



Chapter 3

Inequality of Impact: Environment and Inequality





3.1 WHAT IS INEQUALITY OF IMPACT?

Leading on from the discussion of inequality of income and of opportunity, this chapter explores linkages between inequality and the natural environment, at a time when a clean and healthy environment is increasingly regarded as a human right. Firstly, the analysis looks at where inequalities of income and opportunity appear to coincide with damage to the natural environment. The second part is structured around the question of why and how human-induced environmental degradation tends to worsen socioeconomic inequality by having disproportionate impacts on poor and vulnerable groups and on low-income countries. The empirical analyses ask whether i) air-pollution is a factor that drives up inequality within countries; ii) conservation of natural capital can help reduce inequality within countries; and iii) climate change and natural disasters widen income inequality within countries?

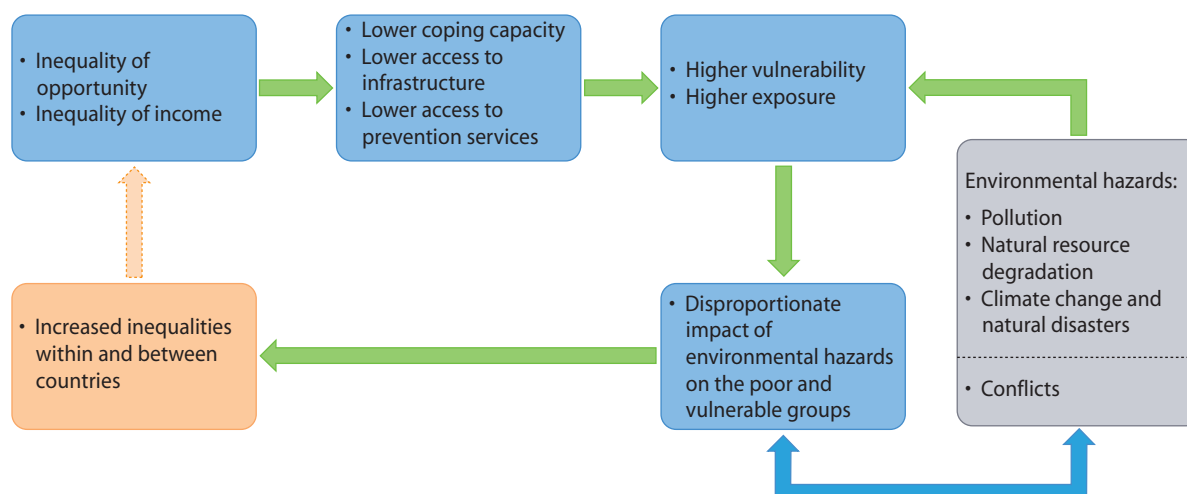
Figure 3.1 illustrates the relationship between inequality and the environment explored in this chapter. It summarizes the key driving mechanism of the unequal impact of natural hazards on poor and the marginalized communities. The inequality of income and opportunities discussed in chapters 1 and 2 identifies several groups of people that are “left behind”. These groups of people are often confronted with the following situations: i) low capacity to cope with environmental hazards; ii) inadequate access to infrastructure to protect themselves from environmental hazards; and iii) absence or low level of prevention services to environmental hazards.

As a result, they become highly vulnerable and disproportionately exposed to environmental hazards. Exposure and vulnerability are two main factors of risk and therefore environmental hazards can have a bigger impact on these groups. A degraded environment threatens the health, livelihoods and wellbeing of disadvantaged groups and this, in turn, further affects the inequality of opportunities and outcome- creating a vicious cycle. To add to this complexity, conflicts arising from natural-resource use and management can reverse gains made on human development and mostly impact the poor.

The question of whether higher levels of inequality are associated with environmental damage is not a new one. For more than 20 years researchers have sought to understand if there is a relationship between them, and, if so, what the causes might be. The conclusions have been mixed, but a degree of empirical consensus has emerged in three broad areas:

- Several cross-country comparisons have indicated a relationship between inequality and deforestation/ biodiversity loss, where more equal countries tend

Figure 3.1 Inequality and environmental impact



Source: ESCAP.

to have lower rates of deforestation and impacts on biodiversity.¹

- Some studies have found that countries with higher levels of inequality tend to consume relatively high levels of energy and carbon-intensive products, such as meat, use more water and generate more waste.²
- The quality of governance seems to play a role for moderating environmental pressure and degradation. However, there is no strong agreement on what aspect of governance – such as whether a country is a formal democracy, the existence of active civil society organizations, or the level of corruption – is most important.

Inequality of impact among countries

Further studies have looked at unequal relationships among countries and the implications for the natural environment. Wealthier countries, with their superior economic status and geopolitical power, can consume more natural resources than they have available domestically and outsource polluting and resource-intensive production processes to less prosperous nations.³

Inequality of impact within countries

The relationship between socioeconomic status and unequal exposure to environmental risk factors within countries has been intensively studied, especially in developed country contexts. Often labelled “environmental justice”, it emerged as a scholarly discourse in the United States in the 1980s and has since then evolved into a well-established academic field. It is concerned with how different groups in society are exposed to and harmed by pollution and other environmental risk factors, especially how certain socioeconomic or ethnic minority groups are

disproportionately exposed to and affected by such hazards. In high-income countries, an extensive literature confirms the inequalities associated with environmental hazards.⁴ However, despite the dire environmental conditions in many low- and middle-income countries, systematic empirical studies on the links with inequality, including causes and effects, remain limited.⁵

By studying the disproportionate impact of environmental hazards both between and within countries, this chapter adds to the existing literature and derives some key environment-related policies that can help in reducing inequality.

