NATURE'S PARADOX

Stepping Stone or Millstone?

WORLD BANK GROUP

Richard Damania, Ebad Ebadi,
Kentaro Mayr, Jun Rentschler,
Jason Russ, and Esha Zaveri

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1 2 3 4 28 27 26 25

ISBN (paper): 978-1-4648-2164-6
ISBN (electronic): 978-1-4648-2171-4
DOI: 10.1596/978-1-4648-2164-6

Cover image: "A poor kid from India walking on stepping stones over the water. Quality photo for a report." The AI image was generated using Adobe Firefly on February 28, 2025, and was edited in Adobe Photoshop; the final painted effect was achieved using a Photoshop Add-On (Action) from the Envato website.
Cover design: Ruben Silva, SlideBrand, Washington, DC.

Library of Congress Control Number: 2024922725

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Acknowledgments

This book was prepared by a World Bank team comprising Richard Damania (lead), Jason Russ (co-lead), Esha Zaveri (co-lead), Jun Rentschler (co-lead), Ebad Ebadi (contributor), and Kentaro Mayr (contributor). The book has greatly benefited from the strategic guidance and general direction of Juergen Voegele (Vice President, Sustainable Development Practice, World Bank).

In addition to research completed by the authors, this work draws on background papers, notes, and analyses prepared by the following individuals (in alphabetical order): Zhanguo Bai (International Soil Reference and Information Center), Esteban Balseca (World Bank), Kathryn Baragwanath (Harvard University and University of Melbourne), Gabriel Englander (World Bank), Shenghui Feng (World Bank), Joshua Gill (World Bank), Saad Gulzar (Princeton University), Kichan Kim (World Bank), Mira Korb (University of California, Davis), Lucile Laugerette (ENS de Lyon), Jana Franziska Lemke (Forest Governance), Aldo Gutiérrez Mendieta (Tecnológico de Monterrey), Mehmet Metehan Çiftçi (University College London), and Hassan Balasubramanya Soumya (World Bank).

Invaluable feedback and advice were received from the following peer reviewers at the World Bank (in alphabetical order): Ghada Elabed (Senior Agricultural Economist), Nancy Lozano Gracia (Lead Economist), Ruth Hill (Lead Economist), Juan Jose Miranda Montero (Senior Economist), Ambar Narayan (Practice Manager), Giovanni Ruta (Lead Economist), Audrey Sacks (Senior Social Development Specialist), Siddharth Sharma (Lead Economist), Sonya Sultan (Lead Specialist), Stephen Winkler (Social Development Specialist), and Andrea Woodhouse (Senior Social Development Specialist). The authors received incisive and helpful advice, inputs, and comments from (in alphabetical order) Paola Ballon, Jose Cuesta, James Foster, Valerie Hickey, and Renaud Seligmann.

The authors thank Lucy Southwood and Ann O'Malley for their excellent editing and proofreading services, as well as the World Bank publishing team consisting of Christina Ann Davis, Jewel McFadden, and Cindy Fisher. William Pragluski provided the cover design. Finally, Desy Adiati and Sreypov Tep provided impeccable administrative support, for which the team is grateful. This work was made possible by the financial contribution of the Korea Green Growth Trust Fund (refer to https://www.wbgkggtf.org) of the Sustainable Development Practice, World Bank Group, as well as the Global Program on Sustainability (refer to https://www.worldbank.org/en/programs/global-program-on-sustainability).

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Executive Summary

Introduction

This report is about the intersection of two major crises of the 21st century—the sustainability crisis and the social exclusion and inequality crisis. The world is facing massive environmental degradation. Some of these challenges—including climate change, ecosystem collapse, and ocean acidification—represent global existential threats. Others, such as air pollution, water pollution, and land degradation, inflict significant costs on local populations. These environmental challenges are a by-product of unsustainable practices in the pursuit of economic growth. While this growth has raised living standards around the world and lifted billions out of poverty, not all countries or people have benefited equally.

The research presented in this report focuses on the interaction between social exclusion and natural capital—the world's stock of natural resources and environmental assets, which include soil, water, and air. It seeks to determine how socially excluded populations fit into their wider environment, asking if their lands are in less-productive geographies, they endure disproportionately higher levels of pollution, their usage patterns of natural capital lead to more-rapid depletion, they are systematically denied equivalent access to the environmental amenities and natural resources they need for a decent life on a livable planet, and so on.

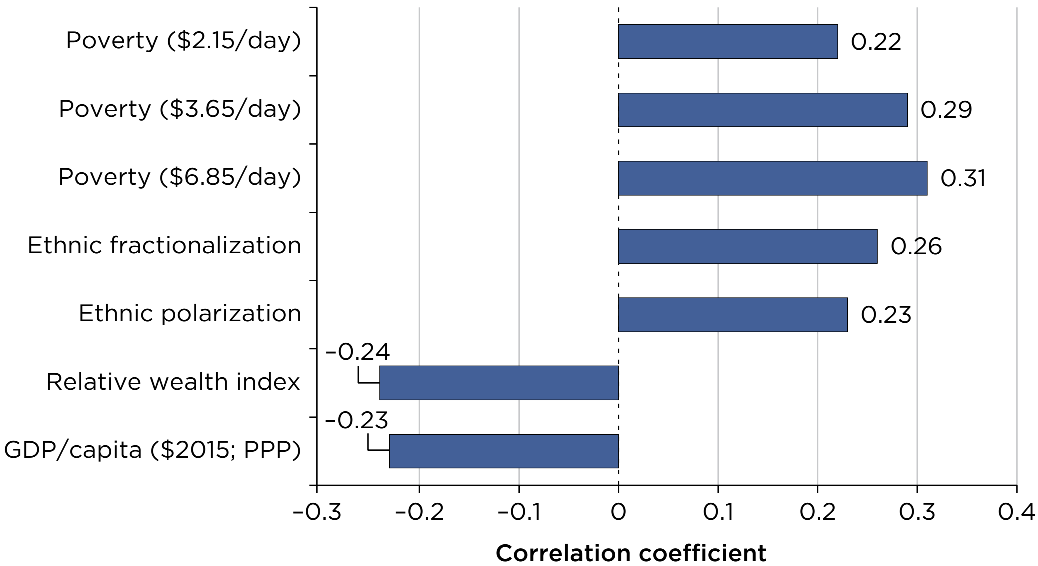
To explore these issues, the report focuses on individuals, households, and communities whose identities put them at an elevated risk of exclusion. To do this, it uses a new index of exclusion risk, the Underrepresentation Risk Index (URRI), which draws on the existing literature. It captures the share of a population in a specific geography whose identity group—ethnicity, race, or Indigenous status—have been historically excluded from executive power, and, therefore, from representation in government. The underlying rationale is that lacking representation over prolonged periods of time indicates the existence of barriers to decision-making, which then translates into exclusion across many aspects of society. The focus is based on evidence that shows that barriers to decision-making have led to a lack of access to public goods and services, and increased exposure to environmental degradation has led to vulnerabilities above and beyond what traditional poverty and socioeconomic measures might predict.

The URRI is a unique, spatially explicit data set, built from a variety of sources. A fundamental building block is the Ethnic Power Relations (EPR) data set, which provides information on the political status of an identity group in a country. From these data, ethnic or racial groups that have never experienced political exclusion according to the EPR data set dating to 1946 are considered to be at low risk of being underrepresented, while all other groups are considered to be at high risk of underrepresentation. These data are then combined with data on race, ethnicity, and Indigenous status from IPUMS, which provides data on individuals across 31 countries, accounting for more than half the global population.

National-level estimates suggest that approximately 1 in 4 people are at high risk of being underrepresented and the resulting vulnerability that goes with it. This figure suggests that such divisions are a pervasive problem across the world. An inverse relationship exists between a country's economic prosperity and the proportion of its population at risk of being underrepresented. In low-income countries, the at-risk population percentage is as high as 62 percent, whereas in high-income countries, it decreases to 14 percent.

This form of exclusion is distinct from other, often-used measures for marginalization and social disharmony, such as poverty, fractionalization, and polarization. Poverty—measured in absolute or relative terms—is among the most commonly used metrics for social progress and inclusion in the economics literature. The correlation between poverty and those identified as being at a high risk of being underrepresented is not strong (refer to figure ES.1). This broad relationship is perhaps best seen in specific examples. Diasporas from East Asia and the Middle East and minority groups including Jains, Jews, Parsis, and Sindhis have seen substantial economic success around the world, despite significant discrimination in decades and centuries past. Economic success does not always translate into political and social inclusion, and these and other minority groups can still face discrimination, restricted access to services, disenfranchisement, social segregation, stigmatization, and harassment. Likewise, while ethnic fractionalization and polarization measure diversity, which can lead to social disharmony, this neither guarantees nor necessarily implies marginalization in the sense of exclusion from markets and services.

FIGURE ES.1 Correlations between the URRI and other socioeconomic and diversity measures



Sources: World Bank staff calculations, using data from the EPR data set; IPUMS International; Chi et al. 2022; Kummu, Taka, and Guillaume 2018.
Note: Figure shows the correlation coefficients between the URRI and other second administrative-level poverty, diversity, wealth, and income measures. The Relative Wealth Index evaluates the wealth of an area relative to others within the same country (Chi et al. 2022) to provide a dimension of economic well-being that is defined in relative, rather than absolute, terms. EPR = Ethnic Power Relations data set; GDP = gross domestic product; PPP = purchasing power parity; URRI = Underrepresentation Risk Index.

Drawing on a variety of data sources, this report identifies new patterns of exclusion, attributes of the excluded, and the economic forces that drive these. The key findings that follow are based on a series of background papers, the results of which are provided in the online technical annexes. More details are also provided in boxes throughout the report.

Key finding 1: Underrepresented populations disproportionately live in rural areas, work in agriculture, and lack access to critical public goods and services

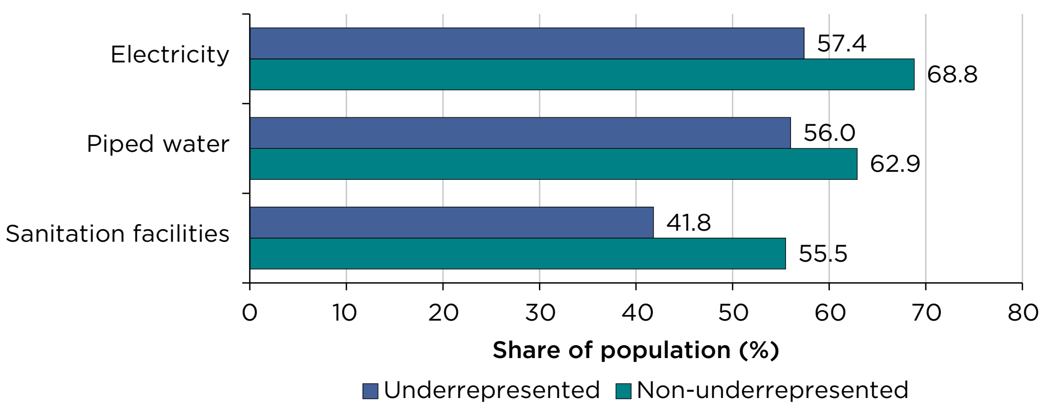
Only 42 percent of underrepresented populations live in urban areas, compared to 53 percent of non-underrepresented populations. Thus, these groups are more likely to work in agriculture and are significantly more likely to rely on the environment and natural capital for their livelihoods. An immediate implication is that, all else being equal, underrepresented populations may be more exposed and vulnerable to land degradation.

Underrepresented populations have systematically lower levels of access to basic public services than non-underrepresented groups. These groups are less likely to have access to electricity (10 percentage points [pp]), piped water (7 pp), and improved sanitation facilities (13 pp) (refer to figure ES.2). This differential persists even when accounting for differences in wealth and location, implying systematic discrimination is likely driving the relationship.

Key finding 2: Underrepresented populations are less exposed to ambient air and water pollution but may be more impacted by these, possibly due to a deficit of public goods and services

Underrepresented populations tend to live in rural areas or in the peripheries of cities, where ambient air pollution is usually lower. This finding implies that these groups tend to be less exposed to environmental pollutants, such as PM2.5—fine particulate matter that the human body

FIGURE ES.2 Access to basic public services at the household level, by representation status



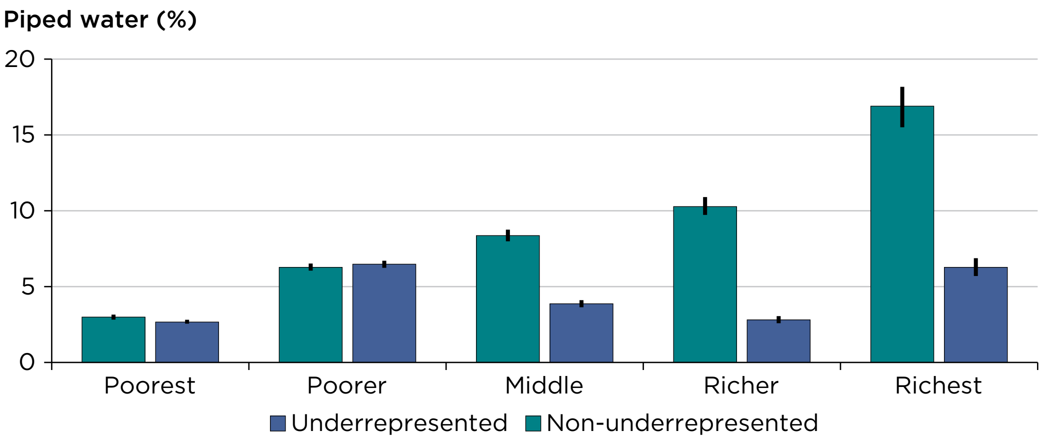
Sources: World Bank staff calculations, using data from the EPR data set (Vogt et al. 2015) and IPUMS International (Minnesota Population Center 2020).
Note: EPR = Ethnic Power Relations data set.

cannot filter—and other correlated air pollutants. The data show that ambient water quality levels are similar between underrepresented and non-underrepresented populations.

However, despite living in a relatively cleaner environment, the impacts of pollution weigh more heavily on underrepresented people. For example, these groups are more likely to lack access to piped water and, therefore, face greater exposure to diarrheal diseases. Wealth does not improve access rates for underrepresented populations: large gaps in piped water access persist between underrepresented and non-underrepresented populations, even among the richest households (refer to figure ES.3). This finding suggests that wealth and economic growth will not automatically result in greater inclusion.

Although underrepresented and other vulnerable households produce less outdoor air pollution, they are exposed to more indoor air pollution due to a greater reliance on fossil fuels used for cooking and heating. The most-vulnerable people—low-income households, women, children, and

FIGURE ES.3 Access to piped water, by underrepresented status and household income



Source: World Bank staff calculations, based on DHS data for 60 countries.
Note: Households are split into wealth quintiles using the DHS household wealth index and categorized into underrepresented and non-underrepresented groups using the methodology presented in chapter 1 of the main report. Bars show the shares of households in each group that have access to piped water. Error bars show 95 percent confidence intervals. DHS = Demographic Health Survey.

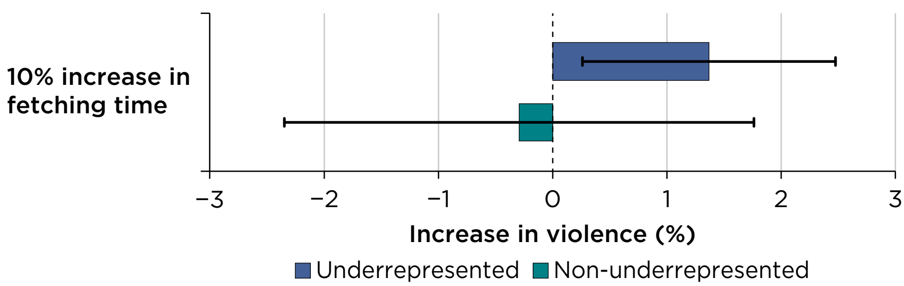
underrepresented households—often depend on solid fuels, such as biomass, for their daily needs, putting them at greater risk of indoor air pollution. In addition, while higher incomes usually mean cleaner cooking and heating solutions, even richer excluded households often continue to use dirtier energy.

Women tend to be responsible for working the land and securing water, food, and fuel for cooking and heating, facing significantly greater challenges when the resources they depend on are depleted. For example, disparities in water access burden women disproportionately, requiring them to travel long distances. This issue increases their vulnerability to sexual violence and other social inequities, and underrepresented women are even more likely to be sexually assaulted while fetching water (refer to figure ES.4).

Key finding 3: Underrepresented populations are more exposed to—and more impacted by—land degradation and deforestation

Underrepresented populations are more likely to live on lands that are currently being deforested and degraded at higher rates. These groups

FIGURE ES.4 Vulnerability to sexual attacks when fetching water: Underrepresented versus non-underrepresented women



Source: World Bank staff calculations, based on DHS data for 10 Sub-Saharan African countries (refer to annex 3H).
Note: Figure indicates the effects of a 10 percent increase in fetching time on the likelihood of violence. Women are categorized into underrepresented and non-underrepresented groups using the methodology presented in chapter 1 of the main report. Error bars show 95 percent confidence intervals. DHS = Demographic Health Survey.

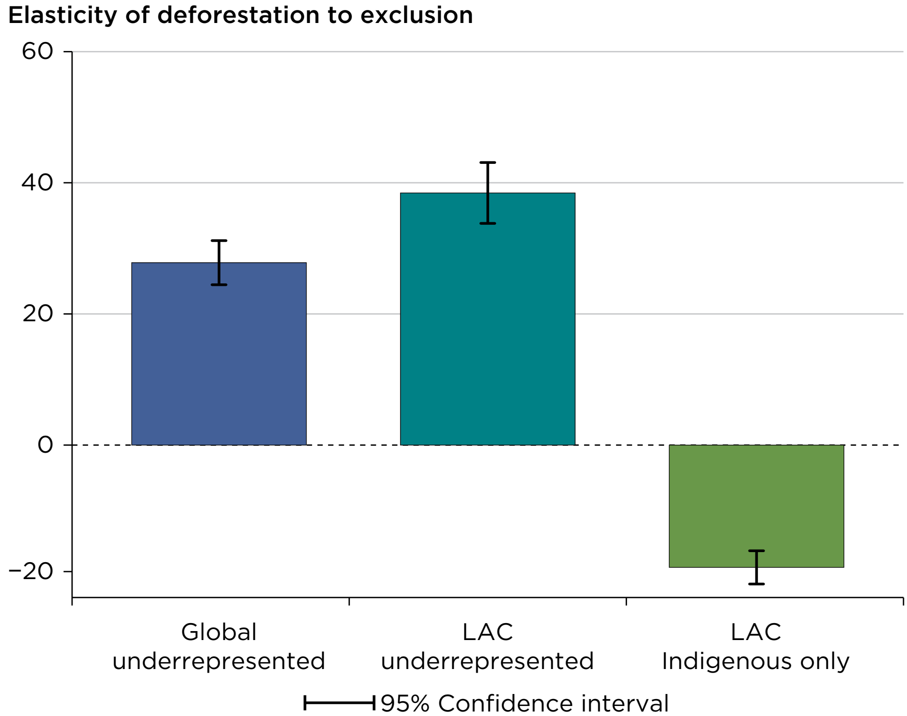
are, therefore, exposed to the adverse impacts of deforestation, which include diarrhea and malaria. A lack of public goods—such as safely managed, piped drinking water; access to medical facilities; and malarial bednets—which are crucial for reducing the spread of such diseases—may contribute to the greater vulnerability of these groups. Underrepresented populations are also more exposed to land and soil degradation on agricultural land. Reduced organic carbon in soil, a key nutrient for plant growth, leads to lower yields in regions with high shares of excluded populations.

However, underrepresented populations do not appear to be endowed with land that is inherently less productive but instead end up with more-degraded lands, likely driven by actions associated with vulnerability itself. Underrepresented and marginalized populations tend to rely more on environmentally based income and consumption sources, such as agriculture, timber, and nontimber forest products, for their livelihoods. These activities can increase pressure on land, reducing land productivity and degrading the land, particularly if incentives and circumstances lead to unsustainable use levels.

However, an exception exists to the deforestation relationship in Latin America, where deforestation on Indigenous lands is lower than on non-Indigenous lands

Contrary to other populations at high risk of being underrepresented, higher shares of Indigenous populations in Latin America are associated with lower rates of forest loss (refer to figure ES.5). Over the past 20 years, deforestation rates have been lower in areas of Latin American and Caribbean countries with a higher share of Indigenous populations. While these results do not necessarily imply causality, they do resonate with other studies that have found deforestation and land degradation are lower on Indigenous lands, pan-tropically, relative to nonprotected areas.

FIGURE ES.5 Social exclusion, Indigenous populations, and deforestation in Latin America and the Caribbean



Source: World Bank staff calculations, based on data from www.globalforestwatch.org.
Note: Results presented are from a univariate regression with log (deforestation) as the dependent variable and log (underrepresented share) as the independent variable, and the unit of observation is the second administration unit. The y-axis shows the percentage of increase in tree cover loss from 2001–19 for a 100 percent increase in excluded (left two bars) and Indigenous (right bar) populations. LAC = Latin America and the Caribbean.

Key finding 4: Underrepresented populations have fewer options and face starker trade-offs between economic opportunities and environmental quality

When marginalized communities are excluded from labor markets, they may move into less-polluted rural areas, where economic opportunities are limited. However, moving may not translate into better health outcomes. For example, although their risk of exposure to poor water quality (measured by ambient biological oxygen demand) is lower, the lack of water services implies a greater incidence of diarrheal impacts from environmental pollution.

When new economic opportunities emerge in a region, underrepresented populations often obtain fewer economic benefits and endure more environmental damage than their nonexcluded counterparts. In Africa, new mines can present opportunities for better-paying jobs but also can reduce environmental quality through air and water pollution. Faced with fewer options, underrepresented populations are more likely to move near the newly opened mines, where air pollution levels are highest. In addition, while they benefit economically from higher wages, the wage premium they receive is lower than non-underrepresented households in the same area.

Breaking the cycle

Deliberate policies and analysis are needed to ensure that policies that promote environmental sustainability are just and that a just pattern of progress is environmentally sustainable. The challenges of exclusion and environmental damage in developing countries are often, but not always, linked. Irrespective of the extent of correlation, progress in one area can often create setbacks in another. For example, policies designed to increase inclusive growth can lead to environmental destruction, and environmental policies can disproportionately harm excluded people by locking them out of economic opportunities.

Policy makers should take heed of Tinbergen's Rule, which posits that, to achieve multiple desired outcomes, the number of policy instruments must be at least equal to the number of policy targets. Tinbergen's Rule—named after Dutch economist Jan Tinbergen—is foundational in economic policy making, emphasizing that a mismatch between the number of instruments and targets can lead to inefficiencies and unintended consequences. The key insight of this rule is that a single policy instrument is unlikely to efficiently and appropriately account for all the nuances and necessities needed to achieve multiple outcomes and may lead to counterproductive or unintended outcomes. For example, policies aimed at economic inclusion, such as safety net programs or subsidies, often have unintended environmental consequences. In addition, environmental instruments, such as protected areas, subsidy reform, or pollution taxes, often have unintended distributional consequences. Such policies must, therefore, be paired with other instruments to account for and prevent these unintended effects.

Exceptions to this principle, although rare, do exist when inclusive policies reinforce environmental goals or vice versa. For instance, payment for ecosystem services schemes can provide income to rural inhabitants in exchange for environmental management, generating win-wins.

Policy actions when authorities are favorable to change

Where the authorities are amenable to change, representation can empower local communities to enhance environmental outcomes. This representation has been successful among Indigenous communities, whose traditional practices often support conservation goals. Success, though, can be contingent on other factors. For example, having both strong tenure security and an institutional environment that is willing and able to enforce these rights is key.

Representation is only part of the solution and should be considered a first step. Robust mechanisms are required to prevent elite capture and ensure the meaningful participation of marginalized groups. Elite capture can occur even in participatory programs that seek to include disadvantaged individuals in policy making, if high opportunity costs make it hard for them to take part or entrenched social norms make it hard for them to oppose those who traditionally hold more power. Deliberation and communication can help overcome potential capture by local elites and promote common interests to ensure accountability and transparency. However, there are no assurances that the influence of entrenched interests can be stifled.

Policy actions in adversarial environments

When increased representation is ineffective or not an option—usually because of misaligned goals with authorities—public engagement and coalition building are key. In such a policy environment, policy changes will prove difficult, as those with influence may benefit from the status quo. However, if the goals of civil society and key stakeholders align with inclusive environmental policy, opportunities may exist to nudge the policy discourse.

An informed public is integral to persistent political engagement, and active and effective civic participation hinges on increasing the flow of accurate information. Affordable environmental-monitoring technologies that harness geographic information systems, such as air quality trackers, can enable nongovernmental organizations (NGOs), local communities, and citizen scientists to conduct monitoring tasks. By lowering the cost of accessing information, such technologies can empower local communities to take action. Educational programs on how to manage natural resources sustainably can also foster inclusive, sustainable development.

Civil society organizations, NGOs, and international actors can play a key role by providing information, encouraging open discourse, and offering forums for discussions. Barriers to information are often higher for excluded populations—for example, due to financial constraints or hostile environments. Thus, lowering the cost of accessing information that allows them to participate in governance, advocacy, or environmental monitoring is a valuable first step in empowering them.

When the political environment is fragile, trusted NGOs that have established partnerships with local communities can be useful for building coalitions. NGOs often have the required knowledge on local conditions and how to best interact with governments in policy-making terrains that might be otherwise difficult to traverse. Understanding these dynamics is key to selecting the right development and aid tools, and these approaches require a degree of decentralization to redistribute decision-making power away from central governments to draw on local knowledge.

NGOs and local communities can enhance the policing and monitoring of outcomes where capacity is limited. In areas where governments lack capacity to monitor and enforce rules—such as on the high seas and in remote rainforests—NGOs can fulfill an important function by informing governments, international secretariats, and public stakeholders of any violations. Experience from wildlife reserves across Africa has shown that, by taking on management responsibilities, NGOs can substantially improve conservation outcomes while simultaneously promoting local development.

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Abbreviations

AOD	aerosol optical density
AP	African Parks
ASM	Amazonian Soy Moratorium
BOD	biochemical oxygen demand
CIESIN	Center for International Earth Science Information Network (Columbia University)
CPAT	Climate Policy Assessment Tool
DHS	Demographic Health Survey
DID	difference-in-differences
EEC	Environmental Engel Curve
EIU	Economist Intelligence Unit (United Kingdom)
EPR	Ethnic Power Relations data set
ESF	Environmental and Social Framework
GBV	gender-based violence
GDP	gross domestic product
GSAP	Global Subnational Poverty Atlas
GWP	Global Water Partnership
ha	hectare
HIC	high-income country
ICDPs	integrated conservation and development projects
IEA	International Energy Agency
INE	Instituto Nacional de Estatísticas (Portugal)
IRENA	International Renewable Energy Agency
LAC	Latin American and the Caribbean
LGBTQ	lesbian, gay, bisexual, transsexual, queer
LIC	low-income country
LMIC	low- and middle-income country
LRAs	land restoration activities
MT	metric ton
NDVI	Normalized Difference Vegetation Index
NTFPs	nontimber forest products
NGO	nongovernmental organization

NPP	net primary productivity
OLS	ordinary least squares
pp	percentage points
PPP	purchasing power parity
RAISG	Amazon Network of Georeferenced Socio-Environmental Information
RWI	Relative Wealth Index
SES	socioeconomic status
SOC	soil organic carbon
SOM	soil organic matter
SSA	Sub-Saharan Africa
UCDP	Uppsala Conflict Data Program (Sweden)
UMIC	upper-middle-income country
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNSD	United Nations Statistics Division
URRI	Underrepresentation Risk Index
WHO	World Health Organization
USDA	U.S. Department of Agriculture

Note: All dollar amounts in this publication are U.S. dollars unless otherwise indicated.

CHAPTER 1

Environment and Inclusion

"[W]hat we can or cannot do, can or cannot achieve, do not depend just on our incomes but also on the variety of physical and social characteristics that affect our lives and make us what we are."
—*Amartya Sen* (1998 Nobel Prize Laureate for Economic Sciences)

Introduction

The world has witnessed unparalleled economic progress in the past three decades. By 2022, extreme poverty rates had fallen from 40 percent to 9 percent, infant mortality rates had more than halved, illiteracy rates had tumbled, and most people had gained access to electricity and safely-managed drinking water (World Bank 2024a–e). However, despite these great strides, two challenges threaten to derail hard-won progress: (1) a worsening sustainability crisis and (2) growing inequality and exclusion.

Rising wealth and growing populations mean the demand for land, water, and air is growing exponentially, while the supply of these critical natural resources is in decline, due to overuse, pollution, and the consequences of a changing climate. Deforestation, soil degradation, and wetlands destruction have diminished the fertility of land and the functionality of watersheds (Damania et al. 2023). Water quality is declining in rich and poor countries alike, while plastics, pharmaceuticals, and forever chemicals proliferate in waterways and oceans (Damania et al. 2019). Air pollution kills more people than all wars and forms of violence combined (UCDP 2023; WHO 2021).

