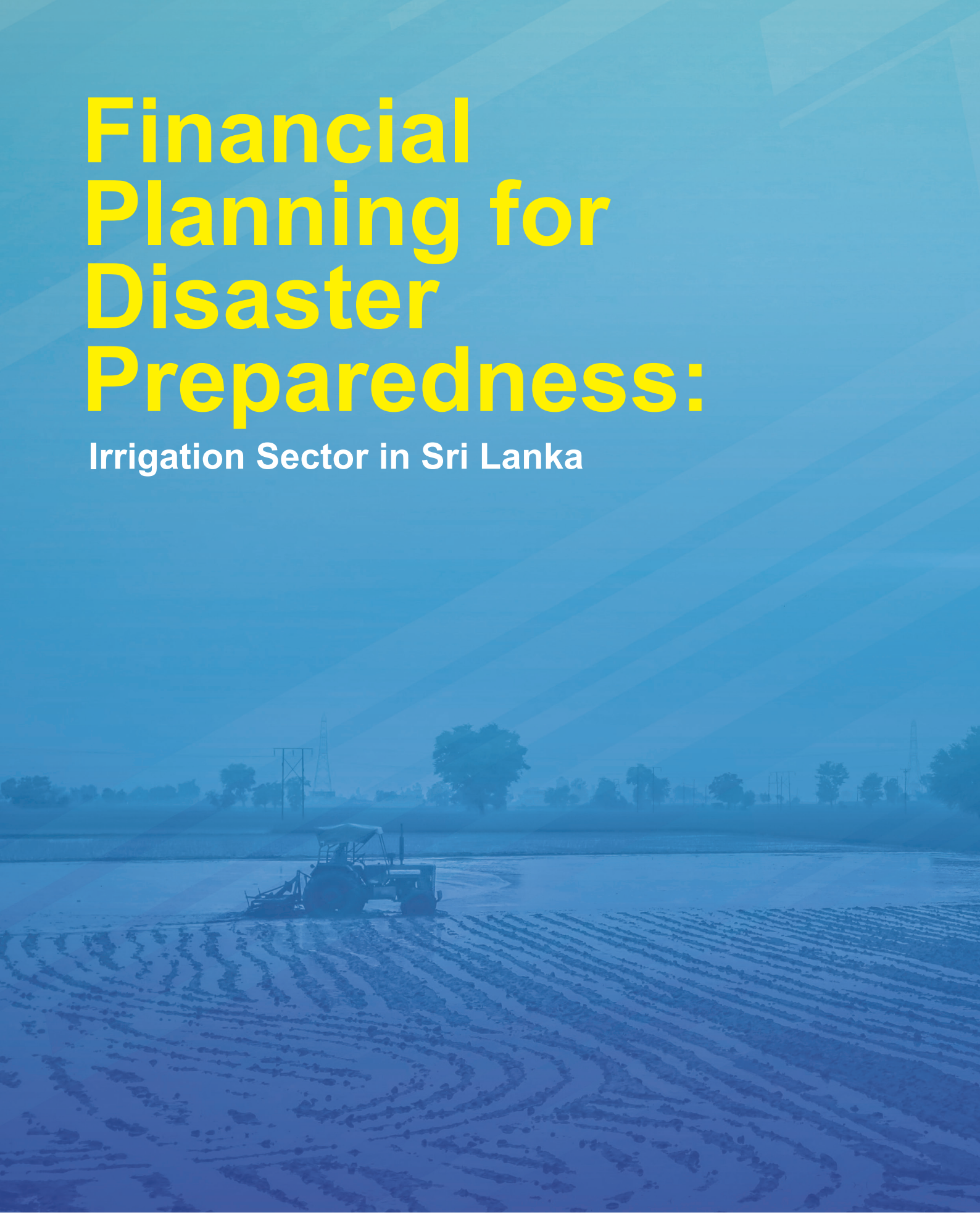
Financial Planning for Disaster Preparedness:

Irrigation Sector in Sri Lanka



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This information content in this publication is presented for informational purposes only, and does not attempt to predict the cost of insurance cover that will actually be experienced under the scenarios considered. The figures presented should be considered as a sensitivity analysis examining the impact on certain drivers of the cost of insurance that arises from different pooling scenarios. The actual impacts on costs that will be realized under any scenario will be influenced by numerous factors, many of which are not considered here.

The United Nations Development Programme(UNDP) delivered output 3 of such Project with the aim to enhance technical capacities for recovery planning, and implementation, including adapting the Post Disaster Needs Assessment (PDNA) and Disaster Recovery Framework (DRF) guidelines to national contexts and specific infrastructure sectors, with the focus of this guidance being Sri Lanka irrigation sector.

This guidance has been prepared by independent consultant Mr. Salvador Perez, under the overall supervision and technical guidance of Ms. Rita Missal – UNDP Recovery Advisor, Ms. Joana Sampainho – UNDP's Recovery Analyst, and in close collaboration with Punyavana Vishaka Hidellage – the National Project Coordinator in Sri Lanka.

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Acronyms

ADB	Asian Development Bank
CDMP	Comprehensive Disaster Management Program
DDMCU	District Disaster Management Coordination Units
DMC	Disaster Management Center
DPPER	Disaster Preparedness Plan for Emergency Response
DRF	Disaster Recovery Framework
DRR	Disaster Risk Reduction
GoSL	Government of Sri Lanka
IDMP	Institutional Disaster Management Plan
JFPR	Japan Fund for Prosperous and Resilient Asia and the Pacific
JICA	Japan International Cooperation Agency
M/DM&HR	Ministry of Disaster Management and Human Rights
NCDM	National Council for Disaster Management
NEOP	National Emergency Operations Plan
NIC	National Identity Card
NITF	National Insurance Trust Fund
NNDIS	National Natural Disaster Insurance Scheme
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ODA	Official development assistance
PDNA	Post Disaster Needs Assessment
UNDP	United Nations Development Programme
WB	World Bank

1. Executive Summary

Sri Lanka is prone to disasters, such as storms, cyclones, floods, landslides, and tsunamis. In accordance with the ND-GAIN[1] indices, both the Climate Risk Index[2] as well as the Inform Risk Index[3], the country faces significant challenges in terms of financing losses and damages. Based on these indexes, Sri Lanka is one of the countries with a high risk to disasters.

Moreover, over the coming decades, Sri Lanka is expected to be affected by a warmer climate resulting from climate change. Therefore, the severity of hazards is expected to be exacerbated due to the climate change.

Given the disaster challenges Sri Lanka faces, as well as the costs of damage currently following an upward trend within the country, it is especially important to assess and implement ex-ante risk financing strategies, such as the proposed in this document: specific annual budget allocation for disaster, disaster fund, contingent credit, and parametric sovereign insurance to respond effectively to these challenges from a public finance perspective.

The aim of this report is to raise awareness of the fiscal impact that natural disasters have on Sri Lankan public finance. In this context, the report recommends ex-ante risk financing instruments as a part of disaster risk financing strategy.

An ex-ante risk financing strategy, in contrast to ex-post financing, reduces liquidity risks and uncertainties around financing after a disaster and prevents extra charges associated with funding, given that the sovereign risk profile could be negatively impacted. Thus, ex-ante risk financing instruments increases public finance's resilience against disasters.

This can result in a better response to and recovery from disasters and an increased focus on prevention and preparedness. It also enables an increase in the level of control and predictability in the management of public finances.

The core objective of this report is to provide technical inputs for the Government of Sri Lanka to develop the country's financial preparedness planning and assess post-disaster budget execution capabilities.

The primary components of this report are:

- An analysis of disasters risk profile of Sri Lanka, considering damage costs, affected people, and major hazards;
- An overview of the main legal and institutional disaster management policies;
- A review of current disaster budgetary processes, including case studies of financial instruments in place highlighting those focused on ex-ante and ex-post financing while estimating Sri Lanka's financing gap in the irrigation sector;
- Based on the estimated financing gap, an ex-ante risk financing instruments portfolio analysis is presented, illustrated through a hypothetical disaster scenario in the irrigation sector and providing insight into how different financial instruments may interact and help close—to a certain extent —the financing gap;

1 https://gain.nd.edu/our-work/country-index/rankings/

2 https://www.germanwatch.org/en/17307

3 https://drmkc.jrc.ec.europa.eu/inform-index

» With respect to sovereign parametric insurance focus in the irrigation sector, the analysis sought to identify several trigger point metrics for a set of insurance schemes, illustrating the impact of a comprehensive disaster risk financing strategy across several layers of insurance.

1.1 Risk profile

According to Desinventar, Sri Lanka experienced 25,504 incidents linked to natural disaster events between 1965 and 2020. Floods were responsible for the majority (32.7%) of these incidents[4] , whereas strong winds and droughts accounted for 23.6% and 12.0%, respectively. However, tsunamis are the less frequent, but resulted in the higher impacts. Landslides rank second in causing substantial damages. Among all hazards, floods and tsunamis have impacted the most households.

According to EMDAT database for Sri Lanka, between 1964 and 2022, there was a noticeable rise in the cost of damages trend, for example in the period 1964 to 2005 the annual average cost reaching US$89 million. This cost escalated to US$327 million annual average cost from 2006 to 2022, indicating a 3.6x increase in the annual average cost of damages from the earlier period, even without accounting for the 2004 tsunami amount of damages the trend remains growing up.

While the 2004 tsunami had a notable effect, floodings have caused the highest damage costs. Approximately 50% of the damages during the assessed period resulted from flooding events, with the tsunami accounting for 30%, and the remaining 20% arising from other natural hazards.

1.2 Fiscal disaster management

Currently, there are very few instruments for disaster risk financing in Sri Lanka. Most of the funding for these instruments comes from the national budget and the donor community, particularly international donors. As such, funding is provided in an ex-post manner.

However, there is no specific budgetary line in the State Budget for disasters response and recovery. Instead, when disasters occur, from a general budgetary line takes funds to be allocated to different ministries and state agencies budgets, which complicates the monitoring of budgetary allocations. Although the Ministry of Disaster Management provides some insight into the resources designated for disasters, it only accounts for a small proportion of the total budget assigned to major events.

On the other hand, an insurance program funded by the government is in place which used to provide nationwide financial coverage for property damage or loss of life caused by natural disasters, except for droughts that result from natural events. In 2016, the Ministry of Finance initially allocated LKR 300 million (US$1.8 million) for this purpose. This program is currently discontinued.

4 A disaster can be composed of several incidents, according to the classification of Desinventar.

1.2 Financial instruments targeting disasters

There are numerous options available to enhance Sri Lanka's sovereign disaster risk financing strategy by examining worldwide best practices in disaster risk management and evaluating the current risk financing instruments in place, with a particular focus on the irrigation sector to help enhance Sri Lanka's disaster risk financing strategy in this particular sector.

For instance, establishing a dedicated budget line item in the national budget managed by the Ministry of Finance would increase accountability and visibility of funds allocated to disaster preparedness, providing much needed transparency to affected populations and key stakeholders involved in disaster management.

As developing economies look for ways to accumulate cash for rainy days, disaster funds are increasingly being used as a source of accumulation. The purpose of this type of instrument is to meet the needs of developing economies, providing contingency funding to the government in the case of major disaster, and then finance government services, especially those linked to emergency and recovery expenses. Consequently, they must be tailored to the government's risk profile as well as the sector for which they will be used in order to be effective.

There is also the option of contingent credits as an ex ante financial instrument, which establishes a relationship between a financial institution (usually a multilateral financial institution or a development organization of a high-income country) and a borrower, in the form of a contractual agreement. According to the terms of the loan, a catastrophic event (previously defined) will trigger the disbursement of funds if such an event occurs. Because of this, the negotiation of the loan takes place prior to the disaster occurring as a result.

Contingent credit could be used for flooding, as many other natural hazards, the financial mechanism is very flexible to be customizable for a single hazard or several ones. These instruments could be triggered for medium (30 to 90 years of return period) to high severity events (above 100 years of return period). This instrument could be activated with a national state of emergency as a main trigger mechanism.

Last but not least, parametric insurance is a form of insurance in which an insured (the government) and an insurer enter into an agreement. As a result of a previously defined catastrophic event, the parties agree, in exchange for a premium, to compensate each other for damages resulting from the later occurrence of the event. A disaster can be defined via certain scientific parameters through which you can verify that a disaster has taken place and then disburse the payment accordingly.

Several examples internationally could illustrate how parametric insurance could fit the need of government contingent financing in case of disasters. For example, Mexico in 2006 issued a parametric cat bond (a type of parametric insurance) for earthquake and in 2009 for hurricanes. Since that first insurance, Mexico become in a world leader getting insurance coverage from cat-bonds in periodical basis. In Latin America, many other countries followed this example, like Colombia, Chile, and Perú, in Asia Turkey and The Philippines with similar insurance schemes dedicated for disasters.

In the Caribbean, government of Islands States created an insurance pool (in the way of an insurance company) that provides insurance coverage for government members of the pool in case of a major disaster. This scheme was expanded recently to central America countries, where there are many countries with similar insurance coverage.

The insurance pool has been replicated to Africa and the Pacific Island States, under the same principle. Which is provide insurance coverage for disaster spending, for instance emergency expenses and recovery, for the government participants in those schemes.

2. Introduction

Sri Lanka is exposed to multiple climatic hazards (droughts, floods, and landslides) and tsunamis, and is ranked as a high-risk country by Country Index - Notre Dame Global Adaptation Initiative (ND-GAIN), the Climate Risk Index, and the Inform Risk Index.

Climate change is expected to increase the frequency and severity of weather-related disasters through a continued rise in mean temperatures and increasingly variable precipitation. Under the highest emissions pathway, (RCP8.5) temperatures are projected to rise from 2.9°C to 3.5°C by the 2090s, over the 1986–2005 baseline. In contrast, warming of 0.8°C – 1.2°C is projected over the same time horizon on the lowest emissions pathway (RCP2.6)[5].

Sri Lanka faces a high challenges to improve readiness to respond to climate shocks, currently ranks low at 104 out of 192 countries (Figure 1).

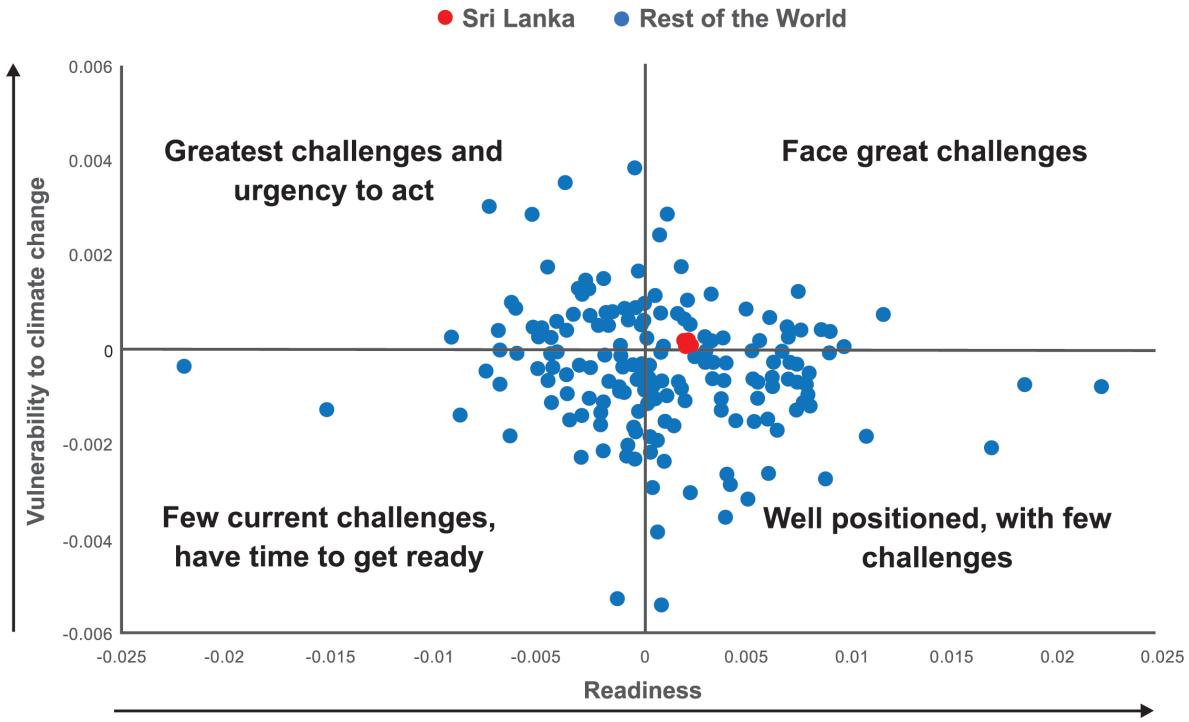

Figure 1. Comparing Sri Lanka readiness to respond to climate shocks and the rest of the world

Source: Data from ND-GAIN.

