

Reaching those left behind

The 2030 Agenda for Sustainable Development promotes equality, empowerment and inclusivity by addressing the needs of people who have been discriminated against, marginalized or excluded. Fulfilling this agenda will, however, depend not just on promoting human development but also reducing the many disaster risks for vulnerable groups and building their resilience. It is especially important to identify and reach those who are furthest behind if the goal of eradicating poverty by 2030 is to be achieved.

Disasters cause huge economic losses. According to the World Bank, disasters threatened the GDPs of all the Least Developed Countries and more than 60 developing countries. In a small developing country, even a single medium-size disaster can reverse economic development. In a matter of minutes or hours, rapid-onset catastrophic disasters like earthquakes, tsunamis, flash floods and volcanoes can destroy the hard-earned development gains of decades or even centuries.

Disasters also undermine social development, affecting health, education, housing, culture and religion, water and sanitation, and social protection, as well as the livelihoods of vulnerable communities, particularly in agriculture and fisheries. Recurring disasters repeatedly erode livelihoods and coping capacities that insidiously disempower people and communities over generations.³² This chapter argues that disasters and exposure to multiple hazards play a significant role in reversing social development that will continue to widen various gaps in inequality unless enhanced efforts and investments are undertaken for reducing the risks and impacts. This chapter will address the general impact on disasters, poverty, deprivations and inequalities. The chapter further identifies the most vulnerable groups within high multi-hazard risk areas and also provides a geographical analysis of people located in areas of overlapping exposure and vulnerability. The chapter will provide empirical evidence using both aggregate and household level data from the Demographic and Health Survey (DHS) and, using computable general equilibrium models (CGE),

will show how disasters contribute to persistent poverty, rising inequalities and the further exclusion of vulnerable sections of society. By identifying the specific vulnerabilities of those left furthest behind, this data provides a deeper understanding on the key question of how policies for disaster resilience can help include and empower the poor. By empirically showing how the layered vulnerabilities stem from residing in multi-hazard risk hotspots, the chapter will contribute to a deeper understanding of disaster risk as it evolves dynamically over time for the poorest and most marginalized. Furthermore, by geographically locating the populations most at risk, the chapter shows priority areas where policy action is needed.

Evidence from the ground- disaster impacts on social sectors and vulnerable populations

To assess the overall impacts of disasters on these development sectors, ESCAP analysed 29 post-disaster needs assessments (PDNA) from 20 countries in Asia and the Pacific. The data shows that almost 40 per cent of disaster impacts were on social and productive sectors (Figure 2-1).

Within the social sectors, the hardest hit are housing, education and social protection (Figure 2-2). While in the productive sector the greatest impact is on subsistence livelihoods (Figure 2-3).

The impact on the social sectors is even greater in the LDCs.³³ Disasters are particularly harmful for vulnerable populations in these countries who rely heavily on strong social and productive sectors to work their way out of poverty. In this way disasters decrease their ability to absorb shocks, and as people try to cope by decreasing nutritional intake or removing children from school, disasters are a transmission belt for transmitting poverty intergenerationally.

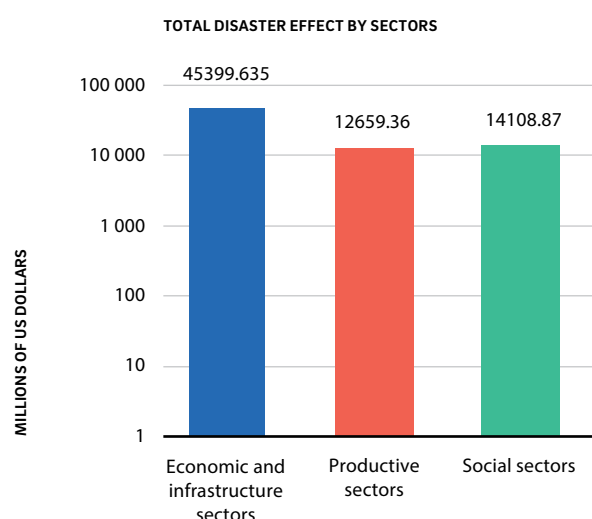
Disasters impact all forms of inequalities within and across countries

The Asia-Pacific region has a greater intersection between risks from disasters, inequalities of income, opportunity, and poverty because the region's

population is more highly exposed to disaster risk than all other regions of the world. The following sections will demonstrate empirical modelling analysis linking disasters to various forms of inequalities across the region and within countries.

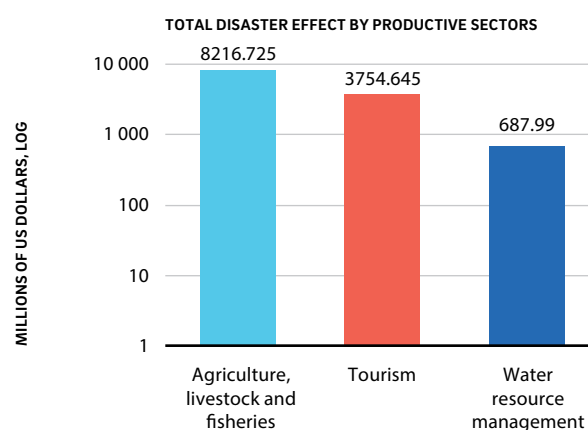
In the next section, where possible, these intersectional linkages have been demonstrated using the latest Demographic Health Survey (DHS) data along with multiple hazard exposure data from the 2015 Global Assessment Report. Hazard data was derived for provinces from the exposure data available in the Global Assessment Report and recoded into high- and low-hazard risk depending on the land area exposed to floods, earthquakes, landslides (earthquakes and floods), and cyclones. The sociodemographic data from DHS and the hazard exposure from GAR were combined to examine the

FIGURE 2-1 Disaster impacts by sector



Source: ESCAP, based on GFDRR, PDNA reports.

FIGURE 2-3 Disaster impacts on productive sectors



Source: ESCAP, based on GFDRR, PDNA reports.

FIGURE 2-2 Disaster impacts on social sectors

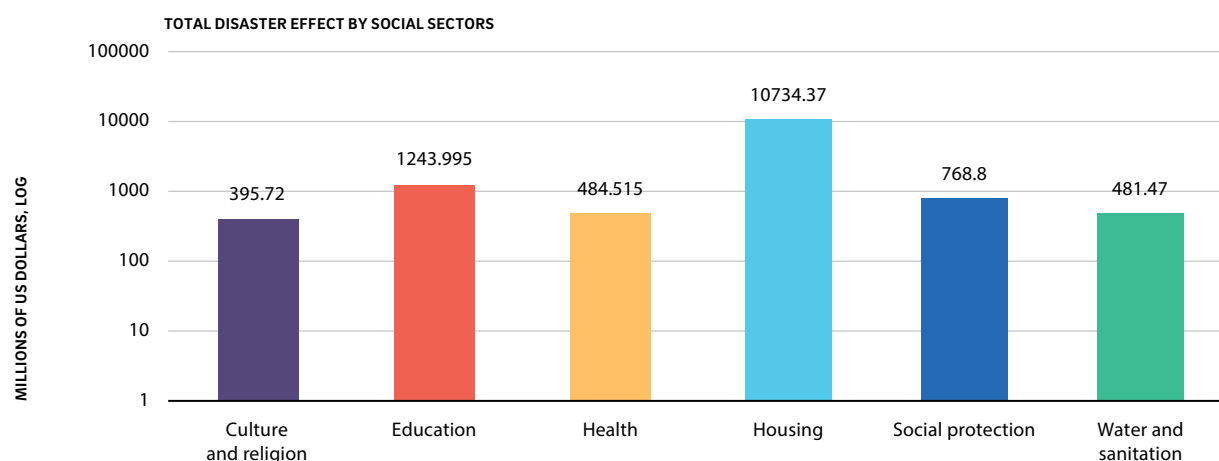
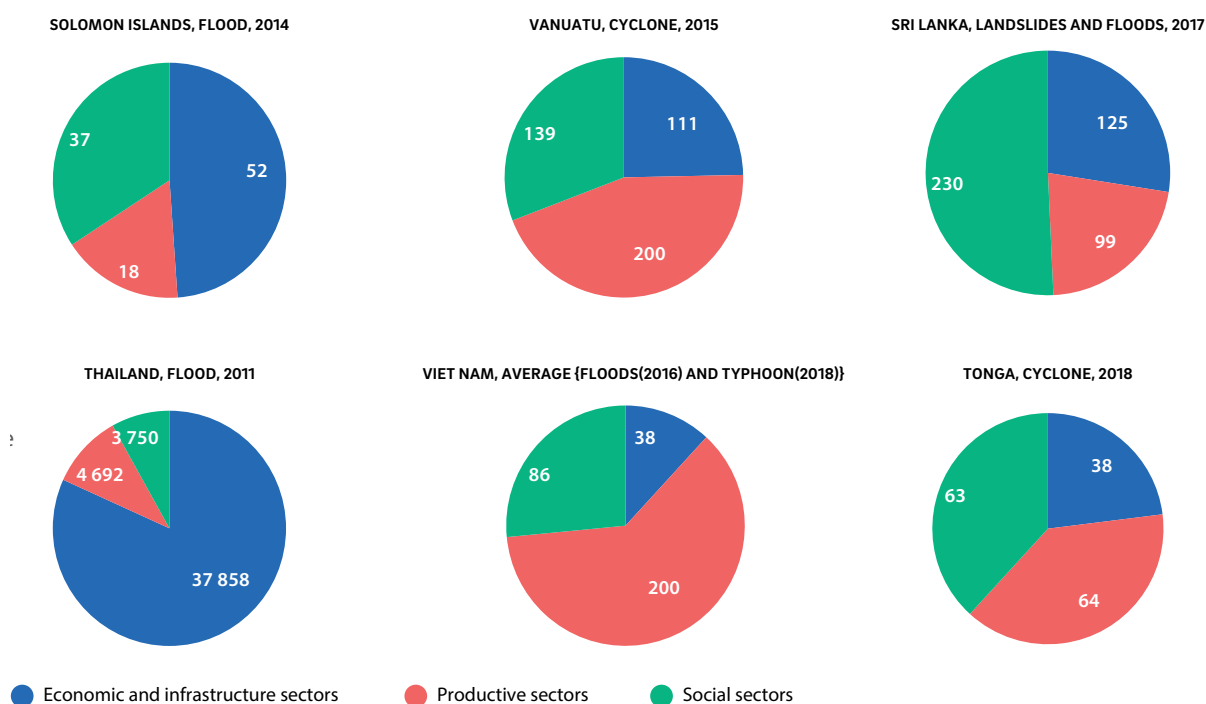




FIGURE 2-4 Sectoral impact of disasters on selected countries (US\$ million)



Sources: Country PDNA, Global Facility for Disaster Reduction and Recovery.

FIGURE 2-5 Impact analysis of disasters on social sectors and vulnerable populations



Source: Country PDNA, Global Facility for Disaster Reduction and Recovery.

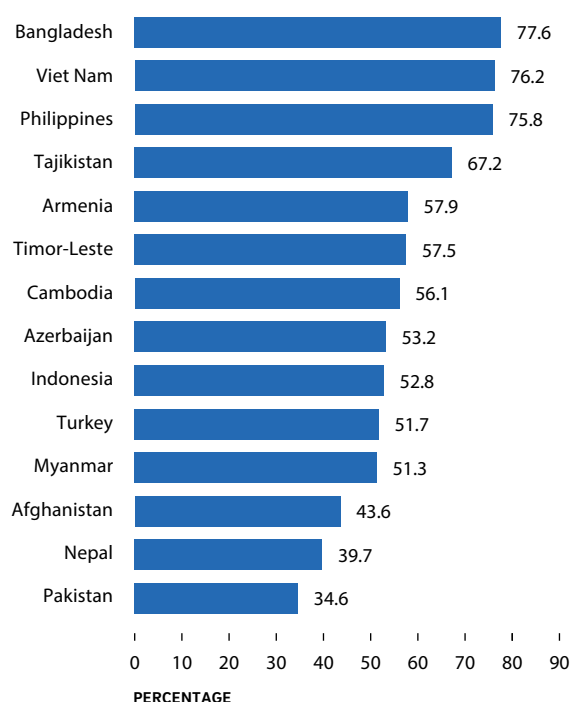
overall impacts of disaster on inequalities at the regional level (across countries) and at the household level (within countries).

At the regional-level (across countries) regression analyses were conducted, using aggregated DHS household data at the provincial level from 17 countries spanning 247 provinces³⁴ (see Annex 2.1 for list of countries), to examine region-wide relationships between disasters and inequalities. When examining the regression results, it is noted that while the coefficients are in the small to medium range, they are still significant and demonstrate that disasters are nevertheless a serious risk that needs to be accounted for when considering development.

In addition, for 14 of these countries, logistic regression analyses were conducted using household-level DHS data to examine how, within countries, disasters can exacerbate existing inequalities of income and opportunity leaving already marginalized people more vulnerable.

Figure 2-6 shows the overall extent of the population's exposure to multi-hazard risk among the 14 Asia-Pacific countries with DHS data.

FIGURE 2-6 Proportion of population living in high-multi-hazard-risk areas



Source: ESCAP, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015 and DHS Household Survey.

