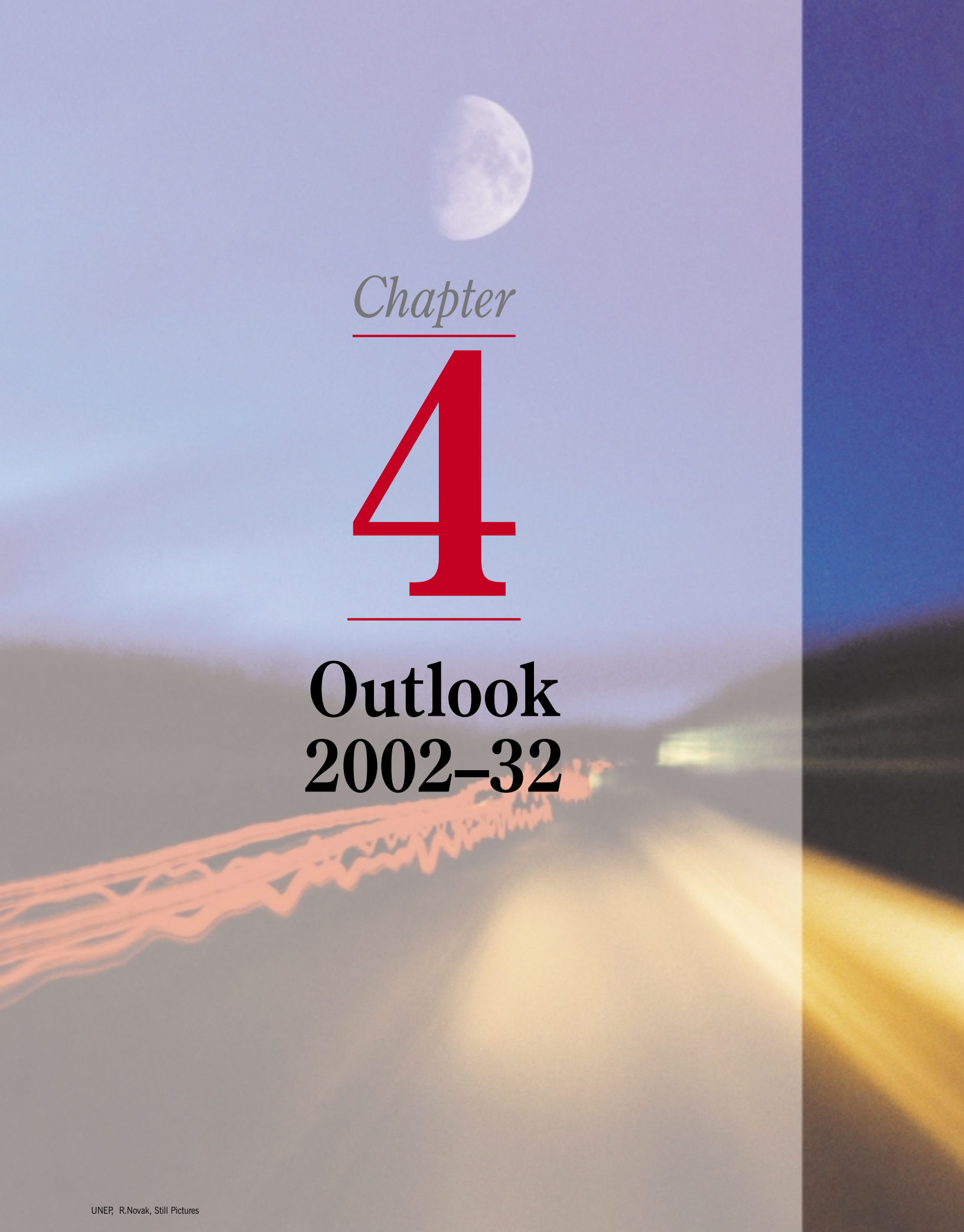


Chapter

4

Outlook 2002–32

UNEP, R.Novak, Still Pictures

The record of the past three decades shows how tricky it can be to foresee the future course of events on such a time scale. Enormous social, economic and political changes have shaped and transformed present-day realities over that period, not least the oil crises of the 1970s, the end of China's isolation and the collapse of the Soviet system, that were not — and perhaps could not have been — predicted.

Some aspects of modern life might have been foreseen in general terms, by extending such long-term trends as reduction in trade barriers, continual technological innovation and the growing role of the service sector. Following the 1972 Stockholm Conference, the emergence of a worldwide environmental movement might have been anticipated and hoped for. But few, if any, recognized the major regional and global issues such as acidification, stratospheric ozone depletion and climate change, which have driven much of the action in recent years.

Moving into the future means travelling into uncharted waters. Some of the way ahead is clear but there is much that cannot be mapped out, even with advanced technologies. As before, there will be challenges that can be prepared for but others that will seem to materialize from out of the blue.

'The record of the past three decades shows how tricky it can be to foresee the future course of events on such a time scale.'

How shall we proceed as a society? By placing faith in further globalization and liberalization, trusting primarily in the market economy to solve wider social and environmental concerns? Or by putting policy first, whereby coordinated action to solve social and environmental problems balances the drive for economic development? If and when troubles arise, will everyone work together to address these threats, or will groups that are better off focus on self-protection, creating fortress conditions that increasingly exclude the 'have-nots'? Or could a more visionary state of affairs emerge, where radical shifts in the way people interact with one another and with the world around them stimulate and support sustainable policy measures?

There is no knowing which of these — or other — possible futures will actually unfold over the next 30 years. Much of what will happen has already been set in motion by policy decisions and actions that have already been taken. Uncontrolled forces, both human and natural, will contribute to the course of events. But informed decision-making also has a real and vital role to play in the process of shaping the future.

Scenario analysis can make a difference to this process. By exploring an array of possible future scenarios, today's decision-makers can get a clearer picture of what tomorrow might bring in terms of human well-being and environmental security and what the impact of their decisions is likely to be. And they can determine more accurately what it would take — and what they can do — to create a more desirable future.

Scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out and what new factors will come into play. Since it emerged as a formal methodology in the middle of the past century, scenario analysis has evolved swiftly as a tool for anticipating the future. It is now generally accepted that scenarios do not predict. Rather, they paint pictures of possible futures and explore the differing outcomes that might result if basic assumptions are changed. Hence the relevant question that scenarios can answer is not what will happen but what might happen and how people could act to encourage or counteract particular events and trends. As a way of exploring the unknown, scenario analysis can result in surprising and innovative insights.

The scenarios developed for *GEO-3* have an environmental focus but recognize that the environment cannot be discussed without also considering what may be happening in the social and economic spheres. The scenarios therefore span eventualities in many overlapping areas, including population, economics, technology and governance. Moreover, though many issues are of global concern, some take on special relevance or sharper focus when viewed at a regional or smaller scale. To take account of this effect — and so that each can enrich the others — this chapter presents both global and regional perspectives. In addition, the role of policy choices in shaping the future is highlighted in the scenarios wherever possible, although this influence can be hard to judge because other policies and independent developments may cloud the effects of any single policy.

Drawing on the experience and work of other scenario initiatives, including those of the Global Scenario Group (Raskin and Kemp-Benedict 2002), a set of four scenarios has been developed for *GEO-3*.

The *Markets First* scenario envisages a world in which market-driven developments converge on the values and expectations that prevail in industrialized countries;

In a *Policy First* world, strong actions are undertaken by governments in an attempt to reach specific social and environmental goals;

The *Security First* scenario assumes a world of great disparities, where inequality and conflict prevail, brought about by socio-economic and environmental stresses; and

Sustainability First pictures a world in which a new development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions.

For each of these scenarios, an overall narrative — 'A tale of four futures' — describes the future in the next 30 years in a predominantly qualitative manner, providing both regional and global perspectives.

The stories of the four scenarios are followed by a more detailed examination of their environmental implications, drawing on quantitative data derived from a number of analytical tools — and with a regional focus intended to highlight particular concerns in the different regions. A brief comparison of qualitative and quantitative approaches is provided in the box. For more details of the *GEO-3* scenario analysis, see the technical annex to this chapter (page 398).

Narratives or numbers?

Scenarios can be told in many ways. The two most common methods used in scenario analysis have been descriptive, written narratives (qualitative scenarios) and tables and figures incorporating numerical data, often generated by sophisticated computer models (quantitative scenarios). Both approaches have strengths and weaknesses and their relative worth has been much debated.

- Qualitative scenarios can explore relationships and trends for which few or no numerical data are available, including shocks and discontinuities. They can more easily incorporate human motivations, values and behaviour and create images that capture the imagination of those for whom they are intended.
- Quantitative scenarios can provide greater rigour, precision and consistency. Their assumptions are explicit and their conclusions can be traced back to the assumptions. The effects of changes in assumptions can be easily checked, pointing to important uncertainties. They can provide order-of-magnitude estimates of past, present and future trends in, for example, population growth, economic growth or resource use.

In *GEO-3,* qualitative narratives take centre stage with the quantitative tools playing a supporting role.

The chapter concludes with 'Lessons from the future', a discussion of important lessons arising from the scenario analysis for future environmentally relevant policy development. Before embarking on the journey through these four possible futures, however, it is useful to know the key assumptions made in constructing them and how these act as driving forces behind the scenarios. These assumptions are therefore outlined in the next section.

UNEP, M Rogers, Bolivia, Still Pictures

Driving forces

Earlier chapters of this report have reviewed present conditions and trends in a number of socio-economic factors that are driving environmental change. How these factors evolve will shape global and regional development and the state of the environment far into the future. Trends may continue as they have in the past or change speed and direction — perhaps even going into reverse. Trends may lead to convergence or divergence between circumstances in different regions of the world. Trends in one region or responses to one driving force may oppose others that originate elsewhere, or they may run up against absolute physical limits.

The scenarios explored in the pages that follow are based on certain assumptions about how these driving forces will evolve and interact with developing situations, potential future shocks and human choices. This section briefly describes the assumptions made about driving forces underlying the scenarios and, in particular, how these assumptions differ from scenario to scenario. For descriptions of the scenarios see pages 329, 334, 339 and 344 in the next section.

The seven driving forces under consideration are demography, economic development, human development, science and technology, governance, culture and environment. The environment is

included as a driving force because it is more than a passive receptacle for change. Just as the assumptions about human and societal behaviour shape the scenarios, so do the assumptions about pressures exerted by the environment.

Developments arising from each of the driving forces will not unfold in isolation from one another. Issues will interweave and chains of cause and effect are likely to be hard to trace back to individual sources. Finally, any number of possible future trends could be constructed from the available array of variables. Narrowing down this range to a small yet richly contrasting set of futures that are consistent, plausible, recognizable and challenging, depends on starting out with an intelligent set of assumptions.

Demography

Population size, rate of change, distribution, age structure and migration are all critical aspects of demography. Population size to a great extent governs demand for natural resources and material flows. Population growth enlarges the challenge of improving living standards and providing essential social services, including housing, transport, sanitation, health, education, jobs and security. It can also make it harder to deal with poverty.

Rapid population growth can lead to political and social conflict between ethnic, religious, social and language groups. Increases in the numbers of people living in towns and cities are particularly important because urbanization means big changes in lifestyle, consumption patterns, infrastructure development and waste flows. Population structure — the relative proportions of children, persons of working age and elderly people within a population — has important repercussions for future population growth as well as for matching the provision of education, healthcare, incomes and pensions, to predicted needs. Finally, internal and international migration, whether voluntary or forced, can sometimes ease and sometimes worsen the pressures that other demographic factors and other forces place on society and the environment.

Because so many of the people who will have children over the next 30 years have already been born, much can already be said about population over that period. All of the scenarios assume continued growth in global population, tailing off at the end of the period as more countries pass through the demographic transition. Nearly all the growth occurs in developing countries, with North America the only developed region with noticeable growth. Slightly lower population levels are foreseen in *Policy First* and *Sustainability First*, reflecting the idea that policy actions and behavioural changes speed up the transition to slower growth. In *Security First*, lack of effective policy as well as much slower economic and social development, combine to slow down the transition. This leads to significantly higher population levels in this outlook, regardless of devastating demographic trends or events such as the HIV/AIDS pandemic in Africa that might be expected to have the contrary effect.

Urbanization increases or remains stable in almost all regions in all the scenarios, with the greatest increase in those regions currently least urbanized — Africa and much of Asia and the Pacific. In all regions, much of the development occurs in large coastal cities, a shift with serious implications for the coastal environment.

Apart from the Antarctic sub-region, which has no permanent resident population, current and future population structure differs markedly from region to region. North America, Europe and Japan have significantly larger shares of elderly people, a pattern that persists and increases in all scenarios. This trend is less marked in *Security First*, where advances in medical science (and hence in life expectancy) make less headway in all regions. Other areas, particularly Africa, West Asia, Latin America and the Caribbean and South Asia, are dominated by youth. Their share of the population in these regions — but not their absolute population size — gradually decreases over the next 30 years in all scenarios.

'North America, Europe and Japan have significantly larger shares of elderly people in all scenarios.'

In terms of migration patterns, *Markets First* and especially *Security First* are likely to have more conflicts and inequality, provoking more and more movements of refugees and economic migrants. Whereas more openness is assumed under *Markets First*, barriers to migration are expected in *Security First*. *Policy First* and *Sustainability First* also assume more open migration, especially for refugees and

displaced communities. At the same time, more equitable sharing of resources for economic development and international assistance reduce the need for migration.

Economic development

Economic development encompasses many factors, including production, finance and the distribution of resources both between regions and across sectors of society. Although the pattern varies conspicuously, there has been a general trend towards more service-based economies. Product, financial and even labour markets are becoming increasingly integrated and interconnected in a worldwide economy with global commodity chains and financial markets. Similar trends are appearing at a regional level in several parts of the globe. These processes have been spurred on by advances in information technology, international pacts designed to remove trade barriers or liberalize investment flows and the progressive deregulation of national economies. The same advances have also allowed wealth produced by national and transnational mergers to become concentrated in fewer and fewer hands. There has also been an increase in inequality in terms of income and resource use across — and often within — nations. For many nations the problem of inequality is made worse by debt burdens that seriously constrain growth. As transnational enterprises respond to global business opportunities, the traditional prerogatives of the nation-state and the capacity for macro-economic intervention by the state are challenged anew.

'For many nations the problem of inequality is made worse by debt burdens that seriously constrain growth.'

In *Markets First*, it is assumed that most of the trends noted above persist, if not accelerate. Economic development outweighs social and environmental concerns in most international discussions. Resistance continues but no radical changes in policy result. Recognition that maintenance of environmental and social conditions is important for ensuring economic development slows economic growth down over time, but not very noticeably.

In *Security First*, trends towards global integration continue for some parts of the economy, yet come to a halt or even go into reverse for others. Over time, more and more activity takes place in the grey or underground economy.

Integration trends persist in *Policy First* and *Sustainability First* but they are tempered by the introduction of new policies and institutions to tackle social and environmental concerns. This reflects improved understanding of the crucial roles of human, social and natural capital in determining economic health. Changes in attitudes and behaviour in *Sustainability First* affect these trends more than in the other scenarios as the whole notion of economic development becomes increasingly subsumed in the broader concept of human development.

The effect of these changes on per capita income varies strongly across regions and scenarios. Average income growth in all regions is lowest in *Security First* but also very unevenly distributed due to the greater inequality within regions. In the other scenarios, average growth at the global level is similar but there are key differences between and within regions. In *Policy First*, the more equable distribution of growth makes average incomes of the wealthy grow slightly slower than in *Markets First*, whereas incomes rise more rapidly among the poor. The most dramatic increases in income growth are seen in Africa, but also in parts of Latin America and the Caribbean, Asia and the Pacific, and West Asia. The convergence in per capita incomes is even greater in *Sustainability First*, especially as wealthier persons shift their emphasis away from market-oriented production and consumption. However, large differences remain at the end of the 30-year period.

Human development

Health, education, security, identity and freedom are aspects of human development that are all clearly related to economic development, yet go well beyond it. Dramatic differences in access to these important human needs are a feature of the contemporary global scene. Impoverishment and inequity are critical problems for the poorer countries but conspicuous pockets exist even in the richest countries. As the world grows more interconnected, these forces affect everyone directly or indirectly, through immigration pressure, geopolitical instability, environmental degradation and constraints on global economic opportunity.

The United Nations, World Bank, International Labour Organization (ILO) and International Monetary Fund (IMF) recently set out specific international development goals for poverty reduction, universal primary education, gender equality, infant and child mortality, maternal mortality, reproductive health and the environment. Achieving these goals depends on: 'Stronger voices for the poor, economic stability and growth that favours the poor, basic social services for all, open markets for trade and technology, and enough development resources, used well' (IMF and others 2000).

