CHAPTER 2

Managing disasters during a global pandemic

Across Asia and the Pacific, governments have raced to control the COVID-19 pandemic and protect their people. Many countries, in the region, have also had to simultaneously contend other natural disasters. The biological threat has compounded the impacts of floods, droughts, cyclones and locust swarms, making it more difficult to respond effectively.

National responses to the COVID-19 pandemic have differed according to the spread of the infection and the timing, as the virus has typically been transmitted in waves or centred in specific locations. During the early stages of the pandemic, countries with previous experience of the SARS virus appeared to be better prepared, basing their responses on surveillance, testing, contact tracing, and strict quarantine.[56]

In many cases, countries took advantage of scientific and technological advances.[57] Frontier technologies, such as artificial intelligence (AI) and the manipulation of big data, enabled a better understanding of the mechanisms of virus transmission. Advanced modelling techniques have been used for early detection, rapid diagnostics, prevention of the spread of the virus spread, as well as for managing critical supplies and delivering equipment.[58] Such technologies have been used effectively for example, in Australia, China, New Zealand, the Republic of Korea, Singapore, Thailand and Viet Nam.[59] Countries that are leaders in the use of such technologies have been able to successfully deploy them at scale, and even a few lesser technologically advanced countries have shown some degree of success. However, least developed countries have often lacked the capacity to harness the potential of such technologies, making their efforts to combat the pandemic even more challenging.[60]

Effective protection strategies, with or without the latest technologies, involve social distancing and better hygiene combined with efficient test-isolate-treat regimes. These techniques work well in the more developed countries. But, they need to be adapted to operate efficiently in the densely populated urban slums of developing countries. In these cases, official action can be complemented with local surveillance by communities which offer governments 'ears to the ground', for example, by checking for unintended consequences of official action and taking corrective steps. The value of community action taken in the early stages of the pandemic and empowered by new technologies, has been demonstrated in Dharavi, Asia's largest slum, located in Mumbai. The Dharavi model, which has been lauded by the World Health Organization, involves "chasing the virus" through micro-mapping, robust surveillance, public-private partnerships, community engagement, and proactive leadership (Figure 2-1).[61] Dharavi appeared to have kept its COVID-19 cases under check, during April/early May 2021, amid the second wave of the pandemic that swept through Mumbai and other parts of state of Maharashtra. Amid the rise of fresh infections, Dharavi reported fewer cases than expected.[62]

56 United Nations, Economic and Social Commission of Asia and the Pacific, "Weaving a stronger fabric: Managing cascading risks for climate resilience", Policy Brief, 26 January 2021c. Available at https://www.unescap.org/kp/2021/weaving-stronger-fabric-managing-cascading-risks-climate-resilience (accessed on 12 March 2021).

57 Jobie Budd and others, "Digital technologies in the public-health response to COVID-19", *Nature Medicine*, vol. 26 (2020), pp. 1183–1192. Available at https://www.nature.com/articles/s41591-020-1011-4

58 Sera Whitelaw and others, "Applications of digital technology in COVID-19 pandemic planning and response", *The Lancet Digital Health*, vol. 2, No. 8 (29 June 2020), pp. 435–440. Available at doi: 10.1016/S2589-7500(20)30142-4

59 United Nations Economic and Social Commission for Asia and the Pacific, "Pathways for managing systemic risks in Asia and the Pacific: Regional and subregional approaches", Note by the secretariat, Seventy-seventh session, Committee on Disaster Risk Reduction, 26–29 April 2021b. ESCAP/77/19. Available at https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_77_19_E.pdf

60 United Nations Economic and Social Commission for Asia and the Pacific, "Collaborative actions to harness technologies during Pandemics", Note by the secretariat, Third Session, Committee on Information and Communications Technology, Science, Technology and Innovation, 19–20 August 2020. ESCAP/CICTSTI/2020/1. Available at https://www.unescap.org/events/committee-information-and-communications-technology-science-technology-and-innovation-third

61 Mahaveer Golechha, "COVID-19 containment in Asia's largest urban slum Dharavi-Mumbai, India: Lessons for policymakers globally", *Journal of Urban Health*, vol. 97, No. 6 (December 2020), pp. 796–801.

62 News18, "How Dharavi is bucking the trend in Mumbai amid second wave of Coronavirus", video, 12 April 2020. Available at https://www.news18.com/videos/ivideos/how-dharavi-is-bucking-the-trend-in-mumbai-amid-second-wave-of-coronavirus-3633638.html

FIGURE 2-1 **The Dharavi "chase the virus" model**

Source: ESCAP based on Mahaveer Golechha, "COVID-19 containment in Asia's largest urban slum Dharavi-Mumbai, India: Lessons for policymakers globally", *Journal of Urban Health*, vol. 97, No. 6 (December 2020), pp. 796–801.

Effective risk communication

When faced with a series of cascading disasters, success depends on effective communication between health experts, governments and at-risk communities. In these circumstances, the authorities are expected to transmit real-time and actionable information. At the global level, this was achieved through the World Health Organization's Situation Dashboard. The ArcGIS platform within this dashboard has provided the latest location-specific updates on the outbreak, including numbers of infected people and deaths. The dashboard has also been locally adopted and modified at the country level, with relevant surveillance management systems in place. These systems have also incorporated the use of social media, which over recent years has been changing citizens' behaviours and expectations, and the ways in which power is sought, used, or contested. For example, in Indonesia, especially in the rural and sub-urban areas, religious leaders have used their social media accounts/channels to raise awareness about the risks of COVID-19 among their followers.[63]

Government action has also been supported by academic institutions and local companies, which have helped track the rapidly changing situation using data analytics, integrated geospatial data, machine learning and AI tools. Some small and medium enterprises have also helped with effective risk communication.[64] For example, in Thailand, a privately developed Covid-19 tracker is one of the most popular interactive web portals. However, governments need play an important role in consolidating the COVID-19 data to avoid the use of conflicting or overlapping information within the public domain.

The latest technologies have been boosting the efficiency and speed of existing disaster risk management tools. In particular, they can support risk hotpot mapping, a technique which has proved effective in previous complex and dynamic disasters. Such mapping has now been adapted for epidemiological risks, enabling countries to visualize the incidence of COVID-19. Using this tool, countries have been able to predict the spread of the virus, revealing the interconnections between cases and clusters of infections, and identify 'super-spreaders' or super-spreading events. Government agencies can play an enabling role in managing such integrated risk mapping exercises.

Based on this information, countries can make critical and risk-informed interventions, such as imposing lockdowns in risk hotspots, and insulating other provinces and cities from the spread of the virus. Within hotspots, governments can manage local outbreaks by establishing containment and buffer zones. For example, during the outbreak, Indonesia also experienced many floods and landslides and had to manage cascading risks. In response, the Government implemented targeted interventions in specific zones, based on dynamic risk assessments (Figure 2-2).[65] The resulting cluster-containment response strategies are yielding positive results and also helping other countries restrict the transmission of COVID-19, especially within vulnerable communities.[66] The Indonesian National Board for Disaster Management (BNPB) has been a central task force for coordinating and managing COVID-19, integrating disaster and COVID-19 information for relevant use, and also using information from OneData Indonesia.

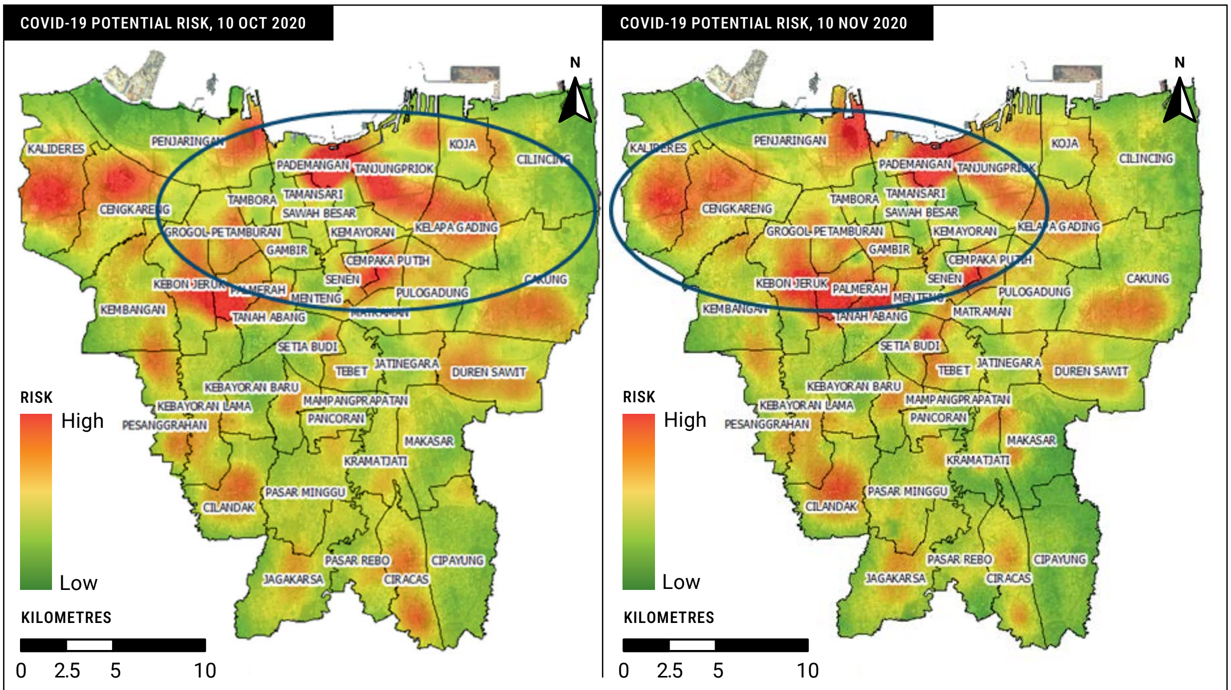
63 Hasanudin Abidin, Geospatial Information Agency, Indonesia, personal communication, 3 May 2021.

64 Sanjay Srivastava, "Flattening the curve of COVID-19", blog, 13 April 2020a. Available at https://www.unescap.org/blog/flattening-curve-covid-19

65 Fajar Yulianto, "How Space Technology Applications Contributed to Combating COVID-19: Development of LAPAN Hub COVID-19", presentation at the Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP) Meeting, 2020.

