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Financing loss and damage from slow onset events in developing countries

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Based on a systematic review of journal articles, books and book chapters, and policy papers, we evaluate possible sources of finance for addressing loss and damage from slow onset climate events in developing countries. We find that most publications explore insurance schemes which are not appropriate for most slow onset events. From this, we determine that only a few sources are sustainable. Levies and taxes are seen as relatively fair, predictable, adequate, transparent, and additional. These results confirm that current options for sustainably and equitably financing loss and damage from slow onset events are limited.

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Introduction

With increasing pressure from developing country Parties to the United Nations Framework Convention on Climate Change (UNFCCC) for a mechanism to address loss and damage associated with climate change, the Warsaw International Mechanism was established at the Nineteenth Conference of the Parties (COP19) in 2013 [1]. Since then, however, there has been minimal progress in mobilizing financing for loss and damage, which is unofficially defined by the UNFCCC Secretariat as 'the actual and/or potential manifestation of impacts associated with climate change [. . .] that negatively affect human and natural systems' [2, p. 3]. Loss has been characterized as the negative impacts of climate change that are permanent, and damage as those impacts that can be reversed [3]. Non-economic loss and damage further recognizes that some climate impacts such as the loss of traditional ways of living, cultural heritage and biodiversity are hard to quantify and often go unnoticed [4]. The term encapsulates losses whose valuation raises ethical concerns, for example, a decline in human health and loss of life [4]. A distinction has been made between avoidable (through mitigation and adaptation efforts) and unavoidable loss and damage [3]. Loss and damage, therefore, goes beyond adaptation [5], as it occurs when the costs of adaptation cannot be recuperated, or when adaptation efforts are ineffective, maladaptive, or impossible [6]. Even if current mitigation and adaptation efforts are successful, some residual loss and damage will occur [6]. As a result of this, financing for loss and damage has been a core demand of many developing countries, with very strong calls coming from the African Group and the Least Developed Countries Group in the climate negotiations [7–9].

Several authors such as Broberg [10], Kehinde [11], and Schinko *et al.* [12•] have proposed potential sources of loss and damage finance, many of which are best suited to address rapid onset events. These events, such as cyclones and floods, are discrete and occur in a matter of days or even hours. Other authors such as Durand *et al.* [13••] and Gewirtzman *et al.* [14••] have inventoried existing sources of finance, though questions remain over whether they are appropriate for addressing non-economic loss and damage, and slow onset events, which 'evolve gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events' [15, p. 7].

These slow onset events – and not the discrete rapid onset events – are the focus of this article. Slow onset events include sea-level rise and increasing temperatures. As steadily building threats, climate-related slow onset events do not garner the same international attention drawn to disasters that rapidly emerge, peak, and cause devastation with little warning. However, slow onset

events can rival rapid onset events in terms of a decline in human health and loss of life. Because of hunger and malnutrition arising out of food insecurity induced by desertification, historically more people have died from slow onset events than from rapid onset events [16]. Appropriate financial responses are a critical component of establishing global climate justice in a warming world [17]. However, further questions remain about the extent to which sources of finance can be mobilized and made sustainable, and whether they are fair, feasible, predictable and adequate.

In order to identify and synthesize the most recent and significant academic and policy research across the social sciences and humanities on financing loss and damage from slow onset events in developing countries, we conducted 26 systematic searches for journal articles, books and book chapters, and policy papers published since the establishment of the Warsaw International Mechanism in 2013 across three databases. We conducted 12 searches in Google Scholar, 11 in Scopus, and three in EBSCOHost (search strings are included in Appendix 1). We used variations of 15 broad keywords such as 'climate change', 'finance' and 'loss and damage'. These keywords were chosen based on their relevance to our research question – what are the current financing options for loss and damage from slow onset events in developing countries? – and based on our knowledge of the literature, and our combined experience with the UNFCCC and its context. These keywords, we believe, allowed us to retrieve nearly all papers relevant to our scope; we did not limit our search to peer-reviewed literature. Of special note, however, is that we excluded keywords such as 'insurance', which many authors have argued is better suited for rapid onset events such as cyclones and floods [18•], and 'liability' and 'compensation', which have been sources of contention in the UNFCCC and which would have been barriers to agreement at COP21 in Paris if they had been included in the negotiation text [19,20].