Overlaps of disasters with inequalities in incomes and opportunities can leave people more vulnerable

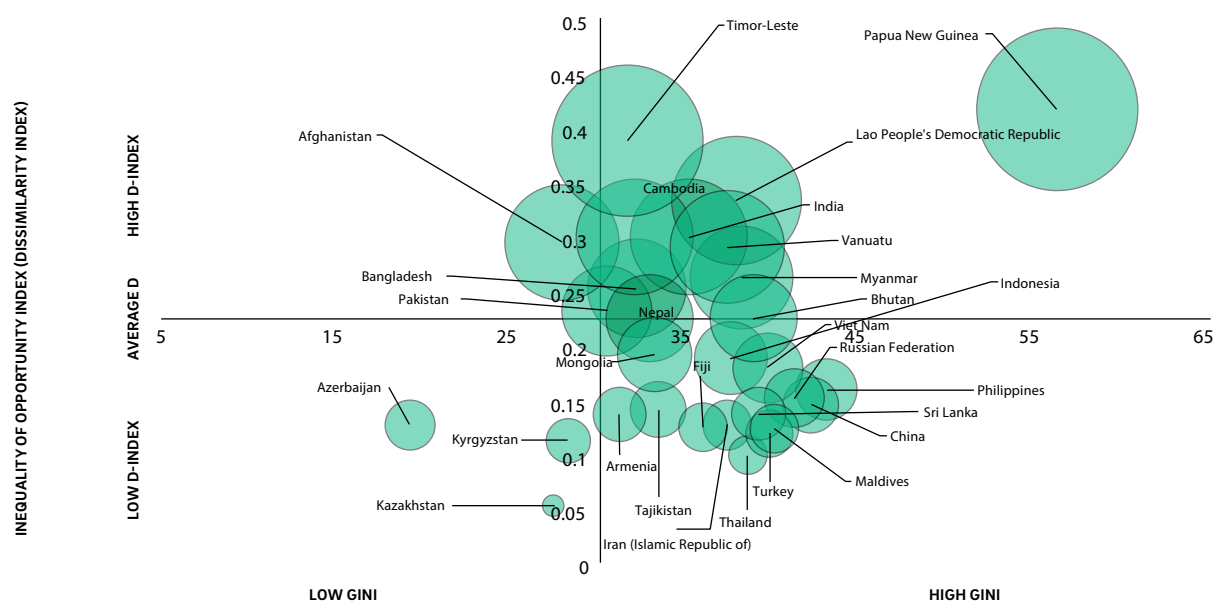
Inequality of income refers to how income generated in the production of goods and services is distributed across a population. The best-known measure is the Gini coefficient.³⁵ Inequality of opportunity refers to differences in "access to key dimensions necessary for meeting aspirations regarding quality of life."³⁶ This can be measured with the D-index,³⁷ which shows how all population groups fare in terms of access to opportunities such as attainment of education, childhood nutrition, and household access to basic services. These indices can be used along with the UNDP human development index to follow the linkages and pathways between disasters and inequalities.

Figure 2-7 illustrates the overlaps of inequalities of income and disaster risk. For example, the highest disaster risk (as represented by the size of the bubble) is for Papua New Guinea which also has the highest levels of inequality in income. Many of the selected countries fall within the quadrants of high-income inequalities. The exceptions are a few Central Asian countries such as Armenia, Azerbaijan, Kazakhstan, and Kyrgyzstan. The countries most likely to have significant overlaps between inequalities and disasters include Bangladesh, Cambodia, India, Lao People's Democratic Republic, Timor-Leste, Myanmar, Papua New Guinea, and Vanuatu.

Similarly, Figure 2-8 illustrates the interactions between inequalities of opportunity and disaster losses (average annual loss). The countries most likely to continue to suffer from the combined vulnerabilities include Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic, Papua New Guinea, and Vanuatu. As noted in Chapter 1, when the risk of slow-onset disasters, like drought, is added to the existing annual average loss, the emerging riskscape is very different from the previous riskscape. In this riskscape, Vanuatu emerges as the country with the highest disaster loss as a percentage of GDP (8.3 per cent).

Figure 2-7 and 2-8 both show that the most vulnerable and marginalized people in these countries face higher risks of being affected by disasters, thus widening the inequality gaps. This leads to a vicious cycle of poverty, inequality and disasters.

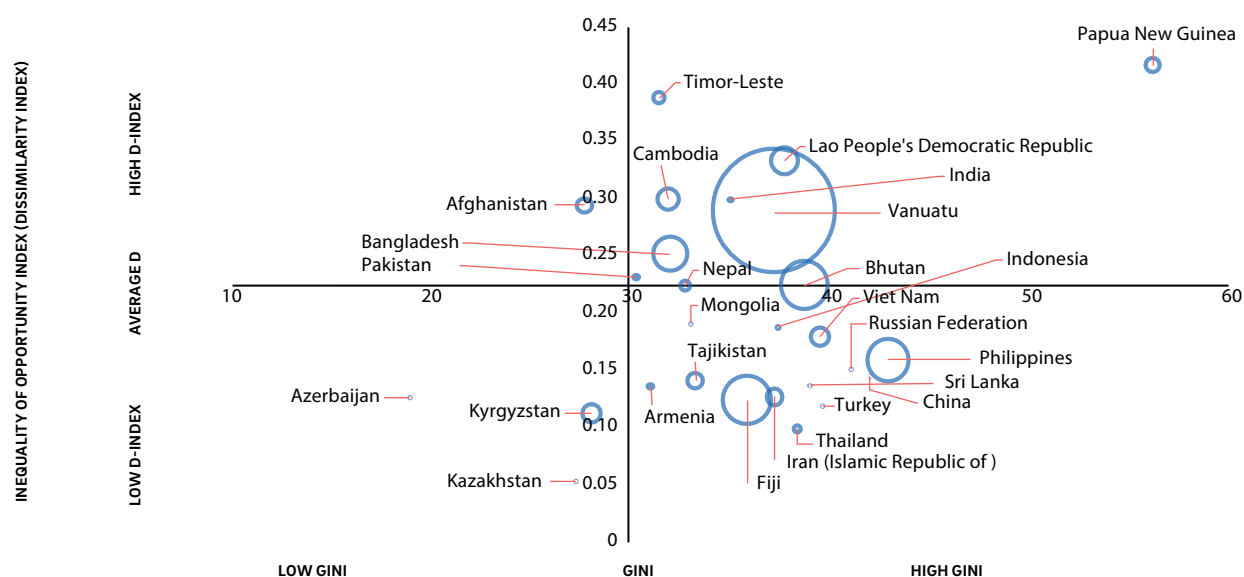
FIGURE 2-7 Overlaps of inequalities of income and disaster risk for select countries



Source: ESCAP calculations for GINI, ESCAP calculations for Average annual loss, ESCAP calculations for Dissimilarity Index (D-Index) from ESCAP theme study "Inequality in Asia and the Pacific in the era of the 2030 Agenda for Sustainable Development."
 Note: The size of the bubble indicates the extent of risk from multiple hazards

FIGURE 2-8 Overlap of inequalities of opportunities and disaster losses for select countries

THE INTERSECTION OF INCOME INEQUALITY (GINI), INEQUALITY OF OPPORTUNITY (D-INDEX) AND AVERAGE ANNUAL LOSS AMONG SELECTED ASIA-PACIFIC COUNTRIES



Source: ESCAP data based on DHS surveys, ESCAP calculations for GINI, Inform Index, 2019, Average annual loss (ESCAP figures).
 Note: The size of the bubble indicates annual average losses as a proportion of GDP.

Disasters contribute to income inequality and poverty

The *Asia-Pacific Disaster Report 2017* examined the impact of disasters on inequality and estimated that for Asia-Pacific countries, a 1 percentage point increase in the number of disasters corresponded to a 0.13 percentage point increase in the Gini coefficient. This report examines the relationship more closely. The across-country regression analyses using DHS data show that provinces that are more exposed to multiple hazards (floods, cyclones, landslides and earthquakes) have higher Gini coefficients. Annex 2.2 shows the regression results across the 17 countries with available data. While the coefficients are not large, meaning disasters do not impact the Gini coefficient as much as education, for example, they are still significant. Adjusting for wealth, education and population, exposure to hydrometeorological hazards (floods and landslides), on average, increases the Gini coefficient by 0.24 percentage points.

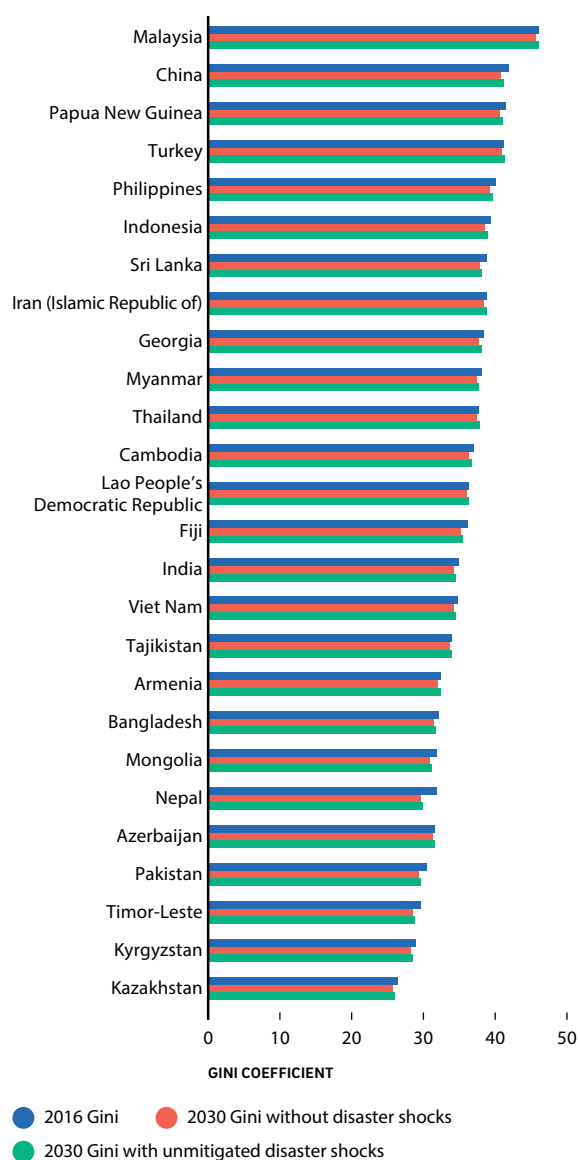
Another technique is used to project the impact of disaster shocks on income inequality. This is a comparative 'static computable general equilibrium model' (CGE) which indicates how disaster shocks affect inequality. (The model explanation, its uses and limitations are detailed in Annex 3.1). Figure 2-9 shows how income inequality varies across 26 Asia-Pacific countries, being the highest in Malaysia, and lowest in Kazakhstan. It also shows how the Gini is modelled to change by 2030, with and without disaster shocks. All countries can expect inequality to fall by 2030, but the decrease is lower in countries hit by disasters.

There is also a close connection between disasters and poverty. Previous research by ESCAP found that the poorest nations and the poorest people had the least capacity to mitigate the impacts of disasters and were often the worst affected.³⁸ Poor populations typically lose more because they are overexposed to disasters and have less ability to cope and recover, especially if they have little social protection or post-disaster support. Moreover, disasters often have permanent impacts on their education and health.³⁹

Within-country analysis, using the DHS surveys, concludes that among the 14 countries where data is available, wealthier individuals are better able to protect their assets and well-being because they can avoid living in areas likely to be hit by disasters. Poorer people, on the other hand, are more exposed and are repeatedly hit by disasters and lose wealth

and assets. This is illustrated in Figure 2-10 which shows how the lower risks for the wealthy vary between countries. Tajikistan, for example, has the highest discrepancy between the wealthy and poor living in high disaster risk areas. The World Bank notes that despite Tajikistan's sustained economic growth of the past few years and the country's notable achievements, poverty and low standards of living remain a pressing problem;⁴⁰ poorer populations, who have higher odds of residing in high disaster risk areas, can continuously lose wealth and assets which push them deeper into poverty. On average, across the 14 countries, the wealthiest individuals comprising the top 20 per cent of the wealth distribution are almost 70 per cent less likely to reside in high-multi-hazard risk areas.⁴¹

FIGURE 2-9 Projected Gini in 2030, with and without unmitigated disaster shocks



Source: ESCAP calculations based on CGE model.

BOX 2-1 Resilience and the 2030 development agendas

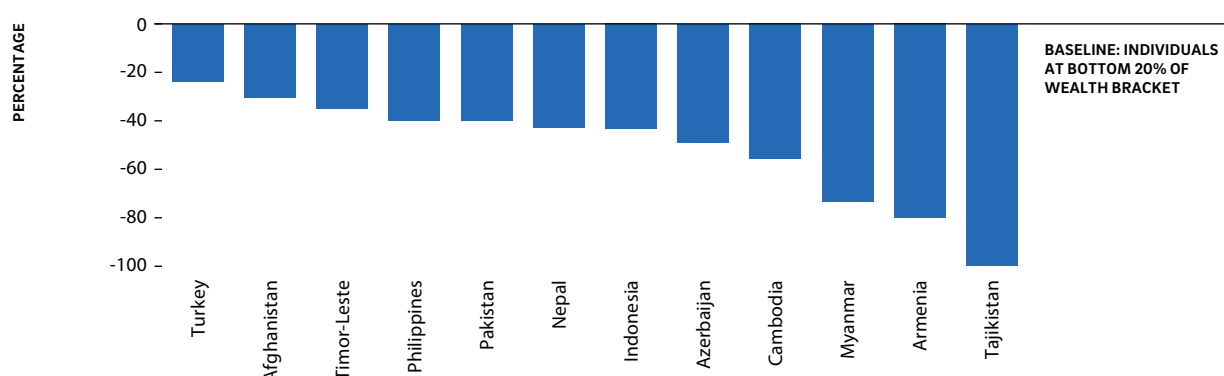
The Sendai Framework for Disaster Risk Reduction 2015–2030 acknowledges that disaster risk reduction requires empowerment and participation that is inclusive, accessible and non-discriminatory, paying special attention to people disproportionately affected by disasters, especially the poorest. The framework advocates that gender, age, disability and cultural perspectives should be integrated in all policies and practices of disaster risk management.

Article 6 (5) of the Paris Agreement states that adaptation actions should follow a ‘country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions.’

The New Urban Agenda adopted at Habitat-III of 2016 developed a vision of cities for all. It refers to ‘the equal use and enjoyment of cities and human settlements, seeking to promote inclusivity and ensure that all inhabitants, of present and future generations, without discrimination of any kind, are able to inhabit and produce just, safe, healthy, accessible, affordable, resilient and sustainable cities and human settlements to foster prosperity and quality of life for all.’

The Agenda for Humanity advocates key ‘strategic and normative transformations’ in order to ensure that no one is left behind. These include addressing displacement and migration, ending statelessness, empowering and protecting women and girls, ensuring education for all and empowering young people.

FIGURE 2-10 Odds of the wealthiest 20 per cent living in high-multi-hazard risk area



Source: ESCAP calculations based on DHS surveys, latest data and multi-hazard data from Global Assess Report, 2015.

Note: Results are based on country-specific logistic regressions. Only countries with statistically significant coefficients and odds-ratios are shown.