3.2 UNEQUAL IMPACTS OF AIR POLLUTION

Air pollution is a growing threat to the wellbeing of people in the Asia-Pacific region, especially in China, India and South-East Asia. The region’s rapid industrialization, urbanization and rising vehicle ownership is driving this upward trend.⁶ Some cities have become notorious for smog and highly detrimental health impacts, including premature death.⁷ Indoor air pollution is also a serious health issue in the region’s poorer areas, both rural and urban. In South-East Asia, 62 per cent of households use wood or charcoal for cooking, while 32 per cent of households rely on highly polluting kerosene and oil lamps.⁸

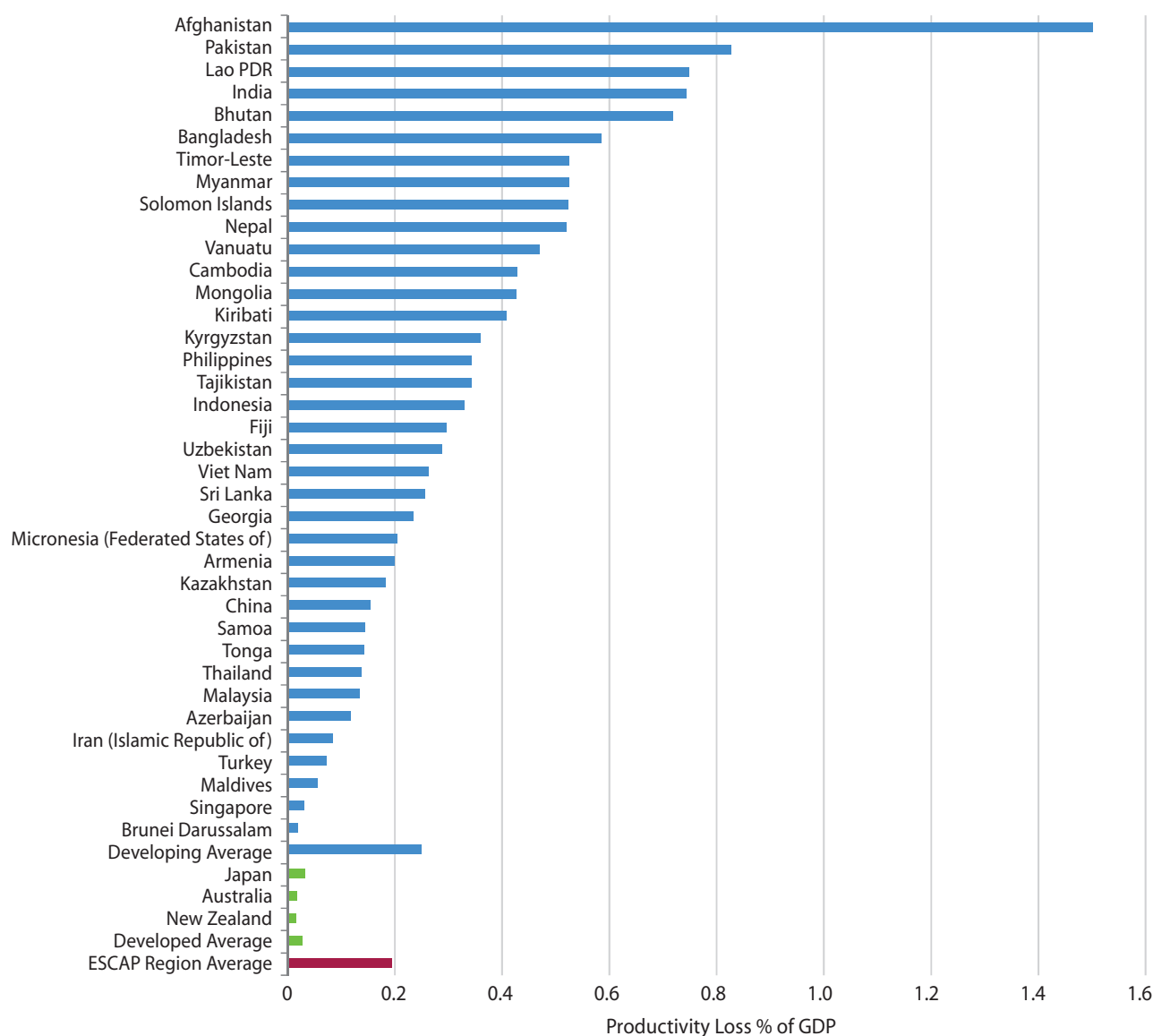
3.2.1 Inequality among countries

Around 92 per cent of pollution-related deaths occur in low- and middle-income countries. Asia and the Pacific countries fare poorly – more than 5 million lives are lost on average across the region as a result of pollution (including ambient and household air pollution, unsafe water and unsafe sanitation, and exposure to lead pollution).⁹ To evaluate the role of pollution in

exacerbating inequality among countries in the region we have focused on productivity losses as a percentage of GDP arising from excessive levels of pollution. ESCAP analysis shows that the average loss in productivity as a percentage of GDP due to the aforementioned pollution sources is more than eight times higher in developing countries (0.25 per cent of GDP) than in industrialized countries (0.03 per cent of GDP) in the

region. The analysis also indicates a clear disparity between developing and industrialized countries with regards to the consequences of pollution (Figure 3.2). Developing countries account for around 96 per cent of the region's annual productivity loss that is caused by pollution. This implies that pollution can exacerbate income inequality between the region's developed and developing countries.

Figure 3.2 Productivity loss due to pollution, percentage of GDP



Source: ESCAP calculation using data appendix from Landrigan et al. (2018).

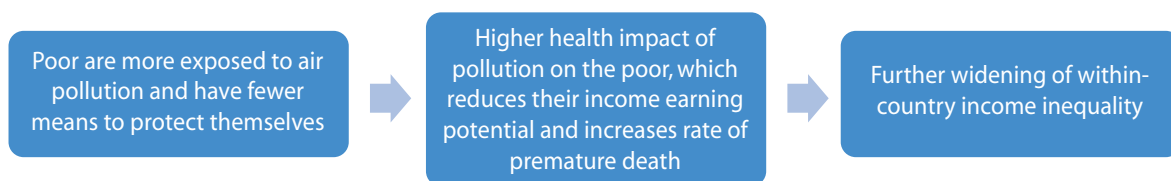
Note: Group averages are GDP weighted.

3.2.2 Inequality within countries

Studying the impact of air pollution on inequality within countries ideally requires disaggregated data on the differential exposure of pollution on subregions and sub-groups within a population. Given the paucity of such data in most countries, we have used a proxy measure of air pollution damage and a regression

analysis that strongly suggests pollution can be an important driver of inequality within countries.