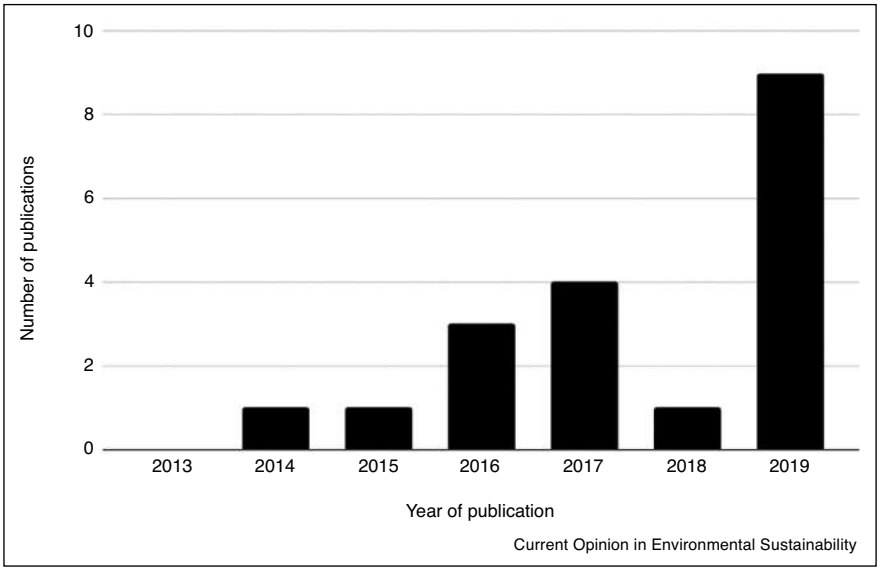
Our systematic search retrieved 1,486 results across the three databases. We long-listed 75 results based on the relevance of their titles to financing loss and damage in developing countries, and short-listed 42 based on the relevance of their abstracts to financing loss and damage from slow onset events in developing countries. Here, we considered all eight types of slow onset events identified in Paragraph 25 of Decision 1/CP.16 establishing the Cancun Adaptation Framework at COP16 in 2010 — sea-level rise, increasing temperatures, ocean acidification, glacial retreat and related impacts, salinization, land and forest degradation, loss of biodiversity, and desertification [15]. Where articles were not specific to slow or rapid onset events but to loss and damage in general, we drew on our collective expertise to decide whether it provided enough data to be included in our final synthesis. Where journal articles, books and book chapters, and policy papers only mentioned slow onset events in passing, we excluded them. Based on this, we excluded an additional 23 results after we read the full texts because they (a) did not identify and/or evaluate sources of financing for loss and damage from slow onset events in developing countries, (b) largely focused on either (i) loss and damage but not its financing, (ii) rapid onset events, or (iii) developed countries. This led to many UNFCCC technical documents being excluded from our final synthesis. As a result, of the 19 remaining journal articles, books, and policy papers, we focused on the eight that were published between 2017 and 2019, and drew selectively on the 11 older works published between 2013 and 2016 (inclusive) (see Appendix 2 for a list of included studies). These publications, the largest number of which were published in 2019 (see Figure 1) and are journal articles (see Figure 2), proposed, identified, inventoried and/or evaluated various sources of finance for addressing loss and damage from one or more of the eight slow onset events we identified above.

Based on work by Roberts *et al.* [21••], Schalatek and Bird [22], and van Drunen *et al.* [23], we developed and applied a three-component coding template to the sources we identified across the remaining 19 publications. The three articles on which the coding template is based offer the most comprehensive understanding of loss and damage finance to date. While they were not limited to slow onset events, we found that they offered the best means to develop our criteria. Against a three point scale (low/medium/high), we rated the (1) appropriateness of the finance source for slow onset events, (2) extent to which the finance source can be considered sustainable (i.e. whether revenues are likely to increase or decrease over time), and (3) extent to which the finance source meets eight other related financing criteria — (i) fairness, (ii) feasibility, (iii) predictability, (iv) adequacy, (v) transparency, (vi) additionality, (vii) direct access, and (viii) vulnerability focus (see Table 1 for more details). In presenting our results below, which first overviews the various sources of finance captured in the literature and which is then organized according to the three-component coding template described above, we also discuss the challenges in financing loss and damage from slow onset events along with possible approaches to managing them. We conclude by recapping the key messages and by highlighting promising areas for future research.

Overview of sources of finance

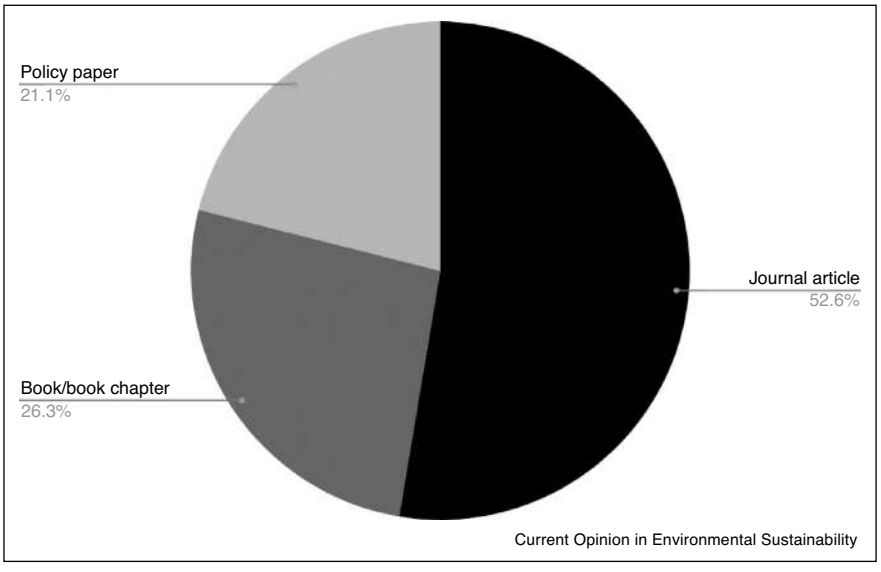
From our review of the 19 journal articles, books, and policy papers, we identified five sources of finance for addressing loss and damage from slow onset events in developing countries: (1) insurance and risk pooling, (2) contingency finance, (3) bonds, (4) levies and taxes, and (5) other sources, based on the principles of attribution, rehabilitation and/or compensation. Here, we defined 'source' as a mechanism whose revenues are public, private or a mix of both. Fifteen

Figure 1



Year of publication.
(Source: Authors).