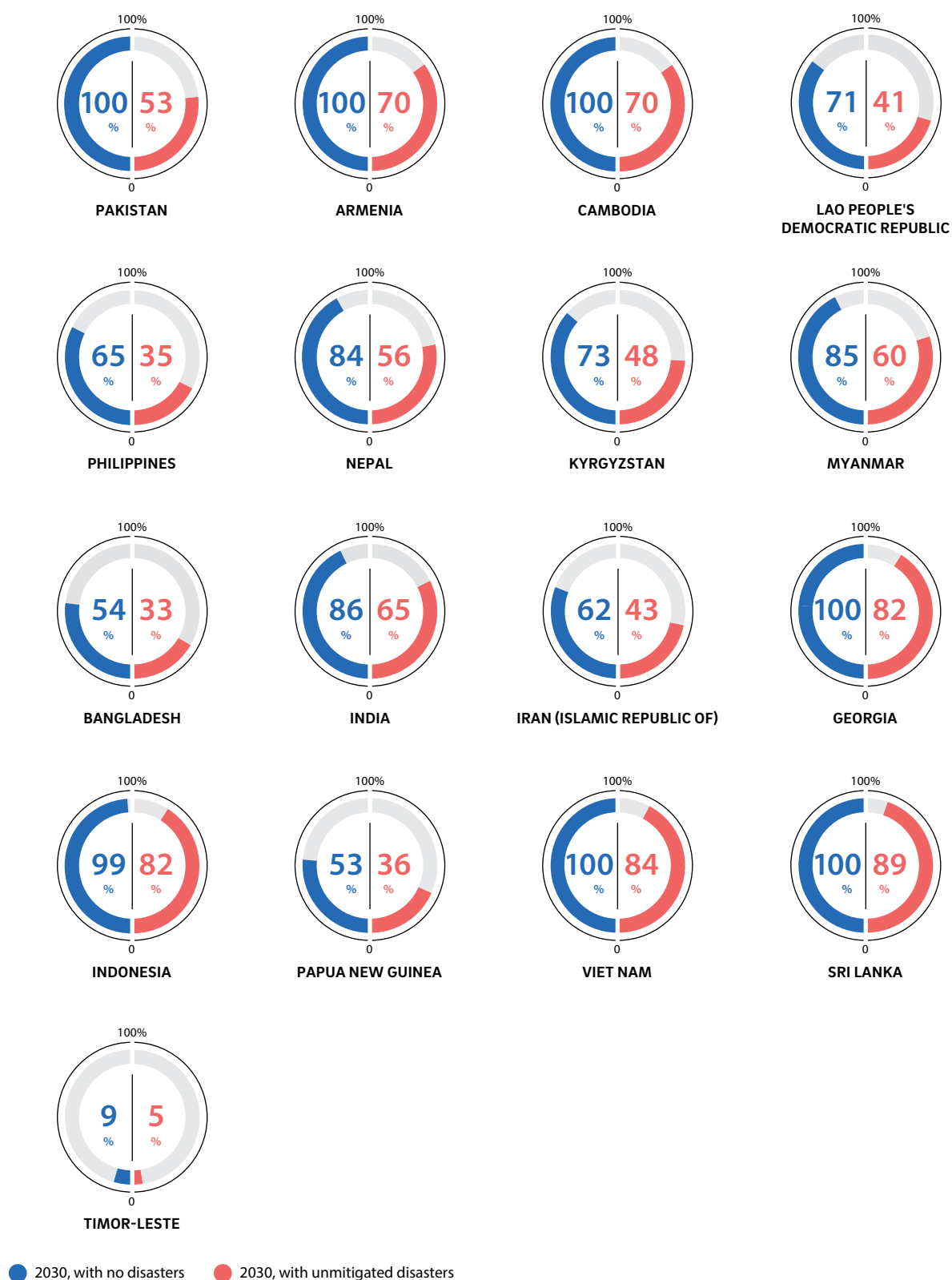
Another CGE model was used to project the impact of disaster shocks on poverty. The results are displayed in Figure 2-11, which estimates how disasters could affect poverty rates among 17 Asia-Pacific countries in 2030. For most countries with no disaster shocks, the projected poverty rates will fall. But if disaster shocks and their impacts go unmitigated poverty rates will fall less.

In Bangladesh, for example, the current poverty rate is 15 per cent. Without disaster shocks, the rate, in 2030, will decrease to around 7 per cent. However, with continued unmitigated disaster shocks the

poverty rate will increase to around 10 per cent, lower than the current rate but higher than it would have been had the shocks been mitigated.

In Timor-Leste, on the other hand, unmitigated disaster shocks will cause poverty to rise even above the current level of 41 per cent. Without disaster shocks, poverty is projected to decrease by 2030 to 38 per cent. However, with unmitigated repeated disasters, the poverty rates are projected to be 43 per cent. This demonstrates the importance of immediate and long-term efforts at mitigation.

FIGURE 2-11 Percent reduction in extreme poverty rates in 2030 with and without disasters in selected countries (Baseline poverty rate=2016)



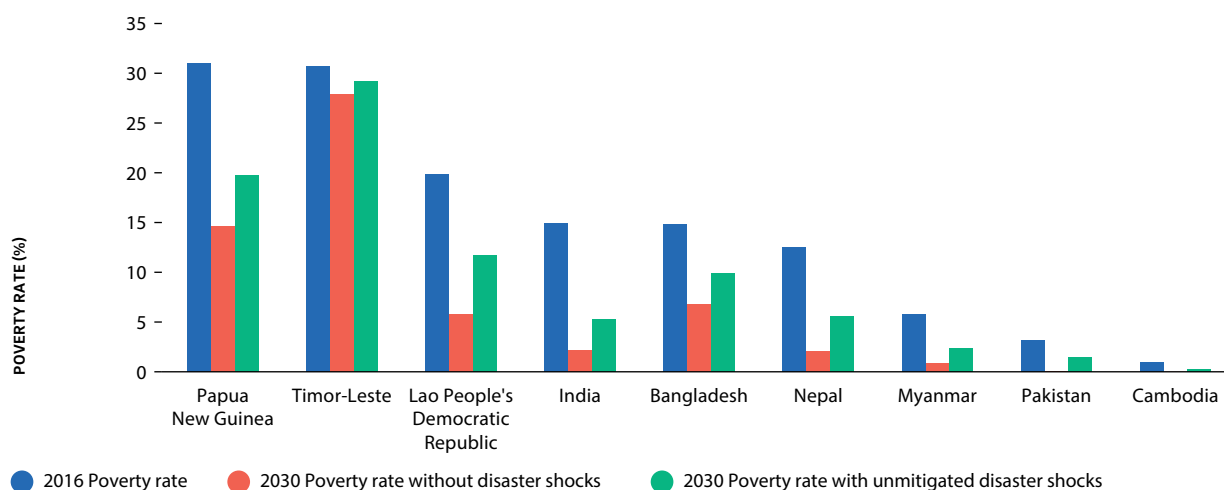
Source: ESCAP calculations based on CGE model.

The effects of disasters on poverty are greatest for countries in the top-right quadrants of Figure 2-7 and Figure 2-8. This is further indicated in Figure 2-12, which shows that the percentages of people living in poverty in these countries are projected to increase at much higher rates. These countries are also the same countries that belong to the key disaster risk hotspots as noted in Chapter 1, and are part of the emerging riskscape. Unmitigated and repeated disasters will continue to keep people in poverty or push them back into poverty.⁴² Thus, efforts to reduce poverty and disaster risks should be complementary.

Disasters contribute to inequality of opportunities

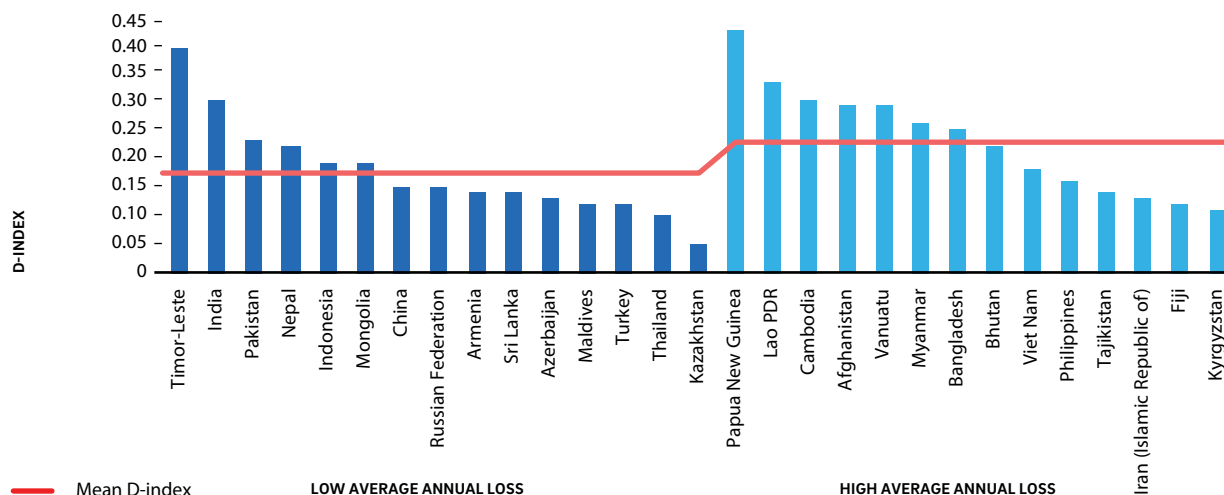
ESCAP analysis shows that countries with high annual average disaster losses currently have high inequality of opportunities. Continuing with business as usual, with no efforts at mitigation or prevention, will result in these inequalities widening further. This is illustrated in Figure 2-13. The group of countries on the right, with high future disaster losses, as measured by AAL, are generally those with greater inequality of opportunity, as measured by the D-index.

FIGURE 2-12 Countries with high Gini and high D-index, projected poverty rates in 2030

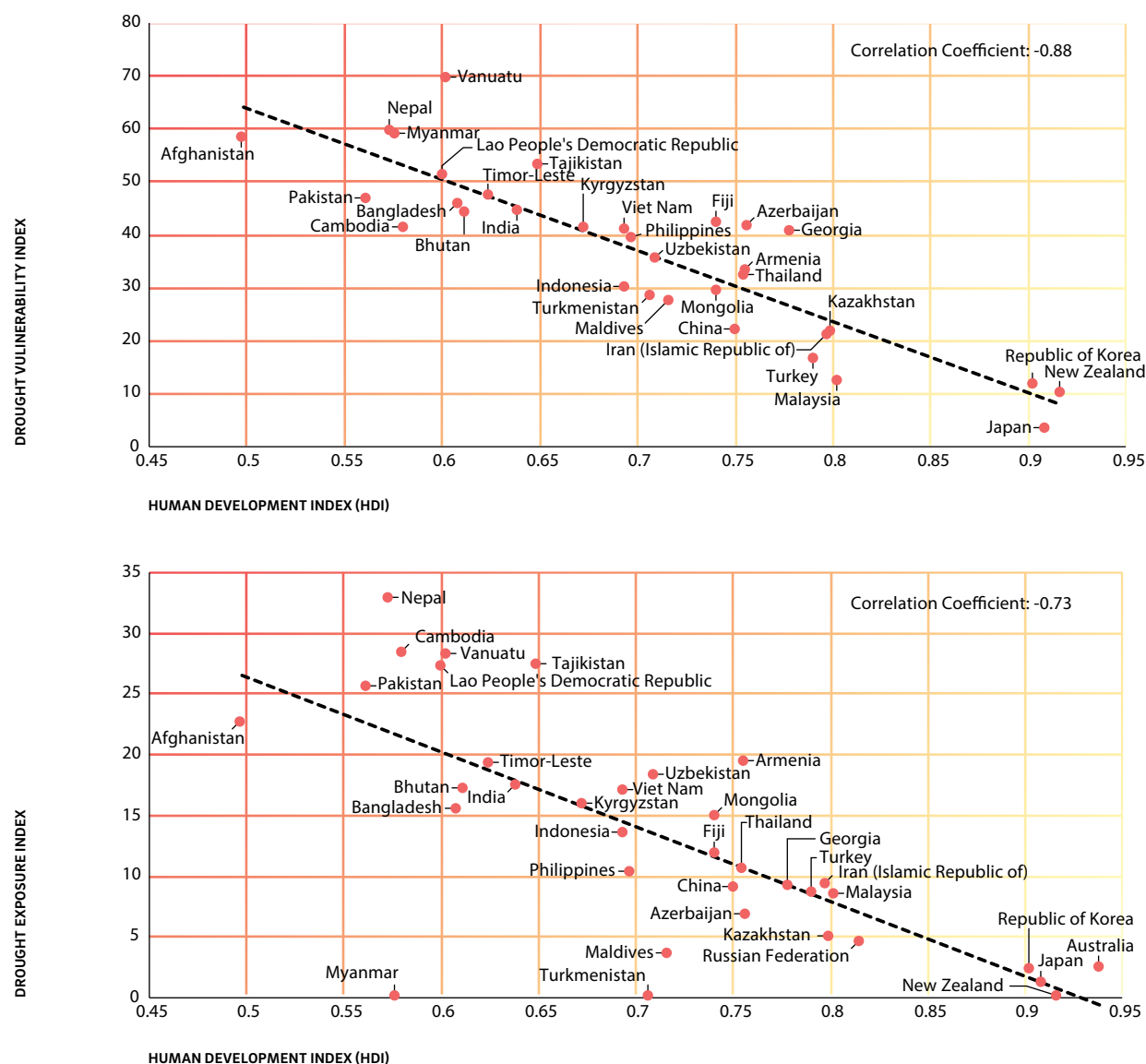


Source: ESCAP calculations based on CGE model.

FIGURE 2-13 Overlap of inequality in opportunities and future disaster losses



Note: The group of countries on the right, with high future disaster losses, as measured by AAL, are generally those with greater inequality, as measured by the D-index.

FIGURE 2-14 Influence of drought exposure and vulnerability on human development index

Sources: ESCAP, based on HDI data from UNDP and probabilistic risk assessment.