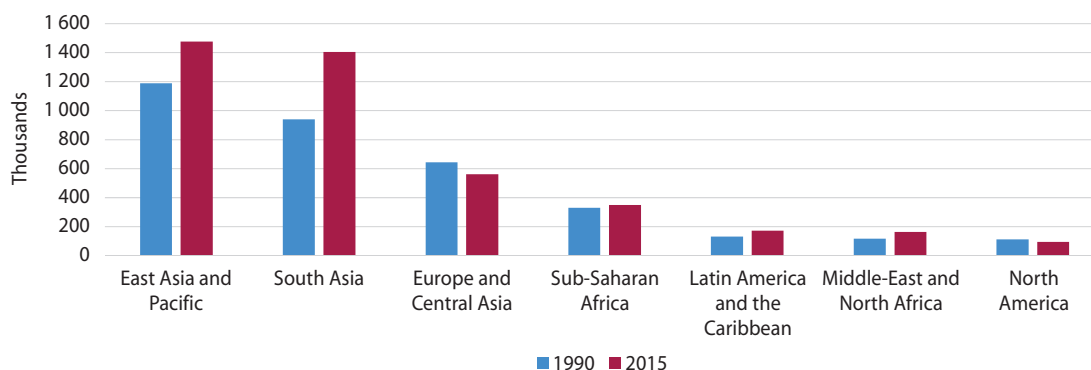
This section posits that when damage from air pollution in a country crosses a certain threshold, the increase in damage is associated with an increase in income inequality within countries. This relationship is described in Figure 3.3. The transmission mechanism is supported

Figure 3.3 Mechanism of transmission of the impact of air pollution on inequality within countries

by existing qualitative data from the region, which confirms that poor and disadvantaged people are more exposed and vulnerable to the pernicious impact of pollution. Because they are less able to protect themselves from pollution, their health and productivity suffer disproportionately.

To confirm this relationship, air pollution has been selected as a measure of environmental impact and introduced in the regression framework summarized in chapter 1 (see Annex Table A1). Associated with sickness

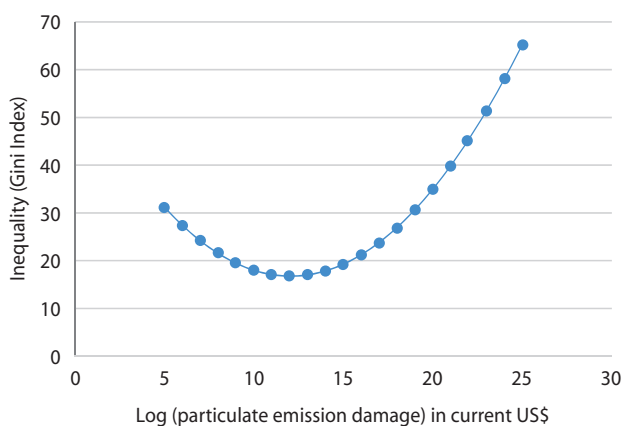
and premature death, air pollution clearly undermines productivity and participation in the workforce. Damage from particulate emissions provides a good proxy variable to measure the aggregate damage caused by air pollution. It is defined here as “damage from ultra-fine particles – particulate matter with a diameter of less than 2.5 microns (PM_{2.5})”.¹⁰ Figure 3.4 shows that the Asia-Pacific region (especially East Asia and Pacific and South Asia) experienced the world’s sharpest rise in premature deaths as a result of ambient air pollution (PM_{2.5}) between 1990 and 2015.

Figure 3.4 Premature deaths from ambient air pollution (PM_{2.5}), by region, 1990 and 2015

Source: Lange, Wodon and Carey eds. (2018).

The regression analysis builds on studies such as the Lancet Commission on pollution and health.¹¹ High levels of particulate emission damage imply that air quality has worsened beyond an acceptable threshold, indicating that air pollution is fast becoming a major environmental problem within countries.¹² The results clearly show that as air pollution exceeds certain thresholds it significantly increases levels of inequality within countries.

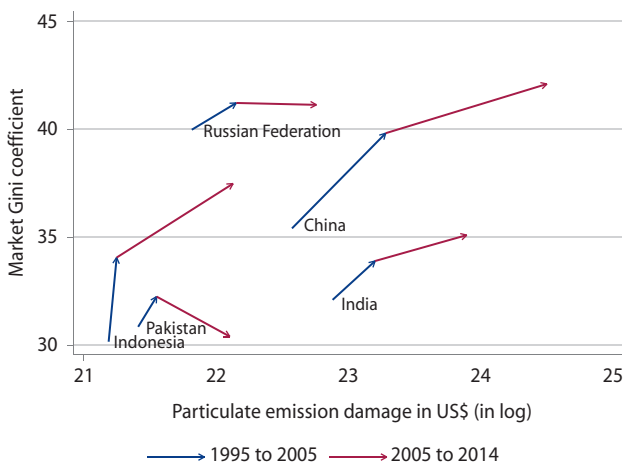
The relationship between the two variables is illustrated in Figure 3.5. The U-shaped curve suggests that at lower levels of particulate emissions damages inequality falls with a rise in pollution. However, this relationship turns out to be positive once aggregate PM_{2.5} emissions cross a threshold, suggesting a sharp rise in inequality is associated with increases in damage from particulate emissions.

Figure 3.5 Inequality and environmental degradation, within countries

Source: ESCAP illustration of relationship between inequality and particulate emission damage, as shown in the regression analysis in Annex 1.3.

Figure 3.6 plots the observed variations in the Gini coefficient and particulate emission damage between 1995 and 2005 and from 2005 to 2014 in the five countries that experienced the highest damage from particulate emissions in the Asia-Pacific region in 2014. As predicted by the regression results, spikes in particulate emission damage were associated with increases in income inequality, with the exception of Pakistan and the Russian Federation between 2005 and 2014.

Figure 3.6 Income inequality and particulate emission damage in selected Asia-Pacific countries, 1995-2005 and 2005-2014



Source: ESCAP calculation using data sources described in Annex 1.3.

Note: These five countries experienced the highest level of particulate emission damage in 2014, among Asia-Pacific countries for which Gini coefficients were also available.