66 Sanjay Srivastava, "Outpacing COVID-19: Key innovations prompt early warning for early action", blog, 21 April 2020b. Available at https://www.unescap.org/blog/outpacing-covid-19-key-innovations-prompt-early-warning-early-actions

FIGURE 2-2 Mapping the potential risk of COVID-19 spread in Jakarta, Indonesia



Source: Fajar Yulianto, LAPAN, UNGGIM Asia-Pacific Meeting, ESCAP 2020.
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Nevertheless, in practice, many interventions have had their shortcomings.[67] Often, they have not been sufficiently 'granular' or decentralized to identify and target risk-informed interventions to specific areas, or have not been updated quickly enough to keep pace with the spread of the virus. Furthermore, without the necessary measures to enforce social distancing or constrain large gatherings, there have been exponential increases in the number of COVID-19 cases. For this pandemic, another constraint has been the limited scientific understanding of the meteorological and air quality factors that influence its transmission and spread.[68]

Multi-hazard, early warning systems

For addressing pandemics, governments can build on previous experience of multi-hazard, impact-based early warning systems, which aim to provide reliable, targeted warnings and guidance for informed long-term planning. These systems also ensure that governments and other stakeholders are willing and able to prepare for reasonable worst-case scenarios.[69] New Zealand, for example, is well prepared for natural hazards, and has numerous Alert Level systems for volcanoes, tsunamis, and weather hazards. It was thus able to devise a similar set of protocols for its COVID-19 Alert Level System,[70] which has four colour-coded levels: prepare, reduce, restrict, and lockdown. For each level, permissible and non-permissible activities are well-defined, with specific outcomes, summaries, and measures for public health, personal movement, travel and transport, gatherings, public venues, health and disability care services, workplaces, and education. New Zealand is one of the few countries on track for rapid and complete control of the COVID-19 outbreak (Figure 2-3).[71]

67 Pramod K. Mishra, "COVID-19, Black Swan events and the future of disaster risk management in India", *Progress in Disaster Science* (2020). Available at https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-939196

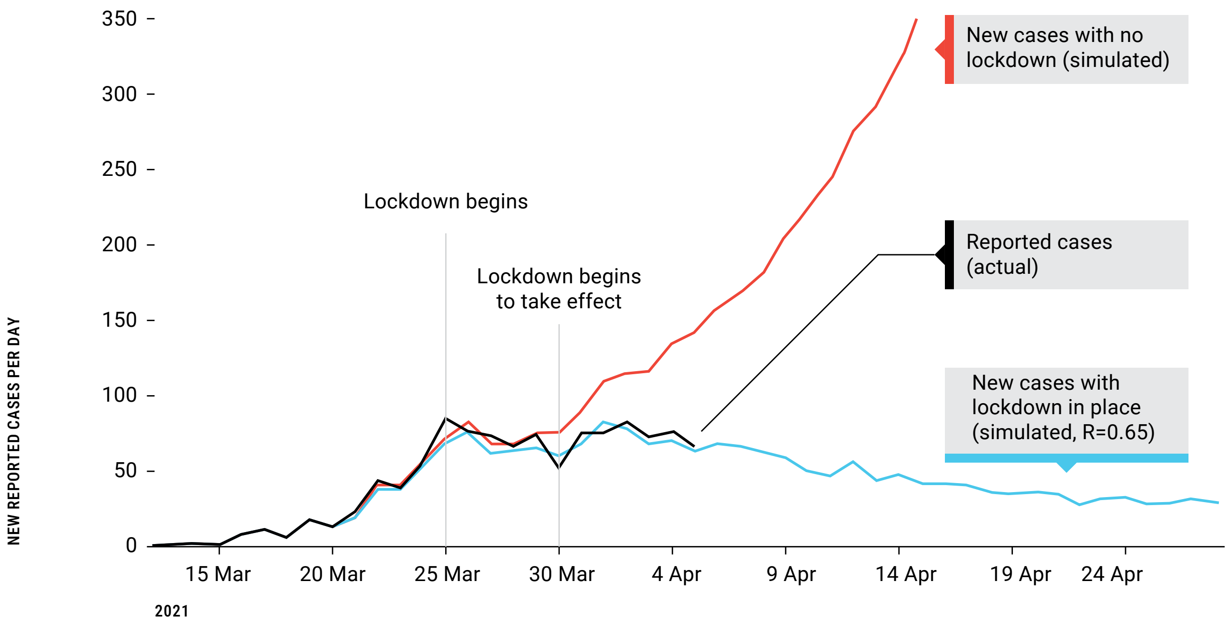
68 World Meteorological Organization, "First Report of the WMO COVID-19 Task Team: Review on meteorological and air quality factors affecting the COVID-19 pandemic" (Geneva, 2021a). Available at https://library.wmo.int/doc_num.php?explnum_id=10555

69 David P. Rogers and others, "Learning from multi-hazard early warning systems to respond to pandemics" (Washington, D.C., World Bank, 2021). Available at http://documents1.worldbank.org/curated/en/429511592591445701/pdf/Learning-from-Multi-Hazard-Early-Warning-Systems-to-Respond-to-Pandemics.pdf

70 Unite Against Covid-19, "COVID-19 Alert System". Available at https://covid19.govt.nz/alert-system/about-the-alert-system/

71 Michael J. Plank and others, "A stochastic model for COVID-19 spread and the effects of Alert Level 4 in Aotearoa New Zealand", Journal of the Royal Society of New Zealand (11 April 2020). Available at doi: https://doi.org/10.1101/2020.04.08.20058743

FIGURE 2-3 **New Zealand – modelling the impact of lockdown**



Source : A stochastic model for COVID-19 spread and the effects of Alert Level 4 in Aotearoa New Zealand, Michael J.Plank *et al*, 08/04/2020.

Responses to disasters during the COVID-19 pandemic

While responding to the pandemic, Asia-Pacific countries have also had to contend with their regular sequences of other natural hazards, including cyclones, floods, heatwaves, bushfires, sand and dust storms, locust swarms, typhoons, storm surges, droughts, earthquakes and volcanic eruptions. These, more familiar, events have different risk pathways from biological hazards, but the multiple emergencies can intersect and converge in complex and destructive ways. Nevertheless, in this shifting new riskscape, advances in risk assessment, early warning systems, disaster preparedness and response have helped many Asia-Pacific countries to keep infections at manageable levels.[72]

Cyclones and floods

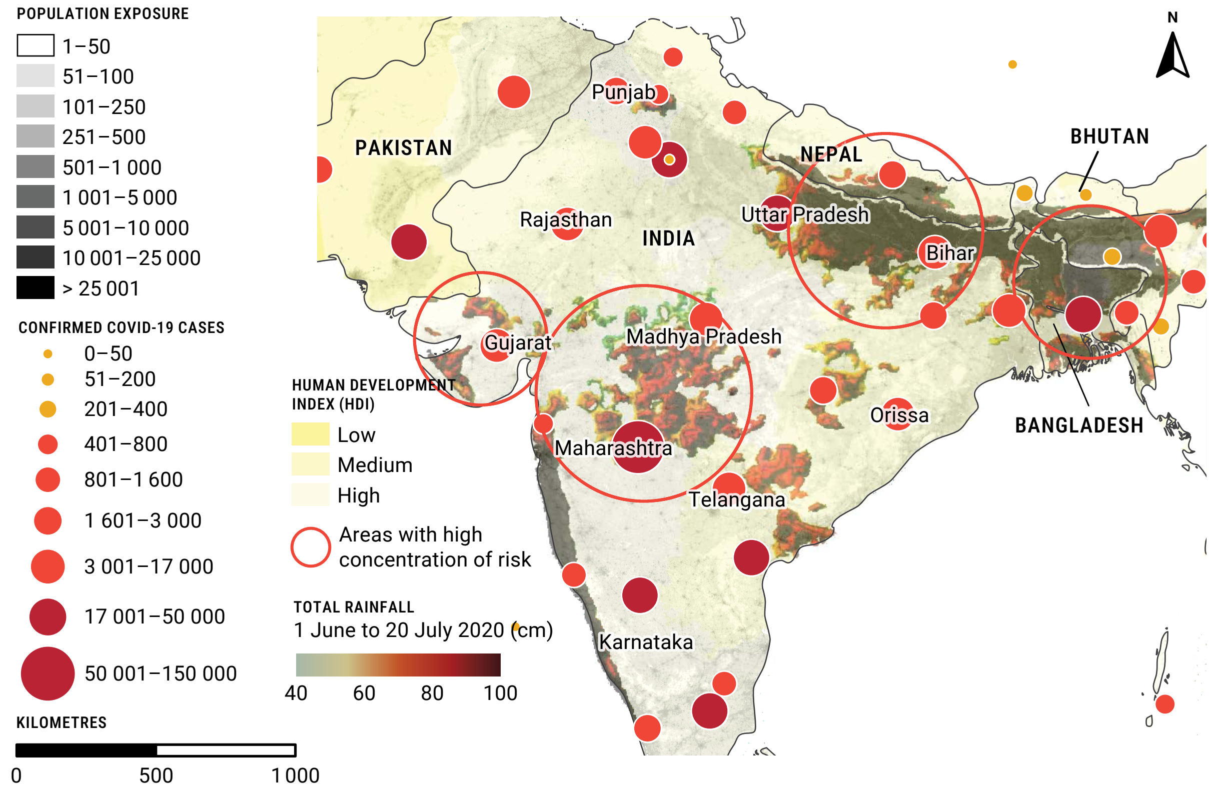
In May 2020, during the COVID-19 pandemic, cyclone Amphan hit the densely populated, low-lying coastal areas of Odisha, West Bengal, India, and the adjoining areas of Bangladesh. Cyclone Amphan affected 10 million people and killed more than a 100 people. But the casualties were far fewer than would have been expected without the early warning systems, which accurately forecasted the path of the cyclone and helped in the evacuation of more than 3 million people.[73] Local authorities, however, had to strike a balance between the impacts of these two crises. Where the risk of COVID-19 transmission was high, but the threat from the cyclone was lower, authorities only allowed shelters to be half full, in order to facilitate social distancing. In areas with the highest exposure to the cyclone, shelters operated at full capacity, with all possible preventative measures in place.

These large-scale evacuations relied on impact-based, risk-informed, early warning systems and thus saved thousands of lives. Having people in shelters, with limited space and services, nevertheless, increased the risk of infection. In India, it was reported that 59 members of the National Disaster Response Force, and 170 personnel who fought against cyclone Amphan, tested positive for COVID-19.