Among these countries, drought, in particular, takes a high toll on human development. The economies of many of these countries are based on agriculture. Slow-onset droughts have caused significant losses in agricultural production, depleted fresh water supplies, and increased both inflation and poverty.⁴³ As noted in Chapter 1, new ESCAP analysis finds that, in many countries, the risks associated with drought and the agricultural sector represent a very significant proportion of overall multi-hazard risk. In the region as a whole, this is a major opportunity cost to economic and social development.⁴⁴ This is reflected

in a significant and high correlation between drought exposure and vulnerability and human development (Figure 2-14). Countries at the highest risk are those with high exposure and vulnerability to drought and low human development index such as Afghanistan, Cambodia, Nepal, Pakistan, and Vanuatu.

Fulfilling the 2030 Agenda will mean reducing inequality so as to leave no-one behind. Many countries, embracing the fundamental principles of equality between human beings, have encouraged affirmative action to address inequalities. They

have helped remove many inequities and started to unleash the latent energies of communities and countries that have been subdued for centuries. Nevertheless, around the world there are still many forms of inequality — indeed in some cases there are new layers of injustice. These fall broadly into two categories, based either on deprivation or on discrimination.

Inequality through deprivation

Millions of people around the world continue to be deprived in many ways; principally lacking food, employment, health care and education.⁴⁵ As can be seen in Figure 2-13, countries with high inequality as measured by the D-index are the ones that will suffer the most from future disaster losses.

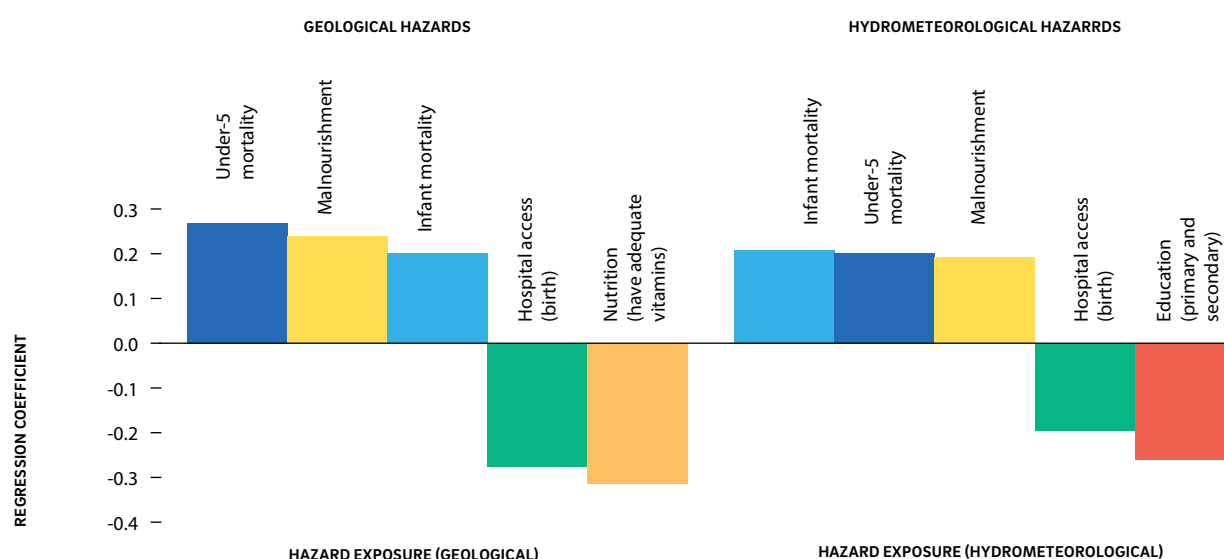
Across the Asia-Pacific region, having many people living in multi-hazard areas tends to increase deprivation. This is illustrated in Figure 2-15 which summarizes regression analyses (Annex 2.2) and shows the size of impact of hazards on four deprivations across the region with province-level data from 17 Asia-Pacific countries. These results are based on cross-sectional data so causality may be difficult to determine, but they do indicate pathways through which increased exposure to disasters can exacerbate inequalities in social development. Figure 2-15 will be referred to when examining each deprivation in depth.

Hunger and malnutrition

Climate-related disasters, notably floods and drought, have been increasing and they have significant implications for hunger and malnutrition. Floods can impact food security and nutrition through a reduction in food production which affects livelihoods of both agriculture and nonagriculture-based populations.⁴⁶ For droughts there are fewer data, but these indicate that droughts have an extremely severe impact on nutrition. In 2017, in Afghanistan, for example, a drought that caused scarcities of water and food exacerbated already high malnutrition rates among children, and pregnant and lactating women.⁴⁷ As noted in Chapter 1, drought and floods are endemic to the region and are key drivers of hunger and malnutrition and almost 70 per cent of total average annual losses from disasters are in agriculture.

Droughts have their greatest impacts on countries that depend heavily on agriculture. For example, among ASEAN countries, agriculture generates around 11 per cent of value-added to GDP, and more than 25 per cent in countries such as Cambodia and Myanmar.⁴⁸ ESCAP measured the impact of drought using regression analysis with data from the INFORM risk index, which takes into account the number of people affected, the frequency of drought, and the extent of exposed cropland. The analyses show that while drought by itself has no significant relationship on the GDP of the Asia-Pacific region as a whole, for

FIGURE 2-15 Hydrometeorological and geological exposure and impact on deprivation (summary of regression analyses)



Source: ESCAP calculations based on DHS survey reports, latest data and multi-hazard data from Global Assess Report, 2015.

Note: Only statistically significant coefficients in the model are shown.

ASEAN countries however, drought and GDP have a significant negative association where increase in the drought index has the potential to reduce the GDP of ASEAN countries. Thus, for the 10 ASEAN countries, a 1 per cent point increase in the drought index can lead to a 0.62 per cent point decrease in sub-regional GDP (Details of the analyses are available in Annex 2.4). A prolonged drought, can decrease agriculture production and availability of food, therefore increasing the rates of overall malnutrition.

Child nutrition is threatened by both climate-related and geological hazards. Across the assessed countries in the region, for climate-related hazards, a 1 percentage point increase in exposure leads to a 0.19 percentage point increase in malnutrition among children under five, while a similar increase in exposure to geological hazards increases the malnutrition rate by 0.24 percentage points (Figure 2-15). This is a serious risk for young children; malnutrition not only threatens their survival but also affects brain development, increases the risks of infection, and reduces educational attainment and productivity.⁴⁹

The harm to children can also be reflected in low birthweights. Analysis among households in 14 Asia-Pacific countries shows that living in high-multi-hazard risk areas is a significant risk factor for low birthweight, which is also linked to mother and child malnutrition. This is illustrated in Figure 2-16, which shows that children born in high-risk multi-hazard areas have lower odds of being born an average size at birth.⁵⁰ In Myanmar, for example, they are 44 per cent less likely to be born an average size. This

may be because their mothers are malnourished during pregnancy. Low birthweight increases the risk of infant mortality as well as of health and developmental problems in adulthood.^{51, 52, 53}

This underlines the importance of key services for children in hazard-prone areas. Such services need to be tailored and strengthened to reach the most marginalized and sustain access for all.

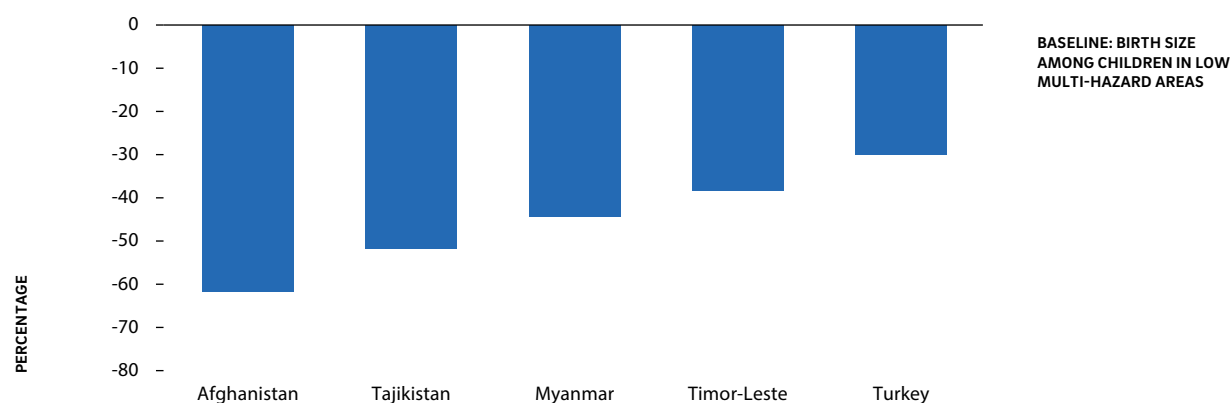
Health

Large sections of humanity are still deprived of the basic human right to health. One key indicator of the standard of health in any country is the under-five mortality rate. Between 1990 and 2016 the overall worldwide child mortality rate fell from 91 to 41 per 1,000 live births. Nevertheless, this still meant that around six million children under the age of five were dying each year.

Overall health, as indicated in child mortality rates, depends on many factors, such as wealth, education, and employment. But disasters also play a part. Across-region regression analysis from Figure 2-15 indicates that a 1 percentage point increase in exposure to disasters increases infant and under-five mortality rates by 0.2 and 0.3 percentage points respectively.

Other measures of health show more direct impact of disasters. Floods, for example, have been shown to increase water-related infectious diseases, such as diarrhoea, due to water contamination and damage to water systems. Floods and cyclones also increase

FIGURE 2-16 Lower odds of average birth size among children born in high-multi-hazard risk areas



Note: Only countries for which there are statistically significant results are included.

Source: ESCAP calculations based on DHS surveys from 14 countries for the latest years. Multi-hazard data are from the Global Assessment Report, 2015.

the number of breeding sites for mosquito vectors and facilitate transmission of diseases such as leptospirosis.⁵⁴ Earthquakes can also cause outbreaks of endemic infectious disease due to displacement of populations and overcrowding in temporary shelters.⁵⁵ In Viet Nam, for example, a study of 4,645 reports of typhoons, earthquakes and floods found significant increases in communicable diseases both pre- and post disasters.

Disasters also affect health by reducing the quality and reach of services. Across the 247 provinces for 17 Asia-Pacific countries, ESCAP's analysis indicates that living in high-multi-hazard areas tends to reduce access to healthcare for women giving birth. Among the 247 provinces across the 17 countries in the region, a 1 percentage point increase in exposure to hydrometeorological and geological hazards leads to decreases of 0.2 and 0.3 percentage points, respectively, in access rates to hospitals for women giving birth (Figure 2-15). This demonstrates the need for resilient, critical infrastructure in high-risk multi-hazard areas, which are more susceptible to earthquakes and related landslides.

Within-country analysis at the household level also shows that, in several countries in Asia and the Pacific, women living in high multi-hazard-risk areas have less access to professional medical help (doctors, nurses or midwives) pre- and post childbirth. In Timor-Leste for example, they are 43 per cent less likely to have such help than women in low-risk areas (Figure 2-17).

Employment

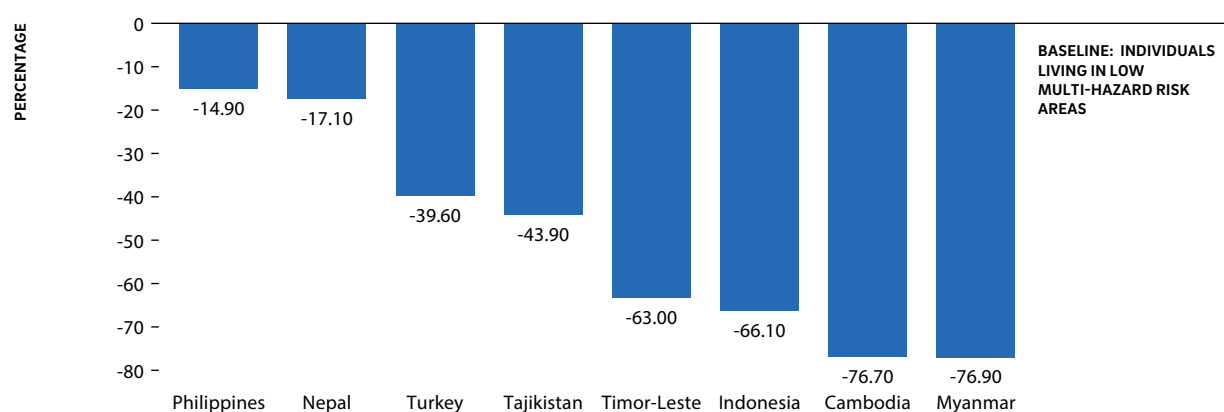
In Asia and the Pacific, the overall unemployment rate is low at 4.2 per cent. This is due largely to fast economic growth in larger economies like China, India and Indonesia. However, this only refers to formal employment and does not capture high levels of unemployment and underemployment in the informal sector, which largely goes unreported and is at the highest risk from disasters, particularly in agriculture.

There is some evidence that women's employment decreases post disasters.⁵⁶ However, due to lack of data there has not been much analytical work. Through the analysis of DHS household surveys, the following evidence-based insights on how disasters can impact employment can be provided.

The first insight is that in high-risk, multi-hazard areas, women are significantly more likely to be employed. Across the 17 countries, regression analysis shows that for each percentage point increase in area exposure to hydrometeorological hazards, women's employment rate increases by 0.2 percentage points. And in the case of geological hazards, the increase is around 0.4 percentage points (Figure 2-15). This also probably reflects higher levels of poverty that require more women to work.

Within-country logistic regressions show that in Nepal, in high-multi-hazard risk areas, women's rate of employment was 2.3 times, or almost twice of that of men (Annex 2.3). In the Philippines it was 1.2 times

FIGURE 2-17 Lower odds of access to prenatal and medical care for women in high-multi-hazard risk areas



Source: ESCAP calculations based on DHS surveys from 14 countries, latest year and multi-hazard data from Global Assess Report, 2015.

Note: Shows the odds of people in high-risk areas accessing health care compared with those in low-risk areas. Adjusted for wealth and education. Only statistically significant coefficients in the model are shown.

that of men. Because in high-multi-hazard risk areas a higher proportion of women are employed, their livelihoods are more heavily tied to, and impacted by recurrent disasters and may provide additional insights into why women's employment decreases post disasters more than that of males. Only in Pakistan, men are significantly more likely to be employed than women in high-risk areas.