Figure 2



Type of publication.
(Source: Authors).

publications non-exclusively explored insurance and risk pooling; three explored contingency finance; two explored bonds; four explored levies and taxes; and four explored other sources (see Figure 3). This confirms that the relevant literature published between 2013 and 2019 disproportionately focused on insurance and risk pooling as a possible source of finance and left other sources such as bonds underexplored.

Broberg [10], Durand *et al.* [13••], Gewirtzman *et al.* [14••], Künzel *et al.* [24], Nordlander *et al.* [25••], Roberts *et al.* [21••], and Schinko *et al.* [12•], as part of an edited volume that is broadly about loss and damage and not specific to slow onset events, are among the 15 publications that focused on insurance and risk pooling as a possible source of finance for loss and damage from slow onset events in developing countries. These articles and book chapters

Table 1

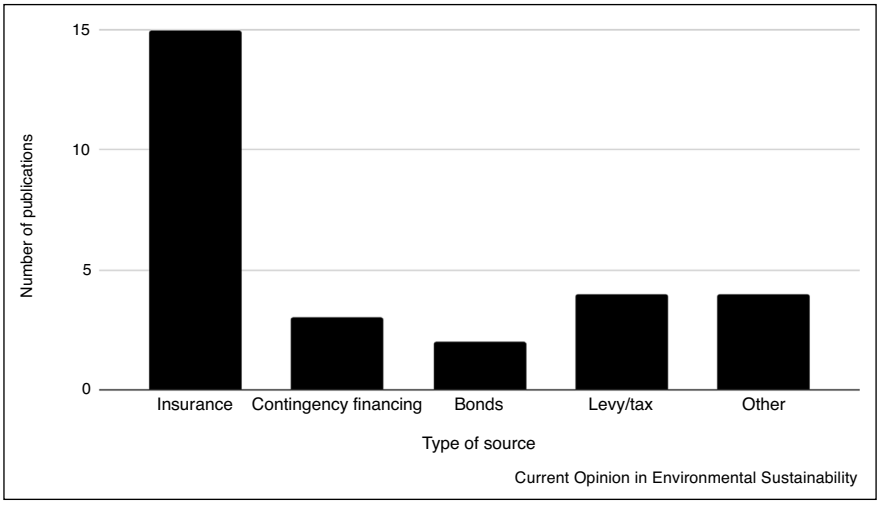
Coding template

–	Type of source	Insurance and risk pooling Contingency financing Bonds Levy/tax Other	
1	Source is appropriate for slow onset events	Suited to address the temporal/slow nature of slow onset events	Low: not appropriate Medium: somewhat appropriate High: appropriate
2	Source is sustainable	Revenues likely to increase over time	Low: revenues likely to decrease over time Medium: revenues likely to remain the same over time High: revenues likely to increase over time
Source is . . .			
3 (i)	Fair	Does not impose an additional burden or injustice on the recipient country	Low: completely imposes Medium: imposes somewhat High: does not impose
3 (ii)	Feasible	Institutions are able to implement; use of source will be accepted	Low: major institutional reforms are necessary or likely to invoke severe political obstacles Medium: minor institutional reforms are necessary to implement or likely to face some obstacles High: institutions are available and capable to implement or will be widely accepted
3 (iii)	Predictable	Provides a steady and predictable source of funds	Low: the revenues can be predicted with little accuracy Medium: the revenues can be predicted with some accuracy High: the revenues can be predicted with considerable accuracy
3 (iv)	Adequate	The amount of funding is sufficient to cover the cost of loss and damage from slow onset events	Low: source would cover few costs Medium: source would cover some cost High: source would cover most of cost
3 (v)	Transparent	The revenues are verifiable, measurable and reportable	Low: it is impossible to verify, to measure and to report the revenues Medium: the revenues are difficult to verify, to measure and to report High: the revenues are easy to verify, to measure and to report
3 (vi)	New and additional	Funds provided are more than existing official development assistance commitments or adaptation financing and are not counted towards fulfilment of existing national official development assistance commitments or adaptation financing	Yes No
3 (vii)	Direct access	Funds to be made available as directly as possible (eliminating multilateral intermediary agencies)	Yes No
3 (viii)	Vulnerability focused	Funds to be made available to those countries internationally and population groups within countries that have experienced the greatest loss and damage	Yes No

(Source: Authors; based on Roberts *et al.* [21••], Schalatek and Bird [22], and van Drunen *et al.* [23]).

