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Macro-level insurance for financing post-disaster recovery: The case of National Disaster Insurance Policy in Sri Lanka

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ABSTRACT

This paper evaluates the use of macro-level insurance to finance post-disaster recovery and reinstatement by investigating the case of the National Disaster Insurance policy implemented by Sri Lanka. The national scheme provided cover for all properties in the country against hazards such as flooding and provided compensation for those affected. Analysis of secondary data obtained from the organisations that managed the scheme showed that the scheme has delivered a much higher return compared to the total insurance premium paid, suggesting that the scheme has delivered a net positive benefit compared to the cost of the premium and can be considered a viable option. However, the existing secondary data did not reveal the values of other costs and indirect benefits associated with the scheme to compute a meaningful benefit-to-cost ratio. Further rigorous, evidence-based cost-benefit analysis is required to assess the cost-effectiveness of a scheme of this nature. A cost-benefit analysis approach based on an analytical hierarchy process is proposed as a possible solution to assess the cost-effectiveness of the scheme, which could be used by government organisations as an alternative, where analytical and research resources may be limited, to evaluate a range of disaster recovery financing options using stakeholder opinion.

KEYWORDS

Analytical Hierarchy Process (AHP); Cost-benefit analysis (CBA); Disaster Risk Management; Disaster Recovery; Flood Risk Management; Insurance; Macro-level; Re-construction

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1. Introduction

Low and middle-income countries are often affected by and are increasingly vulnerable to natural hazard-induced disasters events due to several factors such as the growing concentration of population, rapidly growing asset base in hazardous areas, and lack of enforcement of preventative measures such as building codes and standards in place (Ghesquiere et al 2006; Cummins and Mahul, 2009). Sri Lanka is one such disaster-prone developing country in the South Asian region. The most memorable was the Boxing Day tsunami in 2004 which resulted in 35,000 deaths, 22,000 further injuries and over 150,000 people lost their livelihoods (UN-HABITAT, 2011). This event wiped out more than 100,000 houses in Sri Lanka alone, requiring new houses to be built to accommodate those affected (UN-HABITAT, 2011). In addition to this one-off Tsunami, Sri Lanka is regularly affected by natural hazard-induced disasters such as flooding, landslides, cyclones and droughts. Recently, major flooding in 2017 affected 879,778 people with 219 deaths and caused destruction and damage to around 80,000 houses (Ministry of Disaster Management, 2017). Flooding in 2018 affected 188,328 people with 26 deaths and caused destruction and damage to around 11,000 houses (National Disaster Relief Services Centre (NDRSC)). Until recently Sri Lanka has significantly relied on ex-post instruments to finance disaster recovery efforts. Evidence suggests that such ad-hoc, ex-post instruments have resulted in mixed results due to various weaknesses and have not been able to support reconstruction activities effectively. For example, it was claimed that many post-tsunami housing projects have not been completed and houses remained partially completed even after 10+ years after the 2004 Tsunami event (Wedawatta et al, 2018). Further, funding from external sources is often required to facilitate reconstruction as governments in developing countries find it difficult to fully finance these in the event of a major destructive event. For example, in Sri Lanka, post-tsunami housing was mostly financed by external agencies including foreign governments and non-governmental organisations. This could often result in delays in securing finance, thereby shifting the reconstruction timeframe and requiring disaster-affected communities to spend more time in temporary shelters. Linnerooth-Bayer and Mechler (2007) showed that even with external support, governments of developing countries struggle to manage the liquidity deficit associated with post-disaster reconstruction, apart from exceptions such as the 2004 Tsunami. There is also the issue of certain communities being less well served than others, based on which agency is funding reconstruction and their terms. This creates a sense of injustice and discontent among communities. Whilst this is not an exhaustive account of financing difficulties faced by the governments of developing countries, is indicative of challenges associated with ex-post instruments.

In 2016, the Sri Lankan government introduced a new insurance scheme to cover all properties in Sri Lanka for natural hazard-induced disasters. This is an innovative insurance scheme as in many countries the property owners are responsible for their property insurance. This scheme covered lives and properties of all households up to Rs 2.5 million (£10,750) each in respect of damages as a result of cyclones, storms, tempests, floods, landslides, hurricanes, earthquakes, tsunamis and any other similar natural hazards. However, this new insurance scheme only covers properties up to a certain extent and is subject to upper limits the government can claim from the cover per annum, therefore, the scheme, in reality, is most relevant to low-income property holders. This, therefore, could be a potentially beneficial scheme as low-income householders, often the most vulnerable, are automatically protected and it also removes the need for ad-hoc government funding for housing reconstruction following a disaster event. – yet it comes at a cost to the public pocket due to the large premium involved. More importantly, such a scheme is likely to carry various direct and indirect benefits as well as costs; e.g. shift away from preparedness at the individual household level etc. The scheme has received mixed views related to its benefits from the local authorities, the public and researchers (John, 2016; Fernando and Jayasekera, 2018). Whilst the scheme has changed with the changes in government regimes over the years, it remains one of the first initiatives to provide insurance coverage at a national level against damages from natural hazard-induced disasters. To the best of the authors' knowledge,

there has been little credible research-based appraisal of the benefits offered by the scheme. This paper discusses a methodological approach to the financial appraisal of the National Natural Disaster Insurance Policy against its alternatives. It is intended that a systematic appraisal of the scheme will provide credible evidence much needed by the authorities to continue to fund the scheme, to identify administration weaknesses or to make decisions on investigating alternative disaster financing mechanisms.