Second, within-country logistic regressions show that in many countries, households depending on agriculture employment and especially those who are poor, are significantly more likely to also be situated in high multi-hazard risk areas (Figure 2-18). For example, in the Philippines, poor households with agricultural employment are 2.4 times more likely to live in high- multi-hazard risk areas. In landlocked developing countries such as Armenia and Azerbaijan, agriculture is a large part of the economy. In Armenia, for example, nearly 35 per cent of the workforce is in agriculture and weather events push thousands into poverty.⁵⁷ The livelihoods of subsistence agricultural populations therefore are extremely susceptible to disaster shocks, since they exist within the perfect storm of multiple risks and deprivations.

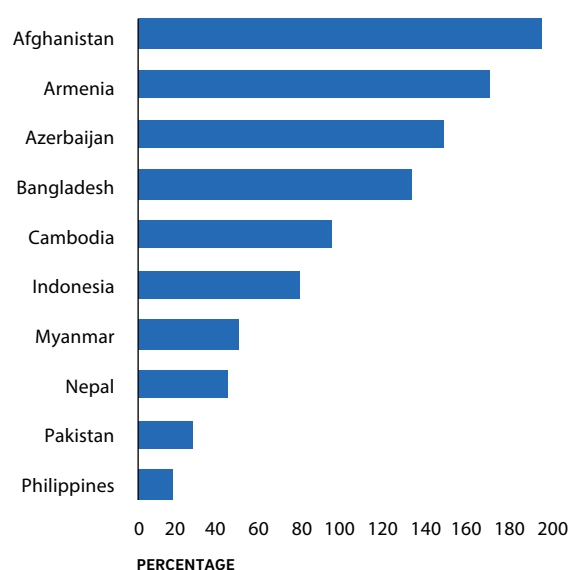
Education

Education shapes inequality in access to all opportunities, including nutrition, employment, and household-level services.⁵⁸ In education, the Asia-Pacific region has experienced significant advances and is on track to meet the 2030 SDG education goals.⁵⁹ But this achievement has not been happening in a balanced way, so the playing field has yet to be levelled. Disasters threaten education as they are liable to destroy schools and increase rates of dropout and non-attendance.⁶⁰ Education accounts for 8 per cent of the damage and loss in the social sector.

In countries such as Nepal, where earthquakes have caused large-scale disruption, many children have lost months of education. The Philippines, Indonesia and Myanmar often experience repeated disasters every year, so children regularly lose school days, thus reducing the quantity and quality of schooling.⁶¹

ESCAP regression analysis, across 17 countries at the provincial level, indicates that a 1 percentage point increase in exposure to hydrometeorological

FIGURE 2-18 Higher odds of agricultural poor living in high-multi-hazard risk areas



Source: ESCAP calculations based on DHS survey reports, latest data and multi-hazard data from Global Assess Report, 2015.

Notes: (1) Only statistically significant results from the model are shown (2) Adjusted for wealth, education, and urban/rural divide.

decreases education rates for primary and secondary education on average by around 0.26 percentage points respectively (Figure 2-15).

Discrimination—who will be left the furthest behind when disaster hits?

Evidence from prior sections show that in many Asia-Pacific countries, populations are more likely than not to be highly exposed to multi-hazard risks. It has also been demonstrated that people living in high multi-hazard areas are thus likely to have lower nutrition rates, lower education rates and lower access to healthcare. But they can also face discrimination based on gender, age, ethnicity, religion and other divisions. Potential gender-based discriminations can be exacerbated by disasters, as noted previously.

A study of these discriminations from a disaster risk perspective opens the door to a deeper exploration on the intersections of deprivations and discriminations within areas that are already exposed to high-hazard risk. Examining these intersections will help identify groups that are the furthest left behind and where

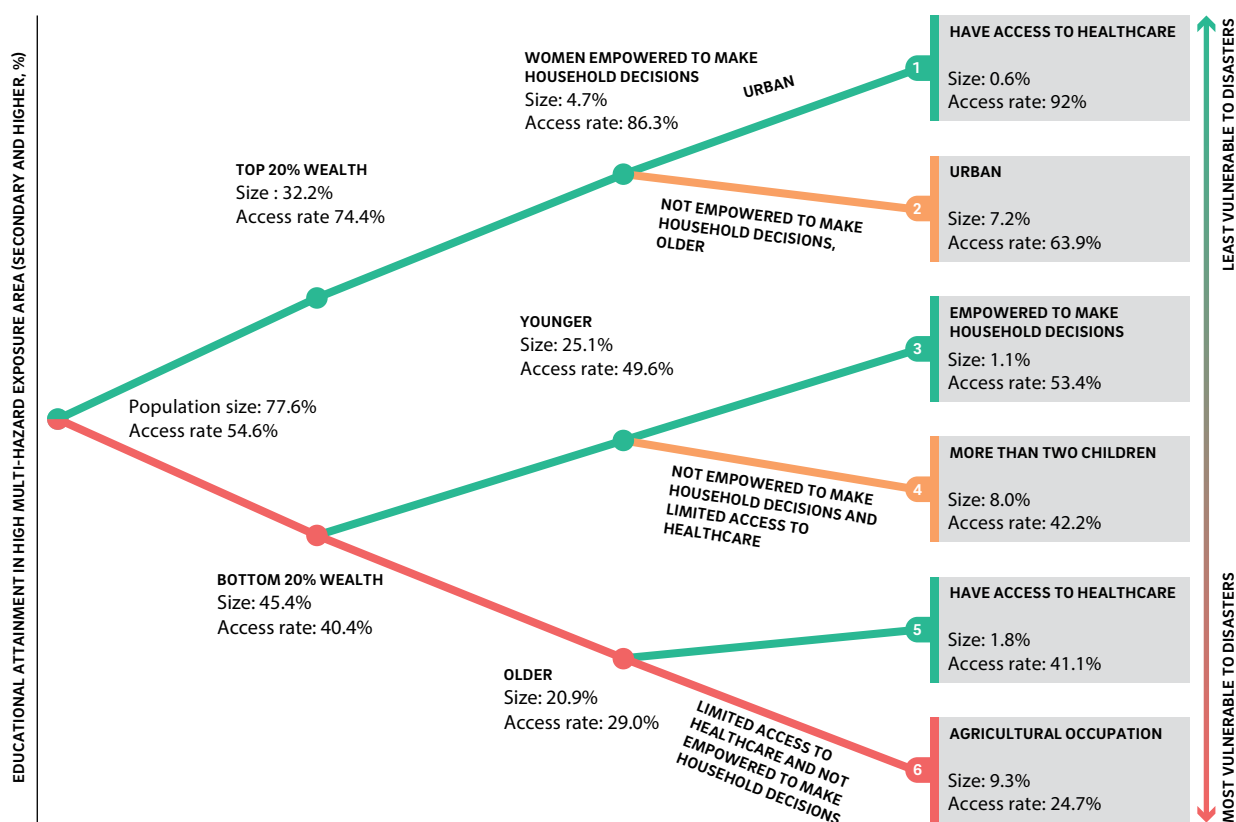
strengthening disaster risk reduction can support social development, including building individual resilience.

This section uses the classification tree methodology to identify those households and individuals that lack access to specific opportunities in high multihazard areas. The trees reveal the circumstances shared by the most disadvantaged and advantaged groups in the high multi-hazard risk areas. Using an algorithm, the analysis produced country- and opportunity-specific classification trees for the 14 countries for which sufficient DHS data and hazard data were available for education and health care opportunities.⁶² The classification tree methodology is similar to the one used in a prior ESCAP (2018) publication entitled, “Inequality in Asia and the Pacific”, and a detailed description of the methodology can be found there. The approach is commonly used in data mining and machine learning where an algorithm splits the value for each access rate to an opportunity into significantly different population groups based on shared pre-determined circumstances.⁶³

This approach can be illustrated for Bangladesh to show who is most at risk from the overlaps of deprivation, discriminations and hazard risk. The classification tree, in Figure 2-19, shows which populations will be the most disadvantaged when disasters hit, specifically for education. The tree starts with the average rate of secondary or higher educational attainment in high-multi-hazard risk areas (55 per cent). The algorithm determines that this population should first be split into the bottom 20 and top 20 per cent of population in terms of wealth. Individuals who belong to the top 20 per cent wealth bracket have educational attainment of rates of 74 per cent as opposed to those at the bottom 20 per cent who have a 40 per cent attainment rate.

The tree indicates that within the bottom 20 per cent wealth group, older individuals (50–64) are worse off than younger individuals. In high multi-hazard risk areas, younger populations have secondary or higher education rates of almost 20 per cent higher. The tree can then be branched further down to show that the worst-off group in terms of education are the poorer, older

FIGURE 2-19 Education levels and vulnerability in high-multi-hazard risk areas in Bangladesh



Sources: ESCAP, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015, and DHS Household Survey.

populations, who have limited access to healthcare, are not empowered to make household decisions, and work in agriculture.

The total gap between the groups with the highest and lowest access is a staggering 68 percentage points for the set of population that lives in high multi-hazard risk areas.

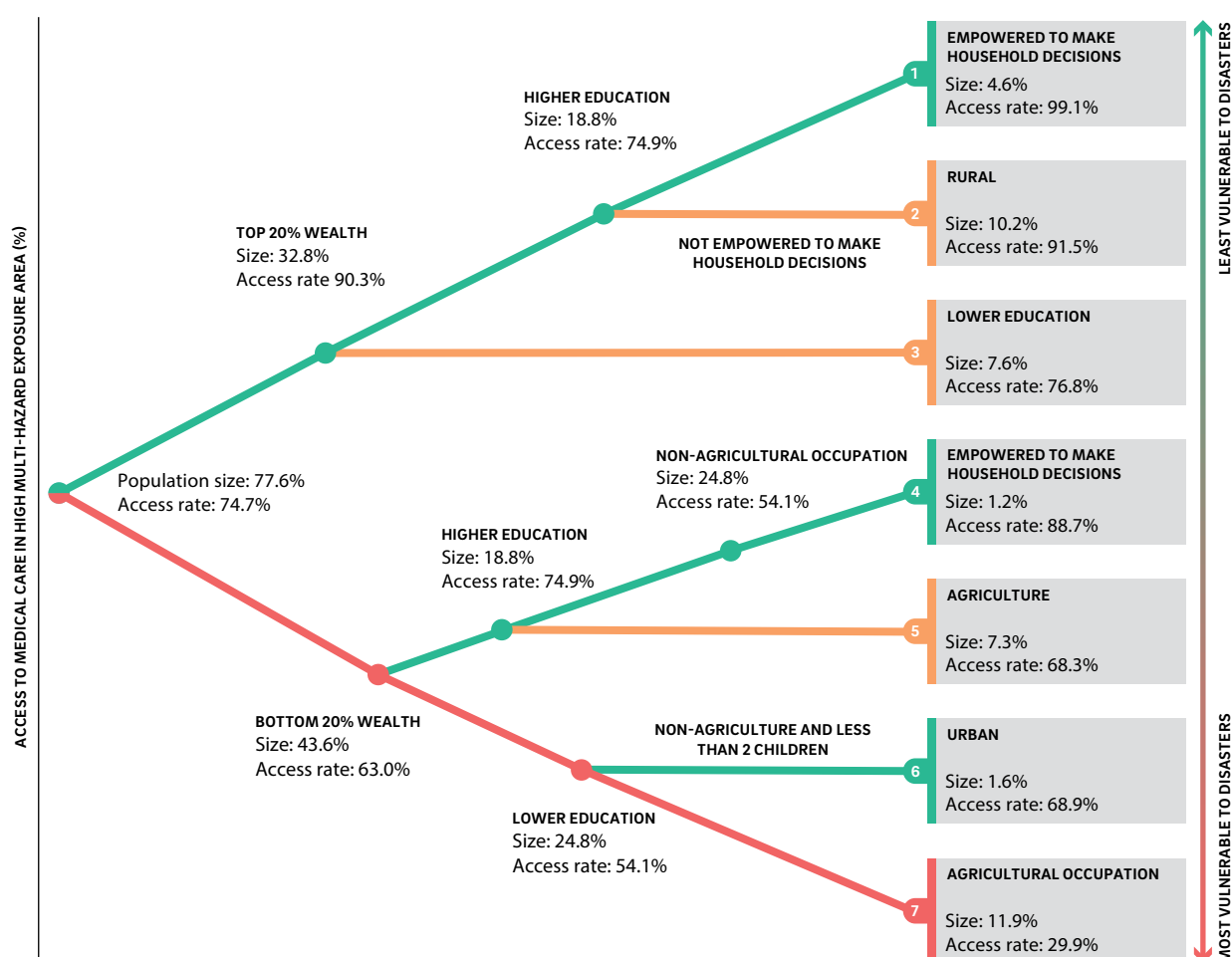
The tree for healthcare follows a similar pattern (Figure 2-20). Access is highest for those in the highest wealth bracket, who are highly educated and whose women are empowered to make household decisions. For these women, healthcare access is almost 100 per cent. This is in sharp contrast to those in the worst-off group: for women in the bottom 20 per cent of wealth, with low education, and in agricultural occupations, the access rate is around 30 per cent. The total gap between the groups with the highest and lowest access is 70 percentage points. Thus, the characteristics of these groups need to inform

the development of community-based resilience policies as well as policy development at the national level across all sectors.

It is clear from the classification tree that when disasters hit, the cumulative effects of these negative circumstances will hit these vulnerable groups the hardest. If education is already difficult to attain, when disaster hits the scant number of children who are going to school could drop out. The large inequalities between the best-off and the worst-off groups also suggest that the worst off are more susceptible to disaster impacts where school or hospital infrastructure is not robust.