72 *The Disaster Riskscape across Asia-Pacific: Pathways for Inclusion and Empowerment* (United Nations publication, 2019c).

73 Asia-Pacific Disaster Resilience Network, "When crises converge: Responding to natural disasters in South Asia", policy brief, February 2020. Available at https://www.unescap.org/sites/default/files/Policy%20brief_when%20crises%20converge_v1%20(4).pdf

FIGURE 2-4 **Population affected simultaneously by floods and COVID-19, in South Asia (June to July 2020)**



Sources: ESCAP, based on ESRI and Johns Hopkins University Coronavirus COVID-19 Cases V2, 16 June 2020; NASA's Integrated Multi-Satellite Retrievals for GPM (IMERG) 1 June–20 July 2020; WorldPop 2020 Population Estimates and Sub-National Human Development Index (SHDI) Version 4.0, 2020.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Source: NASA Earth Observatory, "Excessive monsoon rains flood Asia - Integrated multi-satellite retrievals for GPM (IMERG) for 1 June to 20 July 2020". Available at: https://earthobservatory.nasa.gov/images/147006/excessive-monsoon-rains-flood-asia (accessed in August 2020).

Other areas in the Asia-Pacific region faced similar crises when hit by disasters, in 2020. In April, cyclone Harold hit the Solomon Islands, Vanuatu, Fiji, and Tonga and here too timely early warning systems minimized the impact. In May, cyclone Vongfong hit the province of Albay, in the Philippines, where precise early warnings and zero-casualty approach followed by timely evacuations undoubtedly saved lives.[74] There was a similar response, in June 2020, when cyclone Nisarga struck densely populated areas on the west coast of India where COVID-19 was already spreading fast.

The heavy monsoon flooding in South Asia, in 2020, was also a prime example of this convergence of disasters. In Assam, India, the highest single-day spike of over 1,200 COVID-19 cases occurred during the heaviest floods and multiplied the impacts on vulnerable populations. For example, farmers whose crops were damaged by the floods were unable to harvest the surviving crops due to the pandemic lockdowns.[75] The subregion of South and South-West Asia was most impacted by the simultaneous occurrence of floods and COVID-19 (Figure 2-4).

Drawing on the experience of 2020, five key lessons can be used to incorporate the COVID-19 pandemic into the new riskscape:[76] (i) revise the standard operating procedures for evacuation, (ii) re-purpose existing cyclone shelters, resources and tools for early warning, (iii) protect responders, (iv) reduce

74 Kareff Rafisura and Cedric Daep, "The world is in lockdown, but tropical cyclones are not", blog, 28 May 2020. Available at https://www.unescap.org/blog/world-lockdown-tropical-cyclones

75 Sanjay Srivastava and others, "2020: The year when crises converged", blog, 15 January 2021. Available at https://www.unescap.org/blog/2020-year-when-crises-converged

76 Kamal Kishore, "Managing tropical cyclones during COVID-19, Early lessons learned and reflection from India", World Bank Blogs, 27 July 2020. Available at https://blogs.worldbank.org/climatechange/managing-tropical-storms-during-covid-19-early-lessons-learned-and-reflections-india

additional burden on hospitals, and (v) apply classic principles of disaster risk management to protect the most vulnerable first. In addition, meteorological agencies in charge of providing early warning information need to be supported, with all possible measures, to ensure business continuity should they become inoperative due to the impacts of the pandemic.

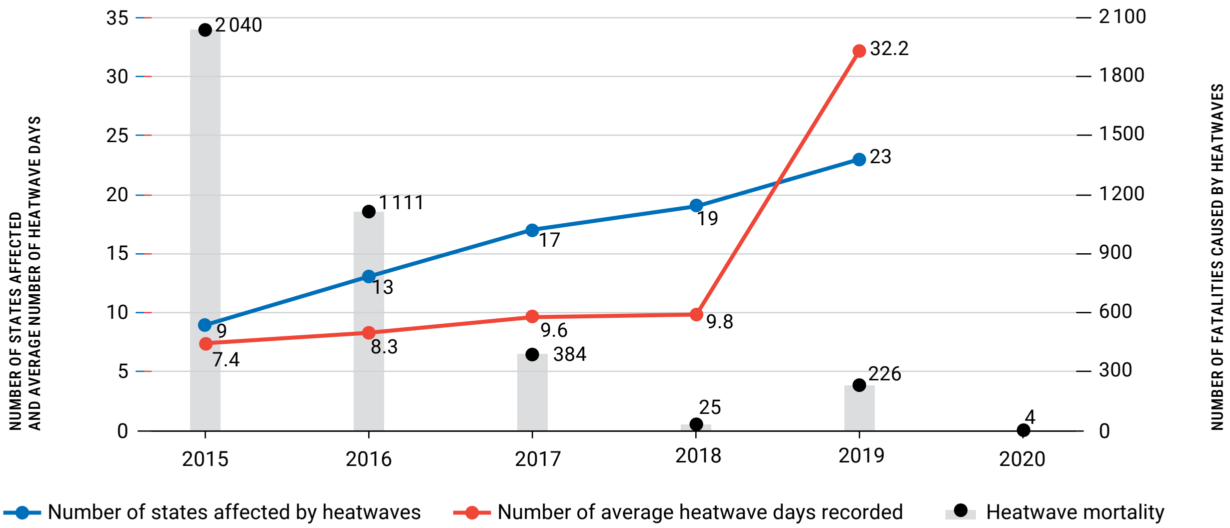
Glacial lake outburst floods

On 7th February 2021, in the Uttarakhand state in India, a block of the Nanda Devi glacier broke off, triggering landslides and a flash flood that killed at least 61 people, and around 143 people went missing. Simultaneously, as of 7th February, a total of 96,493 positive COVID-19 cases had been recorded in the state.[77] The combination of the glacial lake outburst with the pandemic placed additional burdens on all response authorities. A similar incident had occurred in 2013, in the adjoining town of Kedarnath, when a cascade of devastating floods and landslides killed more than 5,700 people, destroying bridges and roads and leaving 300,000 pilgrims and tourists trapped in the valleys for many days. These glacial lake outburst floods pose a serious threat to mountain communities across Bhutan, India, Nepal and Pakistan, and from the Himalayas as well as the Caucasus, Pamir, Hindu Kush-Karakoram and Tien Shan mountain ranges.

Heatwaves

Historically, India has been severely affected by heatwaves which, between 1992 and 2016, have caused 25,716 deaths. State authorities and India's National Disaster Management Agency have made preparations that successfully reduced deaths, as reflected in the 'Guidelines for Preparation of Action Plan — Prevention and Management of Heat-Wave,' (Figure 2-5).[78] Some of this success relies on precise warnings. The Indian Meteorological Department provides not only a seasonal outlook over the country, at a sub-divisional scale, but also guidance on temperatures over a two-week scale.[79] Australia too consistently ranks heatwaves as the greatest cause of death from natural hazards. Therefore, in response, Australia has developed and implemented heatwave prediction and modelling, as well as improved communication and outreach. In total, six Asia-Pacific countries have put heat action plans in place that cover heat vulnerability and impact science, impact forecasting, partnerships, risk communication and policy actions.[80]

FIGURE 2-5 More heatwaves but fewer deaths in Indian states, 2015–2020



77 Uttarakhand State Control Room, Integrated Disease Surveillance Programme, "Health Bulletin", 7 February 2021. Available at https://health.uk.gov.in/files/2021.02.07_Health_Bulletin_1.pdf

78 National Disaster Management Authority, "Beating the heat: How India successfully reduced mortality due to heat waves", Ministry of Home Affairs, Government of India, 2021. Available at https://ndma.gov.in/sites/default/files/IEC/Booklets/HeatWave%20A5%20BOOK%20Final.pdf

79 India Meteorological Department, "Forecast Demonstration Project (FDP) for Improving Heat Wave Warning in India: Implementation Report, 2019", (New Delhi, February 2020). Available at https://internal.imd.gov.in/section/nhac/dynamic/fdpheatreport2019.pdf

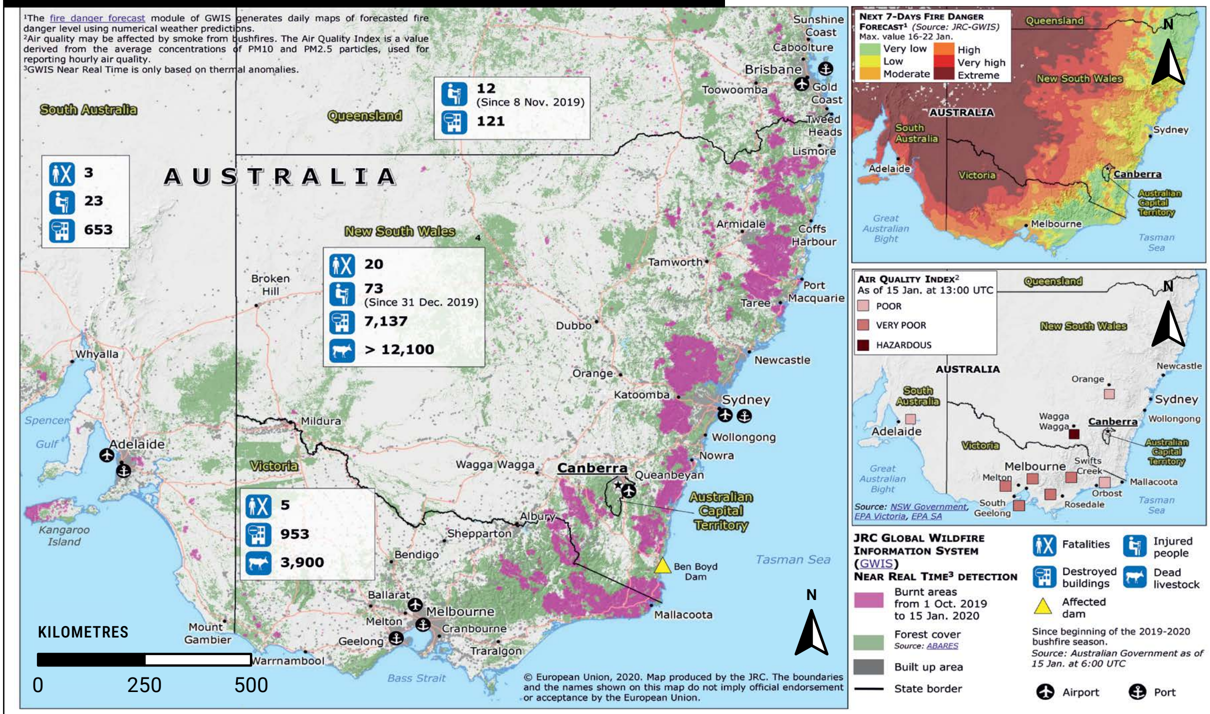
80 Joy Shumake-Guillemot and others, "Progress Report 2017–2020", Global Heat Health Information Network, 2020. Available at https://ghhin.org/wp-content/uploads/GHHIN-Progress-Report-2020.pdf

Bushfires

Between July 2019 and February 2020, bushfires of unprecedented scale and intensity raged across Australia, burning over 17 million hectares of land (Figure 2-6). As a result of prolonged drought, extreme heat and strong winds, the fires intensified rapidly in November, particularly in the Australian Capital Territory and the states of New South Wales, Queensland, South Australia, Victoria and Western Australia.[81] In all, 33 people lost their lives, 3 billion animals were killed or fled, and more than half of Australia's adult population was affected by smoke.[82] The Australian Bushfire Warning System was used by emergency service agencies to indicate the level of threat and the recommended action.[83] Amid the pandemic, recovery procedures and actions met with the additional challenge of safeguarding against the virus along with tackling the fires.

