

Counting the Cost 2023

A year of climate breakdown

December 2023



Above: A group of people, including the elderly, being evacuated using locally made canoes from their destroyed villages to safer places in Chikwawa district, Malawi.



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Christian Aid exists to create a world where everyone can live a full life, free from poverty. We are a global movement of people, churches and local organisations who passionately champion dignity, equality and justice worldwide. We are the change makers, the peacemakers, the mighty of heart.

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Foreword

It can now be said that 2023 is the hottest year on record. The effects of climate change are increasingly obvious, not least in the increasing frequency and severity of climate related disasters. Floods, storms, heatwaves, and droughts are all becoming more intense and climate attribution science is becoming clearer that climate change is causing these more intense disasters. What tends to be less clear, beyond the immediate impact we see in news reports about homes washed away or crops destroyed by drought and heat, is how the deeper human costs are borne. One way of understanding the cost of climate change is to estimate the economic impacts of climate-related disasters. This report uses a new methodology to provide data and analysis on the climate-related disasters which have had the biggest economic impact per head of population in the countries where they occurred.

Below: Patrick Watt, Chief Executive Officer, Christian Aid.



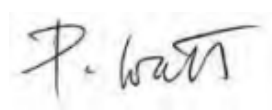
Our list features some disasters which generated global media coverage, from Cyclone Freddy in Malawi to the wildfires in Hawaii. But other disasters, despite having broad and deep economic impacts, hardly registered on news feeds. From floods in China to storms in Peru, 2023 has witnessed many disasters that carried a heavy cost but received little international attention. Our top 20 list features a range of disasters across 14 countries, showing that certain countries – through some combination of size, geography, income level, and other factors – are more prone to experience economically costly disasters. We find that the wildfires which affected Hawaii in August carried the highest per capita cost, of over \$4,000 per person. This far exceeds the second costliest disaster in per capita terms, which was Guam’s May storms, which cost almost \$1,500 per head of population. Even large countries with big populations feature on our list: The USA, China and Mexico - all high population countries - have nonetheless experienced disasters which cost tens of dollars per head of population, and billions of dollars in the aggregate.

The top 20 list also shows that the relative economic impact of disasters is highly unequal. In wealthier countries people are better able to prepare for possible future extreme weather events, and can invest in better homes and other buildings, take out insurance, and be more confident that when things go wrong there is a safety net to help them get back on their feet. In poorer countries, while some rich people may be able to buy a measure of protection, underlying preparedness and resilience is often lacking, and fewer households have the financial buffers that enable people to bounce back after a disaster. In the first instance, this means that more people die in disasters in poorer countries. It also means that recovery is slower, and more unequal, with many people pushed further into poverty as assets are destroyed or damaged.

The fact that poorer countries, and communities contribute little to global heating makes climate-related disasters a double inequality. This is an injustice that a growing number of poorer countries, and civil society campaigners have rightly challenged. The agreement at COP27 to establish a fund to help meet the cost of loss and damage, was an admission that this injustice should be addressed, even if the principles of liability and compensation have yet to be formally

recognised. A failure to rapidly phase out of fossil fuels will only add to the bill for loss and damage. The operationalisation of the Fund – and its backing with sufficient funding – is an urgent priority. The financial commitments made at COP28 represent a step forward, but they are a fraction of what is needed, and are largely recycled from existing budgets.

With the frequency and intensity of climate disasters projected to increase dramatically soon, governments must take decisive action now – individually and collectively – to limit global heating to 1.5 degrees; and adapt to the effects of climate change. More effective adaptation is key through better building and infrastructure, investment in climate-adaptive agriculture, and by strengthening people's financial resilience. International climate finance, targeted at the poorest and most climate vulnerable countries, must be scaled up to deliver on this agenda. But even with these measures, some of the effects of the climate crisis will go beyond what people can adapt to. Where people face irreversible loss or damage, justice demands that those countries that have contributed most to the climate crisis and have reaped the greatest benefits from carbon-intensive industrialisation, help heal the effects of climate change experienced by people living in poverty.



Patrick Watt

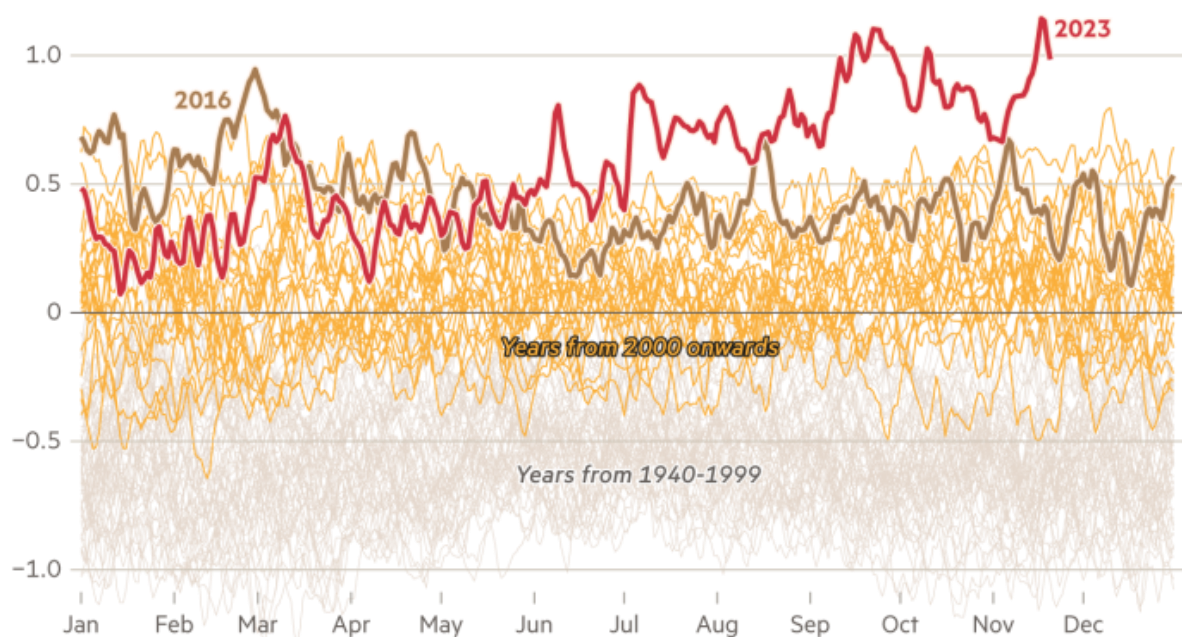
Chief Executive Officer, Christian Aid

Introduction

The UN Secretary General Antonio Guterres lamented in September 2023 that “climate breakdown has begun”.¹ He was speaking following the hottest northern hemisphere summer on record, even before September broke new records (see graph below), leading to predictions that 2023 will be the first year that the global temperature could breach the threshold of 1.5C above the historic baseline.² The impacts of global heating are felt not only in very high temperatures but across a range of more acute and more frequent weather events which can lead directly to death, destruction of homes and livelihoods and may render certain places uninhabitable. Our list of the most significant climate-related weather events covers heat, drought, wildfires, floods and storms. Climate breakdown means we expect more of all these kinds of events and that their impacts will be greater, despite effective efforts to adapt to global heating.