Among obstacles to achieving these goals are: 'weak governance; bad policies; human rights abuses; conflicts; natural disasters, and other external shocks. The spread of HIV/AIDS. The failure to address inequities in income, education and access to health care, and the inequalities between men and women. But there is more. Limits on developing country access to global markets, the burden of debt, the decline in development aid and, sometimes, inconsistencies in donor policies also hinder faster progress' (IMF and others 2000).

Policy First and *Sustainability First* place emphasis on meeting basic needs and providing the resources to meet them, even where this may hinder short-term economic growth. In *Sustainability First*, relatively more of the provision of basic needs comes from groups outside the public sector, both businesses and nongovernmental organizations.

In *Markets First*, these issues are not addressed to the same extent, as it is taken for granted that economic development naturally leads to social improvement. In addition, more of the facilities that have traditionally been provided as public services are privatized. These trends are even more pronounced in *Security First*, accompanied by greater inequality in terms of access. Where new funds, whether public or private, are invested in development, physical security increasingly takes precedence over social welfare.

Science and technology

Science and technology continue to transform the structure of production, the nature of work and the use of leisure time. Continuing advances in computer and information technology are at the forefront of the current wave of hi-tech innovation. Biotechnology galvanizes agricultural practices, pharmaceuticals development and disease prevention, though it raises a host of ethical and environmental issues. Advances in miniaturized technologies transform medical practices, materials science, computer performance and much more.

The importance of science and technology extends beyond the acquisition of knowledge and how it is used. Continuing concerns over the distribution of the benefits and costs of technological development provoke much national and international debate. Such concerns include technology transfer, intellectual property rights, appropriate technologies, trade-offs between privacy and security, and the potential for information-poor countries to find themselves on the wrong side of a 'digital divide'. The ultimate resolution of these matters influences the future development of science and technology, as well as their impacts upon society and the environment.

'In Markets First, it is assumed that the rapid technological advances of recent years continue, but are increasingly driven by profit motives.'

In *Markets First*, it is assumed that the rapid technological advances of recent years continue, but are increasingly driven by profit motives. Over time this may actually slow down development as basic research is given less priority. Technology transfer, intellectual property rights and other issues are tackled, but mainly to the advantage of those with greater power in the marketplace. Environmental benefits largely come about as side effects of efforts to improve the efficiency of resource use. These patterns are even more pronounced in *Security First*, where — in addition — the diversion of more and more public funding into security provision, coupled with social, economic and environmental crises, means slower progress all round.

Rapid advances in science and technology are also assumed in the *Policy First* and *Sustainability First* scenarios, but these are driven by different factors. Direct investment by governments, subsidies and regulation — for example, pollution taxes — play a dominant role in *Policy First*. In *Sustainability First*, these levers are overshadowed by changing preferences of both consumers and producers. In both scenarios, greater caution on the part of governments

and society at large may slow technological development in some areas, but it also helps to head off serious side effects. Greater efforts are also made to share the benefits of science and technology.

Governance

Governance refers to actions, processes, traditions and institutions by which authority is exercised. It is most often associated with governmental bodies at the national level and with regional or global institutions such as the United Nations, but this need not always be the case. Private institutions, such as corporations and non-governmental organizations, also play an important role in governance. In all cases, developments that affect participation, accountability, transparency, corruption and civil strife have an important influence on the shape of the future.

Although the forms and effectiveness of governance differ markedly around the world, various tendencies can be identified. One tendency is towards greater individual autonomy and the devolution of authority. This shift is expressed at the personal level in terms of a growing emphasis on individual 'rights' — human rights, women's rights and the like. It is also noticeable in the devolution of governmental authority to smaller and more local units and in separatist movements. The private sector, too, has moved towards 'flatter' corporate structures and decentralized decision-making. A second and somewhat opposite tendency is towards forms of greater regional integration and global governance through such mechanisms as international trade and environmental agreements. Another tendency is towards greater integration and the growth of networks within and across private and public institutions. This is seen, in part, in the rise of global public policy networks and the emergence of civil society as an important voice in decision-making in many regions.

'In Policy First, continual movement towards greater coordination is assumed ... in pursuit of a broader agenda.'

In *Markets First*, present trends are assumed to continue but with heavier emphasis on ensuring the smooth functioning of markets. Efforts are focused on the development of international institutions which encourage free markets for resources, finance and products. In *Policy First*, greater coordination is assumed, particularly at the level of international governance. This includes the development of new institutions and more cooperation between the public and private sectors. Significantly, these changes are driven from the top, by governments, corporations or large non-governmental organizations (NGOs).

In *Sustainability First*, the shifts in governance are assumed to be driven much more from the bottom up. Reflecting the changing values and making use of the trends towards greater participation in general, individuals and grass-roots organizations become more and more involved in setting the agenda, a lead that larger organizations then follow. Governments continue to govern but do so in a fashion that involves more power sharing.

As with much else in the *Security First* scenario, assumed trends regarding governance differ over time and across groups more than in the other scenarios. Corruption, ineffective governance and reactions against both, contribute to breakdown in parts of society. As societies regroup, governance among the 'haves' is assumed to become more centralized and autocratic, but largely effective. International co-ordination also bolsters the relative stability of these groups. Among the 'have-nots', the nature and effectiveness of governance is mixed.

Culture

Culture includes the set of values and institutions that enables a society to develop and maintain its identity. Cultural signatures differ around the globe and reflect, for instance, conflicting ideas about the worth of economics as an integrating system of values or about the importance of technology and technological change as springboards for human progress. They also hinge on differing concepts of justice and fairness, and on differing beliefs about the relationship between people and the natural and spiritual world.

Recent history, particularly where racism, colonialism and genocide have occurred, cannot be overlooked. Much has been said about the expansion of Western culture to the detriment of others, about reactions to this spread and about possible clashes of civilizations as a result. It is clear that many individuals aspire to Western lifestyles, while others see Western values permeating societies and

associate them with selfish individualism and excessive consumption. This spread is both a cause and an effect of economic globalization, aided by the far-reaching penetration of information technologies and electronic media. At the same time, there have been clear signs of nationalist and religious reaction against it, sometimes resulting in terrorist activities and in open warfare within or between nations.

Among the four scenarios, *Sustainability First* assumes the largest shift from current trends in terms of culture. The ascendance of the values of solidarity, reciprocity, sufficiency and stewardship is at the heart of this scenario. To the extent that these core values are not violated, tolerance is also a key aspect of culture in this scenario. In *Markets First*, little change in current trends is assumed. As befits the basic notion of a market, the trend towards individualism accelerates, as does a trend towards homogenization of culture. At the same time, so do passive and active resistance by particular groups and regions. In *Security First*, these and other trends lead to clashes that undermine many elements of society. *Policy First* assumes a middle path between *Markets First* and *Sustainability First*; efforts to encourage some of the trends of the latter compete with tendencies to follow the trends of the former.

Environment

Though the focus of this section is on the importance of socio-economic change in triggering environmental impacts, it is clear that environmental change is a potent driving force in its own right. Countries and regions must contend not only with unequal environmental endowments, but also with acute environmental problems. Human impacts on the environment have aroused growing anxiety. Atmosphere, land and water resources have been spoiled. Persistent organic pollutants and toxic substances have accumulated in living organisms.

'Among the four scenarios, Sustainability First assumes the largest shift from current trends in terms of culture.'

Species have been lost and ecosystems degraded. In addition, social and ecological systems are vulnerable to natural and human-influenced hazards and catastrophes.

The way natural systems react to these pressures (the rate, for instance, at which climate patterns change as a result of higher concentrations of greenhouse gases, or the response of coastal ecosystems to pollution), can have a big impact on social, economic and other natural systems. The realization that individual states cannot shield themselves from environmental change is already changing the basis of geopolitics and global governance.

The scenarios presented here do not differ greatly in their assumptions about the environment as a driving force. Most significantly, it is assumed that natural systems are in a more fragile condition in *Security First* than in the other scenarios. This implies that ecosystem collapses and curbs on the capacity of certain natural systems to provide goods and services are more likely, even when facing the same pressures. In *Policy First* and especially in *Sustainability First*, the values of stewardship and caring for the environment play a greater role in guiding science, technology and governance, as well as in shaping economic and social development.

UNEP, V Bugaldon, Still Pictures

A tale of four futures

The turn of the 21st century was an opportunity to reflect on the past and speculate about the future. This milestone not only heralded the beginning of a new millennium but also marked more than 50 years of several key global institutions, not least the United Nations and World Bank.

Events at regional level also provide much food for thought. The countries of the European Union (EU) face the possibility of membership nearly doubling in one or two decades, spurred on by the end of the Cold War and the collapse of the eastern bloc. In Africa, the relatively peaceful end of apartheid in South Africa and the transition from military to civilian rule in Nigeria have changed the political climate. These turnabouts in the continent's two most populous countries open the door for new debate on how to solve Africa's persistent problems, including civil wars, poverty, inequality and the AIDS pandemic. Political changes in Asia and the Pacific, notably in Indonesia and the Philippines, and the repercussions of the economic crisis in the late 1990s are stimulating fresh dialogue about the future of the region. In Latin America and the Caribbean, a period of relative stability has prompted increased willingness to address important issues inherited from the past. As they find themselves in the centre of some of the most publicized geopolitical events, the people of West Asia eye their future warily. Meanwhile, the recent economic slowdown and terrorist attacks have led many North Americans to reassess their actions at home and abroad to a degree not seen in decades.

'When sizing up prospects for the future, some find grounds for optimism but others are more apprehensive.'

At this time, the world is marked by tumultuous change. A global system seems to be taking shape as economic interdependence increases. Information technology accelerates the spread of ideas and the human transformation of nature becomes evident on a planetary scale. As economies grow, the rich get richer and many of the poor manage to escape from poverty. But huge disparities persist as vast wealth coexists with abject poverty and each extreme generates its own characteristic environmental pressures.

When sizing up prospects for the future, some find grounds for optimism but others are more apprehensive. In spite of potentially powerful anti-globalization forces, the optimists foresee the formation of a true global market and relish the opportunities for greater efficiency and connectedness. The pursuit of individual wealth on a global economic playing field made level by universal governance mechanisms to reduce market barriers can, they believe, open the way to a new age of affluence for all. If developing country institutions can be adapted to benefit from the new technologies and the emerging borderless economy, and if appropriate forms of global governance can be created, the rising tide of global prosperity will lift everyone to new heights of well-being.

Sceptics, looking at the same phenomena, see riskier times ahead. They point to wealth and power accumulating in just a few hands, especially those of transnational corporations. They see unequal expansion of modern production methods around the world, two-track development and stubbornly one-sided and manipulative approaches to global negotiations. The pessimists fear the result will be erosion of trust between the North and the South and between populations within both, ending up in a chronic inability to forge credible, legitimate and enforceable agreements on sustainable development. How, they wonder, can unbridled pursuit of economic growth be kept within environmental limits? Will market-driven global development, far from engendering a sense of participation in a common global society, tend instead to continue to split humanity into privileged and excluded, North and South, modernist and traditionalist factions? If the accelerated transition to a global economy fails to give institutions time to adapt, will community cohesion and democratic participation be sacrificed to it?

Many feel apprehensive, too, about the prospect that their children will inherit an impoverished and fragile world that is ecologically, socially and economically depleted. More fundamentally, some object to the encouragement of traits and lifestyles founded on individualism and greed, which they see emerging from this global consumer culture.

Markets First

Most of the world adopts the values and expectations prevailing in today's industrialized countries. The wealth of nations and the optimal play of market forces dominate social and political agendas. Trust is placed in further globalization and liberalization to enhance corporate wealth, create new enterprises and livelihoods, and so help people and communities to afford to insure against — or pay to fix — social and environmental problems. Ethical investors, together with citizen and consumer groups, try to exercise growing corrective influence but are undermined by economic imperatives. The powers of state officials, planners and lawmakers to regulate society, economy and the environment continue to be overwhelmed by expanding demands.

Several important initiatives pave the way for the major developments in the new century. The Doha round of negotiations within the World Trade Organization (WTO) — including its newest member, China — provides the legal basis for an expanded global trading system. Significantly, it has written into it a recognition that this system must take into account important social and environmental concerns, in addition to the core economic goals. A multilateral agreement on investment liberalizes investment regimes first in Organization for Economic Cooperation and Development (OECD) countries, with expectations that this will follow shortly throughout the world. The coalition against terrorism paves the way for new approaches to international security.

Meanwhile, efforts continue to salvage the climate negotiations, to build upon multilateral environmental agreements in other areas and to address important social issues. Much of this effort initially hinges on international activities, particularly the World Summit on Sustainable Development (WSSD) and follow-up activities, which galvanize a renewed commitment to action.

'Factors combine to make the shift to a liberalized, market-oriented society almost universal.'

This commitment revolves around a mixture of old and new initiatives designed to gain a better understanding of the issues that cause concern and to tackle them more effectively. Goals and targets related to basic needs (food security, access to clean water,

sanitation, literacy and life expectancy) and environmental conditions (urban air quality, availability of fresh water, resource use, waste disposal and habitat/species preservation) are reiterated. A commitment is also made to strengthen international institutions of governance.

The best laid plans …

Businesses and NGOs play an important role. The industry lobby argues for clear and economically efficient rules and regulations. It also points to the value of voluntary standards and programmes, such as the Global Compact and Global Reporting Initiative negotiated with the United Nations. The NGOs, along with some business groups, stress issues of equity and fairness for current and future generations, as well as respect for other species.

'Privatization spreads, social safety nets are reduced and reliance is placed on market-based approaches.'

Over the next decade there is a clear divergence in the follow-through on these various sets of activities. Barriers to trade and movements of capital gradually vanish, as protectionism becomes a thing of the past. New instruments promote market openness and global competition. Virtually all national governments advance a package of policy adjustments, including modernization of financial systems and investment in education to create a workforce that is competitive in the emerging global market. Privatization spreads, social safety nets are reduced and reliance is placed on market-based approaches.

There is still distrust of what is viewed as a typically Western mode of development, growing at times into outright hostility. Gradually, however, the shift to a liberalized, market-oriented society becomes almost universal. New technologies, particularly in the form of digital information and communication technologies (ICTs) continue to increase connectivity between different parts of the world. This is reinforced by the presence of multinational corporations, or at the very least their products, in many parts of the world.

Businesses benefit from liberalization and globalization, and increasingly operate across national borders. At an institutional level, international bodies maintain an important role in guiding economic and related policy in many countries, particularly those that are still burdened by high debt loads. At a personal level, more young people from around the world take the opportunity to travel and study in other countries. Taken together, these factors seem to imply that an air of inevitability surrounds the ongoing processes of globalization. How they play out, however, differs from region to region.

In Europe, a major focus is on the continuing project of broadening and deepening the EU. The extension of the EU to the east continues with a number of countries being added in waves of accession. Economic interdependence between nations continues to grow, along with widespread adoption of the Euro and harmonization of financial systems. Political union proceeds more slowly, however, as countries prove less willing to forgo their sovereignty in other areas. For example, although most nations are intent on cutting back social safety nets, there are differences over how far and how fast these cuts should be applied. Taxation is also a point of contention. Nevertheless, there is a general shift in governance away from the nation state, to higher as well as to lower levels. By the end of the second decade of the century, various regional bodies, some of which override national borders, play as large a role as some nation states.

Even as it struggles to deal with persistent conflicts and the AIDS pandemic, Africa pushes ahead with economic modernization and greater integration into the global economy. Shifts away from official development assistance towards foreign direct investment give multinational corporations more influence. At the same time, the influence of international organizations is maintained as efforts continue to restructure and pay off foreign debts. These efforts strongly shape the portfolio of economic investments, which continues to emphasize the production of exports. Regional cooperation, in the form of free trade zones and power pools, works to better integrate the continent. Similarly, transboundary collaboration is expanded in an attempt to deal in some areas with water conflicts, in others to pursue cross-border conservation and development initiatives.

Continuing dependence on oil throughout the world still provides a strong economic base for much of West Asia, the development of alternative energy sources and efficiency improvements having failed to make more than minimal advances. The strategic importance of the region increases as the world's remaining oil supplies become even more concentrated here and in nearby Central Asia and is a major reason why countries in other regions want to ensure stability in West Asia. Along with local traditions, oil dependence keeps the globalization process from proceeding as quickly in certain areas of society here by comparison with some other regions. Some countries in West Asia continue to grapple with foreign debt. The repayment process keeps moving forward, however, thanks to flexible conditions for debt restructuring. An Arab Free Trade Agreement is eventually reached.