Further disaggregated evidence from within countries supports the transmission mechanism mentioned earlier; that poor and disadvantaged groups are the most exposed to environmental degradation. A study in Shanghai examined the causes of mortality in different socioeconomic groups and found that death from cardiorespiratory diseases, which are closely linked with exposure to air pollution, was more likely among residents with low educational attainment (illiterate or only educated to primary school level) compared with those with high educational attainment (having attended middle school or above).¹³ A recent review of air pollution assessments in India showed several examples of higher levels of exposure for low-income households compared with those with higher median incomes.¹⁴

Studies in cities in Viet Nam found that respiratory illnesses were twice as common in low-income households as in high-income ones.¹⁵ A study of China's Jiangsu province found that townships with a higher percentage of rural migrants (a disadvantaged

group due to their lack of formal residency in urban areas) are more likely to be exposed to higher levels of air pollution.¹⁶ This adds another dimension to the findings of chapter 2, where access to various opportunities was positively associated with educational attainment in the household. It confirms that circumstances (such as the educational attainment of a parent) over which one has no control often determine opportunities, as well as outcomes.

Apart from differences in exposure to pollution, there is also a disparity in peoples' ability to protect themselves. Studies in China of households' demand for face masks and air purifiers (which have become status symbols in some places) have confirmed these differences: high-income groups are much more likely to own air purifiers, which are more expensive than masks and much more effective.¹⁷

The analysis underscores the need to systematically study the impact of pollution on low-income households and to identify ways to reduce their exposure. The 2018 Asia Pacific Clean Air Partnership Joint Forum highlighted several solutions to improve air quality in the region ranging from technological solutions to regulatory reforms involving diverse stakeholders.¹⁸ The findings of this section imply that these solutions to tackle air pollution can have the co-benefit of reducing inequalities, providing additional incentives for their implementation.

3.3 UNEQUAL IMPACTS OF NATURAL RESOURCE DEGRADATION

All societies are inextricably linked to the natural world, but the connections are deepest and most obvious for rural households, smallholders, forest-dependent communities and artisanal fishing villages. There is evidence that income inequality between households is lower among rural households that rely on income derived from forests and agricultural land.¹⁹ Marine and coastal ecosystems in the Asia-Pacific region have also traditionally provided economic, social, environmental and cultural value to society and played a part in maintaining income inequality at relatively low levels. However, patterns of natural resource use are changing drastically due to urbanization, industrialization and changes in consumption choices. For example, calculations show that urban expansion will result in a 1.8-2.4 per cent loss of croplands by 2030, with Asia suffering the highest absolute loss of cropland area.²⁰ This section explores how overuse and degradation of natural resources can have significant implications for inequality among countries and within them.

3.3.1 Natural capital and inequality among countries

The “natural capital” of a country is the value of its stock of natural resources, which underpins development and survival. Various attempts have been made to measure natural and human capital, which arguably provide a richer account of the true wealth of nations than that of traditional GDP. This section uses the measure of natural capital estimated by the World Bank,²¹ which provides an internationally comparable measure of natural capital of countries from 1995 to 2014.²² Specifically, the focus is on the renewable component of natural capital, namely, forests, agriculture land and protected areas. This renewable component of natural capital can be increased in value by measures such as increasing the forest cover, protected areas, promoting alternate higher value of existing forests in the form of eco-tourism, improving of crop-yield and bringing more land into productive use.

Natural capital comprises of close to 47 per cent of the asset of low-income countries, and even in low-middle income countries it comprises of about 27 per cent.²³ How countries use their natural capital and transform it into other forms of capital such as human capital and created capital, and the rate at which this happens determines their development pathway.

Researchers have been able to more comprehensively map the flow of natural resources across the world economy to determine the true “material footprint” of countries. In the Asia-Pacific region, high-income countries have a material footprint more than double the size of their low-income counterparts.²⁴ This alludes

to the fact that the over-exploitation of natural resources in developing countries is often driven by consumption demand in richer countries. Some resource-rich developing countries are also forced by market pressure to use their natural capital at a much faster rate than can be supported by their macroeconomic and institutional capacity.²⁵ As a result, developing countries often bear the disproportionate negative externalities of natural resource use and over-exploitation. This can lead to conflicts related to control and management of resources, which can further weigh on economic growth and worsen between-country inequality.

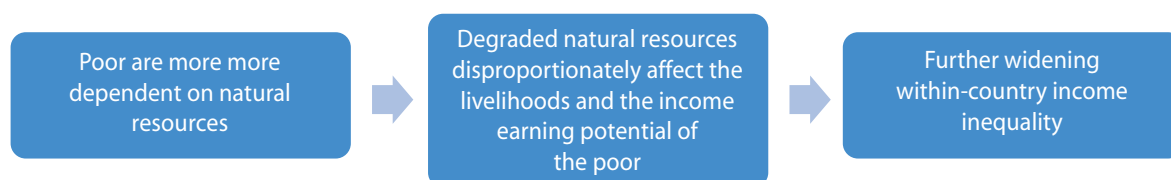
3.3.2 Natural capital and inequality within countries

When natural resources are over-exploited, poor people who depend on them for their livelihood are usually disproportionately affected. The loss of earnings and opportunities feeds into rising inequality within countries, as illustrated by Figure 3.7. Overall, as the value of renewable natural capital available per capita declines it can contribute to an increase in income inequality within countries.

The cross-country regression model in Annex Table A.1 is also used to estimate how natural resource degradation affects inequality. The results show that as the availability of renewable natural capital expands in countries, income inequality seems to decrease. Conversely, income inequality rises within countries as their natural capital is exploited.

As shown by the case study from Indonesia (Box 3.1), the ecological impacts of loss of natural capital such as

Figure 3.7 Mechanism of transmission of impact of natural resource degradation on inequality within countries



forests can be extensive. Figure 3.8 contrasts the variation in forest capital (a component of renewable natural capital) in Indonesia, along with variation in the Gini coefficient during 1995-2014. There were significant losses in renewable natural capital per capita arising from forests in the periods from 1995 to 2005 and from 2005 to 2014, with a total reduction amounting to 22 per cent of the value of forest capital in 1995. The fall in forest capital per capita was

associated with a substantial increase in the Gini coefficient in this period, as predicted by the regression analysis.