2. Literature Review

2.1. Big picture-Disaster risk management and risk transfer

Disaster risk management is defined as "the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses" (UN General Assembly, 2016). Effective disaster recovery approaches need to be planned within an overarching and strategic disaster risk management (DRM) plan, and risk management framework suitable for an individual country's circumstances. Adaptation and mitigation measures (such as flood barriers) and disaster preparedness measures (such as early warning systems) need to be considered proactively and implemented where feasible to prevent and reduce disaster risks before planning and relying on ex-post-disaster recovery measures (such as insurance or donor aids) (Warner et al, 2013; Weingartner et al, 2017). Particularly for developing countries, risk prevention and reduction is more effective for high frequency – low sever disasters while a combination of risk prevention, reduction and transfer approaches are suitable for low frequency – medium/ high severity disasters (Warner et al, 2013). Recent research published by the World Bank explains multiple benefits of disaster risk management in their triple dividend of a resilience framework (Tanner et al, 2015). Tanner et al (2015) provide a comprehensive account of potential benefits related to three dividends: avoided losses, unlocking economic potential, and generating development co-benefits. It is also suggested that investments in ex-ante DRM measures (those implemented before a disaster event) could yield significant and tangible benefits, even in the absence of a disaster (Tanner et al, 2015). For example, disaster mitigation measures may provide reassurance for individual householders to undertake long-term planning to improve their welfare or for external investors to invest in a particular region or in a country which could reduce unemployment. Or instruments such as insurance can transfer risks and reduce uncertainty and stimulate investment, and in turn, can support macroeconomic growth (Weingartner et al, 2017). Internationally, international policy frameworks such as Sendai Framework for Disaster Risk Reduction, the Financing for Development Framework, the Sustainable Development Goals, and the climate change agreements all emphasise the need to incentivise and enable greater ex-ante disaster risk management measures (Tanner et al, 2015).

However, it is evident that many organisations and governments tend to invest low in disaster mitigation and preparedness measures but rely heavily on ex-post-disaster (those implemented after a disaster event) recovery measures (Tanner et al, 2015, Wedawatta et al, 2010). Resource limitations, ongoing fiscal pressures, lack of understanding of risks and impacts and greater political favour for more visible post-disaster support initiatives have led many developing countries to depend more on ex-post-disaster recovery measures (Cummins and Mahul, 2009; Tanner et al, 2015). Further, solid quantified evidence of the benefits of disaster mitigation and preparedness investments is limited and existing commonly used methods of investment appraisals avoid or undervalue the benefits resulting from DRM measures (Tanner et al, 2015). External reasons such as the underdeveloped nature of catastrophic risk markets and the readily available post-disaster donor assistance also push governments and organisations towards ex-post measures (Cummins and Mahul, 2009; Tanner et al, 2015). Individuals also have different reasons not to invest in disaster risk management measures (Warner et al, 2013; Ingirige et al, 2014; Tanner et al, 2015). The importance of ex-ante measures rather than relying on ex-post measures is often

highlighted, which reduces risks and enhances preparedness. This paper focuses on the key ex-ante DRM measure of insurance.

2.2. Insurance for disaster recovery finance

The ex-ante instrument of insurance is gaining popularity as a financial protection measure against natural hazard-induced disasters in both developed and developing countries. Insurance is a proactive (ex-ante) approach to managing the financial impacts of disasters and entails a risk transfer mechanism which provides financial security against disasters and in the long term helps to reduce poverty (Weingartner et al, 2017). Insurance cover damages to property and life and they can also be purchased to indemnify against business interruption caused as a direct consequence of property damage. Insurance can provide a wide range of benefits in the short and long term for individual households, businesses and governments. Appropriate insurance provisions can provide a range of benefits including; improved resilience to recover from disaster impacts; timely availability of funds to speed up recovery and reduce further post-disaster damages to assets and lives; peace of mind helping long-term planning and certainty for long-term investments for businesses which could stimulate investments and in turn, can boost productivity, welfare gains and macroeconomic growth; secured aid for recovery reducing disaster-related poverty (Warner et al, 2013; Hallegatte et al, 2016; Weingartner et al, 2017). The provision of risk-related information during the application process would lead to an increase in risk awareness for buyers, hence supporting more informed investment decisions with a better awareness of risks. Eg: risk-based premiums put 'a price tag on risks' (Ingirige et al, 2014) which could be used for business risk assessment calculations. Further, public actors and NGOs can enhance the cost-effectiveness of their disaster response by learning from the insurance industry (Clarke and Dercon, 2016). At the government level, innovative approaches to insurance (such as national insurance funds and CAT bonds) have been identified as effective mechanisms of post-disaster recovery financing, particularly to support resource-poor developing countries (Mechler, 2016). Even though the effectiveness of the insurance is dependent on factors such as the budget of the respective government, the types of disasters, the country's aversion to risk and the return rate, in general, insurance appears more cost-effective when the national budget is limited (Weingartner et al, 2017). In addition to the economic view, insurance is now increasingly becoming a social policy where without insurance many activities are deemed too risky and would not be undertaken (Surminski, 2014).