To some observers, the decline in natural capital, like the canary in the coal mine, is a sign of unsustainable economic activity that could undermine the foundations of human well-being (Folke et al. 2021). Others note that economic growth continues unabated, and environmental degradation may be the price to pay for economic progress. From this perspective, trade-offs are inevitable for greater human prosperity. However, because nature provides essential services for life, earth, and the economy, mounting evidence suggests that the trend of declining natural capital may cast a long and foreboding shadow into the future (Dasgupta 2021).

Global economic growth has brought convergence in per capita incomes across countries, but persistent inequalities and differences in opportunities within countries remain (Chancel et al. 2022). Although these often relate to income and wealth, other drivers of inequality exist. Opportunities may be constrained and limited where individuals are unable to participate in social or economic activities due to exclusion based on their religion, ethnicity, gender, or other identities and circumstances, which can hamper access to wide-ranging opportunities and essential services. Denial of opportunities can impair economic performance and reduce capabilities and welfare (Foster and Sen 1997; Hsieh and Klenow 2010; Higgins et al. 2018).

This report focuses on the interaction between social exclusion and natural capital—the world's stock of natural resources and environmental assets, which include soil, water, and air. It seeks to determine how socially excluded populations fit into their wider environment, asking if their lands are in less-productive geographies, they endure disproportionately higher levels of pollution, their usage patterns of natural capital lead to more rapid depletion, they are systematically denied equivalent access to the environmental amenities and natural resources they need for a decent life on a livable planet, and so on. Addressing these challenges requires holistic policy solutions that can simultaneously tackle green and just transitions. Although work on just transitions has advanced the dialogue on the intersection among development, poverty, and the environment, understanding of how social exclusion mediates among these three issues is at a much-earlier stage. This report is an attempt to remedy this issue.

Social exclusion is a well-understood concept, but despite many attempts, it has no algebraically formalized universal definition. A core pillar across definitions is the partial or full exclusion of or prevention from accessing and participating in economic and social life. Some definitions emphasize the dynamic nature of exclusion, regarding it as a continuous state rather than a snapshot at a given time (Silver 2007; United Nations 2016). Others highlight the multidimensionality of the issue and caution against conflating exclusion and poverty, despite their often-intertwined nature (Byrne 2005; Cuesta, López-Noval, and Niño-Zarazúa 2024). This report uses the following World Bank (2013) description:

> In every country, certain groups—whether … immigrants, Indigenous people, or other minorities—confront barriers that prevent them from fully participating in their nation's political, economic, and social life.

> These groups are branded by stereotypes, stigmas, and superstitions. They often live with insecurity. And such disadvantages not only preclude them from capitalizing on opportunities to lead a better life, they also rob them of dignity (World Bank, 2013, xv).

Many facets of an individual's or social group's characteristics can form the foundation of social exclusion. Exclusion is often based on a trait that differentiates excluded from nonexcluded groups. These can be broadly categorized into three larger groups:

- *Identity-based exclusion* is rooted in a fundamental aspect of a person's identity, such as race, indigeneity, sexual orientation, religion, or gender identity.
- *Circumstance-based exclusion* is tied to the circumstances people find themselves in, such as refugee status, age, or disability.
- *Socioeconomic-based exclusion* applies when factors such as poverty and unemployment restrict people from participating in society.

Whether exclusion occurs is usually context-specific, because a group that experiences exclusion in one place and time might not do so in another. Similarly, the severity of exclusion can change when a person's identity and characteristics intersects with multiple factors of exclusion; for instance, research has shown that participation in labor markets can be challenging for women of minority ethnic groups (Elu and Loubert 2013).

For exclusion to exist, some distinguishable features across individuals must be present. Research on two measures of ethnic diversity—ethnic fractionalization and ethnic polarization—suggests that, as a society grows in diversity, trade-offs emerge (refer to box 1.1). Ethnic heterogeneity can lead to inefficient and unequal provision of public goods; biased policies; and in extreme cases, violent conflict (Alesina and La Ferrara 2005; Easterly 2001; Montalvo and Reynal-Querol 2005), which can further fuel social exclusion and encourage natural capital degradation. For example, deforestation has been found to be worse in areas of high fractionalization (Alesina, Gennaioli, and Lovo 2018).

However, diversity can also enhance productivity through innovation, skill complementarity, creativity, trade, and a wider range of products (Alesina, Harnoss, and Rapoport, 2016; Montalvo and Reynal-Querol 2021), which, in turn, can diminish resource scarcity and encourage environmentally beneficial behaviors, such as land restoration. It can also strengthen inclusivity, as, for example, research conducted in 33 African countries found that acceptance of LGBTQ neighbors is higher in more-pluralistic communities (Dreier, Long, and Winkler 2020). The implication is that generalizations may mislead and outcomes may depend on particular circumstances and power relations.

Although they are closely related and often occur simultaneously, it is useful to differentiate between *social exclusion* and *poverty*. Not all social groups that are excluded are poor, and not all poor people are socially excluded. Without awareness of this distinction, formulating policy is difficult and might result in targeting the wrong channels for solutions (Cuesta, López-Noval, and Niño-Zarazúa 2024). For example, investments in the human capital of an impoverished minority will be less effective when access to labor markets is restricted in the first place. Similarly, the reasons people face environmental disamenities or the way they consume natural capital can be driven by poverty, social exclusion, or a combination of both.

BOX 1.1

Approaches for measuring ethnic diversity

Heterogeneity is a minimum condition for social exclusion to exist. So, how can *social heterogeneity* be quantified?

One commonly used measurement in the sociology and economics literature is the Ethnic Fractionalization Index, which assesses the likelihood that two randomly selected individuals from a society belong to different ethnic groups (for example, refer to Abascal and Baldassarri 2015; Alesina et al. 2003; Alesina and Zhuravskaya 2011; Easterly and Levine 1997). It is calculated via the widely used Herfindahl–Hirschman Index (for example, refer to Alesina et al. 2003; Fearon and Laitin 2003), which is constructed as the following:

$$Fractionalization_j = 1 - \sum_{i=1} share_{ij}^2$$

where $share_{ij}$ represents the share of group i within a specific country or location j. The index ranges from 0 to 1, where 0 represents complete *homogeneity* (all individuals belong to the same group), and 1 represents complete *heterogeneity* (each individual belongs to a different group).

Another widely used measure is the Reynal-Querol Polarization Index, which scales the extent to which a society is divided into two distinct and antagonistic ethnic groups from 0 to 1 (Montalvo and Reynal-Querol 2005). The underlying rationale is that, as two groups become equally sized, neither dominates a priori, giving rise to the propensity for conflict.

(Box continues next page)

BOX 1.1

Approaches for measuring ethnic diversity *(continued)*

With more than two groups, the relative propensity for conflict decreases, as coalition-building and stalemates can develop. Using the same notation as the Ethnic Fractionalization Index, the Reynal-Querol Polarization Index is constructed as follows:

$$Polarization_j = 1 - \sum_{\{i=1\}} \left(\frac{0.5 - share_{ij}}{0.5} \right)^2 share_{ij}$$

Given the substantial academic interest in diversity and its outcomes, it is not surprising that there have been other attempts at measurement beyond fractionalization and polarization (Steele et al. 2022). Some are extensions of the established fractionalization and polarization indexes. *Cultural fractionalization,* for example, expands on the Ethnic Fractionalization Index by incorporating linguistic similarity between groups (Baldwin and Huber 2010), thus accounting for the mediating impact of speaking related languages. Similarly, *peripheral polarization* modifies the Ethnic Fractionalization Index by changing the focal point from two equally sized groups to a group's size relative to the central (majority) group (Desmet, Ortuño Ortín, and Weber 2005), putting a heavier emphasis on the size differentials between a main and remaining social groups. Others aim to provide new ways to quantify diversity. The *generalized entropy* measure, for example, decomposes diversity into an in-group share, which is a simple measure of population share of the majority, and the *out-group entropy* component captures heterogeneity among minorities to simultaneously measure both out-group fractionalization and polarization (Koopmans and Schaeffer 2015).

Despite the innovation occurring in the space, the analysis undertaken for this report omitted these additional measures, either due to their more-demanding data requirements or a limited evidence base.

Exclusion and environmental degradation

It is well known that poverty can be a cause and consequence of social exclusion (Sen 2000), but the intersection with environmental outcomes is less obvious. It is unclear when activities that lead to the depletion of forests, fish, and air and water quality start entrenching exclusion or poverty and when they act as a stepping stone toward prosperity. It is also unclear when environmental degradation is the cause of increasing poverty and inequality and when the economic constraints caused by social exclusion engender poverty with environmental consequences. The available evidence is mixed. Some studies suggest that poverty may induce greater environmental degradation (Banerjee and Duflo 2012; Barbier and Hochard 2018). This finding may be because the poor population may be compelled to prioritize their immediate needs—often simply to survive—and will, therefore, have a greater propensity to deplete their natural capital (Khan 2019; Nguyen et al. 2017). At the same time, greater wealth is associated with more-affluent lifestyles that can weigh more heavily on the environment (Levinson and O'Brien 2019; Sager 2019).

There is also limited understanding of the multiple links between exclusion and environmental degradation and how this relationship is mediated by poverty and income. Discrimination could result in those who are excluded being exposed to greater environmental hazards—such as natural disasters and harmful pollutants—which, in turn, deepen poverty. For example, the United States's redlining policies of the 1930s used neighborhood race profiles to determine who obtained financial services (McKnight and Kretzmann 1990). Decades after this discriminatory practice was outlawed, its harmful legacy persists: excluded populations are concentrated in more-polluted areas, with less access to green spaces and infrastructure, further entrenching poverty, worsening health outcomes, and diminishing labor productivity (Swope, Hernández, and Cushing 2022).

There are also plenty of examples of poor or excluded populations sorting into more-polluted locations. Research on the distributional impacts of mining finds that industrial mines may increase poverty, while small artisanal mines reduce poverty (Gamu, Le Billon, and Spiegel 2015), despite being more environmentally damaging. Wealthier and nonexcluded populations often live in more-polluted inner-city suburbs with greater employment opportunities, while excluded and poorer populations often live in rural areas with less air pollution but fewer employment opportunities (Behrer and Heft-Neal 2024).

The economic underpinnings of such choices can be traced back to Adam Smith's (1776) theory of compensating wage differentials. Smith observed that workers will bargain for a higher wage in jobs that are unpleasant, dangerous, or otherwise unattractive. Risky jobs consequently command a compensating differential either in higher wages or in other offsetting advantages such as favorable job amenities. A vast literature quantifies the magnitude of these wage differentials, captured in a statistic provocatively termed the *value of statistical life*.

Exclusion and discrimination may alter this trade-off significantly. If excluded groups have less bargaining power, this reality would constrain the opportunities available to them and alter the balance between risks and rewards. A fundamental question that remains unanswered is how such risk–reward choices impact and are impacted by changing environmental conditions. The remaining chapters in this report attempt to illuminate this issue by exploring the available evidence on links between exclusion and environmental amenities.

Focus of this report

This report contributes to wider efforts to improve understanding of the linkages between social exclusion and environmental outcomes. Those at the fringes of society—whether through lacking representation, poverty, or other factors—may have insufficient capacity to shoulder the additional burdens of a deteriorating ecosystem (Tran et al. 2021). For example, impoverished subsistence farmers might struggle to implement flood resilience measures due to financial constraints (Akter and Mallick 2013). To formulate efficient and effective policy responses, policy makers must, therefore, gain a deeper understanding of who is affected, where, and why.

This report examines whether measures of identity available at subnational scales—such as ethnicity, indigeneity, and race—discernably affect levels of environmental endowment and damage. Perhaps surprisingly, in low- and middle-income countries, indicators of societal heterogeneity are not systematically associated with the availability of environmental assets. This finding contrasts with the growing environmental justice literature in the United States and other high-income countries (HICs), where belonging to an ethnic minority or race is associated with greater exposure to environmental harms (Banzhaf, Ma, and Timmins 2019; Jbaily et al. 2022).

An important finding of this report is that exclusion from decision-making consistently explains the presence of both environmental disamenities and the lack of public-goods provision. The findings are consistent with the World Bank's definition of *process legitimacy,* which argues that how policies are designed and implemented needs to be "accepted as fair and credible by all stakeholders" (Barron et al. 2023). This result also supports emerging empirical literature on the representation of minorities and excluded groups in policy decisions. These studies find that representation at legislative stages is often decisive in serving the needs of marginalized groups (refer to box 1.2), improving services, infrastructure, and employment opportunities (for example, refer to Beach, Jones, and Walsh 2024; Hopkins and McCabe 2012; Pande 2003; Sances and You 2017).

However, a nascent discussion highlights that, unless representation leads to being heard and ends discrimination, representation of a marginalized group does not in itself lead to improved governance and participation (Heinze, Brulé, and Chauchard 2024). Links with environmental issues remain unexplored in this literature.

BOX 1.2

What are the benefits of inclusive decision-making?

Having a voice and being involved in decision-making is vital. Yet, how does being represented—either directly or indirectly—benefit marginalized individuals?

Much contemporary discourse emphasizes the growth benefits of a more-inclusive society. The argument goes that, by reducing the pool of talent, exclusion reduces the human capital available for productive enterprise, diminishing economic growth. Concerns have been long-standing, with 19th-century philosopher and political economist John Stuart Mill emphasizing the importance of representation in identifying the common good (Mill 1862). Moreover, the need to consider a wider range of political interests pushes decision-makers to balance multiple perspectives and move beyond personal biases (Brink 2022).

Empirical evidence indicates that obtaining representation—and, therefore, a voice in decision-making—can have economic and societal benefits. Reaffirming the right to vote in 1965 not only conferred higher wages to southern Black Americans, it also gave textile mill operators an opportunity to draw on a wider pool of labor without directly angering their established White workers (Wright 2013). The benefits of diminishing the structures that encouraged the disenfranchisement of an entire group of people thus stretched beyond those given a voice. Similarly, political representation of women has improved education and health care provision in multiple low- and middle-income countries (Hessami and da Fonseca 2020). From a broader perspective, transitioning from a nondemocratic governance system to a democracy has benefited long-term economic growth by up to 20 percent (Acemoglu et al. 2019; Gründler and Krieger 2016). Democratization can also quell behaviors, such as ethnic favoritism, which do not allow inclusive decision-making, by making policy makers aware of political punishments when they go against the desires of the electorate (Burgess et al. 2015).

Drawing on existing literature and data sets, this report uses a measure of exclusion risk from decision-making that captures the share of the population in a geography whose identity group has historically lacked access to executive state power. This approach is based on the Ethnic Power Relations (EPR) data set published by the Center for Comparative and International Studies at ETH Zurich. The underlying rationale is that lacking representation in the national executive over prolonged periods indicates the existence of barriers to power. Combining the EPR data with country-level census data allows for the generation of the Underrepresentation Risk Index (URRI), which classifies these risks at the subnational level (refer to box 1.3). The URRI data set is made available with this report (refer to annex 2.A) and covers more than 50 percent of the world's population.

BOX 1.3
How is the URRI built?

The Underrepresentation Risk Index's (URRI's) fundamental building block is the Ethnic Power Relations (EPR) data set, which provides information on the political status of an identity group in a country; it tracks whether they are excluded from executive state power. In these data, an ethnic or racial group is considered politically relevant if it significantly impacts political processes and decision-making. However, the data are likely incomplete, as groups that are considered politically irrelevant are not tracked. To remedy this issue, the URRI augments the EPR data by including all groups irrespective of political relevance. In particular, groups that have never experienced political exclusion in the EPR data set dating back to 1946 are considered to be at low risk of underrepresentation, while all other groups are at high risk. Thus, all ethnic and racial groups missing in the EPR data set are designated high risk due to their history of lacking a voice in political decision-making.

However, this categorization may lead to an overestimation of high-risk populations as ethnic groups that indirectly participate in policy making might not be included in the EPR data and, hence, are designated as high risk. In addition, EPR data might not capture wider-reaching issues, such as *malapportionment*, where each vote does not translate to equivalent amounts of political power. One example is the US electoral college system, where the number of votes in presidential elections is not directly proportional to the population size of each state. Finally, the EPR data only

(Box continues next page)

BOX 1.3
How is the URRI built? *(continued)*

measures representation in the executive at the national scale; representation at a smaller scale, such as villages and townships, or other branches of government, such as the legislative or judiciary, is not captured.

One extension to the baseline EPR data is that Indigenous populations are classified as being at high risk of underrepresentation. Research has shown a strong correlation between belonging to an Indigenous group and experiencing socioeconomic deprivation (World Bank 2015), due to historical marginalization in decision-making and development planning.

Overall, URRI is a comprehensive underrepresentation risk measure capable of covering multiple identity groups simultaneously, while the EPR data set provides information on subsets of groups that have a significant impact on political processes and decision-making. The index is constructed as follows:

$$URRI_j = 1 - \frac{1}{N_j}\sum \mathbb{1}\left\{\left(politically\ relevant\right)_i \& \left(non\text{-}underrepresend\ identity\right)_i\right\}$$

where *j* is a geographic unit, *i* is an individual in location *j,* and *N* is the total population. Similar to the ethnic fractionalization and polarization indexes, URRI is bounded by 0 and 1, with 0 indicating that no one in the location is part of an identity group at high risk of underrepresentation, and 1 indicating that everyone is.

To map the population at high risk of underrepresentation, the IPUMS International data set is used to identify the distribution of marginalized populations at the second administrative unit (this varies by country, and is, for example, the county in the United States, the prefecture in China, and the division in India). For 31 countries, data are available on at least one of three identity dimensions of exclusion: individual ethnicity, race, and indigeneity.[a] As URRI can be calculated for each identity individually or any combination thereof, it can capture the risk of an individual lacking representation based on any or all of these identities. An advantage of this approach is that it recognizes that the basis for exclusion and discrimination differs across countries and allows for more-precise assessments based on particular identities where data are incomplete.

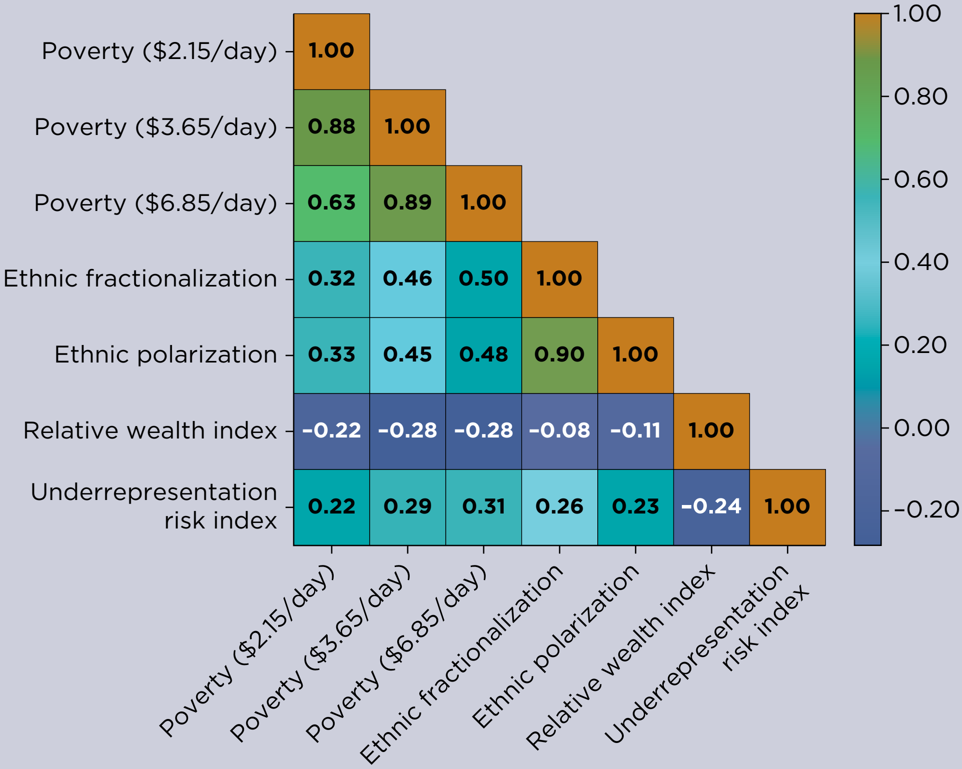
Due to the intersectionality among poverty, exclusion, and identity heterogeneity, it is valuable to understand their quantitative relationship. Figure B1.3.1 shows the correlations between the variables at the second administrative unit, which is the highest spatial resolution available in

(Box continues next page)

BOX 1.3
How is the URRI built? *(continued)*

the data. URRI is positively correlated with the remaining two ethnic diversity variables: fractionalization and polarization. The magnitude of the correlations is not large, however, indicating that high diversity tells little about the existence of lacking representation. Overall, underrepresentation shows the strongest correlation with poverty at the $6.85/day threshold, corroborating that exclusion and poverty are often intertwined, yet distinct.

FIGURE B1.3.1 Correlations between the URRI and other socioeconomic measures



Sources: World Bank staff's calculations, using data from the EPR data set (Vogt et al. 2015), IPUMS International (Ruggles et al. 2024), GSAP (World Bank 2023), and RWI (Chi et al. 2022) data.
Note: The matrix measures the correlation coefficient between social exclusion variables; the unit of observation is the second administration unit. EPR = Ethnic Power Relations data set; GSAP = Global Subnational Poverty Atlas; RWI = Relative Wealth Index; URRI = Underrepresentation Risk Index.

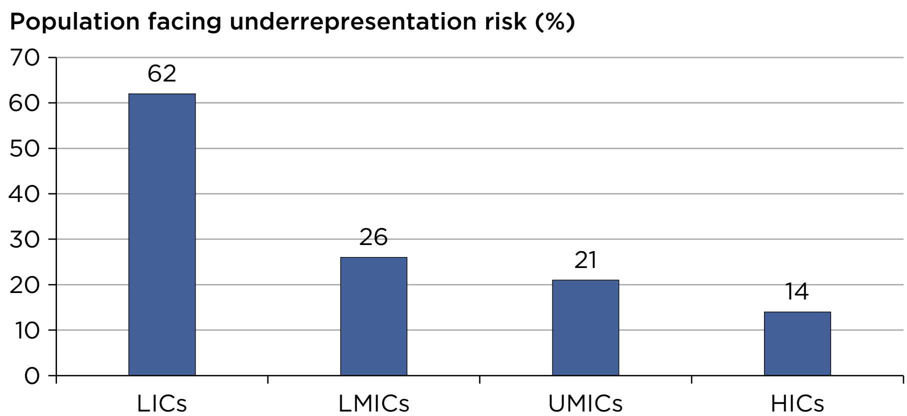
[a] The URRI measure is compiled using data on ethnicity, race, or indigeneity reported by 31 countries at their second administrative unit levels. See the technical appendix for more details.

For this report, *underrepresented* is frequently used as short-hand for *high risk of exclusion from decision-making* to ease reading. The terminology was chosen because those with lack of access to national executive power have been and are likely underrepresented in decision-making processes.

Estimates show that approximately 1 in 4 people globally have characteristics that put them at high risk of being underrepresented and that they live more often, but not exclusively, in countries at earlier stages of development (refer to figure 1.1). This finding suggests that such discrimination in one form or another is a pervasive problem across the world. An inverse relationship exists between a country's economic prosperity and the proportion of its population at risk of underrepresentation. In low-income countries, this at-risk population percentage is as high as 62 percent, whereas in HICs, it decreases to 14 percent.

A key advantage of this new index is that it can simultaneously quantify those who are underrepresented along more than one identity dimension. For example, it can measure the population at risk of underrepresentation due to ethnicity, race, indigeneity, or any combination of these. In contrast, societal diversity measures, such as ethnic fractionalization, can be measured only along one dimension of identity. Identity-specific inclusion indicators, such as the Gender Inequality Index (UNDP 2010), offer deep insights into the dynamics around one exclusion identity but cannot be used in conjunction with others without severe adjustment.

FIGURE 1.1 Population shares at risk of underrepresentation, by country income levels



Source: World Bank Staff calculations, using data from the EPR data set (Vogt et al. 2015).
Note: EPR = Ethnic Power Relations data set; HICs = high-income countries; LICs = low-income countries; LMICs = low- and middle-income countries; UMICs = upper-middle-income countries.

There is, however, an important caveat: while the URRI has the flexibility of encompassing multiple exclusion identities and being consistently comparable, there is no guarantee that a randomly selected individual in the index lacks political power. Rather, they are part of an identity group that is at an elevated risk of lacking representation.

Other notable features of the index include the following:

- *An important benefit of the index for assessing environmental issues is the high geospatial resolution, which allows the calculation of underrepresentation risk at the second administrative unit.* This unit will differ among countries, corresponding, for example, to counties in the United States and divisions in India. So far, other indices such as the Economist Democracy Index (EIU 2024), Varieties of Democracy (Coppedge et al. 2024), *Freedom in the World* (Herre et al. 2013), and *Worldwide Governance Indicators* (Kaufmann and Kraay 2023) rely on national-level data; other developments in measuring social exclusion also use national-level data and suggest that globally, approximately 2.4 billion people, or 32 percent of the world's population, are socially excluded (Cuesta, López-Noval, and Niño-Zarazúa. 2024). These types of data are valuable but less suitable for assessing subnational variations, which are crucial when examining environmental issues, as these vary at small spatial scales. For example, annual average air pollution—measured in fine particulate matter (PM2.5) concentrations—in some urban areas routinely rises above 50 $\mu g/m^3$ (micrograms per cubic meter of air), 10 times the World Health Organization guidelines, while such high exposure is rare in rural areas when excluding natural causes like wildfires. Without high-resolution data, it is impossible to attribute who endures the burdens of a deteriorating environment, and important details can be lost in country averages.
- *Expert survey-based indexes offer an additional advantage over descriptive measures of inclusion.* The EPR data that serve as the foundation of the URRI are created by soliciting the opinions of country experts on the representation of different ethnic and racial groups in positions of power. Expert opinions are less susceptible to distorting effects, which can happen in political processes. The share of ethnic minorities in the executive, for example, can be susceptible to multiple distorting effects that muddy whether low representation is the result of political exclusion rather than, for example, a lack of political engagement or the fielding of unpopular candidates. Drawing on the judgment of a panel of country experts can provide a more-robust measurement of underrepresentation risk than relying on summary statistics alone.

- *The URRI assumes nonadditionality of exclusion.* This assumption means a person who falls into one exclusion identity that can lead to underrepresentation is treated the same as one who falls into multiple groups. This supposition is alleviated by the outcome of interest being underrepresentation: exclusion through one identity can be enough to go unheard in the decision-making process.

The remainder of the report examines how lacking representation and the environment intersect. Chapter 2 explores deprivations associated with underrepresentation in two domains: public services and environmental disamenities. Chapter 3 investigates the mechanisms mediating between underrepresentation and exposure to deforestation, land degradation, and water pollution. It sets out to answer whether the forests, land, and water of those without a voice are under greater pressures than those of other groups and what could drive these inequalities. Chapter 4 spotlights the dynamics of air pollution exposure and underrepresentation. Outdoor air pollution can be incidental to or be driven by economic choices, that is, where to settle and what kind of labor to perform can heavily influence exposure to fine particulate matter. Finally, chapter 5 builds on the results of this report to discuss challenges and approaches in implementing inclusive and environmental policies.

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CHAPTER 2

Public Services for Underrepresented Populations

From Infrastructure to Critical Resources

"The welfare of each is bound up in the welfare of all."
—*Helen Keller* (author and disability rights activist)

AT A GLANCE

- Even when accounting for regional incomes or other societal factors that hamper public goods provision, access to three types of critical public services—electricity, piped water, and sanitation systems—is lower for underrepresented populations, implying that this issue reflects policy, in addition to any limits deriving from affordability.
- Underlying trends indicate that underrepresented households often live in poorer and more ethnically fractionalized or more-polarized areas. Nevertheless, lack of representation is a more-consistent and more statistically robust indicator of access to a variety of public services than fractionalization and polarization measures. Having a voice in decision-making is more crucial for explaining disparities in local public services provision than having communities homogeneous in ethnicity, race, or indigeneity.
- Exposure to environmental degradation varies by type of environmental amenity or asset under consideration. While underrepresented households are far more likely than non-underrepresented populations to inhabit more-degraded land, they are equally affected by poor water quality and are less likely to face dangerous air quality in comparison.
- This issue is due to fundamental environmental and economic trade-offs, as the siting of polluting industries, the way people use natural capital, where people move, and other socioenvironmental factors can intersect with political decisions and available opportunities.

Introduction

In recent history, Flint—a majority Black American and largely lower-income city in the US state of Michigan—had a dreary claim to infamy: residents experienced severe short- and long-term health problems caused by inadequate municipal water systems and inappropriate water sources. Twelve people died after contracting Legionnaire's disease, and long-term health issues from elevated lead exposure are likely to manifest. The discourse around this tragedy highlights multilayered failures to react to early warning signs due to the marginalized population affected (Campbell et al. 2016). In this example, a perfect storm of unsafe water, poor water treatment, and failures to remedy the health hazard resulted in marginalized populations being hurt.

This chapter highlights that many of the contributing factors in Flint—including the lack of public services and poor environmental quality—are present in the lives of underrepresented populations around the globe. Presenting findings from original research along with evidence from other studies, the chapter showcases the low public-goods provision experienced by underrepresented populations and focuses on their exposure to dangerous environmental disamenities. Both factors on their own are causes for concern. When they occur simultaneously, however, the outcomes can be severe.