FIGURE 2-6 Australia seven-day bushfires forecast on 15 January 2020

EMERGENCY RESPONSE COORDINATION CENTRE (ERCC), DG ECHO DAILY MAP, 15 JANUARY 2020



Source: Government of New South Wales; Environment Protection Authority Victoria; South Australian Environment Protection Authority; European Union; Reliefweb, Experience of Care and Health Outcomes (ECHO) Australia, 15 January 2020;

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Source: Emergency Response Coordination Centre (ERCC), "Australia | Bushfires: DG ECHO Daily Map", 15 January 2020. Available at https ://reliefweb.int/sites/reliefweb.int/files/resources/ECDM_20200107_Australia_Bushfires_update.pdf

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

81 Emergency Response Coordination Centre (ERCC), "Australia | Bushfires: DG ECHO Daily Map", 7 January 2020. Available at https://reliefweb.int/sites/reliefweb.int/files/resources/ECDM_20200107_Australia_Bushfires_update.pdf

82 Elisabeth du Parc and Louisa Yasukawa, "The 2019–2020 Australian bushfires: From temporary evacuation to longer-term displacement", Internal Displacement Monitoring Centre (IDMC), (September 2020). Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/Australian%20bushfires_Final.pdf

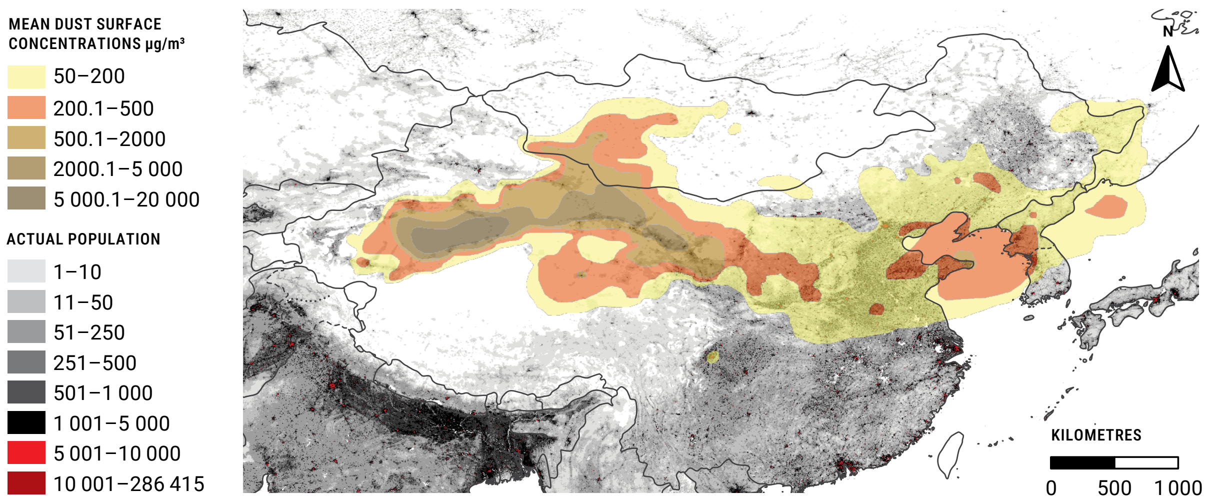
83 Department of Fire and Emergency Services, "Bushfire Warning Systems: How and when to use them", 2020. Available at: https://www.dfes.wa.gov.au/firechat/documents/downloads/bushfire-warning-systems-dfes-how-and-when-to-use-them.pdf

Sand and dust storms

In March 2021, amidst the COVID-19 pandemic, the populated areas of East and North-East Asia were hit by the worst sand and dust storms (SDS) in a decade.[84] These extended from the Gobi Desert and the central and western deserts over Mongolia, to some provinces in the North and North-West China including Beijing, and affecting 40 per cent of the population. The pollution level was more than 150 times the recommended limit (Figure 2-7).[85] SDS affected 66 per cent of the population in the Republic of Korea, and 8 per cent of the population in Mongolia. These countries issued yellow alerts for sandstorms and followed up with necessary response measures.

FIGURE 2-7 **Populations exposed to sand and dust storms in East and North-East Asia, 15–18 March 2021**

SAND AND DUST STORM FORECAST FOR 15 MARCH 2021, 21:00 UTC



Sources: ESCAP, based on Sand and Dust Storm Warning Advisory and Assessment System Asian Regional Center (SDS-WAS Asian-RC) Sand and Dust Storm Forecast for 15 March 2021, 21:00 and Worldpop Population Counts 2020.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Source: ESCAP based on World Meteorological Organization, "Severe sand and dust storm hits Asia", 16 March 2021b. Available at: https://public.wmo.int/en/media/news/severe-sand-and-dust-storm-hits-asia.

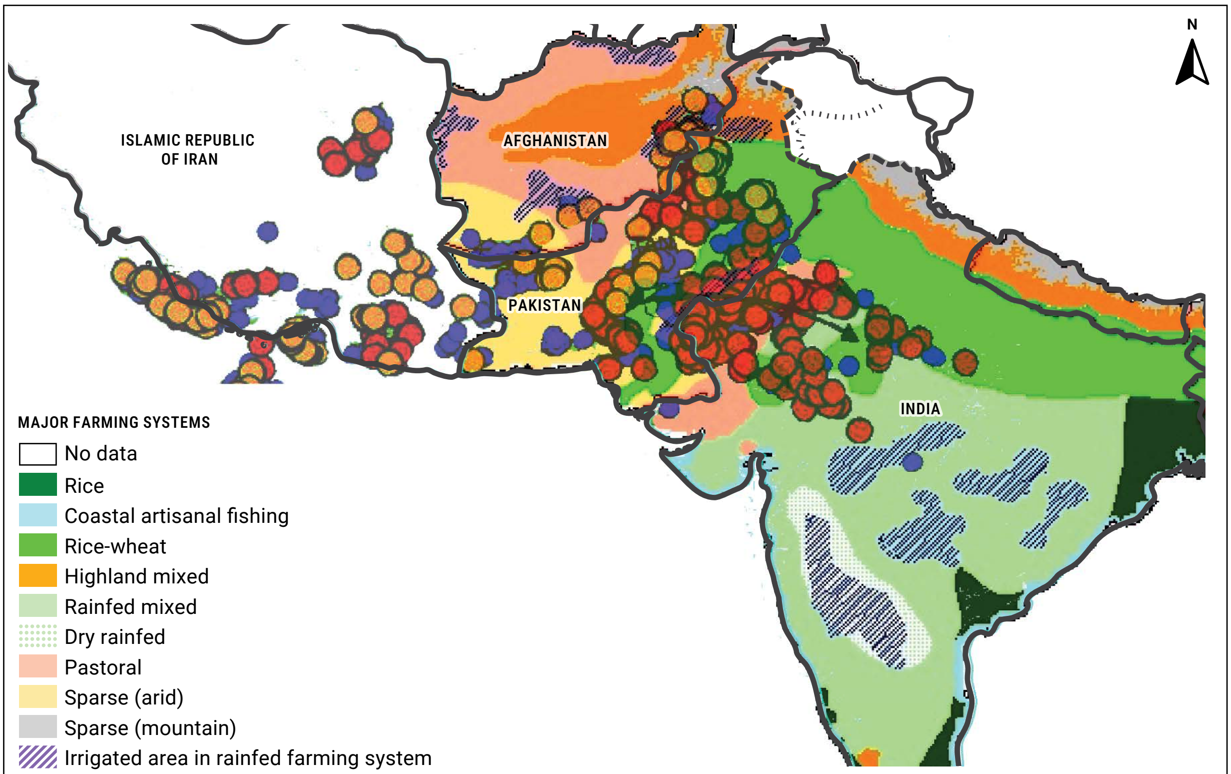
84 Scott Lindstrom, "Sandstorm hits Beijing China", Cooperative Institute for Meteorological Satellite Studies (CIMSS), Satellite Blog, 16 March 2021. Available at: https://cimss.ssec.wisc.edu/satellite-blog/archives/40262

85 World Meteorological Organization, "Severe sand and dust storm hits Asia", 16 March 2021b. Available at: https://public.wmo.int/en/media/news/severe-sand-and-dust-storm-hits-asia

Locust swarms

In both India and Pakistan, locusts threaten food security and livelihoods, particularly in the rice-wheat farm systems. In the spring of 2020, swarms of locusts formed in breeding areas and migrated east to the Indo-Pakistan border and beyond (Figure 2-8). The more extensive swarms in 2020 may have been caused by abnormal weather conditions. Timely early warning systems lessened the impact, though COVID-19 lockdowns constrained some of the usual measures of containment.