Insurance policies could be categorised into Micro, Meso and Macro (Warner et al, 2013) depending on for whom the coverage is provided. Insurances purchased by individuals or a small group of people to cover health, life, property, crop etc fall into the category of micro-insurance. Meso insurance such as derivatives normally covers larger entities such as communities, associations, and cooperatives. Macro insurance such as catastrophic bonds and national insurance funds are purchased to cover an entire nation or a government. Also, recent moves include the global pooling of large-scale risks (for example G7 InsuResilience initiative). Based on the claim and payout procedure, insurance can be categorised as indemnity insurance and index-based insurance. Traditional indemnity insurance assesses the damage caused to the claimants and pays a sum to rectify the damage. When properly designed, traditional insurance can provide tailored coverage for specific assets and perils (Ghesquiere et al, 2006). Therefore, this type of insurance may encourage moral hazard and discourage claimants to take action to protect assets or lives. On the contrary, index-based insurances are parametric and make indemnity payments based on a pre-agreed parametric index that is assumed to proxy actual losses based on the location and level of intensity of the disaster event (Cummins and Mahul, 2009). Index-based insurance is negatively attracted by householders due to the potential risk of not receiving a payout after having purchased the cover (Weingartner et al, 2017) or having less payout than the actual recovery cost (Cummins and Mahul, 2009). Whilst, theory and some examples suggest that insurance is an effective disaster financing mechanism, many key scholars still believe that they may not provide intended benefits in practice (see, for example, Botzen et al, 2009; Surminski and Oramas-Dorta, 2014). For

instance, Surminski and Oramas-Dorta (2014), by reviewing 27 flood insurance schemes and highlighted that only a minority of schemes show any link between risk transfer and risk reduction. This could be crucial, particularly in developing countries whose insurance market is young and the population has a substantial level of low-income households (Weingartner et al, 2017). More context-specific research is therefore required to evaluate the effectiveness of disaster recovery insurance schemes, particularly in developing countries. In 2016, the Sri Lankan government subscribed to a macro-level insurance scheme to cover lives and properties, specifically all households and small businesses against damages caused by natural hazard-induced disasters. This was an attempt to provide blanket cover to all households and small businesses at a national level and was an attempt to provide swift financial relief to those, especially low-income households, to recover in the aftermath of a disaster. There, however, is no evidence of a rigid cost-benefit analysis being undertaken before its implementation. Similarly, there has been little academic scrutiny of the costs/benefits of the scheme, especially considering the potential indirect impacts of such a national-level insurance cover on preparedness, individual insurance policies etc.

3. Research Method

The research method adopted here is a case study of the 'National Natural Disaster Insurance Policy' (NNDIP) of Sri Lanka. This is an indemnity-based macro insurance policy obtained by the central government, to cover all the properties (residential and Small and Medium-sized Enterprises) in the country up to the limits agreed upon. To the best of the knowledge of the authors, this is a novel and one-of-a-kind insurance scheme. As Yin (Yin, 2018) has explained, studying a single case is appropriate if the single case represents an extreme or an unusual case deviating from common practice as in the case of Sri Lanka's NNDIP. To find information about the case of NNDIP data is collected via document review including the analysis of data obtained from the National Disaster Relief Services Centre (NDRSC). Document review included key documents such as annual NNDIP policy documents. The scheme was discontinued in 2020 with the change of the government regime and a new mechanism was introduced to compensate victims of natural hazard-induced disasters directly via the treasury. Whilst the scheme has been discontinued, it is one of the novel initiatives implemented by a disaster-prone low-income country to provide disaster relief to its residents, especially to cover low-income households. As such, academic scrutiny of the scheme will provide valuable insights to regions/countries that may be interested in implementing a similar scheme in the future.

4. Findings

4.1. Cover available from the NNDIP

NNDIP in Sri Lanka covered the lives and properties of all households and SMEs against natural hazard-induced disaster events such as floods, cyclones, storms, landslides, earthquakes, tsunamis etc apart from droughts and fires. Droughts were covered under a separate crop insurance scheme implemented by the government. SMEs here are defined as businesses with an annual turnover of less than Rs 10 million. Each property (and contents) are currently covered up to Rs 2.5 million per disaster event. In comparison, before the NNDIP, the government provided financial assistance of up to Rs 0.1 million for a fully damaged property or up to Rs 0.05 million for a partially damaged property–if the monthly income of the household is less than Rs 5,000 (Ministry of Finance And Planning, 2013). So, the relief available under the current scheme is a significant increase from what was available from the government before. The total cover currently available from the policy is Rs 15 billion (See Table 1). From this Rs 2.5 billion is allocated for emergency relief and the remaining Rs 12.5 billion is allocated for damages to property and contents. The Ministry of Finance, Sri Lanka pays the policy premium to the National Insurance Trust Fund

(NITF). NITF has been established in 2006 by an act of parliament, to provide insurance facilities to government institutes and employees in a more effective and coordinated manner whilst ensuring maximum benefits to all persons eligible for benefits (National Insurance Trust Fund Act 2006). Its services include providing medical insurance to public servants, motor and not-motor general insurance and agricultural insurance for government institutes. Given the insurance provider itself is a public institute, it is easy to see that the NNDIP is primarily intended as a risk management strategy as opposed to being a profitable commercial initiative. This essentially differentiates NNDIP from an insurance policy provided by a private financial institute. However, the scheme still needs to be financially viable if it is to be sustainable in the long run. It also has to be noted that NITF invests in re-insurance for NNDIP which carries a cost but part of the claims paid to disaster victims are compensated via re-insurance. As can be seen in Table 1, the premium of the NNDIP policy has increased from Rs 300 million to Rs 1500 million over 4 years; signalling a fivefold increase. This is an indication that the premium charged initially has not been sustainable and further funding was needed to make the scheme work financially. The question then is whether the scheme offers a positive net benefit over cost.