In the Western Hemisphere, Latin America and the Caribbean become ever more economically integrated with North America. This development is spurred on by the assistance provided by the United States to Mexico in the 1990s and to Argentina and other nations in the 2000s, boosted by the interests of large corporations. It is also seen as a way to address, in part, the joint problems of an ageing and shrinking workforce in the United States and immigration from the south. Moves towards integration culminate in a Free Trade Area for the Americas (FTAA) in the middle of the second decade of the century. In the process, existing trade agreements like North America Free Trade Agreement (NAFTA), Commom Market of the South (MERCOSUR) and Caribbean Community (CARICOM), get absorbed under the FTAA umbrella. A number of nations go further, adopting the US dollar as a national currency.

In the Asia and the Pacific region, the recovery from the economic downturn of the late 1990s and from the decade-long recession in Japan, sees many countries return to the patterns of growth and degree of integration into the world economy they had previously experienced. To this are added the continued economic reforms in China and India, the two most populous nations in the world. With its accession into the WTO, China becomes a major world importer and exporter, eventually growing to rival the United States as the world's largest economy. The advances in technology coming out of Asia and the Pacific, the impact on corporations that set up facilities here and the increased exposure of its cultures all enlarge the role this region plays on the global stage.

… gradually go astray

While systems of governance and longer term planning remain poorly developed, the regional shifts described above modify relationships between regions and the concerted management of common resources. These resources are increasingly incorporated into the global economic system but authorities in charge of their management persist in putting economic potential first. In polar regions multinationals negotiate agreements, either with nations or, in the case of the Arctic, directly with indigenous populations. More areas and more resources (such as freshwater) are laid open to commercial exploitation.

'China becomes a major world importer and exporter, eventually growing to rival the United States as the world's largest economy.'

Developments in international security look still less promising. The United States falls back on a more unilateralist stance, involving only a limited number of partners. This encourages other nations and regions to continue development of their military forces. Thus opportunities for broad-based international cooperation are not pursued. Acts of terrorism are followed by periods of retaliation involving short-lived coalitions. This keeps the level of the problem fairly low in the short term, but does little to address the root causes of discontent in the long term.

Influenced by large national and multinational corporations based inside their borders, many countries adopt a fairly narrow approach to global negotiations, in which the paramount concern is the protection of their respective national interests rather than shared or common resources. Efforts to ratify a treaty to address climate issues drag on without fruition and are set aside part way through the first decade. There is more success in other arenas, such as dealing with selected persistent organic pollutants, but even here the scope of the agreements is limited and difficulties with enforcement mechanisms lead to disappointing results.

Actions continue to address social and environmental issues, but are mainly taken at local

level. Europe drafts regional conventions which deal primarily with transboundary pollutants and the burdensome environmental legacy of the former Soviet Bloc. Similar efforts arise in other regions, though not always resulting in formal conventions and even then many of the signed conventions are not effectively implemented. There are attempts to cross-link these instruments to trade and other economic agreements. When conflicts arise, however, it is the economic imperative that usually takes precedence. Most notably, the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the WTO tends to override competing pacts reflected in the Convention on Biological Diversity (CBD) and other multilateral environmental agreements. In Europe, the policy change that arguably has the greatest impact on the environment, the reform of the Common Agricultural Policy at the end of the first decade of the century, is pursued for primarily economic reasons.

The United Nations, other international bodies, NGOs and some businesses persist in their efforts to make advances on the goals set out in *Agenda 21*, at the WSSD and in other high-profile arenas. Nevertheless, without full commitment from its member nations and without fundamental reform, the United Nations continues to struggle to play the role many expect of it. It makes slow progress in international coordination on environmental and social issues. It scores moderate successes in peacekeeping and disaster relief efforts, which are called on more and more frequently as the years pass. However, the organization finds itself operating in a primarily reactive, as distinct from a proactive, mode. NGOs also find their efforts hindered by more powerful forces, including the steady ascendancy of individualistic over altruistic values in civil society and public life. When NGOs urge others to work for the common good, their appeals tend to be met with complacent apathy. NGOs that prosper tend to be those that adopt a more market-oriented approach or form partnerships directly with businesses, industry or both.

'Most advances in social and environmental arenas are by-products of efforts to improve economic development.'

Overall, most advances in social and environmental arenas are by-products of efforts to improve economic development.

Constraints are lifted ...

Throughout the world, cuts in subsidies to agriculture and the opening of trade in agricultural products modify the environmental impacts of agriculture. The use of debt-for-nature swaps and the outright purchase of debt for the right to exploit genetic resources contribute to the preservation of some natural areas, especially within tropical regions, while at the same time easing the debt burdens of these countries. Similar actions are taken to preserve natural or cultural heritage sites that also happen to be key tourist attractions.

Somewhat less directly, certain advances in technology and structural changes in economies produce environmental and social benefits, through improvements in efficiency. In transportation, the development and spread of more efficient and cleaner fuel burning vehicles, beginning with hybrid and moving towards fuel celled vehicles (with methanol as the carrier of hydrogen) curbs the increase in fossil fuel use. The growth in transportation is also tempered by continued progress in ICTs. More people now work from home.

Energy efficiency continues to improve as deregulation proceeds, opening up markets in micro-power developments. Micro-power becomes increasingly important in rural areas of the poorer regions, where the high cost of extending electricity grids has restricted the power supply network. Improvements in irrigation techniques and advances in desalination improve water use efficiency, particularly in West Asia and arid parts of other regions. Agriculture further benefits from progress in biotechnology, which increases yields and helps to reduce the pressure on ecosystem resources in many regions. Biotechnology also has positive effects in the areas of wastewater treatment. Advances in nano-technology improve materials use efficiency.

... but not for all

These developments, along with improvements in medical science and healthcare, enhance the lives of many. At the same time, these trends create new or intensify existing social and environmental concerns. Advances in biotechnology and genetic engineering,

both in combating disease vectors and creating hardier crops, open up areas of Africa and other regions to intensive exploitation by large-scale commercial agriculture and ranching. This jeopardizes both natural and agro-biodiversity and it leads to far worse land degradation than before, destroying harvests and livelihoods and driving even more people into poverty.

Improvements in information technology help draw attention to the vast differences between how different people live, often causing great frustration among the less well off. In the polar regions, resource exploitation speeds up as a result of technological advances and easier access due to climatic changes, putting ecosystems in those regions at greater risk. More use is made of hydropower resources in the Arctic, as well as in Asia and the Pacific, Latin America, parts of Europe, and Africa. Water is also transported over increasing distances to drier regions to cater to soaring demand. This trend is highlighted by the initiation of large-scale projects in the 2010s to move water from the Great Lakes and the Pacific Northwest to the arid regions in the southwest of North America. These steps are followed by similar efforts in Europe and parts of the Asia and the Pacific region.

At the heart of all these market-led concerns is a seemingly never-ending obligation on society to muster enough technological and structural progress to catch up with the skyrocketing demand for goods and services. Meanwhile, environmental conditions are constantly shifting. The effects of climate change are becoming clearer, particularly in the polar regions, in poorer countries and along the world's coastlines. Plans are already being made to evacuate some small island states. Other environmental changes, including imbalances in the nitrogen cycle and the continued dispersion of persistent organic pollutants, are also having their impacts, evidenced by the 'red tides' that hit the Mediterranean in the 2010s and the Indian Ocean in the 2020s.

Prolonged (though decelerating) population growth in Africa, West Asia and parts of Asia and the Pacific and increasing urbanization in almost all regions, aggravate problems such as biodiversity loss, water stress and the frequent breakdown of basic services. These are reflected, in turn, in persistent regional conflicts and migration pressures. As a consequence, the economic advances that have characterized the past few decades begin to slow noticeably. More and more effort is needed simply to maintain the achievements realized so far. Social and environmental goals, which are still in the minds of many even though other concerns have relegated them to the back seat, seem to be moving further beyond reach every year.

'The economic advances that have characterized the past few decades begin to slow noticeably. More and more effort is needed simply to maintain the achievements realized so far.'

What lies ahead?

By 2032, many of the same questions that were being posed at the turn of the century remain unanswered. The world has achieved much in terms of modernization and economic growth, presenting new opportunities for millions of people. Yet fundamental questions are still being raised about the sustainability and desirability of this pattern of development. Environmental standards continue to fall and pressures on resources remain severe, raising again the spectres of economic uncertainty and conflict. Social stresses threaten socio-economic sustainability as persistent poverty and growing inequality, exacerbated by environmental degradation, undermine social cohesion, spur migration and weaken international security.

Opinions differ as to where the world is heading. Depending on which indicators the observer chooses to focus upon, arguments can be made for either side. Many argue that the cases of breakdown already seen in some social, environmental and ecological systems portend even more fundamental and widespread collapses in the future. These same groups express particular concern that efforts have not been made to develop the institutions that will be needed to handle these predicaments. Others point out that we have been able to handle most of the crises we have faced and that there is no reason to assume we will not do likewise in the future.

Most people stick to their daily routines, leaving the big questions to others. *Plus ça change, plus c'est la même chose*; the more things change, the more they stay the same.

Policy First

Decisive initiatives are taken by governments in an attempt to reach specific social and environmental goals. A coordinated pro-environment and anti-poverty drive balances the momentum for economic development at any cost. Environmental and social costs and gains are factored into policy measures, regulatory frameworks and planning processes. All these are reinforced by fiscal levers or incentives such as carbon taxes and tax breaks. International 'soft law' treaties and binding instruments affecting environment and development are integrated into unified blueprints and their status in law is upgraded, though fresh provision is made for open consultation processes to allow for regional and local variants.

In the early years of the century, there are signs of a great desire and demand for coordinated leadership from the local to the global level, not only among governments, but also in industry and among NGOs and other citizens' groups. The terrorist attacks on the United States and the subsequent retaliation lend immediacy to the calls for policy reform to come to terms with economic, social and environmental concerns that many see as the root causes of these actions.

Renewing commitments

The award of the 2001 Nobel Prize for Peace to the Secretary General of the United Nations and to the family of organizations that he leads, highlights the renewed interest shown in systems of international and regional governance. To begin with, much of this interest is expressed at and around international activities, including the WSSD, meetings of the G7/G8 and the negotiations of the WTO and multilateral environmental agreements. Protests and demonstrations, coupled with less adversarial side events and more open consultations involving officials, NGOs and the broader public, help to galvanize renewed commitment to action by formal institutions.

This commitment is translated into initiatives to better understand and deal with issues of current concern. A common characteristic of these initiatives is a highly structured approach, complete with the establishment of formal institutions and the setting of very specific targets. Efforts to improve knowledge of the issues build upon existing activities, including the Intergovernmental Panel on Climate Change, Millennium Ecosystem Assessment and Global International Water Assessment. To these are added an Arctic Climate Impact Assessment and a global assessment of the nitrogen cycle.

Target-setting draws on the efforts of international conferences in the 1990s. These were outlined in *A Better World for All* (IMF and others 2000). Following this precedent, global environmental and social priorities are expressed in terms of measures that target basic needs such as reducing extreme poverty, cutting infant and child mortality, improving reproductive health, promoting gender equity, upgrading environmental conditions and achieving universal primary education. Quantifiable indicators are agreed to help track progress towards each of these goals.

The environmental targets fall into two broad categories. Climate stabilization, improving eco-efficiency and reducing toxic wastes require a focus on industrial activities and the demands of modern lifestyles. Halting deforestation and land degradation, maintaining biodiversity, sustaining fisheries and improving access to clean water and sanitation, require issues of poverty and growing populations to be addressed as well. The targets agreed for developing countries reflect a general acceptance that the process of development and industrialization must continue in these regions. Thus, although per capita materials use and releases of pollutants will grow, they should not exceed the levels recorded in the OECD regions and will gradually converge to similar values.

'A common characteristic of these initiatives is a highly structured approach, complete with the establishment of formal institutions and the setting of very specific targets.'

Customizing the blueprint

Although the ultimate goals are similar, the particular circumstances of each region — political, economic, cultural and environmental — dictate different emphases in each region. In Africa, a premium is placed on food security, governance, economic diversification, population growth and urbanization, universal primary and secondary education, poverty, health (particularly in relation to HIV/AIDS), deforestation and land degradation.

Deforestation, inequity, poverty, urbanization, freshwater resources and regional air pollution head the

reform agenda in Asia and the Pacific. In Europe, the accent is on energy, governance (especially in relation to EU enlargement), agriculture, transport and the preservation of natural areas. Governance, healthcare, universal primary and secondary education, deforestation, poverty and inequity, and urbanization are highlighted in Latin America and the Caribbean.

Discussions in North America focus on energy use, perverse subsidies, trade regimes and water availability in the arid west. The principal concerns in West Asia are water availability, food security, diversifying the economy, healthcare and universal primary and secondary education. In the polar regions, the focus is on governance in relation to international activities in the Antarctic, rights of indigenous peoples in the Arctic and resource exploitation in both.

Collaborative frameworks

The strengthening of governance institutions at all levels is critical to achieving agreed goals. At the global level, these include the United Nations organizations and Bretton Woods institutions, which implement new or step up ongoing reform efforts. Fresh impetus also boosts existing multilateral environmental agreements, while existing protocols, such as those on climate and biosafety, are ratified.

Complementing this drive are efforts at regional level to increase intra- and inter-regional cooperation mechanisms and make them more efficient. These efforts are stimulated by a series of regional meetings, drawing together nation states and regional and sub-regional entities. The most conspicuous of these is held in Africa by the newly formed African Union, which results in the Africa Millennium Charter for Sustainable Development.

Of course, the efforts at both regional and global levels require action at the national level. Furthermore, intentions expressed at the higher levels need to be translated into meaningful goals and actions to be implemented at national and sub-national levels. This requires nations to place greater faith in — and assign more authority to — ministries focusing on social and environmental policies.

It is understood that significant changes in social and economic systems will be needed to achieve the targets that have been set and that these changes will take time. Action is required at many different levels. Certain areas stand out in which nations must cooperate with one another and with global institutions. Among them are global environmental issues such as stratospheric ozone depletion, climate change, biodiversity loss and the long-range transport of persistent organic pollutants. Perhaps more important because they lie at the root of these environmental concerns are economic issues like trade and foreign debt. Technology development and transfer (particularly in the areas of ICTs, biotechnology and energy use) and the maintenance of intellectual property rights are also on the joint agenda. Other issues that demand attention are migration, security and sharing common resources from, for example, the oceans, the polar regions and space.

'It is understood that significant changes in social and economic systems will be needed to achieve the targets that have been set, and that these changes will take time.'

Trade and industry take a lead

Not all activity is limited to the governmental sphere. Business groups, such as the International Chamber of Commerce (ICC), World Business Council on Sustainable Development (WBCSD) and the International Standards Organization (ISO), work to enhance the positive role in policy making played by industry. NGOs continue to build partnerships, between themselves and with business groups and government organizations.

In trade, the opening up of international markets continues, with much of the action occurring at the regional level. New entities, such as the Arab Free Trade Association in West Asia, are formed, while existing unions survive and grow. A Free Trade Area of the South is initiated by an agreement between MERCOSUR and South Africa.

The role of the World Trade Organization continues to evolve. The Doha round of negotiations works to balance free trade with social and environmental considerations. It plays a special part in opening up agricultural markets by means of the Agreement on Agriculture (AoA) and in managing the exploitation of resources in the Arctic and Antarctic, including total prohibition of trade in certain resources. It also seeks to tackle the broader issues of trade in biological and genetic resources, working in close coordination with the parties to the CBD and associated protocols.

Dealing with debt and conflict

In terms of foreign debt, many developing countries feel they need and deserve special help to pursue sustainability. Key lenders, including the World Bank and the IMF, work together with borrowers to restructure and — in some cases — eliminate existing debts. Options such as debt for nature or debt for poverty alleviation swaps are explored as options to manage international debts in ways that help achieve sustainability goals. Development aid is increasingly seen as a matter of national and international security, prompting nations to increase contributions progressively to target levels set — but rarely achieved — in the previous century.

'Efforts at international and regional levels help provide economic and political support for policy changes needed at national and sub-national levels.'

Increasingly, regional and international bodies adopt a more direct role in resolving conflicts within and between nations. One of the lessons learned from periodic terrorist activities and the responses to them is that greater cooperation between nations, even where it may involve sacrificing some elements of sovereignty, can bring definite benefits in terms of national security.

Efforts at international and regional levels help provide economic and political support for policy changes needed at national and sub-national levels. Comprehensive environmental and social policy frameworks are established. Where necessary, international actions such as insisting on treaty compliance and limiting aid and capital flows, help to put pressure on governments that are slow to introduce reforms. More often, however, nations are proactive in taking action internally.