2023 is on course to be the warmest on record

Daily global 2-metre surface temperature anomaly,
1991-2020 baseline (C)



Source: Copernicus
© FT

Source: Financial Times 30.11.2023 World heading for hot 2024 after records ‘shattered’ in 2023, says WMO [World heading for hot 2024 after records ‘shattered’ in 2023, says WMO](#)

To identify the most significant climate-related weather events of 2023, we have used the renowned EM-DAT database ([EM-DAT - The international disaster database \(emdat.be\)](#)) ‘the international disaster database’ as our starting point. We have only included the kinds of events whose growing, and intensity scientists have concluded are significantly attributable to the overall trends from climate change; therefore, we omit earthquakes where their link to climate change is not sufficiently established. All weather events are affected by climate change because they are happening in an atmosphere 1.3C hotter and over 7% wetter than the historic average.³

The World Weather Attribution service aims to determine how far climate change has made a particular disaster more likely than would otherwise be the case.⁴

Where possible, we have supplemented the data in the EM-DAT database with other recognised analyses of disaster impact, including from UN sources and national statistics as well as insurance providers. Since our focus is on understanding the impacts of significant weather events on people, we focus on direct human impacts such as the number of deaths and particularly the 'total number of people affected' metric provided in the EM-DAT database. We have also looked at the financial costs of disasters where such information is available across a range of international and national sources.

Methodology: per capita costs of climate disasters

In our study, we have adopted the per capita cost methodology to assess the economic impact of the costliest climate disasters in 2023. This approach involves dividing the total damages caused by each disaster by the total population of the affected area, thereby providing a per-person economic burden estimation. This method offers a more individualised perspective of the disaster's impact, highlighting the financial strain on the average citizen rather than just the aggregate economic toll. Our primary data source is EM-DAT, complemented by extensive desk research, World Bank and IMF databases, and other relevant publications. We have also referenced the AON Quarter 3 data for cross-verification, despite the noted discrepancies in cost reporting between AON and other sources like EM-DAT or Post Disaster Needs Assessments (PDNAs).

In addressing the data limitations, particularly the gaps in EM-DAT and the inconsistencies in total cost reporting, we have employed a rigorous approach to additional data. In the first instance we sorted the data by the number of people impacted by the disaster divided by the total population. We then scoured Relief Web portals, official Post Disaster Needs Assessments (PDNAs), and news articles to fill in the missing information on the economic cost of the disaster. In some cases, such as Libya, where the cost estimate was unavailable, we have found alternative data on humanitarian need. This comprehensive and meticulous approach ensures a more accurate and representative analysis of the per capita cost of climate disasters in 2023, providing valuable insights into the individual economic impacts of these catastrophic events.

Because our methodology relies on assessing the economic impacts of climate disasters, we only assessed disasters for which some economic impact data could be found. Whilst we supplemented data from EM-DAT by looking at a range of other official and authoritative sources, in some cases we could not find any estimate of economic costs. For example, more than 120 people have died in Kenya, and around 1 million have been displaced because of floods between October and early December (when the data was finalised for this report).⁵ These floods, which have affected other countries in eastern Africa, follow a prolonged dry period which led to severe drought, contributing to a dramatic rise in food insecurity. Many households have therefore had to contend with flooding with increased poverty and vulnerability. Clearly the floods have had significant economic and wider human impacts for hundreds of thousands of people, but without any kind of economic estimate it is impossible to put such disasters in our analysis. This highlights the importance of public and private sector experts to monitor and assess economic impacts of climate-related disasters.

The results would be different if we looked at different datapoints. There is no perfect way to capture the multidimensional effects of disasters; we have focused instead on estimated economic costs. We have proposed this simple methodology to help demonstrate that such disasters are becoming more frequent and serious; that people living in poverty in lower income countries are disproportionately more likely to be affected despite contributing least to climate change; and that however successful our efforts to mitigate climate change, huge resources will need to be mobilised for adaptation and Loss and Damage. This implies the need for significant financial flows from rich polluting countries to lower income ones.

Top climate disasters

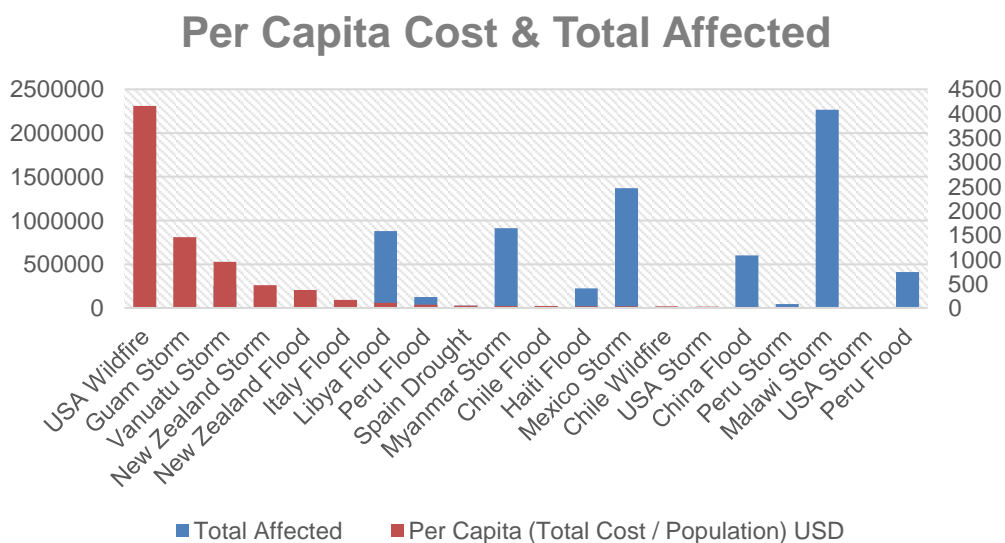
Rank	Country	Event	Cost per person \$
1	Hawaii/ USA	Wildfire	4161
2	Guam	Storm	1455
3	Vanuatu	Storm	947
4	New Zealand	Storm	468
5	New Zealand	Flood	371
6	Italy	Flood	164
7	Libya	Flood	105
8	Peru	Flood	66
9	Spain	Drought	50
10	Myanmar	Storm	41
11	Chile	Flood	39
12	Haiti	Flood	36
13	Mexico	Storm	35
14	Chile	Wildfire	30
15	USA	Storm	25
16	China	Flood	23
17	Peru	Storm	20
18	Malawi	Storm	17
19	USA	Storm	16
20	Peru	Flood	9