covered two types of insurance – index-based and indemnity-based – at three scales – micro, meso and macro. Nordlander *et al.* [25••, p. 1] broadly examined the benefits and drawbacks of insurance schemes, which they noted as being 'widely supported' and part of the Warsaw International Mechanism. The benefits include shifting the 'risk of loss and damage from one entity to another in exchange for a premium'; the drawbacks include being traditionally applied and/or relevant to rapid onset events [25••, pp. 2 and 4]. Considering this drawback, Nordlander *et al.* [25••, p. 5] suggested that insurance schemes could be substantially redesigned to cover non-economic loss and damage, a concept that recognizes that some climate impacts are hard to quantify, by coupling it with 'insured economic assets' or triggering automatic compensations 'whenever a consequential climate-related event occurs'. Schinko *et al.* [12•] further proposed a needs-based framework, and argued that insurance schemes have the

Figure 3



Overview of sources of finance captured in the literature (2013–2019). (Source: Authors).

potential to address both climate risk management as well as to become a source of environmental compensation for developing countries.

Building on these arguments, Broberg [10] presented the lessons learnt from the implementation of three parametric risk pooling schemes operating in three of the most vulnerable regions in the developing world — the Caribbean Catastrophe Risk Insurance Facility, the African Risk Capacity, and the Pacific Catastrophe Risk Assessment and Financing Initiative [also see Refs. 26, 27]. The author clarified that parametric schemes differ from traditional insurance schemes since 'payouts are not based on an assessment of the actual post-event losses, but are instead triggered by certain pre-defined parameters being met' [10, p. 3]. For example, payouts associated with a cyclone would be based on the strength of the system (as measured by wind speed) and not on the dollar value of the post-event loss and damage. These schemes would, therefore, require careful design in order to work optimally as they can be used after hazardous events but before multilateral humanitarian aid is implemented. The author, however, cautioned that parametric schemes are not a miracle solution as they may be dependent on donor assistance because of the financial limitations of developing countries.

Durand *et al.* [13••], Gewirtzman *et al.* [14••], and Haque *et al.* [28•] substantively covered contingency finance, which refers to the additional amount or percentage added to a financial flow in order to ensure that it is either spent or remains as a buffer. These 'rainy day funds' can be 'used to extend existing low-level resource coverage to benefit a larger number of people' [13••, pp. 8 and 9]. Gewirtzman *et al.* [14••] and Haque *et al.* [28•] gave the example of the Bangladesh Climate Change Trust Fund, which the central government uses to finance climate-related and climate-related projects. Roughly 34% of the annual endowment is dedicated to 'emergencies', in which monies are set aside before an event occurs [14••]. This Fund has supported nationwide projects across six focus areas, including comprehensive disaster management and infrastructure [28•]. The authors writing on contingency finance agreed that, while it can help improve risk planning and response in developing countries, this approach to financing loss and damage invariably places an added and potentially perpetual burden on the poorest and most vulnerable countries, given the temporal nature of slow onset events. Additionally, continually earmarking buffer funds for specific impacts such as sea-level rise that have changing and/or fluctuating certainties will negatively impact operating budgets at the local and national levels. Less funds will be available from year to year to address the pressing needs identified in the 17 Sustainable Development Goals, which include poverty eradication (Goal #1) and healthy lives and wellbeing (Goal #3).

Durand *et al.* [13••] and Gewirtzman *et al.* [14••] are the only publications over the period that substantively explored bonds as a source of finance; Roberts *et al.* [21••] covered them in the context of existing mechanisms but not as an innovative financing proposal. A distinction is made between climate-themed and catastrophe bonds, with the latter typically not covering slow onset events and coming with 'stricter terms and conditions' [21••, p. 214]. Climate-themed bonds are debt securities that finance mitigation and adaptation projects; payouts are mostly provided by the private sector;

purchasers are typically institutional investors [13••,14••]. Catastrophe bonds are 'high-yield debt instruments that transfer specified risks from the bond issuer to an investor in order to provide the bond issuer funds if a catastrophe strikes' [21•, p. 214]. In their analysis, Gewirtzman *et al.* [14••] argued that the link between bonds and non-economic loss and damage, in particular, is unclear as they have been mostly applied to mitigation and inconsistently to adaptation. While Durand *et al.* [13••] contended that climate-themed bonds can 'serve as an attractive long-term investment instrument in areas such as infrastructure projects, where there are likely to be significant returns for purchasers', the likelihood of them being applied to loss and damage is low. Schäfer and Künzel [29] suggested setting up risk transfer solutions via catastrophe bonds to finance loss and damage from slow onset events.

Given the stricter terms and conditions associated with bonds, Durand *et al.* [13••], Künzel *et al.* [24], Richards and Schalatek [30••], and Roberts *et al.* [21••] discussed levies and taxes as viable alternatives. Proposals included levies on international airline travel and fossil fuels such as bunker oil, taxes on financial transactions, and global carbon pricing. Durand *et al.* [13•, p. 1] concluded that these are all viable proposals for 'both gathering and effectively using funds to support loss and damage response' but that a levy on international airline travel is one of two stand-out approaches (the other being risk transfer). Cameroon, Chile and South Korea are among the countries that have implemented such levies and that have raised significant funds to support their national development goals [30••]. Roberts *et al.* [21••] agreed that this route could have potentially positive outcomes for financing loss and damage from slow onset events and could be linked to contingency finance where funds raised are earmarked for this purpose.