The empirical analysis underscores that in countries that experience a high rate of reduction of different components of natural capital, the resulting natural resource degradation and subsequent loss of ecosystem services can be an important mechanism that

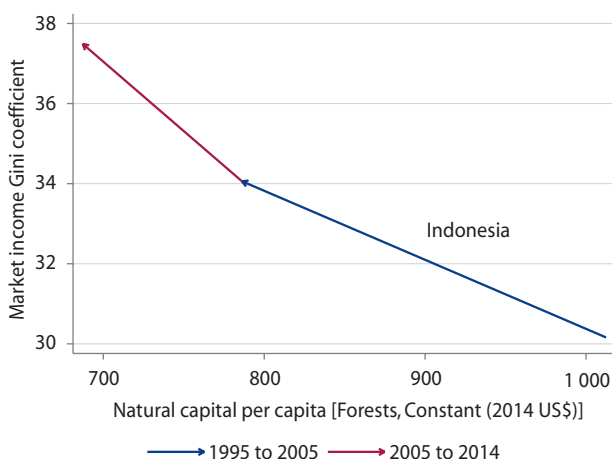
Box 3.1 Ecological impacts of palm oil expansion in Indonesia

The expansion of palm oil cultivation in Indonesia provides a sobering example. Between 2000 and 2012 the country lost an estimated 0.84 Mha of primary forest each year, amounting to more than 6Mha, and significantly outpacing deforestation rates in Brazil; half of this forest loss has been attributed to palm oil expansion. The loss to biodiversity has been devastating, as a single hectare of rainforest harbours more than 200 species of plant, more than 60 per cent of which are endemic. Converting forests to palm oil plantations results in the loss of large amounts of carbon from biomass and from the disturbed soil. In particular, drainage of peat swamps for oil palm establishment is associated with extremely high CO₂ emissions when organic matter that has accumulated over millennia is allowed to decompose.

Wildfire smoke is a major source of air pollution that adversely affects human health and productivity in South-East Asia. Despite regulations against land-clearing fires, “slash and burn” agriculture is a common occurrence in the dry season. Wildfire smoke can cause respiratory and cardiovascular disease and even death. In addition to devastating health effects, wildfires have adverse economic effects. Closed businesses, schools and limited transportation can bring economies to a halt, and the effects of fires spread far beyond the geographic region where they originate. Pollutants from agrochemicals associated with palm oil production (fertilizers, pesticides, and rodenticides) have harmful impacts on terrestrial and aquatic ecosystems. Palm oil mill effluent, which is microbially digested in open ponds, often overflows into waterways during heavy rains. The use of dangerous herbicides and pesticides also directly affects the health of workers who handle these chemicals.

Source: Petrenko et al (2016)

Figure 3.8 Transition of value of natural capital per capita (from forests) and market Gini in Indonesia, 1995-2014



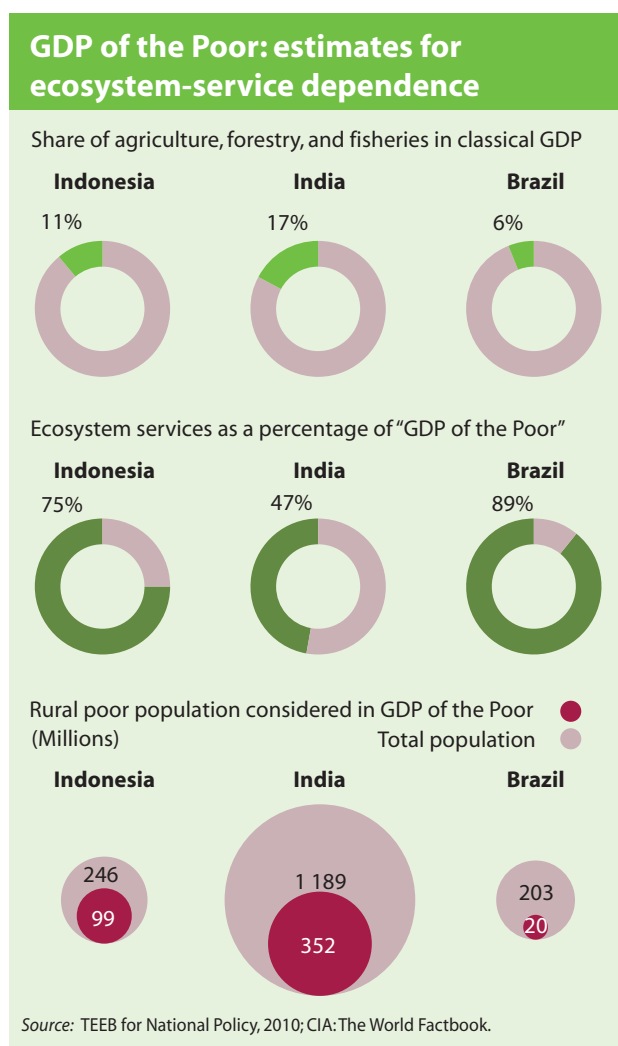
Source: ESCAP calculation using data sources described in Annex 1.3.

exacerbates inequality within countries. However, the existing measures of natural capital management of countries are rather incomplete. For example, as of now they do not capture the value of marine/fishery resources or the value of numerous other ecosystem services such as protection from natural hazards, ensuring water cycles, preserving biodiversity and ensuring carbon storage. We do not yet have accounts of ecosystem services that low-income rural households often depend on in practice, and there is also a scarcity of studies looking at multidimensional poverty and ecosystem services.²⁶

Ample evidence supports the transmission mechanism presented earlier in this section. The 2005 Millennium Ecosystem Assessment pointed out that resource exploitation, such as deforestation, often has skewed distributional effects – benefiting certain groups while leaving the rural poor worse off. Indigenous peoples are a particularly vulnerable group, as their traditional ways of life are completely entangled with their natural environment. An estimated 481 to 579 million people in Asia and the Pacific are considered forest peoples.²⁷ Traditional indigenous territories, which contain around 80 per cent of the planet’s biodiversity, even though they encompass up to 22 per cent of the world’s land surface, are under serious threat of deforestation, agricultural and industrial expansion and uncontrolled fires.²⁸

The unequal distribution of land further contributes to the vulnerability of many households and communities across the region. For example, around 55 per cent of Indonesia’s farmers rely on less than half a hectare, while less than a quarter of small-scale farmers in Cambodia have land titles.²⁹ In Bangladesh, around 75 per cent of the rural population consists of landless labourers or marginal farmers owning less than 0.2 ha of land.³⁰ Estimates suggest that ecosystem services and other non-marketed goods make up between 50 and 90 per cent of the total source of livelihoods among poor rural and forest-dwelling households, which can be termed as the “GDP of the poor” (Figure 3.9). Natural resources and associated ecosystem services therefore have significant implications for the reduction of multidimensional poverty and inequality.³¹

