measures	**Governance measures**	**Education and training**
- Damage and loss evaluation - Steps for recovery and rebuilding - "Build back better" and then analyse the documentation	- Regional strategies for growth - Campaigns that encourage - Disaster relief funds	- Distribution of products and materials that raise awareness - Conduct seminars and classes - Conversations between residents, researchers, healthcare providers and government officials - Establishing networks and participating

Source(s): Authors' own work

Table 3. A brief overview of the initiatives' DRR and CCA metrics, split down by group category and percentage of each contribution

Sub regions	Impact mitigation (%)	Crisis preparedness (%)	Response (%)	Post-disaster rebuilding (%)	Governance (%)	Education and training (%)
South Asia	42.88	14.31	28.59	28.59	7.16	51.00
Temperate East Asia	57.16	14.31	14.31	42.88	0	42.88
Pacific	42.88	0	14.31	0	0	57.16
Southeast Asia	51.87	7.43	11.13	29.65	7.43	40.76

Source(s): Authors' own work

Bangladesh, which is a result of the Integrated Disaster Management Initiative. The practical approach is to advocate for sustainable farming methods. Diversified farming and rainwater collection are two examples of climate-smart practices that projects such as India's ICRA initiative promote to farmers. Soil health and the preservation of water are two additional benefits of these practices that contribute to greater food security. Measures in DRR and CCA also rely heavily on infrastructure. The main goal of the "Build Back Stronger" program is to establish infrastructure in the Philippines that can endure severe weather. Elevating roads and buildings in areas prone to flooding is one way to increase security for the community and decrease vulnerability.

Through community disaster risk management (CBDRM) techniques, the inhabitants are empowered to identify risks and create customised responses. Initiatives in Nepal that incorporate traditional practices and regional expertise have been successful in bolstering resistance to natural disasters like earthquakes and landslides. Ultimately, targeted DRR, warning systems, methods of sustainable agriculture, improved infrastructure and community-based initiatives greatly assist in bolstering resilience. These initiatives address both the effects of disasters and the promotion of sustainable development in disaster-prone areas. They are using science to simulate storm water. Another example is urban watershed management, where heavy rains during the rainy season can harm water infrastructure and amenities while also affecting how much water is available in cities like Tokyo, Hanoi and Thailand. To propose solutions and a structure for long-term planning to deal with these water management problems, a model was created that integrates hydrological, engineering, social, economic and weather data. The development and planning of residential stormwater drainage infrastructure can benefit from the model (Wang *et al.*, 2024). Promoting community-based disaster risk management (CBDRM) in which residents actively participate in risk evaluation, response planning and adaptation efforts is another important best practice. When contemporary disaster resilience frameworks include native knowledge and traditional coping methods, the results are spectacular across South Asia and the Pacific. Furthermore, to get funding and technical knowledge for DRR projects, multi-sectoral cooperation among public agencies, NGOs, and private companies has shown to be an essential component.

4.4 Policy integration for DRR and CCA

According to UNDRR, disaster risk management is an important part of sustainable development. The published-2015 sustainable development schedules acknowledge that both climate change and disasters impede advances in development, so it is crucial to improve people's and society's resistance to these threats. Conceptually, DRR and CCA are part of the SFDRR, and the goals of the SFDRR help bring about some important SDGs. The SDGs can be accomplished faster with the help of supporting mechanisms that back up the SFDRR goals and objectives, like finding common and integrated DRR–CCA strategies (Versaillot and Honda, 2024).

Here, we discuss the various ways in which CCA can be defined or used as a component of DRR and how expert professionals see DRR and CCA integrated into policy formulation and mainstreamed throughout sectors. We also outline shared objectives to provide a high-level overview of the connections between SFDRR and the SDGs. Governments should put more money into adaptation measures, work to improve cooperation between governments and boost capacity-building programs on a national and regional scale if they want DRR and CCA to work properly. To ensure long-term resilience towards climate-induced disasters, further research should investigate whether these best practices can be scaled and create frameworks for linking DRR with national development plans.

4.4.1 Important implications from the initiatives. The survey asked questions 14 and 15 to gather suggestions and perspectives on how policies can incorporate DRR and climate change action. We created a co-occurrence relationship between frequently used terms from the answers to broad enquiries to collect suggestions for integrating and combining DRR and CCA across scales and sectors. The following sections outline the two main points that were made clear. An emphasis on DRR initiatives and plans supported by local communities.