There are a number of justice considerations underpinning the mobilization of financing for loss and damage associated with climate change, which the above sources deemed inadequate for addressing as they do not account for the principle of common but differentiated responsibilities and respective capabilities, upon which the UNFCCC is built. As a result, Mathew and Akter [31], Wewerinke-Singh and Salili [32], and Wolfrom and Yokoi-Arai [33] linked attribution and the polluter pays principle to argue for compensation and rehabilitation in developing countries. Wewerinke-Singh and Salili [32], in highlighting the importance of multi-level governance and cooperation, examined how climate-vulnerable countries can and should use existing structures to address loss and damage. Vanuatu, for example, targeted polluting countries in the Global North and fossil fuel companies through litigation in order to make a case for compensation [also see Ref. 34]. In this regard, countries and companies would be the potential sources of finance, thereby invoking the principle of common but differentiated responsibilities and respective capabilities [also see Ref. 34].

Criterion #1: appropriateness of source for slow onset events

Our coded literature argued strongly that insurance is not appropriate for financing loss and damage from slow onset events as premiums are based on the calculation of probabilities [18•,35,36,37•]. It is seen as being more appropriate for random and discrete events, which are uncertain and unforeseen (i.e. rapid onset events), and for serving adaptation as a risk-spreading instrument. Here, some authors such as Broberg [10] believe that parametric insurance schemes offer some hope. Parametric schemes differ from traditional insurance schemes because 'payouts are not based on an assessment of the actual post-event losses, but are instead triggered by certain predefined parameters being met' [10, p. 3]. To be applied to slow onset events, these schemes would require careful design in order to work optimally and to not increase dependence on external donor financing [10].

Though contingency financing, the setting aside of income as 'rainy day funds,' was also not seen as being appropriate for slow onset events as it is usually meant for emergencies [13••,14••,28•], Durand *et al.* [13••] suggested that there may be scope for using climate-themed and catastrophe bonds. Highlighting that the African Risk Capacity, the Caribbean Catastrophe Risk Insurance Facility and the Turkish Catastrophe Insurance Pool have either successfully used or are considering using catastrophe bonds at the regional scale, the authors pointed out that, because these bonds are not closely linked to economic conditions or to the stock market and allow diversification, they are attractive to investors [13••]. Sea-level rise bonds, they argued, could provide dividends in the event that the mean sea-level exceeds a pre-determined threshold [13••]. Schäfer and Künzel [29] also suggested that risk transfer solutions set up via catastrophe bonds, as an *ex ante* measure, can be used to finance economic loss and damage from slow onset events. *Ex ante* measures aim at addressing the residual risk of irreversible impacts that cannot or will not be avoided through mitigation and/or adaptation [29]. *Ex post* measures aim at addressing actual loss and damage by minimizing or responding to the socio-economic or human effects of actual irreversible impacts [29]. The authors, however, provided no other details regarding the operationalization of these risk transfer solutions and did not identify any *ex post* measures that are appropriate for addressing economic and non-economic loss and damage from slow onset events.

Several authors, however, argued that climate justice warrants that all climate change impacts be taken care of by those who overwhelmingly contribute to causing both rapid and slow onset events, that is, that the polluter

pays principle should apply [see Refs. 31–33]. Richards and Schalatek [30••] contended that the most appropriate option for applying the polluter pays principle is to impose carbon pricing, based on the carbon content of fossil fuels. This could initially target major fossil fuel companies [also see Ref. 32] and may come in different forms, including levies and taxes on fossil fuel extraction, international aviation and bunker fuel [see Refs. 13••, 21••, 30••].

Our review aside, there has been an evolving global consensus on carbon pricing as the cardinal instrument to address climate change, with mobilized funds invested in ambitious mitigation and effective adaptation in developing countries [38]. Divestment of coal shares by banks and other funds and the discontinuation of insurance for coal mining and coal-fired power generation can encourage the retiring of fossil fuel activities, concomitantly encouraging investment in renewables [39]. Some of the money raised could be invested in preventing slow onset events, such as desertification and land degradation in more risk-prone zones in developing countries. Overall, while most publications explored using insurance schemes to finance loss and damage, authors agreed that they are not appropriate for most slow onset events. The dominance of insurance schemes in the discourse, however, leaves behind a major gap in both the research and global climate policy agendas, which needs to be filled.

Criterion #2: extent to which sources can be considered sustainable

We operationalized whether sources were seen by the reviewed articles as 'sustainable' in a straightforward way: *whether revenues are likely to increase or decrease over time*. By that criterion, five author groups were skeptical of the sustainability of key sources of loss and damage finance.

Kehinde [11], Mathew and Akter [31], Nordlander *et al.* [25••], Wewerinke-Singh and Salili [32] and Wolfrom and Yokoi-Arai [33] indirectly assigned four different sources low probabilities of being sustainable in the sense of providing increasing funding over time: insurance schemes, funding based on the polluter pays principle, compensation, and attribution, respectively. Wolfrom and Yokoi-Arai [33] observed that it has been 'very difficult' to get agreement from nations to admit liability and provide payments [also see Ref. 34]. Kehinde [11] and Linnerooth-Bayer *et al.* [18•] observed that insurance normally requires rapid onset of damages; Lashley and Warner [40] agreed and added that insurance is also not very affordable for those needing it most, that is, developing countries.