The table of the top 20 climate disasters in 2023 shows that many different countries were affected by a range of climate events from wildfires to floods and storms. Where climate science is not clear on the general link between climate change and types of events, we have not included

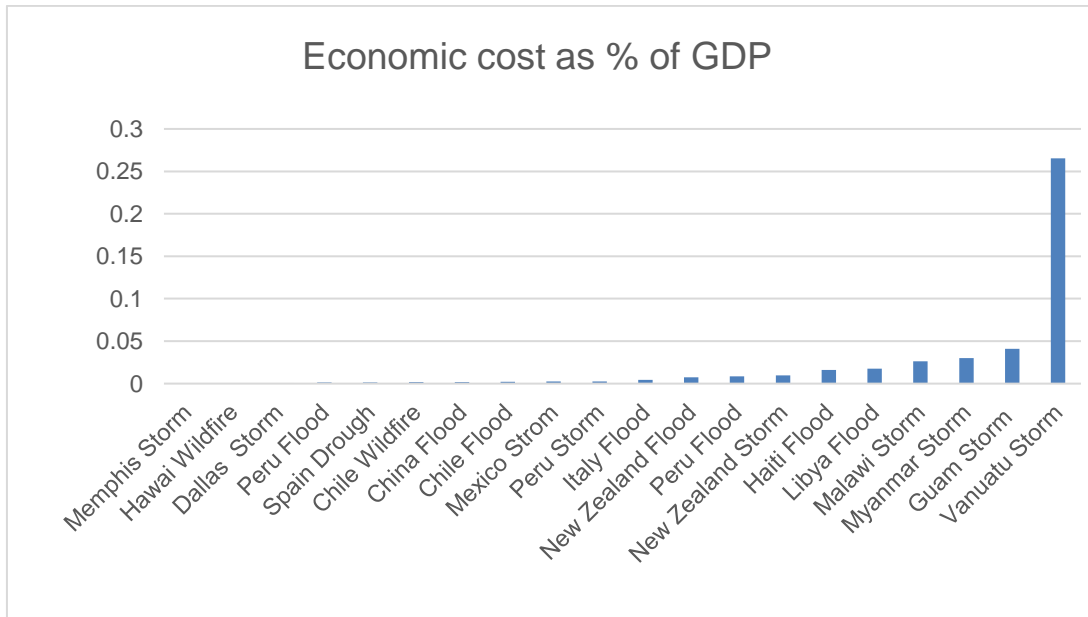
them in our analysis. Therefore, the devastating earthquakes in Turkiye/ Syria and in Morocco are screened out of our analysis since climate science is not clear on whether climate change is affecting the frequency and intensity of earthquakes. For most climate related events, climate attribution science is getting more definite in showing much stronger probability of causal links between climate change and a particular event (usually presented as a given event being x% more likely to have occurred because of climate change). But in some specific cases, a particular event may 'merely' be an example of a long-run historical pattern rather than caused somewhat by climate change.

Our analysis focuses on the economic impacts of climate disasters. But it is notable that there is a high degree of overlap between the disasters which feature in this list of the 20 most significant on a per capita basis with equivalent top 20 lists of climate disasters analysed by the total number of people affected, and with the total cost of disasters (not controlling for per capita costs). This means that however the list of the top 20 'worst' climate disasters is constructed, there is a high degree of consistency across the numbers of people affected (killed, injured, displaced etc), the total economic costs and the economic costs on an average individual level within the relevant country.

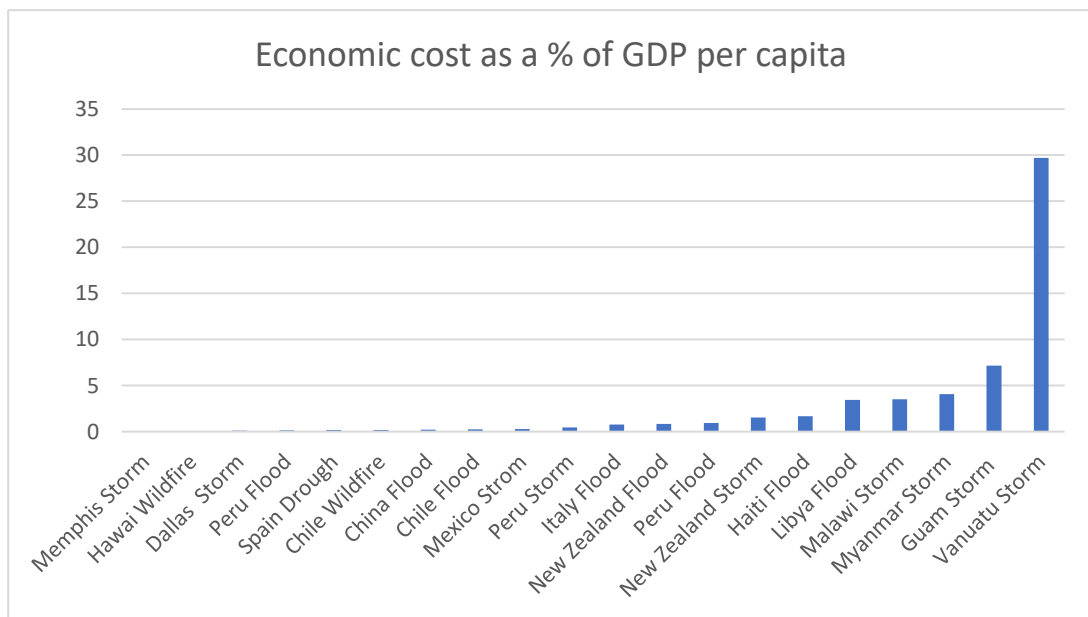
The overlap between disasters which have the highest per capita economic costs and those which affected the most people is captured in the graphic below. The per capita economic costs scale is on the right and the total affected on the left-hand axis. Unsurprisingly the per capita costs are generally higher in higher income countries where the cost of living is higher and insurable costs are easier to estimate. Meanwhile, the disasters which affected a greater number of people tended to occur in lower- or middle-income countries. The intensity and breadth of a climate disaster will also impact on per capita costs, especially when considered at a national level. Tropical storms (with windspeeds of 39-74 mph) are more frequent than hurricanes, typhoons, and tropical storm (windspeeds in excess of 74 mph) may cause less human and economic damage particularly if buildings and other infrastructure are designed to withstand such windspeeds.



Looking at the economic cost as a proportion of GDP shows how significant the Vanuatu disaster was:



This list looks a little different when we examine the per capita cost as a proportion of per capita income, largely dominated by middle income countries (except for Hawaii given the level of devastation affecting a high proportion of the state):



We now turn to the top disasters for 2023 as measured by per capita economic costs. In our case studies, we look at the highest-ranking disaster for each country in the top 20 (therefore we do not cover numbers 5, 14, 15, 17, 19 and 20 since disasters in New Zealand, Chile, USA and Peru are covered by bigger disasters in the top 20); the numbers refer to the rank in the top 20 list.