FIGURE 2-8 Locust swarms forming in spring 2020



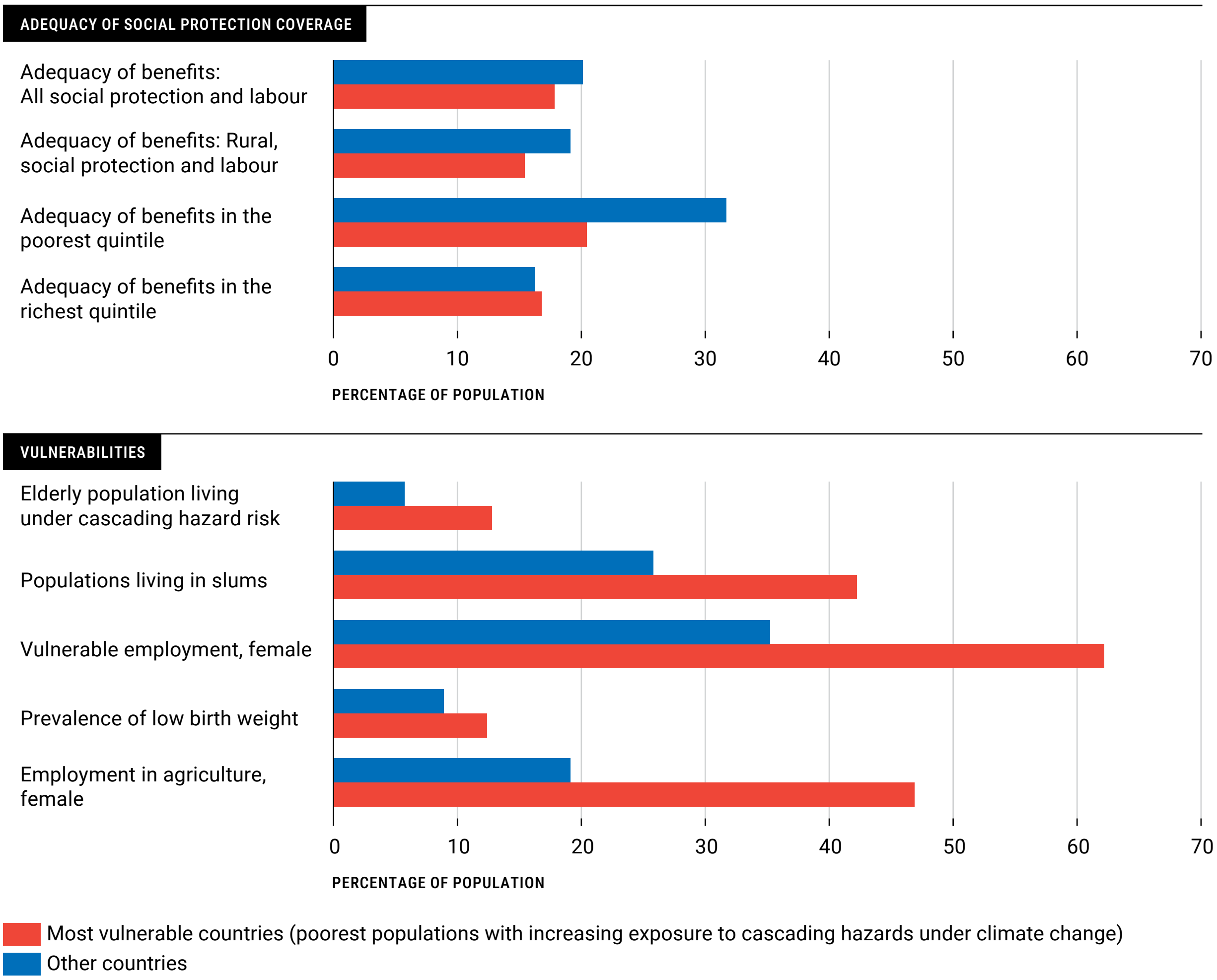
Sources: ESCAP, based on FAO Desert Locust data, 4 June 2020 and FAO Major Farmland Systems.
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Social protection: moving from being shock-responsive to being shock-prepared

In countries that offer the least social protection, those most vulnerable to disasters are generally the poorest of people (Figure 2-9). ESCAP analysis has found that in countries with high pre-existing vulnerabilities, an epidemic sets back educational outcomes by a year and a half, and a natural disaster sets back environmental performance by six years.[86] These countries also typically have higher incidences of low birthweight, and have more people living in slums. They also have larger shares of their populations, as well as more women, working in agriculture and in vulnerable employment.

86 *Economic and Social Survey of Asia and the Pacific 2021: Towards post COVID-19 resilient economies* (United Nations publication, 2021a).

FIGURE 2-9 **Asia-Pacific countries vulnerable to climate hazards and social protection**



Source: ESCAP calculations based on GAR Risk Atlas (2015); Global Assessment Report on Disaster Risk Reduction 2015 (United Nations publication, 2015a). Available at https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2015 World Bank, Climate Change Knowledge Portal, 2018. Available at https://climateknowledgeportal.worldbank.org/#. For Disability Adjusted Life Years, see World Health Organization, Global health estimates: Life expectancy and leading cause of death and disability". Available at https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates; and World Bank, "The Atlas of Social Protection: Indicators of Resilience and Equity", 8 April 2021. Available at https://datacatalog.worldbank.org/dataset/atlas-social-protection-indicators-resilience-and-equity (accessed 10 March 2021).
Note: Adequacy of Benefits as define in the World Bank, 'The Atlas of Social Protection Indicators of Resilience and Equity' is the "*Total transfer amount received by all beneficiaries in a population group as a share of the total welfare of beneficiaries in that group*".

Overall, these communities would be less vulnerable to the impact of disasters if they could rely on social protection that includes disaster preparedness. Over the years, countries have been offering a social protection programme that is more shock-responsive. But the scale of the impacts of the pandemic has also shown that it would be better for social protection programmes to be shock-prepared, with a culture of prevention that builds on inclusiveness and resilience. This requires a comprehensive portfolio of investments in the poor throughout their life cycles. Many countries already have the building blocks in their health and education investments. Now they need to offer social protection that is universal and shock-prepared. Some of the measures needed are listed in Table 2-1.[87]

87 United Nations Children's Fund, *Programme Guidance: Strengthening Shock Responsive Social Protection Systems*, December 2019. Available at https://www.unicef.org/media/63846/file (accessed on 21 March 2021).

TABLE 2-1 **Key actions for shock-responsive social protection programme**

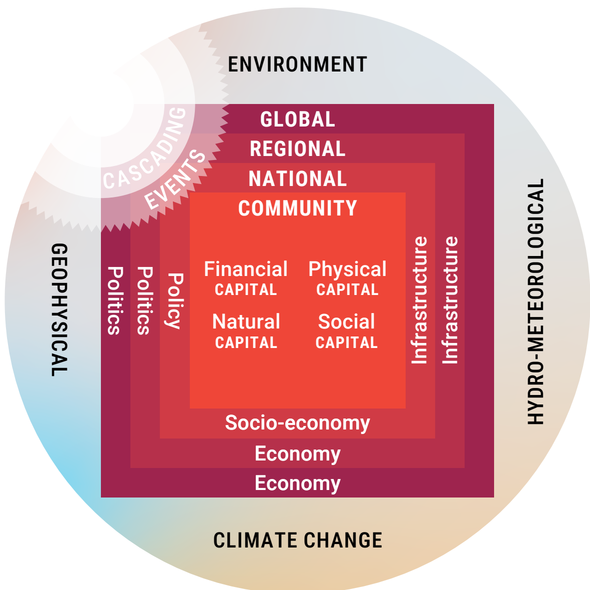
<table>
<tr><th colspan="6">Use emerging technologies to support resilience, and ensure that routine social protection programmes are based on a solid understanding of the risks, shocks and stressors, including cascading hazards.</th></tr>
<tr><td colspan="3">Focus on vulnerability to shocks by expanding routine coverage in areas frequently affected by shocks; and incorporating vulnerability criteria into routine targeting.</td><td colspan="3">Safeguard continuity of service delivery when recipients need support the most. This is often referred to as ‘resilience building of systems’ to future shocks by adopting the principles of contingency planning.</td></tr>
<tr><th colspan="6">Prepare to scale up existing programmes or activate new emergency programmes to accommodate new populations and needs.</th></tr>
<tr><td colspan="2">Vertical expansion of existing programmes. Benefits or lengths of programmes can be temporarily increased. New components may also be added.</td><td colspan="2">Horizontal expansion of programmes to temporarily include new beneficiaries.</td><td colspan="2">Where possible, build emergency programmes on existing systems. These could be led by the social protection sectors or by humanitarian actors, or those engaged in disaster risk management.</td></tr>
<tr><th colspan="6">Align, where relevant, existing social protection programmes with scalable measures for disaster preparedness.</th></tr>
<tr><td colspan="3">Incorporate multi-hazard parameters to strengthen social protection systems and disaster preparedness, align the objectives, and improve targeting and delivery of social protection.</td><td colspan="3">Extending services to fully cover complex and multi-dimensional risks, such as wrapping a child protection or nutrition-support programme around a standard cash transfer programme.</td></tr>
</table>

Source: Adapted from United Nations Children’s Fund, *Programme Guidance: Strengthening Shock Responsive Social Protection Systems*, December 2019. Available at https://www.unicef.org/media/63846/file.

Identifying vulnerable groups

Hazards can converge, across global and local levels, with their intensities and impacts multiplying in ways that have not been seen before.[88] Figure 2-10 demonstrates the links between local communities and larger structural forces that can produce social inequities at multiple levels and lead to cascading disaster events.[89] In these circumstances, the key principle of disaster risk management remains to identify the most vulnerable and protect them first. Usually these are people with low socioeconomic status, in both urban and rural settings, farmers and agricultural communities, children and young people, women, persons with disabilities, older people, and migrants or displaced populations (Figure 2-11). These vulnerabilities also overlap with one another creating populations with extreme susceptibility to converging hazards.