Tax breaks and other instruments

A vital step in many countries is to restructure tax systems and subsidy programmes in order to bring them more in line with social and environmental goals. Such reforms also enable governments to acquire some of the huge amounts needed to finance the changes in public sector systems needed to achieve set targets.

In other cases, more stringent and direct regulations are introduced, including restrictions or outright bans on particular activities, such as logging in national parks, the use of particular chemicals and even driving in urban areas. These efforts can also be very costly, at least in the short term.

Although hampered at times by the actions of governments and NGOs, businesses play a positive role in many areas. As a sequel to the 14000 series of standards on environmental management systems, the ISO introduces a series of standards related to the social and ethical dimensions of business. These actions build upon and complement joint efforts by governments and business, such as the Global Compact for Business and the Global Reporting Initiative. Businesses take an increasingly active role in the consultation processes associated with many policy initiatives, a form of intervention that does much to stimulate technology development and transfer.

Action by NGOs and consumer groups includes the use of consumer boycotts and media campaigns to push less progressive businesses to act. They lobby for new labelling and reporting requirements to ensure that business practice is more transparent and accountable. Several of these groups are explicitly included in later rounds of the WTO negotiations. At the same time, these pressure groups also act as watchdogs on governments, ensuring that leaders act responsibly. Stricter limits are placed on how government officials behave, allowing most who overstep reasonable bounds to be voted out of office.

Challenges remain

Most people support these efforts and exhibit trust in and patience with their leaders. Tension exists, though, as most citizens mistakenly assume that the changes can be made in ways that do not fundamentally alter their lifestyles in terms of convenience, mobility and similar comforts. In addition, some people resent the higher direct and hidden costs that they are being forced to pay to effect these changes. Others are impatient with the time it takes to make the dramatic changes they see as necessary. Frustrations also arise as the evolution of social, economic and natural systems does not always progress on the same schedule as the institutional changes that are being implemented.

Potential conflicts of interest arise in achieving desired goals. One example is the effort to meet increasing demands for food from populations that are

growing in both size and affluence, without impairing biological diversity or soil fertility. This dilemma stimulates calls for a new global Green Revolution, although the social and environmental drawbacks of the first are still evident. Questions are raised about the risks of biotechnology, including genetic engineering, on which any such drive will have to rely. The environmental, medical, social, economic and ethical issues surrounding these technologies raise the temperature of public debate to heights not seen since the era of the nuclear debate.

Biotechnology watchdog

Early efforts to address specific issues arising from biotechnology and gene transfer, such as the Cartagena Protocol on Biosafety, had set the stage for a regulatory regime for biotechnology development and use, to ensure that 'the planet's biological diversity (including human systems) will be able to coexist with this powerful technology' (UNEP 2000). Such efforts lead to the founding of a new international regulatory body in the early 2010s, patterned on the International Atomic Energy Agency but with greater authority.

Despite these challenges the signs of positive change strengthen the resolve to ensure that the agreed targets will be met. The initial responses of the institutions increase their legitimacy and stature. Events such as the 75th anniversary of the United Nations and World Bank and the 50th anniversary of UNEP present occasions to celebrate the progress that is being made, but also to acknowledge the challenges that remain and to reassert the need for continuing action.

The demands of continued population and economic growth still outweigh many incremental advances in sustainable production. Regional conflicts, often over contested resources, persist in several parts of the world, directly causing social and environmental damage, as well as diverting scarce resources from other priorities. And tropical storms, droughts, floods, wildfires, earthquakes, chemical spills and other industrial accidents remind society that natural and technological systems do not always behave according to plan.

It takes time for many to accept the idea of global public policy for the pursuit of sustainable development. Furthermore, the path pursued has meant adopting a highly technocratic approach and has not engendered a widespread shift in basic attitudes and behaviour. This makes certain policy actions either unfeasible or less effective than had been assumed.

Reviewing progress

As the world looks back after three decades, there are mixed feelings. Much has been accomplished, but much remains to be done. Although not all the long-range targets have yet been achieved, the world is on a fair trajectory to meet them. It is clear, though, that there are significant differences in progress on the different goals and in different regions.

There has been broad success in reducing extreme poverty, achieving universal primary education, improving gender equity, reducing infant and child mortality and improving reproductive health. International debt relief has contributed to the funding required to meet these targets in many developing countries. Areas of concern remain, including much of Africa, where 10 per cent of the population go hungry in most sub-regions. But even this represents reductions of two-thirds to three-quarters over the 30-year period. Similarly, the more technology-dependent environmental targets — increases in materials use efficiency and reductions in the releases of toxic materials — have proved to be achievable.

'Growing (although stabilizing) populations and improving lifestyles continue to intensify demands for water, food, forest resources and space.'

A key role has been played by the private sector, which has accepted major responsibility and ploughed more profits back into research and development and into global and regional business coalitions. These new groupings have actively supported technology transfer to developing countries. The effect of private sector initiatives is further reflected in the achievement of such goals as improving urban air quality and providing access to safe water.

For the goals related to water stress, land degradation, deforestation and marine overfishing, significant though costly advances have been made, but considerable risks remain. Growing (although stabilizing) populations and improving lifestyles continue to intensify demands for water, food, forest resources and space. Changes in climate have

contributed to these concerns. Whilst the percentage of the population living in areas of high and severe water stress remains stable, the total number of persons potentially affected has risen.

Crises have been prevented through expensive infrastructural developments and pricing policies, which place a greater financial burden on end users. The amount of land at risk from water-induced soil degradation has risen significantly due to agricultural expansion into marginal lands and climate changes. But the rate at which degradation is actually taking place has fallen substantially over the period as farmers have implemented more stringent land conservation measures in response to changing tax and subsidy structures. By 2032 there is almost no net advance of degradation.

'The actions required to keep the world on track to meet the long-term goals have not always been popular and have often been expensive.'

There has been success in halting deforestation. Total forest area has even increased in most regions, in part because the area under plantations has expanded. However, the level of exploitation of forests has continued to increase. Similarly, growth in aquaculture and better management of fishery systems (including stricter controls on marine fish catches) have prevented further decline in most fish stocks, but overall exploitation has not fallen significantly.

Finally, the scale and nature of the efforts needed to address climate change and biodiversity decline have proved to be enormous. Emissions of carbon dioxide and other greenhouse gases per unit of economic activity have fallen significantly throughout the world and absolute levels have fallen in the wealthier regions. More rapid economic development and continued population growth in other regions have resulted in higher absolute emissions, even though per capita emissions in these regions remain relatively low. The net result is a continuing rise in global emissions.

Atmospheric concentrations of CO_2 continue to climb, indicating that much more stringent measures will be required in the future to bring them back down to the target levels. Global temperatures have risen by nearly 0.75°C since the turn of the century and continue to increase, although models indicate that, as reductions already negotiated take effect, this rate of increase has reached a plateau and will begin to decline in a few decades. The regional manifestations of climate change and the infrastructure development that has taken place to meet growing human needs and to achieve the other goals have placed many human and natural systems at increased risk.

In summary, the forces driving the world in unsustainable directions, while not necessarily defeated, appear to be on the way to being tamed. Not all the alarming trends have been reversed, though even in the worst cases 'things are getting worse at a slower rate' (Meadows 2000). The actions that have been required to keep the world on track to meet the long-term goals have not always been popular and have often been expensive. Halting deforestation, land degradation and marine overfishing has required drastic measures, at times including total bans on human activity in some areas.

Efforts to reduce emissions of greenhouse gases have required fairly high levels of taxation on most energy sources and certain industrial chemicals, as well as expensive shifts in agricultural practices. There is a question as to how much more can be accomplished with similar policies, even given fresh technological advances. There is also a question mark over how long businesses and the general public will carry on accepting such policies. Without fundamental changes in human behaviour and demands, the achievement of sustainability could well mean an ever more managed, bureaucratic, technocratic and ultimately dehumanized world.

Security First

This scenario assumes a world of striking disparities where inequality and conflict prevail. Socio-economic and environmental stresses give rise to waves of protest and counteraction. As such troubles become increasingly prevalent, the more powerful and wealthy groups focus on self-protection, creating enclaves akin to the present day 'gated communities'. Such islands of advantage provide a degree of enhanced security and economic benefits for dependent communities in their immediate surroundings but they exclude the disadvantaged mass of outsiders. Welfare and regulatory services fall into disuse but market forces continue to operate outside the walls.

In the early years of the century, a world view that puts market principles and security concerns to the fore, dominates global development. This is reflected at international level in the half-hearted mood of debates at the WSSD and similar meetings. Negotiations on climate change and other multilateral environmental agreements drag on with minimal progress.

Where there are advances at international level, these tend to be in areas with a more economic focus, such as international trade and foreign investment. Even in this arena, promising initiatives like the Global Compact for Business, the Global Reporting Initiative and the Doha round of trade negotiations under the WTO, are slow to deliver on their promises to create the basis for more equitable and sustainable economic globalization.

In the aftermath of the terrorist attacks on the United States and the initial armed response in Afghanistan, the emphasis is on providing security by more traditional means, such as military power and control of arms and financial flows. Little attention is paid to the social and environmental issues that many argue provide the motivation for terrorist activity.

The market's call: the need for security

The momentum for sustainable development, so promising in the 1990s, gradually fizzles out, for a wide range of reasons. The voices that urge the world to build upon this momentum and achieve agreed goals go unheeded as the belief spreads that free markets alone can come up with flexible enough checks and balances to deal with issues of social justice and global environmental care. This complacency also reflects competing concerns, such as recurring fiscal crises and downturns in national economies, cycles of terrorist activity and retaliation and the continuation of armed conflicts in several parts of the world. Hence the first decade of the new century is in many ways a period of muddling through.

In Africa, the decade is characterized by prolonged civil conflicts affecting many nations and often drawing in neighbouring countries. In these cases little progress is made in introducing greater transparency and accountability into governments. At the same time, the AIDS pandemic continues, curtailing economic advances even in those countries that enjoy political stability.

Conflicts also continue to simmer in parts of West Asia, at times boiling over into periods of intense violence. Disputes over water, oil and other resources are intensified by, and contribute to, these conflicts. Instability in the price of oil, due to fluctuating demand and the inability to control supply in the region and elsewhere, slows economic growth in the region.

Economic problems remain significant in many parts of the Asia and the Pacific region. Downturns reminiscent of the crash that occurred in the late 1990s periodically resurface and impact upon a broader range of countries. Here, also, internal and external conflicts continue to command attention and divert valuable resources.

In Latin America and the Caribbean, problems posed by the continuing growth of mega-cities plague many countries while internal conflicts, often related to the drug trade, persist. At the same time, pushed by the countries of North America and multinational corporations, the primary focus of many politicians is on the continued expansion of free trade in the region, rather than on social and environmental concerns.

'A world view that puts market principles and security concerns to the fore, dominates global development.'

Security is a consuming preoccupation in North America, giving rise to concern not only over the threat of direct physical attacks but also over dependence on foreign suppliers for strategic resources. The latter fear increases the pressure to exploit resources within the region, including parts of the Arctic. Arctic resources are made more accessible as ice-free periods in the north are extended by the warming of the climate. Access is also eased by a

wave of privatization in the region, extending to the control of natural resources.

Similar bursts of resource exploitation are also occurring in the Arctic parts of the Russian Federation and the Nordic countries. Much of the effort of European policy-makers is focused on dealing with expansion of the EU. A few more countries are admitted into the Union, but persistent tensions related to taxes, subsidies, immigration, freedom of movement and other issues, slow this process. Disagreements also linger on between a central core of countries that wishes to move towards much greater integration and others that prefer a looser union. Meanwhile, countries in Eastern Europe generally make little economic progress and suffer further tensions and internal conflicts.

'In all regions and at the global level, large, non-state entities increasingly influence and drive the political agenda. These include multinational corporations, but also crime syndicates.'

In all these regions and at the global level, large, non-state entities increasingly influence and drive the political agenda. These include multinational corporations, but also crime syndicates. The level of corruption within governments is generally understood to be increasing, although given little improvement in transparency and accountability, this is not easy to verify.

The start of the second decade of the new century sees the world functioning in a more *laissez faire* manner than before. Businesses wield enormous power but maintain a focus on enhancing shareholder value, believing it is the job of governments to address environmental and social issues. They, however, expend resources to build up private police forces to protect their assets in areas with strategic resources, especially in countries where protection is considered unreliable.

Veering towards breakdown

Government efforts to tackle environmental and social problems are generally late in coming and ineffective in scope. Furthermore, governments use much of their power to protect the economic interests of national and corporate enterprises to which they are increasingly tied. NGOs and other groups in civil society find themselves focusing more and more on short-term crises, rather than working to influence long-term development patterns.

This trend is epitomized by the collapse of the Antarctic Treaty system, a result of pressure from non-claimant states and non-state actors, coupled with the failure of claimant states to reach agreement on resource exploitation and environmental protection. There is a rush to exploit the region's mineral and marine living assets, including freshwater in the form of ice. This free-for-all does not mean equal access for all groups, as the more powerful states and large corporations still exert dominance. Exploitation of resources by these groups also speeds up in the Arctic. There, the impacts have an important social element as native peoples gain little benefit. Although many people move north to take part in the expanded economic activity, most income flows out of the region.

As the decade proceeds, the effects of the erosion of institutions at the international and national levels become more apparent. If the first decade was a period of muddling through, this is one of stumbling and serious falls. Conflicts in various parts of the world never coalesce to form what might be called a Third World War. They do, however, escalate in particular regions and at particular times to destabilize nations. Of even more concern to some is the sporadic use of chemical, biological and other non-conventional weapons. The sheer numbers of refugees also creates severe problems in neighbouring (mainly non-combatant) states. The ability of international institutions such as the United Nations High Commission for Refugees to cope with these events has been compromised by reductions in support, leaving them overwhelmed.

These conflicts, along with enduring economic weaknesses and environmental deterioration, affect regions further afield, as migration pressures increase throughout the world. These pressures stem not only from factors within regions forcing migration, but also from tantalizing images broadcast by the media that lure them elsewhere. The response of the receiving countries is mixed, with some more open to new immigrants than others. Over time, however, even the countries and regions with relatively open borders begin clamping down as they focus on problems at home.

Some of these problems spring from recurrent economic malaise. In North America, Europe and parts of Asia and the Pacific, part of the problem is the

declining size of workforces. Allowing highly educated and skilled workers from other regions to immigrate eases this shortage somewhat. Unfortunately the deterioration of educational opportunities in many regions has reduced the availability of such workers. From the perspective of their home regions, the departure of even a small number of skilled migrant workers represents a significant loss of indigenous capacity. The repercussions affect economic and political stability, further widening the gap between have and have-not nations.

Environmental changes and events also have widespread effects, in wealthy and poorer regions alike. The impacts of climate change and variability become more apparent. The gradual rise in sea level is punctuated by severe storms that cause heavy damage to coastal (and even some inland) areas. In Europe, North America and the wealthier parts of Asia and the Pacific, the financial losses are staggering, even if there are no dramatic losses of life. Re-financing on a huge scale, not only to recover the losses where possible, but also to prepare for future events, diverts important resources from other parts of the economy.

In other regions, particularly Latin America and the Caribbean, and the poorer parts of Asia and the Pacific, the loss of life is significant and the financial losses seriously damage economies. After the immediate clean-up, there is little funding left to make ravaged areas less vulnerable in the future. Elsewhere, droughts are adding to water stress, already on the increase because of runaway growth in water demand. This shortfall cripples agriculture in many parts of West Asia and Africa, where it directly menaces the very survival of many people and increases regional tensions, and also in North America, where it tips the balance in favour of pursuing risky, large-scale water transfer projects.

Many sectors bear the mark of developments in the areas of biotechnology and genetic engineering. Difficulties in mastering these new technologies are made worse by a drop in public funding for research and development. Finance for these purposes is now concentrated in the hands of private firms that are biased in favour of those applications that will yield the highest profits. Minimal social and environmental safeguards characterize the early phases of biotechnology development.

Significant advances are achieved in medicine, agriculture and environmental clean-up technologies, but detrimental side effects also arise. These include accidental releases, illicit use by terrorist groups, epidemics among human and animal populations and negative impacts on various plant species. Attacks on biotechnology trials by eco-terrorists and pro-nature activists further complicate matters. Ultimately, a clampdown on research and application trials is imposed by governments and key firms involved in these fields.

The net result is a slowdown in advances in those areas with potentially the highest impacts for the broadest section of society, such as the production of food crops. In combination with the deterioration of arable land in many areas, food stocks fall perpetually short in some regions. Cutbacks in foreign assistance have left relief agencies unable to handle many of the resulting crises. In general, conventional forms of development aid decline and poverty rises.