On the other end of the spectrum, Richards and Schalatek [30••], Durand *et al.* [13••], Gewirtzman *et al.* [14••], and Roberts *et al.* [21••] identified seven mechanisms that are likely to be stable or increase in revenue over time. Durand *et al.* [13••] and Gewirtzman *et al.* [14••] saw catastrophe bonds as sustainable; Durand *et al.* [13••] saw climate-themed bonds more generally as sustainable in revenue over time. Durand *et al.* [13••], Richards and Schalatek [30••] and Roberts *et al.* [21••] all argued that international airline passenger levies are highly sustainable. Their arguments included studies of the impact of a fee on passengers likely having little impact on demand for long-haul flights, since those fees are a small fraction of the cost of a highly variably priced commodity. Other authors did not explicitly address the sustainability of this source. Richards and Schalatek [30••] thought a global carbon or fossil fuel levy and global carbon pricing could be seen as highly sustainable over time, whereas Durand *et al.* [13••] and Roberts *et al.* [21••] saw these taxes as only moderately sustainable, as amounts will decrease over time if the policy is effective in catalyzing the shift away from fossil fuels.

Durand *et al.* [13••], Richards and Schalatek [30••], and Roberts *et al.* [21••] made a case for a levy on bunker fuels (airplane and ship fuel) being highly sustainable over time, especially because these fuels are among the only products not currently taxed within nations or internationally. Durand *et al.* [13••] and Roberts *et al.* [21••], specifically, extended their analysis of the sustainability of an international financial transaction tax as these funds were not expected to decrease in normal economic times. Finally, Lashley and Warner [40] considered micro-insurance as sustainable over time in terms of revenue source.

We characterized our other assessments of these potential sources of funding for loss and damage as 'medium' on whether they were likely to be sustainable in revenue generation over time. That is, they each were seen as having potential, but also being difficult to maintain collections over time. Insurance schemes were frequent given moderate rankings, based on arguments outlined in Broberg [10], Durand *et al.* [13••], Gewirtzman *et al.* [14••], Kehinde [11], Künzel *et al.* [24], Linnerooth-Bayer *et al.* [18•], Mathew and Akter [31], Roberts *et al.* [21••], Schäfer and Künzel [29], Schinko *et al.* [12•] and Surminski *et al.* [36]. Solidarity levies and contingency finance are both described as moderately sustainable in revenue source by Durand *et al.* [13••], Gewirtzman *et al.* [14••] and Roberts *et al.* [21••]. Finally, Haque *et al.* [28•] thought government funds like the Bangladesh Climate Change Fund are moderately sustainable. Thus, overall, most proposed sources for slow onset loss and damage suggest are only modestly sustainable over time. Only a few sources, including catastrophe bonds, international airline levies, and taxes on bunker fuels are potentially highly sustainable over time.

Criterion #3: extent to which sources meet other related financing criteria

Of the five potential sources of finance that we cover in this review – insurance and risk pooling, contingency

finance, bonds, levies and taxes, and other sources – there is consensus in the literature that levies and taxes in the form of a national or international financial transaction tax, an international airline passenger levy, a solidarity levy, a bunker fuel levy, or a fossil fuel/carbon levy may be the most appropriate sources for addressing loss and damage from slow onset events in developing countries. They are seen as being relatively fair, predictable, adequate, transparent, and additional [see Refs. 13••, 14••, 21••, 24, 30••].

The literature, in particular, concluded that levies and taxes would not impose an additional or unjust burden on recipient countries (fairness); that the revenues that they would generate would be verifiable, measurable and reportable (transparency); and that the funds generated would be provided in addition to existing official development assistance commitments and adaptation financing (newness and additionality) [also see Ref. 41]. The reviewed literature, however, considered that these sources would likely face severe political obstacles (except for an international airline passenger levy which is considered by the reviewed literature to be relatively feasible). The literature also concluded that these sources would not completely provide a steady and predictable source of funds (predictability); and would not be entirely sufficient to cover the cost of loss and damage from slow onset events (adequacy).

Importantly, none of these levies and taxes meet the direct access criterion (i.e. that the funds should be made available as directly as possible to developing countries, eliminating bilateral or multilateral intermediary agencies), nor the vulnerability focus criterion (i.e. that the funds should be made available to those countries and population groups within countries that have experienced the greatest loss and damage, including the least developed countries and small island developing states). This tends to suggest that these two criteria have not been fully considered by the proponents of the most appropriate sources for addressing loss and damage from slow onset events that were identified in the literature.