Climate Disasters

1. Hawaii/USA wildfire (August)



Above: Ambulance, Hawaii Fire Department, Kona Hawaii August 2023. Credit: Cata Hula/Shutterstock.

The climate disaster which had the highest average cost per person was the devastating wildfire which affected large proportions of the population of Hawaii. Wildfires have become more common in Hawaii, a phenomenon linked to land use change and climate change.⁶ These are both relevant in Hawaii. The long-term drought trend and increasing heat have been cited as contributing to the circumstances where a wildfire could have such big impacts.⁷ Since the island archipelago of Hawaii is geographically distinct from mainland USA, we calculated the per capita cost of the 8-11 August wildfires by dividing the total estimated economic cost amongst the 1.44 million population of Hawaii. On this basis, each Hawaiian is estimated to have 'lost' \$4,161, more than twice as much as the next highest per capita loss.

The wildfire mostly affected the island of Maui in Hawaii, leading to 181 deaths and 7695 affected by the wildfire, roughly 1 in every 200 residents of Hawaii overall and around 1 in 20 on Maui Island. Given the population of Maui Island is under 200,000 these are high per capita impacts, and since the GDP per capita of Hawaii is around \$60,000,⁸ the total estimated costs of the wildfire represent close to 10% of the average income of Hawaiians. The total economic cost of the wildfire has been estimated at around \$6bn.⁹ As well as this significant figure, official analysis from Hawaii shows how the impact of such a disaster is likely to have continuing economic impacts, with the wildfire largely responsible for a reduction in the forecast economic growth in 2024 from 2% to 1.5%. Many small businesses were affected, requiring not only insurance claims for re-building and other capital costs but significant increases in unemployment with many people facing long periods of reduced income.

For example, the Department for Business, Economic Development and Tourism estimated that “initial unemployment claims jumped from an average of 130 cases per week before the wildfire to 865 cases in the first week after the fire, to 4,449 cases in the second week after the fire, and to 2,705 cases the third week after the fire.”¹⁰ Therefore, even when homeowners, business owners and public institutions have adequate insurance to cover the costs of replacing and rebuilding assets, the level of economic support through social protection and other measures will not replace all foregone income, as well as costing the state twice – through higher payments to those affected by unemployment and reduced economic activity meaning lower tax revenues and more stretched public services. Understanding the longer-term economic impacts of such disasters is important to make sure those affected are equitably compensated for the range of consequences from a wildfire which lasted four days but left enduring scars.

2. Guam storm (May)



Above: Tamuning, Guam - May 24, 2023: Destruction caused by super typhoon Mawar, which made landfall on May 24, 2023 as a Category 45 storm. Credit: Eric Celebrezze/ Shutterstock.

Almost half (9 out of 20) of our list are storms. The high prevalence of storms is likely to increase due to climate change. Research analysed by the Intergovernmental Panel on Climate Change concludes it is likely that the global proportion of major (Category 3–5) tropical cyclone occurrence has increased over the last four decades because of climate change and that human-induced climate change increases heavy precipitation associated with tropical cyclones.¹¹

For around 15 hours from noon on May 23 to early morning on May 24, tropical storm Mawar battered the US territory of Guam, situated in the Pacific Ocean around 2,000km east of the Philippines. With wind speeds of up to 145mph, it was the strongest tropical storm endured in

Guam for decades.¹² Despite the ferocity of the storm which devastated many buildings, knocked out utilities and uprooted trees, just two people died but over 100,000 were affected representing over 60% of the territory's population. The estimated economic costs of the storm are \$250m or \$1,455 per capita. Given the high proportion of the population affected, this kind of level of 'loss' is likely to be widely experienced.

Whilst the per capita costs of the storm may be easier for a reasonably wealthy territory to absorb (Guam's per capita income is about \$36,000), reports highlighted that key utilities were not operating for most residents one week after the storm, with most parts of the island without power, water or internet.¹³ The absence of these basic services are not necessarily fully reflected in the per capita economic loss figures given how intrinsic water and power are for many essential functions in particular. When back-up solutions such as portable generators do not function properly, impacts are compounded. Small island territories such as Guam are often more vulnerable to longer-lasting impacts of disasters because new supplies take longer to arrive, and it can be harder to repair infrastructure with a much smaller workforce. However, since the damage was not as 'deep' as in some disasters, once utilities were restored, there were fewer continuing economic impacts of tropical storm Mawar on Guam.

3. Vanuatu storm (March)



Above: VANUATU - MARCH 15: A cyclone hit the islands of Vanuatu destroying about 80 % of the buildings. Credit: Ausnewsde/Shutterstock

Two tropical cyclones struck the small island archipelago of Vanuatu at the beginning of March. Both tropical cyclone Judy and Kevin were Category 4 tropical storms which, together wreaked considerable damage to the small country. These tropical storms coincided with two significant earthquakes on 3 March, though the damage from the earthquakes was assessed to be much less than from the two tropical storms across 4 days. During this time, two-thirds (66%) of Vanuatu's population of around 300,000 were affected by the consecutive tropical storms,

according to the National Disaster Management Office, with an even higher proportion of the total population affected by lower strength winds.¹⁴ Perhaps remarkably, there were no deaths attributed to the two severe tropical storms.

Vanuatu's government published a comprehensive Post Disaster Needs Assessment, outlining the impacts of tropical cyclones Judy and Kevin.¹⁵ The government of Vanuatu wanted to have a quick and clear assessment of impacts and needs to act quickly, informed by slower responses to previous disasters which led to higher risks for longer, hence publishing the PDNA and Recovery Strategy just 3 months after the tropical cyclones. Increasing resilience is a key tenet of the recovery plan so that future disasters may have a lower impact overall on the people of Vanuatu. One of the key economic impacts of the cyclones is reduction in the forecast of GDP growth in 2023 from 3.6% to 3%. The per capita average impact of the two cyclones was almost \$1,000 at \$947. As well as being a highly substantial individual amount, this represents almost a third of the GDP per capita of the average Vanuatuan which is only just over \$3,000 making it a lower-middle income country according to the World Bank.¹⁶

Over half of Vanuatu have been contending with reduced health services; the livelihoods of almost 40,000 people were affected whilst more than 6,000 households had their homes destroyed. The PDNA also provides economic estimates of damages and losses incurred across sectors, disaggregating public and private costs. It is notable how carefully the impacts are documented, less perhaps because Vanuatu experiences many natural disasters linked to climate change but more because the widespread impacts of these disasters mean it is vital to identify how to strengthen resilience in the face of future ones. Governments should monitor and measure the impacts of disasters, including sharing information across borders, to inform early action and response plans.