Note: The Notre Dame Global Adaptation Initiative (ND-GAIN) aims to help private and public sectors prioritize climate adaptation, ultimately lowering risk and enhancing readiness.

5 Climate Risk Country Profile: Sri Lanka (2021): The World Bank Group and the Asian Development Bank.

Between 1965 to 2022, there was a clear upward trend in the cost of damages. During this period, the annual average cost of damages was US$ 89m, compared to an annual average of US$ 327m from the period 2006-2022. The annual average cost of damages saw a 3.6-fold increase from the 1964-2005 to the 2006-2022 period, even without considering the 2004 tsunami (which, on its own, caused US$2 billion worth of damages).

The 2004 tsunami was a turning point in disaster risk management public policies. The year after the tsunami, Sri Lanka made reforms and enacted the Disaster Management Act. These new policies boosted disaster risk management as never before in the country. In addition, the National Council for Disaster Management (NCDM) and its operational office, the Disaster Management Center (DMC), were established for issuing operational guidelines and operate during and after the disasters.

However, in terms of disaster risk financial management, there is still a pending agenda to be addressed. Disaster risk financing is currently concentrated in retention instruments, (those funded directly from the own State resources) through post-disaster budget reallocations. In the case of irrigation-related ministries, there is a line item for maintenance costs that is often used to finance the first post-disaster expenditures.

Sri Lanka is no stranger to innovative instruments; in 2014, it signed a $102 million Development Policy Loan with a Catastrophe Deferred Drawdown Option (DPL with a CAT DDO), a line of credit that can be drawn on partially or in full if a country declares a state of emergency after a natural disaster. The DPL with a CATDDO is a facility of the World Bank provides through some type of loans, which originally targeted for specific proposed and could be used in some percentage to finance disaster losses, in case of a major disaster. This instrument was not renewed after this first experience with disaster risk financing.

There is still much to be done in disaster risk financing for the government. This report presents options for ex-ante disaster risk financing instruments and explores how retention instruments could be incorporated, such as by creating an explicit budget line for disaster response and recovery, as well as a disaster fund, and reinvesting in contingent lending schemes. Finally, since this report specifically analyzes the irrigation sector, the possibility of providing insurance against the impact of disasters on that sector is explored.

In this report, we assess current instruments established in Sri Lanka and assess alternative funding sources. Section 1 provides an executive summary; Section 2 provides an introduction; Section 3 outlines Sri Lanka's risk profile; Section 4 summarizes legal and institutional disaster risk management structures; Section 5 discusses fiscal disaster management in Sri Lanka; Section 6 evaluates the risk-retention and risk-transferring instruments portfolio for tropical cyclones. The final sections,- Section 7 and Section 8, provide limitations and recommendations resulting from the analysis.

3. Risk Profile and Impacts of Disasters in Sri Lanka

The data used in this report was collected from various sources including EM-DAT[6] , DesInventar[7] , and the Government of Sri Lanka (GoSL). Overall, the data provides insights into hazards that the country faces.

According to Desinventar Database, in Sri Lanka, from 1965 to 2020, there were 25,504 incidents[8] linked to disasters events: 32.7% were floods, followed by strong winds and droughts, accounting for 23.6% and 12.0%, respectively. It is important to point out that droughts and floods are the hazards with higher number of affected people[9] in total accumulated during the period assessed. However, assessing natural hazards by event, tsunamis have caused the most deaths, injuries, and missing persons in a single disaster event.

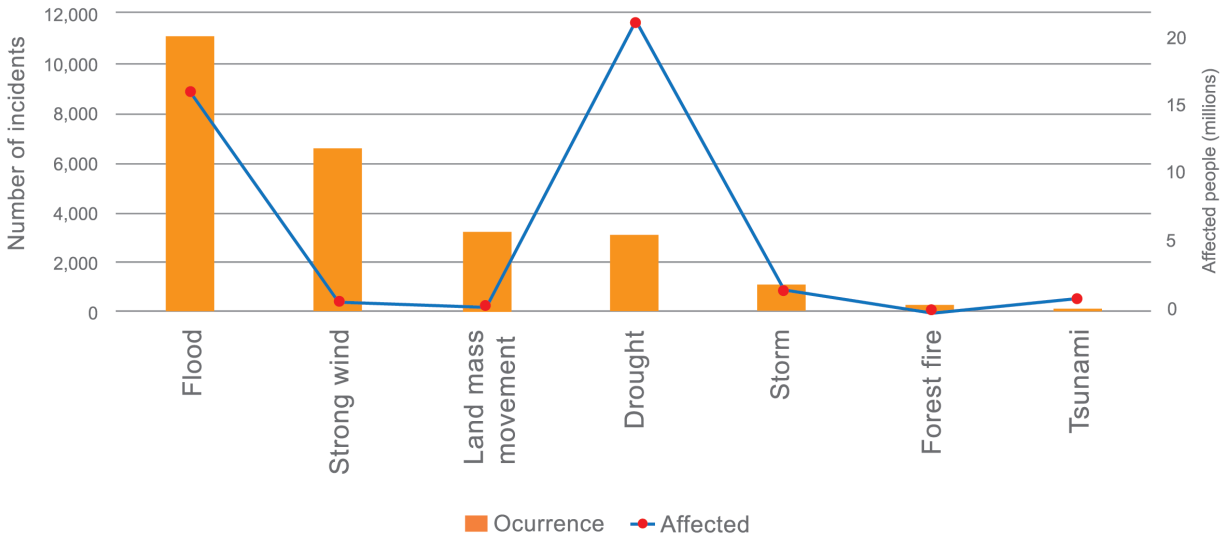

Figure 2. Frequency by peril and impact size in people affected (million)

Source: Desinventar

The EM-DAT database highlights the most frequent natural hazards that affected Sri Lanka between 1964 to 2022 in terms of the frequency and cost of damage by hazard. Floods were the most frequent peril in the period, occurring nearly every 0.7 years and costing an average of US $44 million (2021, values) per event (Figure 3), with a total cost of US $3,608 million (2021, values[10]). Droughts and storms both occurred approximately every 4.5 years, with an average cost reaching US $5 million and US $99 million (2021, values), respectively (each totaling US $55.3 million and $1,286 million, (2021, values)). A single tsunami caused US $ 2,040 million in damages (values in 2021).

6 EM-DAT, https://public.emdat.be/data

7 http://www.desinventar.lk/

8 As was mentioned previously, for Desinventar database an incident is part of

9 EM-DAT classify the incidents in 113 catastrophes.

10 Refers to the prices of the year of reference.

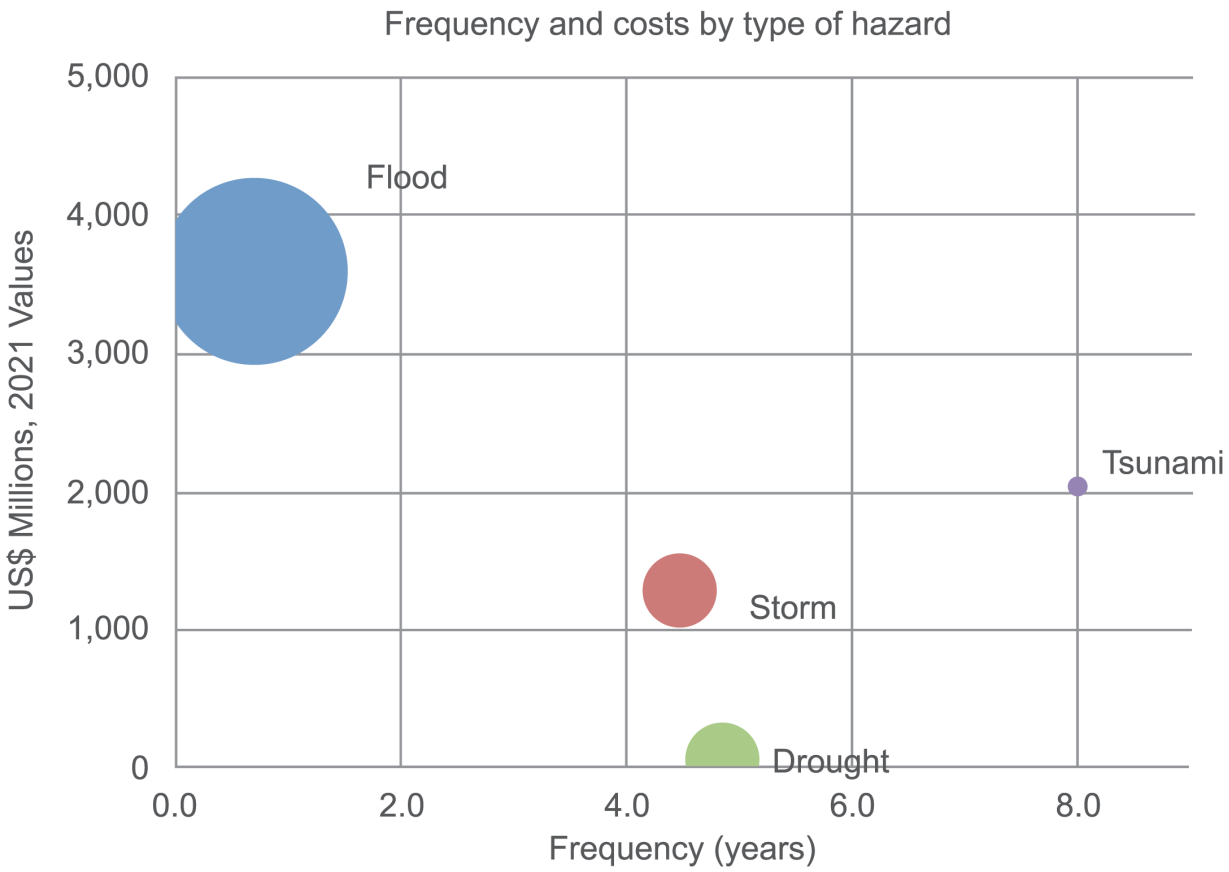

Figure 3. Frequency by peril and impact size in US $Million (2021, values)

Source: EM-DAT data and estimation based on author methodology

The inconsistency and lack of data regarding cost of damages and loses is a big challenge for Sri Lanka (according to PDNA[11] definitions). There is also a lack of data breakdown by sector, at the subnational and local levels. For national data, EM-DATA provided 58 years of available data from 1965 to 2022.

Figure 4 shows an overview of the cost of the cost damages during the period 1965 to 2022. During this period, there was a clear upward trend in the cost of damages from 1964 to 2005. The annual average cost of damages was US$ 89m. This indicator increased to US$ 327m during the period 2006-2022. The annual average cost of damages grew 3.6x from 1964 to 2005 compared to the period 2006 to 2022, even without considering the major tsunami event that occurred in 2004.

11 The Post-Disaster Needs Assessment (PDNA) is an international methodology for estimating the physical damages, and economic losses of recovering from a disaster.

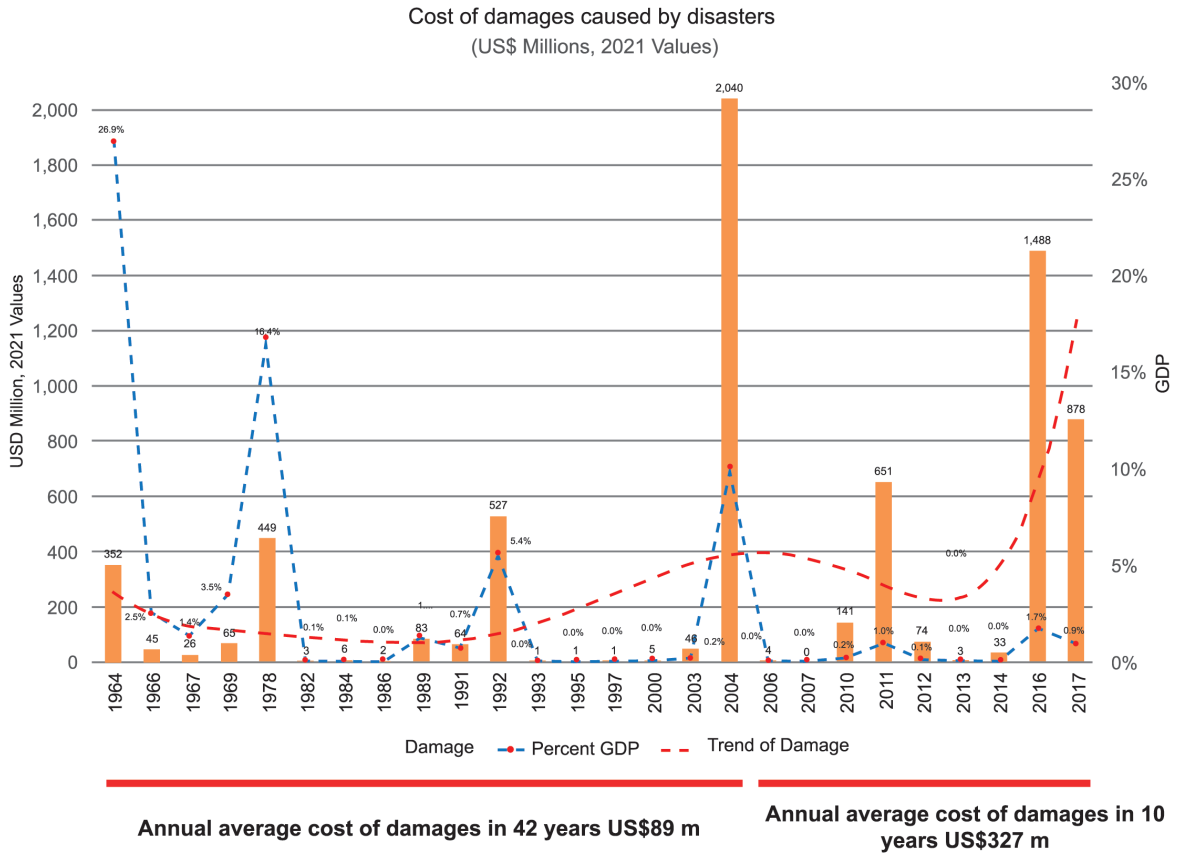

Figure 4. Cost of damages caused by disasters, (US $Million, 2021 values)

Source: EM-DAT data and estimation based on author methodology

The 2004 tsunami was the most severe catastrophe in the period studied (1964-2022). However, according to Jackson (2006)[12] , this was not a single event. Considering the geological history of Sri Lanka, it is not a unique event, either. In fact, Jackson (2006) classified this event as a 200-year return period[13] . According to the paleotsunami history assessment, several similar events have occurred in the last 5500 years.

Despite the tsunami in 2004, the key driver for explaining the cost of damages historically are floodings. For the period assessed, approximately 50% of the damages arose from flooding events; the tsunami accounted for 30% and the rest (20%) were due to other natural hazards.

12 Jackson, K. L. (2008). Paleotsunami History Recorded in Holocene Coastal Lagoon Sediments, Southeastern Sri Lanka [University of Miami].

13 A return period is equal to the reciprocal of the expected frequency. There is an inverse relationship between the average frequency of occurrence and the return period between occurrences. For instance, a 10-year flood has a 10 percent chance of being exceeded in any given year, and a 50-year flood, 0.02 percent.

4. Legal and institutional arrangement for disasters management

The 2004 tsunami was a watershed in the disaster risk management in Sri Lank. After this event, the country took several actions to strengthen its disaster management policy[14,15,16]: For example, it made reforms in 2005 and enacted the Disaster Management Act. In addition, the National Council for Disaster Management (NCDM) as a high-level policy-making body to protect the country from any calamity, and its operational office, the Disaster Management Center (DMC), were created[17], under the NCDM, as the lead agency in disaster risk management in the country in the implementation of the NCDM guidelines

In February 2006, the Ministry of Disaster Management and Human Rights (M/DM&HR) was appointed to address human rights issues. In 2007, the National Disaster Management Coordination Committee was established, implementing the Hyogo Framework for Action. In 2009, the DMC initiated a process of developing nine hazard profiles of the country. In 2010, the National Disaster Management Policy was adopted, which considers the participation of local level authorities and supports multi-stakeholder approaches. In 2014, the NCDM approved the Sri Lanka Comprehensive Disaster Management Program (CDMP), which considers reducing climate and disaster risks by minimizing impacts on people, property, and the economy[18].

The Sri Lanka Disaster Management Act established a comprehensive framework for disaster risk management, leading to a policy shift from response-based mechanisms to a proactive approach to disaster risk management.

It also requires the preparation of the National Emergency Operations Plan (NEOP) and the Institutional Disaster Management Plans to counteract a disaster at the national and subnational levels[19].

The chairman and vice chairman of the NCDM is H.E. The President and Hon Prime Minister, respectively. Other members are Leader of the Opposition, Ministers in charge of 20 selected subject areas, Provincial Council Chief Ministers, and five members of the Opposition[20].