FIGURE 2-10 **A model of multi-hazard cascading risk and social vulnerabilities**



Source: Adapted from Deborah S. K. Thomas, Sojin Jang and Jean Scandlyn, “The CHASMS conceptual model of cascading disasters and social vulnerability: The COVID-19 case example”, *International Journal of Disaster Risk Reduction*, vol. 51 (December 2020). Available at https://doi.org/10.1016/j.ijdrr.2020.101828

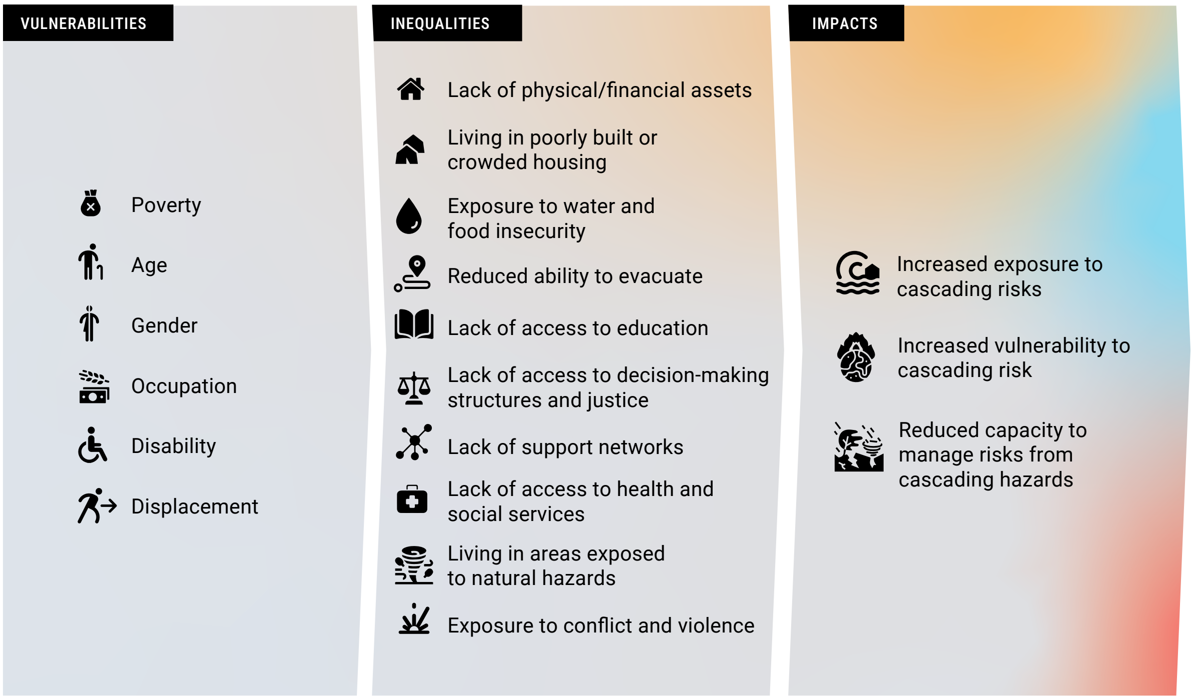
For such vulnerable people, the situation is likely to be worsened by climate change. The extent of vulnerability can be tracked using the Human Development Index (HDI). ESCAP analysis shows that in areas of low and medium HDI, in the worst-case climate change scenario, the number of people at risk will increase by around one-third (Figure 2-12). These people are mainly in the Ganga Brahmaputra and Meghna basin, the Indus basin, parts of South-East Asia and some Pacific countries. Poverty and disasters are always closely connected; the poorest people typically live in the most exposed places, who also lose a higher proportion of their assets during disasters, and are thus driven deeper into poverty.[90]

88 International Federation of Red Cross and Red Crescent Societies, “Come heat or high water: Tacking the humanitarian impacts of the climate crises together”, World Disasters Report 2020 (Geneva, 2020). Available at https://media.ifrc.org/ifrc/wp-content/uploads/2020/11/20201116_WorldDisasters_Full.pdf

89 Ibid.

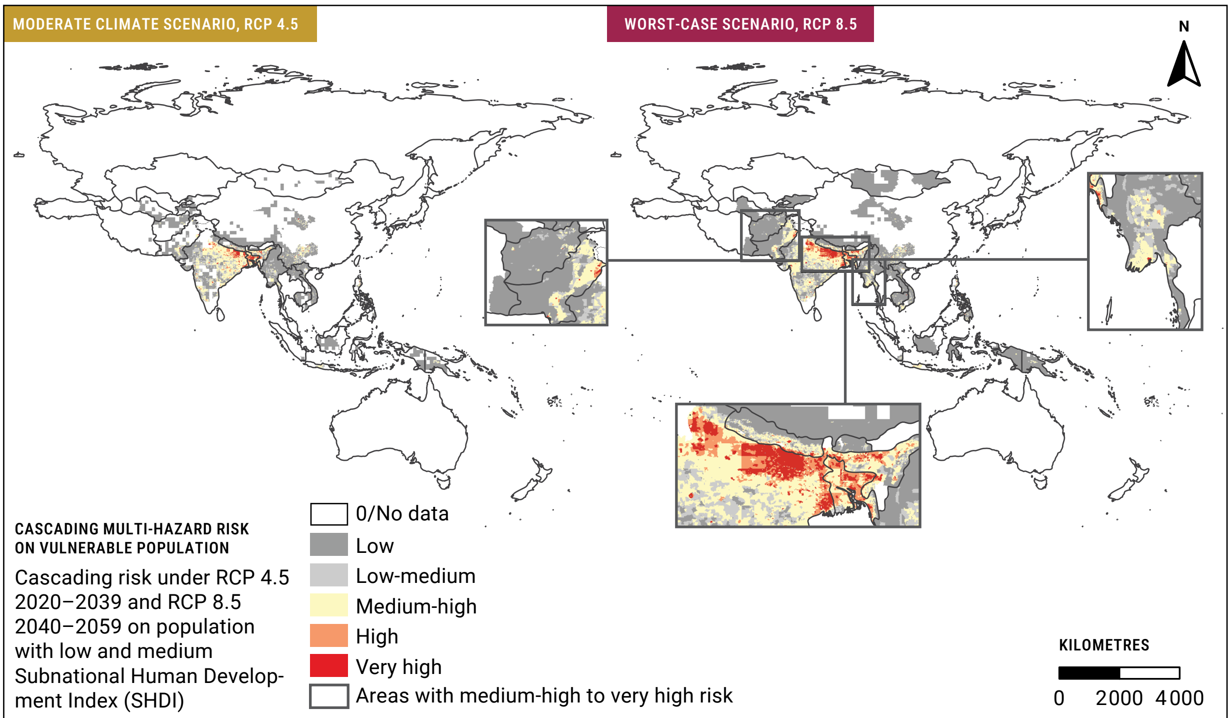
90 Stephane Hallegatte and others, *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters* (Washington, D.C., World Bank, 2017). Available at https://openknowledge.worldbank.org/handle/10986/25335

FIGURE 2-11 Those most impacted by multi-hazard cascading risk



Source: Adapted from International Federation of Red Cross and Red Crescent Societies, "Come heat or high water: Tacking the humanitarian impacts of the climate crises together", World Disasters Report 2020 (Geneva, 2020). Available at https://media.ifrc.org/ifrc/wp-content/uploads/2020/11/20201116_WorldDisasters_Full.pdf

FIGURE 2-12 Populations with lower levels of human development at risk from cascading risks



Sources: ESCAP calculations, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015; Climate Change Knowledge Portal, 2018; Disability-Adjusted Life Years (DALYs) estimates 2000-2019; Sub-National Human Development Index (SHDI) Version 4.0, 2020 and UN WPP-Adjusted Population Density 2020, v4.11.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Table 2-2 indicates the countries and subregions where poor people are at increasing risk of disasters under moderate (RCP 4.5) and severe (RCP 8.5) climate change scenarios. The poor populations at the greatest risk under RCP 8.5 live in: Bangladesh, India and Nepal in South and South-West Asia; Myanmar, Lao People's Democratic Republic and Philippines in South-East Asia; Tajikistan followed by Kyrgyzstan in North and Central Asia, China in East and North-East Asia; and Papua New Guinea in the Pacific. The top five countries which are at the greatest increase in risk, between 2020 and 2040, are Pakistan, Afghanistan, Bhutan, Myanmar and Cambodia.

TABLE 2-2 **Countries with the highest proportions of their poorest population exposed to multi-hazard cascading risk (current and two climate scenarios)**

Subregion	Country	Timescale under climate change scenarios			
		Percentage of population with low/medium HDI under RCP 4.5 (2020–2039)	Percentage of population with low/medium HDI under RCP 4.5 (2040–2059)	Percentage of population with low/medium HDI under RCP 8.5 (2020–2039)	Percentage of population with low/medium HDI under RCP 8.5 (2040–2059)
South and South-West Asia	Afghanistan	12	35	19	34
	Bangladesh	98	97	91	98
	Bhutan	22	39	45	43
	India	58	65	60	71
	Nepal	79	88	88	90
	Pakistan	22	79	31	79
South-East Asia	Cambodia	7	4	26	25
	Indonesia	7	15	14	15
	Lao People's Democratic Republic	14	23	26	30
	Myanmar	29	26	47	50
	Philippines	15	24	26	30
	Thailand	0.28	0.09	0.39	0.45
	Timor-Leste			18	8
	Viet Nam	12	23	25	30
North and Central Asia	Kazakhstan		0.1	0.1	0.1
	Kyrgyzstan	0.1	7	8	8
	Tajikistan	12	18	15	16
	Turkmenistan		5		5
	Uzbekistan		0.02	0.05	0.09
East and North-East Asia	China	3	4	3	3
Pacific	Papua New Guinea	15	17	16	16

The urban poor

Climate change is already affecting people in the region's rapidly growing cities. People in cities are particularly vulnerable to heatwaves. Concrete buildings that retain heat, along with the loss of green spaces, contribute to the 'urban heat island' effect in which ambient temperatures are significantly higher than in surrounding rural areas. Slums and informal settlements with improvised housing can also form micro-heat islands.