Little action is taken to alleviate the debt burden of poorer nations. The global economy remains stratified and fails to embrace the billions who are economically and politically marginalized. This split is deepened by institutions of international trade that focus on freeing up markets in developing countries, without also doing so in industrialized regions. The flow of new technology and training from the industrialized countries also declines.

'The global economy remains stratified and fails to embrace the billions who are economically and politically marginalized ... traditional livelihoods and communities also erode.'

Not only are the poor excluded from the new economy, but also traditional livelihoods and communities erode as global markets penetrate peripheral regions, seeking cheap labour and control of resources. In poorer countries especially, economies increasingly come under the control of transnational corporations. In parts of Latin America and the Caribbean, Asia and the Pacific, and Africa, this takeover is very clearly seen in the commercial exploitation of biological resources with little compensation for the majority of the people in these regions.

The drawdown of fiscal resources of the state treasury in poor countries leads to disintegration of social and civic services. In particular, systems of

education, especially higher education, collapse. This deepens the divide between the rich and the poor and exacerbates absolute poverty. Furthermore, as a result of cutbacks in public provision of education, much of the alternative schooling that is available is laden with prejudicial seeds of intolerance and violence.

As conditions worsen in many places the excluded grow increasingly restive. Many seek their fortunes in exploding mega-cities. The pace of urbanization puts extra strain on already overextended infrastructures, leading to more problems with air pollution and lack of access to clean water and sanitation. Limited economic opportunities in cities foster the growth of organized crime. In an atmosphere of despair, illegal drugs find ready markets. Many of the poor try to migrate to rich countries and rising numbers of them resort to illegal entry. The stream of people on the move grows into a river of the desperate flowing (both within and across national boundaries) towards the wealthy areas. Affluent groups respond with growing xenophobia and oppressive policing of borders. Social polarization spreads and extremists and terrorist groups find ready recruits.

In this atmosphere of rising social, environmental and economic tension, violence is endemic. Poor countries begin to fragment as civil order collapses and various forms of criminal anarchy fill the vacuum. War and environmental degradation lead to massive movements of refugees in some regions. Environmental changes and overloaded infrastructures also favour another kind of migrant; new and resurgent infectious diseases and the vectors that carry them.

Divided world

Alarmed by migration, terrorism and disease, members of the affluent minority fear that they too will be engulfed. Even some of the more prosperous nations feel the sting as infrastructure decays, technology fails and institutions collapse. As OECD economies falter and their populations age, social programmes introduced in the 20th century but neglected year after year, begin to unravel.

'Many of the poor try to migrate to rich countries and rising numbers of them resort to illegal entry. Affluent groups respond with growing xenophobia and oppressive policing of borders.'

These and other factors lead to a dramatic swing in approaches to governance. Having stood by, sometimes willingly, and seen their powers eroded, governments strive to reassert their authority. To stem the collapse, the forces of order react with sufficient cohesion and force to impose an authoritarian order throughout much of the world. In many regions these shifts appear merely as a continuation of normal practice or a return to the not-so-distant past. In others, though, sacrificing long cherished ideals (such as democracy, transparency and participation in governance) for greater security is no easy trade-off. A growing sense of lifeboat ethics — an acceptance that only by letting some drown can the others remain afloat — allows the governments and citizens of these countries to make certain consensual choices. Other decisions are eventually made without popular consent and are accepted without question.

This process takes time to develop, but a pattern gradually emerges. In rich nations, the wealthiest people flourish in protected enclaves and the general public receives some assurance from the increased level of security. Strongholds also persist in the poorer nations, protecting the remaining elites and strategic resources. In some regions, control is unstable; the power base shifts as one faction or ethnic group overpowers another.

The strongholds are 'islands of prosperity in an ocean of poverty and despair' (Hammond 1998), descendants of the walled cities of earlier eras and the gated communities of more recent times. Sometimes the walls are physical; at other times they are more metaphorical. Nevertheless, these bubbles of wealth are not isolated. They are connected in a global network with shared economic, environmental and security interests. Through this network, globalization continues, albeit in a distorted form.

Within the walls, life proceeds with some semblance of order. Technological advances continue to be made. Health and educational services continue to be provided, consumption patterns do not shift dramatically and environmental conditions hold steady. Businesses assist in the provision of some socially important programmes, especially those directly related to their interests, for example, education to address skill shortages and provision of basic needs to workers. Still, there is always a recognition that security is of paramount importance.

It is pursued by various authoritarian policies and institutions, whose methods include surveillance and the profiling and harassment of particular dissident groups.

Outside the walls, the majority is trapped in poverty. The provision of basic needs — water, health services, sanitation, food, shelter and energy — is piecemeal or often non-existent. Many people are denied basic freedoms. By comparison with the cohesive societies within the walls, this world is increasingly chaotic and disconnected. Technological progress continues to be made in these communities, at times by theft or leakage from within the walls, but also by indigenous enterprises. Such breakthroughs tend to be small-scale, however, and the lack of harmonization and capacity building prevents dramatic advances that might prompt large improvements. The inability to achieve economies of scale further hinders progress and growth.

The interplay between life inside and outside the enclaves goes well beyond merely policing the borders between the two. The bubbles of prosperity depend heavily on a constant flow of resources from areas not fully under their control. Where the elite are able to exert control, there is strict management of source areas for products of commercial value and those that serve a more basic life support function. These well-protected areas, both on land and in the oceans, provide a haven for many other species, but do little to improve the lot of people who are excluded. Where areas are simply mined and abandoned, those on the outside are expected to deal with the aftermath.

The elite also rely upon the broader world to absorb the excesses of their lifestyles. Wastes produced within the strongholds are transported into outlying areas. The pressures that such wastes place on unprotected natural systems add to the problems of people struggling to survive. These problems include overuse and fouling of water sources above and below ground, the effects of uncontrolled use of dirty fossil fuels, contamination from untreated solid wastes, continued deforestation to provide fuelwood and the degradation of marginal areas used for agriculture.

Trade also crosses the boundaries between the two worlds. Those inside the walls have not lost their taste for products that must come from outside, including illegal drugs and those derived from rare species. Both money and military supplies find their way outside in return, where they trigger not just external chaos and lawlessness but also periodic terrorist attacks against the fortresses.

'The forces of order react with sufficient cohesion and force to impose an authoritarian order throughout much of the world.'

In this atmosphere, both the informal and legitimate small enterprises flourish by serving local needs. Charities and other welfare providers in civil society try to assist where governments and businesses fall short in the provision of basic needs, which happens in many cases, but the task proves far from simple and their efforts far from effective.

What lies ahead?

By 2032, an air of uneasy stability has begun to settle on this divided world. It is unclear, though, how long this truce can last. The forces for further breakdown are ever present. At the same time, dreams of a better way still beckon. Whereas many of the fears of the pessimists have come true, fresh opportunities for positive change have not ceased to appear. Outside the walls, small islands of calm exist and work is under way there to build links with others and with progressive elements within the fortresses, offering hope that someday, like the phoenix rising from its ashes, a better world for all might yet emerge.

Sustainability First

A new environment and development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions. A more visionary state of affairs prevails, where radical shifts in the way people interact with one another and with the world around them stimulate and support sustainable policy measures and accountable corporate behaviour. There is much fuller collaboration between governments, citizens and other stakeholder groups in decision-making on issues of close common concern. A consensus is reached on what needs to be done to satisfy basic needs and realize personal goals without beggaring others or spoiling the outlook for posterity.

In the early years of the century, there is evidence of a compelling desire and demand among people everywhere for action to address the social, economic and environmental concerns affecting many regions of the world. The terrorist attacks on the United States and subsequent retaliation lend immediacy to calls to address economic, social and environmental concerns that are seen as the root causes of such extreme actions. A reinvigorated NGO community becomes a key channel through which citizens everywhere express their demands. The Internet amplifies what has become a global dialogue, or more accurately a multitude of dialogues, on the need for action.

An age of reflection …

Some of these exchanges take place in formal government arenas. Others, partly prompted by pressures from shareholders, employees and customers, are happening in industry, both within and among firms. Similarly, NGOs (including many that have a multinational presence) are reflecting upon their roles and missions.

'There is evidence of a compelling desire and demand among people everywhere for action to address the social, economic and environmental concerns affecting many regions of the world.'

There are also fresh attempts to collaborate across the governmental, industrial and NGO sectors. In total, however, these efforts pale by comparison with the myriad dialogues between individuals and small groups of interested citizens within and across regions.

Much of this desire for remedial action is expressed in and around the lobbies of international activities, including the WSSD and other United Nations conferences, meetings of the G7/G8 group of nations, at the negotiations of the WTO and multilateral environmental agreements, and at meetings on specific social and environmental issues, such as climate change and HIV/AIDS.

At times, the formal events are overshadowed by parallel gatherings. For the most part, the mood of these gatherings is peaceable, akin to that of the Global Forum linked to the 1992 Earth Summit. Less in evidence are the anti-globalization protests seen at the meetings of the WTO in Seattle in 1999 and the G8 in Genoa in 2001. Their goal is to highlight the advances that are being made and to shape the agenda of the governmental meetings. There is greater emphasis on presenting the positive aspects of a societal transformation rather than the negative consequences of inaction. Over time, increasing numbers of representatives from industry and governments participate in these encounters, making them more successful in achieving this goal.

… and a time for action

Much of what is happening goes beyond mere dialogue. Rather than waiting for political leaders to take the initiative, many individuals and groups have begun to act on their own. They note the contrasting outcomes of the 1992 Earth Summit on an informal and local scale, such as the spread of Local Agenda 21 initiatives and those pitched at the more formal and international level, such as the United Nations Framework Convention on Climate Change. They draw inspiration from past and present efforts of local grass-roots movements like the Green Belt movement in Kenya and the Chipko Andalan movement in India. They also recall successful interventions at international level, such as the campaign to end the production and use of landmines.

The business community is another source of inspiration, principally for its success in developing social investment funds and establishing social stock indices. Firms that address environmental issues ahead of regulation, exemplified by companies in the Climate Neutral Network, serve as role models. Also held up as role models are partnerships between governments and other groups, such as Ecotourism Namibia and Community-Based Fisheries Management in Phang-Nga Bay, Thailand.

The more that individuals and groups apply themselves to practical initiatives, the more hope grows that significant changes are possible. The media assist by making these efforts more visible. Progressive elements in government and business communities realize that this is the most promising channel for reform. They also recognize that efforts like these are needed to get to the sources of dissatisfaction that lie at the root of terrorist activities. This realization leads to the creation of alliances amongst individuals from various stakeholder groups in support of key initiatives.

The result is a mixture of old and new initiatives. Some initiatives are highly coordinated and involve large numbers of people. Others are pursued by small groups with wide ranging, but loosely knit connections at local, regional and global levels. Whereas some are formal and embedded in national and international law, many take a voluntary approach, such as the Global Reporting Initiative, Global Compact Initiative and financial initiatives set up by the United Nations and businesses.

Efforts continue to incorporate the results of scientific research and analysis more thoroughly into the policy making process. The Millennium Ecosystem Assessment, the Global International Water Assessment and new studies on the nitrogen cycle and persistent organic pollutants (POPs) complement the ongoing investigation of climate change by the Intergovernmental Panel on Climate Change. The POPs assessment is in part a response to compelling new evidence of the long-range transport of these pollutants and the effects of their presence on animal life in the polar regions. Much like the discovery of the ozone hole over Antarctica in the 1980s, these revelations stimulate intense effort to measure and counter the risk.

These new assessments differ fundamentally from past efforts. Firstly, they are designed to include more expertise from developing regions, and to build capacity in these regions. Secondly, the contributions of social scientists are given equal weight to those of the physical and natural scientists. Thirdly, wherever possible, the many regional and local studies that comprise large parts of these assessments recruit local and lay communities as partners in the research. This stems from the desire of these groups to have a voice in the development and understanding of the issues and in how to address particular concerns.

The knowledge that these individuals and groups (particularly indigenous groups) possess has been accorded increasing recognition. The participatory approach also acknowledges that scope for action extends beyond official government channels and depends upon involvement of local communities.

Setting goals and targets and designing activities to achieve them, builds upon ongoing efforts, but also reflects progress in striking a balance between formal and informal institutions. Social and environmental goals are re-affirmed, among them reducing food insecurity and infant mortality, increasing life expectancy and literacy, stabilizing climate, halting deforestation and reversing declines in fisheries.

'Some initiatives are highly coordinated and involve large numbers of people. Others are pursued by small groups … some are formal … many take a voluntary approach.'

Rather than laying down specific numbers, quotas and timetables, however, more attention is paid to increasing accountability and transparency by instituting monitoring systems and placing responsibility on governments, industries, NGOs and others to disclose information in relation to agreed goals. The underlying principle is that the widespread availability of good information and appropriate checks and balances will encourage progress towards these goals, either directly or by way of pressure from an increasingly vocal citizenry. The goal of policy, in this scenario, is to support the efforts of individuals and groups, in government as well as in civil society, within the non-profit sector as well in the marketplace, to pursue sustainable development.

This evolving approach calls for a reappraisal of existing multilateral agreements. The list includes environmentally oriented agreements such as the United Nations Convention on the Law of the Sea and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. It also features more socially oriented conventions such as those on the Elimination of All Forms of Discrimination Against Women and on the Rights of the Child.

The process of revision provides momentum, too, for the continuing reassessment of international institutions of governance, with a view to

transforming them into more effective organizations. The United Nations, major financial institutions such as the World Bank, regional development banks and the IMF and the WTO are all included. Transparency and accountability are key aspects of this course of action. Similar processes are ongoing in business, voluntary and other sectors.

At regional level, new and old organizations become increasingly active. The Federation of Caribbean Nations grows out of the former CARICOM. In Europe, the growth of the EU proceeds with considerable deference paid to maintaining and improving relationships with the Russian Federation. Africa sees the further evolution of the African Ministerial Conference on the Environment (AMCEN). Most regions also explore greater integration of policies related to trade, migration, the management of water resources and similar transboundary issues. In this way, the regional efforts become part of a semi-formal web of global public policy networks.

A great swing

The journey that these processes set in motion is a long one. It takes many years and does not proceed without constant pressure and action from many sectors of society. A profound set of changes, which were only hinted at in the early years of the century, gradually unfolds, quietly most of the time, not so quietly at others. People everywhere begin to embrace the idea of a 'new sustainability paradigm' that promises to transcend conventional values and lifestyles. This new paradigm combines a powerful personal and philosophical dimension with concern over economic growth, technological potential and political eventualities.

Among more affluent people and groups, disenchantment with consumerism sparks off a quest for more fulfilling and ethical ways of living that can restore a sense of meaning and purpose to their existence. The values of simplicity, cooperation and community begin to displace those of consumerism, competition and individualism. More time is spent on study, art, hobbies and engaging in the wider community.

'A profound set of changes gradually unfolds, quietly most of the time, not so quietly at others. People everywhere begin to embrace the idea of a 'new sustainability paradigm.'

The success of the Truth and Reconciliation Commissions in South Africa, East Timor and elsewhere stimulate similar exercises in other places, including less strictly political settings, such as within the tobacco and chemicals industries. The positive results of the peacemaking process in Northern Ireland and Bosnia enhance efforts in other regions. Dialogues between the world's major religions, directly stimulated by the terrorist activities against the United States and subsequent retaliation, further help to create the foundation for greater understanding and cooperation.

In some regions, the mood of society is a mixture of battle fatigue and disgust with current leaders. Small-scale but locally significant environmental disasters also have an effect on this mood. These factors combine to make more people willing to explore and question fundamental beliefs.

Citizens and consumers, where possible with their votes and wallets and otherwise with their feet and their voices, make it clear that progressive businesses and governments will be rewarded while others will be rejected. At some point, a critical mass is reached, whereby activities that have until now appeared isolated and of little consequence, begin to spread and affect broader regions.

In developing regions and amongst indigenous communities everywhere, a new generation of thinkers, leaders and activists emerges to join and shape the global dialogue. Many regions draw on the dual legacy of nature-conscious traditional societies and ideas of visionary thinkers seeking better paths for development. Cultural renaissance evolves in many regions, rooted in respect for tradition and an appreciation of local human and natural resources. Young people from all regions and cultures play a key role in promoting these values. The increased opportunity to meet and learn from others of their generation, both virtually and in person, fuels a rediscovery of idealism as they join together in the project of forging a global community.

What is new in the current discussion is the willingness of people to reflect upon the positive and negative aspects of their own actions and legacies as well as those of other cultures. Many of these debates are launched within the developing world, engaging an

ever-expanding circle of stakeholders.