14 UNDRR, (2019). Disaster Risk Reduction in Sri Lanka - Status Report 2019.

15 Disaster Management Centre, (n.d.). DMC Profile. http://www.dmc.gov.lk

16 Asian Disaster Reduction Center, (2019). Country Report: Democratic Socialist Republic of Sri Lanka. DMC Sri Lanka. https://www.adrc.asia/countryreport/LKA/2019/Srilanka_CR2019B.pdf

17 Asian Disaster Reduction Center, (2019). Country Report: Democratic Socialist Republic of Sri Lanka. DMC Sri Lanka. https://www.adrc.asia/countryreport/LKA/2019/Srilanka_CR2019B.pdf

18 UNDRR, (2019). Disaster Risk Reduction in Sri Lanka - Status Report 2019.

19 State Ministry of Defence and Disaster Management, (2017). National Emergency Operation Plan (NEOP), August 2017. Disaster Management Centre. http://www.dmc.gov.lk/images/pdfs/NEOP/NEOP_English.pdf

20 Asian Disaster Reduction Center, (2019). Country Report: Democratic Socialist Republic of Sri Lanka. DMC Sri Lanka. https://www.adrc.asia/countryreport/LKA/2019/Srilanka_CR2019B.pdf

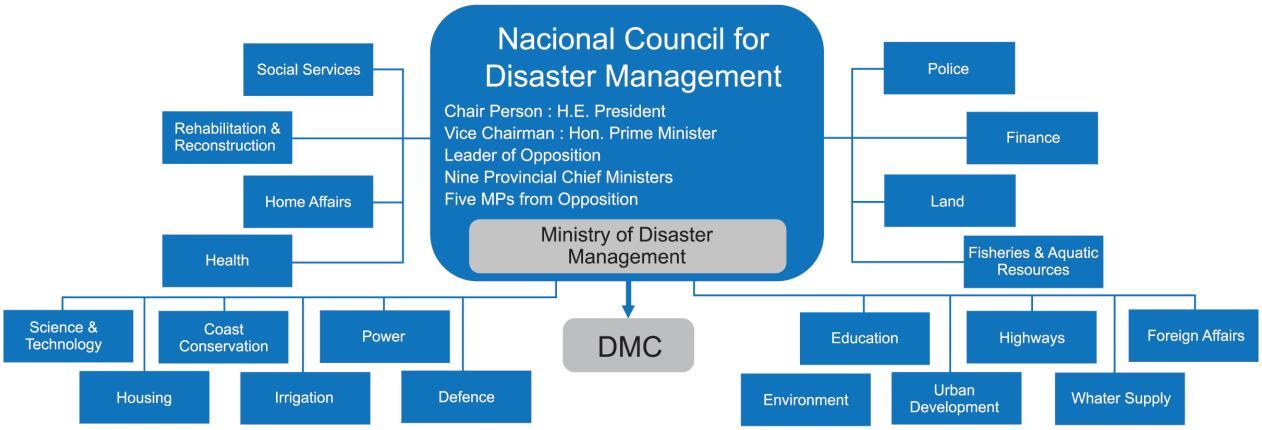

Figure 5. Structure of National Council for Disaster Management
Source: Disaster Management Centre. http ://www.dmc.gov.lk

The main activities of the DMC are research and development, mitigation, planning preparedness, early warning dissemination to the vulnerable population, emergency response, relief coordination, and post-disaster activities in collaboration with other key agencies. To facilitate coordination and implementation of all DMC activities, District Disaster Management Committees were established in the district and Grama Niladhari Wasams division across the country. District Disaster Management Coordination Units (DDMCU) were also implemented in all districts to carry out Disaster Risk Reduction (DRR) activities at the sub-national level [21].

4.1 Sri Lanka's National Disaster Management Policy

A key objective of the National Disaster Management Policy is to introduce sustainable mechanisms, structures, and programs, as well as to establish mechanisms that will help coordinate disaster management efforts at all levels. The aim is to ensure that resources are available through a special fund for DRM activities, so that economic activity and the environment are not disrupted. This policy made DRM a core component of sectoral development programs, ensures that disaster and disaster threat response protocols and guidelines are followed, and that reconstruction and rehabilitation projects adhere to higher standards. It also promotes community-based disaster management and microinsurance to improve the resilience of vulnerable communities by introducing planning guidelines and building codes. The implementation of these measures can enhance Sri Lanka's DRM capabilities and contribute to sustainable development.

21 Disaster Management Centre, (n.d.). DMC Profile. http://www.dmc.gov.lk

4.2 National Disaster Management Plan (NDMP)

The regulation introduced the five-year national disaster management plan, which represents the overall framework developed for the country's disaster management. It outlines specific plans to mitigate the different types of disasters experienced in various areas[22]. The guidance document covers the planned activities of the major phases: mitigation, preparedness, emergency operations, and post-disaster activities such as relief, recovery, and reconstruction. Training, public awareness, and education are also covered in the above phases[23].

NDMP incorporates aspects such as institutional mandates and institutional development; hazard, vulnerability, and risk assessment; multi-hazard early warning systems; disaster preparedness and response planning; disaster mitigation and integration into development planning; community-based disaster management; public awareness, relief, immediate recovery, rehabilitation, and reconstruction; education and training[24].

All state sector agencies, provincial councils, and local authorities should develop the Institutional Disaster Management Plan (IDMP) based on the NDMP, which will be useful for developing the country's response and preparedness capacity[25]. All these plans at all levels and different sectors are to be developed in conformity with the NDMP and NEOP and will consist of the following component parts, as applicable[26] :

1) Risk Assessment,
2) Disaster Prevention and Mitigation Plan,
3) Disaster Preparedness Plan for Emergency Response (DPPER),
4) Contingency Plans,
5) Disaster Rehabilitation and Reconstruction Plan.

Currently, a new National Disaster Management Plan (2023- 2030) is in the process of being drafted and is nearing completion.

22 Disaster Management Centre, (2019). Annual Report 2019. Vidya Mawatha, Colombo 07. https://www.parliament.lk/uploads/documents/paperspresented/1665114129004024.pdf.

23 Disaster Management Centre, (n.d.). About Us - National Disaster Management Plan. http://www.dmc.gov.lk

24 Asian Disaster Reduction Center, (2019). Country Report: Democratic Socialist Republic of Sri Lanka. DMC Sri Lanka. https://www.adrc.asia/countryreport/LKA/2019/Srilanka_CR2019B.pdf

25 Asian Disaster Reduction Center, (2019). Country Report: Democratic Socialist Republic of Sri Lanka. DMC Sri Lanka. https://www.adrc.asia/countryreport/LKA/2019/Srilanka_CR2019B.pdf

26 Disaster Management Centre, (n.d.). About Us - National Disaster Management Plan. http://www.dmc.gov.lk

5. Fiscal disaster management in Sri Lanka

Since the 2004 disaster, a considerable amount of progress has been made in disaster risk management. There is still work to be done to address disaster risk financing, especially making contingent fiscal liabilities to disaster risk financing the norm, as well as considering ex-ante risk financing instruments. Fiscal disaster management ought to also highlight the relevance of specific contingent liabilities from key sectors such as irrigation.

5.1 Sources of revenue

There are currently a variety of challenges regarding financing for the government in terms of face disaster events. Currently, there are also a limited number of sources of financing available for the government. In spite of this, the majority of the sources of funding are concentrated in the national budget and international aid.

Instrument	Risk Layer	Mobilization Timing	Additional Information
Individual Budget Allocation to ministries	Low, medium, and high risk	Ex-post	Currently, a explicit budgetary line does not exist in the State Budget dedicated only for disasters (including preparedness, response, and recovery). Multiple reallocations to ministries and state agencies for disasters are made in case of disasters, which complicate the tracking process for budget allocations. The most evident way to track the resources assigned for disaster is through the Ministry of Disaster Management, which is dedicated to maintenance mainly. However, this is only a sample of the whole budget assigned to disasters in case of a major event.
National Natural Disaster Insurance Scheme (NNDIS)	Medium and high risk	Ex-ante	The NNDIS was launched by the National Insurance Trust Fund, a company wholly owned by the Government of Sri Lanka. There is an insurance scheme in place that offers nationwide financial protection from property damage or death due to disasters (excluding droughts) driven by natural hazards. In 2016, the Ministry of Finance allocated LKR 300 million (US$1.8 million). This is scheme is not anymore operational.
Donor Community and international support	Medium and high risk	Ex-post	Based on disaster severity, the donor community plays an active role in financing response and recovery. For example, according to the OCHA Financial Tracking Service*, Sri Lanka received US $272 m from 2016 to 2023 (among grants and donations provided by development partners).

Table 1. Current state of several funding sources available for Sri Lanka

**https://fts.unocha.org/countries/74/summary/2016*

Table 2, following the structure of the table 1, describes instruments identified for either enhancement or

Instrument	Risk Layer	Mobilization Timing	Additional Information
Explicit annual budget allocation for disaster	Low, medium, and high risk	Ex-ante	International experience reveals that allocating an explicit budget for disaster response and recovery may help to improve transparency and efficiency of spending during and after disasters. This ex-ante budget allocation would occur on an annual basis, channelling resources to ministries or public agencies once the disaster occurs.
Disaster Fund	Low, medium, and high risk	Ex-ante	As part of the regulation enacted after the 2004 tsunami, a National Disaster Fund* was recommended to be created by law. However, this fund has yet to be implemented.
Contingent Credit	Medium and high risk	Ex-ante	Contingent credits are ex-ante financing instruments, which the GoSL has some experience with. In 2010, it had one with the World Bank. It would be advisable to continue with such a scheme.
Parametric Sovereign Insurance	Medium and High risk	Ex-ante	Given the lack of government assets data and exposure to medium and high severity events, parametric sovereign insurance schemes could play a relevant role in Sri Lanka. Particularly those schemes based in international data source.

Table 2. Alternative funding sources suggested and considered for Sri Lanka

**Clause 17(1) of the Act No. 13 of 2005 creates a National Disaster Fund.*

5.1.1 Sources of revenue

» Individual budget allocation to ministries

implementation in Sri Lanka. Further details on each instrument can be found below.

The GoSL has two mechanisms for channeling resources. The first, budget re-allocations, occur when the Government re-allocates resources from budgetary development and maintenance operations to disaster response and recovery, which represents a high opportunity cost. In addition, budget reallocations are usually difficult to track and monitor within the State budget and often there is a limit to resource reallocations without rectification of the State Budget. The second is for some ministries to create their own budgets budgetary lines for maintenance, rehabilitation, and infrastructure projects focused for disasters. For example, in the past, these budgetary lines have been enabled for certain fiscal years in the irrigation sector[27] , providing funding until 5% of the ministries' budget.

27 Ministry of Irrigation and Agriculture, Department of Agrarian Development, Department of Irrigation, Ministry of Mahaweli Development and Provincial Councils.

Figure 6 shows the budget allocated to the Ministry of Disaster Management from 2006 to 2022 for development and maintenance operations; no resources were allocated for ex-ante events.

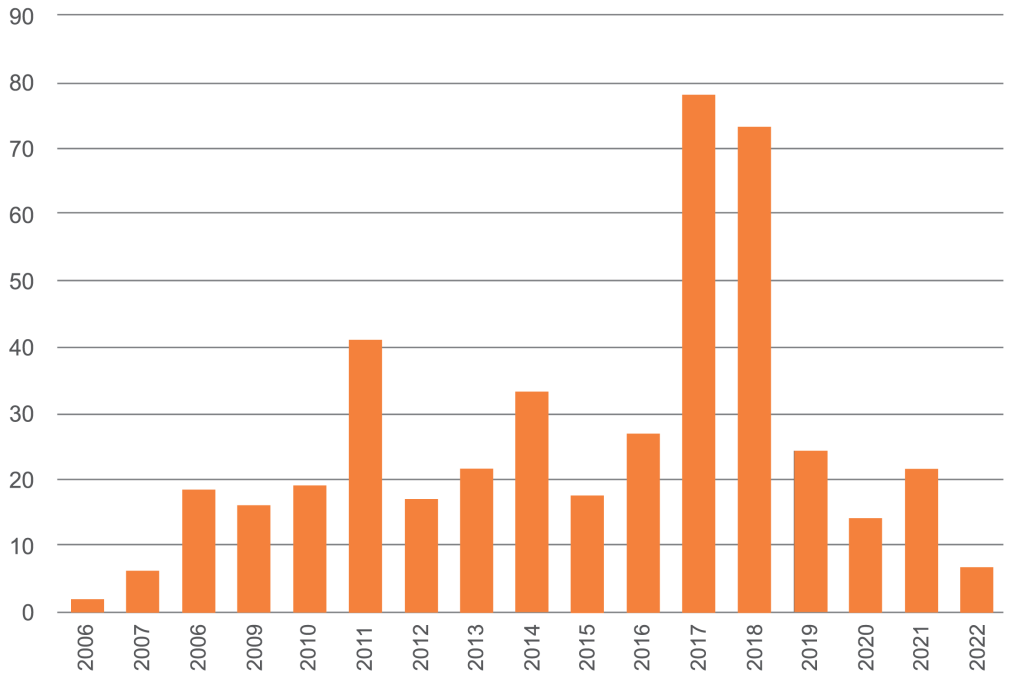

Figure 6. Government spending on disaster management through the Ministry of Disaster Management, (US $Million)

Source: National Planning Department and Ministry of Finance Economic Stabilisation and National Policies

In addition to the resources allocated in the ministries and government agencies mentioned for maintenance, each ministry affected by disasters receives a budget reallocation for spending linked to disasters, mostly ex-post financing. For instance, figure 7 shows spending through ministries and government agencies of the irrigation sector. Most of the spending in this sector was ex-post financing. In the period assessed, 43% was for rehabilitation projects, 56% for irrigation infrastructure, and less than 1% for maintenance.

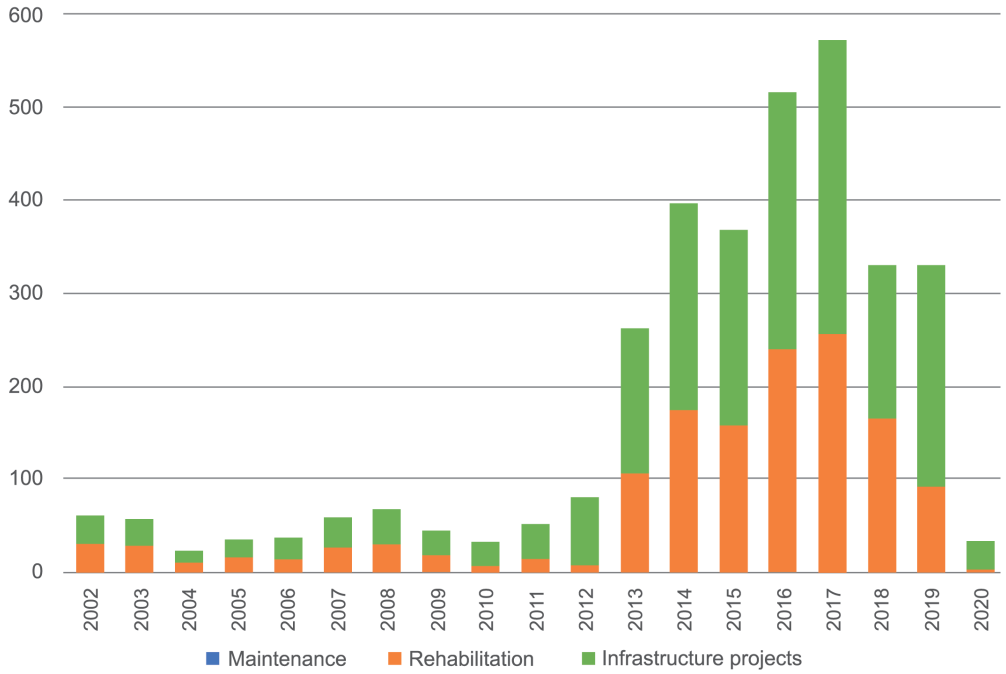

Figure 7. Annual budget allocated in public irrigation sector, (US $Million)agement, (US $Million)

Source: Ministry of Irrigation and Agriculture, Department of Agrarian Development, Department of Irrigation, Ministry of Mahaweli Development and Provincial Councils.

Among the challenges that the country faces is the fact that there is no institutionalized mechanism to systematically and periodically gather information on the damages and losses that are associated with disasters across all ministries and agencies of the government.

» The former national natural disaster insurance scheme (nndis)

The government used to compensates the cost of damages to the population through a universal insurance scheme for individuals and small businesses, managed by the National Insurance Trust Fund (NITF), which is owned by the Sri Lankan government. This insurance policy has been in operation since 2016 and currently it was discontinued; used covers disasters linked to natural hazards, excluding droughts.

The government supports this scheme through an insurance mechanism integrated by two elements: firstly, through financing the premium of this insurance scheme, and second, through the state-owned reinsurer (National Insurance Trust Fund or NITF) to obtain insurance coverage.