Many people are experiencing different patterns of rainfall, and those living along the coast are particularly affected by rising sea levels, and more frequent extreme weather events. Those hit hardest usually live in poor-quality housing on marginal land, and with limited capacity to adapt to slow-onset changes, or to prepare for or cope with extreme weather events. As result, climate variability and change threatens to slow progress, or even reverse hard-won gains, in poverty reduction and development.[91]

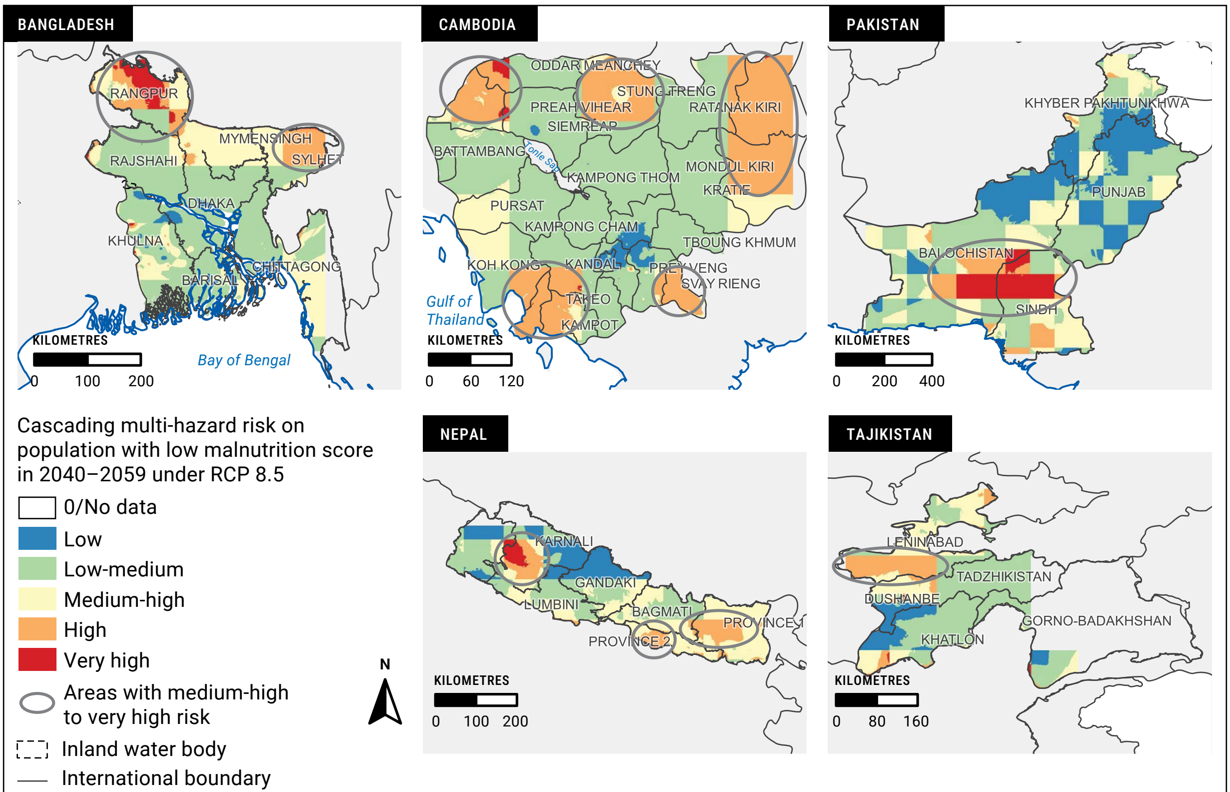
91 United Nations Economic and Social Commission for Asia and the Pacific, "Quick guide for policy makers on pro-poor urban climate resilience in Asia and the Pacific", 11 February 2015b. Available at https://www.unescap.org/resources/quick-guide-policy-makers-pro-poor-urban-climate-resilience-asia-and-pacific (accessed on March 12, 2021).

Children and young people

When disasters strike, children, more than adults, are at higher risk of encountering violence, abuse, neglect and exploitation.[92] Those exposed to meteorological hazards are prone to have lower birthweights and die before the age of five, or suffer from vector-borne diseases or have fewer years of schooling.[93] All these impacts are likely to increase as a result of climate change.

The convergence of climate change, and natural and biological hazards will also increase child malnutrition. This is illustrated in Figure 2-13 for Bangladesh, Nepal, Pakistan, Cambodia, and Tajikistan, countries for which data was available from the Demographic and Health Surveys. For example, in Pakistan, the children at greatest risk live in Balochistan, Sindh, and the Khyber Pakhtunkhwa provinces. In these areas, it will be important to ensure that critical infrastructure, like hospitals, schools, and electricity grids, are resilient to the impacts of cascading hazards.

FIGURE 2-13 **Projected child malnutrition under the worst-case climate change scenario, selected countries**



Sources: ESCAP calculations, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015; Climate Change Knowledge Portal, 2018;Disability-adjusted Life Years (DALYs) estimates 2000-2019; Demographic and Health Surveys (DHS) Programme for Bangladesh (2017), Cambodia (2014),Nepal (2016), Pakistan (2017-2018), and Tajikistan (2017) . Map source: UNmap for Cambodia, 2020.

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92 International Federation of Red Cross and Red Crescent Societies, "Come heat or high water: Tacking the humanitarian impacts of the climate crises together", World Disasters Report 2020 (Geneva, 2020). Available at https://media.ifrc.org/ifrc/wp-content/uploads/2020/11/20201116_WorldDisasters_Full.pdf

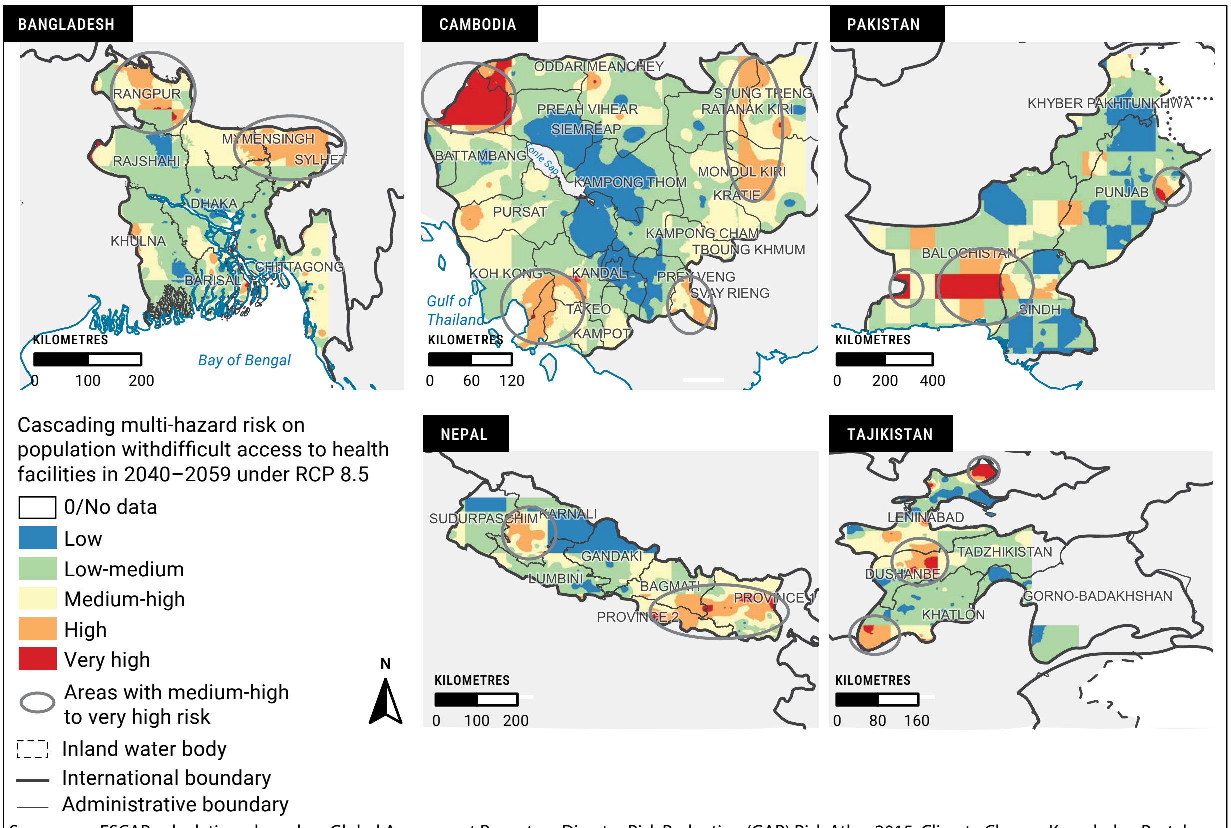
93 *The Disaster Riskscape across Asia-Pacific: Pathways for Inclusion and Empowerment* (United Nations publication, 2019c).

Women

The combination of natural hazards and climate change could also widen gender disparities, particularly with respect to access to nutrition, clean water and education, as well as in menstrual hygiene management and in sexual and reproductive health services.[94] The impacts will be particularly severe for the large numbers of women in low-paid or unpaid work.[95] Areas with high risks of hazards tend to have more women in employment, and therefore are more likely to have reduced employment following disasters.[96] Climate change is also likely to increase the proportion of women in vulnerable employment. Women are particularly vulnerable to the overlaps of natural and other biological hazards which are exacerbated by climate change.[97]

In many countries, women and girls already face multiple barriers in access to healthcare services.[98] Again, the combination of cascading hazards under climate change is likely to exacerbate the problem (Figure 2-14). These are often the same places with increases in child malnutrition, which also affects women as primary caregivers. For example, in Cambodia, the problems are likely to be greatest in the provinces of Bântéay Méanchey and Otdar Mean Chey.

FIGURE 2-14 **Proportion of women with limited access to health care under the worst-case climate change scenario, selected countries**



Sources: ESCAP calculations, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015; Climate Change Knowledge Portal, 2018; Disability-adjusted Life Years (DALYs) estimates 2000–2019; Demographic and Health Surveys (DHS) Programme for Bangladesh (2017), Cambodia (2014), Nepal (2016),Pakistan (2017–2018), and Tajikistan (2017) . Map source: UNmap for Cambodia, 2020.

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94 Cecilia Sorensen and others, "Climate change and women's health: Impacts and policy directions", *PLOS Medicine*, vol. 15, No. 7 (10 July 2018). Available at https://doi.org/10.1371/journal.pmed.1002603

95 International Federation of Red Cross and Red Crescent Societies, "Come heat or high water: Tacking the humanitarian impacts of the climate crises together", World Disasters Report 2020 (Geneva, 2020). Available at https://media.ifrc.org/ifrc/wp-content/uploads/2020/11/20201116_WorldDisasters_Full.pdf

96 *The Disaster Riskscape across Asia-Pacific: Pathways for Inclusion and Empowerment* (United Nations publication, 2019c).

97 World Health Organization, "Gender, climate change and health" (Geneva, 2014). Available at https://www.who.int/globalchange/GenderClimateChangeHealthfinal.pdf (accessed on 21 March 2021).

98 *Inequality of Opportunity in Asia and the Pacific: Women's Sexual and Reproductive Health* (United Nations publication, 2019b). Available at https://www.unescap.org/resources/inequality-opportunity-asia-and-pacific-women-s-sexual-and-reproductive-health (accessed on 21 March 2021).