4. New Zealand tropical storm (February)



Below: Tree fell on road during cyclone Gabrielle. Auckland, New Zealand - February 13, 2023. Credit: Emagnetic/Shutterstock

Tropical cyclone Gabrielle was the worst storm to hit New Zealand so far in the twenty-first century. The cyclone was expected to lead to bigger impacts since the weeks prior to its arrival

had seen severe flooding across much of New Zealand, raising the prospect of landslides. The storm brought further heavy rain on top of the record-breaking downpours in the preceding weeks as well as very high winds. The human impacts of the storm are somewhat difficult to assess. Whilst there are 11 recorded deaths attributed to storm Gabrielle in New Zealand, estimates of the number of people affected vary somewhat. The EM-DAT database assesses that 10,500 were affected by the storm, but a much higher number (around 1.8 million) were subject to a state of emergency in the region where they lived.¹⁷ Within this number, at least 46,000 households lost power.

The economic impacts of storm Gabrielle were significant, at nearly 1 per cent (about \$2.4bn) of New Zealand's GDP of almost \$250bn. This translates to a per capita cost of \$468 per person, a little under 1% of the annual GDP per capita of around \$49,000. Although New Zealand is a wealthy country with developed public and private sectors, analysis indicates that not everyone is adequately protected in the face of climate disasters. For example, almost half of Auckland residents – which was severely affected by the floods immediately preceding storm Gabrielle – did not have home insurance.¹⁸ Although social protection measures may be relevant for some people in some situations, there is therefore a high likelihood that individual, or household economic impacts of a disaster affect people in different ways depending on the level of insurance protection they have in place. Foremost among longer-term recovery needs is rebuilding and repairing homes, businesses, and community infrastructure.¹⁹ Wider economic recovery of local markets is also needed to get affected communities back to the status quo ante.

6. Italy flood (May)



Above: Lugo, Ravenna, Italy, May 18, 2023, Via Amendola flooded Credit: Chiarentini Federica / Shutterstock

The Italian region of Emilia-Romagna experienced three floods in close succession in May. Unlike the analysis of many other disasters covered in this report, attribution science has found that

climate change had only a limited role in the floods.²⁰ The region of Emilia-Romagna is experiencing levels of rain consistent with recent history but experienced severe flooding in May because of three periods of intense rainfall in close succession.²¹ Even with a limited climate change cause, we have decided to keep this disaster in our analysis of climate-related weather events since climate change generally means that there will be more frequent and more acute such weather events. Thus, we can anticipate 'expected' or 'normal' events to occur more often. For those experiencing the impacts of such a disaster, it is little comfort to know that theirs might be considered within the 'normal' bounds of rainfall as opposed to the impacts of climate change.

The floods claimed the lives of 15 people, and around 46,000 people were affected overall, with many displaced from their homes. 23 rivers flooded, and there were over 1,000 landslides affecting over 100 municipalities.²² The impacts of the heavy and persistent rainfall were greater than would have been the case historically because of denser urban development, resulting in less drainage. Improving urban planning and increased use of nature-based solutions, combined with better social protection could mitigate impacts.²³

The economic costs of the floods were extensive, totalling around \$10bn. Although under one in a thousand Italian residents were directly affected by the floods, the average per capita cost across the almost 60 million total population averaged around \$164 each. Although not a very large sum averaged out across the entire population the amount for those directly affected is likely to be over \$200,000 per capita for those directly affected, highlighting the damage to homes and other vital infrastructure. The government passed legislation for a €1.6bn package, the biggest portion of which was dedicated to a workers recovery fund.²⁴

7. Libya flood (September)

One of the most significant climate disasters of all 2023 was the Libya floods in September. Around 11,000 people are thought to have lost their lives when Storm Daniel led to flash floods. One impact was the bursting of two dams near Derna, where many of the fatalities occurred. Rivers flooded in five provinces and almost 1 million people (around 880,000) people were affected, representing more than 10% of Libya's population of around 7 million. This kind of extreme event has become up to 50 times more likely and up to 50% more intense compared to a 1.2C cooler climate.²⁵

In the aftermath of the floods, the UN agency UNFPA estimated that around 230,000 women and girls of reproductive age (15-49) alone needed humanitarian assistance. In the city of Derna, around half of the population of 100,000 were estimated to be in dire need of humanitarian assistance.²⁶ Shelter and healthcare were identified as the two most pressing priorities by those affected.²⁷ As well as the devastating impacts of the flooding, this reflects the difficulties many in Libya faced in accessing public services such as healthcare.

The economic impacts of the floods have been hard to quantify. Unlike for most major disasters, the EM-DAT database does not provide a total cost estimate for the floods. The UN appeal called for \$71.4m in emergency funding,²⁸ which averages just over \$80 per person directly affected. This is likely therefore to be a severe underestimate of the total economic costs of the floods and the corresponding spending needed to recover from them.

Christian Aid's response to the Libya floods

The most immediate and pressing needs identified in the wake of the floods in Libya included ensuring emergency shelters hosting Internally Displaced People had enough shelter, water, sanitation, hygiene and 'winterisation kit' items. Therefore, Christian Aid responded through our ACT Alliance sister agency Dan Church Aid (DCA) which had a pre-existing programme in Libya and was able to respond rapidly to the floods. DCA also supplied these items to medical centres which could then provide effective care to those injured by the disaster. DCA distributed over 164,000 non-food items to shelters, medical centres and directly to households in need. DCA estimates that their emergency response programme reached 1,800 households, supporting around 10,800 individuals directly. As Imhemmed, a temporary shelter supervisor in Derna said, "We thank DCA and their partners. We desperately need these items to maintain cleanliness in the shelters and to help the families who lost everything..."

Below: DCA staff with Libyan Red Crescent workers helping search the rubble, and the delivery of NFIs to the Al Wadha Hospital in Derna.



8. Peru floods (April)

Heavy rain led to extensive flooding along much of Peru's western coastal regions in mid-April, adding to already heavy rains in the preceding two months. There is evidence that the El Nino pattern has since 1960 been exacerbated, and that as human-induced climate change deepens there will be more such acute events.²⁹ In addition to rivers flooding, there were landslides, mudslides and movements of snow and rock. The EM-DAT database records 25 deaths because of the flooding in mid-April, with around 125,000 people affected. But the United Nations Central Emergency Response Fund (CERF) estimated that more than half a million were affected by the end of the immediate floods in mid-April, making it one of the biggest disasters Peru has faced in the twenty-first century.³⁰ Taking a longer timeframe, the United Nations Office for the Coordination of Humanitarian Affairs estimated in July that since January over 800,000 people in Peru were affected by the climate-related weather events.³¹ This very high cumulative number of people affected shows that when severe weather events occur consecutively, many more people are likely to be affected as resilience to an additional acute weather event reduces, for example when rivers are already very high from previous rains.

For those needing assistance, the main priorities in the wake of the flooding were food, water, sanitation, and health services as well as protection.³² Some people needed shelter since they needed to leave homes vulnerable to the floods. The average per capita economic cost of \$66 per person may not seem a large amount but it only represents the estimated costs relating to the floods from 10 to 12 April. The wider costs for the related weather events are higher, not least because they affected many more people. The Peruvian government appealed for international assistance, which led to a United Nations programme amongst others.