Table 1. NNDIP cover details (Adapted from NDRSC, 2018).

Year	Period	Premium per annum (SL Rs)	Total collective coverage per annum (SL Rs)	Coverage for total property damage (SL Rs)	Emergency relief cover
2016	Started on 1 April 2016	300 million	10 billion	7.5 billion	2.5 billion
2017	Renewed on 26 May 2017	500 million	15 billion	12.5 billion	2.5 billion
2018	Renewed on 1 April 2018	500 million	15 billion	12.5 billion	2.5 billion
2019	Renewed on 1 April 2019	1.5 billion	15 billion	12.5 billion	2.5 billion

4.2. Damages awarded by NNDIP

As the first step towards assessing the costs and benefits of the NNDIP, we seek to compare the damages awarded by the policy against the premium paid. According to data obtained from the National Disaster Relief Services Centre (NDRSC), the first two years of operation has resulted in the most number of claims and damages being paid. In 2016 and 2017, there were several large-scale flood events and landslides displacing a large number of people. Most of these payments have been made to cover damage to properties and contents on households and SMEs (Rs 6.49 billion) whilst Rs 627 million has been paid for emergency relief and accidental death due to disaster events.

Table 2. Total number of claims and total damages awarded by NNDIP (Adapted from NDRSC, 2018).

Year	Total claims and damage payments		Total payments for property damages (SL Rs)	Total payments for emergency relief and casualties (SL Rs)
	Total Number of Claims	Total amount of payments (SL Rs)		
2016	138,773	3.61 billion	3.44 billion	167 million
2017	269,642	2.30 billion	2.11 billion	189 million
2018	29,446	674 million	529 million	145 million
2019	24,985	538 million	411 million	127 million
Total between 2016-2019	462,846	7.12 billion	6.49 billion	627 million

Based on the information in Table 2, further analysis of damages payments was conducted and Table 3 shows the percentage of benefits offered by the policy. Further analysis of the damage payments shows that up to now, the policy has delivered a positive financial benefit compared to the amount spent on the insurance premium. This is

mainly due to the lower premium in the first two years of NNDIP and the extent of damages suffered/damages compensated during the first two years (2016-2017). Whilst the percentage benefit compared to the premium paid has reduced over the years (due to increased premium and lower amount of damages suffered/claims paid), the net financial benefit has been positive over the total period the policy has been in operation (254% of the premium paid out as damages).

It can also be noted that whilst a net positive benefit over the premium paid has already been achieved, there has been scope to cover further damages should the damages be higher than what was experienced (total property damages awarded ranges from 3%-46% as a percentage of the aggregate limitations of liability for damages and the total emergency damages awarded ranges from 5%-8% of the total aggregate limitations of liability for emergency relief available). Analysis from Table 3 suggests that as a whole, the cover made available on aggregate has been more than adequate during the first four years of its operation.

Table 3. Total damages paid as a percentage of total damages, premium, and coverage available.

Year	Total damage payments as a % of premium	Total payments as a % of total cover available	Payments for emergency relief as a % of emergency coverage available	Payments for property damage as a % of total property cover available
2016	1203%	36%	7%	46%
2017	460%	15%	8%	17%
2018	135%	4%	6%	4%
2019	36%	4%	5%	3%
2016-2019	254%	13%	6%	14%

Whilst the analysis above shows that the policy has delivered a net positive financial benefit as a whole, it does not directly show whether the cover has been adequate for individual properties (whether the 2.5 million upper limits for a single property have been adequate). To obtain an account of this, summary data obtained from the NDRSC on damages awarded to cover for property damage were further analysed. The analysis revealed that the average damages paid per claim were significantly lower than the upper limit of Rs 2.5 million (See Table 3). Compared to houses, damages paid to SMEs per claim have been higher (See Table 4). This could be due to how a SME is classified for the purpose of NNDIP (annual turnover not exceeding Rs 10 million) and the classification providing cover for SMEs with high-value properties and contents compared to houses. Whilst this will inevitably help SMEs affected, a report by the Asian Disaster Preparedness Centre (2018), notes that the lack of a systematic approach to conducting damage assessments and reporting has significantly delayed the compensation process. It also notes that this delay in the compensation process delays the recovery of SMEs. So, whilst the extent of cover available seems sufficient, the administrative process seems to require improvements to derive true benefits of the scheme.

This analysis was undertaken based on the aggregate figures obtained from the NDRSC. Whilst it provides an account of the overall benefits of the scheme and the average claim size etc, it does not show whether there have been claims above the maximum damages allowed etc. To obtain a better account of this information, we analysed a sample of such damage assessments obtained from the National Building Research Organisation (NBRO) which undertook the damage assessments. To award compensation to victims for damages from natural hazard-induced disasters, damage assessments are conducted by local committees. The sample included 2,931 flood damage assessments from Kolonnawa Divisional Secretariat in Colombo District following flash floods that affected many parts of the country in May 2016 (See Table 5). Flash flooding is a common occurrence in Sri Lanka during the monsoon rainy seasons. For instance, the 2016 May flooding affected 19 out of 25 districts in the country, due to heavy rainfall.