As in other chapters, unless otherwise stated, *underrepresented populations* or *households* refer to "people at high risk of exclusion from decision-making," as defined in chapter 1. While the term may be reductionist, it is used solely for brevity and ease of reading. For more detail on the data used, the technical details of all analyses in the report, and several analyses congruent to the report's findings, refer to the online technical annexes.

Access to public assets and services

As access to clean water, sanitation, and affordable and clean energy are core to the United Nations Sustainable Development Goals, understanding whether underrepresented populations have these critical services provides important context. Some 675 million people lack access to electricity worldwide (IEA et al. 2023), while 2.2 billion lack access to safely managed water (UNICEF and WHO 2023). Knowing which public services are available or unavailable can help planners and policy makers understand and identify who is vulnerable to environmental disamenities.

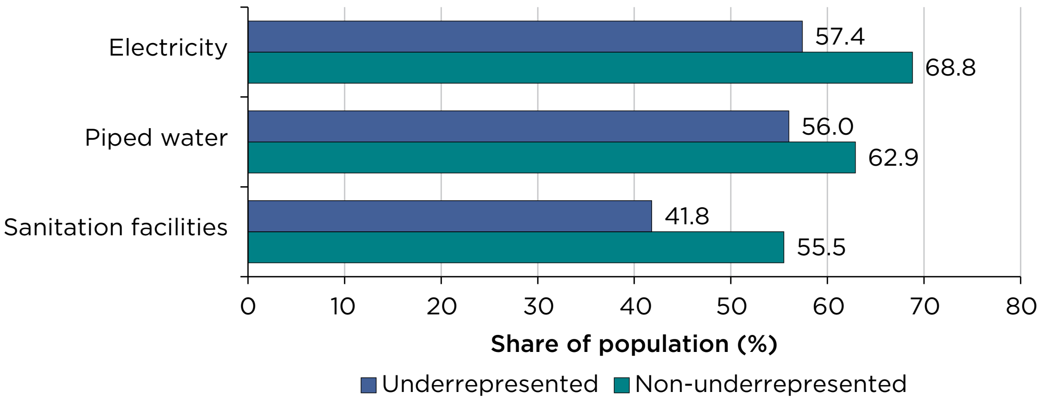
Ethnic and political favoritism are important drivers of disparity between communities in public services provision. This dynamic is widely documented across many regions, where political leaders have been found to favor people from their own ethnic group when allocating public funds and services (Abman and Carney 2020; De Luca et al. 2018; Do, Nguyen, and Tran 2017; Hodler and Raschky 2014).

Wider representation can help improve public services provision for those who are underrepresented (Dickens 2018). Having a voice in decision-making offers a chance to punish representatives that do not act in the best interest of their constituency, which can help diminish ethnic favoritism and lead to a fairer allocation of resources (Burgess et al. 2015). There is evidence that, in low- and middle-income countries (LMICs), empowering women to join government improves health care and education provisions, bolsters economic growth, and reduces corruption (Baskaran et al. 2023; Hessami and da Fonseca 2020). However, emerging evidence also shows that those obtaining representation might participate less in decision-making if they face pervasive discrimination when in office (Heinze, Brulé, and Chauchard 2024).

When diverse groups gain representation in decision-making, ethnic, religious, or racial differences are no longer as decisive in determining who gets included in services provision. Ethnic diversity has been found to affect the provision of public services in multiple contexts, as coordination among heterogenous preferences becomes complicated (Alesina and La Ferrara 2005; Easterly 2001; Miguel and Gugerty 2005). However, analysis for this report (refer to annex 2A) shows that when underrepresentation exists, other measures of diversity—such as ethnic, racial, or Indigenous fractionalization and polarization—do not seem to matter and have no statistical influence on public services provision. Specifically at the second administrative unit level, the Underrepresentation Risk Index (URRI) performs better than diversity indices in explaining local public services provision.

Administrative units with a larger percentage of those who are excluded from decision-making processes tend to have fewer public services, regardless of diversity levels. Political inclusion can be an important correlate of local public services provision. When controlling for underrepresented populations, the results suggest that measure of polarization or fractionalization across identities is statistically insignificant and inconsistent (refer to annex 2A). The URRI offers a more-consistent and more–statistically robust association with a wide variety of public services. This finding corroborates earlier findings that having a voice in decision-making is more important for explaining disparities in local public services provision than having communities that are homogeneous in ethnicity, race, or indigeneity.

FIGURE 2.1 Access to basic public services at the household level, by representation status



Sources: World Bank staff calculations, using data from the EPR data set (Vogt et al. 2015) and IPUMS International (Minnesota Population Center 2020).
Note: EPR = Ethnic Power Relations data set.

Overall, underrepresented households have notably lower access to public services. Figure 2.1 shows the household availability of electricity, piped water, and sanitation facilities. In line with the research on public services provision at the second administrative level, large gaps in access rates can be observed for underrepresented households. These three types of public services are integral for economic development, health, and sustainability, raising concerns about this disparity in access.

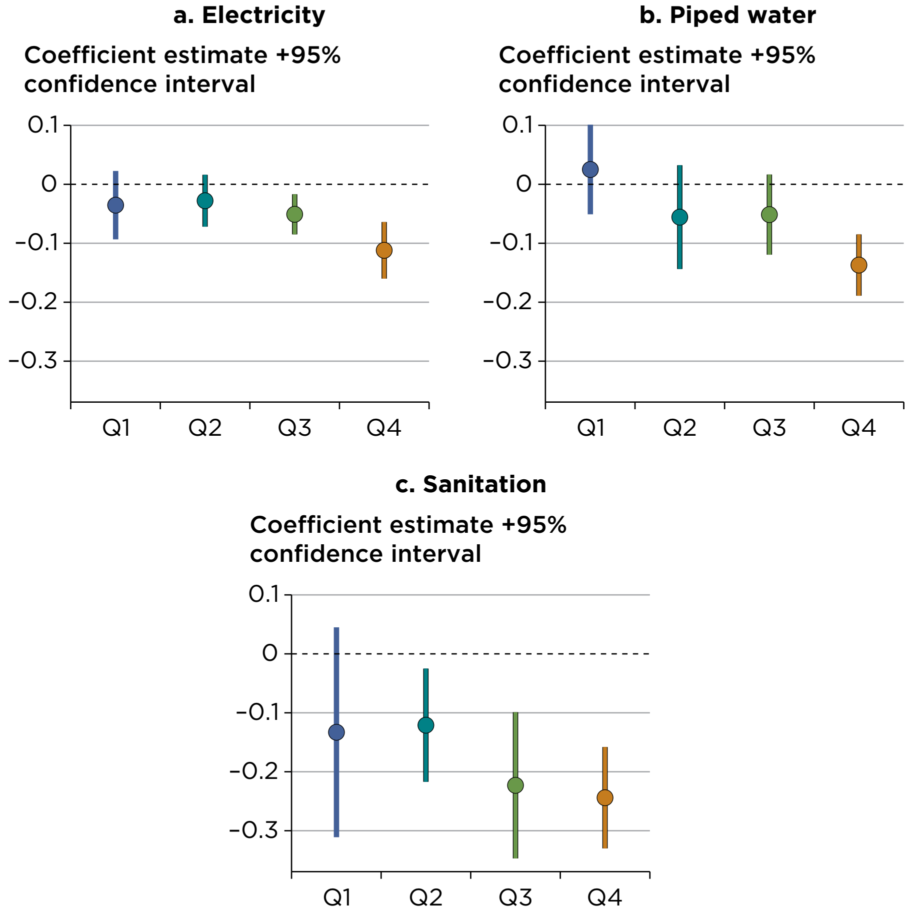
For electricity, there is a substantial (12 percentage points [pp]) access gap between underrepresented and non-underrepresented populations. Electrification has been found to correlate positively with health outcomes, enabling households to move away from more-polluting cooking, heating, and lighting fuels such as kerosene and biomass, reducing exposure to indoor air pollution (Barron and Torero 2017; Bonan, Pareglio, and Tavoni 2017; van de Walle et al. 2013). However, the economic benefits of electrification are more disputed, with large-scale literature reviews finding conflicting results ranging from substantial boosts to income and labor force participation to none at all (Bayer et al. 2020; Jeuland et al. 2021; Lee, Miguel, and Wolfram 2020). Possible explanations for the lack of clear results include differences in estimation methodology, differences in the way electrification is achieved—for example, grid access versus solar power—and heterogeneity in the populations and geographies in the studies.

Domestic access to piped water and sanitation facilities are similarly skewed and are approximately 7 pp and 13 pp lower, respectively, for underrepresented populations. In 2019, an estimated 1.4 million global deaths were attributable to unsafe drinking water, sanitation, and hygiene (Wolf et al. 2023). Piped water can help mitigate the dangers of unsafe drinking water, as it is considered an improved water source that is less susceptible to contamination. Contaminated water is especially dangerous to children, and access to an improved water source has been found to substantially reduce infant mortality and diarrheal disease incidence in many contexts (Damania and Zaveri 2023; Gamper-Rabindran, Khan, and Timmins 2010; Jalan and Ravallion 2003).

New research conducted for this report (refer to annex 3A) and discussed in detail in chapter 3 corroborates these findings, as increases in diarrhea incidence caused by deforestation-induced water quality drops are negated in households with piped water access. Open defecation and poor sanitation also generate strong negative health externalities (Coffey and Spears 2017; Gertler et al. 2015) and can impede learning outcomes, especially for girls (Adukia 2017; Santiago Ortiz-Correa, Resende Filho, and Dinar 2016; Spears and Lamba 2015; Van Eijk et al. 2016). The legacy impacts of poor sanitation in the earlier stages of life can also lead to lower productivity in later life, with studies finding that children exposed to poor sanitation are less productive, earn less in adulthood, and are more likely to remain poor (Lawson and Spears 2016). Large public investments in sanitation build momentum for improving sanitation, suggesting a fundamental complementarity between infrastructure and institutions, with both being central to improving the quality of sanitation in LMICs (Ashraf, Glaeser, and Ponzetto 2016).

Perhaps surprisingly, exclusion in public services provision is greater in richer areas. Where funding for public goods largely relies on taxing and gathering funds from local communities, public services provision might be heavily mediated by local income levels. Figure 2.2, which plots regression coefficients measuring the relationship between the URRI and public goods provision for within-country GDP quartiles, shows that the negative correlation between underrepresentation and electricity, piped water, and sanitation provision is highest in the richest areas. In fact, the trend is almost linear, indicating that this dynamic is not isolated to the wealthiest areas; as a region becomes more affluent, underrepresented households are more at risk of encountering lower levels of public goods provision. Of course, these regressions do not provide information on the drivers of such divergences in public goods provision. Exclusion in richer areas may eventuate because there is greater discrimination in these areas. Alternatively, because poorer areas have no or low levels of services provision, the opportunity to discriminate is less. Thus, this observation is consistent with favoritism or financial constraints, but it does imply that greater wealth will not necessarily eliminate exclusion in services provision.

FIGURE 2.2 **Estimated coefficients of public goods access versus underrepresentation risk, over GDP quartiles**



Source: World Bank staff calculations.
Note: The color coding for the GDP quartiles is as follows: dark blue represents the first quartile, light blue represents the second, green represents the third, and orange represents the fourth. In all regressions, country fixed effects are included. Robust standard errors are corrected for clustering at the country level, and income and urban population share at the administrative unit level are controlled. Income data are aggregated to the second administrative unit level, and income quartiles are calculated within each nation, slicing the administrative units within each nation into four quartiles. GDP = gross domestic product.

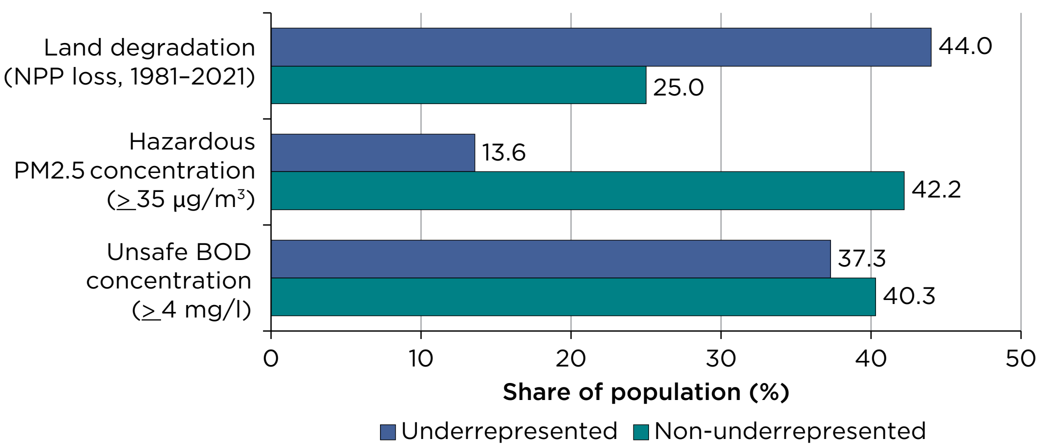
Incidence of environmental disamenities

Having established that underrepresented populations have lower access to public infrastructure, the natural follow-up question is whether they are also disproportionately exposed to environmental disamenities. The literature on environmental justice, which focuses on high-income countries, strongly suggests that, as with public goods, excluded populations face a greater burden of environmental disamenities (Liu et al. 2021; Martinez-Morata et al. 2022). Research in the United States consistently finds racial disparities in the incidence of pollution—for example, in 2016, the average PM2.5 concentration for the Black population was 13.7 percent higher than for the White population and was 36.3 percent higher than for the Native American population (Jbaily et al. 2022). It is unclear if the same trend holds in other countries and at different stages of development.

As land, air, and water are all crucial for survival, an investigation into three exposure statistics on land degradation, air pollution, and water pollution provides useful insights. The results paint a varied picture (refer to figure 2.3), suggesting that while there are clear differences in the exposure of underrepresented and non-underrepresented populations, the situation is not universally better or worse for one group. Instead, the incidence is nuanced, depending on the resource.

Figure 2.3 shows that underrepresented households are disproportionately exposed to land degradation. Long-term decrease in net primary productivity (NPP)—a measurement of plant life's capacity to produce carbon biomass in an area over time—is used to calculate land degradation. However, as NPP changes measure only whether the quality of land has decreased over time, regardless of the baseline or cause, a new analysis for this report (Bai et al. forthcoming) corrects the data for climatic influence

FIGURE 2.3 Exposure to land, air, and water degradation, by representation status



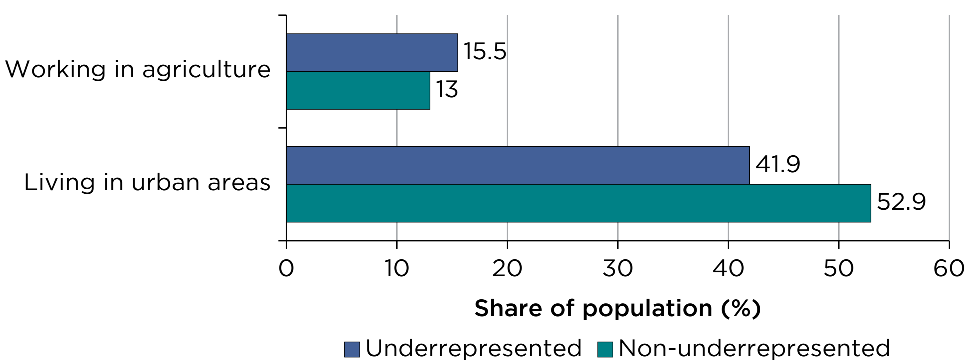
Sources: World Bank staff calculations, using data from the EPR data set (Vogt et al. 2015), Bai et al. forthcoming; IPUMS International (Minnesota Population Center 2020); Jones et al. 2023; and van Donkelaar et al. 2016.
Note: BOD = biochemical oxygen demand; EPR = Ethnic Power Relations data set; NPP = net primary productivity.

to account for the impact of larger climate dynamics, which are beyond the control of the underrepresented. This analysis finds that around 44 percent of excluded households live in areas that have experienced non-climate-related land degradation between 1981 and 2021, while the same is true for only 25 percent of nonexcluded households. In addition, as excluded households are more often rural and agricultural, land degradation is likely to impact more on excluded than on nonexcluded households (refer to figure 2.4).

Maintaining ecosystem services—and therefore, the benefits people receive from a healthy environment—can have wide-ranging positive effects. For example, nondegraded lands can improve mental well-being, can ameliorate poverty, and are integral in ensuring food security (Ferraro and Hanauer 2014; Prăvălie et al. 2021; Summers et al. 2012). Potential drivers of this stark divergence in the occurrence of land degradation are investigated in chapter 3.

For outdoor air quality, underrepresented households are exposed to better ambient air quality than nonexcluded households. Heightened exposure to PM2.5, fine particulate matter that the human body cannot filter, can lead to various respiratory and cardiovascular illnesses that are well documented (Bourdrel et al. 2017; Dominski et al. 2021; WHO 2023). World Health Organization (WHO 2023) air quality guidelines recommend that PM2.5 levels should not exceed 15 μg/m^3 on more than 3–4 days a year. However, for 42 percent of non-underrepresented households and 14 percent of underrepresented households, the annual average far exceeds that limit. These results, together with the urban-rural

FIGURE 2.4 Agricultural employment and urbanization rates, by representation status



Sources: World Bank staff calculations, using data from the EPR data set (Vogt et al. 2015) and IPUMS International (Minnesota Population Center 2020).
Note: EPR = Ethnic Power Relations data set.

division between the two groups, mirror findings that, within a single country, human-caused air pollution tends to be worse in relatively richer areas, due to higher economic activity (Behrer and Heft-Neal 2024).

While these results appear positive for underrepresented households, it is important to remember two additional factors. First, air pollution is typically more severe in areas of higher economic activity and employment, which is consistent with other evidence that employment opportunities are pivotal in determining location choices. Second, the exposure measured here includes only ambient outdoor pollution. Exposure to indoor air pollution can have devastating health consequences, which are not captured here. These two points of caution are explored in greater detail in chapter 4.

Exposure to poor water quality is similar for underrepresented and non-underrepresented populations. Biochemical oxygen demand (BOD) captures the oxygen consumed by aerobic bacteria to break down waste organic matter—such as fecal matter or plant debris—in water under standardized conditions. As higher demand indicates higher organic waste contamination, BOD can serve as a proxy for overall water quality. Unsafe drinking water has been found to cause many health ailments, such as diarrhea and respiratory infections, causing an approximate 1.4 million deaths globally (Wolf et al. 2023). The negative impact of poor water quality can also cascade beyond health impacts, as it has been found to lower economic growth (Russ et al. 2022).

While not substantially different in exposure, it is noteworthy that approximately 40 percent of the total population in the data used for this study live in areas where BOD concentrations are above 4 milligrams per liter, a threshold indicating moderate pollution (Damania et al. 2019). However, as the BOD data used measures the quality of ambient surface level rather than drinking water, infrastructure and water treatment can play a mediating role. As discussed in chapter 3, underrepresented households are more vulnerable to waterborne illness due to their lower access to piped water.

A way forward

Underrepresentation provides a novel measure that offers new insights into public infrastructure provision and patterns of exposure to environmental disamenities. Stark discrepancies exist in the accessibility of core public services—electricity, piped water, and sanitation access—which is perhaps predictable. Across all three, areas with large populations at risk of underrepresentation often experience a dearth of provision even when controlling for common confounders such as income and societal heterogeneity. This issue can lead to substantially lower household-level access, which can exacerbate vulnerabilities to environmental disamenities.

Measures of exposure to environmental hazards show that underrepresented households are not universally worse off and outcomes vary, according to the resource in question. Land degradation is especially severe, water quality is not substantially worse, and exposure to air pollution is lower for underrepresented households. Chapters 3 and 4 explore what these resource and public goods deficiencies mean for underrepresented households via original research and a synthesis of ongoing academic research.

The online technical annex for this chapter is available with the text of this book in the World Bank's Online Knowledge Repository, https://hdl.handle.net/10986/42610.

- Annex 2A Statistics on Local Public Services Provision

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CHAPTER 3

Fissured Landscapes and Divided Waters

Uncovering Social Cleavages

"You cannot protect the environment unless you empower people, you inform them, and you help them understand that these resources are their own."
—*Wangari Muta Maathai* (2004 Nobel Peace Prize Laureate)

AT A GLANCE

- Over the past 40 years, 28.5 percent of the world's land has been degraded, affecting 1.2 billion people living in rural areas.
- Marginalized populations, including those at risk of underrepresentation, are more likely to live on lands that are being deforested and degraded at higher rates and are more vulnerable to land and soil degradation on agricultural land. They are also more prone to diarrhea, malaria, and other diseases that result from deforestation, due to a lack of public goods such as safely managed piped drinking water and access to medical facilities and malarial bednets.
- Evidence suggests that the link between land degradation and underrepresented populations is likely driven by actions associated with vulnerability. Underrepresented populations tend to be more reliant on agriculture, timber, and nontimber forest products (NTFPs) for their livelihoods, which can put pressure on land, degrading it and reducing productivity.
- Underrepresented populations tend to lack access to public goods, inputs, markets, and information on mitigating the effects of reduced organic carbon in soil and zinc-deficient soil, leading to lower yields and nutritional impacts.
- Women, who are often responsible for working the land and securing water, food, and fuel for cooking and heating, face significantly greater challenges when these resources are depleted in terms of additional workload, vulnerability to sexual violence, and other social inequities.

- As the intersection of gender and underrepresentation confers the greatest disadvantage, effective land and water management strategies must consider these dynamics together to ensure agency and equitable benefits.

Introduction

This chapter examines the interplay between underrepresented populations and landscapes and water. Presenting results from new research, it explores how political and economic power can affect environmental quality and how policies and built infrastructure do not always help vulnerable people cope with environmental stresses, focusing on two critical environmental resources: land and water (clean air is covered in chapter 4). It also notes that the degradation of one of these resources can lead to spillovers across the others, with unequal impacts on people.

As in other chapters, unless otherwise stated, underrepresented populations or households refer to people at high risk of exclusion from decision-making, as defined in chapter 1. While the term may be reductionist, it is used solely for brevity and ease of reading. For more detail on the data use, technical details of all analyses in the report, and several analyses that are congruent to the report's findings, refer to the online technical annexes.

Exposure to deforestation

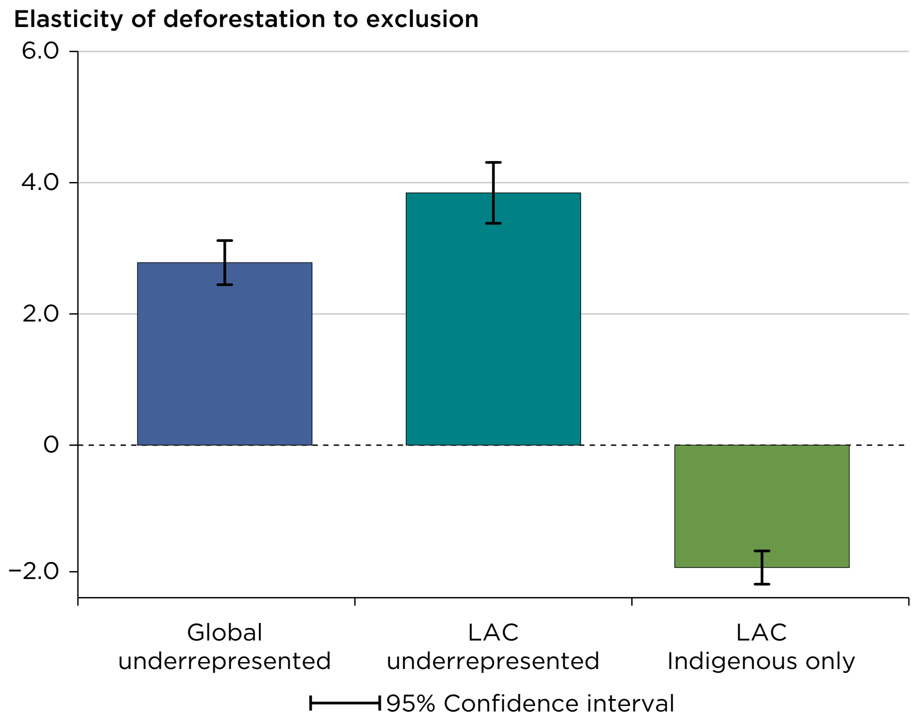
Land is fundamental to human welfare, acting as the cornerstone to the planet's health and humanity's survival. Land nurtures grasslands, forests, and soils, supporting a rich tapestry of biodiversity and delivering essential ecosystem services such as climate regulation, pollination, water storage, and filtration. Such processes are indispensable for agriculture and nutrition, supporting food security for billions. With a natural ability to provide flood and drought protection, land safeguards communities against the increasing severity of climate events (Dasgupta et al. 2019; Taylor and Druckenmiller 2022; Zaveri, Damania, and Engle 2023). It also plays a role in purifying air (Nowak et al. 2018) and water (Mapulanga and Naito 2019) and in reducing the spread of disease (Ellwanger et al. 2020), directly impacting public health. This issue highlights the need for sustainable land management practices to preserve these vital functions for future generations (Damania et al. 2023c).

Deforestation is one of the starkest symptoms of the degradation of the world's land. Dating back to the expansion of agricultural frontiers and colonial resource extraction, deforestation has been a persistent phenomenon for centuries. However, its drivers and dynamics have evolved over time, shaped by changing socioeconomic and political landscapes. Since 2000, the world has lost more than 10 percent of its tree cover, with the tropics accounting for 1.48 million square kilometers of deforestation—an area larger than France, Germany, and Spain combined. Often a consequence of economic activities that may confer market and other benefits, just over a quarter of global forest loss is due to permanent land use change for beef, soy, palm oil, wood fiber, and other commodity production (Curtis et al. 2018). Illegal logging, land grabbing, and infrastructure development can exacerbate deforestation rates, leading to environmental degradation, biodiversity loss, and social conflict.

New analysis for this report reveals that exposure to deforestation is not socially neutral, with the areas where underrepresented populations live experiencing a disproportionate amount of deforestation since 2001. Simple, univariate regressions show that, all else being equal, a 10 percent increase in the underrepresented share of the population in second-administrative units is related to a 2.8 percent increase in the share of land deforested between 2001 and 2019 (refer to figure 3.1). In Latin America and the Caribbean, home to some of the world's most-precious biomes and half the world's tropical forests, this figure rises to 3.8 percent.

The correlations also imply that, as underrepresented population shares increase, the rate of deforestation increases at an increasing rate. This does not mean that the excluded groups are responsible for deforestation; the drivers of deforestation in areas populated by excluded communities, which can range from outside logging companies to mining and other forms of land conversion from economic activity, remains an important topic of research. Incentives for local officials are also important determinants of deforestation activity (Balboni et al. 2023), with studies showing that they may become relatively more permissive of illegal deforestation activity in years leading up to a local election, for example, if doing so improves their electoral prospects (Burgess et al. 2012; Cisneros, Kis-Katos, and Nuryartono 2021). Research has also found that deforestation rates tend to be higher in areas characterized by higher levels of ethnic fractionalization owing to weaker voter coordination in the demand for vital public goods (Alesina, Gennaioli, and Lovo 2019) and that communities with a lower risk of political exclusion, such as those sharing the ethnicity of the ruling elite, tend to receive preferential treatment in resource allocation, resulting in diminished deforestation (Abman and Carney 2020).[1]

FIGURE 3.1 Social exclusion, Indigenous populations, and deforestation in Latin America and the Caribbean



Source: World Bank staff calculations, based on data from www.globalforest watch.org.
Note: Results presented are from a univariate regression with log (deforestation) as the dependent variable and log (underrepresented share) as the independent variable, and the unit of observation is the second administration unit (for example, "municipalities" in some countries). The y-axis shows the percentage of increase in tree cover loss from 2001–19 for a 10 percent increase in excluded (left two bars) and Indigenous (right bar) populations. LAC = Latin America and the Caribbean.

Contrary to populations facing underrepresentation risk due to ethnicity or race, a higher share of Indigenous populations in a region shows a protective relationship with forests (refer to figure 3.1). Over the past 20 years, deforestation rates are lower in areas of Latin America and the Caribbean that have higher shares of Indigenous populations. Although these results do not necessarily imply causality, they resonate with other studies finding lower deforestation and land degradation on Indigenous lands, pan-tropically, relative to nonprotected areas (Miranda et al. 2016; Sze et al. 2022). Regional studies suggest that, while the area of intact forest blocks decreased by about 5 percent in Indigenous areas of Latin America between 2000 and 2016, this decrease more than doubled to 11 percent in non-Indigenous areas (Fa et al. 2020).

With Indigenous people making up only about 6 percent of the global population, their management of at least one-quarter of the world's land surface, spanning 38 million square kilometers across 87 countries, is key to preserving natural capital. Of the land that they own, manage, or occupy, one-third is formally protected and another third includes some of the world's most sparsely populated intact regions (Garnett et al. 2018). In Latin America, this relationship is even stronger, where Indigenous people collectively manage over 230 million hectares of the Amazon Basin, an area larger than France, Germany, Italy, Norway, Spain, and the United Kingdom combined (RAISG 2019).

