Is Growth Enough?

A scenario analysis
prepared for the World Bank

by

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1. Introduction

1.1. Examining key hypotheses

Eliminating poverty is an over-riding objective of Bank policy. Closely associated with it is the goal of achieving environmentally-sustainable growth. This study considers whether these goals can be achieved with current policy approaches. In particular, the study examines a key hypothesis implicit in the Bank's present strategy: Is economic growth alone enough to reduce poverty and is this strategy consistent with environmental goals, or are other strategies likely to be required?

To explore this question, this study analyses three scenarios over the period 1995 (the base year) to 2050. The first is a **reference scenario** that implicitly incorporates current policy approaches. It assumes current Bank projections for economic growth. The second is a **high growth scenario** that explores the implications of more rapid economic growth, assuming growth rates 50% higher than in the first scenario but holding all other assumptions constant. These scenarios are analyzed for their ability to meet poverty and environmental targets. The third **policy reform scenario** takes a radically different approach: it constrains the scenario results to meet certain poverty and environmental targets and explores the types of alternative strategies and policies necessary to achieve such results.

The analysis provides both a global picture as well as detailed results for 11 regions. It also yields insights into the implications for trade of different scenarios, and it explores the sensitivity of the poverty results to different assumptions about distributional patterns. The analysis includes case studies that could easily be performed at a national level for a given country but here focus on small groups of countries with comparable characteristics.

1.2. Scenario approach and key assumptions

Scenario analysis offers structured accounts of possible long-term futures. The value of this approach is not its capacity to predict the future but rather its ability to provide insight into the present. By helping to identify drivers of change as well as the implications of alternative trajectories and the comparative benefits of different strategies, scenarios bring the future to bear in today's decisions. Quantitative scenarios such as those considered in this study can also illuminate inconsistencies and unintended consequences of different strategies, such as exceeding plausible physical limits of water or land availability.

The scenarios considered here are derived from the work of the Global Scenario Group, adapted to Bank data, goals, and hypotheses. (Raskin et.al, 1998) The scenarios aggregate national data into 11 regions that become the basis of analysis. They use UN (1997) mid-range population projections (with slight downward modifications in the policy reform scenario) and incorporate a range of economic growth rates applied to per

capita GDP adjusted for purchasing power parity (PPP). They treat poverty explicitly by incorporating an analytic representation of income distribution as measured by Gini coefficients. Using a sectoral decomposition of regional GDP, the scenarios explicitly calculate energy use based on the demographic, economic and technical trends of each scenario. Food production is estimated from the land and water available, the yields that can be achieved, and the mix of crops, livestock and production practices that are adopted; requirements for food are calculated, taking into account historical trends as well as expected departures from those trends. Trade is assumed to balance demand that cannot be met through domestic production. Deforestation rates are determined as a result of land-use conversions for urban areas, cropland, and rangeland. Renewable water resources are assumed to remain at 1995 levels, but water use is calculated by economic sector. Pollution estimates are calculated based on fuel use, type, and sulfur content, and on the extent of manufacturing activities that use toxic or hazardous materials (based on an adaptation of the World Bank Industrial Pollution Projection System that gives lower-bound emission factors for many industries). A more detailed discussion of the scenario methodology and assumptions is given in the Appendix and in an earlier GSG publication. (Heaps et.al, 1998)

A central assumption in this analysis is the gradual convergence of regional consumption patterns and technology levels. The convergence algorithm adopted expresses the idea that, in the course of economic development, the structure of economies, certain activity levels such as travel patterns, and intensities or other measures of technological levels in non-OECD regions converge toward those of the highly industrialized societies as GDP/capita increases. Rather than exactly recapitulating the history of OECD regions, however, developing and transitional economies are assumed to adopt improved technologies and practices more rapidly, as a result of globalization, so that their activity or intensity levels approach OECD levels in a given scenario year as their GDP/capita approaches 1995 OECD levels. This assumption has the result that industrial and household efficiencies in non-OECD countries, for example, improve even more rapidly than historical patterns would suggest, especially in high-growth scenarios. In addition, this analysis imposes a number of consistency checks to prevent double counting, insuring that use of land, water, and other finite natural resources by different sectors does not exceed realistic levels.

1.3. Goals, indicators and targets

To measure progress toward eliminating poverty and achieving environmentally-sustainable growth requires adoption of specific indicators. Those used in this study constitute a minimum set and thus may not be fully adequate to ensure that the goals are achieved. Nonetheless, they constitute a necessary set of conditions associated with the goals and thus suffice for comparing the effectiveness of alternative strategies over half a century.

In this study, we use hunger (undernutrition) as a proxy or indicator for poverty, since a reduction in hunger is closely correlated with alleviation of the entire nexus of unfulfilled basic needs associated with absolute poverty. Indeed, since people who can afford to

purchase an adequate supply of food will normally do so and since reported per capita income may understate actual income from barter or informal activities, the extent of hunger may be a better measure of absolute poverty. The targets adopted here, which the policy reform scenario is constrained to meet and which provide a gauge against which to compare other scenarios, are a 50% reduction of hunger by 2025, compared to 1995 levels, and a further 50% reduction by 2050.

This study uses several indicators to measure *local* environmental sustainability, including the availability of an adequate supply of freshwater, local pollution, and degradation of local ecosystems in ways that hinder their ability to provide food, fiber, timber, and ecosystem services including biodiversity. For freshwater, the indicator used is the ratio of water use to the available renewable resource. The target adopted is that this ratio not exceed 0.4 -- a level of use judged unsustainable by the U.N. Comprehensive Freshwater Assessment -- for any country by 2050; and for those countries that already exceed this value in 1995, that the 2050 value show some reduction. For local air and toxic pollution, the indicators are sulfur emissions (calculated from energy use levels, fuel types, and sulfur content) and releases of persistent organic pollutants and heavy metals (that track closely to industrial sector GDP adjusted for technology convergence). The target adopted is that per capita levels of these emissions and releases converge to 10% of 1995 OECD levels by 2050. Deforestation, land degradation, and marine over-fishing are all important measures of ecosystem degradation, but for ease of analysis only deforestation is used in this study as an admittedly imperfect proxy. The target adopted is that deforestation will cease by 2025 and net reforestation will begin by 2050. In all instances the targets were used to constrain the policy reform scenario and as a basis for gauging the results of other scenarios. The analysis also produces estimates of greenhouse gas emissions, as a proxy for global sustainability issues such as climate, but does not constrain the policy reform scenario to meet specific targets.

2. Is Growth Enough?

We first consider poverty questions, analyzing the **reference**, **high-growth**, and **policy reform** scenarios to explore whether economic growth by itself is enough to meet the goals for poverty (measured as hunger) reduction put forth in the introduction. We also consider a sensitivity analysis that explores the impact of differing assumptions about income distribution. The results suggest that if poverty is to decline significantly, growth is not enough but must be accompanied by a decrease in income disparity within some countries.