Figure 3.9 Estimates for ecosystem-service dependence



Note: Created by GRID-Arendal, available at: <http://www.grida.no/resources/8133>

3.4 UNEQUAL IMPACTS OF CLIMATE CHANGE AND NATURAL DISASTERS

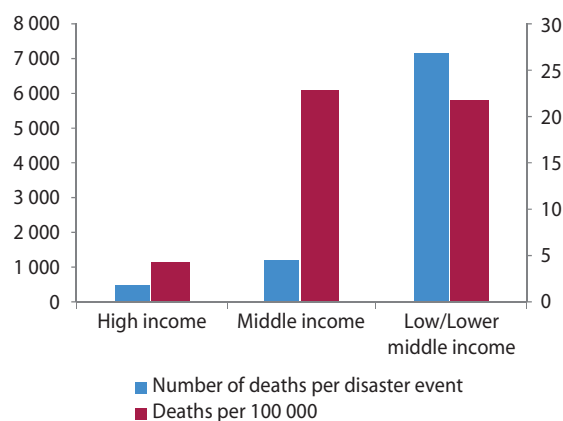
From shifting weather patterns that threaten food production and livelihoods, to rising sea levels, the impacts of climate change are already being felt across the Asia-Pacific region. Often the poorest and most disadvantaged communities face the greatest impacts, which adds to the urgency of introducing policies that drastically reduce greenhouse gas emissions. The section below discusses the implications of climate change and natural disasters to both inequalities between and within countries.

3.4.1 Climate change, natural disasters and inequality among countries

The Asia-Pacific region is more exposed to the impacts of climate change than other world regions. Six of the 10 countries most affected by climate change in 1996-

2015 are in Asia.³² Furthermore, in 2017 the region accounted for 43 per cent of all registered disaster events and 68 per cent of all fatalities.³³ The impact of disasters on human lives is very unevenly distributed, with mortality rates from "disaster events" four to five times higher in low- and middle-income countries than in high-income countries (Figure 3.10).

Figure 3.10 Deaths per disaster event and per 100,000 inhabitants, by country income group, 2000-2015



Source: ESCAP (2017g) based on data from EM-DAT database.

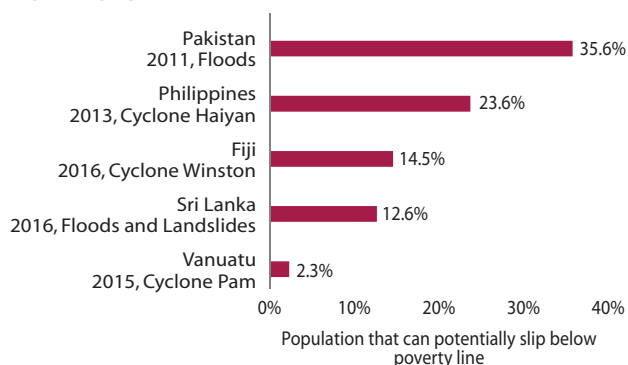
While the estimated economic losses from climate hazards in rich countries are much higher than in poorer ones in absolute numbers, the relative economic impact on low-income countries is dramatically higher – losses representing 5 per cent of GDP in low-income countries compared with 0.2 per cent in high-income ones.³⁴ This disproportional economic damage is clearly hampering development efforts in low-income countries, especially in sectors such as agriculture and marine resources. Other climate impacts, such as water scarcity, severe heat waves and increased incidence of malaria and dengue fever, also affect low- and middle-income countries disproportionately, worsening inequality among countries.

3.4.2 Climate change, natural disasters and inequality within countries

Disasters can lead to widening disparities in income. Data from 19 countries in the Asia-Pacific region point to a positive relationship between the number of disasters a country has faced and its income inequality levels.³⁵

Figure 3.11 shows that up to 35 per cent of the population in the affected areas was likely to fall below the poverty line as a result of the disaster. These findings highlight the vulnerable situation of the large numbers of people in the Asia-Pacific region categorized as "near-poor". The powerful tropical cyclones that have

Figure 3.11 Impact of recorded disasters on poverty rates, selected Asia-Pacific countries, 2011-2016



Source: ESCAP (2017g) based on the ESCAP statistical database and country post-disaster damage assessments.

devastated parts of the region in recent years are reminders of the challenges many vulnerable communities and municipal authorities face.

Insurance clearly plays a key role in enabling people, businesses and institutions to recover from natural disasters, but access to it varies enormously. In 2013, for example, 67 per cent of the economic losses from natural disasters in the United States were insured, while the corresponding figure for Asia was just 7.6 per cent.³⁶ Access to services such as insurance and banking is improving across the Asia-Pacific region, but it remains the privilege of wealthier citizens in many countries.

Women and children in low-income households are disproportionately affected by disasters and by slow-onset impacts of climate change.³⁷ Stunted children are disproportionately found in households belonging to the poorest 40 per cent of the population, and their mothers almost always have lower education levels. Poor, crowded urban communities are often located on marginal land that is vulnerable to floods and landslides. People who spend longer periods working outdoors or have limited access to water or air conditioning are inevitably most at risk from heat waves, which are becoming increasingly frequent in parts of the region. Malnutrition further contributes to the susceptibility of low-income groups to heatwaves.³⁸

3.5 ENVIRONMENTAL INEQUALITIES AND CONFLICTS

Competition over natural resources can lead to, intensify or sustain violent conflict, especially if resources are owned or controlled by a small group. On the one hand, a rich endowment in natural resources generates revenue streams that can be channeled into sustainable development, reducing income inequalities and hence alleviating the potential for conflict. On the other hand, the exploitation and mismanagement of natural

resources can deepen poverty and social inequality, exacerbating impacts of climate change and conflict. Inequality in natural resource ownership, coupled with weak political institutions, creates self-perpetuating negative cycles that can be very difficult to break.