The insurance mechanism operates in two basic risk layers: the first is through the `premium' paid by the government which is used to compensate damages until certain level, defined by the level of high frequency of damages to be covered, once defined, the second is for NIFT to get a reinsurance coverage for excess of damages over the first layer. In other words, once the resources provided by the government are exhausted, the reinsurance coverage is activated.

According to a study[28] of the insurance scheme, as soon as a disaster strikes, the first damage assessment is done by the district secretaries and Grama Niladari (government officials who communicate with communities at the village level).

Compensation of LKR 250,000 and LKR 2,500,000 will be paid in the event of a death and property damage, respectively. Compensation is credited directly to the bank account of the victim after the damage has been quantified and determined. It is necessary to verify the identity of the victim through the identification number of the National Identity Card (NIC), the claim form, and proof of ownership of the property before the claim can be paid out to the victim.

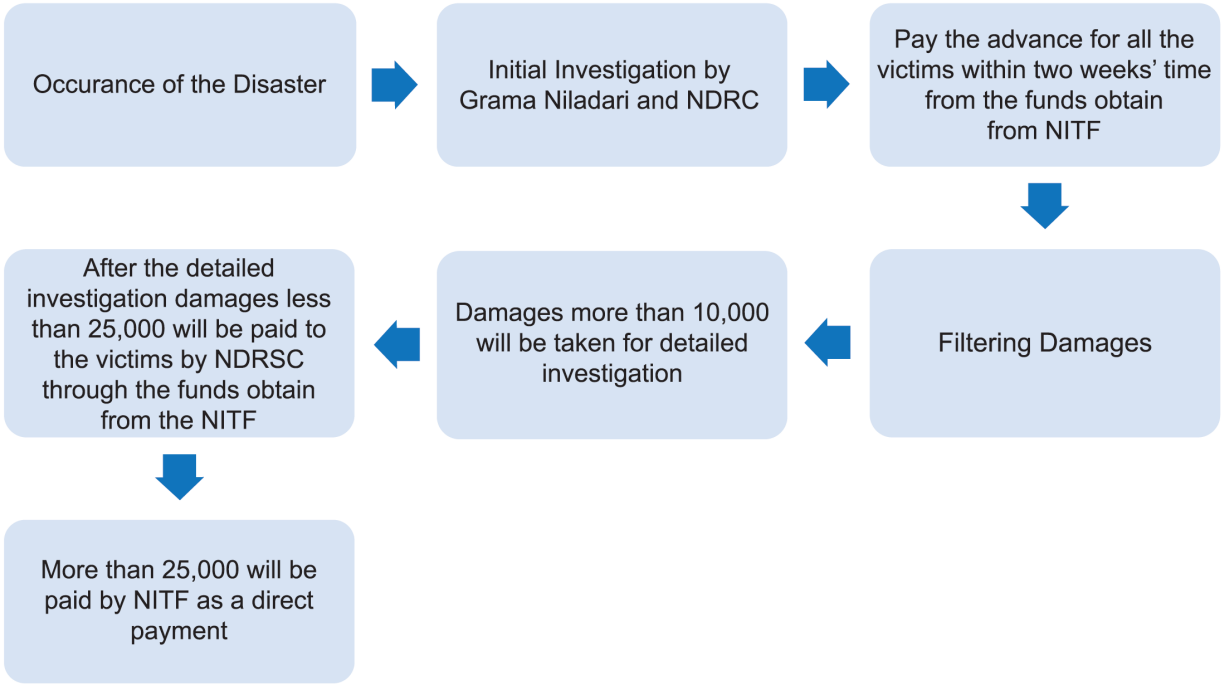

Figure 8. Process of disaster evaluation and compensation in Sri Lanka

Source: Liyanage, K.L.A.K.T., et al, State-Funded Macro-Insurance Policy for Disaster Resilience: A Study on National Disaster Insurance Policy in Sri Lanka. Lecture Notes in Civil Engineering, vol 205. Springer.

» International donor community and international support

Resources from donations and international assistance are usually provided in the case of catastrophic events that are not recurrent and where the number of losses is uncertain. Such resources are therefore mainly used for immediate response actions, such as humanitarian assistance.

As part of the pros of this instrument, this is a source of resources of low costs for the governments affected, since many donors have humanitarian programs to support relief activities, among other actions.

28 Liyanage, K.L.A.K.T., Wedawatta, G., Vijekumara, P.A., Kulatunga, U. (2022). State-Funded Macro-Insurance Policy for Disaster Resilience: A Study on National Disaster Insurance Policy in Sri Lanka. In: Ghosh, C., Kolathayar, S. (eds) A System Engineering Approach to Disaster Resilience. Lecture Notes in Civil Engineering, vol 205. Springer, Singapore. https://doi.org/10.1007/978-981-16-7397-9_26

However, some of the limitation of this instrument are that:

(1) Resources are limited, representing a portion of the total need for emergency response and recovery, and rarely support reconstruction programs;
(2) It may be motivated by the visibility of the disaster in the media, so attendance and recurrence cannot be predicted;
(3) Internal and international arrangements must be made to schedule and receive resources, which can be a complex and time-consuming process involving uncertainty;
(4) The allocation of resources is not very flexible, as they are generally framed for previously identified expenditures according to the criteria of the sponsor program.

There is an active role requesting financial support from the international donor community and development agencies by the Government of Sri Lanka. According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Tracking financial service, since 2016, the country has received roughly US$149 m as support from international donors mainly focused in finance the emergency activities after disasters. The majority of this funding came from the US (52%), followed by Japan (36%), Germany (7%), and various other countries.

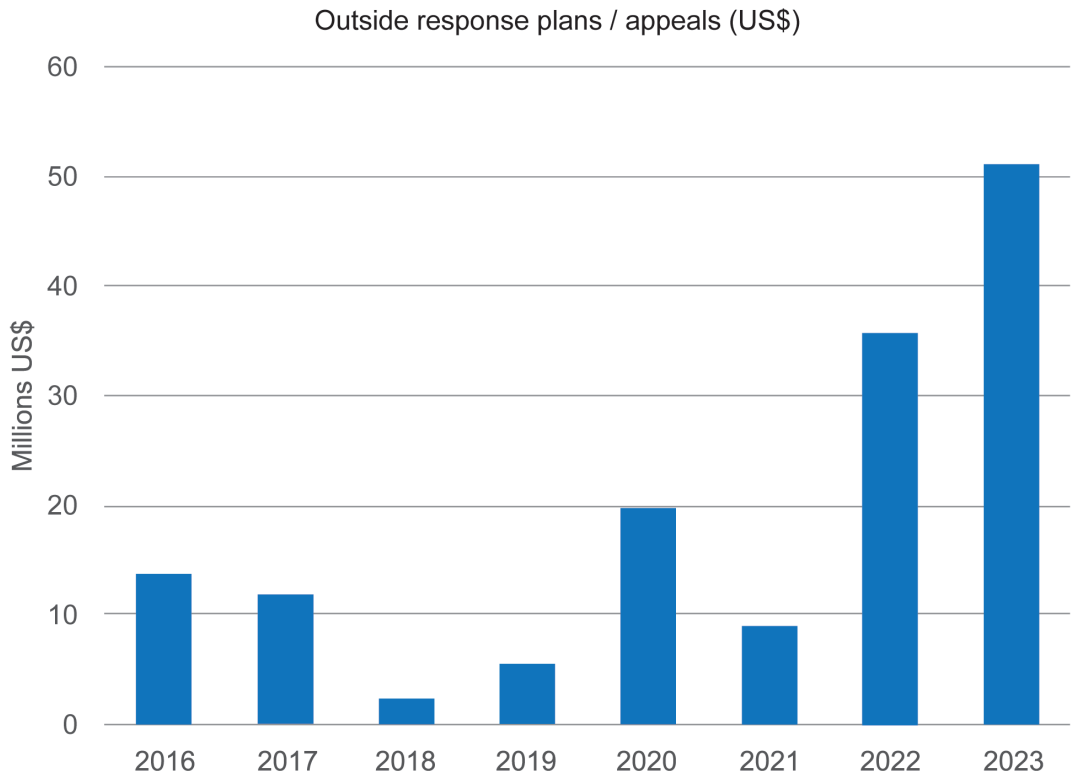

Figure 9. Outside response plans (US$ m) for Sri Lanka

Source: OCHA - Tracking financial service.

Another key source of funding is from development agencies of high-income countries and multilateral financial organizations. For example, through the Japan International Cooperation Agency (JICA), Japan, from 1991 to 2019, provided an annual average of US$452 in official development assistance (ODA) loans, many of which were linked indirectly or directly to disasters. In the case of the World Bank (WB) during that same period, there was a reported annual average for IBRD loans and IDA credits of approximately US$91 m, and the ADB posted an annual average loans around US$159 m.

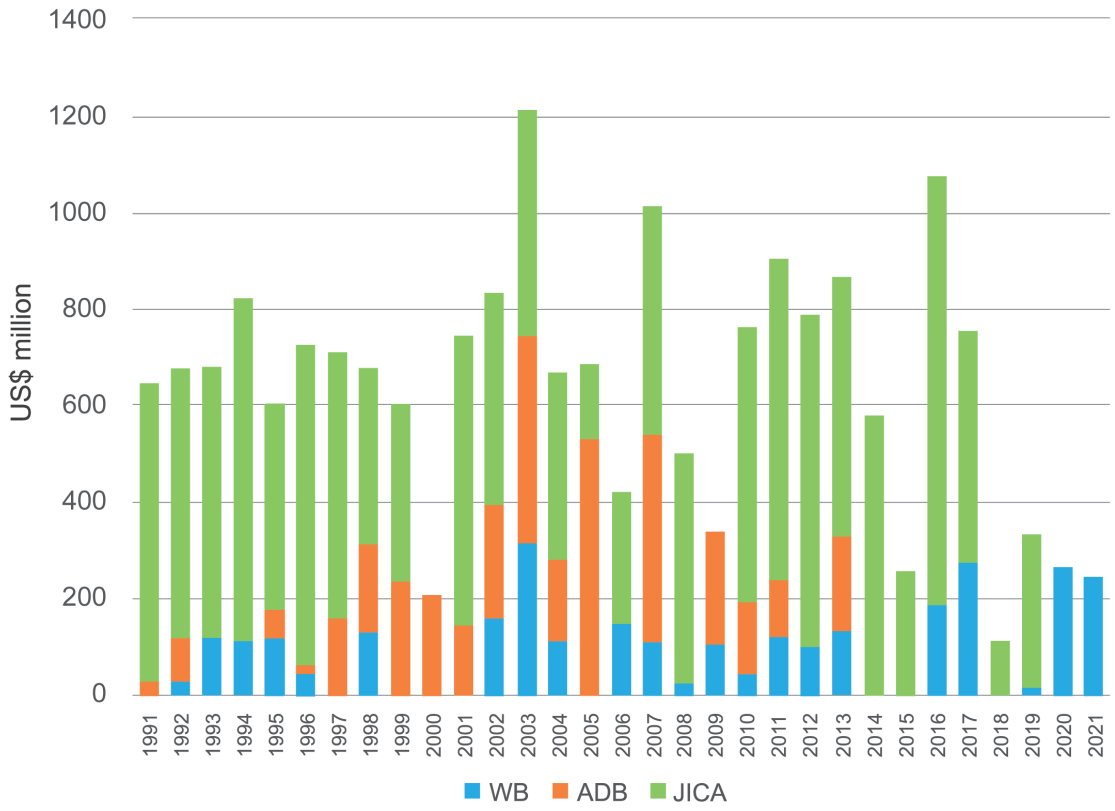

Figure 10. Loans from ADB, JICA (ODA Loans) and WB (IBRD loans and IDA credits) to Sri Lanka

Source: ADB, JICA and WB.

5.1.2 Suggested sources of funding

The following ex-ante disaster risk financing instruments are inspired by international best practices[29] in managing disaster risk. Considering the current disaster risk financing instruments in place for Sri Lanka, there are several windows of opportunity to improve the current state of sovereign disaster risk finance strategy focused in the irrigation sector. However, it is necessary to highlight that these instruments could be implemented at the multi-sectorial level or individually.

» Explicit annual budget allocation for disasters

International experience shows that several benefits are achieved by establishing a explicit budget lines for disasters response and recovery. Benefits include transparency for all key actors in the budgeting process and flexibility to allocate as bridge budgetary line to another budgetary lines within the ministries affected, as well as predictability of funds and quick disbursement in case of disasters during the fiscal year.

These identifiable budget lines can also be strengthened when specific regulations are created for their management. Once a budget line is created with these characteristics, stakeholders can trace resources to their sources and uses. In other words, in many countries the budgetary lines manage follows a general budget law for any kind of budgetary lines. Based on international experience, the budget authority could issue additional regulation for explicitly regulates a budgetary line focused in disasters, this kind of regulation helps to provide transparency for all stakeholders involved in a disaster.

29 OECD (2015), Disaster Risk Financing: A global survey of practices and challenges, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264234246-en

This kind of budgetary line consists of resources managed by Ministry of Finance and is concentrated in a labeled budget line for disasters only. Resources from this line are then transferred to entities that require them in the case of a disaster.

In addition, the operation of the budgetary line could be strengthened by establishing a regulatory framework specifically designed for disaster management. This regulation ought to be disseminated to the main stakeholders previously involved in disaster management. In general, this type of mechanism can be created within the national budget in a multisectoral budget line.

Therefore, the entire mechanism is a general budgetary line dedicated for disasters, managed by the Ministry of Finance as a bridge to the ministries affected or stakeholders involved in the disaster. At the same time, each ministry involved would have a specific budgetary line for contingency expenses within its budgets. In each fiscal year, the first budget affected would be the ministries involved in the disaster management, and then, after this budgetary line are exhausted, it would be feeding by the general budgetary line managed by the Ministry of finance.

» Disaster funds

Disaster funds are an instrument increasingly used in developing economies. This type of instrument responds to developing economies' needs and constraints. As such, they must be tailored to the country risk profile, the sectors to be financed, and the needs of each sector.

Disaster funds evolve with risk management capabilities and public finances in general. Consequently, it is a common practice to establish a fund that covers explicit spending concepts involved in disaster risk management. These include emergency expenses, rehabilitation and reconstruction, considering a detailed breakdown of spending concepts. This practice helps to organize and implement ex-ante bidding process for eligible good and services required during a disaster, for instance during the emergency stage. This type of good a services could be contracted before the disaster strike. For example, medical supplies, food, provisional shelter, medical services, removal debris services, among others.

When building a disaster fund, there are several basic elements to consider: creating mechanisms that allow them to be above budget cycles and then accumulate resources (fiscal year after fiscal year) and establishing a minimum annual amount to be assigned. It is also crucial to define the sources of the fund, which can be the remainder of budget items or specific transfers from the budget, and percentage from State Budget to be allocated in each fiscal year for feeding the fund. In some countries, sources are defined as specific taxes dedicated to feeding the fund. Finally, the fund should be hosted by a financial institution of high financial solvency, such as the central bank. Specific regulations must be developed to govern the fund's operation. In some countries, for example, the fund may be a trust fund.

The funds for disasters could be allocated to a single sector and then fed to ministries and agencies in that sector. Additionally, the funds could be built from a broader perspective, in other words, at the national level, the fund could be separated into several subaccounts, each of which would be separated by sector, allowing for a greater degree of transparency in managing the resources at hand.

» Contingent credits

Contingent credits are an ex-ante financial instrument that establish an agreement between a financial institution (usually a multilateral financial institution or a development agency of a high-income country) and a government. This loan is characterized by the agreement that a catastrophe event (previously defined) triggers the loan disbursement. Due to this, the entire loan negotiation takes place before the disaster occurs.

In addition, multilateral entities could encourage the use of ex-ante financing instruments, including disaster risk management and disaster risk financing strategies. Additionally, certain criteria for lending minimums, such as fixed amounts or percentages of GDP, apply.

This type of loan is not only favored by multilateral institutions for its speedy disbursement but is also relatively cost-competitive among them and has a lower cost than the market standard.

Sri Lanka signed a contingent credit agreement with the World Bank in 2010. Considering this kind of credit as a source of financing is recommended, since more multilateral financial institutions may be able to provide proposals as the ADB.

In the case of a specific sector, it is possible to design the standby loan contract to give preferential consideration to the financing of a particular sector, for example the irrigation sector.

» Parametric Sovereign Insurance

Parametric insurance is a contract whereby the insurer undertakes to compensate the contracting party when the previously agreed parameters or triggers of an event—generally quantitative, such as the intensity of the event or the amount of the loss—are met. This insurance is measured and/or calculated by a third party using a predetermined methodology of variables independent of the insured and the insurer.

Parametric insurance is based on the probability of occurrence of an event and not the loss it could cause, so no adjustments are made to these. Instead, once compliance with the parameter is corroborated, the insurer must compensate the insured in an almost expeditious manner, in accordance with the provisions of the contract. The indemnity may be staggered, associated with the value of the parameter -.