It is widely recognized that Indigenous support is central to forest conservation plans, underscoring the need for conservation to support their rights and recognize their contributions. This issue supports ensuring that Indigenous people retain rights to the lands and natural resources that they have customarily owned and occupied, including those used on a seasonal or temporary basis (for example, by pastoralists). It also includes their right to self-determination; self-governance; and free, prior, and informed consent over investments or policies that could affect their customary lands and natural resources. Recognition for their conservation contributions could take the form of direct participation in the flow of benefits from carbon markets; being involved in the design and implementation of national climate and conservation policies; and investments in their governance, technologies, and connectivity to support their role as stewards. With benefit sharing and collaborative partnerships increasingly essential to meeting local and global conservation goals, Indigenous voices must be included in land use decisions to align conservation with their aspirations (refer to box 3.1).

BOX 3.1

Gentle resistance: The bottom-up Chipko movement

For many marginalized communities, whose daily tasks are entwined with nature, both life and livelihoods depend heavily on access to land and water resources. The Chipko movement in India, named after the Hindi word for "to cling," began when men and women in the Western Himalayas stood firm to protect forests from commercial logging. In 1973, Chandi Prasad Bhatt, social worker and pioneer of the movement, played a pivotal role in organizing the first protests by villagers. A year later,

(Box continues next page)

BOX 3.1

Gentle resistance: The bottom-up Chipko movement *(continued)*

Gaura Devi ignited the most-iconic women-led protest in the history of the Himalayas, which came to be recognized as the fountainhead of the environmental movement.

As the movement grew, the act of *chipko* (embracing a tree) evolved into an *andolan*, a broad-based movement that united individuals across social, caste, and age divisions. The movement led to the enactment of India's Forest Conservation Act in 1980, aimed at preserving woodlands, and a new federal environment ministry to serve as a central agency for biodiversity protection and environmental safeguarding.

The Chipko participants sought recognition of their tribal rights to forest resources, which were vital for their sustenance. By embracing trees, villagers were protesting not only the degradation of forests but also the impact this issue had on their own lives and livelihoods. For example, when nearby forests were depleted, women often faced long treks to collect firewood. In recognition of its influence on natural resource conservation in India, the movement received the Right Livelihood Award in 1987, often referred to as the *alternative Nobel Prize*.

The subject of numerous books and scholarly articles, the Chipko movement has maintained its stature as a prominent example in the discourse on sustainability. It illustrates the power of regional or local demands for sustainable development, as well as how marginalized communities can elevate environmental issues to global prominence and bring about institutional change. However, for such movements to effect sustained change, the institutions that design and implement land use law and regulations must not be captured by vested interests but remain transparent and accountable to the demands of citizens.

Sources: Gadgil and Guha 1995; Guha 2024; Mundoli 2024.

Forest loss and cascading health impacts

Forest loss can have cascading impacts on human health by interacting with other forms of natural capital, such as water. It is well known that forests and NTFPs make significant economic contributions to rural livelihoods by providing a safety net and a source of income generation, especially for those living in and around forests. What is less known is that forest ecosystems are also essential for human health.

The loss of upstream forested watersheds can decrease the capacity of soil to filter water, increase soil erosion, and decrease water quality, impacting downstream watersheds (Damania et al. 2023b). As a result, deforestation can impact water quality many hundreds of kilometers downstream (Mapulanga and Naito 2019). Polluted drinking water can lead to adverse health impacts, causing acute and chronic diseases including diarrhea, a leading cause of death among children younger than 5 years (Prüss-Ustün et al. 2014) and responsible for an estimated 13.5 percent of global stunting (Danaei et al. 2016), widely recognized as a major impediment to human development (Galasso and Wagstaff 2018).

New research for this report shows that children from underrepresented households are more likely to experience an increase in diarrhea due to upstream deforestation, even after accounting for wealth. To estimate the causal effects, the analysis (refer to annex 3A) uses variation in upstream deforestation to assess impacts on waterborne disease outcomes for rural households downstream (refer to box 3.2). The analysis finds that children from wealthy households are not as vulnerable to health impacts, partly because wealthier households tend to have healthier environments, with better access to safe water sources, health care, and nutrition.

However, wealth is not the only household characteristic that determines vulnerability due to deforestation. Using data across 800,000 children from 60 countries, the analysis suggests that children from underrepresented households face a disproportionate increase in diarrhea, even after accounting for household wealth. This finding occurs because such households are disproportionately exposed to upstream deforestation associated with poorer water quality, and they also have limited capacity to cope with degraded water quality.

BOX 3.2

Estimating unequal health impacts from forest loss due to waterborne diseases

Few studies have investigated the causal links between the loss of forest cover and the hydrological services they provide and human health (Damania et al. 2023b). Such an endeavor is challenging due to the multiple factors determining health outcomes and the degree of complementarity that must be accounted for by including socioeconomic, demographic, infrastructure, environmental, behavioral, and institutional factors (Pattanayak and Pfaff 2009).

(Box continues next page)

BOX 3.2

Estimating unequal health impacts from forest loss due to waterborne diseases *(continued)*

To address the potential bias from nonrandom forest loss and confounding trends, the new study for this report exploits quasi-random variation in deforestation upstream to assess impacts on waterborne disease outcomes for rural households downstream. In low- and middle-income countries, forests provide vital water filtration services for those who use unimproved drinking water sources. When upstream watershed areas are cleared, downstream water can become more contaminated or more turbid.

To estimate the health impacts of forest cover loss via the water channel, the study focuses on waterborne diseases such as diarrhea, because diseases have different ecologies and, therefore, different transmission mechanisms (Berazneva and Byker 2017; Garg 2019; Pattanayak and Pfaff 2009). The study links health data from the Demographic Health Survey (DHS), which captures health and socioeconomic outcomes for 800,000 children in rural areas in 60 countries from 2000 to 2020, to high-resolution deforestation data from Hansen et al. (2013) and water catchments using HydroBASINS to establish a pathway from upstream to downstream regions. It then uses the Ethnic Power Relations data set described in chapter 1 and self-reported ethnicity data from the DHS to identify historically marginalized households to ascertain whether the health impacts are worse for children from excluded households.

For more details on this study and its findings, refer to annex 3A.

The greater vulnerability of excluded households to the health effects of poor downstream water quality likely results from a lack of access to safe water sources. When forest cover declines and water quality deteriorates, having access to piped water provides a safer alternative and significantly reduces the incidence of diarrheal disease for children living in downstream areas. Diarrhea among children residing in areas with upstream deforestation and who lack access to safe water is almost seven times higher than those children who have access to safe water.

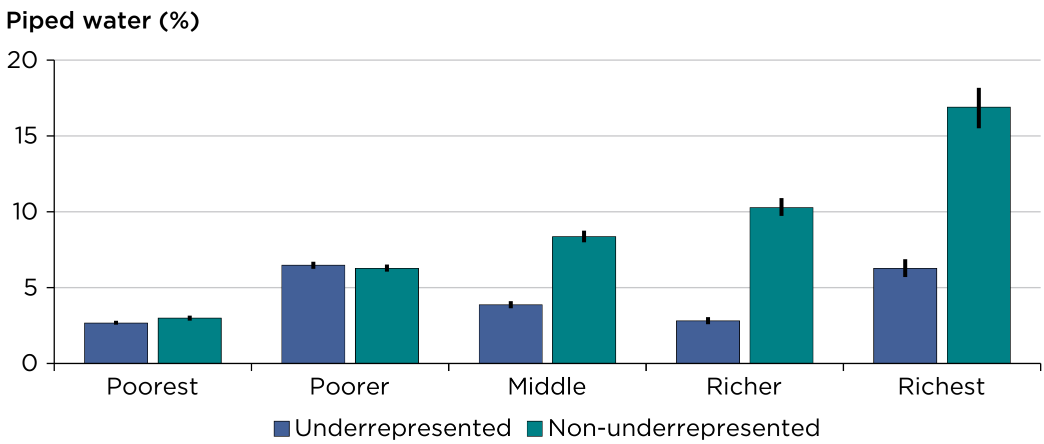
Poverty is one determinant of who gets access, with 18 percent of poor households compared to 45 percent of richer households having access to safe water. Underrepresentation risk is another determinant of access.

Even at a similar level of wealth, those who are at high risk of underrepresentation have lower access to safe water sources than those who are nonexcluded (refer to figure 3.2). This finding follows from the analysis presented in chapter 2 that, for underrepresented households, wealth does not confer access to additional services.

Notably, figure 3.2 shows that differences in access to safe water between underrepresented and represented populations increases at higher income quintiles. This phenomenon could either reflect greater discrimination among certain wealth quintiles or fiscal constraints at low levels of provision in poorer regions, implying a limited scope for discrimination. Put simply, in the extreme case if there is zero provision of an impure public good such as safe water, there can be no discrimination in its provision. Whatever the causal drivers, the results suggest that wealth per se may not be sufficient to eliminate underrepresentation risk.

Deforestation can also increase malaria risk factors and disproportionately impact the most-vulnerable groups. Malaria remains a significant global health challenge, with 249 million cases reported in 2022, of which 608,000 resulted in fatalities (WHO 2023). The distribution of malaria cases and deaths are often uneven, disproportionately affecting individuals in low- and middle-income countries (LMICs), poorer populations, and socially marginalized groups. A rapidly growing body of research over the

FIGURE 3.2 Access to piped water, by underrepresented status and household income



Source: World Bank staff calculations, based on DHS data for 60 countries.
Note: Households are split into wealth quintiles using the DHS household wealth index and categorized into underrepresented and non-underrepresented groups using the methodology presented in chapter 1. Bars show the shares of households in each group that have access to piped water. Error bars show 95 percent confidence intervals. DHS = Demographic Health Survey.

past decade has uncovered the possibility that greater tree cover loss may increase local risks of malaria transmission, highlighting the close ties among the environment, public health, and the economy (Bauhoff and Busch 2020; Berazneva and Byker 2017; Chakrabarti 2021; Fornace et al. 2016; Garg 2019; Terrazas et al. 2015; Wayant et al. 2010).[2]

New research for this report finds that malaria-related health risks from deforestation are higher for underrepresented populations. Focusing on large Amazonian economic regions, the analysis (refer to annex 3B) exploits a key driver of deforestation in the country—soybean production—to obtain plausibly casual estimates (refer to box 3.3). Soybean production has historically been expanding into the Amazon Rainforest, due to inadequate yield improvements to meet demand. As humans push deeper into the Amazon, contact with mosquitos increases, leading to increased opportunities for malaria transmission. Vulnerable communities are particularly susceptible to infection and illness, as they are more likely to lack malaria control technologies and preventive measures such as vector controls, insecticide-treated bednets, medical facilities that can provide early detection and prompt treatment, and local capacities to regularly assess malaria situations.

The analysis reveals that, for every 2,000 people in the population, 1 to 10 additional cases of malaria occurred in the Amazon due to deforestation. To give perspective to these results, the implication is that deforestation resulted in 42,500 new cases of malaria in a typically large Amazonian country, suggesting that deforestation may have been linked to about 20 percent of all cases.

The results also suggest that the effect asymmetrically burdens municipalities with a greater share of underrepresented populations. Specifically, within soy-suitable regions in the outer states of the Amazon frontier, for every 2,000 cases, underrepresented populations experienced 7 more cases of malaria compared to nonexcluded cohorts.

Globally, the result is similar, with a 10 percent increase in tree cover loss associated with a 1.7 percent increase in malaria incidence. The correlational analysis shows that greater tree cover loss is associated with greater malaria across all countries with endemic malaria, with an additional 400,000 malaria cases driven by deforestation. As with the Amazon results, deforestation-related malaria also impacts more on municipalities that have a greater share of underrepresented populations, implying that this result holds more generally.

BOX 3.3

Causal analysis of the deforestation linkages with malaria transmission

Largely driven by an increase in meat and dairy consumption, the world's demand for soybeans has increased significantly over the past decades, more than doubling since the turn of the century, and increasing to more than 13 times its 1960 level (Ritchie 2021). Brazil and the United States play dominant roles in clearing this market demand, accounting for approximately two-thirds of the world's soy production. However, with improving yields insufficient to meet growing demand, increased market supply has come from the extensification of land area devoted to soybean production. Figure B3.3.1 panel a shows that production grew by 300 percent between 2001 and 2023 and yields grew only by 25 percent, with the rest of the growth explained by increases in harvested area (180 percent growth since 2000).

Resulting public concern over soy plantation encroachment into the Amazon region led to the establishment of the Amazonian Soy Moratorium (ASM) in 2006. Prohibiting the purchase of soybeans originating from land deforested after 2006 (changed to 2008 in the 2012 Forest Code), the broad consensus is that, in the short term, the ASM had a positive impact in decreasing deforestation directly related to soybean production (Heilmayr et al. 2020; Kastens et al. 2017). However, over the longer term, many studies have shown that an indirect path has emerged between soybean agriculture and deforestation: As soybean cultivation has expanded into pasture lands, the search for new pasture lands has impacted the forest frontier, leading to deforestation (Décamps 2024; Garnett et al. 2018; Kuschnig, Cuaresma, and Krisztin 2019). The ASM also incentivized land use shifts outside of areas covered by the ASM restrictions, accelerating direct deforestation of second and less-dense forests that characterize these biomes (Lima et al. 2019; Strassburg et al. 2017).

The accelerated production of soybeans beginning in 2016 (refer to figure B3.3.1, panel b) coincides with a spike in the price of the commodity in international markets, which was related to market shortages brought about by El Niño. The relatively short production cycle allows farmers to react to current market prices. The analysis, therefore, uses Food and Agriculture Organization data on the soy suitability of land (aggregated at the municipal level) to identify the broad areas where land use changes may have resulted in deforestation after 2016. It uses a difference-in-differences strategy, where both deforestation and malaria transmission

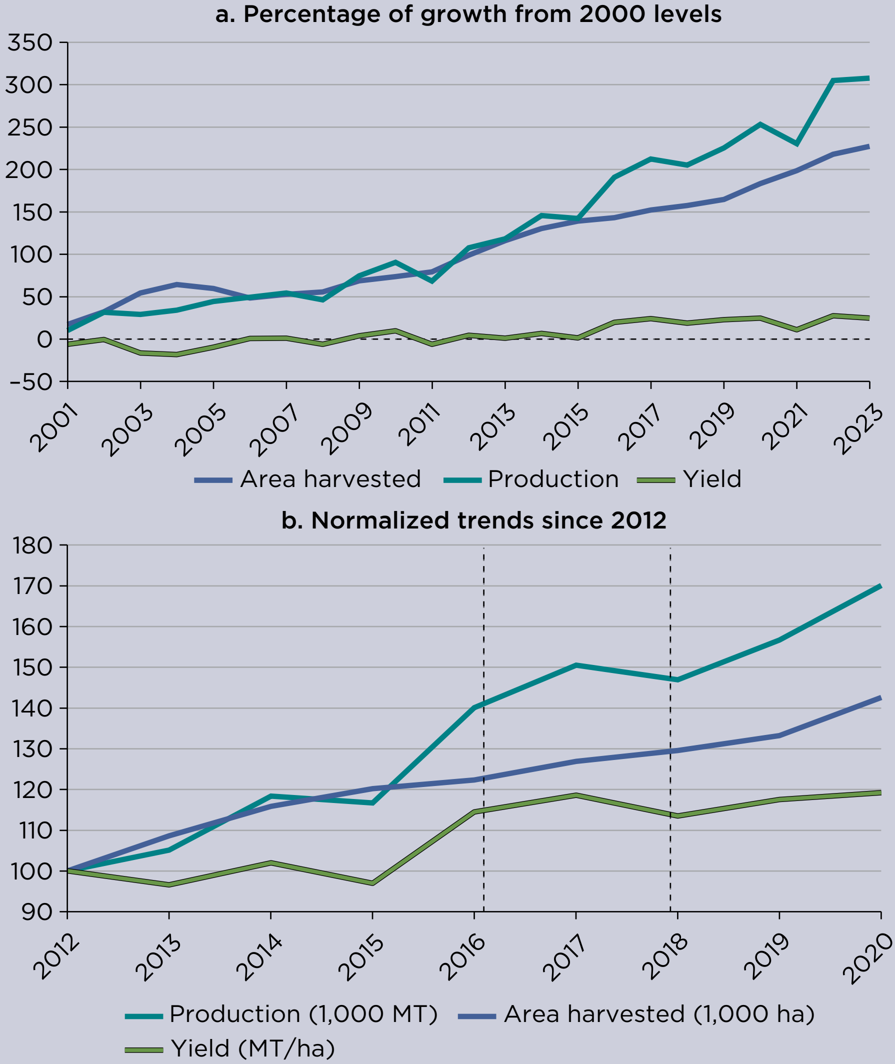
(Box continues next page)

BOX 3.3

Causal analysis of the deforestation linkages with malaria transmission *(continued)*

are compared pre- and post-2016 and in high and low soy suitability areas. The model includes a 2-year lag to give time for farmers to react to the price shock and clear the land. For more details on this study and the findings, refer to annex 3B.

FIGURE B3.3.1 Soybean crop growth and trends in an Amazonian country, 2001–23



Source: World Bank staff calculations, based on USDA data.
Note: ha = hectare; MT = metric ton; USDA = U.S. Department of Agriculture.

Exposure to land degradation

Although land is a critical resource for society as a whole, vulnerable and poor communities disproportionately rely on its bounties for their livelihoods. Approximately 79 percent of the world's poor populations live in rural areas (United Nations 2019) and depend on agriculture and other key resources derived from land, including timber, wild fruits and berries, nuts and seeds, mushrooms, medicinal products, bamboos and natural fibers used for textiles, resins, and craft materials like palms and cork. Vulnerable households and those at the bottom of the income distribution also tend to rely more on these products for income (Angelsen et al. 2014; Damania, Joshi, and Russ 2020; Fedele et al. 2021; Shackleton and de Vos 2022; refer to box 3.4). For example, Angelsen et al. (2014) found that households with young household heads, large households, and less-educated households across 24 LMICs rely more on these types of environmental income. However, Damania, Joshi, and Russ (2020) found that households in the bottom 20 percent of the income distribution across 5 districts in India rely on environmental income for 30–33 percent of their income, whereas those in the top 20 percent receive 16–18 percent of their income from environmental sources. These analyses are largely income-based due to a lack of data for exploring the reliance of more broadly defined excluded people on environmental income. This is an important topic for future research.

BOX 3.4

Dependency on forests in Nepal is mediated by consumption expenditures

Nepal is one of the few countries where community forest efforts have reversed past deforestation trends (Nepal, Nepal, and Berrens 2017). To better understand how public forests and private trees impact livelihoods, the World Bank collected data from a nationally representative sample of 3,204 households across Nepal who were respondents in the third wave of the 4th Nepal Living Standards Survey, between January and June 2023.

The study found that 37 percent of Nepalese households had accessed public forests, and 48 percent had accessed private trees for nontimber forest products (NTFPs) in the past 12 months, but dependency on NTFPs lowers as consumption expenditure increases. Poorer households were significantly less likely to report accessing neither public forests or private trees than richer households (refer to figure B3.4.1), and a greater share of

(Box continues next page)

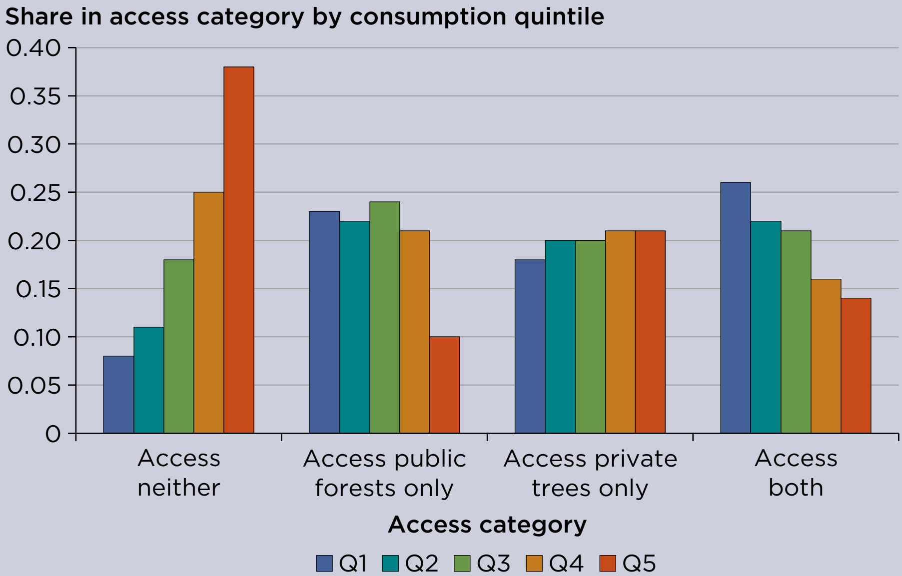
BOX 3.4

Dependency on forests in Nepal is mediated by consumption expenditures *(continued)*

households that exclusively access public forests belong to lower consumption quintiles. However, there is little relationship between income and NTFP consumption from private trees. A greater share of poorer households reported accessing public forests, either exclusively or jointly with private trees, and a somewhat smaller share reported exclusively accessing private trees.

Examining their perceived value, the study finds that NTFPs collected from both public and private forests are more important to poorer households and become less important as consumption expenditures increase. For the poorest households (Q1), the perceived value of NTFPs from public forests is greater than those from private trees, at 41 and 29 percent, respectively (refer to figure B3.4.2). Households in the other consumption quintiles (Q2–Q5) perceive NFTPs from private trees as having slightly greater

FIGURE B3.4.1 **Access to public forests and private trees, by consumption quintiles**



Source: World Bank staff calculations, based on data from the third wave of the 4th Nepal Living Standards Survey, implemented by the NSO (2024) in Nepal.

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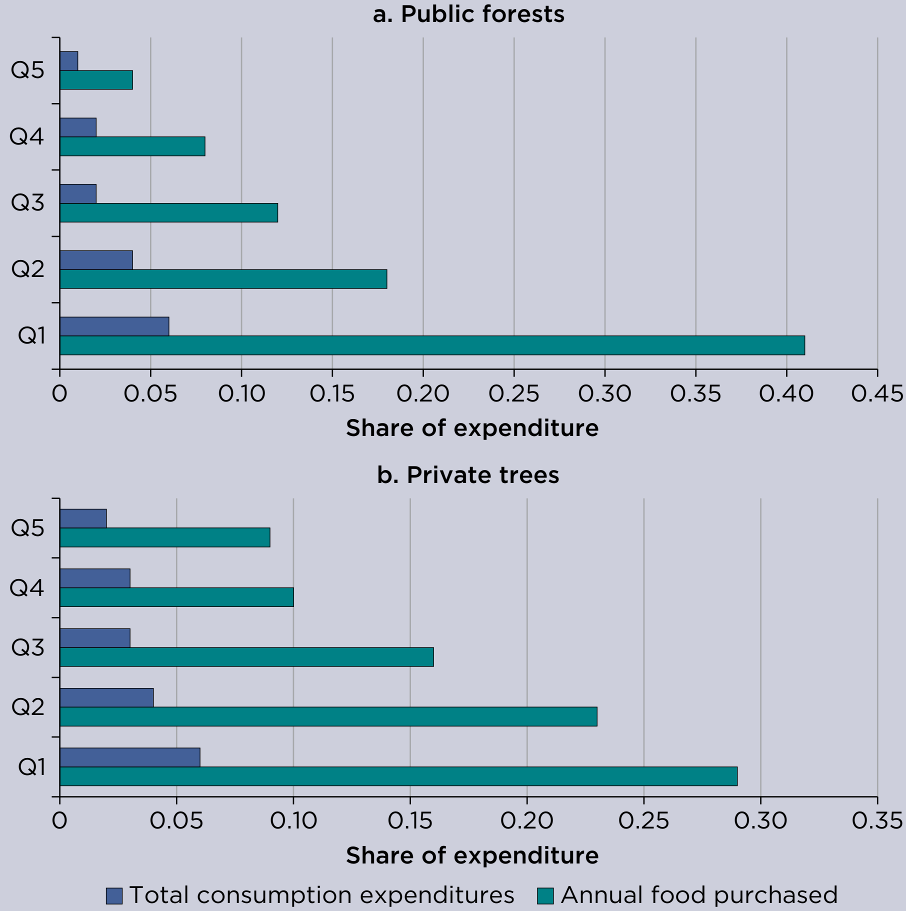
BOX 3.4

Dependency on forests in Nepal is mediated by consumption expenditures *(continued)*

importance than those from public forests. Given that the incidence of private trees is spread across all the quintiles, enhancing value from private trees holds potential for supporting livelihoods, which would help further reduce pressure on public forests.

FIGURE B3.4.2 Perceived value of NTFPs, compared to annual expenditures on food purchased and annual total consumption expenditures



Source: World Bank staff calculations, based on data from the third wave of the 4th Nepal Living Standards Survey, implemented by the NSO (2024) in Nepal.

For more information on this study and its findings, refer to annex 3C.

Over the past 40 years, 28.5 percent of the world's land has been degraded, affecting 1.2 billion people in rural areas. New research for this report (Bai et al. forthcoming) shows that population growth, economic development, and a changing climate are putting pressure on land, degrading soils, causing deforestation, and reducing the land's capacity to support vegetation (refer to box 3.5). Correcting for vegetation changes that are driven by other factors such as climate, map 3.1 identifies lands where vegetation change has a high probability of being induced by humans, through changes in land use or land management. The study also finds that total degraded land area has increased by 4.5 percentage points (pp) since 2003, implying that the problem is not retreating, despite increases in environmental movements over the past two decades. Global hotspots for land degradation include the boreal forests in North America and Asia; large swathes of Sub-Saharan Africa (SSA); mainland Southeast Asia and the East Indies; the Eurasian steppes; and the Cerrado, Pampas, and Chaco in South America.

BOX 3.5

Evolution of measuring land degradation

Land degradation measurement originally involved qualitative field visits. Expert opinions and observations (such as Oldeman et al. 1991) used to be the primary means of assessing land health, with environmental scientists and agronomists conducting field visits to directly observe soil conditions, erosion levels, and vegetation health. This qualitative method, while useful for localized insights, was inherently subjective and limited in scope, relying heavily on the individual expertise and interpretative skills of the observer (Sonneveld and Dent 2009).

Advancements in scientific techniques brought soil sampling into regular use, allowing for a more-quantitative assessment of land degradation. This method involves collecting soil samples across various spaces and times to analyze the soil's physical, chemical, and biological properties, as well as any changes in these. Providing concrete evidence of soil quality deterioration or improvement, such data offer a more-objective and -reproducible basis for assessing land degradation. However, soil sampling is labor intensive, costly, and limited by the physical area sampled, making it less practical for large-scale or global assessments.

The introduction of machine learning has helped achieve a smoother data grid. Some data sets use machine learning or other algorithms to spatially

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BOX 3.5

Evolution of measuring land degradation *(continued)*

interpolate data between observation points (such as Poggio et al. 2021). A downside to this method is the reduced accuracy that comes with modeling data between observations. These methods also usually result in a cross-sectional data set, using data from different years, sometimes spanning decades.

The advent of remote sensing technology, particularly through the use of the Normalized Difference Vegetation Index (NDVI) and net primary productivity (NPP) measures, marked a significant leap forward. These techniques use satellite imagery to assess vegetation cover and growth across vast areas and over extended periods, providing consistent and reproducible data that are useful for monitoring changes in land conditions. NDVI measures the density and health of vegetation by comparing visible and near-infrared sunlight reflected by plants, offering insights into vegetation stress, which is often a precursor to land degradation (Tucker et al. 2005). Similarly, NPP estimates the rate at which plants in an ecosystem produce net useful chemical energy, indicating the productivity of the land (Bai et al. 2008; Conijn et al. 2023; Le, Tamene, and Vlek 2012). These methodologies have revolutionized the scale and frequency of monitoring, enabling global assessments of land degradation trends and facilitating proactive environmental management.

Changes in vegetation, measured by NDVI and NPP, offer useful proxies for land degradation because

- Vegetation cover is a direct indicator of land health. Healthy, productive land typically supports a robust vegetation cover. Changes, especially decreases in this cover, can indicate problems such as soil erosion or a loss of soil fertility.
- Vegetation helps provide critical ecosystem services, including water regulation, carbon sequestration, and soil protection. A decline in vegetation cover can lead to a decrease in these services, signaling broader ecological impacts and land degradation.
- Changes in vegetation are easy to observe and measure, especially with the advent of remote sensing technology. Satellite images can provide consistent data over large areas and long time periods, making it possible to systematically monitor changes in vegetation cover.
- Variations in vegetation can predict further degradation. For example, a decrease in vegetation might lead to increased soil erosion,

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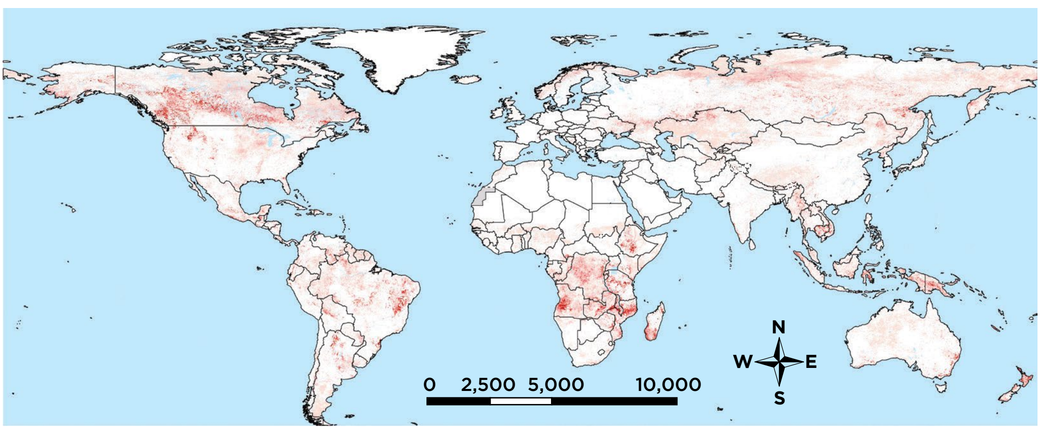
BOX 3.5
Evolution of measuring land degradation *(continued)*

further degrading the land. Thus, monitoring vegetation can help propel early action to mitigate degradation.