2.1. Global patterns

In the **reference** scenario, economic growth rates in each country are based on estimates of the World Bank for GDP growth evaluated at market exchange rates (MER). These growth rates between 1995 and 2025 reflect reasonable expectations for economic growth given the current situation; between 2025 and 2050, growth rates show more

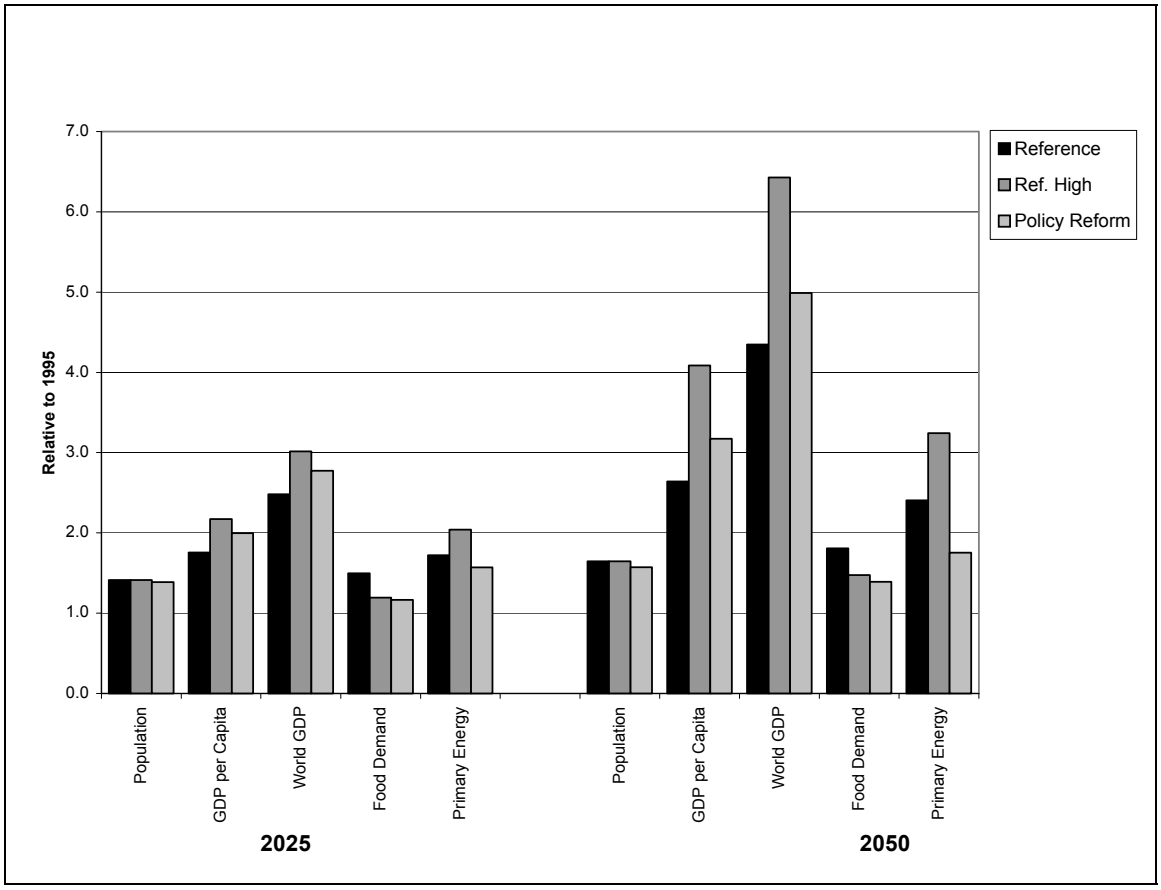
convergence, generally accelerating in regions where growth is slow in the first period and declining slightly in regions where initially growth is more rapid. In the **high-growth** scenario, GDP growth rates in developing and transitional regions are 1.5 times those in the **reference** scenario. The **policy reform** scenario is constrained to meet poverty and environmental targets, with growth rates determined in large part by those constraints. In all scenarios GDP evaluated at purchasing power parity (PPP) is used as a measure of economic activity. The growth rates used in the scenarios for both MER and PPP are shown in Table 1.

Table 1. GDP Growth rates (average annual) in the reference, high-growth, and policy reform scenarios

	Reference				Reference-High				Policy Reform			
	MER		PPP		MER		PPP		MER		PPP	
	1995-2025	2025-2050	1995-2025	2025-2050	1995-2025	2025-2050	1995-2025	2025-2050	1995-2025	2025-2050	1995-2025	2025-2050
Africa	3.8	3.1	3.9	3.4	5.8	4.6	5.2	4.6	6.9	4.7	5.8	3.9
China+	5.2	3.0	4.0	2.6	7.8	4.4	5.3	3.5	7.0	4.2	4.3	2.5
Latin America	3.4	2.6	3.3	2.7	5.2	3.8	4.4	3.7	4.4	3.5	3.5	2.6
Middle East	3.0	2.4	3.6	2.8	4.7	3.5	4.6	3.9	5.2	3.8	4.5	3.0
South Asia	5.1	3.6	4.4	3.4	7.7	5.3	5.9	4.6	6.9	4.6	5.0	3.1
Southeast Asia	3.6	4.5	3.1	2.5	5.5	3.5	4.3	3.6	6.0	4.1	4.4	3.0
East Europe	2.1	1.3	2.0	1.3	3.2	1.9	2.5	1.6	3.4	2.1	2.2	1.2
FSU	1.8	1.1	1.8	1.1	2.7	1.6	2.3	1.5	3.5	2.2	2.5	1.5
West Europe	2.6	1.5	2.7	1.6	2.6	1.5	2.7	1.6	2.6	1.5	2.7	1.6
North America	2.7	1.3	2.3	1.4	2.7	1.3	2.3	1.4	2.7	1.3	2.3	1.4
Pacific OECD	1.2	1.1	2.7	1.9	1.2	1.1	2.7	1.9	1.2	1.1	2.7	1.9
Developing	4.0	3.3	3.7	2.9	6.1	4.2	5.0	3.9	5.9	4.1	4.5	2.9
Transitional	1.9	1.2	1.8	1.2	2.9	1.7	2.3	1.5	3.5	2.2	2.4	1.4
OECD	2.3	1.4	2.6	1.7	2.3	1.4	2.6	1.7	2.3	1.4	2.6	1.7
World	2.7	2.0	3.1	2.3	3.4	2.7	3.7	3.1	3.4	2.7	3.5	2.4

A global overview of the resulting scenarios is given in Figure 1. Values for key variables are shown for 2025 and 2050, relative to the 1995 values. Populations increase by close to 65% in all scenarios between 1995 and 2050. World GDP in the **reference** and **policy reform** scenarios are similar, with GDP in the **reference** scenario increasing by a factor of 4.3, and by a factor of 5.0 in the **policy reform** scenario. In the **high-growth** scenario total GDP grows by 6.4 times between 1995 and 2050. Incomes, represented by GDP per capita, rise by a factor of 2.6 between 1995 and 2050 in the **reference** scenario, and by a factor of 4.1 in the **high-growth** scenario. In the **policy reform** scenario incomes rise slightly slower than in the **high-growth** scenario, by 3.2 times. Food demand is similar in all scenarios, reflecting similar populations, while primary energy use varies widely, reflecting differences in growth rates and policy mixes.