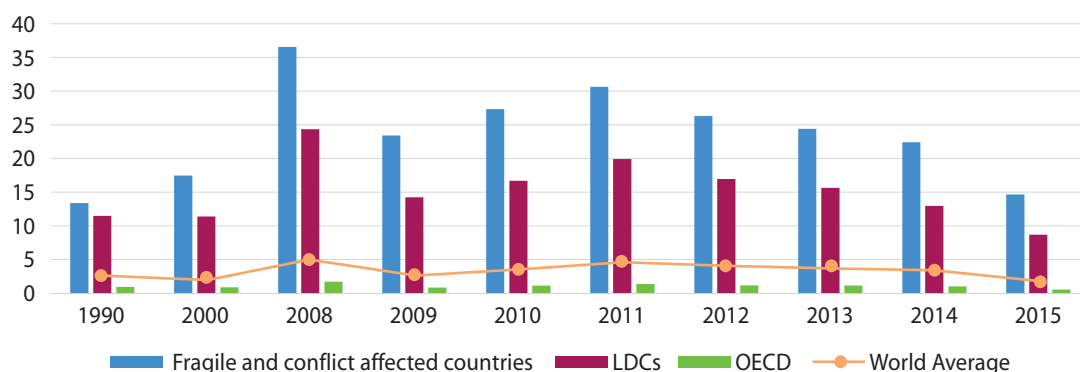
In the Asia-Pacific region the following places and practices have been identified as at risk from natural resource-based conflict: a) The use of freshwater and freshwater ecosystems in the Mekong, Amu Darya, Syr Darya, and Ganges river basins as well as the Aral Sea; b) Air pollution from forest fires in South-East Asia; c) Access to energy resources in the South-China Sea; d) The energy-water-food nexus in Central Asia and e) intra-State, local-level conflicts related to foreign investments in the mining and agro-industry.³⁹

Globally, at least 40 per cent of all intrastate conflicts are assessed as having a link to natural resources in the last 60 years.¹⁰ Furthermore, different types of commodities can correlate with conflict in different ways. For example, oil and other reserves can be associated with a higher risk of conflict while “lootable” commodities such as gemstones can prolong conflict⁴¹ by feeding illicit financial flows and promoting practices that institutionalize inequality.⁴² Global estimates of illicit financial flows show that the problem is significant and widespread and poses particular problems for poor, institutionally fragile and resource-rich countries.⁴³ Figure 3.12 illustrates the clear connection between increased dependence on natural resource rent and fragility and conflict in countries.⁴⁴

Natural resources provide an important basis for rural livelihoods. Consequently, resource scarcity coupled with poverty, inequality, insecure land tenure and imbalances of power all heighten the risk of conflict. Examples include illegal land acquisitions that displace local communities, and energy developments (such as in the Mekong River) that have impact on biodiversity, land-use patterns and, consequently on rural livelihoods. Indigenous peoples have also faced significant hardship in the face of agricultural investment linked to the production of palm oil in South-East Asia.

These factors can, according to the environmental change and violent conflict theory, trigger conflicts of differing types: “simple-scarcity” conflicts due to declining levels of natural resources; “group-identity” conflicts due to large population movements caused by environmental stress; and “deprivation” conflicts due to socio-economic deprivation from environmental scarcities. While the theory does not apply to all conflicts, it is worth studying its implications in the context of the Asia-Pacific region in more detail.^{45, 46}

ESCAP analysis suggests that conflict occurrence is cyclical, with variations that could be weekly or seasonal,

Figure 3.12 Natural resources rents as percentage of GDP

Source: World Bank, World Development Indicators, accessed 2017.

and linked to anthropogenic activities that influence weather cycles and climate patterns. Furthermore, communities in conflict-affected areas tend to be less resilient. Worse is that among the poor, conflicts disproportionately constrain their adaptive capacity and choices. Similarly, community members affected by disasters are more likely to engage in conflict. In these circumstances, inequality across societies can widen quickly. It has therefore become a matter of urgency to recognize that, in addition to more conventional peace-building approaches, climate adaptation and disaster risk reduction are entry points for preventing conflict. In situations where conflict is based on competition for scarce resources, better management of natural resources, combined with climate change adaptation, must be channeled into non-violent resolutions.

3.6 CONCLUSIONS AND RECOMMENDATIONS

The key message of this chapter is that environmental degradation (pollution, exploitation of natural resources, natural hazards and climate change) and related conflicts disproportionately impact the poor and disadvantaged (as well as poorer countries) and can exacerbate inequality of opportunity and outcome both within and among countries. The analysis specifically showed that, within countries, the damaging effects of air pollution can exacerbate inequalities, while conserving and expanding natural capital is associated with reduced inequality. Therefore, it is paramount to recognize the critical role of the environment in efforts and policies that tackle inequality and ensure development is inclusive.

Effective actions need to reflect national and local circumstances, but, with that in mind, the following are some specific policy directions to consider:

Address unequal impacts of air pollution

- While taking action to reduce pollution, make focused efforts to protect vulnerable groups,

especially children, older persons and residents of areas with low socioeconomic status.

- Enhance city planning and zoning to reduce exposure to pollution. Seek to separate residential areas from polluting industries and major roads. Establish green corridors and wedges in the cityscape, and ensure that many streets are tree-lined.
- Strengthen capacity for pollution monitoring and disclose such data in real time to the public, using ICT and other channels. Consider that pollution levels vary across cities, implying a need for multiple monitoring stations to cover the full range of neighbourhoods. Partner with local universities to develop more comprehensive monitoring campaigns. Educate citizens about the relationship between air quality and health, including awareness of protective measures.
- Map out the sources of pollution, especially in poorer neighbourhoods. Use the mapping to enforce regulations on emissions to proactively apply the polluter-pays principle, with adequate measure to increase compliance, reduce corruption and channel funds generated towards resilience-building among vulnerable groups.
- Facilitate the switch to cleaner energy sources in households in order to reduce the burden of indoor (and outdoor) air pollution. Electrification, based on renewable sources, should be promoted wherever possible. Subsidy schemes for the poor can facilitate the uptake of household equipment using cleaner energy. Regulations, awareness campaigns and social marketing will also be needed for enhanced effectiveness.
- Make basic health-care services accessible and affordable to all, as highlighted in chapter 2, and establish regular health screenings in neighbourhoods with low socioeconomic status, especially in schools.