Conclusion

This article reviewed the most recent literature on sources of financing for addressing loss and damage associated with slow onset events. The review, therefore, provides a more robust basis for supporting the development and expansion of available sources of finance that support developing countries. This can inform national, regional and international policy-making and decision-making processes where they aim to assess and address the impacts and risks associated with slow onset events, particularly those within and related to the Warsaw International Mechanism. In the section, 'Overview of sources of finance', we addressed the types of sources of finance covered in the publications: insurance and risk pooling, contingency finance, bonds, levies and taxes, and other sources. In the sections that followed, 3, 4, and 5 we discussed each of these sources in relation to our three criteria, respectively: appropriateness to slow onset events, the extent to which they are sustainable, and the extent to which they meet other related financing criteria. Our findings confirm that only a small portion of financial sources for slow onset events discussed within related scholarly work are sustainable over time, and an even smaller portion are fair, feasible, predictable, adequate, and/or transparent. While insurance, in some cases, may provide a suitable financial response to rapid onset disasters, no comparable financial mechanisms are in place for slow onset events. Also there is inadequate investigation of whether proposed sources would (a) provide direct access for developing countries and (b) serve the most vulnerable first.

Scholarship from Durand *et al.* [13••], Gewirtzman *et al.* [14••], Nordlander *et al.* [25••], Richards and Schalatek [30••], and Roberts *et al.* [21••] as well as from Haque *et al.* [28•], Linnerooth-Bayer *et al.* [18•], Schinko *et al.* [12•], and Schäfer *et al.* [37•], which we reviewed in this paper, all provide a preliminary foundation for a research program on financing loss and damage from slow onset events in developing countries. However, our review highlights that more research, specifically on slow onset events, is required in three main areas.

First, there is great ambiguity surrounding the meaning of 'loss and damage', and how its various forms might be differentiated. The current UNFCCC Secretariat definition is unofficial: 'the actual and/or potential manifestation of impacts associated with climate change [. . .] that negatively affect human and natural systems' [2, p. 3]. This definition neither clarifies the distinction between 'loss' and 'damage', nor the distinction between rapid and slow onset events, which poses a challenge to related policy development and implementation at multiple scales. This lack of clarity on definitions, which is no different from the ambiguity surrounding the definition of 'climate finance' more broadly [see 41, 42], contributes to a dispensation in which rapid onset events are given greater attention and priority, while often more deadly slow onset events fly under the radar. Clarifying slow onset events as a specific class of loss and damage that warrants particular attention and unique responses would help to elevate related concerns in the political contexts in which they have thus far been neglected.

Second, there is a need for greater research on identifying ideal mechanisms for financing loss and damage from slow onset events. Our review shows that, while most publications over the period explored insurance schemes as possible sources, these are not appropriate for most slow onset events. Insurance schemes simply cannot avert, minimize or address loss and damage from slow

onset events. However, the dominance of insurance schemes in the discourse, leaves behind a major gap in both the research and global climate policy agendas. As the UNFCCC fails to generate adequate international financing even for more high-profile priorities such as rapid onset loss and damage and mitigation, a new hybrid approach, potentially between insurance and innovative public financing, is crucial and potentially important for progressing related negotiations. In addition to being commensurate with need, future research should inform an approach that is in line with principles of fairness and equity, whereby countries contribute in relation to their historical responsibility to climate change and capability to take action. It should also shift decision-making power to the impacted countries and communities themselves, including through direct-access to funds and vulnerability-first initiatives. Moreover, it should build upon existing and emerging global institutions and priority areas, including the United Nations Sustainable Development Goals and the other Rio Conventions.

Third, more research is needed about what potential catalysts might break the political log-jam that has led to inadequate political attention and resources dedicated to loss and damage, and particularly, slow onset events. Loss and damage is still not considered on equal footing with climate mitigation and adaptation under the UNFCCC. It remains a politically charged topic [e.g. see discussions in Refs. 34, 43]. Most developed countries' representatives in the UNFCCC consider loss and damage to be part of adaptation; most developing country representatives consider that loss and damage is beyond adaptation and should be funded separately from mitigation and adaptation. Developed countries' representatives fear that recognizing loss and damage on equal footing with mitigation and adaptation would bring new financial demands from developing countries. All this makes the work of identifying appropriate sources of financing for loss and damage somehow speculative. Increased understanding of how the most promising proposals, such as levies on airline passengers and bunker fuel, might overcome political obstacles in order to come to fruition.

Fourth, research should focus on institutional opportunities to address slow onset forms of loss and damage across international governance bodies and processes. Addressing these under the UNFCCC alone will not suffice as the UNFCCC process has not only failed so far to institute a dedicated funding mechanism for loss and damage, but also continues to overlook the importance of slow onset events as a slow killer, even as these events continue to grow in scale, intensity, and frequency as the climate changes. As a result of this, we should draw on the lessons that can be taken from the other Rio Conventions. The United Nations Convention on Biological Diversity and the Convention to Combat Desertification have established measures that address slow onset events impacting terrestrial and marine resources. Ecosystem-based adaptation, enhanced nitrogen fixation and green manuring, for example, can slow land degradation, ensuring food security against climate change. Additionally, a substantial amount of work has been planned for achieving the targets associated with Sustainable Development Goals #14 (life below water) and #15 (life on land), substantive issues that both the United Nations Convention on Biological Diversity and the Convention to Combat Desertification cover. Therefore, financing for addressing loss and damage slow onset climate events has to be viewed in synergy with these and other global commitments.