Figure 1. Scenario Overview



2.2. Hunger in the reference and high-growth scenarios

Population increases and diet changes drive a near doubling of world food demand in the **reference** scenario. Dietary patterns adjust with rising incomes, with an increasing share of calories derived from animal products. Agricultural production also increases, more than tripling. Yields are assumed to increase gradually in all regions. Utilization of land for crops and grazing livestock also increases.

Yet despite increased food production, hunger persists. The reason is that income distributions in the **reference** scenario gradually become more unequal in most countries, based on the assumption of general convergence toward industrial country patterns. For thirty years inequality has been increasing in the United States. In the scenario, income inequality, as measured by the Gini coefficient, continues to increase in the United States, but at half the recent historic rate. Other countries gradually converge toward this pattern, resulting in a general trend of increasing inequality, with the greatest increases occurring in the "transitional" regions of Eastern Europe and the Former Soviet Union.

As income distributions become more unequal, more people fall below the "hunger line", the income at which a family or individual is just barely able to meet minimum dietary requirements for a normally active life. The hunger line is thus analogous to the poverty line used in Bank analyses. In effect, the population below the hunger line represents real food requirements that are not translated into effective or market demand because of poverty. Moreover, the hunger line cut-off tends to rise as countries develop, just as poverty lines do. It takes a larger income to acquire non-food items such as clothing, energy, and transport and just to barely survive as traditional sources of materials support and resources that sustain informal food gathering are eroded by the process of modernization.

The result is that despite generally vigorous economic growth in the **reference** scenario, hunger increases worldwide by 11% between 1995 and 2025 and by a further 9% between 2025 and 2050. In every region, the growth in hunger is lower than population growth, so the incidence of hunger as a percentage of the population declines in every region. Nevertheless, the goal of reducing hunger by one-half between 1995 and 2025 and by a further one-half between 2025 and 2050 is far from being met. This scenario projects that 1 billion people remain undernourished and in absolute poverty in the year 2050, with large concentrations in Africa, South Asia, and China.

To explore how increased economic growth might change this picture, the **high-growth** scenario adopts national economic growth rates in all non-OECD regions that are 1.5 times those in the **reference** scenario (Table 1). Income distributions evolve exactly as in the **reference** scenario. Perhaps surprisingly, even with these very robust growth rates, the hunger reduction target is not met in this scenario, either. World hunger drops by 19% between 1995 and 2050. In all, the scenario projects 713 million people remain undernourished and in absolute poverty in 2050. The greatest absolute increase in hunger (over 80 million) occurs in African countries, while the greatest decrease (over 100 million) occurs in South Asia.

What level of growth would be sufficient to meet the hunger reduction target, under these income distribution assumptions (convergence to industrial patterns)? If we construct variations on the **high-growth** scenario, growth rates in non-OECD regions must be between 2.5 and 3 times that of the **reference** case to reduce hunger to 25% of 1995 levels by 2050, implying extraordinary and almost certainly unachievable rates of economic growth for many regions. Evidently, plausible rates of accelerated economic growth by itself are not enough.

2.3. Sensitivity to Distributional Assumptions.

In the **reference** and **high-growth** scenarios, income distributions in all countries are assumed to gradually converge toward the pattern in the United States, where, as discussed above, income inequality has been steadily increasing. To assess the sensitivity of the results to this assumption, we examine two variations. In the first, the *Constant U.S. Distribution* variation, income distributions in all countries converge toward U.S. patterns, but the U.S. Gini coefficient itself remains at its 1995 value throughout the

scenario. In the second, the *Constant Distributions* variation, Gini coefficients in all countries remain at base-year levels. Regional patterns of changing income inequality are shown in Table 2, where the figures reported are population-weighted average Gini coefficients for each region.

Table 2. Population-Weighted Average Gini Coefficients

		Reference		Const. U.S. Dist.		Const. Distributions	
	1995	2025	2050	2025	2050	2025	2050
Africa	0.42	0.46	0.50	0.43	0.43	0.42	0.42
China+	0.38	0.44	0.47	0.40	0.41	0.38	0.38
Latin America	0.51	0.52	0.52	0.48	0.46	0.51	0.51
Middle East	0.45	0.49	0.51	0.45	0.45	0.46	0.46
South Asia	0.33	0.41	0.45	0.37	0.38	0.33	0.33
Southeast Asia	0.38	0.44	0.48	0.41	0.41	0.38	0.38
East Europe	0.29	0.37	0.42	0.34	0.36	0.29	0.29
FSU	0.30	0.38	0.43	0.35	0.37	0.31	0.31
North America	0.43	0.47	0.51	0.44	0.44	0.43	0.43
Pacific OECD	0.36	0.43	0.47	0.39	0.40	0.36	0.36
West Europe	0.34	0.41	0.45	0.37	0.38	0.34	0.35

Changes in hunger levels for these variations are shown in Table 3. In none of the variations are the hunger-reduction goals met throughout the scenario period, despite the high levels of economic growth in the **high-growth** scenario. The goal for reducing hunger by 50% in 2025 is met in the *Constant Distributions* variation of the **high growth** scenario, but the subsequent decline in the hungry population is insufficient to meet the goal of reducing hunger by another 50% between 2025 and 2050. The regional picture shows a similar pattern. Under **reference** growth assumptions, in all variations, hunger continues to increase in Africa and generally worsens in the Middle East, but declines significantly in China and South Asia under most variations. Thus the results of the scenario analysis seem robust: even with significantly different (e.g., slowly increasing or constant) Gini coefficients, plausible increases in economic growth rates alone are not sufficient to achieve hunger and poverty targets.