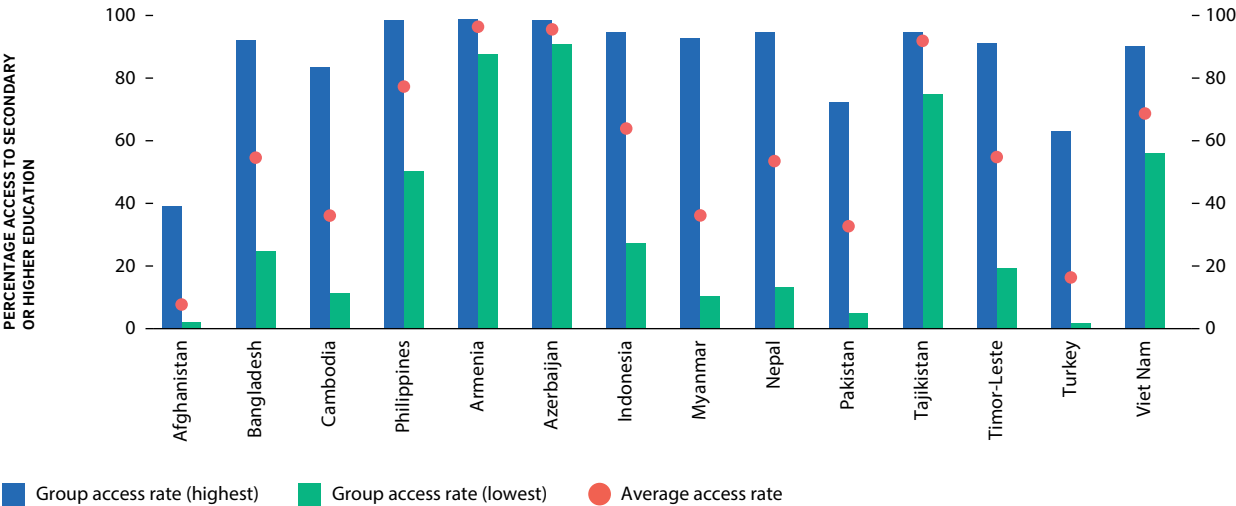
The classification trees therefore indicate the group characteristics for policies that focused on reaching those furthest behind.⁶⁴ The trees for education and healthcare for all 14 countries in high-multi-hazard areas are summarized in Figure 2-21 and Figure 2-22 respectively. The blue lines represent the access of

FIGURE 2-20 Access to health care and vulnerability in high-multi-hazard risk areas in Bangladesh



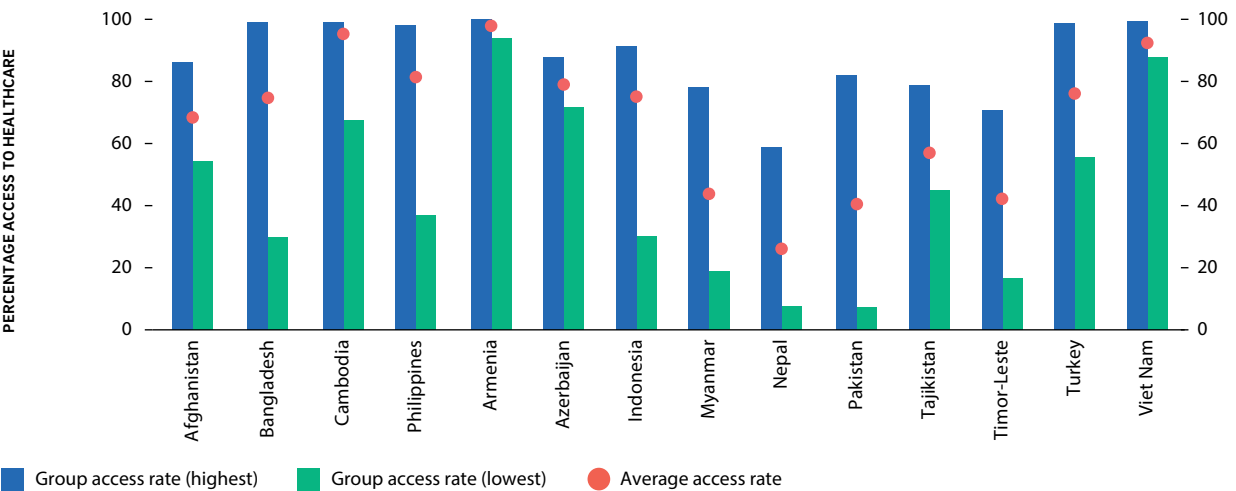
Sources: ESCAP, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015, and DHS Household Survey.

FIGURE 2-21 Inequality of access to education in high-multi-hazard risk areas



Source: ESCAP calculations using data from the latest DHS surveys and GAR hazard risk data.

FIGURE 2-22 Inequality of access to healthcare in high multi-hazard risk areas



Source: ESCAP calculations using data from the latest DHS surveys and GAR hazard risk data for countries in Asia and the Pacific.

the most advantaged groups; the grey bars represent the access of the most disadvantaged groups; and the circles indicate the average access.

Table 2-1 summarizes the findings from the classification trees for the two opportunities and shows the circumstances of populations who are left the furthest behind in high-multi-hazard risk areas. Besides being in the bottom 20 per cent of the wealth bracket, the most common shared circumstance of the most disadvantaged is employment in agriculture. Others, in declining order, are older age, living in rural areas, having more than two children, and for women a lack of empowerment reflected through property ownership. The poor, it seems,

have a multitude of circumstances that work hand in hand to keep them ‘furthest behind’ — generation after generation.

Disaster displaced populations — an emerging discrimination

Different climate hazards present different dilemmas in terms of mobility responses; how and where people move when disaster strikes. Much will depend on people’s economic circumstance, and there are many other scenarios and possibilities. If people are hit by slow and repeated hazards, such as sea-level rise and coastal erosion, they may choose to migrate on a long-term basis.

TABLE 2-1 The groups hardest hit by disasters

SHARED CIRCUMSTANCES OF THE WORST-OFF AND BEST-OFF GROUPS IN HIGH-MULTI-HAZARD RISK AREAS IN ACCESS TO SELECTED OPPORTUNITIES			
INDIVIDUALS LEFT BEHIND IN SECONDARY OR HIGHER EDUCATION ATTAINMENT IN HIGH-MULTI-HAZARD RISK AREAS			
FURTHEST BEHIND		FURTHEST AHEAD	
CIRCUMSTANCES	IMPORTANCE OF CIRCUMSTANCE IN DETERMINING ACCESS TO OPPORTUNITY (IN %)	CIRCUMSTANCES	IMPORTANCE OF CIRCUMSTANCE IN DETERMINING ACCESS TO OPPORTUNITY (%)
Bottom 20% of wealth	13%	Top 20% of wealth	16%
Agricultural occupation	8%	Non-agricultural occupation	7%
Age 50–64	7%	Age 15–49	3%
Age 15–49	1%	Age 50–64	1%
No or limited access to healthcare	8%	Have access to healthcare	1%
Lack of empowerment: Women in household not empowered to make decision or hold ownership of property	6%	Women in household empowered to make decision or hold ownership of property	2%
More than 2 children	7%	Less than 2 children	3%
Rural	3%	Urban	7%
INDIVIDUALS LEFT BEHIND IN ACCESS TO MEDICAL CARE IN HIGH-MULTI-HAZARD RISK AREAS			
Bottom 20% wealth	12%	Top 20% wealth	15%
Agricultural occupation	10%	Non-agricultural occupation	5%
Lower or primary education	13%	Secondary or higher education	11%
Women in household do not hold ownership of property	5%	Women in household hold ownership of property	1%
Rural	6%	Urban	6%
More than 2 children	6%	Less than 2 children	1%
Less than average child birthweight	1%	Less than average child birthweight	1%
Age 50–64	2%		

Sources: ESCAP, based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015, and DHS Household Survey.

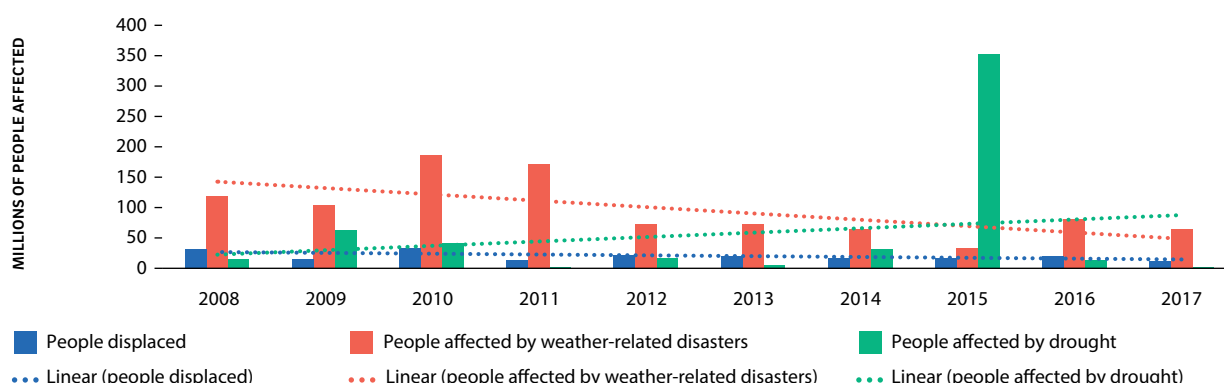
Most of these hazards and their responses would fall under the threat of extensive risk. For intensive risks, such as sudden-onset disasters in the form of floods, storms and cyclones, people are likely to be forced out on a temporary basis until critical infrastructure is restored. Such risks are projected to increase much further with climate change.⁶⁵

While the number of people being displaced by weather-related hazards overall is decreasing, the number of people being displaced by drought, is significantly increasing, on average by 10 million more people per year.⁶⁶ Indeed, Figure 2-23 shows that slow-onset disasters are contributing to a greater share of internal displacement and will play a larger role in the future.

Finding the furthest behind

The following sections identify the geographical location, where poverty, population density, along with low human development and disaster risk areas converge. They provide empirical spatial evidence that support the identification of the 5 risk hotspots that were discussed in Chapter 1. This analysis uses the human development index (HDI), a composite measure of average achievements in three key dimensions of human development: a long and healthy life, education, and decent standard of living. This is combined with the GAR 2015 hazard exposure models, and data on land degradation. A novel interpolation and small area estimation method is used to locate those who live in poverty.

Figure 2-24 shows socioeconomic-hazard risk areas among some selected subregions. The figures amalgamate the index of high population, low HDI and high-hazard risk or high land degradation.⁶⁷ The

FIGURE 2-23 Disaster displacement and people affected by weather-related disasters, Asia and the Pacific, 2008–2017

Source: IDMC, 2017. Internal displacement figures by country, EM DAT (Accessed on 16 January 2018).

Notes: People affected by weather-related disasters include extreme temperature, flood, storm and wildfire.

BOX 2-2 The 2015 Nepal earthquake a setback to development

The destruction was widespread covering residential and government buildings, heritage sites, schools and health posts, rural roads, bridges, water supply systems, agricultural land, trekking routes, hydropower plants and sports facilities. The geodetic network centres including horizontal and vertical control points have been damaged in a manner that affects reconstruction planning. Rural areas in the central and western regions were particularly devastated and further isolated due to road damage and obstructions. In the worst-hit areas, entire settlements, including popular tourist destinations like Langtang, were swept away by landslides and avalanches triggered by the earthquakes. Due to the weakened, ruptured, and destabilized slopes and surfaces, the vulnerable areas have now become even more susceptible to flooding and landslides that can occur during the monsoon.

Hundreds of historical and cultural monuments, at least a century old, were either destroyed or extensively damaged. Over half a million houses were destroyed. The damage exposed the weaknesses of houses that lacked seismic-resistant features or were not in accordance with the building codes.

The disaster also highlighted inequities in Nepali society spanning geography, income and gender. Poorer rural areas have been more adversely affected than towns and cities due to their inferior quality of houses. More women and girls died than men and boys, partly because of gendered roles that disproportionately assign indoor chores to women. The earthquakes pushed an additional 2.5 to 3.5 per cent of Nepalis into poverty in fiscal year 2015–2016, which translated into at least 700,000 additional poor. Moreover, the deterioration of water and sanitation services, disruption of schools and health services, and the possible increase in food insecurity led to a bigger impact on multidimensional poverty.

The effects of the disaster illustrate that the estimated value of total damages and losses (changes in flows) was equivalent to about one-third of the GDP in fiscal year 2013–2014. In addition, for that year the estimated value of damage was equivalent to more than 100 per cent of gross fixed capital formation. To put it differently, if all other capital formation activities were stopped, it would take Nepal more than one year to rebuild the fixed capital that was destroyed by the earthquakes. Furthermore, the estimated production losses represented about 10 per cent of the added value of all goods and services produced in one year, which resulted in a slowdown of the economy in the short term, even though the losses for cultural heritage and environment, among others, would unfold over several years.

Annual economic growth, in 2014–2015, was expected to be the lowest in eight years, at 3 per cent. The losses continued to accumulate during the fiscal year 2015–2016 and beyond until major sectors recovered fully.

Source: Nepal Earthquake 2015. National Planning Commission.

analysis shows that, for example, within South Asia, the most vulnerable populations live in the Ganges-Brahmaputra-Meghna (GBM) basin and parts of Pakistan and Afghanistan. The same analysis in the Pacific shows that Vanuatu is the most vulnerable country in the subregion with a high overlap of low HDI with disaster risk throughout the country.

A similar analysis was performed to identify hotspots comprising the overlaps of socioeconomic deprivation and land degradation in two subregions. Figure 2-25 shows that the highest concentration of people combined with low HDI, and high-hazard risk in Central Asia are in Turkmenistan and Tajikistan. Figure 2-26 further indicates that the highest risks in South-East Asia, are in Myanmar, Indonesia and Viet Nam.

These risk hotspots tend to cut across national boundaries. One of the most extensive is the Ganges–Brahmaputra–Meghna (GBM) river basin, which is the world’s largest river basin and is shared by four South Asian countries Bangladesh, Nepal, India and Bhutan.⁶⁸ The GBM basin shapes social and cultural lives of around 630 million people, almost 70 per cent of whom are rural, and account for the largest concentration of poverty in the world.⁶⁹ Furthermore, they are also people who are at high risk from multiple hazards. Geo-locating these people and understanding their spatial distribution can provide guidance on the priority areas that should receive risk-sensitive investments.

Figure 2-27 uses a small area estimation methodology to estimate a probable location of the poor in the GBM basin.⁷⁰ These use a range of data; urban built up area, nightlight data, as well as the DHS wealth index data. This empirically shows that poorer populations, who will be least able to cope are the ones most exposed to flooding. The box in the figure notes the locations where additional investments and policy attention can bolster the resilience of those who are the furthest behind. The map also shows that the worst-off populations are not confined to a single country so these measures should involve cooperation among the riparian countries.