Table 4. Damage payments to households and SMEs.

Year	Damage payments to Households			Damage payments to SMEs			Total damage payments to Households and SMEs		
	Number of Claims	Payments (SL Rs)	Average claim size (SL Rs)	Number of Claims	Payments (SL Rs)	Average claim size (SL Rs)	Number of Claims	Payments (SL Rs)	Average claim size (SL Rs)
2016	132,713	3,213,578,482	24,214	5,842	228,891,315	39,180	138,555	3,442,469,797	24,846
2017	254,744	1,933,397,984	7,590	14,510	176,725,024	12,180	269,254	2,110,123,007	7,837
2018	28,828	514,774,823	17,857	523	14,683,077	28,075	29,351	529,457,900	18,039
2019*							24,956	410,626,648	16,454
Total	416,285	5,661,751,288	13,601	20,875	420,299,416	20,134	462,116	6,492,677,352	14,050

The analysis shows that damages to all properties have been valued below the maximum damages allowed. The average per property has been Rs 130,232.00. However, the standard deviation is Rs 122,867.00 evidencing the fact that the damages have fallen within a substantial range from the average. The highest assessment has been Rs 2,130,000.00. It has to be noted that within the sample, no property has been totally destroyed and there has been partial damage to properties and/or contents. The average claim here has been much higher than that of the national situation as per Table 4. This could be due to the higher value of properties in the Colombo district (which is the central administrative district) compared to the rest of the country.

Table 5. Damage valuations for properties in Kolonnawa divisional secretariat in 2016.

	Damage assessment (SL Rs)	Number of properties	Percentage of properties
Below the individual property cap	Less than 10,000	56	2%
	10,000-25,000	112	4%
	25,000-250,000	2484	85%
	250,000-2,500,000	279	10%
Above the individual cap	Above 2,500,000	0	0%
Total		2931	100%

5. Discussion

The analysis of the cost and benefits offered by the NNDIP shows that the scheme has offered a net-positive direct financial benefit. However, it has to be noted that this analysis does not involve other costs involved such as the significant costs on local and national government entities to administer the process, possible environmental costs of people shifting towards an indemnity culture moving away from preparedness and resilience etc as well as indirect benefits such as social and economic benefits of faster recovery etc. Undertaking such an assessment to decide whether a scheme of this nature delivers value for money, however, is a complex endeavour. One of the widely accepted methods to use in such analysis is Cost-Benefit Analysis (CBA). For instance, in the UK, CBA is a part of the appraisal of proposals for the use of public resources as explained in the Green Book (HM Treasury, 2022). As mentioned previously, the NNDIP was replaced in 2020 with the change of the government regime in Sri Lanka. A key reason why the scheme could not live up to political scrutiny/decision-making was the lack of strong evidence

to support (or otherwise) its use. If a thorough CBA was available, to policy-makers, practitioners and the general public, there could have been an evidence-based apolitical decision on its implementation. Both the introduction and the subsequent closure of the scheme have come about without a rigorous cost-benefit analysis.

5.1. Traditional CBA

Cost Benefit Analysis (CBA) is the most preferred economic appraisal approach within investment decision-making, and it has been significantly used to evaluate disaster risk reduction investment. The basic idea of CBA is to identify the costs of undertaking a project and compare these to the benefits over time that could accrue from the project. The benefit-to-cost ratio (B/C) provides a dimensionless indicator that can be used to help inform the business decision on whether a project should be funded or not. In a traditional CBA, an appraiser would identify the timing and monetary values of a range of costs and benefits associated with a project in its lifetime. These are then discounted to present values to compute the benefit-to-cost ratio (Mishan and Quah, 2013; Wethli, 2014; Mechler, 2016). A benefit-to-cost ratio > 1 indicates a net beneficial project. CBAs are often conducted during the appraisal stage before an investment decision is made, hence called forward-looking analyses.

Whilst CBA is a well-detailed and systematic approach that could be used for disaster risk mitigation investment option appraisal, applying the traditional approach to CBA briefly explained is challenging to evaluate the national disaster recovery insurance in Sri Lanka. In reality, quantifying potential losses (or avoided losses) and converting them into monetary values is challenging. Therefore, many appraisers include only a limited set of benefits within the appraisal that could be converted to monetary values based on acceptable conventions (Wanigarathna et al, 2023). For example, indirect benefits such as avoided business disruption are often excluded from appraisals or calculated based on simplified coefficients (Kappos and Dimitrakopoulos, 2008). The results presented above indicated actual cash flows paid to house owners (potential benefits) and the insurance premiums paid by the government (cost). However, they do not represent the full array of benefits and costs associated with the scheme. Whilst householders are paid money to repair or reconstruct their buildings (potential benefit), to what extent they are repaired using those payments (actual benefit) is not reported. Considering the slow nature of the repair and reconstruction effort following the 2004 Tsunami,it is fair to assume that a portion of these homes may not be repaired, and insurance pay-outs may have been used for other purposes by households (Wedawatta et al, 2018). In addition, there could be other intangible benefits associated with this scheme. Firstly, 'build back better' principles are often encouraged during repair works (UNISDR, 2015), hence there may be additional benefits associated with the (better) quality houses following repairs. Local construction businesses or self-employed builders and building material suppliers may benefit from the scheme as opposed to alternative donation-based recovery schemes. Further, large sums are required to repair building stocks following disaster events (Lane and Mahul, 2008; Dube et al, 2021) and insurance schemes would be more reliable and assuring compared to unprepared donation-based repairs. Further, the government could, if needed prevent or discourage settlement in an area of increased disaster risk as a condition of payment (Surminski, 2014). However, quantifying these benefits and converting them into monetary values are challenging, hence no approaches or proxies could be identified within the literature to aid such valuation. Similarly, the cost of the scheme identified in the results only represents the direct costs of the scheme in the form of the annual premium paid by the Government. However, the scheme also requires a considerable level of administrative resources and the local authorities and at the national level (NBRO and NDRSC). It is challenging to determine the costs spent at those organisations. Further, Insurance does not cover indirect financial losses such as loss of earnings by suppliers due to disabled businesses, estimated shortfalls in the gross domestic product, and non-economic losses, such as loss of reputation or impaired quality of life [33]. Therefore, an alternative approach to evaluating an initiative similar to NNDIP is proposed here.