While for traditional insurance schemes some catastrophic risk are not usually considered insurable, through parametric ones can be covered, and international experience shows that they are used for catastrophic events, such as tropical cyclones, earthquakes, and extreme rainfall, in order to limit the financial impact of the losses they could cause.

Parametric insurance is relevant in countries with lack of data quality and quantity. The finals capabilities of the parametric scheme are based in local data availability, usually with few raw data, but local stakeholders provides experience and local knowledge which is very useful in the modeling process. On the other hand, this schemes could be developed considering international data sources or/and develop data collection explicitly collected for risk modeling.

A parametric insurance policy for excess rainfall affecting irrigation infrastructure is assessed in this report to illustrate ex-ante risk transfer instruments. There will be several layers of risk covered by this parametric insurance. In this hypothetical case, the insured would be the Ministry of Irrigation and Agriculture.

5.2 Analysis of the resource deficit for disaster management focused in the irrigation sector

The objective of this section is to present the methodology for estimating the financing gap in the irrigation sector.

There are two steps to estimate the financing gap: the first is to determine the historical cost of damage occurred in the irrigation sector on annual basis for a specific period. The second is to estimate the future cost of damages based on the frequency and severity of the damages estimated in the first step.

The second stage results in an indicative cost of damages for future events. The irrigation sector's financing gap will be based on this estimation.

Stage 1

To calculate the historical data on disaster damages, the team of local consultants in Sri Lanka developed a methodology as described in box 1. This methodology allowed the estimation of the cost of damages by disaster in irrigation sector infrastructures from 1990 to 2020.

Based on data collected for PDNAs after the 2016 and 2017 floods events for 09 Districts

1. Estimated irrigation sector infrastructure damage of each district in LKR; Values in LKR converted to USD = Variable 1 (Independent Variable)
2. Population affected in each district as a fraction of the total population of the district in the respective years
3. Damaged houses in each district as a fraction of the total houses of the district in the respective years
4. Irrigated farm area of each district is taken as a fraction of total irrigated farm area of all districts (in the island) – weighted factor
5. Population affected in each district as a fraction of the total population of the district multiplied by weighted factor = population affected in each district as a fraction of the total population of the district = variable 2 (Dependent Variable)
6. Damaged houses in each district as a fraction of the total population of the district multiplied by weighted factor = Damaged houses in each district as a fraction of the total houses of the district = variable 3 (Dependent Variable)
7. Regression Equation:
   Variable 1 (USD) = 4.279 – 28.087 x Variable 2 – 15.856 x Variable 3
8. Values of Variable 2 and variable 3 were calculated for all districts from 1990 to 2020.
9. Using a regression equation, Variable 1 was computed from 1990 to 2020 for all districts

Box 1. Process used for multiple regression to estimate cost disaster induced damages to irrigation structures from 1990 to 2020.

Source: UNDP local consultants at Sri Lanka

Figure 11 represents the estimated annual cost of damages for the irrigation infrastructure in Sri Lanka from 1990 to 2019 the average cost of damage is roughly US$147m.

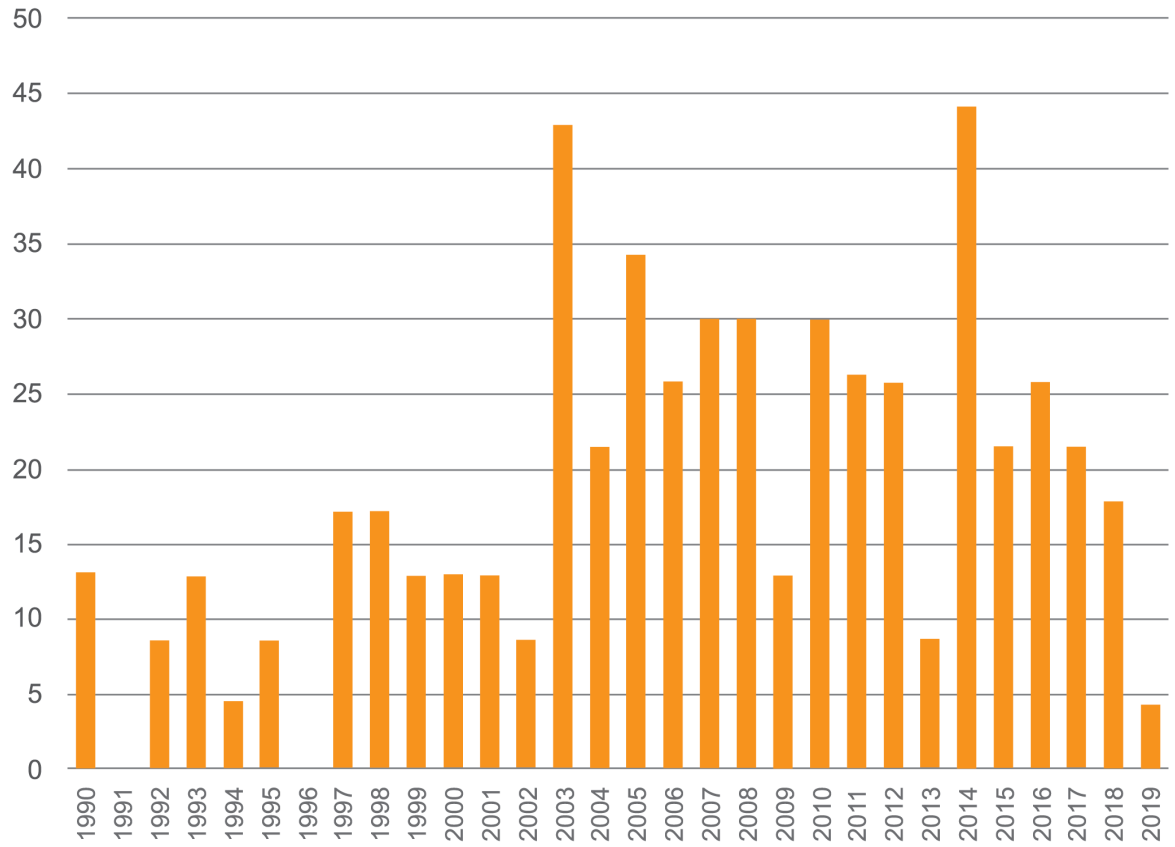

Figure 11. Estimated annual cost of damages to irrigation infrastructure (US$ m)

Source: Data taken from UNDP local consultant in Sri Lanka

Stage 2

In the second stage, based on the historical data, the frequency and severity of the events reported in figure 11 are estimated using on statistical tools[30].

The result of the analysis presented in figure 12 represents the financing gap that Sri Lanka's irrigation sector faces. Each point of the figure 12 shows a combination of return period linked specific level of cost of damages. In other words, as a metric of frequency the return period means the recurrency in years, in average, similar events could occur again. In this figure illustrate each type of disaster in terms of return period and the probable damage.

30 Several probability distribution functions were approximated for the severity of the damage costs. The final function used for this analysis was chosen by means of several hypothesis tests that consider different test such as the Anderson-Darling, Kolmogorov-Smirnov and Cramer-von Mises tests.

Given that irrigation sector is financed by the GoSL, this financing gap could be a proxy of the impact on the public finance of contingent liability by disasters in the irrigation sector for the GoSL.

Table 3 shows classify disaster events by type of return period (alternatively by exceedance probability, considering that the reciprocal value of a given return period is this probability), each type of return period is linked to level cost of damage. The curve represents all combinations of cost of damages for return periods starting in 1000 years to 2 years.

For example, the cost of damages every 10 years of return period is US$33 m, 100 years are US$52m and in a 1000-year return period US$69m.

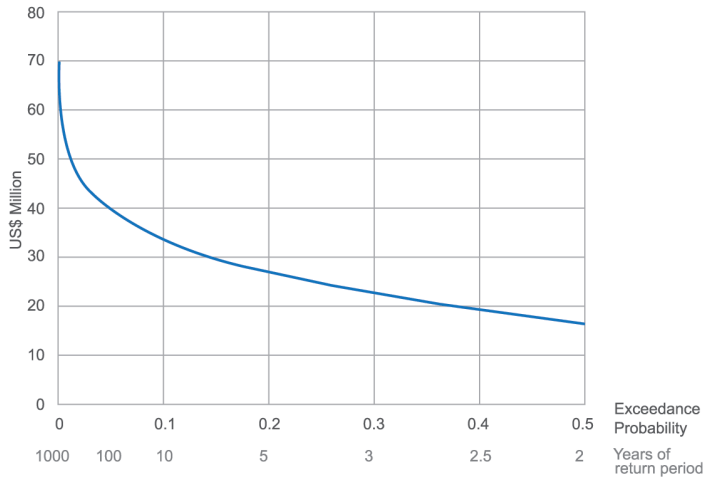

Figure 12. Exceedance probability curve for cost of damages to irrigation infrastructure

Source: Author's estimates based on data from UNDP local consultants

Return of period	Exceedance probability	Cost of damage estimated
10	0.100	33
25	0.040	41
50	0.020	47
100	0.010	52
250	0.004	60
500	0.002	65
1000	0.001	69

Table 3. Selective return of period, exceedance probabilities and cost of damage

Source: Author's estimates based on data from UNDP local consultants

The government financing gap can be defined as the difference between the cost of the damages that would be incurred in the event of a catastrophe and the amount of financial resources the government has available to respond to such damages. As a result of this gap, it is crucial for governments to determine the level of financing required to cover disaster costs, as well as to develop a strategy for financing these costs before a catastrophe strikes.

6. Financial Instruments against disasters

This section aims to describe the ex-ante catastrophic risk financing strategy, using irrigation as an example.

This analysis will be based on ex-ante financial instruments proposed in previous sections. Out of the possible strategies Sri Lanka may employ, this section examines a specific strategy in a concrete case.

As a foundation for the strategy presented here, we will use the financing gap estimated in the previous section as a reference point. As a result of this, a strategy was drafted, proposing various instruments to be used in the event of a catastrophe to close the financing gap estimated previously.

Table 4 shows the risk financing strategy assessed, integrated by risk retention and risk transferring instruments, a portfolio of ex-ante instruments integrated by an annual budget allocation, a reserved fund, and a contingent fund. Finally, as a risk transferring instrument, parametric insurance is presented.

When examining Sri Lanka's risk profile, the financing gap that exists, and the potential entity that may take on Sri Lanka's risk, such a level of coverage may be feasible to put in place. The purpose of this strategy is to illustrate its relevance in providing disaster financing efficiently, even though a wide range of coverage sizes for each instrument exists.

Type of instrument	Instrument	Coverage in US$ million
Risk Retention	Annual Budget Allocation	1.5
	Disaster Fund	2.0
	Contingent Credit	25.0
Risk Transferring	Parametric Insurance	15.0

Table 4. Coverage in US $million by instrument

Source: Author's estimates

Figure 13 illustrates the ex-ante risk financing instrument performance by type of event in terms of return of period, narrowing the financing gap. The strategy fully funded the cost of damages for high frequency events, defined as those occurring every ten to fifty years of return of period.

In the case of 100-year events, the financing gap is almost fully covered, but remains 7% of the total cost of damages for this type of events. Nevertheless, the strategy achieved its goal of narrowing the financing gap for all event types, resulting in a more secure source of funding for this sector.

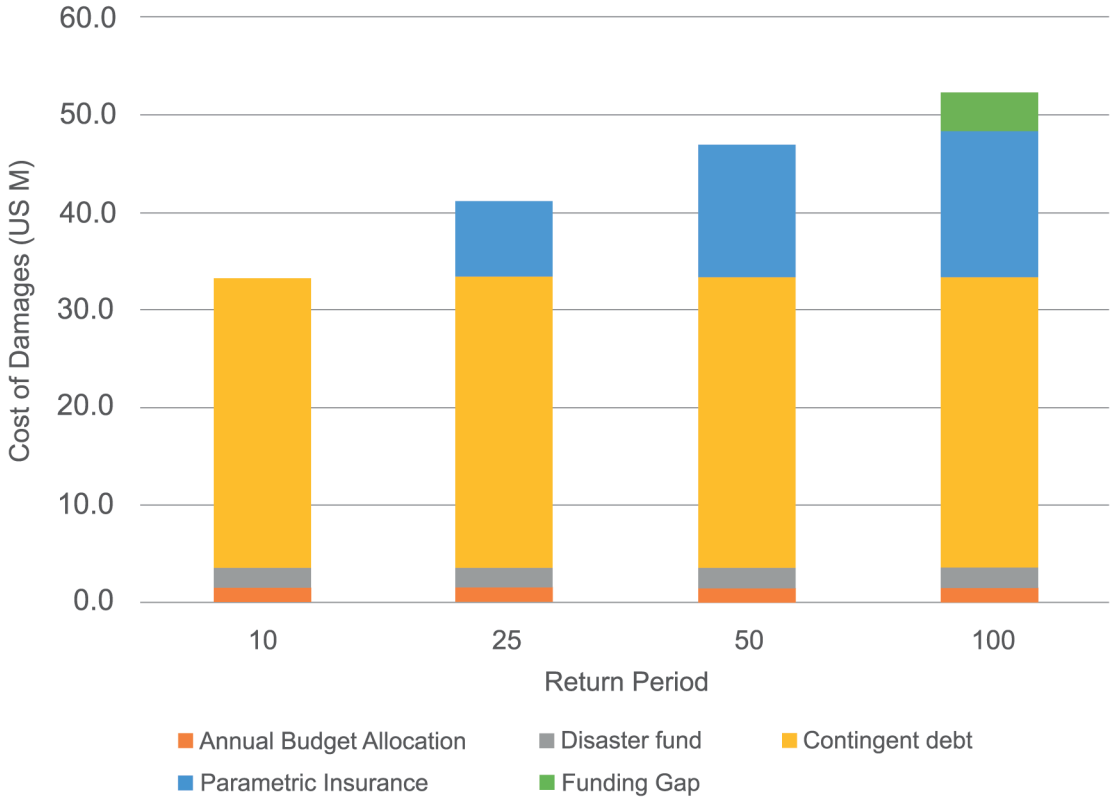

Figure 13. Ex-ante risk financing instruments reducing fiscal exposure to damages in irrigation sector (in US $m) by return of period

Source: Author's estimates

6.1 Exploring alternatives to structure insurance against disasters in the irrigation sector

In this section, we examine in more detail the impact of a parametric insurance policy on the irrigation sector.

The instrument to be used for this purpose is the ex-ante financing instrument described in the immediately preceding section, specifically the risk retention instruments (see Table 5).

This section focuses on the analysis of three different types of insurance with different payout triggers that are assessed, all of which are classified by the return period that triggers the payout.

The study analyzes three types of insurance, or in other words, three independent insurances, schemes assessed in three different layers, . The GoSL is free to choose one of them in particular or to encompass all three as a whole.

A major distinction between insurance policy proposals is their ability to provide financing based on risk appetite. For example, a 50-year return period insurance policy will only activate with events of this type for a payout of US$5m, for 100-year return period trigger with a US$10m payout, and while 150-year trigger would have a US$15m payout.

The insurance cost or insurance premium estimated in this analysis should be treated with caution. This is mainly because it is based on the aforementioned historical loss estimation analysis. In other words, as was mentioned in the section 5.2, there is inherent uncertainty in the data collection and methodological approach to estimate the cost of damages, in the case if this data collection and analysis is improved, could change the indicative premium estimated.

For an analysis prior to a market quotation, it is necessary to have detailed information on the infrastructure, degree of conservation and vulnerability. In addition, it is necessary to have detailed information on the natural hazard, in this case excess rainfall.

Insurance premium costs for a 100-year return period event are typically lower than for a 50-year event. This is due to the lower probability of the event occurring, meaning there is less risk for the insurer. As a result, the insurance premium costs for a 100-year return period event are typically lower than for a 50-year event.

Type of instrument	Instrument	Coverage in US$ million	Indicative Premium
Risk Retention	Annual Budget Allocation	1.5	
	Disaster Fund	2.0	
	Contingent Credit	25.0	
Risk Transferring	Parametric Insurance @50 years	5.0	0.26
	Parametric Insurance @100 years	10.0	0.25
	Parametric Insurance @150 years	15.0	0.24

Table 5. Coverage of the strategy by instruments in US $million

Source: author's estimates

Figure 14 illustrates the types of insurance available, as well as the corresponding risk retention instruments, which are used to finance the costs associated with the insurance. Each type of insurance is triggered by a different type of event, and the amount of the return depends on the severity of the event.