- Vegetation cover is a relevant metric across different ecosystems and geographical areas. Whether in arid areas, where vegetation changes are linked to desertification, or in forested areas, where changes may indicate deforestation or forest degradation, vegetation provides a useful gauge of environmental health.
- Measuring land degradation and improvement through vegetation is quantitative and tangible. A globally consistent measurement can serve as a yardstick for measuring the seriousness of any local situation. Such consistency allows these measures to be used in global analyses, including of the type presented in this chapter.

MAP 3.1 Global loss of net primary productivity in the degrading areas between 1981 and 2021



Geographic coordinates

(KgC/ha/year)

NA 10–20 30–40 50–60 >70 Water
0–10 20–30 40–50 60–70 No vegetation

Source: Bai et al. forthcoming.
Note: Map shows the areas that have lost NPP between 1981 and 2021, a proxy for land degradation. Urban areas (based on 2021 land use maps from the European Space Agency), areas where NPP change is estimated to be driven by changes in precipitation or solar radiation, and areas where NPP has increased are masked.
ha = hectare; KgC = kilograms carbon; NPP = net primary productivity.

Using these data, this report presents new research on how land degradation interacts with underrepresented populations. The aim is to test whether underrepresented populations are more exposed to land degradation, and if so, why? The analysis (refer to annex 3D) used several methods, including machine learning models, linear regressions, and multinomial logit regressions. Box 3.6 describes these methods in more detail.

BOX 3.6

Underrepresentation risk and the determinants of land degradation methodology

How do underrepresentation and poverty interact with land degradation? To explore this issue at the global level, the study built a database of 83 explanatory variables, a near-exhaustive list of factors that can cause, contribute to, or enable land degradation. These variables include environmental conditions such as climate and natural disasters; geographic factors such as elevation, terrain roughness, and land cover; anthropogenic factors such as economic activity, population density, and infrastructure; and social exclusion and poverty indicators. This breadth of data allows for a nuanced examination of the complex phenomena at play.

The analysis begins with a *random forest model,* a robust machine learning technique suited for handling complex data sets with potentially nonlinear relationships and high-dimensional interactions. The random forest model serves a dual purpose, identifying the most-predictive variables of land degradation while also providing a preliminary assessment of the data structure. This nonparametric model constructs a vast number of decision trees, collectively referred to as *the forest,* and outputs their mean prediction. A key feature of the application is the use of permutation importance measures to evaluate the predictive contribution of each variable. By randomly shuffling the values of each variable, it becomes possible to measure decreases in the model's accuracy and assign an importance. This work helps determine the variables that are most influential in predicting land degradation. However, the model does not offer insights into the magnitude of each variable's impact; this issue is remedied by including more-conventional econometric methods.

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BOX 3.6

Underrepresentation risk and the determinants of land degradation methodology *(continued)*

To further explore the relationship between land degradation and underrepresentation risk, the study uses ordinary least squares (OLS) regression, which allows it to quantify the association between land degradation and underrepresentation risk while controlling for other possible confounders. The OLS model is applied to a transformed version of the data set where all variables are converted to z-scores. This standardization facilitates the comparison of coefficients across different variables, revealing the factors most strongly associated with increases or decreases in land degradation.

To delve deeper into the potential mechanisms underlying the observed relationship, the analysis uses a *multinomial logit model,* which is useful for handling categorical dependent variables that represent multiple classes. In this context, it helps reveal whether the likely dominant reason for an association between land degradation and underrepresented populations is *sorting* (that is, underrepresented populations move onto degraded lands for economic, social, or political reasons) or *spillovers* (that is, land degradation is a direct consequence of the actions and conditions of the underrepresented groups). This work is done by distinguishing between vegetation changes caused by purely external factors, such as a changing climate, and those caused by human-driven land degradation. If underrepresented populations are more likely to live in areas where vegetation losses are attributed to external factors, it is likely that sorting is the mechanism at play. If people are more likely to live on lands that have been degraded due to human activity, then internalities are likely the underlying mechanism. If people are equally likely to live on both types of land, then either or both mechanisms may be at play.

For more information on this study and its findings, refer to annex 3D.

The results show that exclusion is strongly associated with land degradation and that this is likely not an adverse endowment effect but a land management issue. Machine learning models, which examine the determinants of land degradation and compare these measures against 43 other variables often associated with land degradation, find that poverty headcount at $3.65/day, excluded population share, and poverty headcount at $2.15/day are the 3rd-, 5th-, and 7th-most-important variables for predicting land degradation, respectively.

Regression results tell a similar story. As the share of underrepresented people increases, the probability of experiencing land degradation between 1981 and 2021 increases. In the extreme, going from 0 to 100 percent underrepresented is associated with a 30–33 percent increase in the probability of land degradation. These results hold even after controlling for many of the major other determinants of land degradation—such as economic growth, weather shocks, natural disasters, and elevation—as well as for ethnic fractionalization and polarization, which themselves do not show a robust association with land degradation. Poverty is also correlated with land degradation, with a slightly stronger association for extreme poverty over moderate poverty.

Evidence shows that sorting is unlikely to be the dominant driver of the relationship between underrepresentation risk and land degradation. It may seem reasonable to conjecture that poor and politically vulnerable populations could be forced—either through institutional or historical discrimination or economic necessity—to move onto degraded lands, resulting in the association described earlier. In addition, while this issue may be the case in some settings, it is unlikely to be the dominant driver of the relationship.

To test this theory, the analysis focuses on lands where a downward trend in either rainfall or solar radiation is the dominant driver of land degradation, finding that underrepresented populations are no more likely to live on these lands than represented populations and that underrepresented people are disproportionately represented only on lands where human actions are likely the dominant driver of land degradation. The analysis found similar results for extreme ($2.15/day) and moderate ($3.65/day) poverty indicators. A reasonable—although difficult to empirically establish—conjecture to draw from these results is that it is *internalities*, or actions associated with vulnerability itself, that are causing the land degradation. These factors include high discount rates (that is, a strong preference for consumption today versus consumption in the future) and a lack of access to the information, financing, and capital people need to implement more-sustainable land management methods.

Productivity losses and health impacts of poor soils

Healthy soils are important for growing nutritious crops, safeguarding the health and livelihoods of populations engaged in agriculture, and supporting habitats. Healthy soil is contingent on maintaining a balance of interrelated factors such as microbes, plant root functions, and physicochemical properties such as pH, soil organic carbon (SOC), moisture, and nutrients.

Soil organic matter (SOM) content is often used as an aggregate indicator of soil quality and health, as it is intricately linked with the physical, chemical, and biological properties and processes of soils (Lal 2020). In the context of agricultural productivity, evidence suggests that SOM impacts crop yields through two key mechanisms: (1) plant available water capacity and (2) plant available essential nutrients, especially nitrogen.

Soil health also plays an important role in crop quality and, subsequently, in human health. Zinc has emerged as the most-widespread micronutrient deficiency in soils and crops worldwide, resulting not only in yield losses but also in deterioration in nutritional crop quality (Alloway 2009). Zinc is an essential nutrient for human health and is vital for many biological functions in the human body, including growth—height, weight, and bone development— immune systems, and fertility (refer to box 3.7).

BOX 3.7

Zinc deficiency in soil and health impacts on underrepresented populations

As well as reducing productivity, land and soil degradation can lead to the deficiency of key minerals, such as zinc, which also impacts farmers. Many African soils are zinc deficient, and applying zinc-fortified fertilizers can enhance crop productivity and the zinc concentration of crops, addressing human zinc deficiency, a widespread global public health concern. New research for this report exploring the impacts of soil zinc levels on the health status of children across 16 Sub-Saharan African countries finds that a 1-part-per-million increase in soil zinc is associated with a 0.03 increase in the standardized height-for-age *z*-score and a 2.3 percent reduction in child stunting. While these results are correlations, they do align with health literature showing the importance of zinc supplementation for reducing child mortality (Bhutta et al. 2013; Kujinga et al. 2018).

The research also shows that underrepresented households find it difficult to obtain alternative sources of zinc, making them vulnerable to soil zinc availability. This issue is due to households' tendency to be located in areas with limited access to markets, either because they are geographically far from larger cities or because they lack the transportation infrastructure to access them. As a result, they are more likely to consume food produced locally. In addition, local areas with zinc-deficient soil can create zinc deficiencies and the resulting health impacts.

For more information on this study and its findings, refer to annex 3E.

The relationship between crop yields and SOM is complex and depends on several interacting factors, including biotic and abiotic stresses, farm management practices, and technology. Therefore, it is difficult to establish causal relationships between SOM and crop yields, but several studies have shown strong correlations between them. One global meta-analysis shows that enhancing SOM in degraded soils can reduce maize and wheat yield gaps by up to 30 percent and 55 percent, respectively (Oldfield, Bradford, and Wood 2019). In terms of critical SOM thresholds below which soil functionality would significantly decline, some have suggested using 2 percent of SOC (Loveland and Webb 2003; Oldfield, Bradford, and Wood 2019), while others have argued for 1 percent (Kay and Angers 1999).[3] The analysis for this report (refer to annex 3F) uses the more-conservative approach, classifying soils below 1 percent of SOC at 5–15 centimeters of depth as poor.

The results show that populations facing underrepresentation risk are disproportionately impacted by poor soil health. Using the growth rate of NPP on cropland as a proxy for the productivity growth rate in agriculture and controlling for environmental factors, including inputs such as fertilizer and irrigation, and a range of socioeconomic variables, results show that poor soils result in a decline in productivity growth. This issue is more pronounced for areas with higher shares of excluded populations, and it persists even when controlling for poverty rates. This finding highlights a public policy failure, as these populations have limited access to public and private resources to help them mitigate the impact of poor soil health using existing technology. These results are also relevant as food insecurity remains a global concern: Although the number of people experiencing hunger has increased due to the COVID-19 pandemic and the ongoing Russia–Ukraine conflict, the global community was already off-track in achieving a zero-hunger target by 2030.

Gender dimensions

Land restoration activities (LRAs) are often heavily reliant on women's labor and can add to their already-onerous workloads. Governments encourage a variety of physical and agronomic approaches, collectively termed as *LRAs,* to reduce erosion, improve soil moisture, and increase organic and inorganic soil nutrient content on both public lands and private agricultural lands. These approaches include bunds, terraces, contours, and ridges, as well as crop choice or rotation, tree planting, pasturing, and fallowing. LRAs on public lands often offer immediate incentives through food or wage compensation, but expanding them to private agricultural lands is more challenging, as it relies on household labor dynamics.

LRAs tend to be labor intensive, and returns from these efforts are often delayed and variable. To sustain the activities over time, households must continue deploying household and nonhousehold labor. In regions where rural households are labor constrained and the agricultural workforce has been “feminizing” over the past two decades as less male labor has been available to work on farms, the burden of sustaining LRA tends to fall on women (Doss 2013; Doss and Quisumbing 2020).

The presence of female labor significantly increases the likelihood of LRA adoption. In Ethiopia, where severe land degradation affects approximately 14.3 million hectares and causes $4.3 billion in economic losses each year, the government has allocated almost $1.2 billion annually over the past decade to rehabilitate degraded land. While adopting LRAs improves the well-being of smallholder households and those who live in their vicinity, gender labor dynamics reveal that the costs and benefits of land restoration differ markedly for men and women. Using data from the Central Statistical Agency of the Government of Ethiopia’s Living Standards Measurement Survey—Integrated Surveys in Agriculture, the analysis shows that an additional person-day of female household or nonhousehold labor can enhance the probability of adopting LRA by 0.4–0.8 percent, whereas the contribution of male labor is negligible or absent (refer to annex 3G).

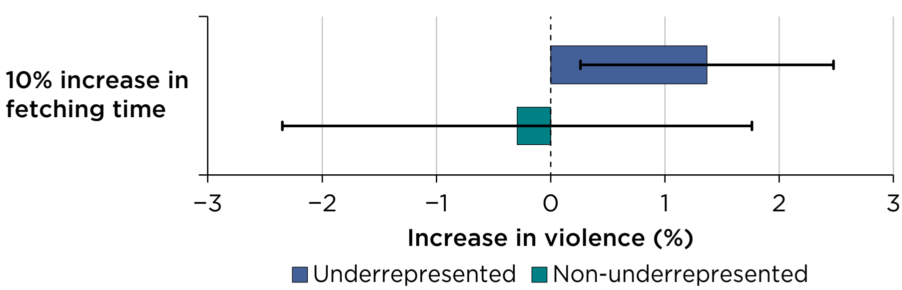
Female labor is statistically important for increasing LRA adoption in male- and female-headed agricultural households, in both Orthodox and non-Orthodox households. This pattern underscores the crucial role of female labor in land restoration efforts. However, failing to consider gender dimensions when designing and disseminating restoration practices can affect their uptake and risks, perpetuating inequalities. To sustain LRA and its benefits, reducing drudgery and the physical demands of these activities and constraints in access to nonhousehold labor will remain critical.

Disparities in water access also disproportionately burden women. Globally, 1.8 billion people—usually women and girls—fetch drinking water from off-premises sources, often traveling long distances. Across 61 countries, women and girls are responsible for carrying water in 8 of 10 households, and in SSA, they are 4 times more likely to fetch water than men (Hossain, Mahajan, and Sekhri 2022; Sorenson, Morssink, and

Campos 2011). When the round-trip fetching time exceeds 30 minutes, people may collect less water than required for their basic needs. This issue places further burdens on women, who often are solely responsible for fetching water and firewood, cleaning, cooking, and other aspects of home production or general running of the household (Fletcher, Pande, and Moore 2017; Sedai, 2021). The time women and girls around the world spend carrying water adds to a staggering 200 million hours—that is, 8.3 million days or 22,800 years—every day (UNICEF 2016).

Water fetching is a hazardous activity for women and children. Distant water sources, predictable gathering schedules, darkness, and other factors all contribute to the heightened risk of violence and predation. Therefore, it is no surprise that on-site water and sanitation are associated with decreased incidence of gender-based violence (Gonsalves, Kaplan, and Paltiel 2015; Hossain, Mahajan, and Sekhri 2022; Sekhri and Hossain 2023). In addition, new research for this report (refer to annex 3H) shows that these effects disproportionately impact women who belong to underrepresented groups, with evidence from more than 40,000 women across 10 SSA countries, indicating that women at risk of underrepresentation who fetch water at long distances are more vulnerable to sexual attacks (refer to figure 3.3). The analysis also finds that these effects are concentrated in regions characterized by significant polarization, where access to water points might be controlled by one dominant group (to the detriment of non-dominant groups).

FIGURE 3.3 Vulnerability to sexual attacks when fetching water: Underrepresented versus non-underrepresented women



Source: World Bank staff calculations, based on DHS data for 10 Sub-Saharan African countries.
Note: Figure indicates the effects of a 10 percent increase in fetching time on the likelihood of violence. Women are categorized into underrepresented and non-underrepresented groups using the methodology presented in chapter 1. Error bars show 95 percent confidence intervals. DHS = Demographic Health Survey.

Gender divisions in water-fetching responsibilities perpetuate inequalities and have broader implications for social equality. Increased time spent securing water sources can reduce the time available to engage in other activities, including leisure, education, or income generation. Studies from several contexts suggest that reducing water collection time frees up time for leisure and child-rearing activities and reduces stress levels and intrahousehold conflict (Devoto et al. 2012).

Where women are more likely to fetch water, children's participation in school is lower, as they help with domestic chores. As a result, depending on the country, improving household access to piped water can improve schooling outcomes for children (Das 2017; Koolwal and van de Walle 2013). For example, one study found that halving the time it takes to carry water in West Africa would increase school enrollment rates by about 7 pp for girls, with similar effects for boys (Nauges and Strand 2017). In the Sundarbans in South Asia, saline water and lack of access to improved water sources increases the chances of girls dropping out of school and becoming responsible for water collection but makes little difference for boys (Das 2017). The physical toll of carrying heavy water containers over long distances can also lead to health issues for women, including persistent pain, movement problems, and musculoskeletal disorders (Bisung and Elliott 2016; Geere et al. 2018; Sorenson, Morssink, and Campos 2011).

Water scarcity further exacerbates these structural gaps, with marginalized groups carrying a disproportionate burden of the impacts of drought. Around 60 percent of the world's population lives in a water basin that encounters water stress for at least part of the year, and close to 85 percent of people affected by droughts live in LMICs, where the number of extreme droughts has increased by 233 percent in the past 50 years (Zaveri, Damania, and Engle 2023). Evidence suggests that water scarcity will further accentuate impacts for the most-vulnerable populations (Brunckhorst et al. 2023; Gascoigne et al. 2024; Hill and Porter 2017). Across SSA, even a 10 percent decrease in precipitation could change the number of people walking more than 30 minutes to their water source from 41 percent to 98 percent, with the majority of this increased burden falling on women and girls (Pickering et al. 2023). In South Asia, when wells dry up during dry spells, the distance to and congestion around surviving water sources increases, making women fetchers more vulnerable to sexual violence (Hossain, Mahajan, and Sekhri 2022).

The social toll of drought also extends to economic impacts. New evidence suggests that the economic costs of drought are worse for areas with higher shares of underrepresented populations: As their share increases, so do the economic costs of drought, with costs rising to up to 1 pp of gross domestic product growth in areas where 100 percent of the population faces underrepresentation risk (refer to annex 3I).

In summary, women are key agents of change within communities and can enhance and improve natural resource management. As such, their needs and opinions are crucial when planning for the provision of key natural resource-based assets, as well as in resilience planning.

The way forward

The results presented in this chapter demonstrate both the higher exposure and vulnerability that marginalized people face with degraded land and water. This group is more likely to live on lands that are being degraded and deforested and are less able to cope due to lower levels of public goods provision like access to water, sanitation and hygiene services and connectivity to markets through rural transport.

Plans to halt deforestation and land degradation should focus on their major driver—unsustainable agriculture. Agriculture is by far the biggest contributor to deforestation, responsible for 90–99 percent of global tropical deforestation (Pendrill et al. 2022). This effect is accelerated by agricultural subsidies that encourage land use expansion, often into forested areas. Every year, the world spends approximately $635 billion on agricultural subsidies. A recent study found that these subsidies are directly responsible for about 2.2 million hectares of forest loss annually, equivalent to about 14 percent of total deforestation (Damania et al. 2023a). Even worse, agricultural subsidies are often poorly targeted, benefiting richer households with larger farms. Reforming these subsidies and repurposing them can be win-wins, transforming them into better-targeted safety programs for marginalized communities while benefiting the environment and reducing deforestation.

Repurposing agricultural subsidies in rich countries can provide benefits well beyond their own borders. The distribution of agricultural subsidies is heavily weighted toward high-income and upper-middle-income countries. Indeed, China, the European Union, Japan, and the United States together account for about 77 percent of global agricultural subsidies. These subsidies do not only have effects within their own country's borders but also can cause negative impacts that spill over to different parts of the world. Damania et al. (2023a) show that livestock subsidies in the United States contribute to significant deforestation in the Amazon. This issue occurs because the subsidies increase the supply of livestock in the United States, which increases demand for soybeans, a major feed crop. The resulting increase in demand raises soybean prices, which makes it profitable to grow soybeans in otherwise unlikely places deep in the Amazon. Thus, even rich countries without tropical forests must examine how their policies can have global environmental impacts on the most-vulnerable populations.

Communities around the world experience inadequate access to water, posing a significant threat to their health and well-being. The wide variation in access to improved water sources and patterns of coverage that persist across countries is only partially explained by levels of economic development. The depressive effects of underrepresentation on inadequate access and subsequent health impacts, even after adjusting for levels of income, are substantive, suggesting that considering how public goods provision may interact with underrepresentation risk would be prudent. This consideration can help inform effective sociopolitical strategies to overcome gaps in coverage.

The online technical annexes for this chapter are available with the text of this book in the World Bank's Online Knowledge Repository, https://hdl.handle.net/10986/42610.

- Annex 3A Deforestation, Diarrheal Disease, and Underrepresentation Risk
- Annex 3B Deforestation, Malaria, and Underrepresentation Risk
- Annex 3C Nepal: Environmental Income
- Annex 3D Land Degradation and Underrepresentation Risk
- Annex 3E Soil Zinc, Nutrition, and Underrepresentation Risk
- Annex 3F Soil Degradation, Productivity, and Underrepresentation Risk
- Annex 3G Ethiopia: Land Restoration Activities
- Annex 3H Women, Water Fetching, and Violence
- Annex 3I Drought, Economic Growth, and Underrepresentation Risk

Notes

1. Abman and Carney (2020) found that ethnic patronage in a fertilizer subsidy program led some areas to receive more fertilizer, reducing deforestation in those areas through improved agricultural productivity.
2. Although Bauhoff and Busch (2020) found that the deforestation-malaria relationship does not necessarily generalize across Sub-Saharan Africa, others found positive relationships at the country level in East Asia (Chakrabarti 2021; Fornace et al. 2016; Garg 2019), South America (Olson et al. 2010; Terrazas et al. 2015; Wayant et al. 2010), and Sub-Saharan Africa (Berazneva and Byker 2017).
3. SOC is about 50 percent of SOM.

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CHAPTER 4

Disparities in Air Pollution

"The unfortunate are always being 'offered opportunities.' Not wealth, not happiness, not even a decent life, but 'opportunities'."—*Thomas Sowell* (American economist, social philosopher, and political commentator)

AT A GLANCE

- Marginalized communities are less exposed to hazardous air pollution, as they often live in rural areas or on the periphery of urban centers, where the air is comparatively cleaner. However, when they do bear the brunt of air pollution, they are likely to be at greater risk, as they have sparse resources to counter the health hazards.
- Underrepresented communities often face tough trade-offs between working in high-risk polluting sectors and better earnings.
- Although they contribute less to outdoor air pollution, poor people endure higher levels of indoor air pollution, which was linked to more than 3.2 million deaths—nearly half of all deaths from air pollution worldwide—in 2020.
- The most-vulnerable groups—low-income households, women, children, and socially excluded populations—often depend on solid fuels, such as biomass, for cooking and heating, putting them at greater risk.
- As wealth increases, the gap between the contribution of underrepresented and non-underrepresented households to air pollution grows.

Introduction

This chapter explores the interplay between social exclusion and air pollution. Presenting original and academic research, it examines whether and why exposure to air pollution differs for underrepresented and non-underrepresented groups. It also explores new research using Environmental Engel Curves (EECs), analyzing the extent to and ways in which underrepresented and non-underrepresented groups across different income levels contribute to indoor and outdoor air pollution.

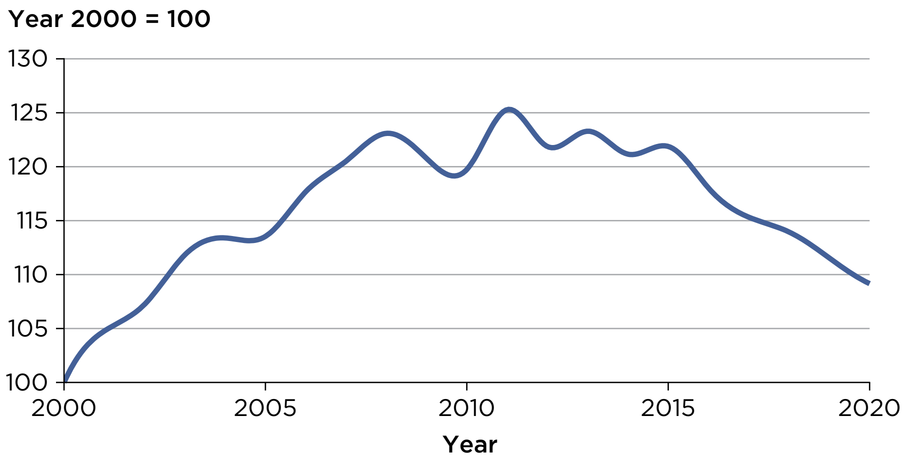
As in other chapters, unless otherwise stated, *underrepresented populations* or *households* refer to “people at high risk of exclusion from decision-making” as defined in chapter 1. While the term may be reductionist, it is used solely for brevity and ease of reading. For more detail on the data used, technical details of all analyses in the report, and several analyses congruent to the report’s findings, refer to the online technical annexes.

Exposure to air pollution

Exposure to ambient and indoor air pollution is among the biggest drivers of premature mortality and morbidity. *Ambient air pollution* describes contaminants in outdoor air, often generated by activities such as transportation, industrial processes, or power generation. *Indoor air pollution* occurs within built environments, such as homes, workplaces, and other indoor areas where people spend their time. Exposure to both types can cause respiratory and cardiovascular conditions, potentially increasing infant mortality rates and reducing life expectancy (Chay and Greenstone 2003; Greenstone and Fan 2018; Pope, Ezzati, and Dockery 2009). The World Health Organization (WHO 2023) estimates that air pollution causes approximately 7 million premature deaths globally each year from ischemic heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections such as pneumonia, which disproportionately affect children in low- to middle-income countries (LMICs). Given that exposure to air pollution can have significant short- and long-term health consequences, understanding where air pollution is most severe—and within these areas, who is more heavily exposed—is crucial.

Globally, air pollution is trending downward, but this figure masks significant heterogeneity across countries. Li et al. (2023) found that global population-weighted PM2.5 exposure increased from 28.3 $\mu g/m^3$ (very high) in 1998 to a high of 38.9 $\mu g/m^3$ (hazardous) in 2011, before declining to 34.7 $\mu g/m^3$ (just below hazardous) in 2019. Figure 4.1 shows this exposure, using 2000 as a base year. The increasing trend up to 2011 was driven by China, India, and Sub-Saharan Africa, while the reduction after 2011 was primarily spurred by China.

FIGURE 4.1 Global population-weighted exposure to PM2.5 air pollution relative to the year 2000

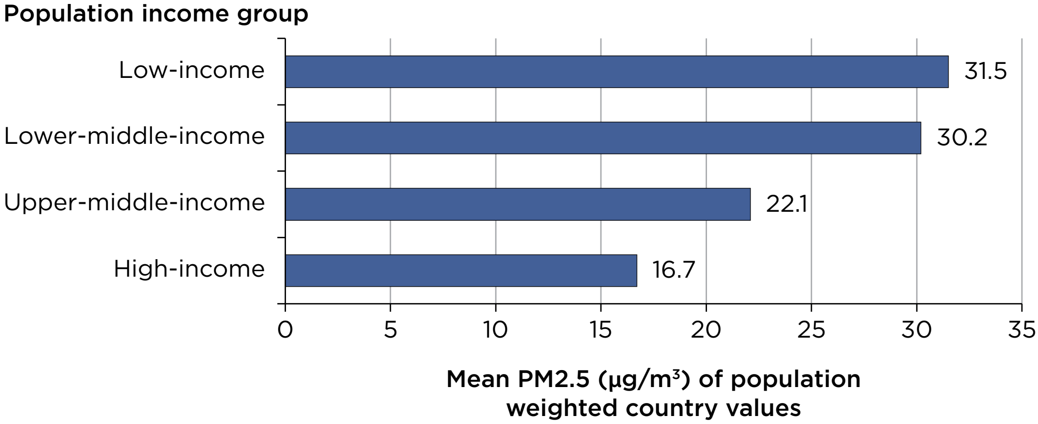


Sources: World Bank staff calculations, based on data by CIESIN 2016 (population) and van Donkelaar et al. 2016 (PM2.5).

High-income countries (HICs) have seen considerable improvements in air quality, while the opposite holds for most low-income countries (LICs) and LMICs (refer to figure 4.2). Rentschler and Leonova (2023) showed that 7.3 billion people globally are exposed to dangerous levels of PM2.5 air pollution, and 80 percent of these live in LICs and LMICs. In general, 64.5 percent of LMIC populations are subjected to more than 35 $\mu g/m^3$ (hazardous). Several factors contribute to higher pollution levels in LICs and LMICs, including less-stringent air quality regulations; the prevalence of older, more-polluting machinery; fossil fuel subsidies; congested urban transport systems; rapidly developing industrial sectors; and shifting agriculture.