Table 3. Hunger relative to 1995 in the distributional variations

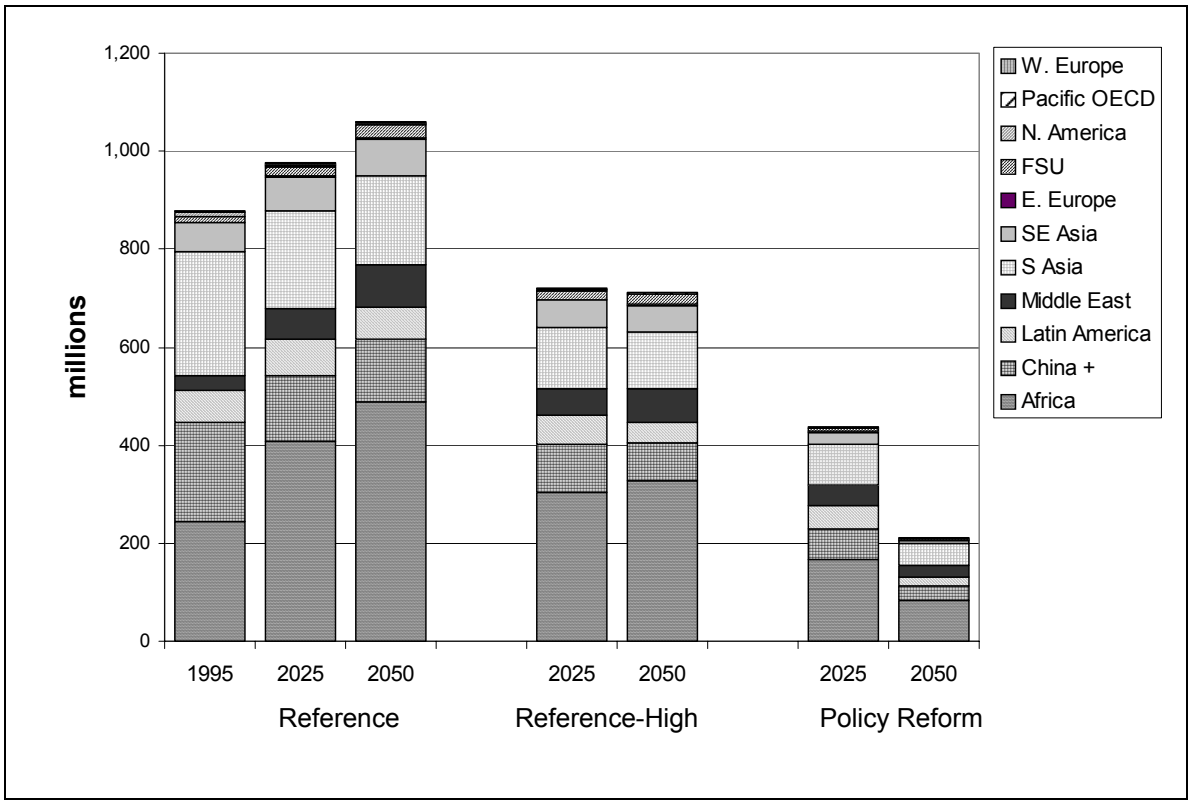
	Scenarios			
	reference		high-growth	
Distribution Variations	2025	2050	2025	2050
Reference	1.10	1.19	0.81	0.80
Constant U.S. Dist.	0.86	0.72	0.60	0.43
Constant Distributions	0.75	0.63	0.53	0.39

2.4 Summary of Poverty Reduction Across Scenarios

Figure 2 displays the hunger patterns for the **reference**, **high-growth**, and **policy reform** scenarios. The **reference** and **high-growth** scenarios do not meet poverty reduction targets, although they do show significant reductions. In contrast, the **policy reform** scenario assumes focused policy attention on social and environmental issues. It does

meet (is constrained to meet) the hunger targets through a combination of economic growth and, in most regions, declining inequality. This scenario and its implications will be discussed further in the final section of this study. Evidently, however, economic growth must be combined with an absolute *reduction* in income inequality if poverty reduction goals are to be achieved.

Figure 2. Poverty reduction in the reference, high-growth, and policy reform scenarios



3. Environmentally Sustainable Growth?

A strategy that seeks to achieve poverty reduction primarily through high rates of economic growth faces a dilemma. Not only are poverty targets difficult to achieve, as the results above suggest, but high rates of economic growth along conventional lines may be incompatible with environmental goals. More significantly, environmental impacts if severe enough have the potential to exact a high human and economic cost in the form of health burdens, to create or exacerbate shortages of critical renewable resources such a freshwater, and to degrade forests, fisheries, soils and other resources on which improved incomes for the poorest segments of society often depend. In this section we investigate the impact of the **reference, high-growth,** and **policy reform** scenarios on a range of developmentally-relevant environmental conditions.

3.1. Environmental Impacts: Local and global pollution

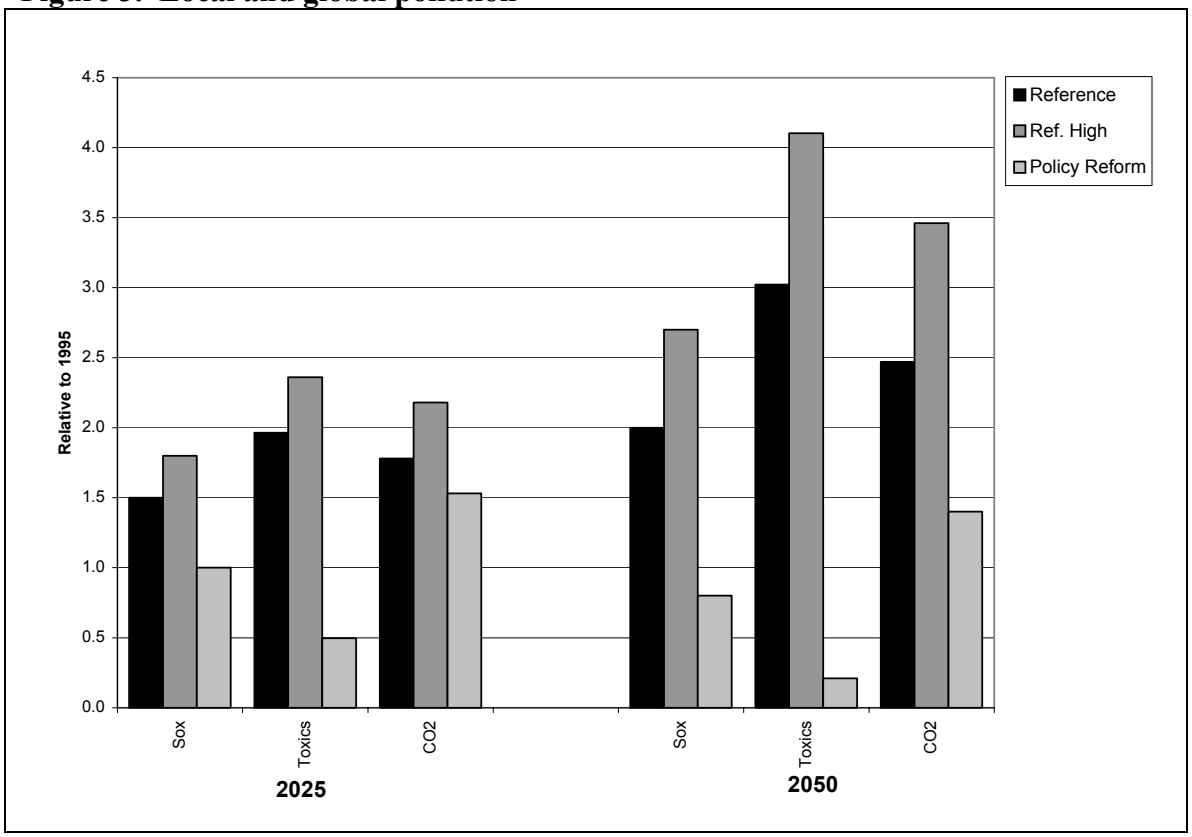
The **reference** scenario is associated with rapid increases in primary energy use, including higher use of sulfur-containing fuels, as well as expanded industrial activities that use chemicals, heavy metals, and other toxic materials. As a result, local air pollution (measured by sulfur emissions) and toxic pollution (measured by releases of toxic materials) increase very substantially, in the absence of focused policies to mitigate these impacts. Compared to 1995, sulfur emissions in 2050 increase 2 times and toxic releases 3 times, primarily in non-OECD regions. In these regions, most of the polluting activities occur in urban areas, which are projected to grow rapidly, thus increasing the population at risk from pollution. The health impact from polluted air and water depends on many factors, including geography and income levels, so that the additional health burden cannot be reliably estimated; likewise estimates of the negative economic impact of ill-health or of loss of tourism or foreign investment due to persistent, severe pollution vary widely. But qualitatively, these human and economic impacts can be expected to increase significantly in this scenario.