Suppose the DRR action plan is to be successful in translating policy into practice, as shown in Figure 8. In that case, it is crucial to prioritise community-based and focused individual strategies. Answers to the query "How can we integrate DRR in the daily operations of regional operators and stakeholders?" from professional practitioners provided the data used to create the figure. Words like "local," "action," "information" and "community" appeared frequently in the responses. We infer from the relationships between these terms that local professionals and communities, in their capacity as direct participants, will play a pivotal role in integrating DRR into the adaptation. To further help achieve DRR and CCA, it is important to educate these pertinent stakeholders and include them in all stages of planning and execution, in addition to the regional governments. For instance, regional populations can play a crucial role in crucial procedures such as developing DRR strategies and co-identification of risks. To maintain effective community engagement, it is critical for authorities to refrain from enforcing their values and opinions and instead give local communities the power to shape and direct DRR initiatives. For instance, foreign organisations and donors should learn about and respect the locals' expertise and resiliency. National authorities appear to have opportunities to

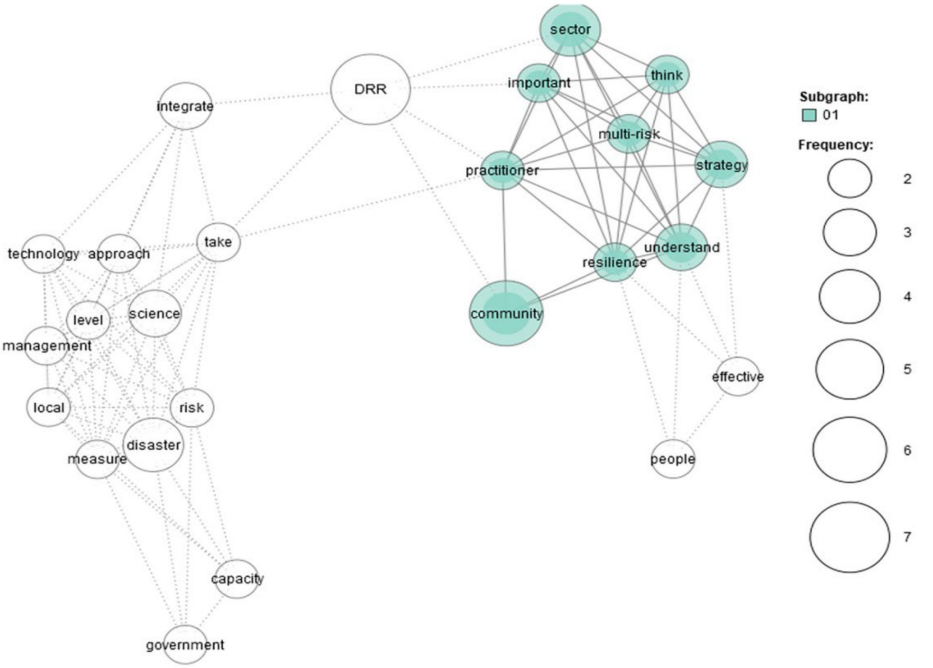

Figure 8. Key components to integrating DRR into social life
Source: Authors' own work

encourage DRR strategy and plan consistency and mutual reinforcements; however, this can only be achieved with the complete buy-in and comprehension of regional communities as well as other non-governmental stakeholders (i.e. community-based groups) who play key roles in the execution.

4.4.1.1 Crucial aspects of integrating DRR across different industries. Figure 8 shows a co-occurrence network that demonstrates a strong association among the various elements involved in incorporating DRR. A distinct black line depicting the strong relationship shows nine critical components of incorporating DRR into national development plans. Essential, multi-risk, "society," "sector," "strategy," "to comprehend," "practitioner," "community," "resiliency" and "think" are among these factors. With the term "With the term "community" being the largest circle (i.e. possessing the highest regularity), we can see how important it is to have community members as main actors and players among three primary variables that are similar: sector, professional, and community. In an era where humans rule, the long-term effects of climate change are expected to be enormous; thus, it is critical to place an emphasis on human capital, particularly community funding, and recognise that individuals contribute to finding a solution. A community's resiliency depends upon its history of interconnection, organisation, disorganisation, and reorganisation; local communities perform a pivotal role in this chain of events, and they are also the economic pioneers and primary actors in the agricultural sector [16]. Governments, professionals and stakeholders at all levels have begun to see that building resilience and adapting are essential for human beings to be resilient in the face of climate change, which becomes more apparent and compelling by the day. According to the IPCC Report, to mitigate the negative impacts or maximise the positive ones, communities and individuals must adjust to the present and future state of the climate and its consequences. This process of adaptation can be seen as part of the broader context of DRR mainstreaming. Additionally, experts stressed the importance of local participation and empowerment for effective DRR mainstreaming spanning sectors and governmental levels, specifically in impacted communities.

Decisions related to DRR are infamously complicated and challenging in multi-risk scenarios; other considerations involving the terms "strategy," "comprehend," "important," "resiliency," "think" and "multi-risk" corroborate this. The utilisation of integrated DRR and CCA (DRR/CCA) strategies including, but not limited to, livelihood diversity, the use of traditional knowledge and procedures, no-regret methods and the development of social capital and partnerships was recommended by one respondent.