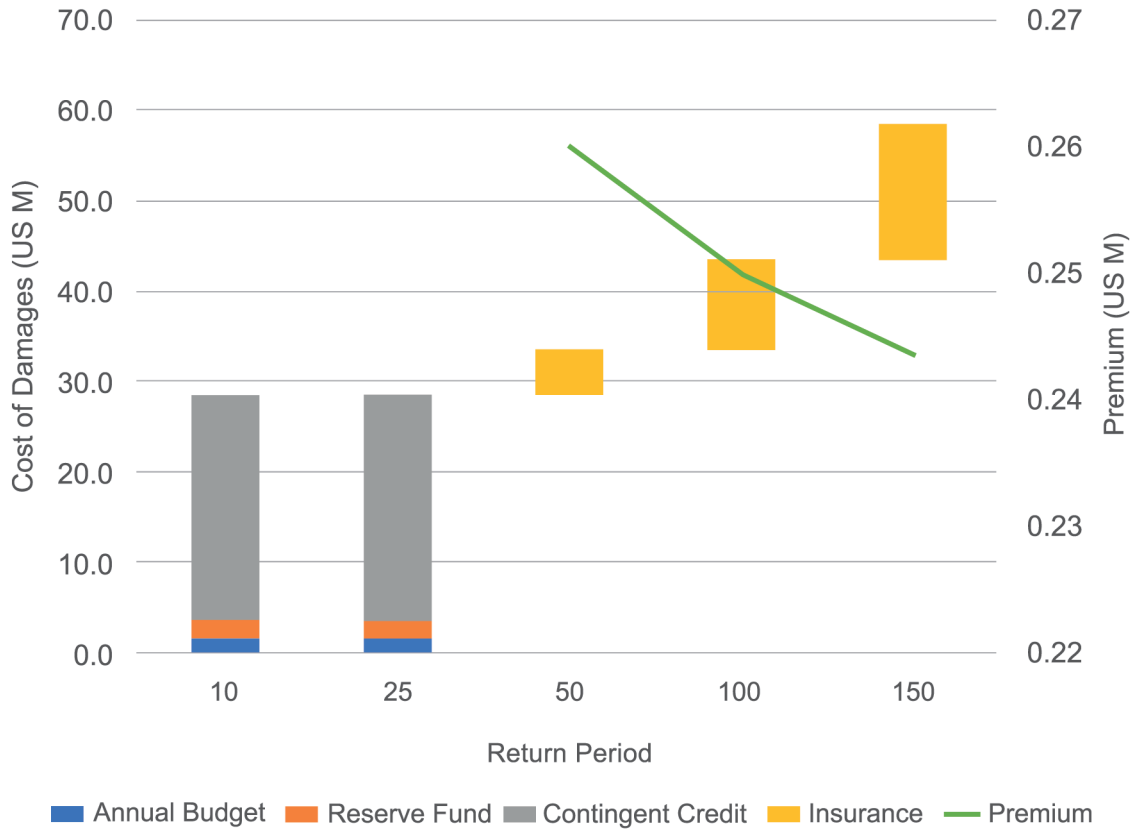

Figure 14. Ex-ante risk financing instruments reducing fiscal exposure of irrigation sector (in US $m) by return of period and insurance scheme proposed

Source: Author's estimates

7. Limitations of the analysis

This report was developed despite the significant data limitations on the historical cost of damage in the irrigation sector.

A UNDP analysis of local consultants' estimates on the cost of damages to the sector provided the basis for this report. Since this study is not a compilation of historical events, but rather an estimate of cost of damages, its methodology (linear regression) contains uncertainty inherent to the statistical estimators used.

Therefore, the results found in this report inherits those uncertainties. Although, it has constructed an analysis that uses rigorous statistical methods based on probability distributions, and goodness-of-fit test, mitigating in part, the uncertainty within the results.

Based on the methodologies described here, the parametric instruments proposed, based on return periods, may require alternative sources to determine the damage caused by a particular hazard, such as excess of rainfall or flooding, since the historical damage cost database does not make this type of distinction.

8. Recommendations for DRF strategies for the Government of Sri Lanka

The report leads to three conclusions: 1) that an ex-ante disaster risk financing strategy can provide disaster financing for the irrigation sector, 2) that a retention strategy can be established through the design and implementation of instruments such as the creation of a specific budget line for disasters and a disaster fund, and 3) that the results focused on the irrigation sector can be easily extrapolated to the national level with a multi-sectoral approach.

Ex-ante disaster risk financing involves pre-arranging funding mechanisms to finance disaster response and recovery efforts in advance of a disaster occurrence. This strategy assessed in this document can provide a number of benefits, including reducing the financial burden of disasters on public budgets and ensuring a timely and effective response to disasters.

For the irrigation sector, an ex-ante disaster risk financing strategy can provide funding for disaster response and recovery efforts in the event of a disaster such as a flood or drought. This can help to ensure that irrigation infrastructure, which is critical for food security, is quickly restored and operational after a disaster. Additionally, an ex-ante disaster risk financing strategy can help to reduce the financial burden on the national public finance, as funds can be pre-arranged to cover the costs of disaster response and recovery efforts.

One example of an ex-ante disaster risk financing strategy is the use of insurance instruments. Insurance can help to transfer the financial risk of disasters away from the government and onto the private sector. Recent research has highlighted the role of insurance in mitigating negative macroeconomic and welfare impacts of disasters, and has shown that a high share of damage covered by insurance can significantly reduce the financial impact of disasters. In the case of the irrigation sector, insurance can provide a means to pre-arrange funding to cover the costs of disaster response and recovery efforts, which can help to reduce the financial burden on public budgets.

The report also analyzed existing risks in the irrigation sector and identified the most suitable instruments for disaster risk management. This can help governments develop appropriate strategies to prepare for and respond to disasters.

We recommend that a database of the assets that are part of the irrigation sector is constructed, though there have already been several advances in this field. These databases should be geo-referenced and provide details regarding construction materials, the state of conservation, and the proximity of the sources of threat on the site.

Accordingly, it is suggested that a probabilistic model be used to estimate the risk exposure of these assets in order to better understand them. The results of this report may be useful for these purposes.

It is suggested to consider the ex-ante financing instruments presented here. Consequently, the GoSL can see the uncertainty diminished by finding rapid financing in an event of a disaster by using them in their risk management strategy.

This report contains examples and suggestions that may have implicit challenges, but international experience in this area may be beneficial to the Government of Sri Lanka since various concerns have been raised in other countries and dealt with successfully.

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10. Annex: Risk reduction and disaster risk financing: An analytical framework

The methodology for financial management of disaster risks and risk reduction, which has three components that are applied sequentially, is presented below. The first is related to risk analysis and considers identifying the assets exposed to risk, analyzing their characteristics in the face of hazards, and determining the potential losses that may occur in the face of a broad menu of catastrophic events' severities.

The second component of the methodology considers risk reduction in which, from the initial risk analysis, structural risk reduction measures can be defined in the assets studied to build resilience. These measures are selected in terms of their viability and efficiency from a structural engineering perspective, and the country's budgetary restrictions are also considered.

Finally, the third component addresses how to use financial instruments for residual risk management, for which the distribution of probable losses is known, given the implementation of risk reduction measures. Based on the new risk scenario, the risk is managed through financial instruments that allow for financing of the probable losses in a cost-efficient manner.

The role of financial instruments is to enable the rapid mobilization of resources in the event of a disaster and to provide protection for the Public Finance. Stakeholder can combine various risk retention and risk transfer financial instruments to meet the costs of emergency response and post-disaster recovery.

Consider including: This disaster risk management framework brings together necessary actions for building resilience, including: risk identification; risk reduction; preparedness; financial protection; and planning for disaster recovery. This framework is based on the fundamental principle of empowering governments and communities to understand their risks and make informed choices about how best to address them.

Figure 15. Methodology for risk reduction and financial risk management

Source: Author's elaboration.

10.1 Component 1: Risk analysis

International practices for catastrophic risk modeling were used, which suggest breaking down the analysis into three independents but closely interconnected modules.

Figure 16 indicates the three main modules that the risk analysis models consider:

1) Infrastructure Identification,
2) Natural Hazard Modelling, and
3) Risk Financing Modelling.

The third module is based on 1 and 2 modules to assess the suitability of financial instruments according to the natural hazard occurrence and the probable losses given the vulnerability of each relevant assets type. In other words, considering the 1 and 2 modules outcomes, in terms of assets inventory and the impact of natural hazards, the probabilistic losses, in terms of exceedance probability, are the base of the risk financing modeling.

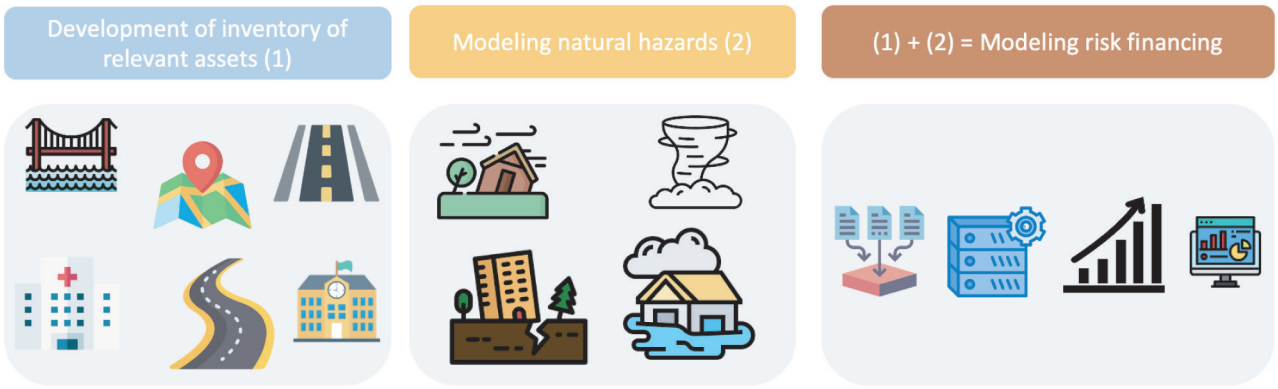

Figure 16. Main modules of a catastrophic risk analysis

Source: Author's elaboration.

The first module develops a detailed analysis of the exposed assets, for which a database is constructed that describes these assets, including the type contents of the assets assesed. Considering their geographic location and their physical characteristics. Figure 17 describes the sequence of activities to be carried out within this module. First, the variables that describe the information inherent to the assets are defined (for example, the location and physical characteristics, among other variables). Subsequently, a detailed analysis of these variables is performed, in order to assess the quality and level of data availability found. Once the information is collected, it is classified and analyzed. Finally, depending on the type of asset, a specific methodology is defined for those missing data variables and that by their nature are required for subsequent modules. For this purpose, a missing data treatment methodology was developed.

Figure 17. Development of inventory of relevant assets

Source: Author's elaboration.

Natural hazard modelling (see Figure 18) is usually divided into three components. The first is the selection of data that best describes the natural hazard, usually using information from both local and international agencies.

Subsequently, the collected data are modeled in terms of analytical framework that describe the behavior of a particular phenomenon.

Finally, once the phenomenon has been modeled, using probabilistic tools, its behavior is simulated in a few tens to hundreds of thousands of scenarios, which allows us to build a catalog of events and assign them a probability.

This modeling simulate potential future are likely to occur, in several sizes, severities and locations to be affected, as well as the frequency in a given location.

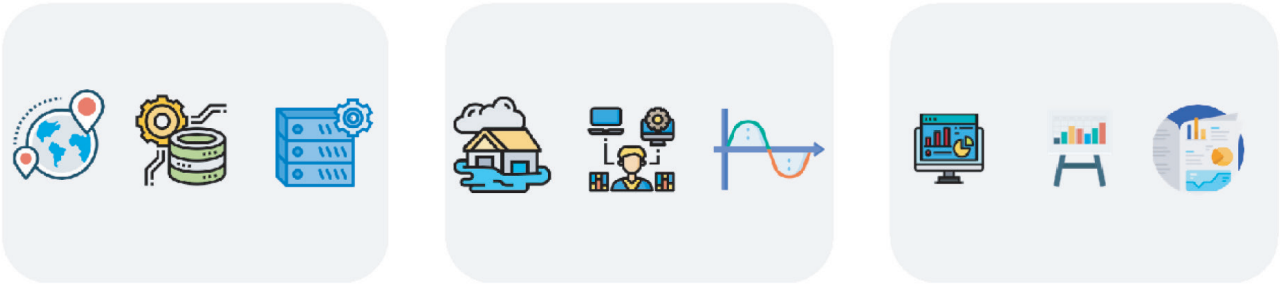

Figure 18. Modeling natural hazards

Source: Author's elaboration.

10.2 Component 2: Risk reduction as the spearhead of risk management

A first approach to understanding the dynamics of disaster risk financing and risk reduction is to consider two dimensions: time and the need for resources to act in the post-disaster phase (see Figure 19).

Regarding the timing of the need for resources, for example, post-disaster recovery programs can take months and sometimes involve years of planning before they can be implemented. The appropriate instruments must consider that not all resources are required immediately after the disaster has occurred. In this sense, resources are usually required for reconstruction over longer periods of time and needed beyond the emergency relief phase.

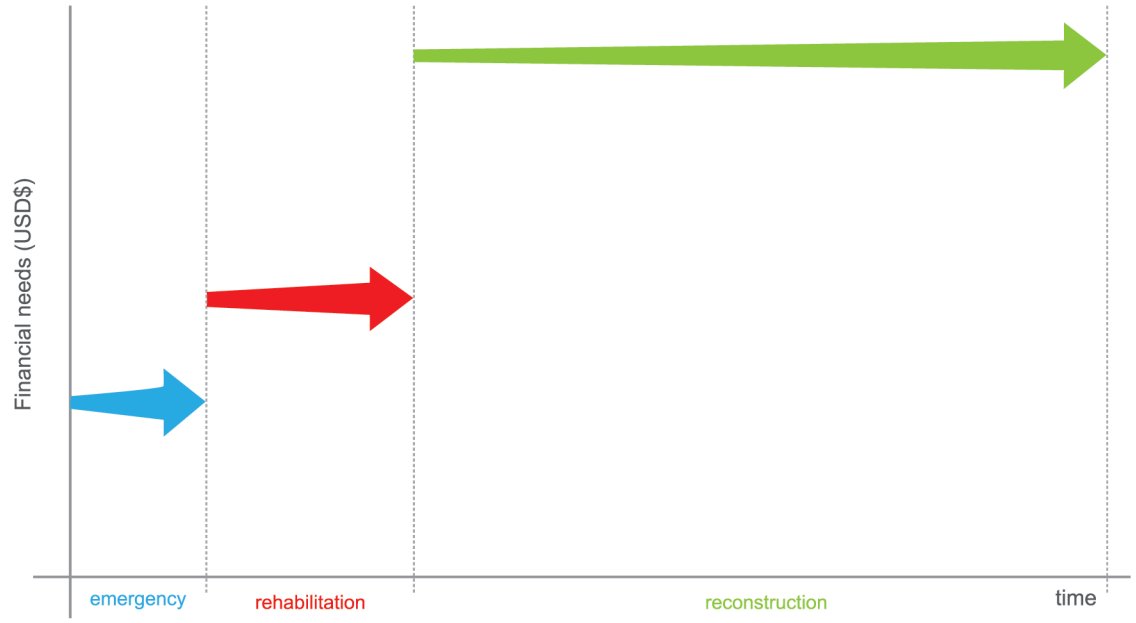

Figure 19. Main phases of post-disaster funding needs

Source: Author elaboration with elements taken from Ghesquiere y Mahul (2010)

Risk management methodologies have a defining impact on the selection of what and how much of an instrument to use. To the extent that disaster risk lays ground for instrument selection, it will help define the magnitude of the instrument to be used.

For example, in figure 20, two parts are shown. On the left side is the exceedance curve of a hypothetical country. This curve shows us, on the horizontal axis, the probability of excess for a particular hazard. For each probability, there is a probabilistic value of losses. On the vertical axis (see figure 20 left side), the zero starts from the right side and tends to infinity towards the right side. On the other hand, the vertical axis starts from zero to infinity in the direction from bottom to top.

Note that on the left side of figure 20, the curve described is ascending and asymptotic to zero, i.e., as the values of the vertical axis (probability of exceedance), the probabilistic losses tend to infinity and are capped by the exposed assets value.

The question to be asked is whether there is any combination of instruments or only one instrument that is suitable for probabilistic losses (implemented cost effective methodologies). To answer this, it is necessary to know the specific structure of the exceedance probability curve and the parameters that define each financing instrument to be analyzed.

Figure 20, on the left-hand side, shows an exceedance probability (EP) curve, which is the likelihood that a loss of any given size or greater will occur in a given year. In other words, An EP curve marked to show a 1% probability of having losses of US 100 million or greater each year.

Another method of expressing EP probability is the Return Period, which describes the expected likelihood of a loss of a given size occurring within a given timescale. As an example, a 50-year return period states that, on average, an event/scenario will repeat itself once every 50 years when repeated samples are taken.

Then, Figure 20, on the right-hand side, shows the same information of EP Curve (left-hand side), but in terms of the return of period. To switch between these two metrics, follow these metrics: Loss Return Period = 1/(Exceedance Probability) and then, Exceedance Probability = 1/(Loss Return Period).