Reduce vulnerabilities to climate change impacts and help improve resilience

- Channel more financial resources for climate change adaptation directly to local communities and civil-society organizations that are rooted in local realities. Provide targeted agricultural extension services to those relying on marginal land and other climate-sensitive lands for their livelihoods.
- Ensure that disaster preparation drills reach also disadvantaged communities and involve especially vulnerable groups, such as women, children, elderly, people with low education, and those with disabilities. Develop evacuation plans and build storm shelters in rural areas likely to be affected by strong cyclones.
- Protect and restore coastal forests that can lessen the combined impact of sea-level rise and storms. Seek opportunities to create green jobs by involving rural poor in such projects.
- Prevent informal settlements in flood-prone urban areas by creating opportunities for affordable housing in safer locations, in line with SDG 11.1.
- Facilitate access to insurance for low-income communities. One way to take action in this area is by joining and supporting the InsuResilience Global Partnership, which has been endorsed by G20, V20, and G7, and which was officially launched in November 2017 at the UN Climate Conference COP23 in Bonn.
- Provide adequate assistance to the growing number of climate migrants/refugees. Take steps towards providing climate migrants the same legal status and right to protection as other refugees. International cooperation, including on financing and in the form of reformed rules for international resettlement, is needed to help secure the livelihoods of these groups.

Secure access to environmental systems as livelihood resource

- Speed up efforts to formalize land ownership, while respecting traditional forms of ownership and use rights, such as collectively managed commons.
- Improve access to justice to help subsistence-oriented communities defend the resources they rely on for their livelihoods and continued existence. Consider establishing special courts for resolving conflicts over land and other natural resources.

- Strengthen mechanisms for social and environmental assessments of large-scale investments in agriculture, and involve local communities in the decision-making process.
- Reduce and reform government subsidies for large-scale fishing, reflecting not only sustainability of fish stocks but also impacts on small-scale coastal fisheries. Support the establishment of a Conservation Treaty for the High Seas.

Cross-cutting actions

- Generate disaggregated data systems and conduct more systematic research, especially in developing countries, to deepen understanding of how environmental hazards impact the poor and disadvantaged groups (as identified in chapter 2). Such research would help deconstruct inequalities that exacerbate vulnerability to natural disasters and reinforce environmental degradation and its impacts.
- Policy processes and decision-making, at all levels should be strengthened to ensure effective participation of women. Instruments to capture sex-disaggregated data should also be in place to reveal the contribution of women to all sectors of economy. Sex-disaggregated data will also be critical in devising ways to harness women's agency to reduce the disproportionate environmental impacts on the poor and disadvantaged communities.
- Incorporate the right to a clean, safe and healthy environment in national constitutions. Although constitutional provisions do not guarantee good environmental stewardship, they provide opportunities for all citizens, regardless of social status, to demand protection from environmental hazards through the judiciary system. Ensure that all citizens have access to justice, with special attention to marginalized groups. Support international efforts to formally include the right to a clean, safe and healthy environment as one of the human rights, in the form of a legally binding treaty.

While environmental degradation aggravates inequalities, and climate change is set to accentuate the impact of existing inequalities, many people are looking to technology to provide the solutions of the future that will help manage risks and asymmetric impacts. The following chapter reviews the impact that technology has had so far in shaping inequalities – and its prospective role in reducing or further aggravating inequalities of outcome, opportunity and impact.

ENDNOTES

- ¹ See Koop and Tole (2001); Holland et al. (2009); Islam (2015).
- ² Dorling (2017).
- ³ Clapp and Dauvergne (2011).
- ⁴ See Evans and Kantrowitz (2002); Jerrett (2009); Boyce (2017).
- ⁵ See Schoolman and Ma (2012); Pant et al. (2016).
- ⁶ Mannucci and Franchini (2017).
- ⁷ Landrigan et al. (2018).
- ⁸ World Health Organization (2016).
- ⁹ Landrigan et al. (2018).
- ¹⁰ Particulate emissions damage is the damage due to exposure of a country's population to ambient concentrations of particulates measuring less than 2.5 microns in diameter (PM2.5), ambient ozone pollution, and indoor concentrations of PM2.5 in households cooking with solid fuels. Damages are calculated as foregone labour income due to premature death. See more details on the variable: <http://databank.worldbank.org/data/reports.aspx?source=2&type=metadata&series=NY.ADJ.DPEM.CD>
- ¹¹ Landrigan et al. (2018).
- ¹² The existence of 'threshold effects' of environmental degradation, is well recognized in the ecological literature. See http://www.openness-project.eu/sites/default/files/SP_Thresholds.pdf
- ¹³ Kan et al. (2008).
- ¹⁴ Pant et al. (2016).
- ¹⁵ World Bank (2006).
- ¹⁶ Schoolman and Ma (2012).
- ¹⁷ Zheng, Sun and Kahn (2015).
- ¹⁸ Asia Pacific Clean Air Partnership (2018).
- ¹⁹ Chhetri, Larsen and Smith-Hall, C. (2015).
- ²⁰ Bren d'Amour et al. (2016).
- ²¹ Lange, Wodon and Carey eds. (2018).
- ²² It comprises energy (oil, gas, hard and soft coal) and minerals (10 categories), agricultural land (cropland and pastureland), forests (timber and some non-timber forest products), and terrestrial protected areas. Natural capital is measured as the discounted sum of the value of the rents generated over the lifetime of these assets.
- ²³ See table ES.1, Lange and Carey eds. (2018)
- ²⁴ United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2017h)
- ²⁵ Lange, Wodon and Carey eds. (2018).
- ²⁶ Suich et al. (2015).
- ²⁷ Forest Peoples Programme (2012).
- ²⁸ World Bank (2008).
- ²⁹ Genetic Resources Action International (GRAIN) (2015).
- ³⁰ Government of Bangladesh (2008).
- ³¹ Suich et al. (2015).
- ³² Kreft et al. (2017)
- ³³ Munich RE (2018).
- ³⁴ United Nations, Department of Economic and Social Affairs (DESA) (2016b).
- ³⁵ United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2017g).
- ³⁶ Impact Forecasting 2014
- ³⁷ Asian Development Bank (ADB) (2017).
- ³⁸ Intergovernmental Panel on Climate Change (IPCC) (2012).
- ³⁹ United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2017d).
- ⁴⁰ United Nations Environment Programme (UNEP) (2009).
- ⁴¹ Ross (2004).
- ⁴² Organisation for Economic Co-operation and Development (OECD) (2016c).
- ⁴³ World Bank (2016b).
- ⁴⁴ Organisation for Economic Co-operation and Development (OECD) (2016c).
- ⁴⁵ Homer-Dixon, Thomas (1994).
- ⁴⁶ Kaplan (1994).