Whilst there is a range of examples of applying CBA to evaluate technical risk mitigation interventions (such as

improved foundations or defence walls) across a range of disasters (flooding [Burton C.; Venton, 2009], Earthquake [Smyth et al, 2006]), examples of applying CBA principles for non-technical risk mitigation interventions in the community or regional level is limited. Non-technical interventions could take many forms. For example, Pesaro et al. (2018) categorised non-technical interventions for flood risk management into 4 categories: riverine environment based (e.g. river management), built environment based (e.g. building regulations), social involvement-based (e.g. education programs) and economic-based (e.g. risk transfer through insurance). The national disaster recovery insurance evaluated in this paper can therefore be termed as a non-technical or 'soft disaster risk reduction intervention' (Moench et al, 2007, Ingirige and Wedawatta, 2018) which intends to aid a whole nation to recover from multiple natural hazards. Forward-looking modelling of benefits (avoided losses) to a whole nation against multiple hazards is complicated and will require enormous levels of technical, economic and social data. Gesquiere et al (2006) avoided these complicated calculations and modelling during their forward-looking appraisal of the World Bank financed Bogotá Disaster Vulnerability Reduction Project. Authors have assessed the impact of the function based on the assumptions made concerning the lives saved and injuries avoided as a result of the interventions, which were then converted to quantitative monetary values using appropriate norms. Whilst this approach could be implemented for an intervention focused on a single hazard risk to a relatively small community, making assumptions on avoided losses across a nation for multiple hazards in case of evaluating Sri Lanka's NNDIP for disaster recovery would be fallible.

Alternatively, some researchers have therefore taken a retrospective evaluation approach in these instances (Moench et al, 2007). In this approach, the costs and benefits of an intervention are identified and gathered after the intervention is implemented and started to benefit a community. Or costs and benefits of similar previous interventions are used to establish potential benefits and costs of new interventions. For example, Pesaro et al (2018) have conducted a retrospective CBA to evaluate the impact of the use of existing dams to retain water in case of heavy rains. Using 2012 and 2013 flood events in the Umbria Region (Italy) as a case study, the authors modelled the losses due to the 'occurred event' (using actual loss data gathered by the Civil Protection), and the losses associated with the 'avoided event' using a standard flood damage modelling procedure (Flood-IMPAT). Whilst this approach misses the opportunity to make decisions based on a systematic benefit evaluation before an intervention starts, it would help local authorities and other organisations to decide if it is beneficial to repeatedly invest in the same or similar interventions. In this sense, this approach could be applied to evaluate Sri Lanka's NNDIP. The results presented in this paper is a good starting point for a similar analysis, and it could be extended to identify and value a range of other costs and benefits explained earlier. Whilst it could be challenging to derive monetary values of costs and benefits, one could arrive at a reasonably accurate retrospective evaluation of the scheme with some effort. However, generalising the finding for repeat implementation would be more challenging due to changing hazard, vulnerability and asset profiles across the country.

5.2. AHP-based CBA framework

As discussed so far, calculating or assuming the impacts of hazards and converting them into monetary values as in traditional approaches to CBA is extremely challenging, resource-consuming and fallible. In this paper, we propose how Analytical Hierarchy Process (AHP) (Saaty, 1994; Wedley et al, 2001) could be used together with CBA principles for evaluating Sri Lanka's national insurance for disaster recovery against its alternatives (Figure 1). Whilst the overarching CBA principles remain the same, this method uses an alternative to converting costs and benefits into monetary values. Two AHP hierarchies need to be first established for the costs and benefits of similar interventions (Steps 2 and 4 in Figure 1). An initial round of stakeholder discussions could then be used to assign relative weights for the costs and benefits of the two AHP models. Stakeholders would then collectively decide to what extent a range of risk reduction interventions (disaster recovery interventions in our case) will contribute to

individual costs and benefits attributes of the AHP models (refer to Steps 3 and 5 in Figure 1). In other words, benefits and costs would be converted to AHP priorities rather than dollars being used as the common currency as in a traditional CBA. The alternative with the highest ratio of benefit priority/cost priority is considered the most beneficial option. In a recent example, Babalola (2020) used a combined AHP-based CBA approach to compare 4 food and biodegradable waste treatment alternatives in Japan. This approach could overcome complicated and laborious calculations related to the monetary values of costs and benefits. It could be a useful tool in comparing Sri Lanka's NNDIP against its alternatives such as government-funded reconstruction, donor-supported reconstruction (donor-driven) or household-funded recovery (owner-driven) which would be far more challenging to quantify in monetary terms. Organisations such as NBRO and NDRSC and other civil servants involved in the administration of the scheme at the local level could provide meaningful contributions to establish AHP priorities.