The accumulated impacts of the floods are also shown in the prevalence of a new dengue epidemic, driven by the impacts of torrential rains and a major heat wave. This reached a record 161,471 cases and 287 deaths during mid 2023 - the highest dengue fever death rate per capita in the Americas.³³ As well as direct economic costs, the disproportionate health impacts of climate-related disasters are another unequal impact for poorer people to contend with. Such health epidemics increase household expenditure on healthcare and increases costs for public and private healthcare services. Despite making significant progress on healthcare coverage,³⁴ dealing with a dengue epidemic increases economic costs for households and the state.

9. Spain drought (April)



Above: Iznajar swamp with drought due to lack of rain. Andalucia, Cordoba, Spain. Credit: Jesus Noguera/Shutterstock.

Even before much of Europe experienced extreme heat during the summer of 2023, some Spanish regions endured a serious drought in April. Spain registered the driest start to the year since records began in the 1960s.³⁵ As a result of the drought, authorities in Catalunya, one of the affected regions, imposed restrictions in 22 villages.³⁶ The drought was exacerbated by preceding seasons of much hotter than usual weather, up to 20C higher than normal in April.³⁷ This contributed to drought stress, for example reservoirs were already low. The drought also coincided with a period of unseasonable heat, including a record temperature for April in Spain

of 38.8C recorded at Cordoba airport on 26 April.³⁸ As well as restrictions on water use, the drought has resulted in poorer agricultural yields, including in the key olive harvest as well as much worse wheat and barley crops.

It is usually harder to identify how many people are directly affected by events such as droughts compared to more 'rapid onset' events such as cyclones and floods. It is therefore likely that estimates of those affected are likely to under-represent all those affected. Whereas in many rapid onset disasters it can be clear if someone has died due to the disaster, the same is harder with 'slow onset' events. Using an 'excess deaths' estimate is one way of trying to estimate fatalities caused directly and indirectly by a slow onset event. For example, the heatwave across Europe in summer 2022 was estimated to lead to 61,000 excess deaths.³⁹ No deaths were reported because of the April drought despite the high temperatures as well as the lack of water, but around 26,000 were directly affected through imposition of reduced water. The economic impacts are also hard to quantify; the EM-DAT database provides an estimate of \$2.4bn, averaging around \$50 per person across Spain nationally. This estimate derives from the government package of support provided in response to the drought which focused on providing new water supplies and support to farmers.⁴⁰

10. Myanmar storm (May)

An extremely severe storm named Cyclone Mocha hit Myanmar on 14 May. It was one of the biggest storms to affect Myanmar, with wind gusts of up to 300 km/h. It initially affected Rakhine and then continued inland with further extremely strong winds and heavy rainfall into 15 May, affecting five states and regions: Rakhine, Chin, Sagaing, Magway and Kachin. An estimated 3.4 million lived in areas which experienced winds of at least 120 km/h, which caused significant damage to homes and other buildings, partly because of the fragile nature of many houses.⁴¹ As well as wind damage to buildings and other infrastructure - including hospitals, schools and religious buildings - heavy rain caused flooding in many affected areas.

145 deaths were recorded because of Cyclone Mocha in Myanmar, with almost 100,000 directly affected according to the EM-DAT database. Later analysis showed ten times as many people, 1.2 million in total, were directly affected by the storm.⁴² The same World Bank analysis estimated that the total economic cost of the cyclone to be \$2.24bn, a high absolute number and a very large amount relative to the size of Myanmar's economy, corresponding to 3.4% of GDP in 2021. On a per capita basis this translates to about \$40 per person across the population of around 54 million, also a significant proportion of the average per capita income of \$1180 (roughly 3.5%). The World Bank's analysis identified the residential housing sector as the most affected, followed by infrastructure and agriculture. The analysis into the economic impacts of the cyclone highlights that pre-existing conflict in some regions exacerbated the impacts of the cyclone, and that these conflicts will likely impact recovery.⁴³ This shows how vulnerability to climate impacts can be increased by lower levels of income because even small absolute costs are relatively high to address, and by conflict which means people and infrastructure are less prepared for disasters and find it harder to recover from them and build resilience to future disasters.

11. Chile flood (June)

From 21 to 25 June, Chile experienced the heaviest rainfall for 30 years. This led to rivers flooding and more than 21,673 people affected, 6,575 people isolated and 1,651 people sheltered,

primarily in rural areas.⁴⁴ Flooding and landslides affected many communities, a large proportion of which live in informal settlements where housing tends to be less resilient to flooding and other disaster impacts. The flooding was exacerbated by thawing ice and snow from mountains which added to swollen rivers. EM-DAT data shows four people died because of the floods and around 21,673 people were affected. The National Disaster Prevention and Response Service (SENAPRED) reported 1,623 houses destroyed, 3,059 with significant damage, 4,069 with minor damage, and 6,424 houses currently under damage assessment. Additionally, 79 temporary shelters were activated providing shelter for 1,651 people.⁴⁵

The total economic costs of the floods are estimated to be \$76m, around \$39 per capita across the country (Chile has a population of just under 20m). Since the GDP per capita in Chile is around \$18,000, this amount is small if evenly distributed across the whole population but as only around one in a thousand were directly affected, the impacts are very concentrated. The impacts of the flooding put additional pressure on key services including healthcare, which were already facing collapse prior to the floods, despite Chile being a relatively wealthy country.⁴⁶ In some areas, people did not have access to clean drinking water in the aftermath of the floods. These kinds of impacts show the importance of increasing resilience to climate shocks in advance. Chile had contended with wildfires in the months prior to the floods, weakening resilience of households and public services.

12. Haiti (June)

Haiti is naturally vulnerable to a range of natural disasters from earthquakes to cyclones. Its experience of past disasters, including a devastating earthquake in 2010 which claimed the lives of around 220,000 people and affected 3.5 million in total.⁴⁷ Haiti's vulnerability to disasters is compounded by a high incidence of poverty with a little under half the population living in multidimensional poverty,⁴⁸ inadequate public services and insecurity. Overall, Haiti is the country most vulnerable to climate disasters in the Caribbean and the 14th most vulnerable country in the world according to the Risk Management Index.⁴⁹ Thus when events such as the heavy rains of early June occur in Haiti, they are likely to have wider and deeper impacts than in many countries.