In the **high-growth** scenario, pollution levels increase still further, but not in direct proportion to accelerated economic growth. The potential increase is mitigated by improvements in efficiency of resource use, some changes in consumption habits, and saturation effects. Food consumption, in particular, eventually levels off with increasing incomes. Nevertheless, energy use increases considerably more in the high-growth scenario than in either of the other scenarios, 1.2 times more than the **reference** scenario in 2025 and 1.3 times more in 2050, despite efficiency increases and sectoral shifts away from energy intensive activities. As a result, sulfur emissions in 2050 compared to the reference scenario are 1.4 times higher; toxic releases are also 1.4 times higher. In contrast, local pollution under the **policy reform** scenario rises more slowly, converging to (reduced) OECD per capita levels.

Global pollution is not a focus of this study. Nonetheless, we note that in the absence of focused policy attention on environmental issues, carbon dioxide levels rise with energy consumption in both the **reference** and **high-growth** scenarios. In the **policy reform** scenario carbon dioxide emissions decline between 2025 and 2050, despite an increase in energy consumption, as regions move toward using less carbon-intensive energy sources. The increase in energy consumption is also lower in the **policy reform** scenario than in other scenarios, due to relatively higher penetration of energy-efficient technologies, as well as changes in consumption patterns.

Figure 3 summarizes local and global pollution under all three scenarios.