The notion that the prevailing market oriented wisdom is both insufficient and undesirable garners more and more support. This switch is most significant in North America and Western Europe, as well as among many of the affluent in other regions, who have been seen as the key purveyors and beneficiaries of this approach to development. At the same time, it is recognized that the increasing openness and participation in governance have played a key role in the advances that have improved life for many people in many parts of the world.

This change of heart gives rise to more measured discussions about the seemingly inexorable spread of globalization in all of its forms. The realization grows that, even if it were possible, it would not be desirable to stem this tide completely. Around the world, from Latin America to Africa to West Asia, the re-examination of history leads to new approaches for dealing with the changes happening in and outside their regions. Inevitably, this re-think is influenced in part by the return of many former emigrants, for brief periods or permanently, who have gained experience and understanding of how cultures can learn from each other without losing their own identity.

A redefinition of roles …

With the growth in global public policy networks, governments, particularly at the national level, often find themselves trying to keep up with what is happening in other sectors and at other levels. In a sense, the leaders have become followers, although they continue to have significant roles. They remain responsible for setting and implementing overall national policy and negotiating and ratifying international treaties. Nation states remain the key players in the areas of national and international security. The public sector retains a pivotal regulatory role, as awareness dawns that *laissez faire* policies often promoted in the name of economic development do nothing to correct flaws in market practices. It also holds a brief to amend existing policies (notably subsidies for natural resource extraction) that encourage such imperfections.

Demand for more participation, transparency and accountability on all sides drives a number of policy shifts. A move away from reliance on exported raw materials towards producing more value added locally is highlighted in Latin America, Eastern Europe, Africa and parts of North America. Expansion of micro-credit and similar schemes is particularly important in the developing world, enabling small-scale producers and manufacturers to purchase the inputs needed to increase the scale and productivity of their operations. Another pattern that emerges worldwide is a shift in the nature of taxes and subsidies towards promoting more sustainable habits of resource use.

New opportunities arise from looking at problems on a larger scale, with a view to recognizing limits and identifying solutions. One example is the opportunity to couple the issues of ageing and shrinking workforces in Europe and parts of Asia and the Pacific, with continued population growth and migration pressures in other regions. Another involves drawing more conscious links between the issue of water stress and the trading of 'virtual' water in the form of agricultural products. This linkage is accorded high priority within susceptible regions, such as West Asia as part of the Arab Free Trade Association, but it also occurs in region-to-region discussions.

'The values of simplicity, cooperation and community begin to displace those of consumerism, competition and individualism.'

… and a redirection of actions

Actions are taken in many regions to preserve major biodiversity hotspots. In Europe and North America, major efforts are made to establish large-scale networks of protected areas and green corridors. Some of the most significant activities hinge on the management of common resources. Ocean fisheries receive greater attention. For this and other reasons, the high Arctic regions and the continent of Antarctica are increasingly recognized as part of a common global heritage. A fundamental revision of the Antarctic legal regime sets an example for similar action in the Arctic, where indigenous groups play a significant role, individually and through the Arctic Council. It becomes widely accepted that the polar regions have to be maintained as places apart, with special rules regarding human activity.

Cooperation on these and other issues also prompts moves to address the tensions at the root of many ongoing conflicts. Sometimes these conflicts and

their impact on other regions catalyse the formation of broad coalitions. The changing nature of security threats, as evidenced in the early part of the century and the pressures from businesses and other groups with strong cross-national connections, push nations towards increasingly multilateral efforts on many issues. At other times, the resolution and avoidance of conflicts are the results of networks and policies that have been established for other purposes. For example, as borders become more open and responsibility shifts from the nation state both downward to more local levels and upward to more multinational levels, many disputes in countries and in border areas in several regions, calm down or fade away entirely.

Underlying many of these shifts are policies to boost transparency and accountability. These policies include more and better certification and labelling requirements, often building upon efforts started by industry. The Forest Stewardship Council, Global Forest Watch and Marine Stewardship Council spawn similar efforts focusing on other resources. These efforts in turn influence other areas of policy, such as trade, foreign debt and the enforcement of multilateral environmental treaties. In the developing world, a major investment programme is undertaken to strengthen capacities of governments, businesses (especially small and medium enterprises), NGOs and local communities to develop, access and use information. These changes are reflected in increased monitoring and communication. As much as any other business sector, the commercial media has shifted away from a pure emphasis on profit towards establishing a broader role in society.

'What is new in the current discussion is the willingness of people to reflect upon the positive and negative aspects of their own actions and legacies as well as those of other cultures.'

There are also fundamental shifts in terms of how the data used to track development are measured, analysed and presented. Aggregate figures that hide discrepancies between, for example, genders and social groups, or between urban and rural areas, give way to more disaggregated data collection and reporting. The changes are highlighted by the continuing evolution of the United Nations System of National Accounts, especially the shift away from Gross Domestic Product as the major indicator of development. Environmental, economic and social indicators track real progress at all scales — business, national, regional and global — giving the public a more informed basis for seeking change. New technologies also play a big role, both as catalysts for, and in response to, many of these changes.

Developments in information and communication technologies enable groups to connect to and learn from each other, by sharing success stories, but also by exposing behaviour, whether legal or illegal, existing or planned, that gives cause for disquiet. These technologies also become more instrumental in coordinating social, political and economic activities. They are the natural medium for a new consciousness, providing a sense of immediacy and unity to a diverse and pluralistic movement.

New technologies play an instrumental role in progress towards goals already set. Among such advances are improvements in energy and water use efficiency, desalination and medical technologies and treatment. These breakthroughs are closely linked to general developments in the areas of nano-technology and biotechnology. Governments, businesses and other private organizations stimulate much of the technological development, not only by direct investment in research and development, but also by offering worthwhile prizes for new developments.

In the areas of biotechnology and genetic engineering, there is strong awareness of potential issues related to biosafety, bioterrorism and moral concerns. Biotechnology also becomes increasingly linked to biodiversity research within regions. Concerns over genetic engineering continue to run high, but they are eased somewhat as developments in this area take on a more regional profile, both in terms of who is undertaking and benefiting from the research and the raw materials used in the processes. Carefully controlled studies in many regions, including Asia and the Pacific, West Asia, Latin America and the Caribbean and Africa, highlight the use of endemic resources.

Small and large businesses, in partnership with NGOs, provide valuable support in setting standards and guidelines, technology transfer and mentoring programmes. They also take greater responsibility for the whole life cycle of projects and products. This includes not only activities related to normal practice, but also those related to infrastructure

development, recovery of post-consumption wastes, capacity building and preparing employees and communities for periods of transition, such as when projects end or operations shift to another locality.

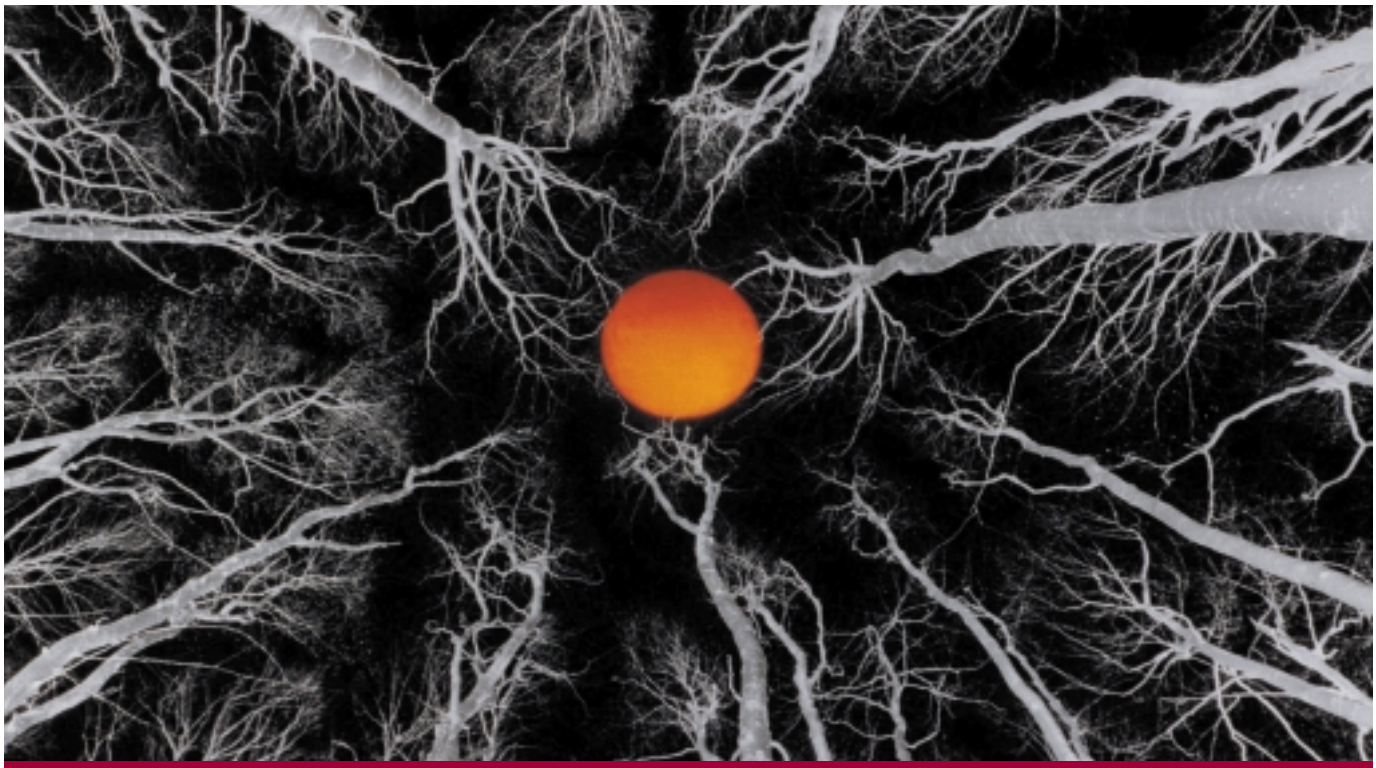
No turning back?

These widespread changes unfold at different rates in different regions. By the year 2032, some shifts are already well on the way to a new, more stable level of functional completion, while others are only beginning to take off. Although there have been setbacks, these have not been major or widespread. The reason for this smooth passage lies in the nature of the process which, while somewhat chaotic and unplanned at times has been driven from the grass roots up with strong support at higher levels. The degree of participation between governments and society, and the ongoing evolution of basic beliefs have been instrumental in allowing governments to pursue policies that would not otherwise have been possible. Examples are the establishment of land and marine sanctuaries and major shifts in the constructive use of tax breaks and penalties.

Furthermore, as businesses, NGOs and governments, working together or apart, achieve notable success, they push for action to encourage others to follow. The evidence of these accrued benefits helps governments in taking action, as they make it very difficult for those who are opposed to them to argue against the feasibility of meeting new targets. And as formal actions are taken, they act as a ratchet, keeping the advances from slipping back.

'New technologies play a big role, both as catalysts for, and in response to, many of these changes.'

The interlinked sets of changes that have occurred during the first three decades of the new millennium are clearly part of a broad societal transformation. Although no one would argue that sustainability has been achieved, there is a clear sense that the world is moving in the right direction and there is no turning back.



UNEP, Ben, Still Pictures

Environmental implications

The foregoing section of this chapter presented stories of four possible futures. Elements of each can be observed in today's world, as can the trends and drivers that could push the world in the direction of one or another of them. Which scenario — or which mixture of scenarios — prevails in reality is a matter partly of contingency and partly of choice.

This section illustrates what the four scenarios can tell us about the consequences of policy and management for the environment over the next three decades. The pressures exerted on the environment, the changes in its state and the impacts on people differ from one scenario to the next. When interpreting the results it should be remembered that not all natural and human systems operate on the same time scale: both feature fast, medium and slow processes. Hence some of the effects of our actions emerge only slowly and much of what will happen in the next 30 years has already been determined. Decisions made over the next 30 years will have significant impacts and implications that reach far beyond this period.

Quantitative material is included to help illustrate the trends that would be expected under each scenario. The quantitative results presented here as charts and diagrams have been derived, in consultation with regional experts, using a range of analytical tools. The results underline the magnitude of the challenges we face in developing environmentally relevant policies for the future. The emphasis is on general trends and the proportional differences under different scenarios, rather than on the precise levels of impacts. More details of the analytical tools used and the variables presented are provided in the technical annex to this chapter.

Certain environmental implications only make sense when viewed at the global scale. It is important to remember, however, that the origins of these global effects are often local, national or regional. The initial global perspective of environmental implications presented below also provides a backdrop for the more detailed examination of the environmental outlook that follows for each region. A box in each regional section outlines a fictitious, but plausible, region-specific 'event' and examines how the event might play out under the four scenarios. Also summarized is the impact that different policy approaches have on the possible outcomes of the event.

Key to charts

Markets First

Policy First

Security First

Sustainability First

Implications: Global

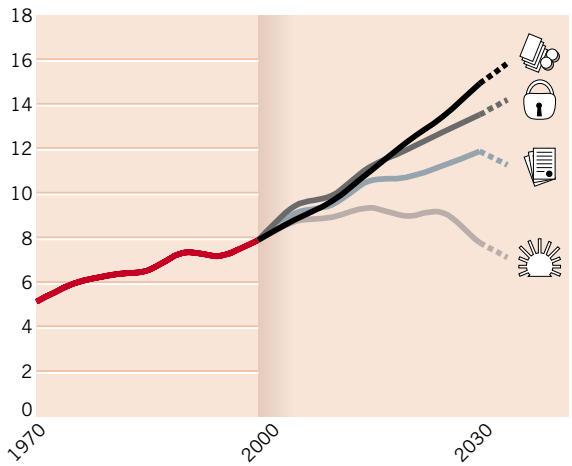
Climate trends

Climate change is one of the most pressing and complex global environmental issues to come to the fore in the past 30 years. The absence of effective policies to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases in the *Markets First* and *Security First* scenarios, as well as slow transfer of technology under the latter, leads to significant increases in CO_2 emissions over the next 30 years (see chart, right). The effects of the economic troubles in a *Security First* world push down per capita energy consumption and lead to the slower emission growth seen at the end of this period. The policy actions taken under a *Policy First* scenario, notably carbon taxes and investments in non-fossil-fuel energy sources, effectively curb growth in global emissions. Actual reductions would start around the year 2030. The dramatic behavioural shifts implied under *Sustainability First*, in conjunction with significantly improved production and conversion efficiencies, result in a very rapid levelling off of emissions followed by a decline by the middle of the 2020s.

Because of time lags in the climate system, these changes in emission patterns will have a delayed effect on the atmospheric concentrations of CO_2 and even more so on the actual changes in climate. Even by the year 2050, some 20 to 25 years after the start of the decline in emissions in the *Policy First* and *Sustainability First* scenarios, the atmospheric concentrations are only beginning to level off in *Sustainability First* and have yet to do so in *Policy First* (see chart). Carbon dioxide trajectories in *Markets First* and *Security First* continue to climb rapidly, reflecting the weak policies and lack of behavioural changes in these scenarios.

The rate at which climate is changing is indicated by the rate of change in average global temperature (see chart, overleaf). The relatively long delay in the response of the climate system shows up in the relatively small differences between the scenarios in their early stages. This figure also reflects the complexity of this issue. There are strong links between climate change and other environmental issues, specifically local and regional air pollution. Reduction in emissions of sulphur dioxide (SO_2), for example, leads to temperature increases which can temporarily more than offset the effects of reducing

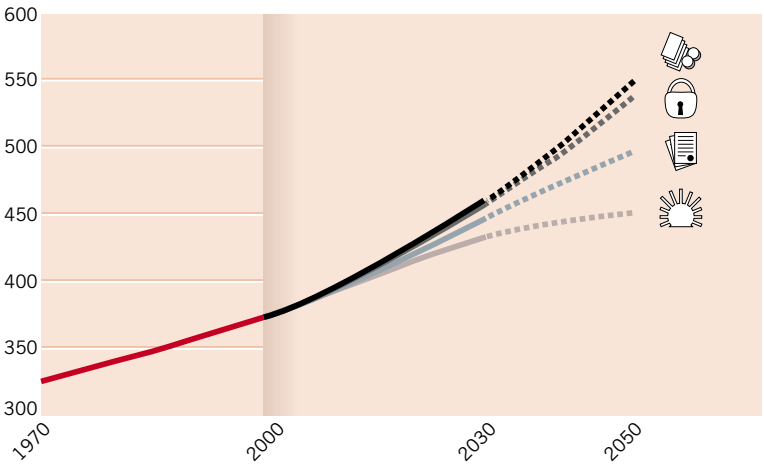
Carbon dioxide emissions from all sources (billion tonnes carbon/year)



Carbon dioxide is emitted above all from the use of fossil fuels. For all four scenarios, it is assumed that stabilization of primary energy use is first reached at the end of the 21st century.