4.4.2 Interconnections between SFDRR and SDGs. Considering the DRR and CCA methods and strategies used in the 24 APN initiatives, the survey results regarding the most significant SFDRR target according to participants, and the basic SFDRR concentrate to the regional initiatives in the present research primarily contributed, we determined that SFDRR Target 2 corresponds with the SDGs Targets 1.5, 11.5 and 13.1, as listed below:

- Addressing marginalised and vulnerable populations' susceptibility to climate-related risks and socioeconomic shocks is a primary focus of Target 1.5. In a similar vein, Target 11.5 seeks to protect populations at risk from water-related and other disasters while minimising disaster-related mortality, individuals affected, and economic losses relative to global GDP. Goal 13.1 is for all countries to increase their ability to adapt and support the effects of climate change and other natural disasters.
- In addition to these goals, incorporating DRR and CCA strategies into the SDGs necessitates incorporating risk reduction strategies into development frameworks for the short, medium and long term. To keep DRR and SDG initiatives in sync, it is important to track development on a national and regional scale.

- The SFDRR and the SDGs have a lot in common, including the following: (1) keeping tabs on the number of casualties, missing persons, and disaster-affected individuals per 100,000 people and (2) making sure that nations have effective plans to reduce disaster risk at the national and local levels. These competing goals highlight the necessity of cross-sectoral cooperation to achieve sustainable development, enhance resilience and manage risks.

5. Conclusion

From 2017 to 2022, the Asia-Pacific area was impacted hard by various hazards and risk factors. This study mapped out the various DRR and CCA regulations, including structural and non-structural ones, and listed each project's unique set of measures. An important takeaway from the study was the need to modify adaptation strategies to specific local contexts by integrating both structural and non-structural efforts for risk reduction. Since different regions are vulnerable to different types of disasters, this study's results highlight the need for disaster risk management programs that are regionally relevant. There are various ways to achieve the goals set out by the SFDRR. For example, Southeast Asia is focussing on flood preparedness, South Asia is implementing agricultural resilience initiatives, the Pacific is planning for prolonged adaptation to increasing sea levels and Temperate East Asia is integrating urban resilience frameworks. Policymakers and researchers need to recognise these distinctions if they want to create resilient DRR and CCA strategies that are flexible and focused on specific regions. In the future, research should focus on improving regionally adaptive structures to make the world more resilient to disasters, with a focus on making context-specific strategies a priority in disaster management planning.

In addition, the reports and important outcomes of the regional initiatives effectively outline the importance of resilience-enhancing at the regional level, which includes developing skills and training, in addition to vulnerabilities and risk evaluations, as crucial components in disaster prevention and mitigation. Given this area's multi-risk environment, it is expected that direct participants and local and national authorities will work together to establish common or collaborative development routes (e.g. by way of a DRR strategy or collaboration in cross-sectoral expansion planning). This will provide synergy between DRR and CCA. The current study shows that there is a possibility of synergy at the regional level, and it also clarifies the emerging concept of integrating DRR and CCA into progress. Collaborating across various ranks and sectors is no easy achievement, but innovations that focus on people and their needs could help stakeholders work together more effectively. By analysing the main results of DRR and CCA projects in the area in conjunction with questionnaire responses from experts in the field, we were able to piece together how local actors and players responded to risks and piloted climate actions. We conclude that dangers in the Asia-Pacific area occur at varying time and spatial scales, impacting food production and water-related sectors the most. Consequently, societies and governments can work together most effectively at the local level to implement DRR and CCA strategies. Our analysis of these APN projects revealed several insights into the challenges and opportunities of integrating DRR and CCA into various industry practices, as well as opportunities to fill important gaps in our understanding and chart a course for the future. Finding these suggestions in the following paragraph is in accordance with SFDRR Target 5, which is to increase national and regional DRR disaster risks by 2020.

6. Policy implications

According to this research, DRR and CCA programs are not sustainable without first including and strengthening the local community. Results from this study of disaster

resilience initiatives in Southeast Asia, South Asia, the Pacific and Temperate East Asia show how important it is to integrate academic studies, policy frameworks and community-based initiatives. The study's important implications all positively impact research, practice and society. Disaster risk management plans at the federal, state and local levels can benefit from the study's policy suggestions. This research shows that disaster resilience initiatives should not be considered in a void but rather should be part of larger development objectives that include CCA and DRR. Here are some policy implications:

- Providing more funding to local governments so they may implement programs to strengthen their ability to prepare for emergencies and boost resilience.
- Creating appropriate policy frameworks for DRR and CCA planning that value native and traditional knowledge.
- Including climate resilience in land-use policy and initiatives to build infrastructure is a key component of risk-informed urban planning.
- Educating the public through community-based risk education initiatives on the significance of disaster readiness.
- Improvements to economic stability through mitigation of economic losses caused by disasters through preventative resilience actions.
- Promoting inclusive risk reduction measures and increasing public participation in disaster decision-making to improve disaster governance's credibility.
- Exploring methods of adaptation for the long run that combine conventional wisdom with modern technical skills.

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