Figure 3. Local and global pollution

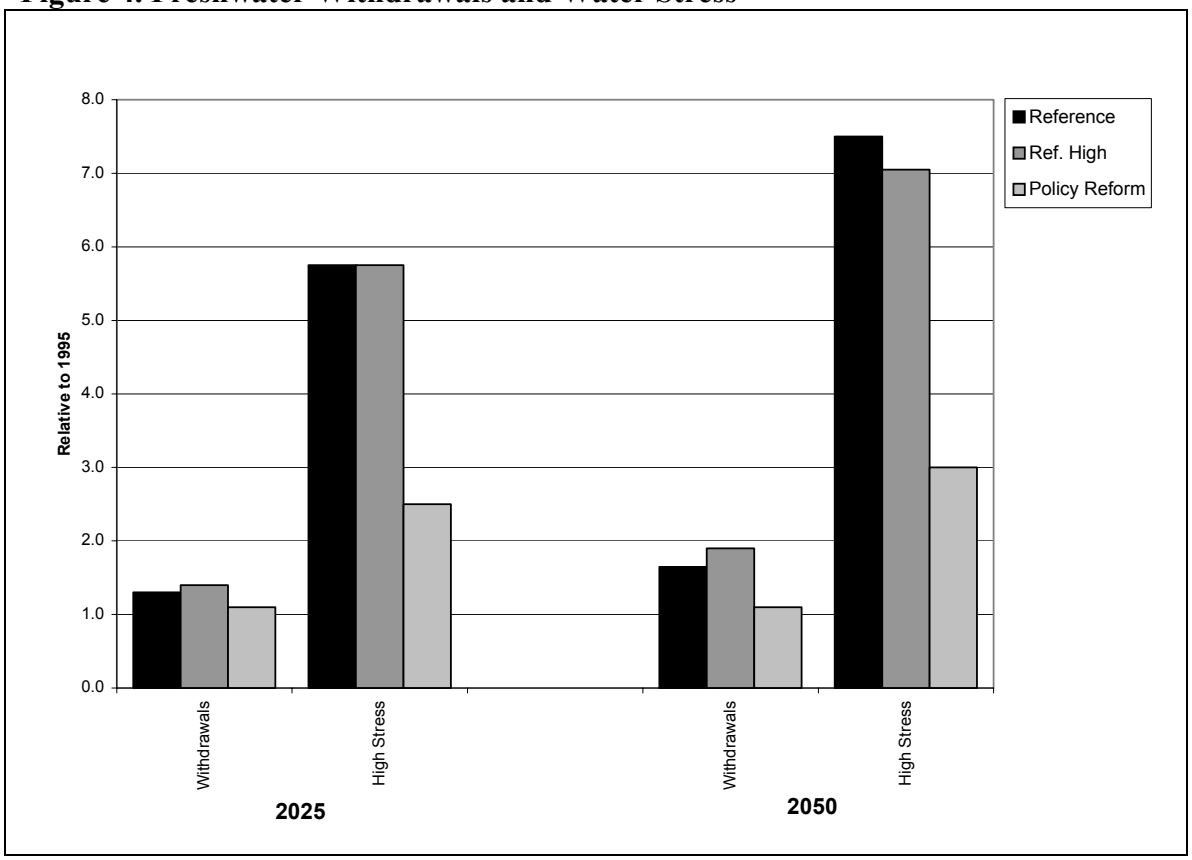


3.2. Environmental Impacts: Freshwater scarcity

Freshwater is a finite resource that is critical for meeting human needs, supporting economic activities, and ecosystem preservation. Yet water withdrawals from rivers and lakes for human activities have increased by nearly threefold since 1950, placing a number of watersheds under a condition of moderate water stress (water use-to-resource ratio between 0.1 and 0.4) or high water stress (use-to-resource ratio greater than 0.4). In 1995, nearly 440 million people lived in areas of high water stress, with an additional 1.4 billion facing unreliable supplies, despite sufficient water on average. In the **reference** scenario, water use increases 62% by 2050 and the population living under high water stress conditions rises to 3 billion, over a sixfold increase. These impacts are especially acute in the Middle East, in parts of South Asia, and in parts of Africa. Under conditions of high water stress, competition for scarce freshwater supplies is likely to hamper attempts to increase access to safe drinking water, limit expansion of irrigated agriculture, and pose increased security risks in shared water basins. Thus the expected human and economic impacts of growing freshwater scarcity in this scenario are substantial.

These impacts are exacerbated by still higher water withdrawals in the **high-growth** scenario. Compared with 1995, water use in 2050 nearly doubles under this scenario and the number of people experiencing high water stress reaches 3.1 billion, close to the *Reference* scenario value. However, the population in moderate stress increases significantly over the *Reference* scenario value, to 5.2 billion, compared to 4.8 billion by 2050. Under this scenario, freshwater scarcity is likely to become a major local and regional issue and a significant constraint on economic development. Under the **policy reform** scenario, in contrast, water withdrawals increase only 6.5% between 1995 and 2050, much less than in other scenarios, as a result of measures taken to restrain demand and encourage greater efficiency in water use. The number of people subject to water stress under this scenario peaks and then begins to decline. Water withdrawals in water-scarce regions, such as the Middle East, are sharply curtailed relative to the **reference** and **high-growth** scenarios. Figure 4 summarizes water withdrawals and the populations subject to high water stress for all three scenarios.

Figure 4. Freshwater Withdrawals and Water Stress



3.3. Environmental Impacts: Land Resources and Ecosystem Degradation

In the course of development, human activity alters landscapes. In particular, increasing demand for food, fiber, and timber are increasing the pressure on natural ecosystems. Expanding human settlements and built environments to satisfy the housing, commercial and transportation needs of growing populations and economies compound these pressures. To avoid serious damage and loss of valuable ecosystem services, fragile ecosystems need to be protected, deforestation and destructive logging practices halted, agricultural practices modified to avoid erosion or other forms of land degradation, and fisheries and other marine resources sustainably managed.

In the **reference** and **high-growth** scenarios, land under the built environment expands as populations increase and incomes rise, with the area affected more than doubling between 1995 and 2050. Agricultural land also expands, driven by increased demand for food and dietary shifts. Cropland degradation proceeds at close to historical rates, requiring that still more land be converted to agricultural uses. Much of the expansion is at the expense of forests, with most of the deforestation and destructive logging occurring in developing regions. In the **reference** scenario, forest areas decline by over 600 million hectares in the 1995 to 2050 period, a loss of about 16%. In the **high-growth** scenario, the comparable figures are 901 million hectares, a loss of about 23%. The fastest rate of forest loss occurs in Africa, where forest area declines at an average of 6 million hectares per year between 1995 and 2050 in the **high-growth** scenario.

In contrast, under the **policy reform** scenario, the decline in forest area in all developing regions is halted and then reversed, although forest areas do not return to their 1995 levels. This is achieved in part by increased agricultural imports in developing regions.

Deforestation and destructive logging eliminates or degrades forest ecosystems, makes watersheds more vulnerable to erosion and rapid run-off, and deprives forest-dependent populations of livelihoods and sometimes firewood. These impacts fall most heavily on low-income or subsistence communities and make it more difficult to achieve poverty reduction goals.

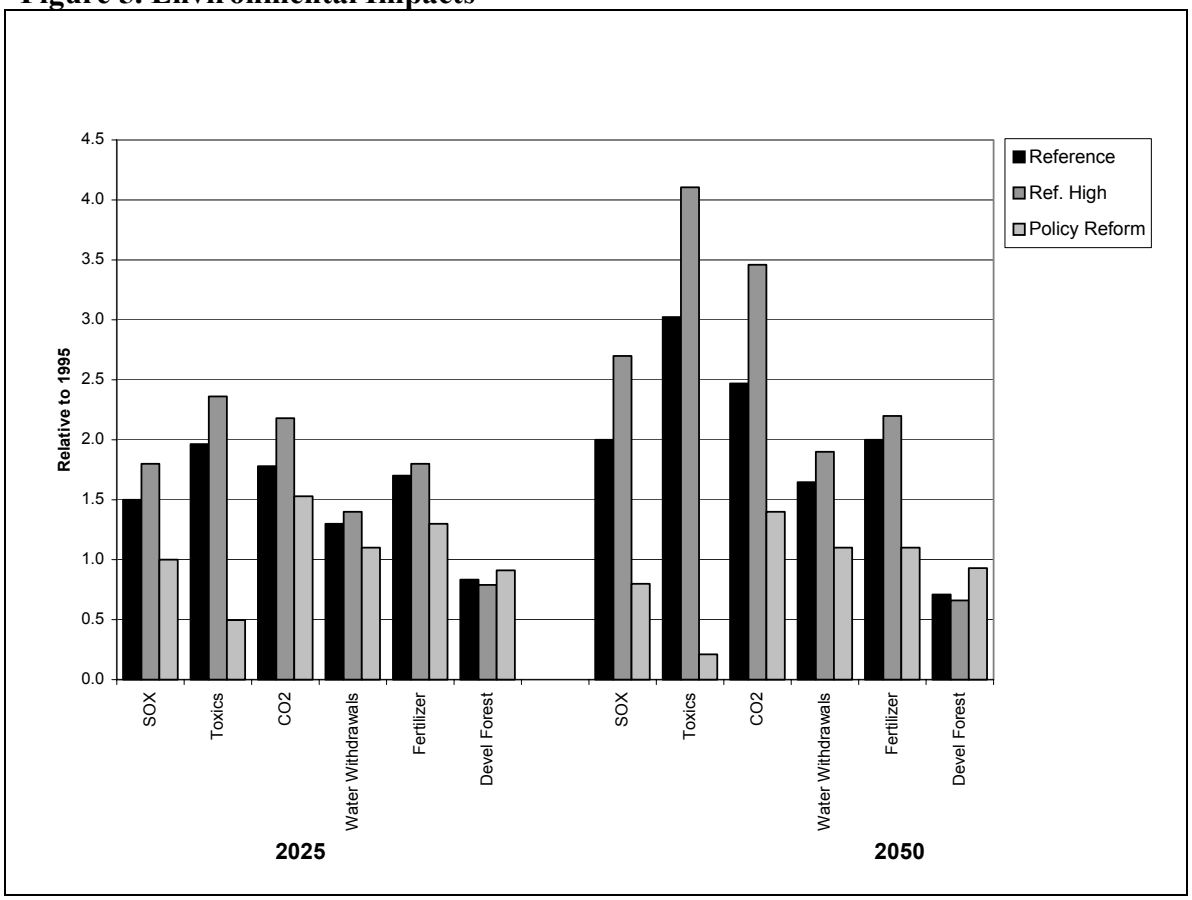
Measures of land degradation and marine over-fishing would also be important gauges of ecosystem degradation, but are not dealt with explicitly in the scenario. Qualitatively, however, rising demand for fish and hence escalating pressure on marine ecosystems is a feature of both the **reference** and **high-growth** scenarios. Growing use of nitrogen-based fertilizers to meet food demand in both these scenarios adds to the potential for run-off and estuarine eutrophication, which add to degradative pressures on the fisheries. Just as with deforestation, rising prices for fish or the outright collapse of fisheries has the greatest impact on dependent populations and conflict with poverty reduction goals.