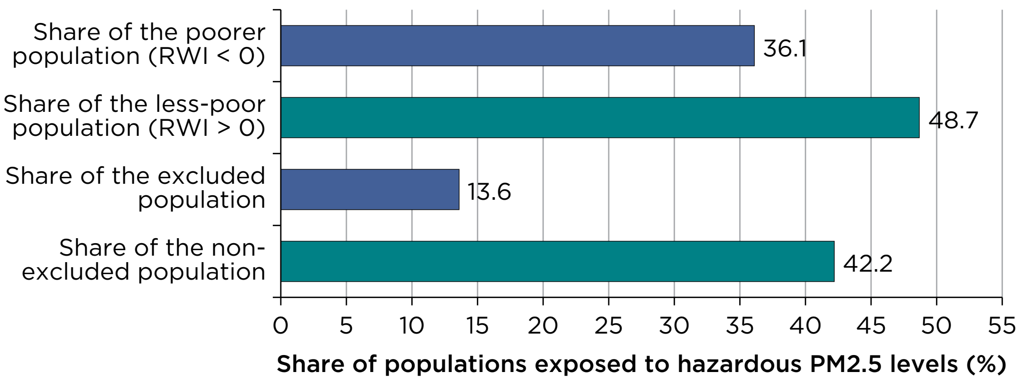
As shown in chapter 2, there is a paradox in patterns of pollution. While poorer countries generally have higher levels of ambient air pollution, within countries, the richer areas tend to be more polluted (refer to figure 4.3). In addition, because excluded populations tend to be located in poorer, more-rural areas, they are less exposed to ambient air pollution. Nevertheless, the welfare cost to poor and excluded populations from air pollution remain high, mainly due to their high vulnerability according to the framework developed by Brunckhorst et al. (2023) in the context of climate change.

FIGURE 4.2 Exposure to PM2.5 concentrations, by country income group



Source: Based on air quality data from van Donkelaar et al. 2016.

FIGURE 4.3 Differential exposure to hazardous PM2.5 based on relative wealth and underrepresentation risk



Source: Based on air quality data from van Donkelaar et al. 2016.
Note: Wealth data is from the RWI, where "poor" is defined as living in an area below the country median RWI. RWI = Relative Wealth Index.

Exposure to outdoor air pollution can also vary according to other socioeconomic indicators, such as race and ethnicity, but there is no conclusive global pattern for these relationships. In North America, communities with lower socioeconomic status (SES) are typically exposed to higher levels of air pollutants (Hajat, Hsia, and O'Neill 2015), while racial and ethnic minorities, especially non-Hispanic Blacks and lower-income groups, are more likely to reside in areas with poor air quality and face a higher risk of mortality from PM2.5 exposure (Jbaily et al. 2022; Miranda et al. 2011; Tessum et al. 2021). This issue occurs even though most PM2.5 pollution is generated by the consumption patterns of the non-Hispanic White majority (Tessum et al. 2019).

The pattern observed in developing countries varies. Because the incidence of PM2.5 is correlated with economic activity, wealthier and nonexcluded populations tend to reside closer to the inner cities, which are also more polluted. Box 4.1 discusses observed migrant location decisions in Latin America.

BOX 4.1

Prioritizing access to economic opportunities over environmental health: Evidence from Santiago, Chile

Income can be a key, but not the sole, determinant in relocation decisions, as households trade off urban accessibility, infrastructure quality, amenity values, and other factors that influence property prices. Nonmonetary household characteristics that heighten their risk of exclusion can also influence location decisions. For example, immigration or Indigenous status can determine which public services and amenities a household can access or where their social networks are concentrated.

New research presented in annex 4B uses block-level census data for the city of Santiago, Chile, together with detailed traffic data, to investigate whether immigrant populations are more exposed to traffic externalities such as air pollution than nonimmigrant groups of a similar socioeconomic status (SES). The analysis uses simulated trip volumes of roads as the dependent variable and block-level population share as the independent variable.

The study finds that, even after controlling for SES, the blocks with a higher share of immigrants tend to be adjacent to roads experiencing more traffic. The results show that a 1.0 percent increase in the share of immigrants is correlated with a 2.8 percent increase in local travel volume. These figures are in line with the city's layout, as the blocks with the highest share of immigrant residents are in the city center.

Historical evidence on immigration shows that migrants settled next to busy traffic corridors rather than the roads being sited next to them (refer to map B4.4.1). The number of immigrants increased rapidly from around 100,000 people in 1990 to 1.6 million in 2020 (Doña and Levinson 2004; Doña-Reveco 2022). While historical maps show that the city's main road networks were built in the 1920s, by 1985 they expanded to suburban areas (refer to map B4.4.2). Thus, the urban road layout was largely in place by the time immigration increased, so new migrants settled into the city center and high-traffic areas rather than main roads being sited in

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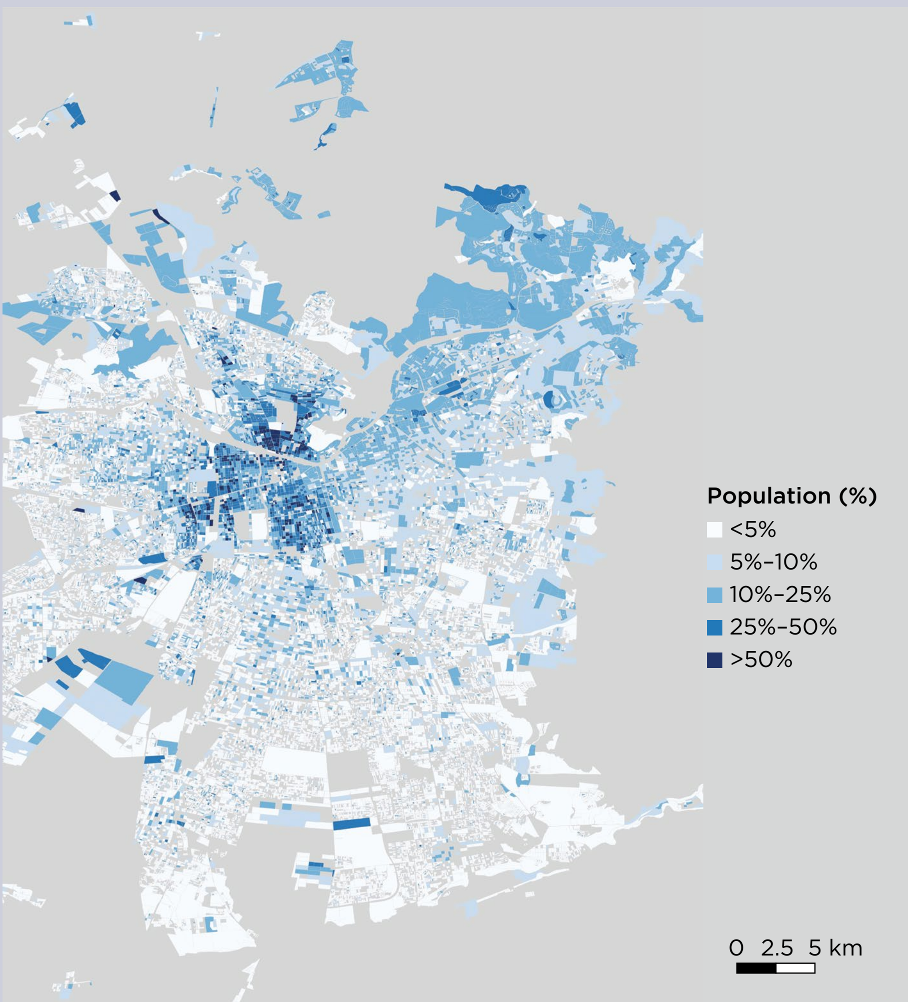
BOX 4.1

Prioritizing access to economic opportunities over environmental health: Evidence from Santiago, Chile *(continued)*

immigrant neighborhoods. While most early 20th-century immigrants arrived from Europe, Santiago's immigrant population in 2020 is predominantly regional migrants arriving from Latin American countries. New immigrants appear to have prioritized access to opportunities in the urban economy by living in areas with high roadside externalities.

MAP B4.4.1 Block-level population shares in Santiago for immigrant and Indigenous households

a. Immigrant households



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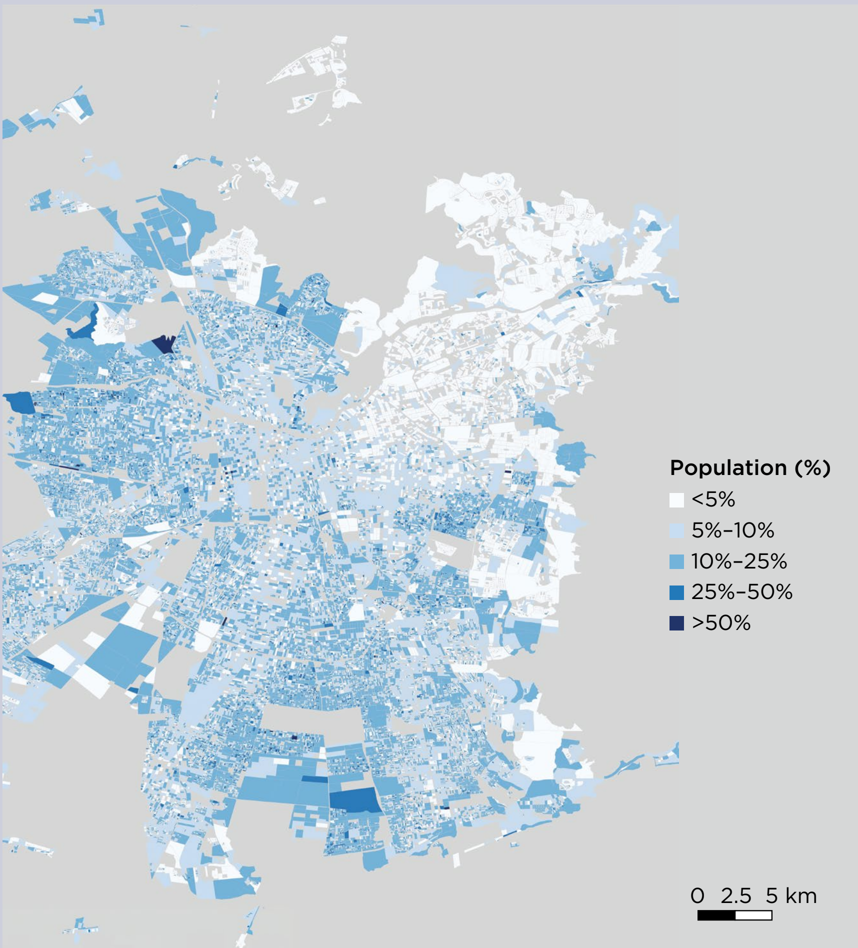
BOX 4.1

Prioritizing access to economic opportunities over environmental health: Evidence from Santiago, Chile *(continued)*

MAP B4.4.1 Block-level population shares in Santiago for immigrant and Indigenous households *(continued)*

b. Indigenous households



Source: World Bank staff calculations, based on data from Instituto Nacional de Estatisticas 2018.

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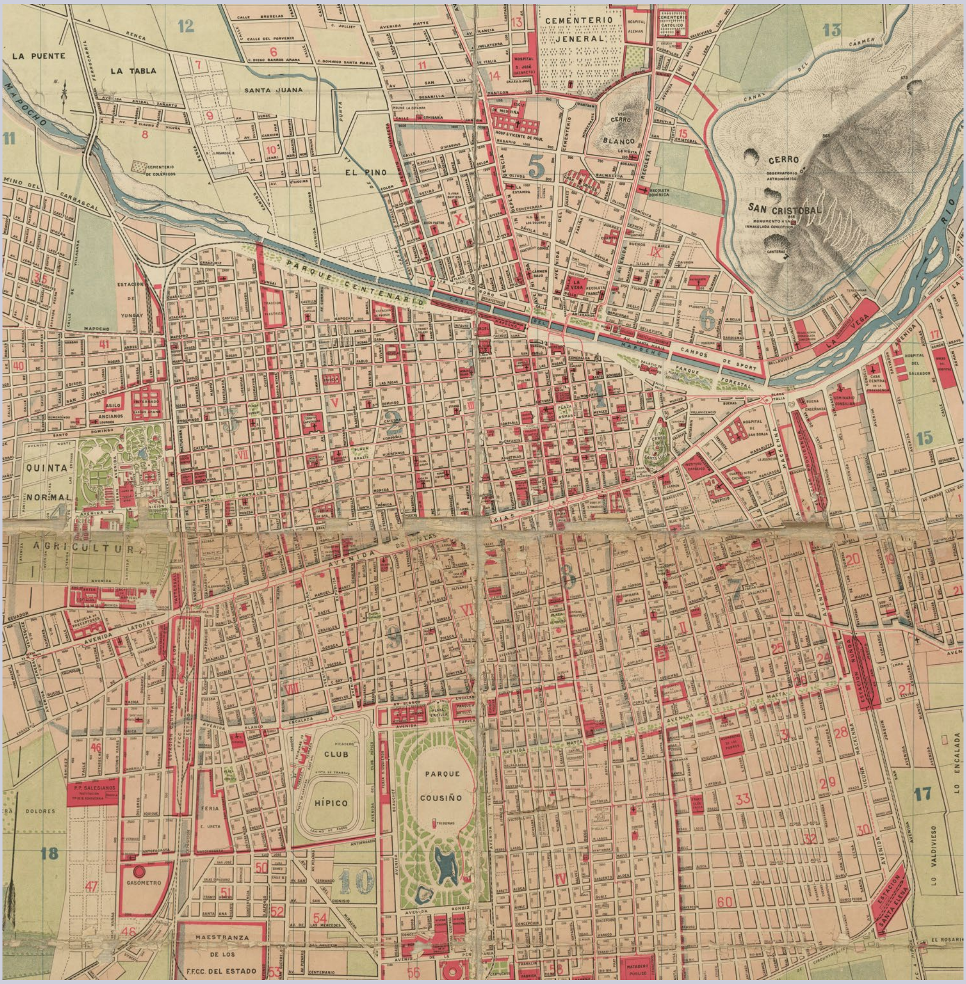
BOX 4.1

Prioritizing access to economic opportunities over environmental health: Evidence from Santiago, Chile *(continued)*

MAP B4.4.2 **Historical street map of Santiago around 1920 and in 2022**

a. Estimated 1920



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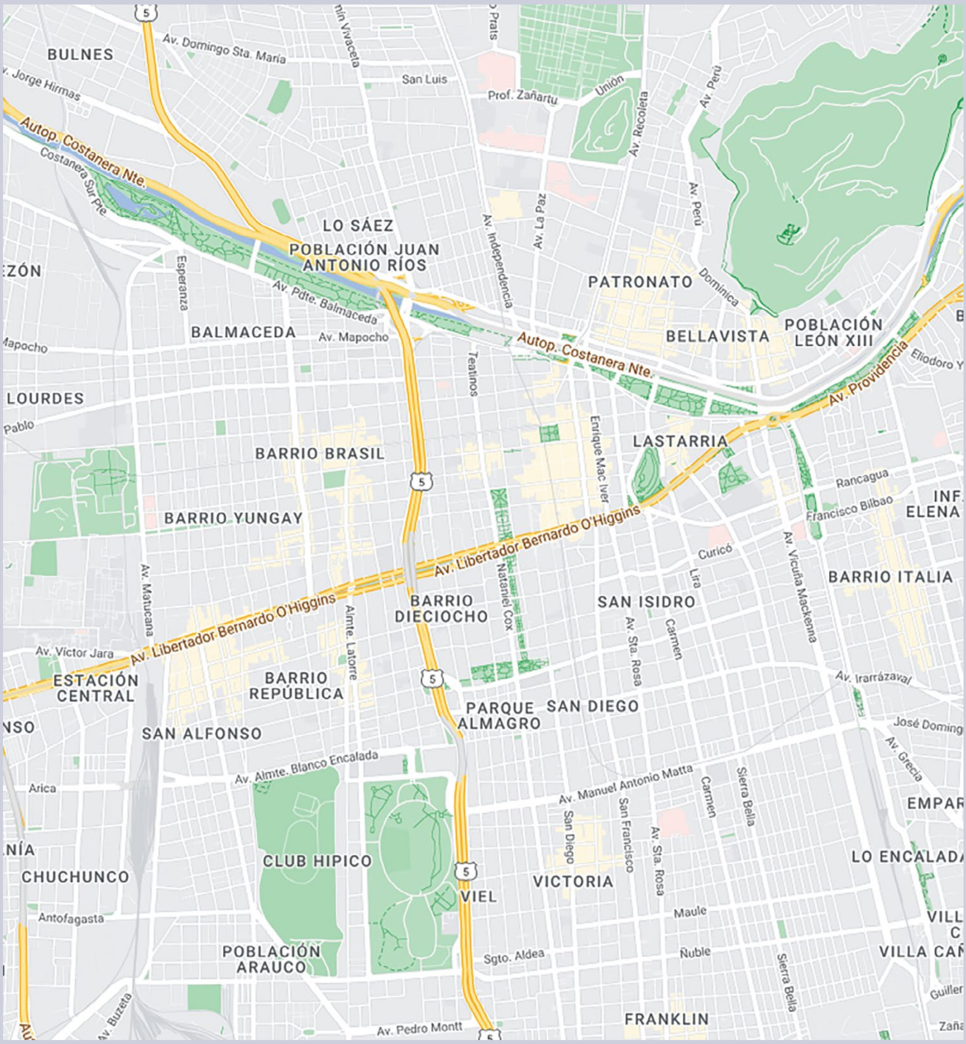
BOX 4.1

Prioritizing access to economic opportunities over environmental health: Evidence from Santiago, Chile *(continued)*

MAP B4.4.2 **Historical street map of Santiago around 1920 and in 2022 *(continued)***

b. 2022



Sources: Panel a: Boloña 1928. Panel b: OpenStreetMap 2023.

In contrast, the relationship between indoor air pollution exposure and SES appears consistent worldwide. Lower-SES households face poorer indoor air quality in HICs and LMICs alike (Ferguson et al. 2020; Rao et al. 2021; World Bank 2011). These households burn more biomass energy for cooking and heating, increasing indoor air pollution. Notably, women and children are disproportionately affected by the adverse consequences of household air pollution (refer to box 4.2). Priced out of cleaner energy options such as liquid petroleum gas, such households may have no choice but to burn more-polluting biomass for warmth and cooking. The need for medical interventions driven by air pollution–related illness can also exacerbate financial stress. Together, these factors increase the vulnerability of marginalized households compared with those who can afford medical care or defensive investments against environmental health hazards.

BOX 4.2

Impact of household air pollution on women and children

People might be more exposed to a higher concentration of pollutants through indoor air pollution than they typically experience outdoors. Sources of indoor air pollution include *household air pollution*, which is generally created by burning solid fuels indoors, mostly for cooking. In 2020, more than 3.2 million deaths were attributed to household air pollution, accounting for almost 50 percent of all deaths attributed to air pollution worldwide (WHO 2023). The biggest disease burden from this type of pollution is in South and East Asia and Sub-Saharan Africa, where solid fuel use is high. Burning solid fuels in traditional cookstoves releases PM2.5, carbon monoxide, nitrogen oxide, and organic air pollutants such as benzene and formaldehyde (Smith et al. 2013), with concentrations sometimes reaching over 100 times higher than World Health Organization guidelines (WHO 2016). Inhaling these pollutants can cause respiratory and cardiovascular diseases, as well as cancers.

Women and children are disproportionately affected by household air pollution, as they spend more time in the home cooking and doing other household chores. With exposure often starting in utero and continuing into adulthood, the cumulative lifetime exposure to household air pollution can be very high (WHO 2016). The effects of PM2.5 and carbon monoxide on birthweight, as well as child respiratory health and pneumonia, have

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BOX 4.2
Impact of household air pollution on women and children *(continued)*

been extensively documented (Edwards and Langpap 2012; Gajate-Garrido 2013; Mishra et al. 2004; Smith et al. 2011). More than 50 percent of deaths caused by pneumonia—the world's single largest cause of death in children younger than age 5 years—have been linked to household air pollution (WHO 2016). Many women also develop chronic conditions, such as bronchitis and chronic obstructive pulmonary disease, as a result of household air pollution (Eisner et al. 2010).

Trade-offs between income and air quality

As with other groups, the exposure of excluded populations to pollution is largely driven by economic factors and the opportunities available to them. For instance, firms may locate in areas closer to excluded communities if there are cost advantages that are available—termed *siting*. Alternatively, poorer or excluded groups may move (that is, *sort*) into more-polluted areas for employment, because of more-affordable housing or discriminatory policies such as the red-lining policies of past decades in the United States (Banzhaf, Ma, and Timmins 2019). Understanding which of these factors dominates in different settings is crucial to design inclusive policies that reduce the disproportionate burden on excluded populations.

Evidence from the mining sector in developing countries suggests that underrepresented populations move into polluted areas if there are economic opportunities. An assessment in mining areas of Africa finds that underrepresented groups were more likely to move closer to a new mine. In addition, once they move into the more-polluted areas where mining occurs, they earn, on average, less than groups who are not underrepresented. Box 4.3 describes the difference-in-differences model that compares wealth levels for households near mines with those that are further away, before and after a mine opens, with more details provided in annex 4A. While mine openings increase wealth for underrepresented households, the benefits are about half as much as those enjoyed by populations not at risk of underrepresentation.

BOX 4.3

Mining as a contributor to local air pollution

Research conducted for this report finds that ethnically marginalized and underrepresented groups prioritize the economic opportunities from polluting industries over environmental health. Examining migration trends toward polluting industrial areas using the influx of migrants from underrepresented ethnic communities near large-scale mines in 12 developing countries, the analysis (refer to annex 4A) combines data on the precise geolocation of mine centroids from S&P Global Market Intelligence with data on ethnicity and wealth levels from the Demographic Health Survey and information on underrepresentation risk and political transitions from the Ethnic Power Relations data set (refer to box 1.3). The study uses the difference-in-differences (DID) design, comparing the characteristics of individuals who moved within 10 km of a mine after it opened to those who moved there before the mine opened and those who moved slightly further away. Although mining can pollute air up to 60 km away, economic effects tend to be concentrated within 10–20 km.

The conflict between boosting economic growth and exacerbating air pollution is especially pronounced in the mining industry in low- and middle-income countries, where local communities are more exposed to pollution. On one hand, the introduction of mining can increase economic activity (Aragón and Rud 2013; Chuhan-Pole, Dabalen, and Land 2017) and employment in more-productive sectors (Kotsadam and Tolonen 2016). On the other hand, mining operations contribute to air pollution during all stages of a mine's lifecycle. The initial removal of rocks and soil above the ore body can release substantial amounts of dust, with estimates as high as 660 kg per day (Ghose and Majee 2000). Processing activities—such as blasting, crushing, stockpiling, loading, and transporting mine rocks—further contribute to dust pollution (Petavratzi, Kingman, and Lowndes 2005), while smelting and refining operations emit particulate matter, carbon dioxide, nitrogen oxides, and sulfur dioxide (Dudka and Adriano 1997). Several small-scale environmental impact assessments have documented that mining increases local air pollution (Ghose and Majee 2000; Mwaanga et al. 2019), although these studies show low external validity and potential evidence tampering (Ghanem and Zhang 2014).

Korb (2024) leveraged the staggered openings of more than 100 large-scale mines across Sub-Saharan Africa by linking them to aerosol optical density (AOD), a high-resolution remotely sensed measure of air pollution.

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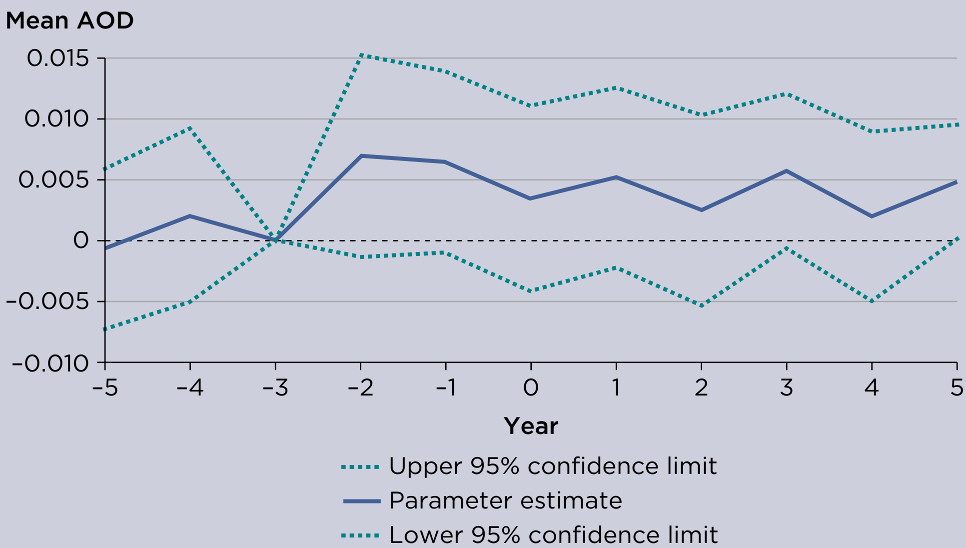
BOX 4.3

Mining as a contributor to local air pollution *(continued)*

AOD measures the amount of light reflected by particles in a column of air and is strongly correlated with ground-based particulate matter pollution (Gendron-Carrier et al. 2022). To isolate the causal effect of large-scale mine openings on AOD, Korb (2024) used a DID design comparing pollution on the sides of a mine that receive more wind with those that receive less wind, before and after the mine opens. Intuitively, wind will carry pollution generated by the mine toward the sides receiving more wind. Regardless of wind exposure, the vicinity of a mine should be similar in terms of unobservables correlated with local air pollution, such as economic activity, making areas receiving less wind effective as control groups.

The analysis showed that, for the average mining area, opening a mine increases AOD by 2.5 percent on a side that receives 100 percent of the wind in a given season. Figure B4.3.1 shows an analogous event study regression to the continuous DID, revealing that the increase in pollution begins 3 years before the start date of commercial production.

FIGURE B4.3.1 Effect of mine opening on air pollution measured via mean AOD



Source: Korb 2024.
Note: Number of mines = 100. Wind intensity measure is the percentage of days of wind from the mine in a season (100 percent). AOD = aerosol optical density.

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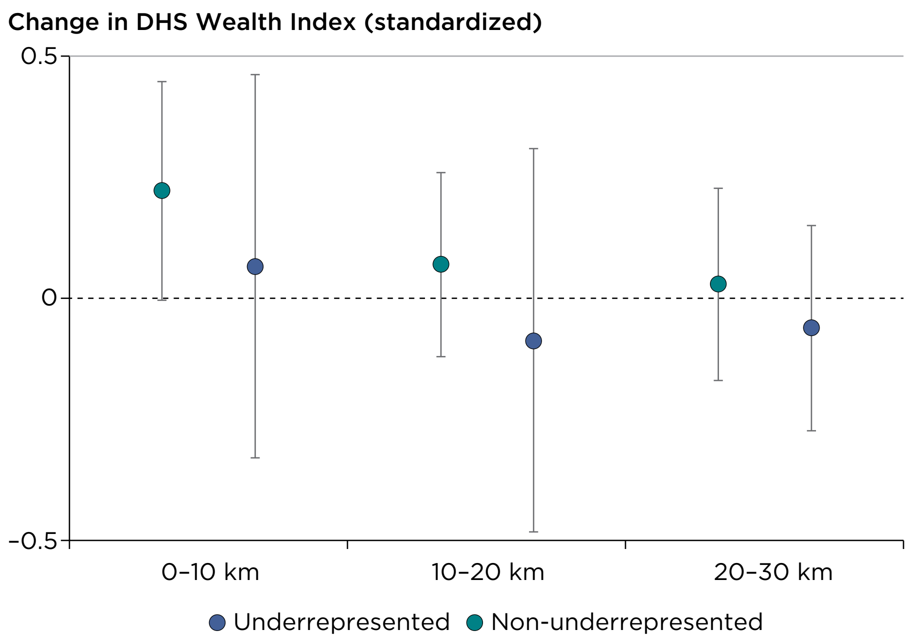
BOX 4.3
Mining as a contributor to local air pollution *(continued)*

This increase coincides with a sharp increase in night-time lights—a common proxy for economic activity—in the same areas. The 3 years before a mine opens correspond to the "investment phase," with construction of infrastructure, roads, and buildings, which all significantly contribute to particulate matter pollution.

Nor do underrepresented groups benefit as much from backward linkages of a mine opening. Figure 4.4 shows that location and distance from a mine confers no benefits on the underrepresented. In contrast, the gains for the non-underrepresented households are concentrated within 10 km of a mine. This finding is consistent with those in other contexts where ethnic preferences are found to influence business decisions (Ravetti et al. 2019).

FIGURE 4.4 Wealth effects of mining on households



Source: World Bank staff calculations, based on data from DHS.
Note: Figure shows the effect of a mine opening on the DHS Wealth Index (standardized) and spatial decay of DID estimates for underrepresented and non-underrepresented groups. DHS = Demographic Health Survey; DID = difference-in-differences.

Consumption patterns and air pollution

In addition to experiencing air pollution, households are also contributors. EECs can be used to explore the contribution of underrepresented and non-underrepresented groups to both indoor and ambient air pollution (refer to annex 4C). The EEC is a graphical representation that estimates the relationship between environmental quality and consumption choices at different income levels (refer to box 4.4). EECs can be used to capture the direct contribution to pollution caused by their consumption activities, such as driving cars, cooking, and heating, as well as the indirect pollution imbedded in the consumed commodity, such as rubber and steel for car manufacturing and the gasoline needed to drive them. In general, the lack of data has made it a challenge to empirically estimate EECs, with most focusing on the United States.