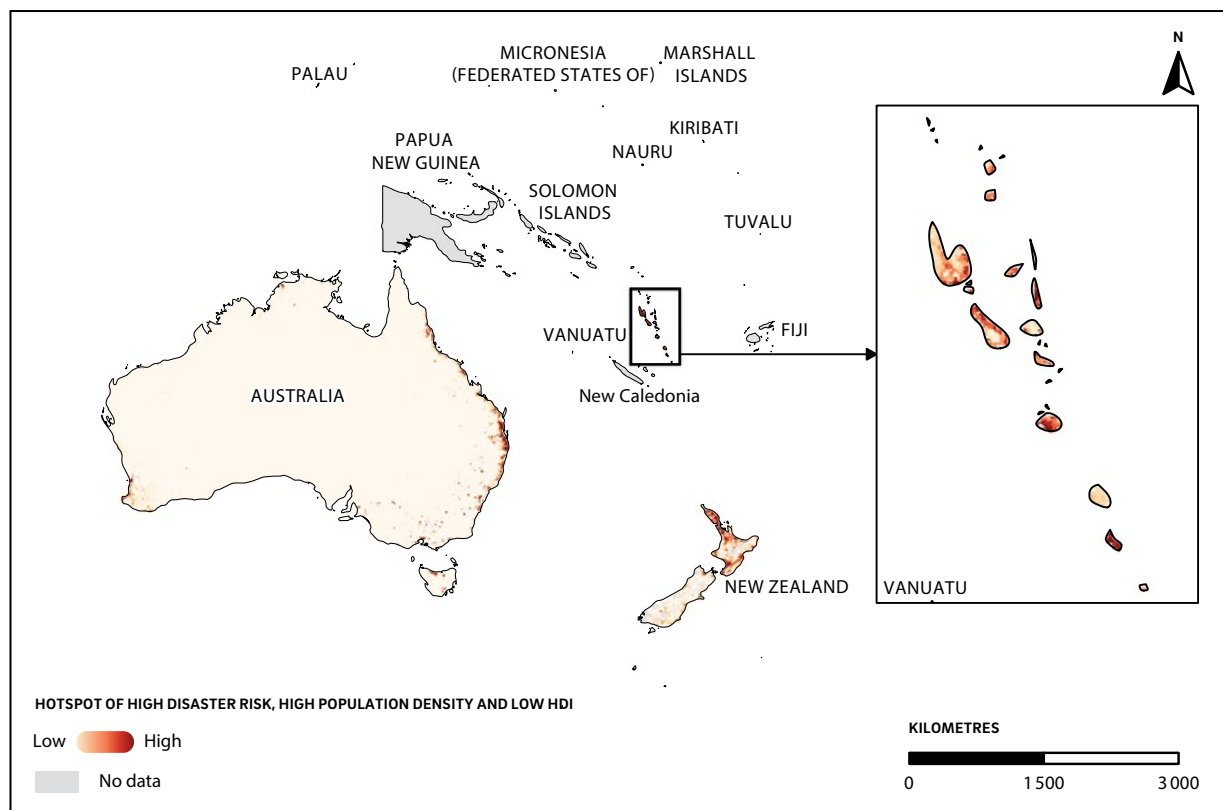
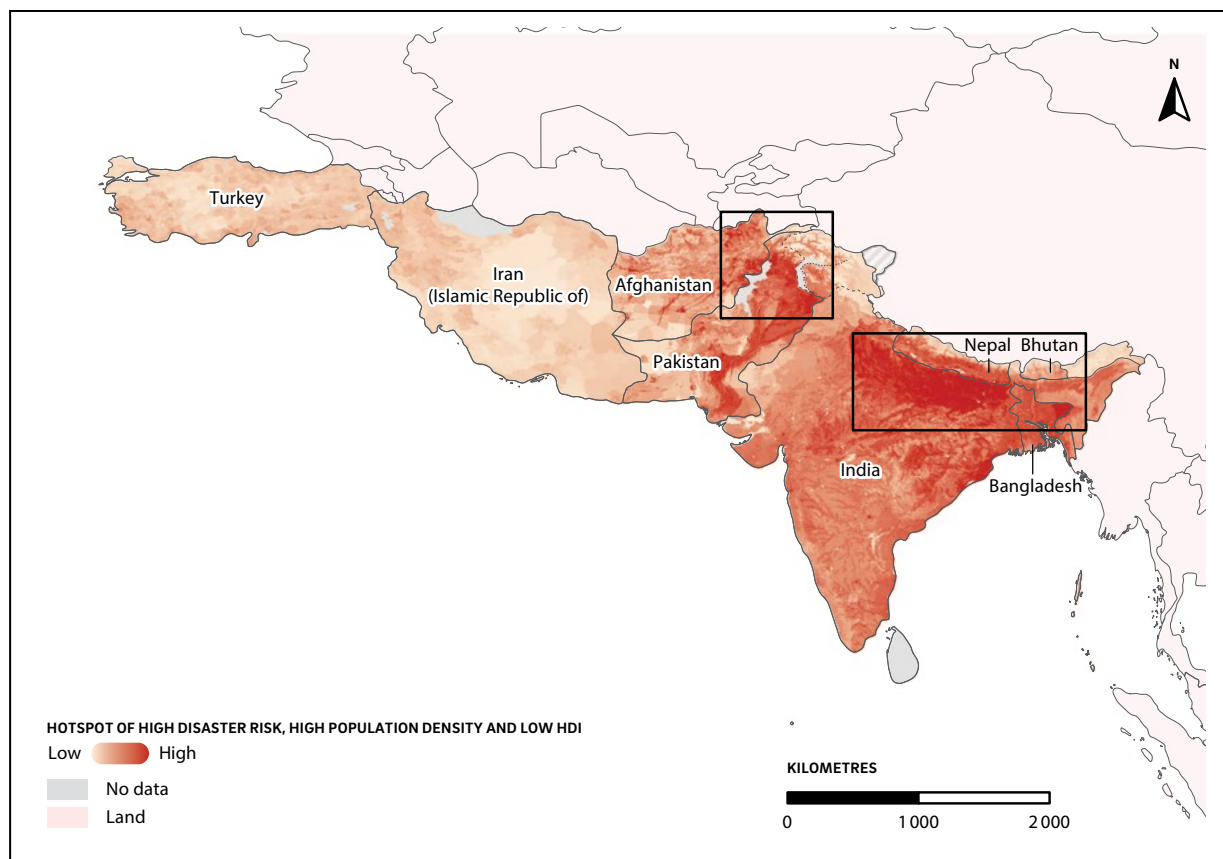
While disasters are often transboundary, many strategies to reduce risk will be local, and community based.⁷¹ For this purpose, it is useful to identify the most vulnerable communities using the DHS geographic information system (GIS). Figure 2-28 illustrates this for Nepal showing that the concentration of risk overlap is greatest in the eastern parts of the country, particularly in Province 3, and the borders between provinces 1 and 3. The second map overlays the country’s primary care hospitals. This can be useful in identifying the critical infrastructure needed to support the most vulnerable populations. The handful of hospitals within the most at-risk areas, if built or upgraded in a resilient and risk-sensitive manner, can support the most vulnerable populations during disaster shocks.

Figure 2-29 shows the corresponding maps for Bangladesh. This shows that the highest concentrations of socioeconomic-hazard risks are along the floodplains. The populations living there are subject to recurrent annual flooding. In addition, it also shows where critical infrastructure, like hospitals, need to be upgraded to withstand disasters and where the most resilient infrastructure needs to be built to support the most vulnerable populations.

What next?

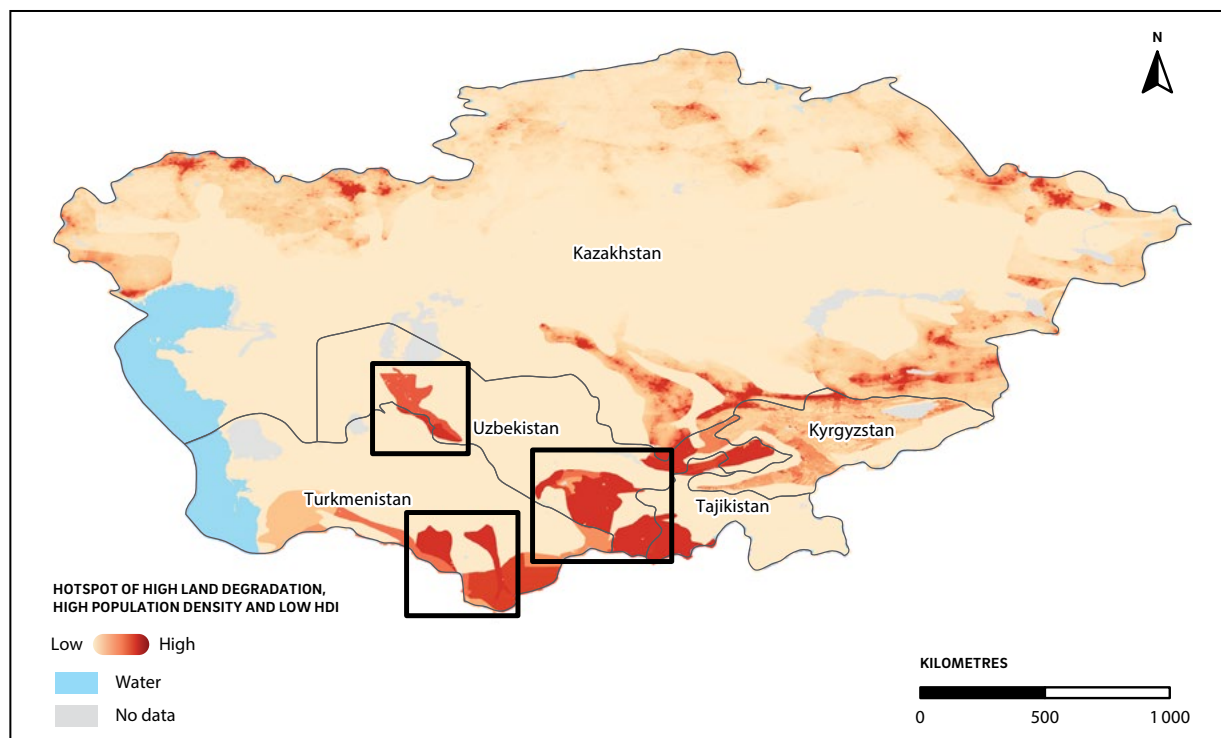
2030 Agenda for Sustainable Development pledged to ensure that “no one is left behind” and to “endeavour to reach the further behind first.”⁷² This chapter has shown that in the Asia-Pacific region there are multiple overlaps between socioeconomic risks and disaster risks that challenge the capacity to fulfil this pledge. The next chapter will demonstrate ways to build comprehensive risk-informed and disaster-resilient policies that will help uplift those left furthest behind.

FIGURE 2-24 Hotspots of low HDI, high population density, and hazard risks



Sources: Calculations by ESCAP based on (1) sub-national HDI data from UNDP, (2) Population statistics from WorldPop, (3) and hazard data from GAR, 2015. 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.

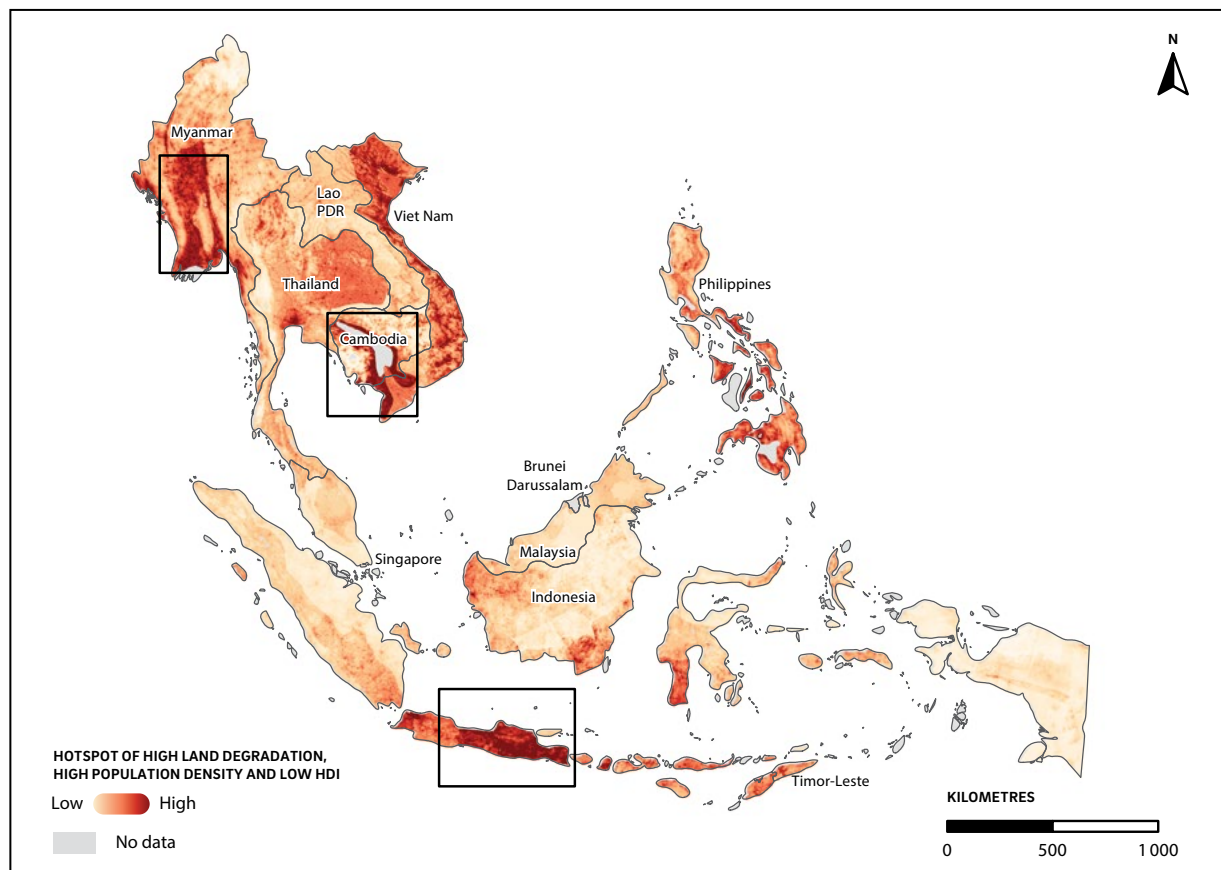
FIGURE 2-25 Hotspots of low HDI and land degradation in Central Asia



Sources: Calculations by ESCAP based on (1) sub-national HDI data from UNDP, (2) Population statistics from WorldPop, (3) and land degradation data from the Global Assessment of human-induced soil degradation (UNEP).