3.4. Summary of Environmental Impacts

Neither the **reference** nor the **high-growth** scenario are consistent with the goal of environmentally sustainable growth. Local pollution, freshwater scarcity, and ecosystem degradation escalate in both scenarios, with the impacts greater under the high-growth

scenario. Moreover, these environmental impacts have potentially significant human and economic impacts that could undercut economic growth and the poverty reduction goal. However, environmental degradation is not an inevitable outcome of poverty reduction efforts, as the **policy reform** scenario illustrates. With some narrowing of income distributions the hunger reduction targets can be met at lower average income growth rates, although in the absence of other factors higher overall living standards can be expected to increase total consumption to some degree. With an assumption of focused policy attention on social and environmental issues, relatively high economic growth rates can be accompanied by a reduction in environmental impacts, as resource use efficiencies increase and consumption patterns shift in response to the policies introduced. Figure 5 summarizes the environmental impacts analyzed here for all scenarios.

Figure 5. Environmental Impacts



4. Regional Trade Patterns

The reference and high growth scenarios imply a number of changes in trade patterns, with some regions becoming larger importers. In this section we analyze these patterns for energy and agricultural commodities.

Energy consumption in the **high-growth** scenario increases substantially faster than in the **reference** scenario, consistent with higher income levels. The volume of trade increases correspondingly. In both scenarios North America is the most significant importer of crude oil, increasing from around 3 billion barrels of oil in 1995 to around 12 billion barrels of oil by 2050. The most significant change between these scenarios, however, is in the energy import requirements for the South and Southeast Asian regions, where the substantially higher demand for crude oil leads to a doubling of crude oil import requirements. Reserves of conventional sources of crude oil—including both proved reserves and the estimated additional reserves available—become depleted over the course of the scenarios to meet the rising demand. Import demands are met by the Middle East, Latin America, China+ and Africa. Exports from China+ and Africa grow considerably over the course of the scenarios.

Coal import requirements are met primarily from the Pacific OECD region. Over the course of the scenario the Pacific OECD region outstrips North America as the most significant coal exporter. The most significant importer is South Asia, where import requirements deepen significantly over the course of both scenarios, but at a much higher rate in the **high growth** case. The increase is due both to increased coal consumption for electricity generation and, to a lesser extent, growth in the industrial sector and an associated rise in industrial coal demand.

Patterns of trade in natural gas are similar in both scenarios, but the total volume of trade is much larger in the **high-growth** case as energy requirements in importing countries rise with increasing incomes. The Former Soviet Union and the Middle East remain the most important exporters throughout the scenarios. In the **reference** scenario North America is the most important importer, and remains the dominant importer in the **high-growth** scenario. However, requirements for natural gas in Western Europe, China+, South Asia and Southeast Asia rival those of North America by 2050.

In 1995, the major crop exporting regions were Latin America and North America. In North America grains are the main export, amounting to nearly 100 million tonnes, while in Latin America other crop commodities dominate, with total exports exceeding 100 million tonnes. The most significant importer in the base year is the Former Soviet Union, which imports around 100 million tonnes of crop commodities, mostly grains. In both the **reference** and the **high-growth** scenarios, North America and Latin America remain the most important exporters. Eastern Europe and the Former Soviet Union also become important exporters as these regions rebound from the collapse during the 1990s. Western Europe and Southeast Asia also become important exporters as these regions expand grain production and other crop production respectively to meet the rising global demand.

Agricultural trade patterns are substantially the same in both scenarios, but the total volume of trade is larger in the **high-growth** case, consistent with the higher income levels. Grain import requirements grow substantially in developing regions in both scenarios to supply increasing demands for both food and feed, as populations grow and

diets improve. The increase in caloric intake is accompanied by a shift toward animal products in diets, with the result that feed requirements for grains increase more quickly than requirements for food. In the **reference** scenario, worldwide feed demand for grains increases from 38% of total requirements in 1995 to 43% in 2050. In the **high-growth** scenario the increase is slightly greater, with feed requirements in 2050 amounting to 51% of total grain requirements. The most substantial increases in imports occur in Africa, South Asia and the Middle East, with more modest changes in Pacific OECD. In China+ and both South and Southeast Asia, the regions remain net exporters of rice, the most important food grain. However, increasing use of other grains in diets and demand for feedgrain leads to increasing net grain imports in these regions.

Global demand for fish and other seafood increases from around 110 million tonnes in 1995 to around 160million tonnes in 2050 in the **reference** scenario. In the **high-growth** scenario demand increases to over 180 million tonnes in 2050. Considering the current yield from marine resources, which are already overtaxed, of about 85 million tonnes, and assuming this yield to continue in the scenario, the level of demand implies substantial expansion of aquaculture, which adds either to the agricultural requirements for feed or to increased exploitation of pelagic fish for fishmeal.

5. An Alternative to Growth

Economic growth is an essential element of any strategy to reduce poverty, but as the previous sections have shown, rapid growth id unlikely by itself meet the Bank's social goals. Moreover, the analysis suggests, rapid growth by itself is likely to sharply increase environmental pressures in ways that create significant threats to human health while also degrading the natural resource base (water, soils, forests) on which economic development – especially in the poorer parts of agrarian societies – in large part depends.

The policy reform scenario elucidates the requirements for simultaneously meeting social and environmental goals – for achieving significant poverty reduction and environmentally sustainable growth. As a normative scenario, it explores not the forecaster's question – "where are we going?" – but rather that of the navigator – "how do we get there?" The strategies required to bend the curve of development in the direction mandated by the policy reform scenario include distributional policies aimed at improving social equity and sectoral policies – for energy, food, land, water, and wastes -- aimed at meeting environmental goals.