BOX 4.4

Environmental Engel Curves

Environmental Engel Curves (EECs) demonstrate how the environmental impact of consumption changes as income increases. EECs are adapted from the original Engel curve, a graphical representation of the relationship between the demand for a specific good or service and income levels. EECs are typically created by plotting the embodied environmental impact of consumption—in terms of air or water pollution, carbon emissions, and so on—on the y-axis and income on the x-axis (refer to figure B4.4.1). EECs can be upward sloping and convex for normal goods, indicating that higher-income households may consume more, leading to more pollution. However, as income continues to rise, the rate of pollution increase can slow due to consumption limits. Conversely, richer households might shift toward more-efficient and less-polluting goods, resulting in a downward-sloping, concave EEC. In lower-income countries, consumption is often dominated by inferior, more-polluting goods, but as incomes rise, pollution from these goods can decrease.

EECs can provide valuable insights into the environmental footprint of consumption choices in certain countries or sectors. They can help illustrate the effectiveness and analyze the distributional effects of pollution control policies. EECs can differ significantly across pollutants and regions, reflecting differences in environmental quality for diverse populations.

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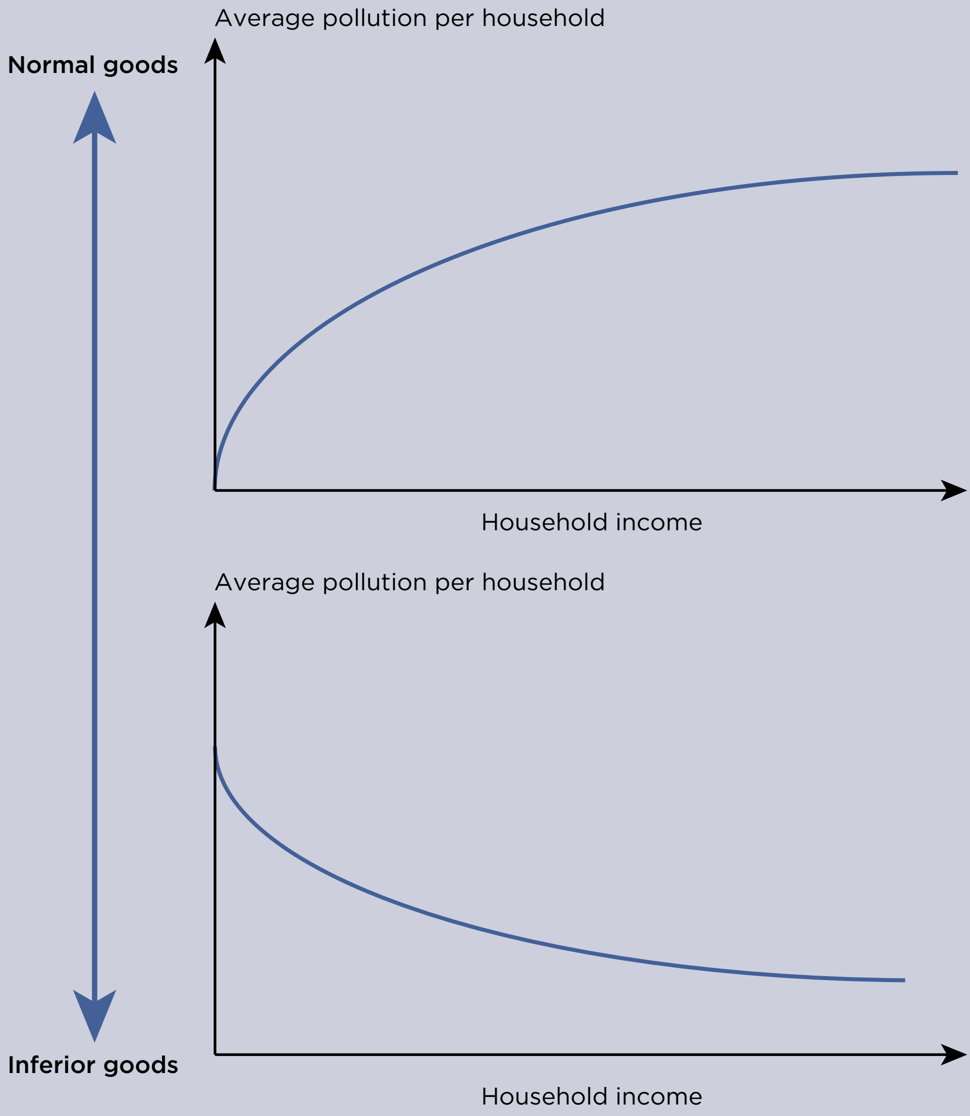
BOX 4.4

Environmental Engel Curves *(continued)*

FIGURE B4.4.1 Stylized EEC relationships for normal and inferior goods



Source: World Bank staff calculations.
Note: EEC = Environmental Engel Curve.

In middle- and high-income countries, economic growth facilitates a shift toward cleaner energy sources, lowering indoor air pollution footprints (refer to figure 4.5). This result is based on microdata from 89 countries, where an EEC analysis was used to document household consumption choices across different income levels. This trend underscores the potential for wealthier households in these countries to adopt more environmentally sustainable energy consumption habits.

However, the transition does not seem to occur in LICs, where budget shares of both high and low indoor air pollution intensity increase with income. This finding may be because households in poor countries may have a higher income elasticity for energy demand, and cleaner fuels may be less accessible in low-income countries.

FIGURE 4.5 Household budget share of energy type, high- versus low-polluting, by country income group

a. Energy types with high indoor air pollution intensity

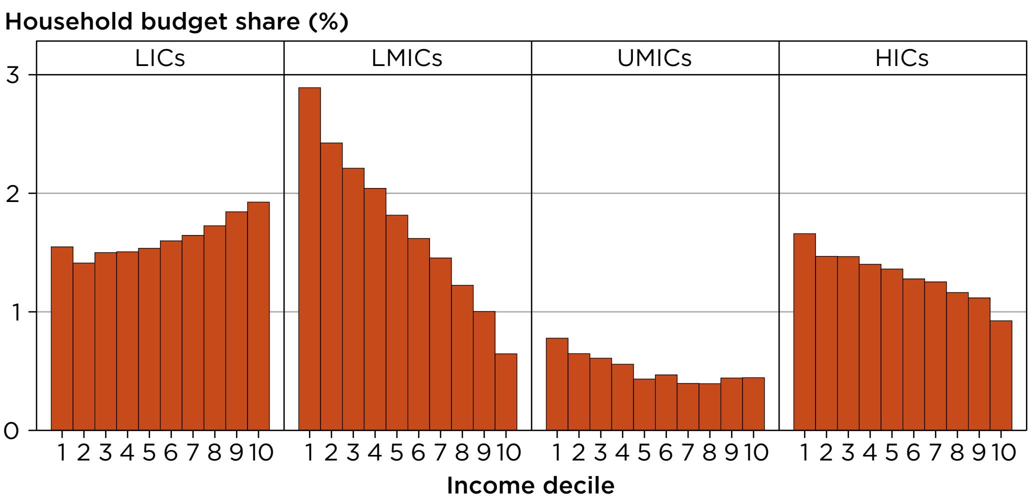


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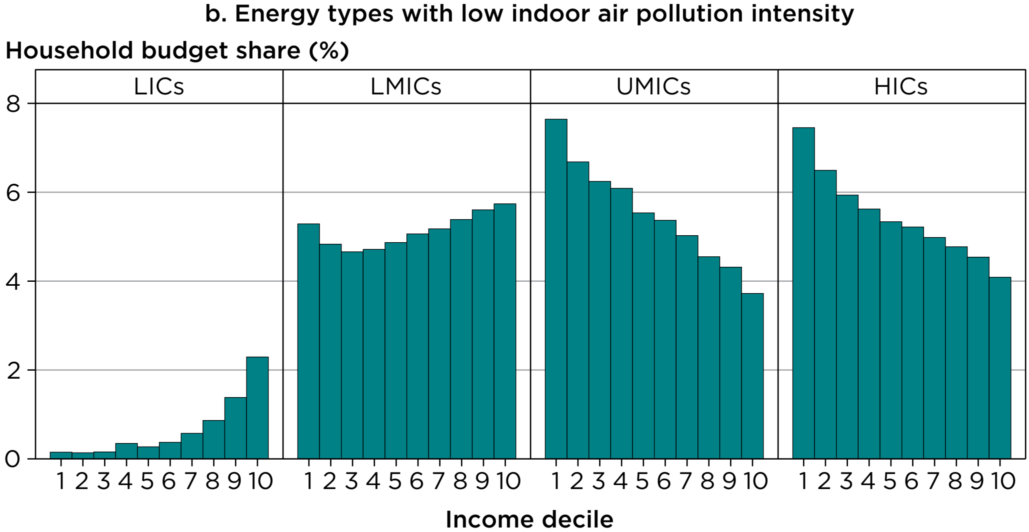
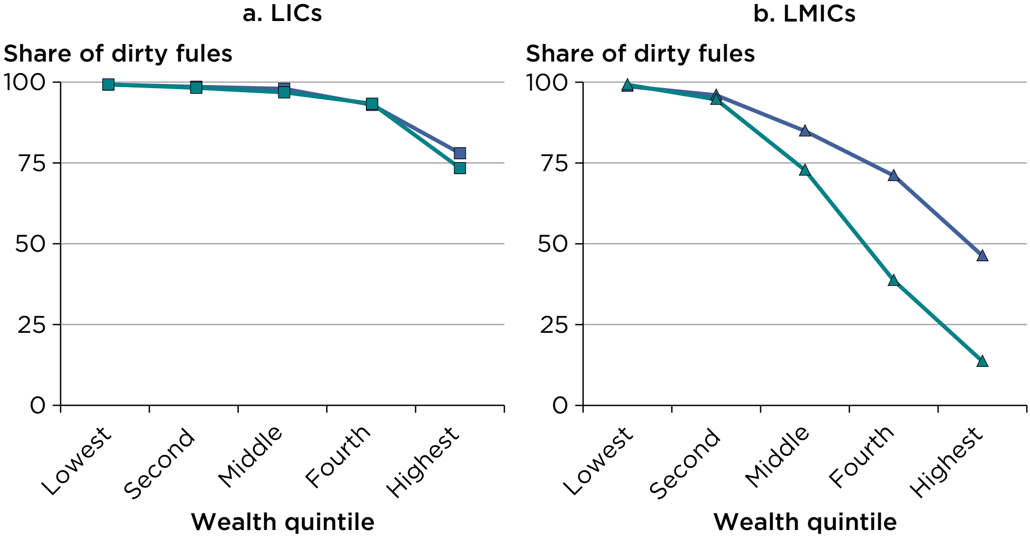
FIGURE 4.5 Household budget share of energy type, high- versus low-polluting, by country income group *(continued)*



Source: World Bank staff calculations, based on data from CPAT.
Note: High-polluting energy forms (panel a) include charcoal, firewood, coal, and kerosene; low-polluting energy forms (panel b) include electricity, LPG, and natural gas. CPAT = Climate Policy Assessment Tool; HICs = high-income countries; LICs = low-income countries; LMICs = low- and middle-income countries; LPG = liquid petroleum gas; UMICS = upper-middle-income countries.

Social exclusion keeps marginalized communities tethered to polluting fuels. Exploring differences between underrepresented and non-underrepresented households in 17 LICs and 13 LMICs, the analysis finds that, as households become richer, the share of households using dirty fuels as their primary cooking fuel generally decreases, particularly in non-underrepresented communities (refer to figure 4.6). While the difference is not significant in LICs, in LMICs, the trends for underrepresented and non-underrepresented households diverge steadily, with the highest gap among the richest households. At the highest income quintile, 46 percent of underrepresented groups rely on polluting fuels compared to 13 percent of non-underrepresented groups.

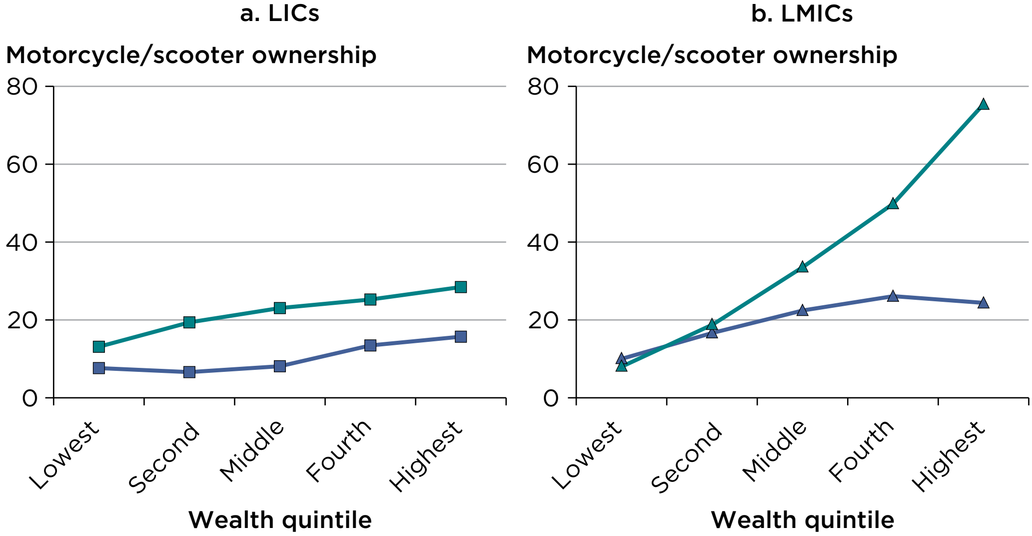
FIGURE 4.6 EECs for cooking fuels by representation status



Source: World Bank staff calculations, based on data from DHS.
Note: The dark blue lines and light blue lines correspond to underrepresented and non-underrepresented in the graph, respectively. DHS = Demographic Health Survey; EECs = Environmental Engel Curves; LICs = low-income countries; LMICs = low- to middle-income countries.

While poorer and underrepresented households are more exposed to indoor air pollution, richer households that are not underrepresented contribute more to outdoor air pollution. In both LICs and LMICs, motorcycle ownership, a proxy for contribution to outdoor air pollution, increases with wealth, particularly in LMICs (refer to figure 4.7). The divergence between underrepresented and non-underrepresented groups is more visible in LMICs, where the EEC for non-underrepresented households is convex, indicating that the rate of households owning a motorcycle increases as households get richer. In other words, moving between higher wealth quintiles, the share of households owning a motorcycle increases more than when moving up between lower quintiles. The EEC for underrepresented populations, however, is concave, showing a higher increase in motorcycle ownership by poor households, while the ownership rate levels off as households get richer.

FIGURE 4.7 EECs for motorcycle ownership for underrepresented and non-underrepresented groups



Source: World Bank staff calculations, based on data from DHS.
Note: The dark blue lines and light blue lines correspond to underrepresented and non-underrepresented in the graph, respectively. DHS = Demographic Health Survey; EECs = Environmental Engel Curves; LICs = low-income countries; LMICs = low- and middle-income countries.

The way forward

Marginalized communities often must weigh the benefits of higher-paying jobs in environmentally harmful industries against the risks of pollution. These decisions are largely influenced by economic necessity and the availability of job opportunities. As this chapter has demonstrated, studies from the mining industry in developing countries show that marginalized groups may settle in polluted areas if it means they can access economic opportunities.

A shift toward cleaner energy and industries that also generate employment could help reduce air pollution while promoting the inclusion of marginalized groups, such as those who often are underrepresented. For example, to maximize the benefits for women in the renewable-energy sector, a broader change in social attitudes and progressive policies concerning gender roles are needed. Women will fully benefit from opportunities in renewable energy when such societal reforms are in place (Baruah, 2015, 2017). Moreover, introducing clean cookstove programs in developing countries can reduce indoor air pollution and help women and children (Edwards and Langpap 2012; Hanna, Duflo, and Greenstone, 2016). By aiming for policies that achieve both environmental sustainability and inclusivity, a cleaner and more-equitable development can be fostered.

The online technical annexes for this chapter are available with the text of this book in the World Bank's Online Knowledge Repository, https://hdl.handle.net/10986/42610.

- Annex 4A Impact of Mining Operations on Underrepresented Communities
- Annex 4B Differential Exposure to Roadside Externalities in Santiago, Chile
- Annex 4C Pollution Intensity of Consumption: Exploring the Environmental Engel Curve

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CHAPTER 5

Policy Options for Breaking the Cycle of Environmental Degradation and Social Exclusion

"We must look at impoverished lives, and not just at depleted wallets."
—*Amartya Sen* (1998 Nobel Prize Laureate for Economic Sciences)

AT A GLANCE

- Environmental and inclusive policies do not always align, and often progress in one area can lead to setbacks in another. Deliberate policy efforts must explore the unintended consequences of policies aimed to benefit inclusive growth on the environment and vice versa.
- Representation, although not a silver bullet, can empower local communities to enhance environmental outcomes. This representation has been shown to be successful among Indigenous communities in areas where traditional practices support conservation goals. Success is often contingent on Indigenous territories being awarded property rights and being in an institutional environment willing and able to uphold such rights.
- Representation is only a first step, and efforts must be supported by robust mechanisms to prevent elite capture and ensure meaningful participation of marginalized groups. Deliberation and communication can help overcome potential capture by local elites and promote common interest to promote accountability and transparency.
- When increased representation is not an option, public engagement and coalition building are key. In such a policy environment, direct advocacy for policy changes will prove difficult, as those in power might oppose altering the status quo. However, if the goals of civil society organizations and key stakeholders align with inclusive environmental policy, opportunities to nudge the policy discourse may remain.

- An informed public is integral to political engagement and, hence, active and effective civic participation hinges on increasing the flow of information. Affordable environmental-monitoring technologies can lower the cost of accessing information, enabling nongovernmental organizations (NGOs), local communities, and citizen scientists to conduct monitoring tasks. Educational programs on how to manage natural resources sustainably can foster inclusive, sustainable development. Information alone seldom suffices in catalyzing collective action but could be a part of the solution.
- When the environment is fragile or where objectives diverge, trusted NGOs with established partnerships with local communities can help navigate unstable political situations. NGOs often have the required knowledge of local conditions and how to best interact in policy-making terrains that might be difficult to traverse otherwise. Understanding these dynamics is key to selecting the right development tools. These approaches may, at times, require a certain degree of decentralization, as drawing on local knowledge can prove beneficial.

Inclusive policies and environmental policies are not always well-aligned

In the late 20th century, the New Zealand government took significant steps to address historical injustices against the Waikato-Tainui tribe, a group of Māori based in the Waikato Region of the country's North Island. More than 100 years prior, the British crown had passed the New Zealand Settlements Act of 1862, which led to the confiscation of more than 3,500 square km of land from the tribe. Decades later, in 1926, that confiscation was deemed excessive by a British Royal Commission, but the compensation—an annual payment of £3,000—was far from satisfactory to the Waikato people. "I riro whenua atu, me hoki whenua mai" (Since land was taken, land should be given back).[1]

Negotiations in 1995 finally led to a Deed of Settlement,[2] which included a payment of cash and land to the Waikato people, valued at $170 million. For the Waikato-Tainui tribe, this settlement meant the return of vast tracts of land, a vital resource for their cultural and economic rejuvenation. The land was both a symbol of their heritage and a foundation for their future, promising to become a cornerstone for their economic development.

With the reclaimed land, the Waikato-Tainui turned to agriculture, particularly dairy farming, to drive economic growth. This effort was greatly enhanced by generous government grants and subsidies aimed at boosting Māori agricultural enterprises and incentivizing land use change, especially the use of synthetic fertilizers like nitrogen and phosphorus. These financial incentives were designed to create jobs, foster self-sufficiency, and ensure a steady revenue stream. By many metrics, the incentives were successful, leading to significant boons to the local economy and an explosion in the local cattle population.

However, the rapid expansion of dairy farming brought unforeseen environmental consequences. Agricultural expansion, coupled with the unsustainable practices incentivized by subsidies, led to overly intensive farming practices. Overgrazing has led to soil compaction and erosion of the land around the river, reducing land productivity. In addition, nutrient runoff from fertilizers and cow effluent polluted the rivers and streams that had sustained the tribe for generations.

The Waikato River, the longest river in New Zealand, flows through these lands and has a special cultural meaning to the Waikato-Tainui tribe, who consider it to be the source of their power and pride.[3] These practices have led to a situation in which more than 7,000 tonnes of nitrogen and 367 tonnes of phosphorus are added to the river each year, doubling the natural level of phosphorus in the river and more than doubling the amount of nitrogen.[4] These nutrients can lead to harmful algal blooms, making the water dangerous to drink and crowding out other organic life, leading the once-complex ecosystem to turn into a dead zone. Nitrogen is also extremely harmful to human health and is correlated with a host of chronic diseases (Damania et al. 2019).

The story of the Waikato-Tainui is not unique. As presented in this chapter, across the globe, policies aimed at fostering economic inclusion often clash with environmental sustainability. This case study illustrates a critical point: inclusive policies are not always environmentally sustainable, and environmental policies are not always inclusive. The challenge lies in crafting policies that align incentives for both goals simultaneously, ensuring that inclusive economic development does not cause environmental degradation.

To achieve this balance, policy makers must be deliberate in their approach. The general problem, known as the *Tinbergen Rule,* is that, typically, each policy objective requires its own policy instrument. Thus, trying to achieve both conservation and inclusive development goals simultaneously through a single instrument is difficult at best, if not futile. Incentives must be aligned to ensure that economic benefits do not lead to excessive environmental harm.

This rule often means that, when designing policies to achieve multiple targets, it is necessary to use multiple instruments (refer to box 5.1). For example, financial support for agricultural development can be tied to the adoption of sustainable farming practices. In that way, grants and subsidies can be structured to reward environmental stewardship. It also means acknowledging any unintended impacts that need to be addressed. Ignoring these effects is an implicit decision, too, which signals that environmental effects are less consequential.

BOX 5.1

Tinbergen's Rule: Aligning policy instruments to achieve multiple targets

In the realm of economic policy, Jan Tinbergen's seminal work provides crucial insights into the alignment of policy instruments and targets. Tinbergen's Rule posits that, to achieve desired outcomes, the number of policy instruments must be at least equal to the number of policy targets. This principle is foundational in economic policy making, emphasizing that a mismatch between the number of instruments and targets can lead to inefficiencies and unintended consequences.

Tinbergen's Rule highlights the complexity of policy making, especially when balancing multiple goals such as inclusive economic development and environmental sustainability. When there are fewer instruments than targets, some goals may be achieved at the expense of others. For instance, policies aimed solely at inclusive economic growth may overlook environmental protection, leading to long-term ecological damage. Conversely, focusing exclusively on environmental goals might impede economic development and inclusivity.

This principle is, for instance, relevant in the case of the Waikato-Tainui tribe's agricultural development policies. While the primary focus was on boosting economic growth and inclusion through financial support and land allocation, these policies lacked sufficient environmental instruments. This imbalance resulted in environmental degradation, including water pollution and soil erosion, demonstrating the critical need for a balanced approach.

To avoid such pitfalls, policy makers must ensure that each target has a corresponding instrument. For example, along with economic incentives for agricultural development should be specific instruments for

(Box continues next page)

BOX 5.1

Tinbergen's Rule: Aligning policy instruments to achieve multiple targets *(continued)*

sustainable farming practices and mechanisms for ongoing environmental monitoring. By aligning instruments with targets, policy makers can achieve a more-holistic and -sustainable outcome. Crucially, a critical examination of all possible unintended consequences of the policy is needed.

Source: Arrow 1958.

One notable policy success is an initiative in South Asia that lifted living standards in low-income areas by enhancing shelters and amenities. With a focus on environmental and social well-being, the initiative has implemented safeguards, ensuring community involvement and addressing gender concerns (Sultan 2021). Practical plans ensure access to clean water, proper waste management, and safe construction practices, benefiting more than 5,000 households in 17 communities. This endeavor is a testament to balanced development and community empowerment.

Policy bundling can enhance overall well-being and potentially diminish disparities. A combined approach that targets both economic and environmental objectives might be more effective than focusing solely on either economic or environmental policies. This approach might mean compromises across objectives, but it would still imply that overall well-being is higher than with the pursuit of a single policy (refer to annex 5A). While a policy bundle can enhance aggregate welfare, not everyone may share in these gains equally. To close the welfare gap between underrepresented and represented, governments should adopt appropriate combinations of environmental and social policies that benefit marginalized populations in both economic and environmental aspects (refer to figure 5.1 and annex 5B).

The rest of this chapter explores policies and principles for achieving both social and environmental objectives. To do so, it considers two cases. The first involves situations in which governments share the objective of eliminating exclusion and policy makers have the capacities needed to address these issues. This case is more conducive to achieving the desired goals. The second case involves situations in which governments have other objectives and do not prioritize improving inclusivity or environmental sustainability.

FIGURE 5.1 **A policy matrix for examining the welfare gap**

Economic impacts of a policy bundle	Environmental impacts of a policy bundle: Benefits the underrepresented	Environmental impacts of a policy bundle: Harms the underrepresented
Benefits the underrepresented	Economic welfare gap ↓ Environmental amenity gap ↓	Economic welfare gap ↓ Environmental amenity gap ↑
Harms the underrepresented	Economic welfare gap ↑ Environmental amenity gap ↓	Economic welfare gap ↑ Environmental amenity gap ↑

Source: Original figure for this publication.

Feasible policies differ significantly in the two cases. In the first, the government shares the same objectives, but typically implementation constraints or political costs exist that make it impossible to implement the most-effective (first-best) policy. This case is analogous to a principal-agent problem: the principal, the advisor, can choose what to advise, but the agent, the implementing government, will only accept feasible policies that can be implemented without, say, losing office as a result. Thus, the "implementation constraint" guides (that is, binds) policy making.

Another more-challenging possibility is one in which objectives between principal and agent diverge. For instance, the government may not prioritize environmental outcomes or support the need for inclusion. In this case, the options are more limited, and the range of possible policy options are defined by the *participation constraint* (also termed the *incentive compatibility constraint*), which ensures that the government's utility or payoff in proposing the new policy is at least as high as some outside option, such as maintaining the status quo or implementing a different policy. If the proposed policy does *not* do at least as well from the agent's perspective, there is no incentive to implement it. These differences are crucial in understanding the dynamics of policy advice and implementation in the presence of convergent objectives with constraints such as political costs or capacity constraints and fundamentally divergent objectives. In each situation, different tools are needed, and different actors will play bigger roles.

When objectives are shared: Working within the system to empower marginalized communities

Empowering local communities can enhance environmental outcomes by making governance more inclusive and locally responsive. The effectiveness of these approaches, however, depends on the capacity of local institutions and the extent to which they genuinely empower marginalized communities (refer to box 5.2). By bringing decision-making closer to affected populations and ecosystems, decentralization allows for the development of context-specific policies that are better suited to local conditions. Such local-level empowerment is important for Indigenous communities, whose traditional practices often support conservation goals (Agrawal 2005; Agrawal and Ostrom 2001; Larson and Soto 2008). Indigenous territories not only provide more-robust environmental protection than typical protected areas but also may embody the principles of effective common-pool resource management (Jusys 2018; Ostrom 1990; Soares-Filho et al. 2010).

Acknowledging original land rights through the devolution of land often results in beneficial environmental impacts (Baragwanath and Bayi 2020; Baragwanath, Bayi, and Shinde 2023; Dawson et al. 2021; Sze et al. 2022; Walker et al. 2020). Granting these rights has been shown to reduce deforestation significantly in areas like the Amazon (Baragwanath and Bayi 2020; Baragwanath, Bayi, and Shinde 2023; Blackman et al. 2017; Holland et al. 2014; Jusys 2018; Nolte et al. 2013). Moreover, forest fires tend to occur less frequently within these Indigenous territories compared to non-Indigenous areas (Nepstad et al. 2006).

BOX 5.2

Integrated conservation and development projects

Integrated conservation and development projects (ICDPs) try to reconcile community development and conservation by promoting sustainable resource use or alternative sources of livelihood. The concept, initiated by the World Wide Fund for Nature in the 1980s, was a response to the realization that conservation efforts could not succeed without addressing the socioeconomic needs of local communities. The essence of an ICDP is the merging of conservation with poverty reduction and rural development goals, commonly advanced by attempting to promote livelihoods compatible with sustainable resource use in—or around—parks and protected areas or by providing compensatory transfers to rural

(Box continues next page)

BOX 5.2

Integrated conservation and development projects *(continued)*

residents who use resources sustainably (Brandon and Wells 1992). The idea is to create synergies between conservation and socioeconomic development, ensuring that both environmental and human needs are met (Hughes and Flintan 2001).

The core idea of ICDPs is that, by giving local communities a stake in maintaining biodiversity, the prospects for conservation success would increase relative to approaches that relied on governments or other external agents imposing resource use constraints. Early conservation strategies often excluded or marginalized these communities, leading to conflicts and the failure of many projects. By integrating conservation with development, ICDPs aim to provide tangible benefits to local populations, such as improved livelihoods, education, and health care, in exchange for their participation in and support for conservation activities.