Extremely heavy rains on 3 and 4 June led to flooding as rain fell on already saturated ground. Initial reports found that 51 people died because of the floods,⁵⁰ but EM-DAT puts the total figure at 78. In addition, an estimated quarter of a million people were affected by the floods, with over 30,000 homes flooded. There was significant damage and disruption to key infrastructure including schools and hospitals in five of ten of Haiti's regions. The economic cost of the disaster was estimated at \$420m,⁵¹ representing over 1.5% of the small economy of around \$26bn which also wrestles with high debt. Given the GDP per capita is a little over \$2,100 the economic costs averaged across the population of \$36 are significant, compounded by the patchiness of public services. Whilst the government receives some insurance-style economic support for natural disasters,⁵² these do not address the full impacts and costs borne by people trying to rebuild their lives following this latest setback.

13. Mexico storm (October)

Hurricane Otis, a category 5 storm, hit southern Mexico on 25 October, wreaking widespread



Above: Hurricane Otis left chaos and destruction in its wake. Acapulco, Mexico October 25, 2023. Credit: Jessica Rodriguez Leon/Shutterstock.

destruction. It was the first time a hurricane of this intensity had affected this part of southern Mexico, including the port of Acapulco which is central to Mexico's valuable tourism sector, employing a large proportion of the population across the state of Guerrero. The record-breaking rapidity of the intensification of the storm has been linked to high sea surface temperatures.⁵³ Very heavy rainfall, strong winds and storm surges associated with the passage of Otis, caused floods and landslides that have resulted in evacuations and severe damage.⁵⁴ EM-DAT records 104 deaths because of Hurricane Otis, with more than one million affected. Tens of thousands of families were evacuated from their homes, finding refuge in temporary accommodation. More than 120 health facilities were damaged whilst over a quarter of a million homes suffered some kind of damage.⁵⁵ In the weeks following the hurricane, essential services were gradually restored but the full recovery from the extensive damage will take much longer.

Whilst there are no overall cost estimates for the impact of the hurricane available at time of writing, private market insured losses from Hurricane Otis were estimated to be between \$2.5bn and \$4.5bn.⁵⁶ Just using this amount pertaining to private assets equates to over \$35 for each of Mexico's over 127 million inhabitants; dividing the sum just amongst those affected by the hurricane (a little over 1% of the population) means individual average economic costs around \$300, a significant sum in a country where the average income is a little over \$12,000 annually. The economic impact in the private sector could have been even bigger but some buildings were not significantly damaged. However, since many were designed to withstand earthquakes, they were heavily affected by the hurricane. Only a few hotels and related tourism infrastructure have re-opened since the storm, meaning vital tourism revenue is foregone, adding to the long-term economic impacts. Investing in resilient structures can lesson material and economic impacts even in the face of unpredictably ferocious storms.

16. China flood (August)

A series of floods over the summer months affected almost 9 million people across China, culminating in the impact from Typhoon Doksuri in August. EM-DAT identifies flooding from heavy rains in August in Beijing and eastern China which led to 51 deaths and affected 600,000 people directly. The series of storms throughout summer and the passage of them, including Typhoon Doksuri, inland increased vulnerability to bigger impacts.⁵⁷ It is difficult to isolate impacts to causes, given the overlapping weather events, some of whose impacts (eg saturated ground and high river levels) will contribute to impacts of subsequent storms.

Whilst the EM-DAT database does not ascribe an estimate of economic impact to the floods around Beijing and eastern China in August, the insurance company Aon estimates that the total economic impacts of 'seasonal flooding' in China from May to September is likely to be over \$30bn.⁵⁸ This makes it the second biggest economic impact of any weather-related disaster in 2023, only behind the devastating earthquake in Turkiye and Syria. Across this series of floods, Aon's data estimates that 370 died, showing the much wider impact across the different floods than the one associated with Typhoon Doksuri in August. Estimating the impact of Typhoon Doksuri, Aon estimates that across the Philippines, Taiwan, China, and Vietnam 106 people died whilst there was over \$2bn in economic damages. It is therefore difficult to assess the economic impacts associated with just Typhoon Doksuri. Instead taking the total economic impact costs of seasonal flooding in China of \$31.9bn gives a per capita cost of \$23 since China's total population is over 1.4 billion. If these costs are 'borne' only by those directly affected by the seasonal flooding (around 8.9 million people), the average costs are around \$3,500 per person, a very large amount in a country where the GDP per capita is around \$12,000.⁵⁹

17. Malawi storm (March)

On 11 March, Cyclone Freddy slammed into southern Africa for the second time in a month – and its return was deadly and destructive. Cyclone Freddy is an example of cyclones lasting longer over land due to climate change;⁶⁰ previously countries such as Malawi were considered too far from the India ocean to experience direct impacts of cyclones. In Malawi, a year's worth of rain fell during the weeks of the cyclone. The heavy rains, floods and landslides caused widespread damage, especially in Blantyre and the Southern Region. The number of people affected in Malawi was very high with EM-DAT recording 679 deaths and over 2 million Malawians affected, more than 10% of the 20 million population. Over 650,000 people were displaced as a result of the cyclone. Cyclone Freddy was currently Africa's second-deadliest cyclone this century after Cyclone Idai in 2019. It is the longest-lasting tropical cyclone ever recorded, lasting 34 days and had the strength of the equivalent of a full North Atlantic hurricane season.

The floods following the cyclone and torrential rains washed away and submerged houses, swept away roads, bridges, and power supply and irrigation infrastructure. Crops, vital to many households' livelihoods as well as their own source of food, were also washed away. Power supply was interrupted for more than three days in Chikwawa and Nsanje districts and in some parts of Blantyre District.⁶¹ As well as undertaking relief and rescue operations, the Malawian government also oversaw a rapid Post Disaster Needs Assessment (PDNA). The PDNA was designed to evaluate the cost of the disaster, estimated at just over \$500m, and it estimated that a full recovery would cost \$680m. Given the scale of the disaster, and the huge number of people affected, this may seem like a relatively low amount, but since the total of economy of Malawi is \$13bn it represents 5%, a much higher proportion than in most other disasters on our list.⁶²

Since the average income in Malawi is under \$500 a year, the per capita cost of \$33 per person to meet the recovery costs is more than 5% of already very low incomes. Although international aid has helped, much of the cost will continue to be borne by Malawians rebuilding and recovering after the devastation of Cyclone Freddy.

Mofolo Chikaonda Appreciates Cyclone Freddy Response in Chikwawa District

The focus of this report is on economic losses from disasters to quantify and understand how disasters affect people. But even where it is possible to quantify economic impacts, these overlook non-economic losses and damages. By assessing disaster impacts in a holistic way, it is possible to understand the range of economic and non-economic impacts. Even non-economic impacts such as cultural heritage may be ameliorated to an extent by economic redress.

Mofolo Chikaonda is a widow aged 69 and comes from GVH Matsukambiya, T/A Ng'abu, Chikwawa District in southern Malawi. Her household consists of 6 children: 4 females, 2 males and 2 grand daughter and 1 grandson. Mofolo explained that they heard about floods coming which was not usual with heavy rainfall. But "as we were at the home around 3 AM that's when we realized raising water levels, it is when we heard village civil protection committee member with megaphone telling us to move out from the house as the water has flooded the village, it has never happened in the past" said Mofolo.