5.1. Meeting Social Goals

Average incomes will rise in developing countries, as long as GDP growth outpaces population growth. But because the economic pie is distributed unequally, poverty does not decline in proportion to GDP growth. In the policy reform scenario, despite vigorous economic growth, substantial improvements in equity within each country are required to lift the incomes of sufficient numbers of the very poor above the "hunger line." Only in this way can Bank poverty reduction goals be met. The scenario suggests that a strategy

of improving equity, through reforms in the policies governing distributional systems, are necessary if poverty eradication is a priority goal.

A wide range of distributional factors can be considered: the poor need more equitable access to education and health care, to credit, to employment and micro-enterprise opportunities, to legal protection, to improved land tenure. The rural poor who are dependent on natural resources such as subsistence farmers, fishermen, and shifting cultivators especially need more equal access to property rights and to participation in decisions affecting those resources. Specific policy instruments to influence distributional systems might include direct income transfers through tax or subsidy measures; targeted anti-poverty programs such as human capital investments in education, health care, and training of the very poor; social empowerment measures that reinforce the rights of women, minorities, and children; strengthening of new social actors by encouragement of community organizations and NGOs; legal measures to guarantee access of the poor to productive assets and opportunities through land tenure, technology transfer, targeted infrastructure investments, and broadened micro-credit access.

In an effective poverty reduction strategy, such measures cannot be afterthoughts but must become as central to national development strategy as the traditional macro-economic measures for fostering growth.

5.2. Meeting Environmental Goals

Even with equity improvements, however, poverty reduction goals are unlikely to be achieved if declining public health, shortages of freshwater, widespread land degradation, and similar environmental problems impoverish large segments of the population anew. It makes little sense, for example, to improve access to health care services while at the same time pursuing growth policies that dramatically worsen air and water pollution and exposure to toxic substances. Nor does land tenure help the rural poor if water supplies run so short that farmers cannot irrigate their fields. Unattended environmental concerns, in short, can undercut the benefits and even the sources of economic growth, especially for the most vulnerable segments of populations. A strategy of environmentally sustainable growth is thus likely to be necessary to meet both social and environmental goals. Such a strategy requires sector-specific policies in a wide range of sectors if countries are to head off serious long-term problems.

5.2.1 Pollution and Health. In the reference and high-growth scenarios, increases in energy demand lead to sharp increases in combustion of fossil fuels and hence to worsening air pollution. Similarly, overall growth of industrial activity significantly increases use of chemicals, metals, and other toxic materials, leading to increased toxic pollution. Such pollution problems are already sources of ill-health—and accompanying social and economic burdens--in the urban areas of virtually all rapidly-industrializing countries. The prospect of significant increases in pollution would pose even more health risk.

The policy reform scenario incorporates policies to improve energy intensity and reduce final demand through greater energy efficiency in both energy production and end-use applications, as well as policies to encourage fuel switching to cleaner and less carbon-intensive fuels. One lever for change is fiscal mechanisms such as eliminating perverse subsidies, carbon or pollution taxes, and emissions-trading schemes. Regulatory approaches include setting progressively more stringent energy efficiency standards. Other levers include increased research, economic incentives to spur investment in energy-efficient and renewable energy technologies, and efforts to lower market barriers through better information and stronger institutional frameworks. The policy reform scenario also incorporates regulatory controls on toxics (such as phasing out leaded gasoline), incentives for investment in cleaner industrial process equipment and for recycling of wastes into resource streams, and disclosure or rating laws (such as those adopted in Indonesia) that provide other kinds of incentives for better private sector stewardship.

These policies are not easy to implement in developing countries, but they pay high dividends, not only in lowered health risk but also in more efficient economies and better use of scarce capital resources.

5.2.2 Water and Food Security. In the reference and high-growth scenarios, water withdrawals increase dramatically, exceeding sustainable limits in many countries and water basins. By 2050, in the reference scenario, more than 50 % of the world's population live in areas experiencing some form of water stress. The resulting heightened competition for water is likely to threaten valuable ecosystems and habitats that depend on an adequate supply of clean water; it may also limit the availability of water for irrigation, since urban and industrial users usually can pay more and have greater political clout. Increasing pollution of both surface and groundwater supplies increases the potential for serious water scarcity. The result could be serious environmental and social problems, undercutting efforts to reduce poverty and increase food security.

In the policy reform scenario, demand for water is moderated through efficiency improvements, resource enhancement, and increases in agricultural trade. Opportunities for increasing irrigation efficiency are numerous: spray irrigation can be replaced by trickle and drip systems; open canals can be covered; and perverse subsidies for water use (or for the energy to pump water) can be eliminated. Tighter plumbing codes and more water-efficient appliances in the domestic sector, and water recycling in the industrial sector, can also help. In some regions, these measures will not be enough: desalinization in coastal areas and capture and reuse of treated wastewater can amplify resources. Ultimately, water will have to be priced to reflect its full economic and environmental value. In some regions, reducing demand by increasing food imports may be an advantageous strategy.

5.2.3 Land Use and Ecosystem Services. These scenarios model land use changes, but do not explicitly treat land degradation and the potential impact on ecosystem services. But the qualitative picture is fairly clear. Current trends toward widespread land degradation,

increasing clearing and over-harvesting of forests, over-grazing of pasture and rangeland, and unsustainable agricultural practices are likely to be continued or exacerbated under the reference and high-growth scenarios. The result could undercut poverty reduction efforts, because many of the very poor are directly dependent for their food supply and livelihoods on the productivity of farmlands, forests, and fisheries. But the true cost is likely to be greater, because degraded ecosystems can no longer provide many vital services, ranging from the water storage and flood control capacities of forested watersheds to nutrient recycling and detoxification of wastes to the generation and renewal of soil fertility to the control of pest species. Without these services, society will have to bear increased costs for erosion damage to downstream dams and fisheries, for water storage and purification, and for flood damage and pest control. Thus a strategy of environmentally sustainable growth will need to institute policies that can manage land sustainably and protect the ability of ecosystems to provide a wide range of goods and services.

5.3. Strategic Implications for the Bank

This analysis argues that focused policy efforts to improve equity and ensure environmentally sustainable growth are both essential to achieve Bank poverty goals, because of the close interlinkage of environmental conditions and poverty. A host of sector-specific policies are also likely to be required to achieve environmental goals. The implication is that distributional and environmental policies need to be at the center of country assistance strategies—that macroeconomic policies aimed at fostering economic growth, while important, are not sufficient to achieve Bank goals.