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

FIGURE 2-26 Hotspots of low HDI and land degradation in South-East Asia



Sources: Calculations by ESCAP based on (1) sub-national HDI data from UNDP, (2) Population statistics from WorldPop, (3) and land degradation data from the Global Assessment of human-induced soil degradation (UNEP).

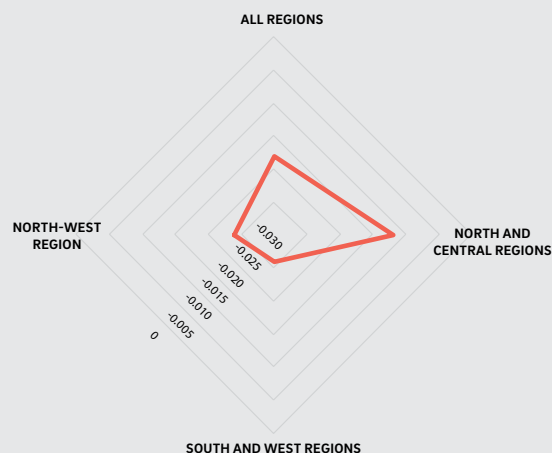
Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

BOX 2-3 Drought impacts on human development in India

Floods and droughts are a recurrent phenomenon in India. In many states, below-average monsoon rains can cause severe droughts. Hardest hit are the rural areas and livelihoods dependent on agriculture. This is especially true where rainfall is the only source of water for agricultural production, as in rain fed and minor tank irrigation areas. In India, at least 30 per cent of the population has agriculture-dependent livelihoods.

A new forthcoming study shows that in all regions but one, drought decreases the state-wide human development index (HDI), particularly in India's north and central regions. The HDI is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The index is the geometric mean of normalized indices for each of the three dimensions.

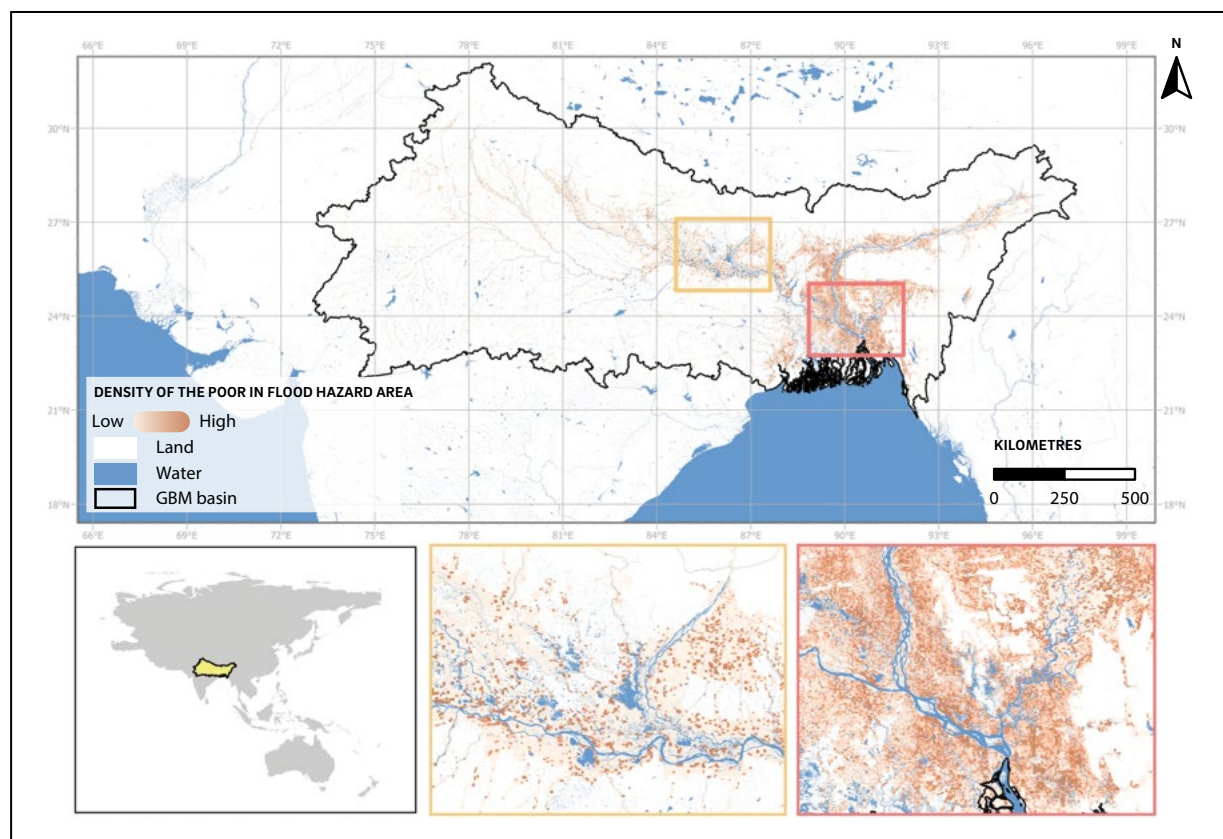
BOX 2-3 Decrease in HDI as a result of drought



Source: ESCAP based on G. Amarnath, "Impacts of natural disaster on economic growth and human development in India- State wise analysis", (forthcoming 2019).

Note: The summary chart of regression coefficients show that droughts affected the North and Central region of India the highest.

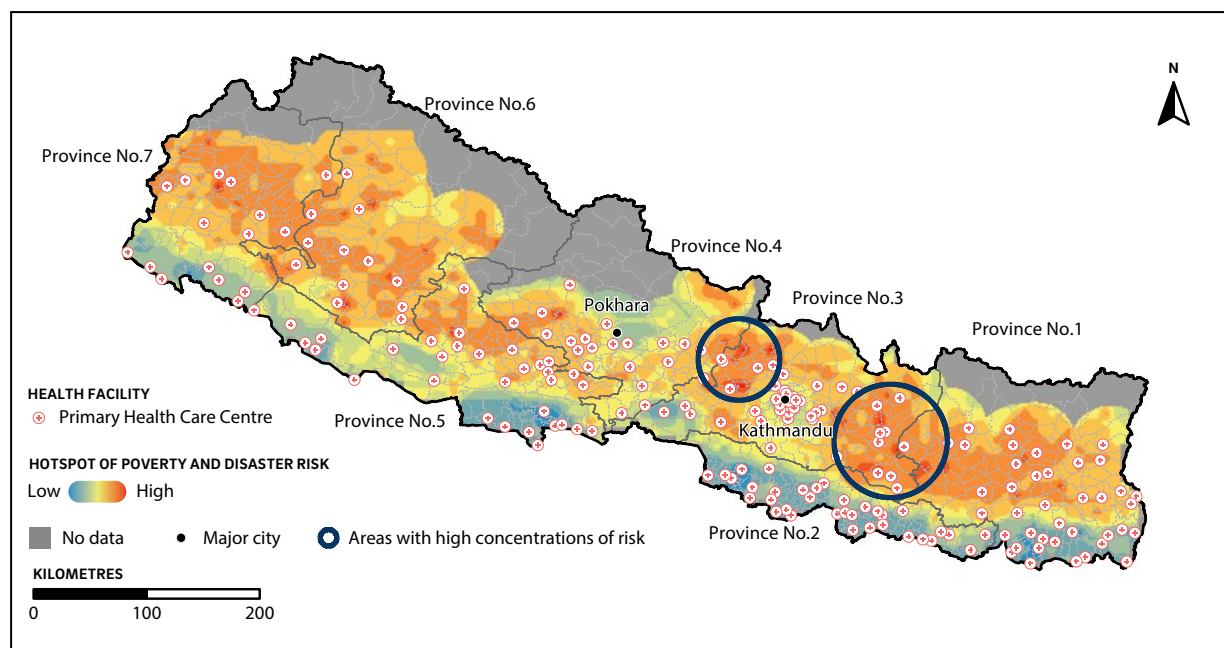
FIGURE 2-27 The most vulnerable populations in the GBM basin



Source: Calculations by ESCAP based on Official population statistics from national statistics office of each of the 5 countries, (2) DHS Programme Household Survey results from Bangladesh, India and Nepal, (3) German Aerospace Centre (DLR) Global Urban Footprint, (4) Earth Observations Group at NOAA Nightlights data, (5) European Space Agency Global Climate Change Initiative (CCI) Land Cover, and (6) UNISDR GAR, 2015 Probabilistic Hazard Maps.

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

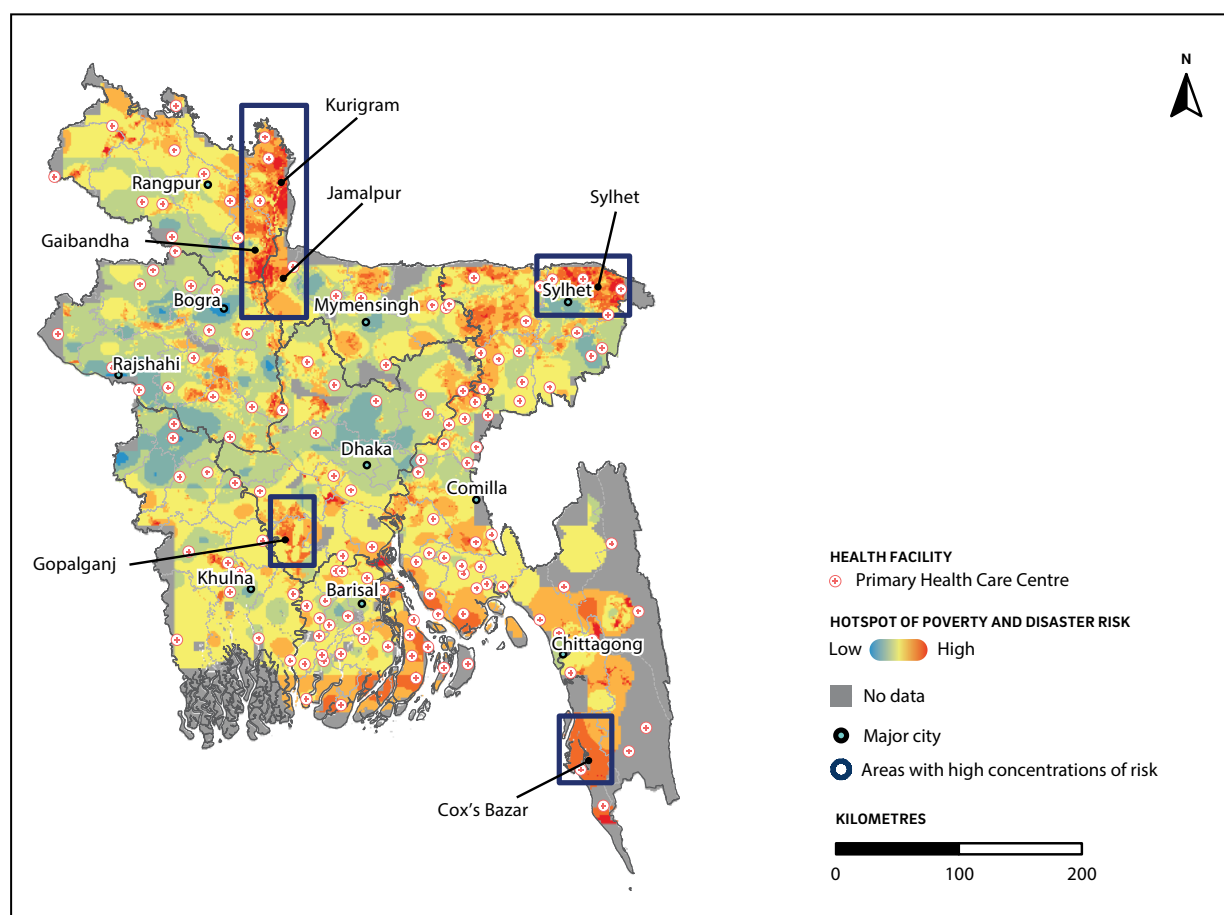
FIGURE 2-28 Mapping vulnerable communities and health facilities in Nepal



Sources: ESCAP, based on DHS Programme Household Survey for Nepal, and multi-hazard data from Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015.

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

FIGURE 2-29 Mapping vulnerable communities and health facilities in Bangladesh



Sources: ESCAP, based on DHS Programme Household Survey and Service Provision Assessment Survey for Bangladesh, and multi-hazard data from Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015.

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

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- 33 ESCAP (2018a).
- 34 Countries included in the region-wide analysis.
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- 46 FAO (2018).
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- 50 Adjusted for factors like wealth and education
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- 53 The odds ratios have been converted to percentage for ease of interpretation. The calculation for this is $(OR-1)*100$.
- 54 Srinivas Murthy, and Michael Christian, (2010).
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- 58 Ibid.
- 59 EMIC Media (2017).
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- 61 Save the Children (2016).
- 62 The methodology is similar to the one used in a prior ESCAP publication, "Inequality in Asia and the Pacific in the era of the 2030 Agenda for Sustainable Development" and detailed description of the methodology can be found there. See ESCAP (2018b).
- 63 ESCAP (2018b).
- 64 Ibid.
- 65 IPCC (2018).
- 66 Drought is a complex phenomenon, potentially exacerbated by changing climate patterns, as well as other soil, vegetation and water-related attributes.
- 67 The methodology and calculation used to generate the combined risk hotspots are given in Annex 2.2.
- 68 Marufa Akter (2016).
- 69 FAO (2011).
- 70 The analysis used several sources, including the WorldPop data, urban built up area, nightlight data, (NASA), as well as the DHS wealth index data to estimate and validate the location and density of poverty in the GBM basin.
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CHAPTER 2: REACHING THOSE LEFT BEHIND

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