Source: IMAGE 2.2 (see technical annex)

Atmospheric concentrations of carbon dioxide (parts per million by volume)



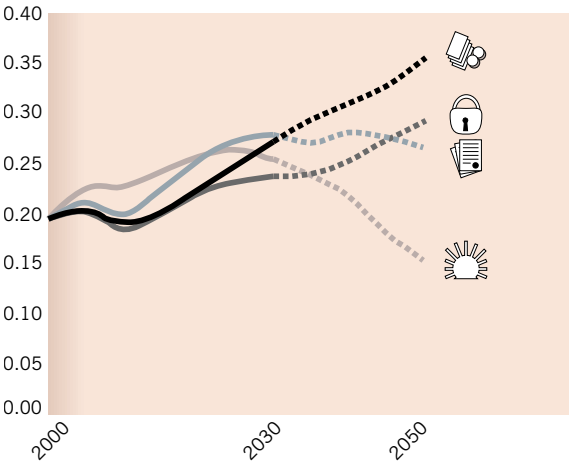
CO_2 emissions. The higher rates of temperature change in the *Policy First* and *Sustainability First* scenarios between now and 2032 reflect the successful implementation of SO_2 reduction policies in these scenarios. In the longer term, however, the dynamics in a world resembling *Markets First* or *Security First* imply much faster and greater overall temperature rises, whilst the rate of temperature increase slows down in *Sustainability First*.

Delays in the response of the climate system are also apparent in other ways. For instance, by 2032, there is very little difference between the scenarios in terms of sea level rise. The total increase since the beginning of the century is approximately 10 cm, yet this level and rate of rise has serious implications for

The build-up of greenhouse gases follows trends in emissions but the stock has a long life span once in the atmosphere. Only the *Sustainability First* scenario is on a trajectory to stabilize at 450 ppm (parts per million) carbon dioxide equivalent.

Source: IMAGE 2.2 (see technical annex)

Global temperature change (°C per ten years)



Temperature change up to the 2030s can no longer be avoided. In all scenarios its rate far exceeds 0.10°C per ten years — the level above which damage to ecosystems is likely.

Source: IMAGE 2.2 (see technical annex)

coastal and low-lying regions throughout the world, implying that adaptation measures are important to consider along with attempts to reduce emissions.

Ecosystems under pressure

Biodiversity preservation represents another major environmental challenge at the global level. Without strenuous policy action, humans continue to develop more of the planet, reducing and fragmenting natural ecosystems. The built-up area increases in nearly all regions and scenarios, the only exceptions being North America and Europe where the area declines slightly in *Sustainability First* (see chart opposite).

Lack of effective controls, including realistic price hurdles to urban land expansion, is most evident in the *Security First* scenario. The percentage of built-up land may seem small, but the infrastructure network (roads, power lines, airports, harbours and dams) that supports these sites affects much larger areas and also sees dramatic expansion over the next 30 years (see chart opposite and maps on page 354). The introduction of such infrastructure can lead to uncontrolled resource exploitation often linked to hunting and poaching, deforestation, land and water degradation, growing of illegal crops, tourism and land conflicts. In both *Markets First* and *Security First*, these resource-driven processes accelerate, with rapid losses of remaining wilderness areas and severe impacts on biodiversity and indigenous peoples. A *Policy First* world continues to protect additional areas and introduce mitigation measures. It does so, however, at rates far below that of development, as in the previous century. Even under *Sustainability First* conditions, increasing impacts from infrastructure — the modern world's central nervous system — as well as continued growth in human consumption of fuels, minerals and goods and services from natural resources, cannot be completely avoided. However, levels may stabilize across the 30-year period.

Together with the growing impacts of climate change, these developments severely deplete biodiversity in most regions in all scenarios (see maps on page 355). One particularly troublesome result related to climate change is that significant areas are at risk because the natural vegetation cannot adapt to the rates of change in temperature and precipitation.

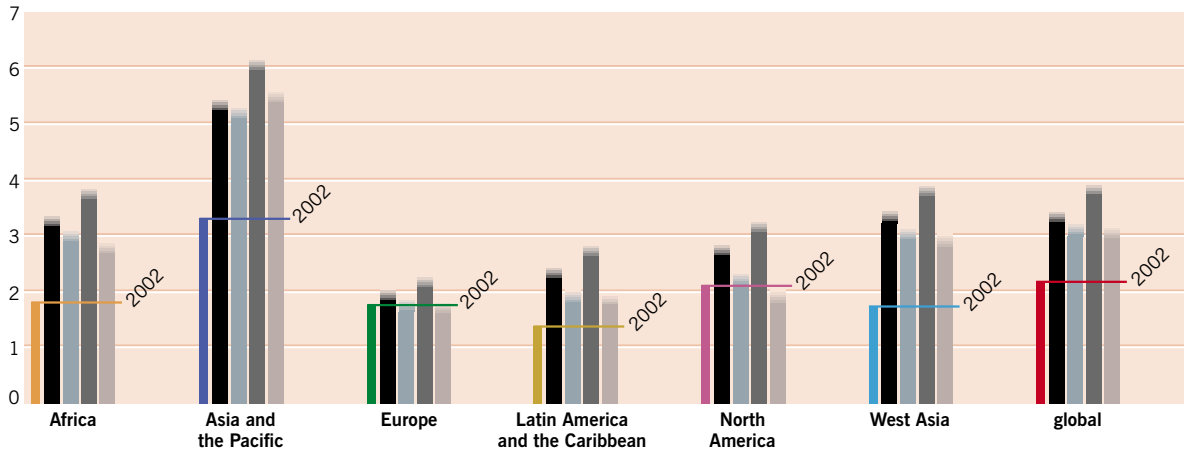
Some change for the worse appears unavoidable in almost any scenario that can be considered for the next 30 years. Nevertheless, reductions in the emission of greenhouse gases, coupled with bold conservation initiatives, including the following, can have a significant limiting effect on the impacts:

- a sharp reduction in further expansion of infrastructure into remaining wilderness areas;
- curbs on further fragmentation of already impacted areas;
- implementation of mitigation measures to reduce impacts on biodiversity from existing networks;
- introduction of potentially costly restoration measures; and
- demarcation of wide buffer areas around nature reserves.

Pressures also increase on coastal ecosystems in most regions and scenarios. In addition to pressures from the direct exploitation of resources in these areas, there are also impacts from coastal infrastructure and land-based sources of pollution (see chart on page 355). These pressures are especially large in Asia and the Pacific, where they stem from various sources, dominated by agricultural activity. West Asia also faces rising pressures under *Security First* and *Markets First* conditions, but generally sound water management practices in the region have a very positive effect, especially in *Sustainability First*.

In Europe the Mediterranean coast comes under special pressure through a combination of urban growth with inadequate waste water treatment facilities, tourism and intensively farmed croplands

Extent of built-up areas (% of total land area)



Population growth and urbanization are drivers of expanding land use for human settlements. Asia and the Pacific, Africa and West Asia see big increases to 2032, irrespective of scenario.

Source: PoleStar (see technical annex)

close to major river mouths. Latin America and the Caribbean currently features minor pressure from land-based sources of pollution along much of its coastline, compared to other regions, but this rises sharply over the coming years. North America and Africa also start from a relatively low base, but certain areas, such as the mouths of large river systems like the Mississippi and the Nile are of key concern.

Pressure on people

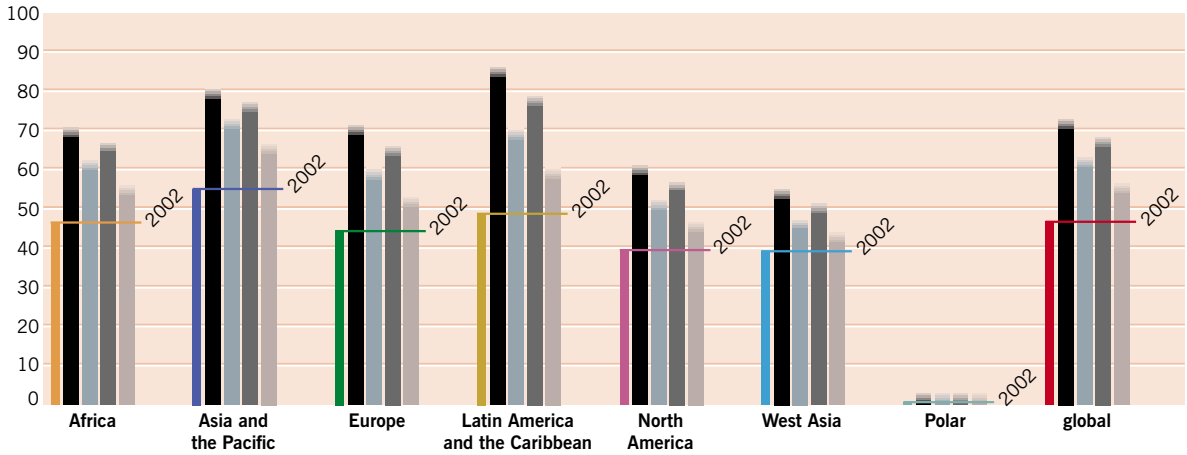
The scenarios carry important implications for the provision of basic human needs that are related to broader environmental impacts. In the longer term, global climate change can have a strong impact on the local availability of freshwater. Meanwhile, growing populations and increased economic activity, particularly in agriculture, lead to increased demand for freshwater in most scenarios.

Permutations of these pressures determine those areas and populations that face the greatest challenges in meeting needs. Outside North America and Europe, these challenges increase in all scenarios, along with a trend toward more extreme water stress (see charts on page 356). Differences in policy actions, such as reforms in the pricing of water and shifts in subsidies, and technological improvements can have a strong effect on the size of these challenges. The ability to meet these challenges reflects broader social and economic policies.

Under the *Markets First* and *Security First* scenarios, the number of people living in areas with severe water stress increases in both absolute and

Key to charts

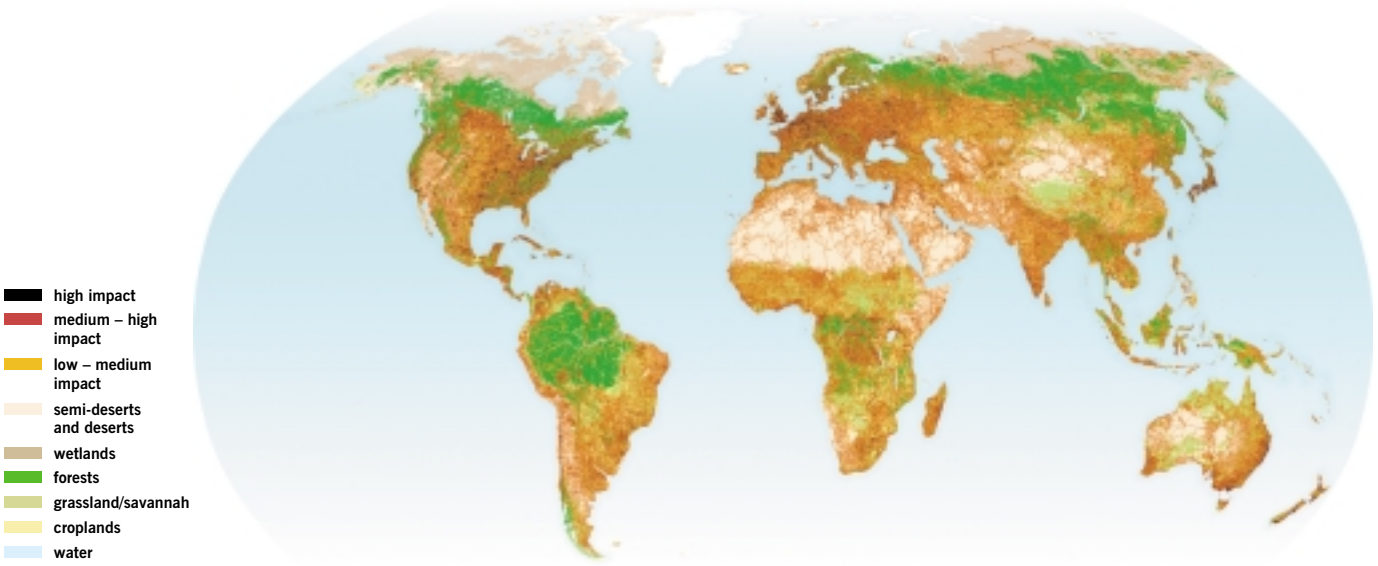
Land area impacted by infrastructure (% of total land area)



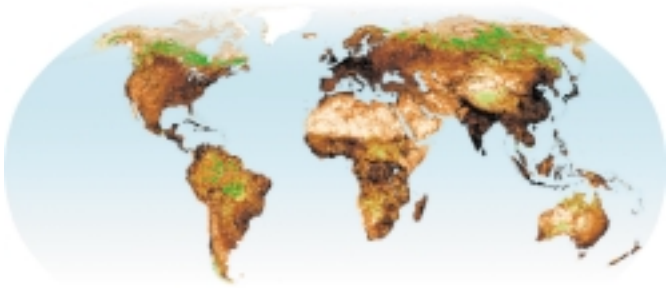
Human demands for resources and transportation continue to impact on biodiversity and ecosystem function up to 2032.

Source: GLOBIO (see technical annex)

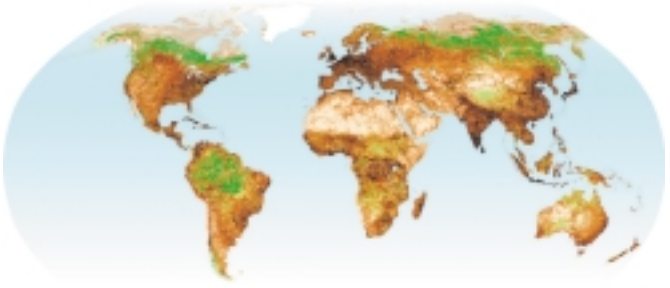
Ecosystems impacted by infrastructure expansion 2002



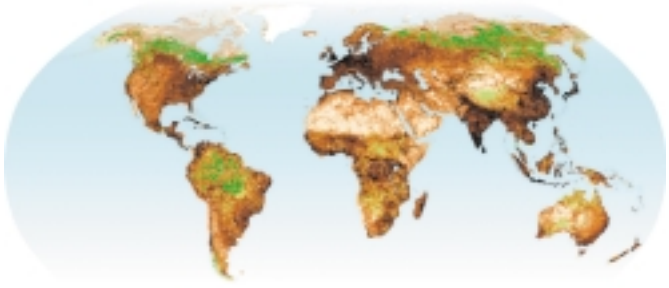
Markets First 2032



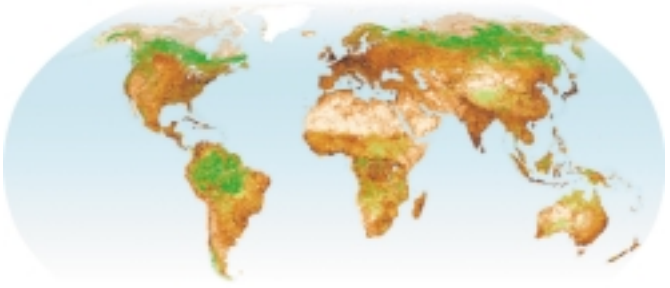
Policy First 2032



Security First 2032



Sustainability First 2032

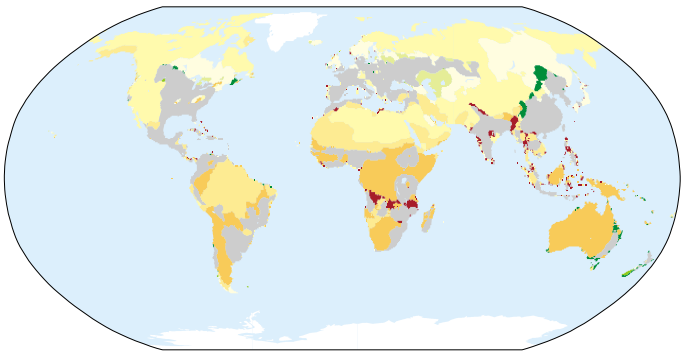


Human resource demand continues to take an ever-greater toll on biodiversity. Land-use induced impacts are most often associated with existing infrastructure. In a *Markets First* scenario, biodiversity comes under threat in nearly 72 per cent of the land area by 2032. The situation is particularly critical in Southeast Asia, the Congo Basin and also parts of the Amazon. The pattern is however evident across all continents and terrestrial ecosystems with the exception of tropical and polar deserts. As much as 48 per cent is directly converted to agricultural land, plantations and built-up areas, compared to 22 per cent today, suggesting widespread depletion of biodiversity. Even the *Sustainability First* scenario suggests continued biodiversity loss across nearly 56 per cent of the land area by 2032.