Mofolo and her household lost all their livestock (five goats), some households items (kitchen utensils, clothes, 3 bags of maize of 70 kilograms each, blankets) which were all swept away by the devastating floods. A total of half (0.5) acres of farmland planted with maize, beans and sweet potato were washed away. "The worst negative impact of Cyclone Freddy that I shall never forget in my entire life is the destruction of the only house that we struggled to construct with my children and loosing of all assets I had bought from piece work of which until now I find it difficult to rebuild" lamented Mofolo. The family had to be evacuated to Matsukambiya Camp in the community.

The government of Malawi and other organisations like Christian Aid and its partner Circle for Integrated Community Development (CICOD), provided some humanitarian support of cash amounting to MK25,000 (around £12), flour, and plastic sheets. Mofolo narrated that with MK25,000 she was able to buy 2 basins of maize which was lifesaving as the household had no food.

The support provided to Mofolo was replicated by Christian Aid's based on a rapid needs assessment:

- Extra food for breastfeeding mothers and children under 5 years old.
- Mosquito nets to protect against malaria.
- Temporary toilets and bathrooms, water containers and water purification treatment to help prevent cholera and other waterborne diseases.
- Mobile clinics to help people process the emotional trauma of the cyclone.
- Cash distributions.

Within 45 days, Christian Aid's partners reached 2,500 households through these activities.

Despite the support from the government of Malawi and other organisations, there is still a need to address the loss and damage that Cyclone Freddy has caused. Households and communities want to build back better, making their homes, schools, bridges, and roads, crops more resilient. They hope to overcome environmental loss through seed banks and better management of livestock.

Mofolo says she is more than ready and willing to relocate and build back better on higher and safer grounds that are not prone to flooding. She is receiving support from Catholic Relief Services to construct a new home. To fully recover from the loss and damage in agriculture Mofolo also needs financial resources to procure farm inputs such as early maturing seed varieties, livestock, and business capital. She would also like to be trained in agronomic technical skills on how to manage her crop, small ruminants, and business enterprises. This would help her, and her family become more able to withstand future floods and other shocks.



Mofolo Chikaonda sitting with her grandchildren after Cyclone Freddy in her temporary shelter.

Conclusion and recommendations

2023's record of being the hottest on record may well be surpassed before long because of climate change. The impacts of climate change will also become more frequent and intense, and therefore, despite more effective adaptation measures, we can expect more climate-related disasters in future years which affect more people around the world. One aspect of this pattern too often overlooked is the injustice of those disproportionately experiencing such disasters in lower (low, lower-middle, and upper-middle) income countries. These countries have done much less to unleash the impacts of climate change wrought in disasters, and their inhabitants will usually have less wherewithal - from lower household incomes, less insurance coverage and patchier public services - to deal with the impacts of storms, floods, heatwaves and droughts.

We shine a light on the costs borne by these countries by using a 'per capita economic cost' of disasters to show that people in lower income countries tend to face relatively more acute and costly disasters – and that whilst international aid and mechanisms such as the newly established Loss and Damage Fund may start to help compensate people for losses and damages they experience – people in poorer countries will continue to bear much of these costs themselves. Of the 14 different countries featured in our top 20 list, 6 are high income countries according to the World Bank (USA, Guam New Zealand, Italy, Spain and Chile); 4 are Upper-Middle income countries (Libya, Peru, Mexico and China); 3 are Lower-Middle income countries (Vanuatu, Myanmar and Haiti) and one is a Low-income country (Malawi).⁶³

When we analyse the data across countries, we see that for richer countries with a large population it is easier to absorb the costs of climate disasters. Even the \$31bn costs associated with the sequence of seasonal floods in China amounts to around \$23 per person across the 1.4bn people; whereas the \$33 per capita cost of Cyclone Freddy to the people of Malawi is both a higher absolute amount at the individual level and a much higher relative amount given the much lower incomes in Malawi. Small islands are particularly vulnerable to costly disasters, with the economic impact of the storm in Vanuatu representing around a quarter of every Vanuatuan's annual income.

Our understanding of climate disasters is filtered through stark images in the media. We struggle to grapple with the scale and depth of disasters – hearing the story about one household's lives being turned upside down by a disaster doesn't necessarily tell us if this household was typical of those impacted by the disaster overall, and what proportion of the population were affected in what way. Understanding non-economic losses needs more research and understanding; as well as estimating what is needed economically to recover and rebuild after a disaster, it is important to assess how to address losses which don't have a clear economic price. We don't tend to know how far the household's government will help them pick up the pieces to rebuild their lives once the media interest has dissipated, nor how easy it will be for the householders to re-start their business, return to school, and begin preparing for the next 'rainy' day.

But by understanding more about the actual and relative economic costs of climate disasters this past year, we can better gauge how to focus efforts to improve preparation and reduce vulnerability, supporting communities to design and implement plans for long-term change; and how tackling the causes and consequences of climate change is imperative for our earth and a matter of global justice. Looking at the impacts of climate disasters on people from Hawaii to Malawi we can see amidst the stories of lives uprooted huge variability in how able households, communities, businesses, and governments can recover from disasters – and how these differences are too often the reverse of those countries' contribution to causing climate change.

Therefore, it is imperative that governments build resilience at home and foster effective cooperation globally to deal with both the causes and increasingly destructive symptoms of climate change.

Recommendations:

- 2024 needs to be the year that climate finance ambition and need is matched by political and economic commitment. Governments must agree a New Collective Quantified Goal to cover mitigation, adaptation and Loss and Damage based on needs rather than political expediency.
- The new Loss and Damage Fund is being operationalised in 2024. As well as needing sufficient funding to respond to climate impacts which cannot be adapted to, those affected by Loss and Damage need to be able to access the funds in a timely manner – much faster than the years some funding currently takes. The governance of the new Fund will be a critical test of global solidarity and effectiveness.
- The unequal impact of climate disasters demonstrates the importance of adaptation to lower vulnerability before disasters strike. Whilst much progress has been made in reducing the incidence of deaths in most cases – though there is evidence that extreme heat is causing more fatalities⁶⁴ - much more can be done to make communities more resilient, for example by investing in agroecology which can withstand climate change better whilst helping to prevent emission in the first place.
- Investment in early warning and early action should be increased, not least because of its effectiveness and value for money.
- Governments should increase resources to monitor and measure the impacts of disasters and share information across borders to inform effective early action and response strategies.
- The global ‘postcode lottery’ facing those experiencing climate disasters shows the importance of governments investing in effective social protection. These services are even more vital when homes and livelihoods have been damaged and can help people recover dignity and agency as well as practically providing income and wider economic benefits. Rich countries have a vital role to ensure lower income country governments have more ‘fiscal space’ to invest in social protection, through debt relief, fairer international tax rules, mobilising international climate finance and development aid.

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