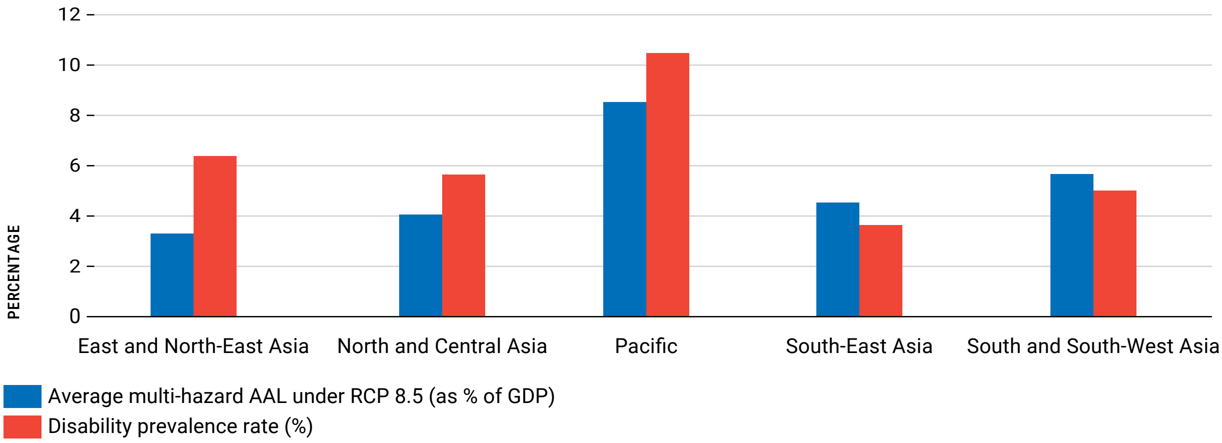
People with disabilities

In Asia and the Pacific, almost 690 million people live with disabilities and during disasters such people are at greater risk. People living with disabilities include those with physical disabilities, those with sight or hearing problems, those with learning disabilities, cognitive/developmental disabilities, or psycho-social disabilities.[99] Following the Great East Japan earthquake and tsunami, for example, the mortality rate for people with disabilities was double than that of the rest of the population.[100]

The Asia-Pacific subregions likely to suffer the greatest losses from climate change also have the highest proportions of people living with disabilities (Figure 2-15). In particular, the Pacific small island developing States, with Vanuatu, Tonga and Micronesia leading, will be at the greatest risk. Under RCP 8.5, 20 per cent of the subregion's GDP is at risk from disasters, and almost 10 per cent of the population lives with disabilities.

Persons with disabilities are often excluded from disaster risk reduction policies, plans and programmes so cannot contribute to decision-making on the measures that would support them.[101, 102] They may also miss emergency-related information and warnings. When considering multi-hazard, early warning systems, critical infrastructure, and the necessary social protection, it is important therefore to include data on disability.

FIGURE 2-15 **A subregional analysis of disability prevalence and losses from multi-hazard cascading risks**



Source: Disability statistics taken from *Disability at a Glance 2019: Investing in Accessibility in Asia and the Pacific* (United Nations publication, 2019a). Available at https://www.unescap.org/publications/disability-glance-2019.

Older people

In Asia and the Pacific, in 2019, more than 400 million people were aged 65 and older and could be at greater risk during slow-onset or sudden disasters.[103] Japan has the world's the highest proportion of older people, and torrential flooding, in July 2020 on the island of Kyushu, affected more than 50 nursing homes, leading to several deaths. Although a warning was issued, it was difficult to evacuate older people.[104] The countries with the highest proportion of their older population living with multi-hazard risks under RCP 8.5 are those in East and North-East Asia and South and South-West Asia (Figure 2-16).

99 *Disability at a Glance 2019: Investing in Accessibility in Asia and the Pacific* (United Nations publication, 2019a). Available at https://www.unescap.org/publications/disability-glance-2019 (accessed on 21 March 2021).

100 Ibid.

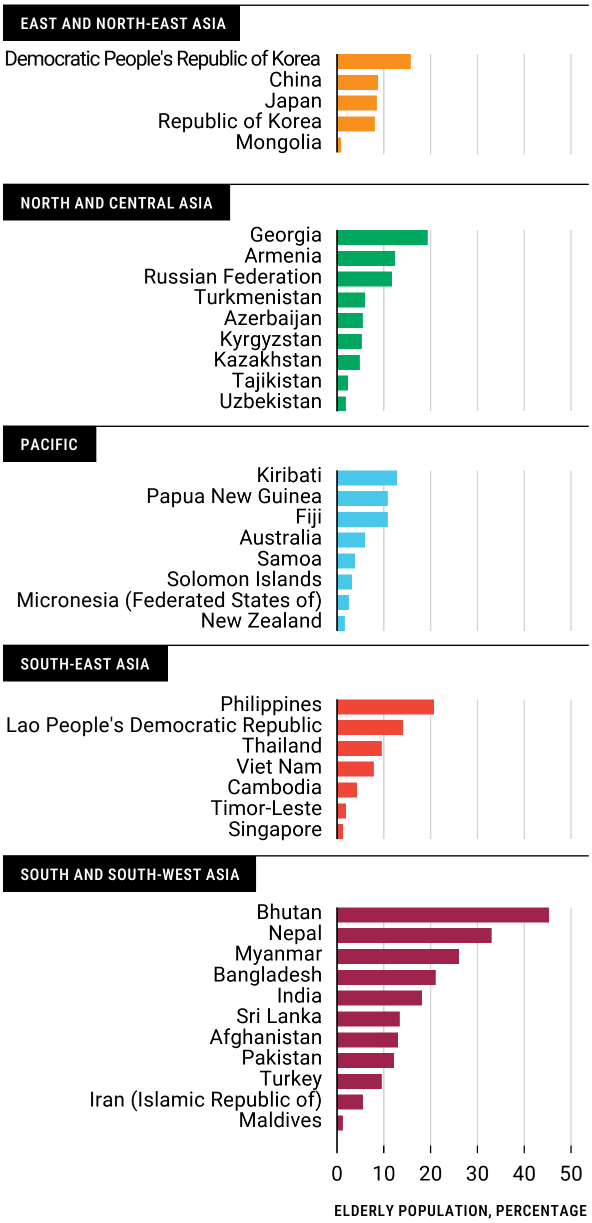
101 Takashi Izutsu, "Disability-inclusive disaster risk reduction and humanitarian action: An urgent global imperative", United Nations World Conference on Disaster Risk Reduction, 29 November 2019. Available at https://www.un.org/development/desa/disabilities/wp-content/uploads/sites/15/2020/03/Final-Disability-inclusive-disaster.pdf (accessed on 21 March 2021).

102 Fred Smith and others, "Disability and Climate Resilience: A literature review", Disability and Climate Resilience Research Project, November 2017. Available at https://www.researchgate.net/publication/320800956_Disability_and_Climate_Resilience_A_literature_review

103 *Disability at a Glance 2019: Investing in Accessibility in Asia and the Pacific* (United Nations publication, 2019a). Available at https://www.unescap.org/publications/disability-glance-2019 (accessed on 21 March 2021).

104 Nishinippon Shimbun, "Japan's nursing care facilities face challenge of safely evacuating during disasters", *The Japan Times*, 24 July 2020. Available at https://www.japantimes.co.jp/news/2020/07/24/national/japan-nursing-care-facilities-disasters/

FIGURE 2-16 **Percentage of elderly population at risk from natural hazards under worst-case scenario**

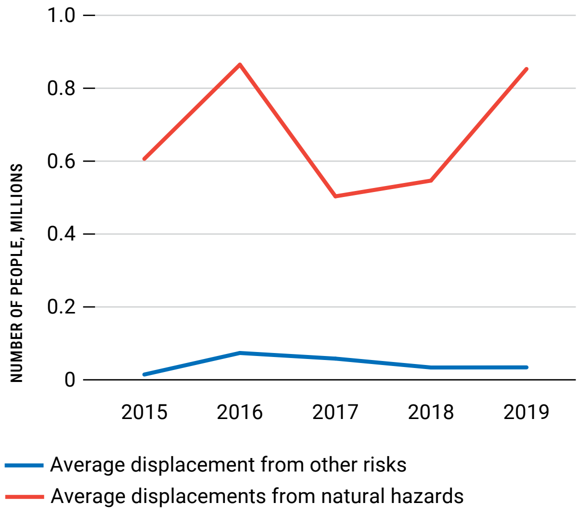


Source: ESCAP based on data from NASA, Socioeconomic Data and Application Centre, "Gridded Population of the World (GPW), v4". Available at https://sedac.ciesin.columbia.edu/data/collection/gpw-v4/maps/gallery/search

Displaced populations

In Asia and the Pacific, around 90 per cent of displacement is due to natural hazards. In the first half of 2020, four of the five countries which accounted for nearly 75 per cent of the new internal displacements due to disasters were in the Asia-Pacific region: India (2.7 million people), Bangladesh (2.5 million people), Philippines (811,000 people), and China (791,000 people).[105] Displaced populations have multiple vulnerabilities (Figure 2-17),[106] and amidst COVID-19, these populations are additionally susceptible. Displacement is also likely to increase as a result of climate change, particularly in the Pacific subregion.

FIGURE 2-17 **Displacement in Asia and the Pacific from natural hazards and other risks, 2015–2019**



Source: ESCAP based on data from Vicente Anzellini, Bina Desai and Clemence Leduc, "Global Report on Internal Displacement 2020", Internal Displacement Monitoring Centre and Norwegian Refugee Council, 30 October 2020. Available at https://resourcecentre.savethechildren.net/library/global-report-internal-displacement-2020

More complex hazards ahead

As climate change intensifies and further biological threats surely lie in wait, Asia and the Pacific will face an increasingly complex set of hazards. In the new disaster riskscape, these multiple threats will often overlap and intersect, triggering a cascading series of events. To combat these threats, countries will need to take comprehensive action to protect the poorest by integrating health and disaster risk management into stronger systems for health and social protection.

105 Vicente Anzellini, Bina Desai and Clemence Leduc, "Global Report on Internal Displacement 2020", Internal Displacement Monitoring Centre and Norwegian Refugee Council, 30 October 2020. Available at https://resourcecentre.savethechildren.net/library/global-report-internal-displacement-2020

106 Max-Planck Gesellschaft, "Climate change increases migration at the expense of the poor: A climate game shows that global cooperation can be possible — although not without effort", *ScienceDaily*, 26 May 2020. Available at https://www.sciencedaily.com/releases/2020/05/200526131531.htm (accessed on 24 March 2021).

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