ICDPs have yielded some positive effects, but significant challenges remain. Some ICDPs have linked conservation with tourism development, providing local communities with income and education opportunities (Baral, Stern, and Heinen 2007). In Africa, projects like the CAMPFIRE program have involved communities in wildlife management, allowing them to benefit economically from sustainable tourism and wildlife resources, although environmental gains have not been convincingly established (Balint and Mashinya 2008). If not designed well, ICDPs can also hasten rather than avert ecosystem collapse if the increased demand for natural products induced by local income growth outpaces the disincentive effects built into the quasi-contract between the conservation agency managing the ICDP and the local community (Barrett and Arcese 1995). Often ICDP design neglects incentives. Where there is underemployment, alternative livelihood programs will not suffice to make less-destructive occupations unattractive and, as a result, development benefits may accompany and sometimes cause environmental damage.

Balancing the dual goals of conservation and development can be complex and goes far beyond careful planning and collaboration among stakeholders, calling for incentive-compatible design. Easily remedied issues such as insufficient funding, lack of community engagement, and inadequate governance structures can hinder the effectiveness of these projects. Moreover, the long-term sustainability of ICDPs often depends on continued external support and the ability to adapt to changing socioeconomic and environmental conditions.

Decentralization alone can have mixed effects on environmental management (refer to box 5.3). While generally successful, the impact of Indigenous territories can vary depending on myriad factors, including the form and security of tenure. In the absence of full property rights, the impact of Indigenous territories is minimal even when surveillance and enforcement are present (BenYishay et al. 2017; Buntaine, Hamilton, and Millones 2015). Success is often observed when Indigenous territories acquire complete property rights (Agrawal and Ostrom 2001; Baragwanath and Bayi 2020) and an institutional environment exists that is willing and able to uphold such rights (Buntaine, Hamilton, and Millones 2015; Robinson et al. 2018).

However, as the case of Māori settlement illustrates, the assignment of property rights cannot ensure that externalities are addressed and that resource extraction is sustainable. Fundamental economic factors such as time rates of preference, the intrinsic growth and regeneration of the environmental asset, and its fragility will continue to matter, although seldom are such factors formally considered in the case study literature that dominates.

Elite capture can occur even in participatory programs that specifically seek to include disadvantaged individuals in policy-making processes. Those excluded may participate less in these processes because of the higher opportunity costs of their leisure time or because entrenched social norms make it hard to oppose those who traditionally hold power. Measures to empower users may work best if linked to political authorities to change power dynamics, for example, via direct representation.

BOX 5.3

Promise and perils of decentralization

Since Ostrom (1990), scholars have recognized that local communities and governments may be better positioned to manage resources sustainably, although success may depend on the local capacity and political will of local governments (Andersson and Gibson 2007). A key point in the literature is that the success of decentralization will be determined by the degree of devolution of rights over the resources (and accountability of decision-makers) (Agrawal and Ostrom 2001). For instance, the devolution of forests to local communities as common pool resources is a prime example of a case in which local communities have been better able to conserve and manage the forests at a lower cost (Agrawal 2005; Agrawal

(Box continues next page)

BOX 5.3

Promise and perils of decentralization *(continued)*

and Ostrom 2001). Ribot (2004, 1) provides the specific conditions of success: "IF institutional arrangements include local authorities who represent and are accountable to the local population and who hold discretionary powers over public resources, THEN the decisions they make will lead to more-efficient and -equitable outcomes than if central authorities made those decisions."

Nevertheless, while involving nongovernmental organizations and smaller levels of government or communities is often crucial for achieving inclusive, sustainable outcomes, allocating power to smaller levels of government and communities can also exacerbate existing inequalities under certain conditions. The status quo may be enforced by decision-makers entrenched at the local rather than the national level (Bardhan and Mookherjee 2000). When prejudices against excluded groups are severe locally, having more-removed decision-making might help alleviate exclusion (for example, refer to the abolishment of slavery in the United States). Similarly, depletion of natural resources might be gainful for local elites, leading to more-aggressive use.

Thus, understanding whether the dynamics of exclusion and environmental degradation are perpetuated at the local or national level is crucial in designing effective policy. Specifically, how proposed policies affect the economic incentives of agents at different layers of government can play a large role in determining policy outcomes. Decentralization has also been seen as leading to less-efficient outcomes because, unlike local actors, central planners could incorporate large-scale externalities in their decision-making (refer to the theory in Burgess et al. 2012).

Source: Baragwanath and Gulzar 2024.

Increasing the direct representation of disadvantaged or minority groups in decision-making bodies can improve natural resources management and improve service delivery and can help sustain commitment to pro-equity reforms. For instance, boosting the representation of tribal minorities may positively affect forest governance, leading to significant improvements in forest conservation (Gulzar, Lal, and Pasquale 2024). This improvement is attributed to better forest stewardship and resistance to commercial exploitation by empowered local communities. Similarly, evidence shows that bird species loss due to infrastructure development is halved when local tribal communities are included in infrastructure mitigation decision-making (Madhok 2023).

Increasing the share of leadership roles held by women can lead to significant improvements in water, air, and land management. Women in leadership positions tend to prioritize issues that are valued more highly by women relative to men, such as access to toilets, clean drinking water, water control (refer to box 5.4), and harvesting. Women leaders are also more likely to consider crop fires a serious issue—possibly because they are more concerned about the associated health costs for children—and therefore tend to strongly favor regulations to curtail them (Jagnani and Mahadevan 2023). Irrespective of differential preferences, research also shows that women are less susceptible to the influence of special-interest groups and usually have a lower propensity for corruption, so their increased representation can lead to positive environmental and social outcomes. For example, evidence suggests that elected women in office are less likely to have connections to or receive campaign funding from the agriculture sector, which benefits from land expansion and deforestation (Baragwanath and Zheng 2024).

BOX 5.4

Water, women, and the importance of voice in decision-making

Despite being disproportionately affected by inadequate water provision, women are heavily underrepresented in the workforce in the water sector (World Bank 2019) and in decision-making roles in water use associations and local government (Adams, Zulu, and Ouellette-Kray 2020; Das 2014). For instance, water use associations provide irrigation services to member farms, requiring managers to pay fees, contribute labor, sign water contracts, attend meetings, and engage in other participatory activities, with training for these duties often provided primarily to male farm managers.

However, when rural male migration is high, as is the case in many developing countries, many farms are operated by women (Buisson et al. 2016), who have not undergone the requisite training and are not equipped with the necessary knowledge to ensure that their farms receive water. This issue has significant implications for both access to water on female-operated farms and the overall functionality of water use associations in their ability to provide services to all members. Training programs should reconsider their implementation to ensure they are inclusive, bringing training to the vicinity of rural homes to reduce mobility barriers and providing child care for the duration of the training (Balasubramanya 2019).

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BOX 5.4

Water, women, and the importance of voice in decision-making (*continued*)

Several international and national organizations have recognized the arguments for improving and increasing women's roles in water management and are making concerted efforts to increase women's influence on decision-making and diversity in the staffing of the water and sanitation sector. These efforts include those from GWP and UNEP-DHI (2021):

- Quotas for water point management in Togo, which strongly recommend involving women;
- Vanuatu's amended Water Resources Management Act, which requires that women make up 40 percent of participation in all local water committees;
- Australia's Victoria state government, which has prioritized developing programs to support women who want to lead at the highest levels;
- Emphasis on women's representation in Kenya's water management, which recommends gender balance in water use associations and catchment advisory committees; and
- Nicaragua's multilevel water governance strategy, which has promoted the participation of women since 2012.

Representation of excluded groups in decision-making roles is only the first step and must translate into the ability to set agendas and influence decision-making (Parthasarathy, Rao, and Palaniswamy 2019). Recent empirical research highlights that inequality does not stop at the gate of political office, as even when women are represented in local governance, they are still less likely to participate in deliberation (Parthasarathy, Rao, and Palaniswamy 2019), and they also face large inequalities in voice and centrality (Heinze, Brulé, and Chauchard 2024). A better understanding of interventions to increase meaningful participation in natural resource governance remains critical as the importance of sustainable water, land, and air management practices increases. Moreover, efforts to boost representation must be supported by robust mechanisms to prevent elite capture and ensure meaningful participation of marginalized groups. Deliberation and communication can help overcome potential capture by local elites and promote common interests to ensure accountability and transparency.

Information is key to ensuring better accountability and building support for change. If official monitoring capacities are constrained, affordable monitoring technologies, such as Geographic Information Systems and air quality trackers, enable NGOs, local communities, and citizen scientists to conduct monitoring tasks. For example, the provision of air quality data by US embassies and consulates has served as a catalyst to inform citizens and encourage discourse on environmental disamenities globally; estimates suggest that the presence of such monitoring stations can reduce air pollution by 2–4 $\mu g/m^3$, leading to a premature mortality decline enumerated at approximately $127 million for the median city (Jha and La Nauze 2022). Similarly, the NGO "Flying for Wildlife Trust" carries out aerial monitoring of elephants to detect poaching, while the NGO "Sky Truth" has used satellite imagery to uncover oil spills. The evidence has been used to inform governments and facilitate arrests and prosecution (Eilstrup-Sangiovanni and Sharman 2021).

When objectives differ: Best-feasible policy approaches

The most-direct policy solutions are often unenforceable in cases in which decision-makers do not share the objectives of fostering greater inclusion or enhancing environmental sustainability or when they have different priorities. Such difficulties to implement sustainable and inclusive policy may be rooted in factors such as economic opportunism and ethnic, religious, linguistic, or other intergroup differences. Dercon (2023, 1–2) highlights that, in many development scenarios, incentives between those offering solutions and those receiving them might be misaligned:

> [P]olicies that most economists think are unreasonable are not uncommon. … [P]olicy makers may in the end not necessarily be interested in economic growth or poverty reduction, but have other objectives. It means that to understand how to give economic advice for better economic or development outcomes, economists giving advice better understand the politics of the economy, and the economic decisions that serve the political outcomes.

These challenges may mean that indirect policy approaches must be considered, that is, solutions that do not actively affect change through the government but are adapted to the given political economy context. Policy making in such contexts is more challenging than when objectives are shared, and constraints and costs are associated with reaching the first-best solutions. Where objectives diverge, options will be more limited. This issue is analogous to a principal-agent model in which the agent is responsible for implementing a policy but has a different objective to the principal—the policy advisor who desires an inclusive and environmentally sustainable outcome. This section suggests alternative actions for cases in which such constraints hamper the implementation or enforcement of inclusive environmental policies.

When objectives are misaligned, two key pathways offer themselves to influence inclusive environmental policy: (1) public engagement and (2) coalition building. In such a policy environment, direct advocacy for policy changes will prove difficult, especially when change entails the loss of incumbent privilege. However, if the goals of civil society organizations and key stakeholders align with inclusive environmental policy, opportunities to nudge the policy discourse might still exist. Research suggests that, even in country contexts where direct participation of citizens in central governance is limited, public sentiments can guide policy makers (Buntaine et al. 2024).

By engaging civil society and cooperating with key stakeholders, a wider discourse can be fostered that can, at times, cascade into larger changes in public policy. International actors and development institutions can aid this process by advocating and implementing policies that foster sustainable and inclusive growth (refer to box 5.5.). However, challenges to policy implementation seldom appear alone, and development policies must be acutely aware of local power dynamics, vested interests, and economic incentives to ensure policy efficacy.

BOX 5.5
The World Bank's Environmental and Social Framework

The World Bank's Environmental and Social Framework (ESF) embodies the group's vision for sustainable development by advocating for the integrated management of environmental and social risks to foster green, resilient, and inclusive development. The ESF provides a comprehensive strategy for addressing issues of social exclusion and environmental degradation while incorporating environmental and social factors into the World Bank's financing processes. Overall, the ESF advances crucial issues such as labor, gender, climate change, biodiversity, community health and safety, and stakeholder engagement via an adaptive risk-based approach that ensures projects uphold long-term sustainability principles.

(Box continues next page)

BOX 5.5

The World Bank's Environmental and Social Framework (*continued)*

The ESF is structured around 10 Environmental and Social Standards, embedding environmental and social factors into project planning and execution to safeguard against environmental impacts, social exploitation, and displacement. These standards encompass a broad spectrum of issues, including fair labor practices, resource efficiency, community health, biodiversity conservation, and cultural heritage protection. Furthermore, they prioritize the rights of Indigenous people and marginalized communities while advocating for stakeholder engagement and information disclosure. In addition, the ESF fosters transparent engagement and emphasizes inclusive and continuous consultation, ensuring that the voices of those affected by developmental projects are incorporated into project planning and decision-making processes.

In South Asia, building on commitments to gender equality and the principles of the ESF, a World Bank project has developed the "Enabling Gender Responsive Urban Mobility and Public Spaces" toolkit. This toolkit, which was developed through consultations with women, girls, and gender minorities, offers governments practical guidance for creating participatory and inclusive urban environments, including gender-inclusive signage and emergency helplines. With many women relying on public and nonmotorized transport, gender-responsive urban mobility infrastructure can significantly enhance their access to education, employment, and training.

Across Western Africa, fishing sustains approximately 70 percent of coastal communities, yet it remains a sector plagued by widespread gender-based violence (GBV) and marginalization of women in decision-making processes. Gender considerations are rarely included in fishing policies and programs, exacerbating pervasive gender inequality. Limited access to resources and education exacerbates the vulnerability of women to GBV in these communities. Building on the principles of the ESF and supplementing the World Bank's efforts to enhance GBV prevention and response systems, a World Bank–funded project is supporting a Small Women's Grants Program to address barriers to women's engagement in economic activities in the fisheries sector. The project aims to provide women micro-finance and leadership training to build their capacity in financially and environmentally sustainable entrepreneurship.

Source: World Bank 2016.

Public engagement

When government cooperation is unlikely, leveraging the public becomes a key mechanism for affecting change. An informed public is integral to engagement and, hence, those who are underrepresented cannot participate actively and effectively in society if information is scarce and organizing is difficult. This subsection discusses how the provision of information, be it via grassroots NGOs, public discourse, or new information technologies, can help encourage public engagement for environmental and inclusive policies. However, understanding the local context before implementing any policy is important. If local preferences are geared toward higher exclusion and more-aggressive use of resources, these additional constraints must be recognized and considered in policy design. Similarly, information is not a sufficient condition for public action or a government response but serves as an important stepping stone.

If poor governance is the primary policy barrier, the provision of data and transparency initiatives can become a valuable tool for engaging the public. Corruption and fraud can be harmful for underrepresented groups, who lack the means to make their voices heard. Strengthening the transparency and accountability of government actors through, for example, open data, public disclosure, and citizen participation can disincentivize corrosive governance practices (Kaufmann 2005). This work can be done if the political will exists at some administrative layers within governments or via NGOs, citizen scientists, or international actors. If safe and feasible, nongovernment stakeholders such as NGOs can serve as watchdogs of public authority and potential irregularities. These approaches are not mutually exclusive: In some cases, central governments allow NGOs to publicly disclose the environmental performance of local governments, thus aiding in information gathering and solving some of the issues of the decentralized implementation gap (Anderson et al. 2019; Li et al. 2018).

If the opportunity cost to civic engagement is high for those who are underrepresented, their voices can be elevated by lowering the cost of staying informed. It is likely that the opportunity cost of learning how to participate in established decision-making channels and staying informed is higher for poor and underrepresented populations; when necessities such as tenure security (shelter) and food are scarce, taking the time to engage in political discourse might become prohibitively expensive. Thus, by making information acquisition easier, it might be possible to foster political engagement in groups that usually go unheard.

For example, NGOs have demonstrated success via information provision for households living in slums; by educating them about their rights as well as their democratic power in elections, a more-active involvement with government was facilitated (Madon and Sahay 2002). Similarly, the role of the internet in organizing marginalized groups is well-documented and can aid in encouraging reform (Mehra, Merkel, and Bishop 2004; Shirazi 2013). If possible, NGOs, international institutions, and citizen scientists can help disseminate information on government activities and policies, enabling a more-constructive engagement with the decision-making process and better monitoring of the use of shared resources (Hill 2018). This issue is especially true for marginalized populations who may have lacked access to such information outright.

Coalition building

A complementary approach to engaging the wider citizenry is fostering cooperation between and with local stakeholders. Leaders of different marginalized communities affected by environmental degradation might be more willing to cooperate to advocate for inclusive environmental policies together. Similarly, NGOs often have the required knowledge of local conditions and how best to interact with governments in policy-making terrains that might be difficult to traverse otherwise (refer to box 5.6). Hence, supporting the cooperation between such actors can aid in their policy advocacy.

Local knowledge is often key to making such strategies effective. For example, if a conflict is driven by animosity between groups, simply providing aid to one could deepen existing divisions. Similarly, fragility caused by an environmental disaster could lead to powerful groups monopolizing the aid provided. Hence, having a finger on the figurative pulse of a location is important in selecting the right development and aid tools.

If the political environment is fragile, for example, due to conflict, trusted NGOs that have established partnerships with local communities can help navigate unstable situations. Programs focused on community engagement are likely to sustain changes in government leadership and inconsistent funding. For instance, a community development program in the Caribbean brought together different actors such as NGOs, community members, and the government to jointly work on development issues such as clean water delivery systems and watershed management. Due to the focus on community work, the community development board was able to proceed with working with government agencies and NGOs even after the end of the official project lifespan (Fischer and Levy 2011).

BOX 5.6

African Parks: A model for sustainable growth in low-capacity environments

Protected areas are the main method by which governments attempt to conserve wildlife, but security challenges, inadequate financial resources, limited technical capacity, and inequitable governance are hindering their management. Protected areas are prevalent in Africa, where they cover 16 percent of land area. In addition to their potential benefits for biodiversity, protected areas can benefit the people living near them through employment opportunities, infrastructure development, and tourism. However, despite appreciation for their importance and goals for their expansion, many protected areas are failing to realize their potential.

In response to these challenges, African governments increasingly are turning to private nongovernmental organizations (NGOs) for assistance. Under collaborative management models, African governments partner with or fully delegate control over protected area management to NGOs, which may offer advantages such as greater access to donor funding, technical expertise, and reduced susceptibility to corruption.

African Parks (AP) is a South Africa–based nonprofit NGO that partners with African governments to manage protected areas. AP's primary mission is to conserve, restore, and connect wildlife populations across regional landscapes in Africa. The organization's scope is continental, and its interventions are ambitious. For example, AP often reintroduces large mammals to protected areas where they were historically lost due to overhunting.

Wildlife conservation via law enforcement lies at the center of AP's management model. As such, the organization often leverages its considerable financial resources to employ heavily armed park rangers and equip them with helicopters, light aircraft, and other monitoring and enforcement technologies. The militarized style of conservation AP pursues perhaps reflects the conflict-affected settings in which it operates. For example, AP rangers active across Central Africa sometimes confront armed groups who hunt wildlife and extract natural resources from within park boundaries.

(Box continues next page)

BOX 5.6

African Parks: A model for sustainable growth in low-capacity environments (*continued)*

At the same time, AP seeks to maximize the benefits of protected areas for local people. In addition to creating job opportunities, AP also constructs and finances infrastructure, schools, and health clinics; offers scholarships for local students; and promotes tourism. As these programs suggest, AP views healthy wildlife populations, effectively managed protected areas, and economic development as inextricably linked.

While several NGOs manage protected areas in Africa, such as the Wildlife Conservation Society, AP currently manages more land and protected areas in Africa than any other NGO. The governments of 12 African countries transferred management of 22 protected areas to AP between 2003 and 2022. During these mandates, which average 20 years, AP has complete management authority. These responsibilities include funding all operations, hiring staff, and security provisions.

New analyses show that AP significantly improves wildlife conservation. Changes in outcomes among protected areas transferred to AP management are compared to changes in outcomes among similar areas that have always been managed by governments. Compared to a counterfactual of government management, management by AP significantly reduces elephant poaching by 35 percent and increases bird abundance by 37 percent. AP management also significantly increases tourism by 37–47 percent, depending on the data set used to measure tourism. Finally, AP significantly increases monitoring and enforcement by 0.9 standard deviations, which could explain the improvements in wildlife outcomes. Therefore, transferring protected area management to NGOs like AP can address some of the challenges undermining effective protected area management in Africa, supporting global initiatives to safeguard the Earth's biodiversity.

Source: Denny, Englander, and Hunnicutt 2024.

If political power is held by only a few decision-makers, implementing reforms that align with their economic interests might prove fruitful. One example are the anti-discrimination laws passed in the United States after the American Civil War. By including Southern Blacks, cotton mill operators could draw from a larger labor supply, which lowered operating costs; due to the economic benefits, resistance from a powerful industrial group toward inclusive reforms diminished (Wright 2013). Recent estimates for the United States put the cost of discriminatory practices at a 4 to 6 percent reduction in gross domestic product. Thus, reducing exclusionary practices can be economically beneficial to decision-makers and wider society (Noel et al. 2019).

The way forward

Deliberate and integrated action is crucial. Environmental sustainability must be aligned with inclusive economic growth to break the cycle of degradation and exclusion. Representation and empowerment of local communities are crucial steps in this process. By ensuring that marginalized groups have a voice in decision-making, policies that are both inclusive and environmentally sound can be fostered.

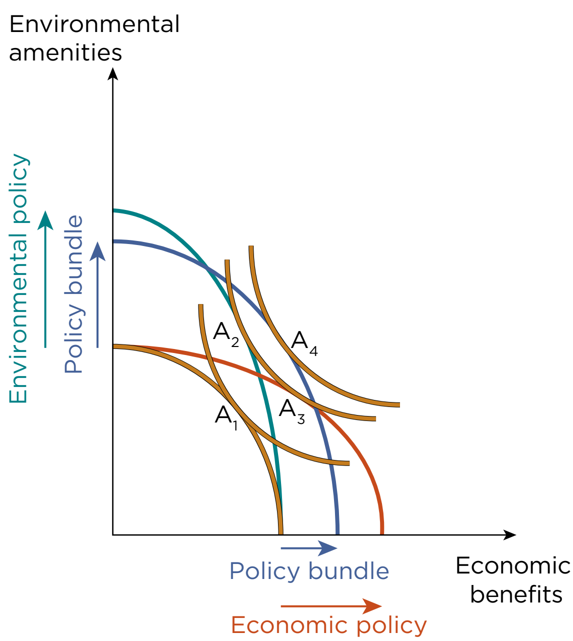
A commitment to comprehensive, inclusive, and sustainable policies is essential to ensure that natural capital serves as a stepping stone rather than a millstone for excluded groups. The creation of a future where both people and the planet thrive must be prioritized. Policy makers and stakeholders are urged to collaborate, leveraging all available tools and resources, to ensure long-term, positive outcomes for all members of society.

Annex 5A Maximizing overall welfare: A policy bundle

A strategy that integrates both economic and environmental policies can boost overall welfare more than if economic or environmental policies were implemented separately. Consider a scenario where the welfare of individuals is composed of both environmental quality and economic benefits. Figure A5.1 depicts production and utility functions that consider both environmental and economic dimensions, with welfare initially indicated at point A1. The government could opt for an economic policy to enhance economic prosperity, an environmental policy to improve environmental quality, or a combination of both. As shown in figure A5.1, adopting either an economic or environmental policy alone would yield the same level of utility, at points A2 and A3, respectively, and would be an improvement over A1. However, a policy bundle has the potential to raise welfare even higher, to point A4. Although this policy bundle might not increase economic or environmental benefits to the same extent as the individual policies would on their own, the overall welfare is nonetheless greater.

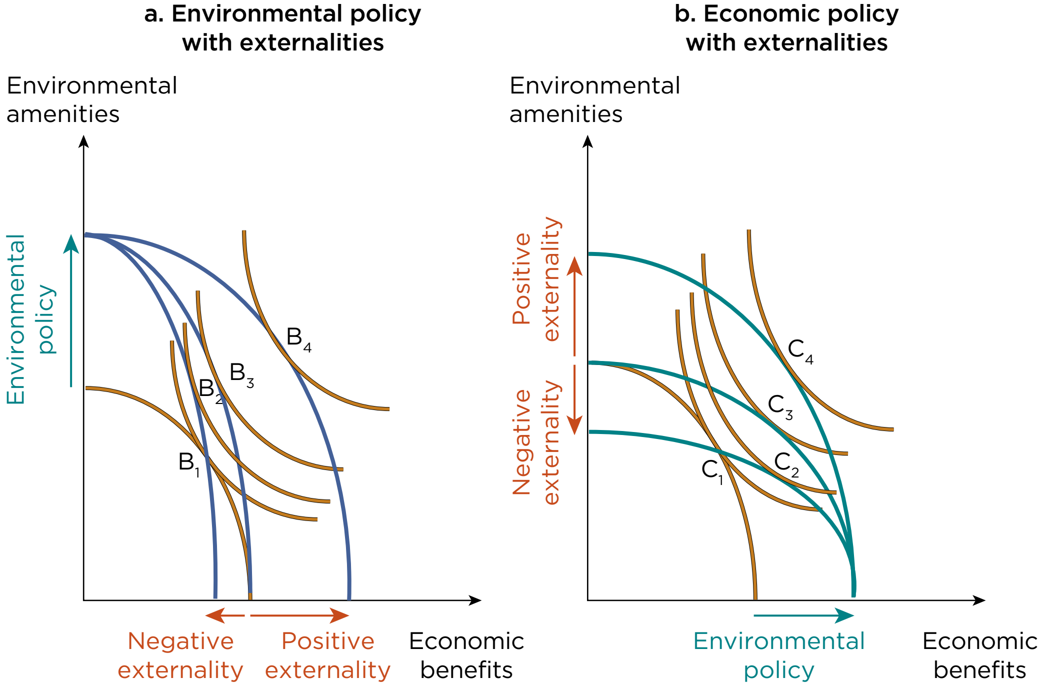
The given scenario presumes that one policy does not affect the other. Nonetheless, when considering the externalities of policies, the outcome may vary. Figure A5.2, panel a, illustrates the effects of implementing an environmental policy with negative, neutral, or positive externalities. The overall welfare could either diminish or augment depending on the negative externality of the environmental policy on economic prosperity, as represented by point B2. However, even the welfare increase is less than it would be in the absence of any negative externality (B3 > B2). Conversely, an environmental policy that exerts a positive externality on economic benefits would guarantee greater overall welfare (B4 > B3 > B2). This rationale also applies to economic policies that have positive externalities on environmental quality (C4 > C3 > C2) (refer to figure 5.2, panel b). Nevertheless, as depicted in Figure A5.2, a policy bundle is more effective in enhancing overall welfare than implementing a single policy. Therefore, a mix of economic and environmental policies that generate positive externalities yields the most-substantial improvement in overall welfare.

FIGURE A5.1 A policy bundle with no externalities



Source: World Bank staff calculations.

FIGURE A5.2 Environmental and economic policies with externalities



Source: World Bank staff calculations.

Annex 5B Bridging the gaps: A comparative framework for examining the welfare gap

To determine the magnitude of the welfare gap between nonexcluded and excluded groups, we can begin with a simple welfare function consisting of two components:

- *Economic benefits (B),* which represents the welfare benefits received from economic activity that can include increases in wages, future opportunities, net income transfers, and government benefits and services and
- *Environmental amenities (A),* which represents environmental amenities that can be degraded by economic growth. Damages to environmental amenities include land degradation, air pollution, reductions in availability or quality of water, or damages from extreme events from a changing climate.

Welfare of nonexcluded (*n*) and excluded (*e*) groups can therefore be written as follows:

$$W_i = B_i + A_i (i = e, n) \quad (5B.1)$$

Differences in welfare between excluded and nonexcluded groups is

$$W_r - W_n = (B_e - A_e) + (B_e - A_n) \quad (5B.2)$$

Rearrange terms in equation (2), and we arrive at

$$W_e - W_n = (B_e - B_n) + (A_e - A_n) \quad (5B.3)$$

The first term on the right side of the equation (5B.3) can be considered the *relative economic growth or economic welfare gap* between excluded and nonexcluded groups. It measures the difference in the fruits of growth that are received by excluded groups and nonexcluded groups. The second term is the *environmental amenity gap*. It measures the differences in environmental damages experienced by nonexcluded and excluded groups. Measuring the magnitude and sign of the *relative economic growth gap* and the *environmental amenity gap* indicates how growth, environmental damage, and social exclusion interact to create welfare gaps. There are four possibilities for the two terms:

1. *Both terms are positive:* There is neither growth injustice nor environmental injustice. Environmental assets act as a stepping stone for excluded groups.
2. *First term positive, second term nonpositive:* There is no growth preference for the nonexcluded, but there is environmental injustice. Environmental damage acts as a millstone.
3. *First term nonpositive, second term positive:* In this case, the sign of the welfare gap is ambiguous and depends on the relative magnitudes of the two terms.
4. *Both terms are nonpositive:* Growth disproportionately benefits the nonexcluded, and environmental destruction further exacerbates the welfare gap, acting as a millstone.

Notes

1. Refer to https://nzhistory.govt.nz/politics/treaty/the-treaty-in-practice/waikato-tainui.
2. Refer to https://www.tearawhiti.govt.nz/te-kahui-whakatau-treaty-settlements.
3. Refer to https://news.climate.columbia.edu/2011/02/24/maori-values-modern-solutions/.
4. Refer to https://www.rnz.co.nz/programmes/in-depth-special-projects/story/2018845362/the-dirty-truth-about-the-waikato-river.

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ISBN 978-1-4648-2164-6

9 781464 821646 90000

SKU 212164