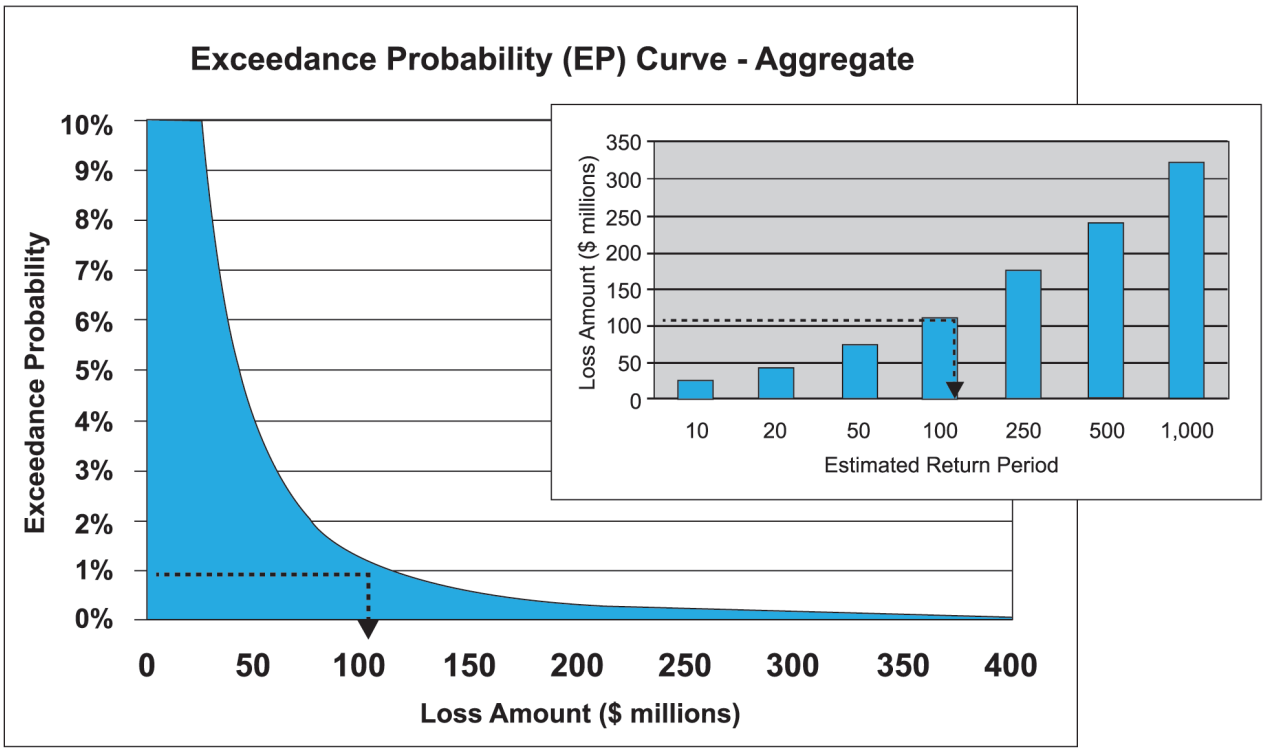

Figure 20. Exceedance probabilistic curve and post-disaster financial needs

Source: AIR Worldwide (Verisk)

Figure 21 considers the investment in risk reduction. The dotted line, below the solid line, shows the fact that risk reduction has a structural effect on the analytical understanding of risk, that is, investing in such a project or projects decreases the risk. Therefore, for the same probability of exceedance, the probabilistic loss decreases. The magnitude of this decrease will depend on the amount of investment and in particular on the structural engineering factors that will be carried out as a risk reduction measure.

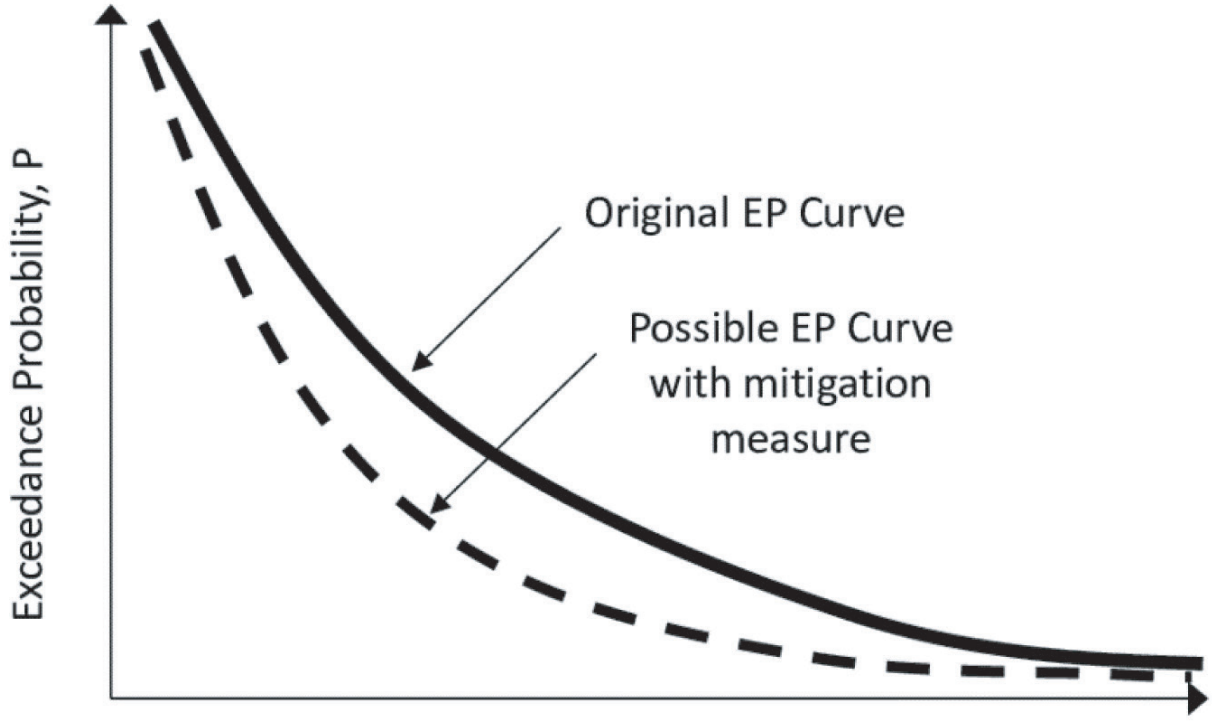

Figure 21. Investment risk reduction effect in risk financing strategy

Source: Czajkowski, Jeffrey & Russo, Elisabetta & Brandenburg, Aaron & Groshong, Lisa & Young, Michael & Nielsen, Matt & Cope, Anne & Giammanco, Ian. (2020). Application of Wildfire Mitigation to Insured Property Exposure. 10.13140/RG.2.2.13898.39366.

Figure 21 condenses not only the risk and financing gap reduction due to mitigation measures, which has structural effects on the description of risk in the long term.

Therefore, in terms of a risk financing strategy, the ex-ante risk financing instruments should reflect these, i.e., risk mitigation and the dispersion of financing at each stage of the disaster in accordance with the risk described by the exceedance probability curve.

10.3 Component 1: Risk financing

Finally, the third module is based on the interaction of modules 1 and 2, which generates loss scenarios, typically by generating exceedance probability curves. These curves are the starting point for the financial analysis. The first element is the identification of the instruments available in the country, to later model the behavior of the instrument for the generated exceedance probability curve. In the last stage, by means of statistical analysis of simulation, the behavior of the instruments are studied in terms of economic efficiency, that is to say, for what type of losses (low recurrence and high severity, to high recurrence and low severity) the instrument has a better yield.

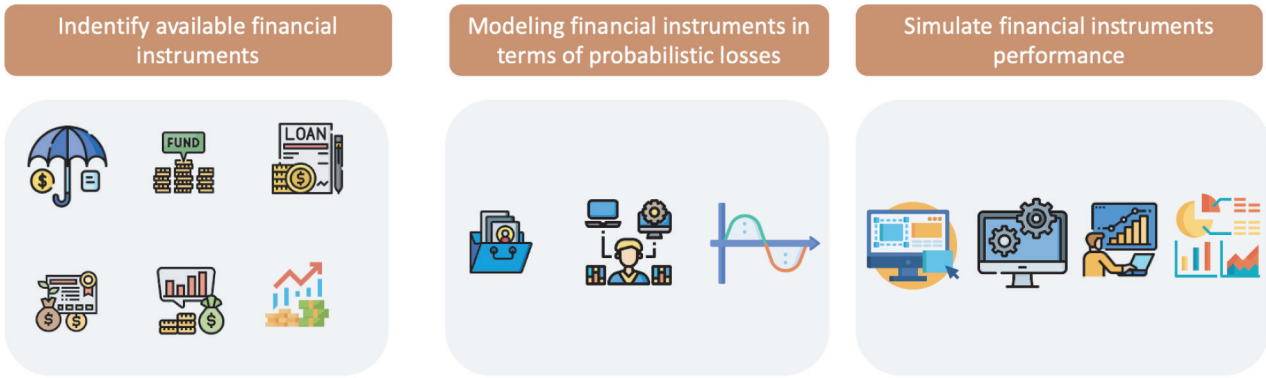

Figure 22. Modeling risk financing
Source: Author's elaboration.

Once the distribution of probable disaster losses is known, the next step is the financial management of residual risk through financial instruments for disaster risk management that allow the financing of such losses in a timely and cost-effective manner. The following sections present the characteristics of financial instruments for risk management that the government can use.

Instruments for financing risk retention: from lower and highest frequency events

Risk retention instrument refers to type of risk financing instrument, that cover or provide financing for retain or assume certain layers of risk. Risk financing could be retained (financially assumed by the government by itself) or transferred (from the government to another party entity). Risk retention financing instruments make it possible to manage disaster losses using government's own resources, assume a first part of the loss in exchange for a reduction in the cost of risk transfer, and are generally used when transferring risk.

- It is not economically efficient for low severity events that generate minor losses but have a high probability of occurrence.
- For some low-frequency events, i.e., low probability of occurrence, but high severity, generate large losses, risk retention could be not enough to finance it.

Depending on the type of risk, it must be determined whether a risk retention instrument for risk management is efficient.

An advantage of risk retention instruments is the flexibility in deciding how and when they would have to be disbursed. However, in order to use them, the restrictions in the applicable regulatory framework for setting up reserves should be reviewed[31], as well as the minimum average balance that they should have in a year to face the average losses that could occur, and that they do not represent idle resources. Finally, these instruments require the definition of clear and transparent rules for their financing and use.

The instruments for financing risk retention are divided into two types, depending on when they are implemented:

- Ex-post, after a disaster, which does not require prior planning, e.g., budget reallocations and sovereign issuance debt.
- Ex-ante, prior to an event, planning should be done in advance and proactively, e.g., disaster funds and contingent lines of credit[32].

The following subsections describe the characteristics of the main instruments for financing risk retention (ex-ante and ex-post).

Budget reallocations

Budget reallocations provide resources in a short period of time, making it the first instrument that is commonly available to meet needs in the event of high-frequency disasters; However, they depend on the availability of resources at the time of the disaster, internal decisions, and the time required to execute the administrative procedures to make the resources available.

Budget reallocation seen as an ex-ante financial instrument is not economically efficient, due to the opportunity cost of modifying the plans of the programmed budget exercise by taking money from projects to which resources had originally been allocated and that will no longer generate the investment returns or the expected social benefit. Therefore, budgetary resources that are allocated ex-ante to an event through budgetary planning of potential losses allow for a reduction in the use of instruments such as budget reallocations.

Budget reallocations could also be used as an option after a disaster, considering that it is one of the most onerous ex-post financial instruments. It reduces the resources allocated to priority projects that contribute to the development of the economy.

Fiscal rules, institutional frameworks, and guidelines that allow for a timely response, as well as internal approval processes that allow for the transparent flow of resources, must be defined in order to make budget reallocations for disaster response.

31 Cardona, O. D., (2009). Financial Management of Disaster Risk - Retention and Transfer Financial Instruments for the Andean Community.

32 Clarke, D. J. and Dercon, S., (2016). Dull Disasters: How Planning Ahead Will Make a Difference, Oxford University Press.

Sovereign issuance debt

Frequently, sovereign debt is utilized to finance disaster-related damages. Governments impacted by disasters issue debt on global markets or binational debt; however, depending on the type of disaster and its severity, the post-disaster macroeconomic conditions exacerbate the conditions under which they issue debt, making financing through this source frequently scarce and costly.

Damage to the sovereign debt risk profile is the primary cause for the scarcity and difficulty of this sort of funding. In other instances, the disaster undermines credit quality by degrading the economy's infrastructure, production and consumption capacities. When the damage is structural and the likelihood of a recovery is doubtful, risk rating agencies lower the sovereign rating of a country's debt, which decreases sources of financing and increases the cost of financing via this source.

Disaster funds

Disaster funds generally accumulate their own resources, in case they are not used during the year, to meet emergency response needs in the event of a disaster caused by frequent, low-severity events. Once the holding fund is sufficiently capitalized, its resources may be used for recovery and reconstruction activities.

The constitution and administration of retention funds involves costs, since the fees of the public or private institution that administers the fund's resources must be covered, as well as the time required to define the rules for the efficient and transparent use of the resources. International experience in financial risk managing has identified the following actions for setting up a retention fund:

A. Analyze the regulatory framework to identify that the creation and management of the retention fund is
permitted, i.e., the fund must comply with applicable regulations.

B. To carry out a legal act, where they are detailed:
   a. Sources of funding;
   b. Legal form, i.e., through a bank account or trust;
   c. Type of account where the resources will be deposited. This could be a commercial bank, central bank, or development bank;
   d. Corporate governance;
   e. Objectives of the fund.

C. Development and publication of manuals and/or rules of operation that detail the framework of action of the fund for disaster response and encourage transparency in decision-making and the use of resources:
   a. Trigger mechanism to make resources available;
   b. Procurement of goods and services regulations;
   c. Financial management, accounting records, and audits.

In addition to its own resources, the holding fund could receive contributions from donors and sovereign debt facilities.

Contingent credit lines

Contingent credit lines are used to finance losses with a low probability of occurrence, to limit the loss, and when it is necessary or impossible to transfer the excess risk to other instruments.

One of its main advantages is that the resources can be used to cover different types of losses. However, it is not cost-effective, since the availability and cost of resources are not favorable due to the economic conditions caused by a disaster, which increase the uncertainty of the contractor's financial situation. In addition, multilateral institutions that grant lines of credit may request a guarantee from the national government.

Contingent lines of credit are particularly contracted with multilateral organizations that provide immediate liquidity in the event of a disaster and can be used for financing:

- Average losses;
- Emergency needs due to disasters when there is no financial instrument for risk transfer;
- Losses that exceed the coverage of insurance, reinsurance, or other financial instruments, such as bridge financing, since the resources are freely available.

These lines of credit are commonly granted to the national government through the Ministry of Finance by multilateral institutions, such as the World Bank, the Asian Development Bank (ADB), and the Japan International Cooperation Agency (JICA), among others. The agreement between the contractor and the multilateral must define the indexes, triggers, or circumstances for the availability of resources.

Table 6 shows the main characteristics and conditions for contracting contingent lines of credit for disaster relief offered by the multilateral institutions mentioned above.

Multilateral Institution	World Bank	Asian Development Bank (ADB)	Japan International Cooperation Agency (JICA)
Name	**Catastrophe Deferred Drawdown (CAT-DDO)**	**Precautionary Financing Option (PFO) under its Countercyclical Support Facility (CSF) or (CSF-PFO)**	**Stand-by Emergency Credit for Urgent Recovery (SECURE)**
Approval Criteria	- Appropriate macroeconomic policy framework; - Disaster risk management programme.	-Existence of an adequate macroeconomic policy framework and debt sustainability, including an IMF assessment letter. -Satisfactory completion of a set of substantive legal, institutional, and policy reforms to disaster risk management (captured in a policy matrix, based on prior actions). -A DPL outlining the government's commitment to development expenditure program to enhance resilience to natural hazards.	- Macroeconomic and public financial management - Plan for implementing JICA's technical cooperation for disaster prevention.
Limit	US $ 500 million or 0.25% of GDP, whichever is less.	-Each DMC can mobilize an amount equal to 0.50% of GDP, up to a maximum of $500 million if financed by regular OCR or a maximum of $250 million if financed by COL/ADF. Small DMCs whose 0.50% of GDP is less than $20 million may avail of up to $20 million, subject to their available resources.	¥10 billion (US $92 million) or 0.25% of GDP, whichever is less.