Whilst the concept is similar, the benefit-to-cost ratios derived based on AHP CBA do not reveal the relationship between actual cost and monetary value of resultant benefits. For example, in a traditional CBA, a benefit-to-cost ratio of 4 would mean every 1 LKR (Sri Lankan Rupee) invested will result in 4 LKR worth of benefits. In an AHP-based CBA, the benefit-to-cost ratio is not related to actual monetary values. Therefore, this approach could be used to evaluate alternatives if the benefits are much more important than the costs to the decision-makers (Saaty, 1994). Alternatively, Wedley et al's (2001) extended AHB CBA approach could be used If the decision-makers are interested in relating the appraisal to monetary values. In their approach whilst the AHP model for benefits and AHP priorities are established based on the stakeholder consultation, the cost of individual interventions is calculated as actual monetary values. The resultant benefits-to-cost ratio would therefore provide a measure of benefit per 1 LKR of expenditure. Option 1 of Step 5 (refer to Figure 1) in the approach proposed in this paper could be used to calculate costs in real currency.

Using this approach effectively to evaluate financing options will require a sound strategy and guidance. The first step would therefore to appoint a facilitator who could perform initial preparations such as deciding on options to be appraised, estimating resource requirements and arranging any initial training or briefings (see Step 1). Developing benefit and cost hierarchies need to follow a collectively designed sound methodology (see Steps 2 and 4). Figure 2 shows two examples of benefit and cost hierarchies that could be used as a starting point or to demonstrate as examples during training sessions. Whilst identifying benefits may be relatively easier, stakeholders could have different views on their relative importance and to what extent each financing option would fulfil them. A sound methodology agreed upon in advance could therefore smoothen these steps. For example, individual stakeholders' ratings may be averaged to decide that reinstating physical damage quicker following a hazard is more important (relative importance) or 50% important (0.5 weightage) compared to other benefits. The approach proposed here could be used to evaluate the cost of options in real currencies or based on stakeholder opinion (Options 1 and 2 of Step 5 in Figure 1). However, deciding the best-suited option during the Step 1 could avoid later disagreements.

6. Conclusions

Despite criticism, insurance remains a valuable risk transfer strategy to counter the residual disaster risk following the implementation of appropriate disaster risk prevention and reduction strategies. In most situations, insurance coverage is obtained at a micro-level for individual households and businesses or at a meso-level for communities or cooperatives. Taking insurance coverage to a new level, in 2016 the Sri Lankan government subscribed to a macro-level insurance scheme to provide cover for all the households and small businesses in the disaster-prone island nation. There is little evidence to suggest though that this initiative was introduced after a robust and comprehensive cost-benefit analysis to assess the costs and benefits of introducing such a scheme. In this paper, an original analysis was undertaken to assess the direct costs and benefits offered by the cover during