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Conflict of interest statement

Nothing declared.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.cosust.2021.03.014.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

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This chapter, which is part of the book 'Loss and Damage from Climate Change: Concepts, Methods and Policy Options', aims to arrive at an agreeable definition of loss and damage, which it recognizes as an initial step towards identifying sources of finance for loss and damage. It provides a framework that uses a needs-based perspective for climate risk management. It suggests that for both transformative and curative measures of risk financing, climate insurance can be utilized because of its potential to address risk management as well as environmental compensation for developing countries.

13. •• Durand A, Hoffmeister V, Weikmans R, Gewirtzman J, Natson S, Huq S, Roberts JT: *Financing Options for Loss and Damage: A Review and Roadmap*. Bonn: German Development Institute/ Deutsches Institut für Entwicklungspolitik; 2016, 1-41.
This discussion/policy paper aims to answer two questions: (1) What is meant by financing a loss and damage response? and (2) What are some possible means of raising predictable financing that will prove adequate to finance a loss and damage response? It concludes 'that there are a number of viable proposals for both gathering and effectively using funds to support [a] loss and damage response. Two proposals stand out: a levy on airline travel and risk transfer approaches' (p. 1). The authors also note that there are 'a number of outstanding issues in funding [a] loss and damage response' (p. 1).

14. •• Gewirtzman J, Natson S, Richards J-A, Hoffmeister V, Durand A, Weikmans R, Huq S, Roberts JT: **Financing loss and damage: reviewing options under the Warsaw International Mechanism**. *Clim Policy* 2018, **18**:1076-1086.
This journal article provides an overview of the mechanisms proposed by the Warsaw International Mechanism to finance loss and damage. The authors find that 'several of these mechanisms may be useful in supporting loss and damage programmes, but identify some key gaps. First, most of the mechanisms identified by the Warsaw International Mechanism are insurance schemes subsidized with voluntary contributions, which may not be adequate or reliable over time. Second, none were devised to apply to slow onset events, or to non-economic losses and damages' (p. 1076). The authors further conclude that, in order to deal with financing loss and damage in vulnerable countries, tools that go beyond the scope of Warsaw International Mechanism's proposals will be required.

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This chapter, which is part of the book 'Loss and Damage from Climate Change: Concepts, Methods and Policy Options', examines insurance schemes, risk pooling, and insurance pools as potential solutions for dealing with loss and damage. It explains that major intervention must be undertaken in the design and implementation of market-based insurance mechanisms in order to meet the Warsaw International Mechanism's aspirations of loss reduction and equitable compensation. While the chapter's main focus is on rapid onset events, it clearly establishes that insurance schemes are unable to address loss and damage from slow onset events.

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21. •• Roberts JT, Natson S, Hoffmeister V, Durand A, Weikmans R, Gewirtzman J, Huq S: **How will we pay for loss and damage?** *Ethics Policy Environ* 2017, **20**:208-226.
This journal article utilizes a framework developed by political geographer Marco Grasso in order to argue that 'making the ethical connections between addressing climate impacts and finance mechanisms could significantly enhance their likelihood of being adopted' (p. 208). The authors reviewed several sources of financing for addressing loss and damage, assessing them based on their 'adequacy, predictability, technical feasibility, fairness, and indirect effects, and whether each has a clear link to loss and damage' (p. 208). The findings suggest that a potentially positive avenue to finance loss and damage is through taxation of international airline travel.

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24. Künzel V, Schäfer L, Minninger S, Baldrich R: *Loss and Damage at COP23: Looking at Small Island Developing States*. Berlin: GermanWatch; 2017, 1-28.

25. •• Nordlander L, Pill M, Martinez Romera B: **Insurance schemes for loss and damage: fools' gold?** *Clim Policy* 2019:1-11.
This journal article examines the benefits and drawbacks of insurance schemes in dealing with loss and damage. The analysis concludes that insurance schemes, even though popular, are not well rounded enough to deal with the full range of loss and damage; they would make 'pre-existing inequalities' worse—such schemes are currently not viable options for financing loss and damage, especially from slow onset events. The authors conclude that additional research to address the challenges associated with insurance schemes should be carried out by policy-makers.

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27. Robinson S-a: **A richness index for baselining climate change adaptations in small island developing states**. *Environ Sustain Indic* 2020, **8**:100065.

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This chapter, which is part of the book 'Loss and Damage from Climate Change: Concepts, Methods and Policy Options', presents a case study of Bangladesh in order to examine different mechanisms for addressing loss and damage from climate change. The proposed plan in Bangladesh is a national mechanism that builds on existing structures.

29. Schäfer L, Künzel V: *Steps Towards Closing the Loss & Damage Finance Gap: Recommendations for COP25*. Berlin: Germanwatch; 2019, 1-24.

30. •• Richards J-A, Schalatek L: *Financing Loss and Damage: A Look at Governance and Implementation Options*. Washington, DC: Heinrich Böll Stiftung North America; 2017.

This discussion/policy paper aims to address the question of how financing will be implemented for loss and damage, a question that has not been given enough attention and that has not been completely answered in the academic literature. The authors suggest creative ways of financing loss and damage 'in the form of a carbon levy, aviation levies, financial transaction taxes' (p. 1), while also highlighting that an international financing mechanism for loss and damage should be established within the UNFCCC framework.

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