Trigger Mechanism	- Predetermined trigger, such as the declaration of the country's state of emergency.	-Disbursement is available only if pre-specified condition(s) linked to a disaster caused by natural hazard—typically the DMC's declaration of a state of emergency, or its equivalent—have been met.	- Formal request from the country.
Validity (available)[33]	- For three years.	- Up to the full allocated amount is available for disbursement at any time within 3 years of signing the legal agreement(s).	- For three years.
Conditions of Execution	- Flexibility of the country to decide when and how much to disburse. - Country-specific regulations for the exercise of spending. - Disbursement within 48 hours of request, and for various types of disasters.	-There is a policy matrix which include a set of substantive legal, institutional, and policy reforms to disaster risk management aimed at enhancing the DMC's resilience to natural hazards. ADB should demonstrate its value addition in supporting the reforms.	- Regulatory framework for the procurement of services or goods applied by JICA. - Disbursement within 15 business days of request.
Operational Requirements	- Satisfactory DRM program at the time of disbursement.	-The policy matrix should include a detailed PPPF, itemizing future reforms as well as ADB policy and technical support priorities.	- Adjust the operation of the credit to JICA's cooperation.
Cost of Financing	- Fixed price: projected by the WB, and if applicable, plus a market risk premium. - Variable prices: 6-month LIBOR + / - BM financing margin.	- 6-month LIBOR +/ - ADB's financing margin for CSF resources specifically	- Fixed for all types of SECURE credit, with a rate of 0.01%.

33 From the start of the contract with the multilateral institution.

Renewal Availability	- Once, for a maximum of six years in total.	-The initial availability period of the CDF for regular OCR, COL, and ADF is 3 years. Regular OCR-financed CDF can be renewed up to four times for a maximum of 15 years, while COL and ADF-financed CDF can be renewed once for a maximum of 6 years. Each renewal is for a period of up to 3 years.	- Up to a maximum of 15 years with extension procedures every 3 years.
Payment Period	35 years	15 years	40 years
Grace Period	3 years	NA	10 years
Renewal Cost	0.25%	0.25%	0.00%
Initial commission	0.50%	0.25%	0.50%
Standby fee	0.00%	NA	0.00%
Commitment Committee	0.00%	0.15%	0.00%

Table 6. Characteristics and contracting conditions of contingent credit for disaster response, offered by multilateral institutions

Source: Author's elaboration with information from the World Bank (WB), the Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA).

Donors and international assistance

Resources from donations and international assistance are usually provided in the case of catastrophic events that are not recurrent and where the number of losses is uncertain. Such resources are therefore mainly used for immediate response actions, such as humanitarian assistance.
Donations for disaster relief are a source of resources of low costs for the governments affected, since many donors have humanitarian programs to support relief activities, among other actions. However, some of the limitations of this mechanism are that:

- Resources are limited, representing a portion of the total need for emergency response and recovery, and rarely support reconstruction programs;
- Donations may be motivated by the visibility of the disaster in the media, so attendance and recurrence cannot be predicted;
- Internal and international arrangements must be made to schedule and receive resources, which can be a complex and time-consuming process involving uncertainty;
- The allocation of resources is not very flexible, as they are generally earmarked for previously identified expenditures.

As a summary of the section, table 7 presents the main characteristics of the instruments for financing risk retention that were described in this section.

Instruments	Budget reallocation	Disaster Relief Holding Funds	Contingent lines of credit: - of Multilaterals	Donations and international assistance
Amount	Medium	Limited	High, maximum of US $500 million	Limited
Flexibility in the amount	- Agreed, according to need	- Defined annually	- Agreed, according to need	- Agreed, according to need
Financial cost	- Opportunity cost of resources.	- Account or Trust Administration - Opportunity cost of resources.	Institutional interest rates + commissions	- Opportunity cost of resources.
Reference to calculate the cost	- Social Discount Rate and Benchmark Rate of Return	- Social Discount Rate and Benchmark Rate of Return	- LIBOR plus Rate and Fee Adjustments	- Social Discount Rate and Reference Rate of Return.
Flexibility in the use of resources	- According to the needs	- Distribution of resources according to needs	It is defined when the agreement is made, they can be: - Free destination, - With predetermined destinations.	In accordance with the donor's objectives and mission.
Disbursement time	- Days to weeks	- Days to weeks	- Weeks	- Weeks to months
Logistics	- Negotiations with government and legislative body - Fulfillment of the requirements and procedures.	- Design and implementation of the fund.	-Negotiations with the institution and government and comply with the requirements and procedures.	- Approach donors and comply with the requirements and procedures.

Table 7. Characteristics of risk retention financing instruments

Source: Author's elaboration

Instruments for financing risk transfer

Instruments for financing the transfer of risk make it possible to eliminate the contracting parties' uncertainty about the materialization of the risk by transferring it to a financial institution. Traditional insurance is the most common instrument used to transfer disaster risks from the insured to the insurer[34]. However, there are currently several alternatives, such as parametric insurance and catastrophe bonds.

Insurance

It is a contract in which the insurer is obliged to compensate the contracting party, in exchange for the payment of a premium, in the event of a loss covered by said contract and which is agreed by both parties[35].

Traditional Insurance for Governments

The insurer, through a contract, assumes the risk of a disaster and undertakes to indemnify the insured for the losses caused by the disaster in exchange for the payment of a premium. Traditional insurance for governments (or insured) contracts may include the figure of the deductible, which is an amount or percentage of the loss payable by the insured and which sets the amount above which the insurer will be liable for losses in excess of that amount or percentage. Additionally, a maximum amount of coverage to be paid by the insurer is established. Losses exceeding this amount will not be covered.

In order to make the claim of a traditional insurance coverage, a loss adjustment process must be carried out, in which an adjuster verifies and quantifies the magnitude of the insured's losses, so that the insurer, based on this information, makes the indemnity to the insured.

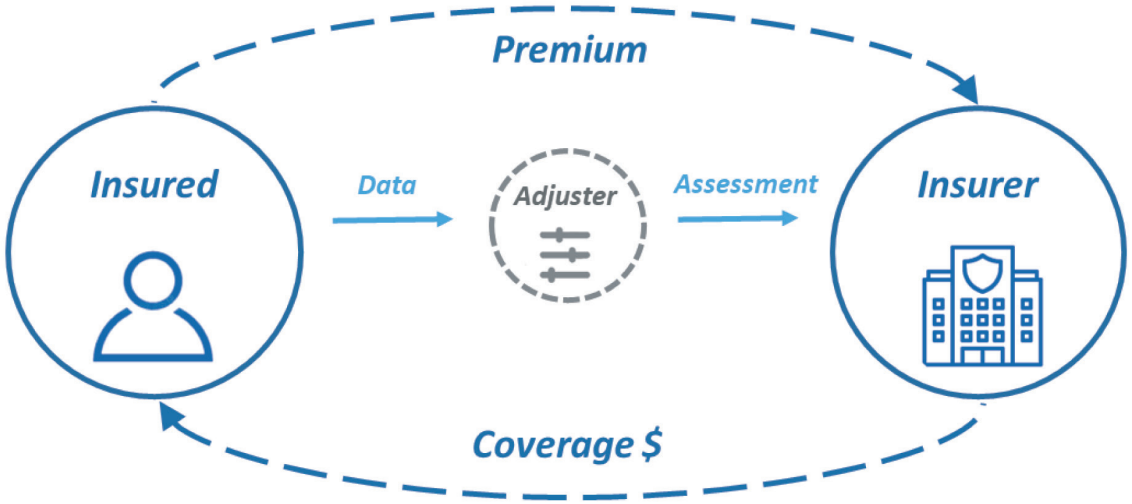

Figure 23. Traditional Insurance Operation

Source: Author's elaboration

34 Clarke, D. J. and Dercon, S., 2016, Dull Disasters: How Planning Ahead Will Make a Difference, Oxford University Press.

35 Cardona, O. D., 2009, Financial Management of Disaster Risk - Retention and Transfer Financial Instruments for the Andean Community.

Parametric insurance

Parametric insurance is a contract whereby the insurer undertakes to compensate the contracting party when the previously agreed parameters or triggers of an event—generally quantitative, such as the intensity of the event or the amount of the loss—are met. This insurance is measured and/or calculated by a third party using a predetermined methodology of variables independent of the insured and the insurer.

Parametric insurance is based on the probability of occurrence of an event and not the loss it could cause, so no adjustments are made to these. Instead, once compliance with the parameter is corroborated, the insurer must compensate the insured in an almost expeditious manner, in accordance with the provisions of the contract. The indemnity may be staggered, associated with the value of the parameter -.

While for traditional insurance schemes some catastrophic risk are not usually considered insurable, through parametric ones can be covered, and international experience shows that they are used for catastrophic events, such as tropical cyclones, earthquakes, and extreme rainfall, in order to limit the financial impact of the losses they could cause.

Figure 24. Parametric insurance Operation

Source: Author's elaboration

Through an insurance or reinsurance contract, or by issuing a catastrophic bond, parametric insurance coverage is granted. The difference between these mechanisms is the entity with whom the contract is made—considering its risk retention capacity—which could be an insurance company, a reinsurer, or the capital market.

Capital market: catastrophe bonds

The capital market is an alternative for financing and transferring disaster risks, where financial mechanisms have emerged that allow risk to be assumed. Although it does not replace insurance and reinsurance markets, it complements them by transferring part of the risk.

When Insurance markets (traditional and parametric) experiment a high pricing season, catastrophe bonds could be an affordable alternative.

The catastrophe bond is a fixed income financial asset in which the investor buys a security for a value that will be repaid at the end of a period, and during which they receive cash flows based on the interest granted by the bond.

For the issuance of catastrophe bond securities, the issuer and the investor use a special purpose vehicle (SPV) as an intermediary, which is created for that purpose, through one or more collateral assets of the issuance, the insurance premiums of the policyholders. The SPV is a separate legal entity that enters into an insurance contract with an insurance company to issue the catastrophe bond securities in exchange for payment from investors who purchase the security. The company that transfers the risk of the bond receives a premium, which is used by the SPV to pay investors coupons.

In this instrument, a trigger must be established, such that when the circumstances are met under which all or part of the principal and/or coupons (interest on the principal) must be used, indemnification is made to finance a disaster. This compensation may be based on actual losses, according to the sum insured agreed with the insurer issuing the bonds, or through payments based on indexes that cannot be influenced by the insured and that are related to the coverage of the disaster risk that the bond is covering.

Figure 25 shows the operation of the catastrophe bond, from the interaction of the insured with the insurer, and of the latter with the capital market through the SPV.

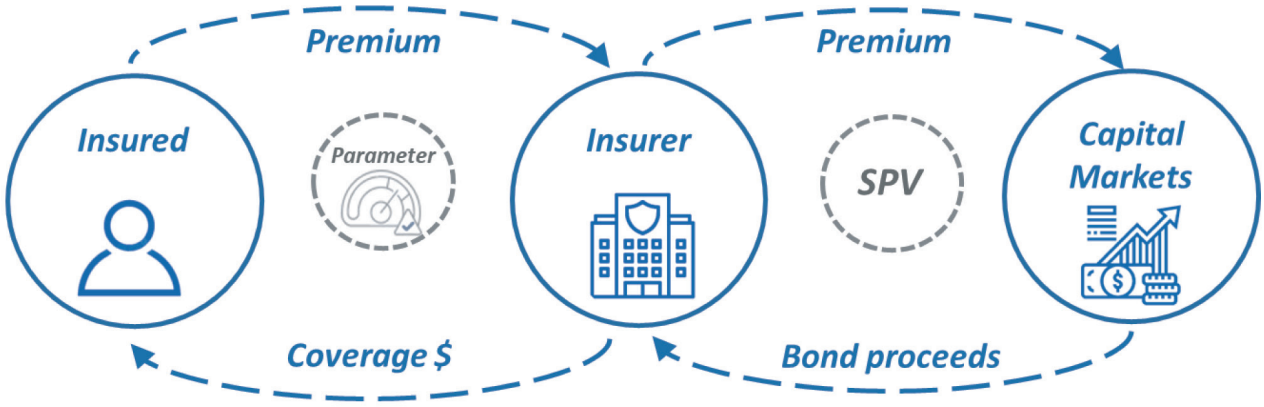

Figure 25. Operation of the catastrophic bond

Source: Author's elaboration.

Finally, as a summary of this section, table 8 presents the main characteristics of the risk transfer financing instruments discussed above.

Instruments		Advantages	Limitation	Cost of anchoring	Flexibility in the use of resources	Disbursement time	Logistics	Financial Cost
Insurance	**Traditional**	- Agreed sum insured - Clarity of coverage	- Ensure appropriate costs	-Risk premiums	- Free destination	- Tardiness	- Established processes (e.g., transparency) - Inspection and adjustment periods	- Pure Risk Premium + Commissions
	Parametric	- Agreed sum insured - Clarity of coverage	-Ensure appropriate costs	-Risk premiums - Basis risk*	- Free destination	- Expedited	- Established processes (e.g., transparency) - Corroboration of the detonator	- Pure Risk Premium + Commissions
Capital markets	**Catastrophic bonus**	- Agreed sum insured - Clarity of coverage	-Ensure appropriate costs	-Risk premiums - Basis risk	- Free destination	- Expedited	- Established processes (e.g., transparency) - Corroboration of the detonator	- Pure Risk Premium + Commissions

Table 8. Characteristics of risk transfer financing instruments

Source: Author's elaboration

Note: Basis risk in insurance refers to the possibility that someone has purchased insurance, but the money they receive in a claim does not equal the full cost of that particular claim event.

Component 4: Risk layering approach

The methodological paradigm for risk management based on risk layering, which is the practice of combining different types of financial instruments (risk retention and risk transferring) to manage and finance the financial impacts of disasters. The goal of risk layering is to create a diverse and resilient portfolio of risk transfer mechanisms that can provide coverage against different types of disaster events, while minimizing the potential for coverage gaps or overlaps.

In the field of disaster risk financing, risk layering typically involves combining traditional insurance mechanisms (such as property and casualty insurance), alternative risk transfer mechanisms (such as catastrophe bonds, parametric insurance, and risk pooling arrangements) with risk retention instruments (budget allocation, budget reallocation, contingent debt and ex post debt). By layering these different instruments, governments, can better manage their financial risks, reduce their exposure to catastrophic losses, and improve their ability to respond to disasters.

The concept of risk layering showed in figure 26 illustrates the strategic interactions of the risk financing instruments previously mentioned. Which settings are tailor made following the government's risk tolerance, funding needs, and budget, the strategy may be modified to meet its specific needs. The figure presents all possible settings for the risk financing instruments.

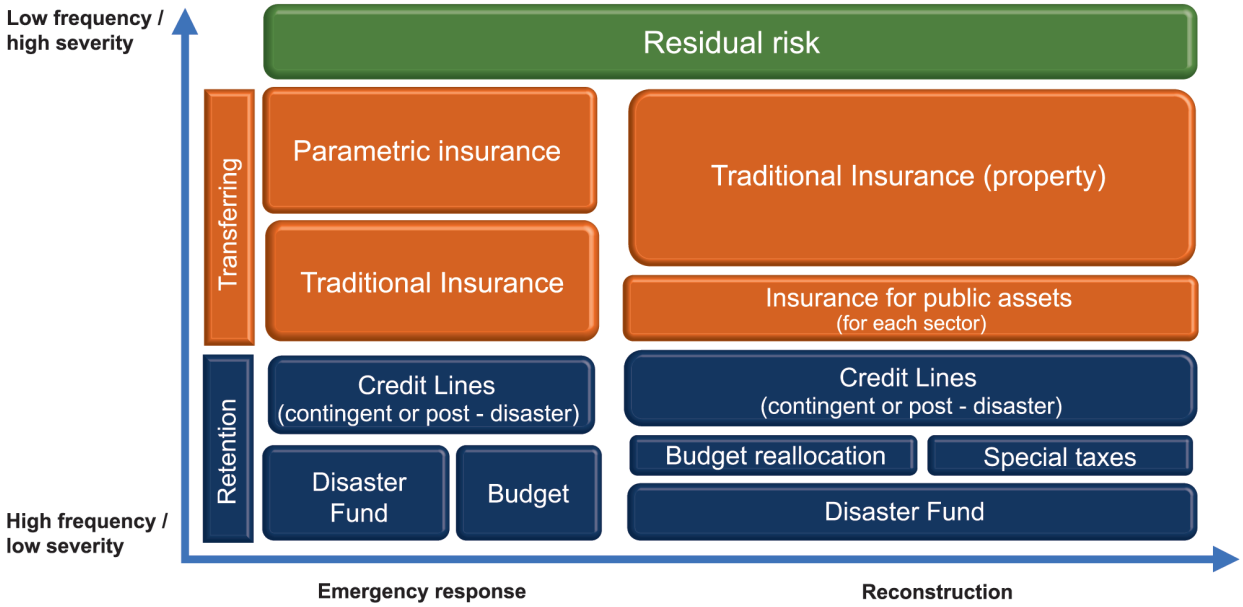

Figure 26. Risk layering methodology for risk financing

Source: Author's elaboration with data from World Bank (2021)

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