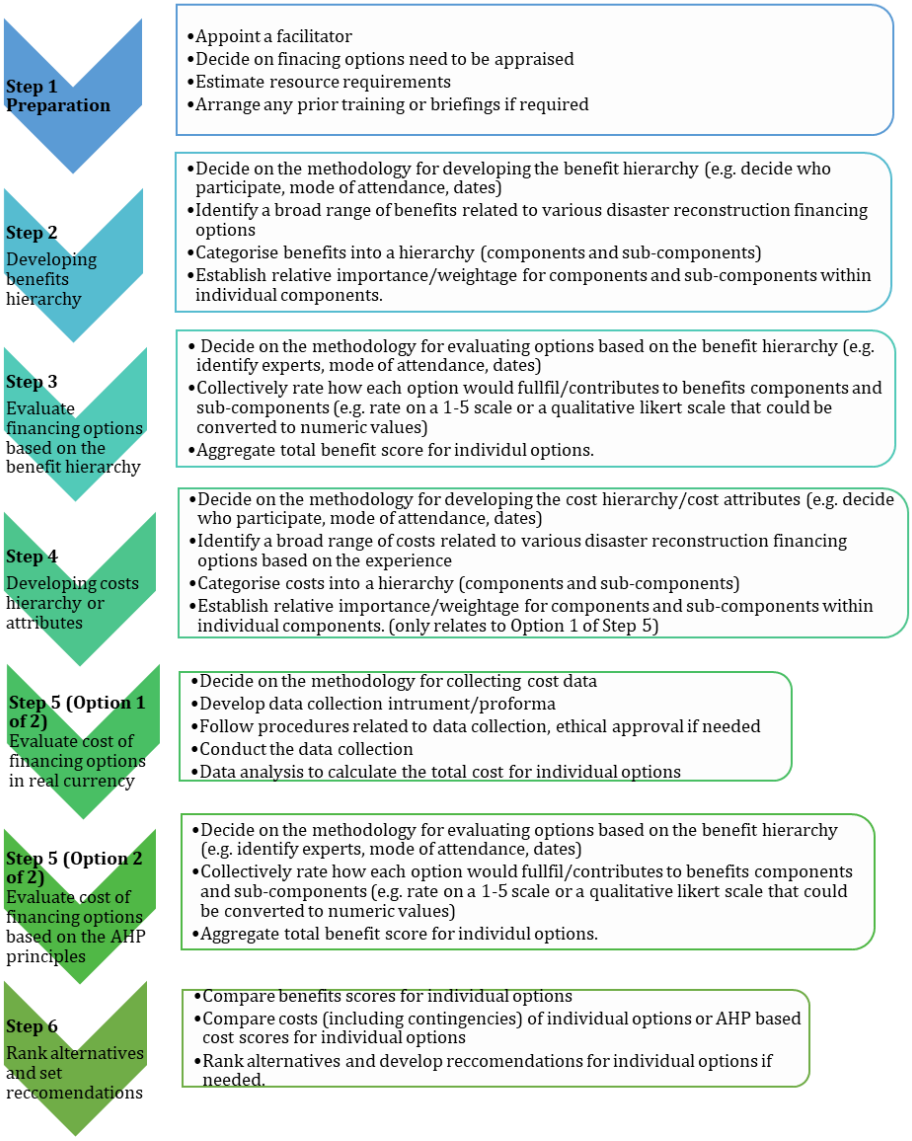

Figure 1. AHP-based approach to cost-benefit analysis.

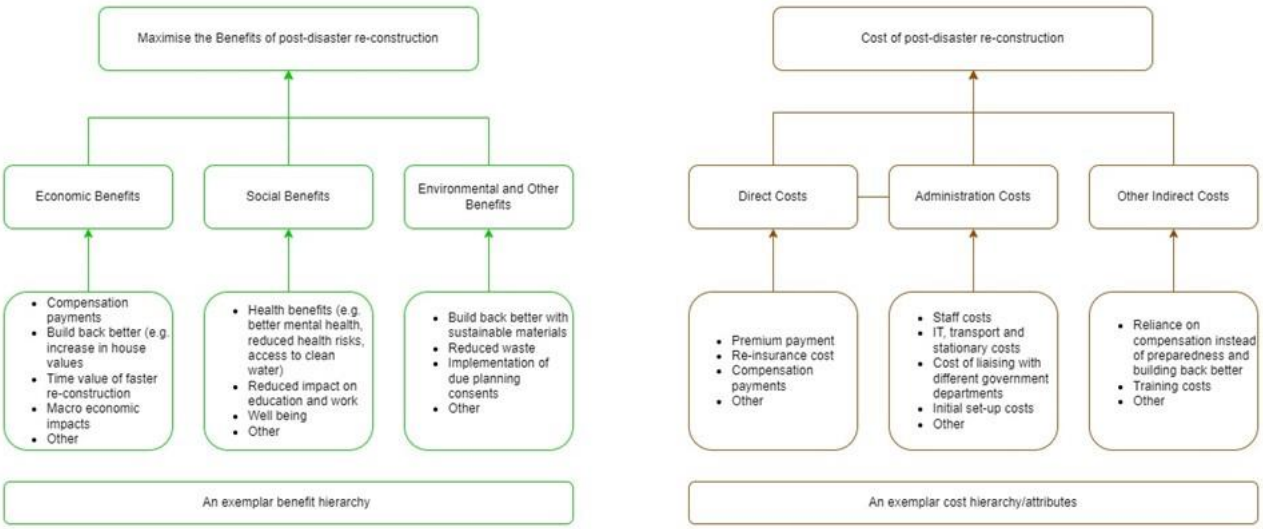

Figure 1. Exemplar Benefit and Cost hierarchies.

its period of operation. The analysis revealed that the scheme has offered a net-positive return on the investment when direct costs and benefits are considered. The premium of the policy has increased during the period of its operation, and the level of benefits compared to the premium has decreased. However, the level of compensation awarded by the scheme has remained well below the aggregate limitations of liability, suggesting adequacy of the level of protection offered by the scheme. The evidence from direct costs and benefits of the scheme suggests that such macro-level insurance schemes for nations, regions or localities can be a useful tool to provide relief to at-risk communities, especially in low-income developing countries where micro-level insurance is not widespread among low-income households/small businesses.

Whilst the scheme has provided relief to thousands of disaster victims, it has also been criticised due to the significant administrative burden on government entities to manage damage assessment and compensation processes, potential negative impact on building-back-better etc. After several years of operation, the scheme was discontinued and replaced with a direct compensation mechanism via the treasury. A key reason the scheme could not stand its scrutiny was the lack of a robust cost-benefit analysis to demonstrate how it delivers value compared to its cost. Whilst the decision to discontinue the scheme was brought about by a change in the government regime, the availability of robust evidence may have helped its survival as it would have received public backing. A robust cost-benefit analysis of such a national-level initiative with far-reaching and multi-faceted implications however is no mean feat and requires significant analytical and research resources. This research proposed an analytical hierarchy process-based cost-benefit analysis approach that can be adopted in contexts where such resources are limited. The proposed method allows investigators to include a range of direct and indirect costs and benefits within their analysis and measures them using stakeholder opinion. This eliminates limitations of the traditional cost-benefit analysis approach which requires quantifying and monetising benefits and costs, hence pushing investigators to exclude many indirect costs and benefits from the analysis. The proposed method also promote stakeholders to investigate a range of costs associated with the scheme, hence could prompt them to streamline costs. The proposed approach can be used in similar situations to assess costs and benefits in resource-constrained contexts. The approach proposed however is conceptual and the next stage of the research will be the validation of the proposed conceptual approach by applying it to assess both the national insurance scheme as well as its replacement.

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Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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