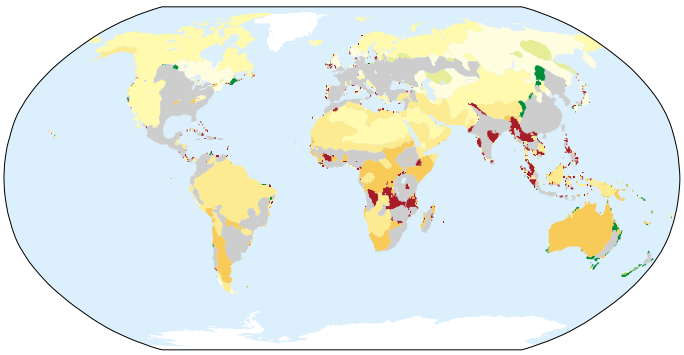
Source: GLOBIO (see technical annex)

Change in selected pressures on natural ecosystems 2002–32

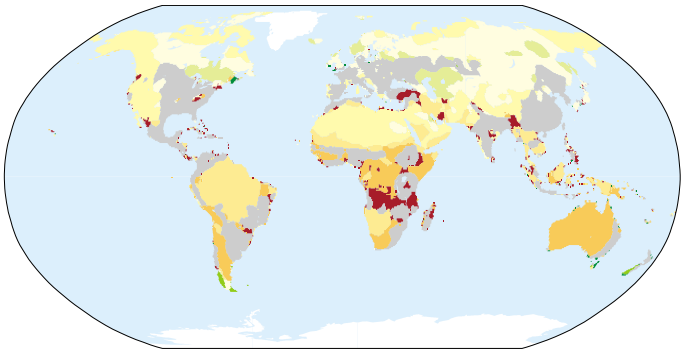
Markets First



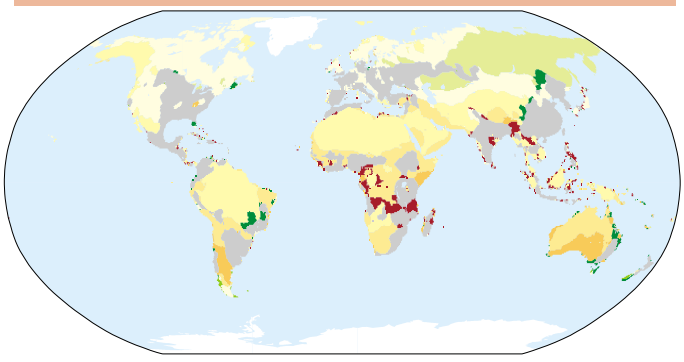
Policy First



Security First



Sustainability First



Pressures (population density, density of energy use, clear cutting, rate of temperature change)

substantial decrease | no change | substantial increase
small decrease | small increase | strong increase

Overall change in land use

from domesticated to natural area | remains domesticated
from natural area to domesticated area | ice and polar area/no data

The maps picture the combined effect of habitat loss and decreasing quality. *Security First* features a large conversion of natural into agricultural land. By 2032, this conversion is in full motion, especially in the Southern Hemisphere. The *Markets First* scenario sees a strong decrease of the quality of nature in most regions. In some regions agricultural land is taken out of production and presumed to be reconverted into natural area. However, in biodiversity terms this reconverted land is of low quality during the first decades or longer. *Policy First* and *Sustainability First* show roughly comparable results in the scenario period. But their trends by 2032 are different, with *Sustainability First* moving towards a sharp decrease in pressures.

Note
These maps show the change in pressure between 2002 and 2032, relative to the 2002 situation. The development of the biodiversity situation in absolute terms is shown in the regional bar charts. For example, the increases in pressures in Australia and New Zealand are large in relative terms because the pressures in 2002 are small. The reverse applies to West Asia.

Source: IMAGE 2.2 (see technical annex)

Potential increase in nitrogen loading on coastal ecosystems

	North America	Latin America and the Caribbean	Africa	Europe and Central Asia (without Turkey)	West Asia (with Iran and Turkey)	Asia and the Pacific (without Iran)
Markets First	●●	●●●	●●	●●	●●●	●●●
Policy First	●	●●●	●●	●	●	●●●
Security First	●	●●	●	●	●●	●●
Sustainability First	●	●	●	●	●	●●

Expected increase by 2032 ● small ●● large ●●● very large

Nitrogen loading can be taken as a proxy for a wider range of land-based pollution on coastal ecosystems. Currently it is especially large in East Asia, and Western and Central Europe and along the Mediterranean coast of West Asia and Northern Africa.

Source: IMAGE 2.2 (see technical annex)

Key to charts

Markets First

Policy First

Security First

Sustainability First

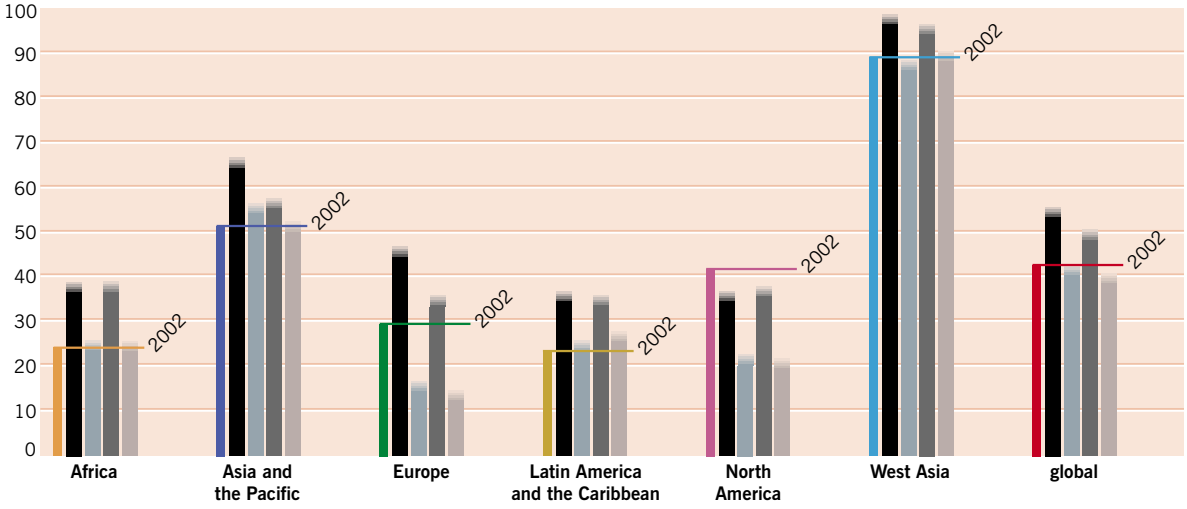
When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress.

Source: WaterGAP 2.1 (see technical annex)

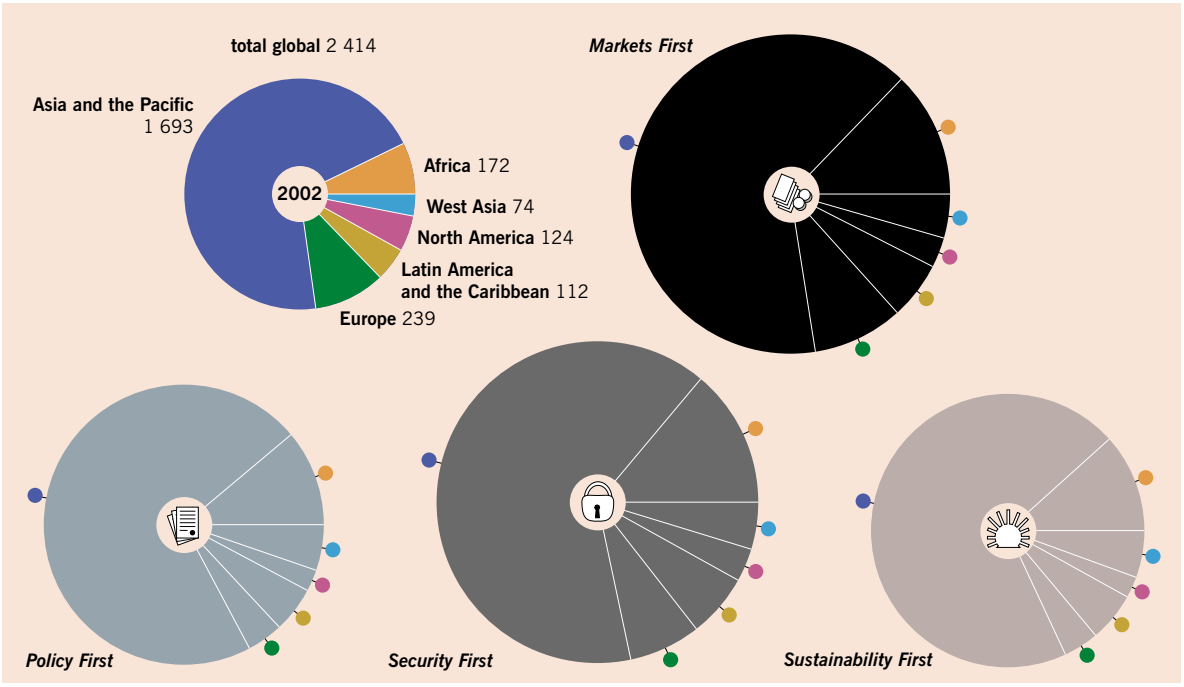
All the pie charts show total global impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: WaterGAP 2.1 (see technical annex)

Population living in areas with severe water stress (%)



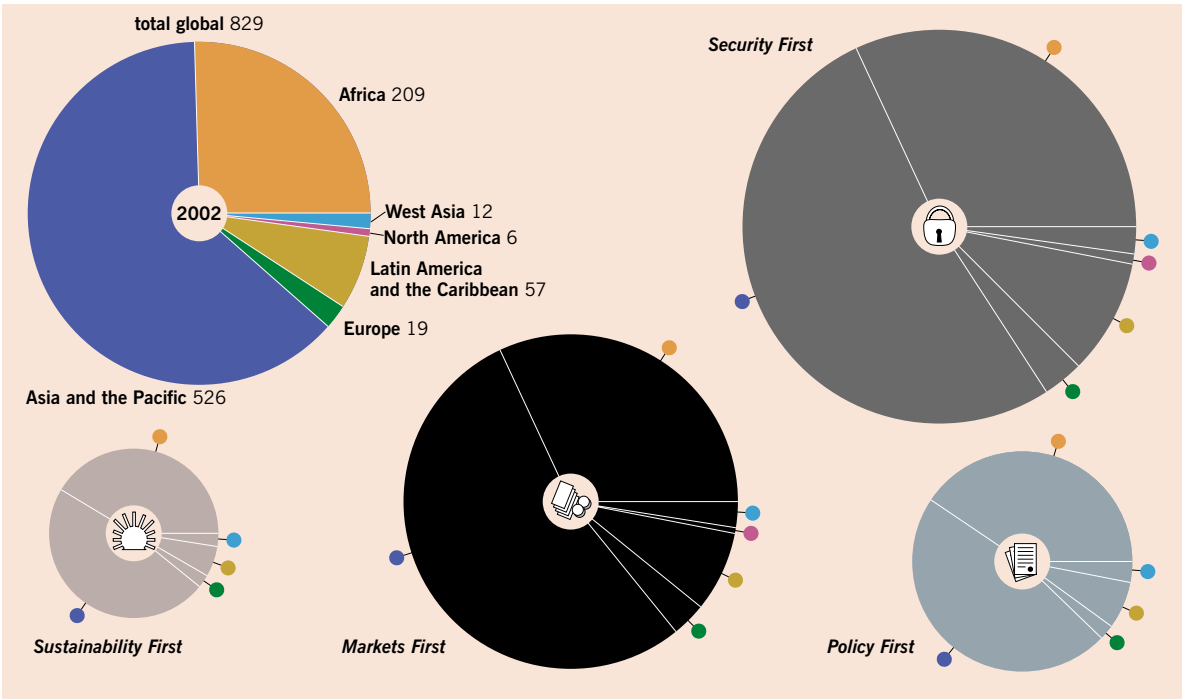
Number of people living in areas with severe water stress (million persons)



relative terms in almost all parts of the world. These increases are partly due to continuing population growth in water-stressed areas and partly due to new areas experiencing severe water stress (namely large parts of Africa, North and Latin America and Europe). The situation is different under the *Policy First* and *Sustainability First* scenarios. In most regions the actual area under severe water stress remains more or less constant or even decreases, due to stable or decreasing water withdrawals, particularly for irrigation. This results in little change in the overall proportion of people living in water-stressed areas by 2032. Nevertheless, the absolute number of people living in water-stressed regions increases significantly across the developing world.

Similarly, the size of demands for food and the ability to meet them in the different scenarios reflects a combination of shifts in supply and demand, which

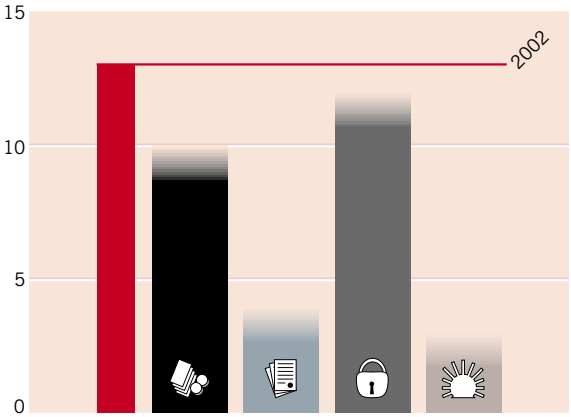
Population living with hunger (million persons)



All the pie charts show total global impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: PoleStar (see technical annex)

Population living with hunger (%)



A world of *Markets First*, although by no means equity-oriented, would reduce the percentage of the population living in poverty, and with it hunger. But in some regions, most notably in Africa, this does not counterbalance population growth. Committed action towards achieving social goals could bring hunger levels back into line with global targets in the Millennium Declaration.

Source: PoleStar (see technical annex)

can be influenced by social, environmental and economic policies. In a *Markets First* world, even with decreases in the percentage of the population facing hunger, the total number affected changes relatively little and even increases in some regions as populations grow (see charts). The targeting of hunger reduction as a key goal under the *Policy First* or *Sustainability First* scenarios, and the general emphasis on more balanced development between regions, helps to achieve dramatic reductions in both the percentages and the total numbers of people affected. The sharp increases in most regions in *Security First* points to the unsustainability of such a scenario in terms of social acceptability.

Implications: Africa

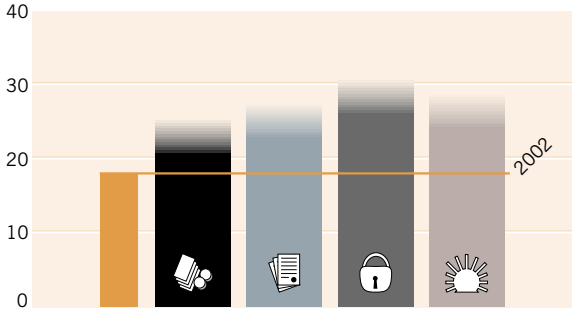
Poverty is endemic in many areas of Africa and a rapidly growing population continues to rely on natural resources and agriculture for much of its economic productivity and for the provision of basic human needs. These conditions leave the region highly vulnerable to adverse impacts of environmental change. Further insights are offered below into what the scenarios mean for land, forests, biodiversity, freshwater and coastal and marine resources, all crucial to the sustainability of Africa's economies and livelihoods. Also explored (see box, page 362) is the destiny under each scenario of an African Environmental Protection Commission, established under the recently formed African Union.

Land hunger bites

Growing populations, economic development and changes in climate all contribute to increasing the risk of land degradation in much of Africa (see chart below). Stronger economic growth in the region under *Policy First* and *Sustainability First* conditions, implies that the risk of land degradation is higher than in *Markets First*. The sharper increase apparent in *Security First* reflects the greater area of land brought into agriculture under this scenario in order to meet the demands of the still rapidly increasing population. It also indicates relative inability to fall back on food imports and diminishing rates of return from improving agricultural practice.

The translation from risk to actual degradation may be mediated in a number of ways, however (see chart). Cropland has been extensively degraded in the past in Africa due to salinization, wind and water erosion. In the worlds of *Policy First* and *Sustainability First*, easier access to support services helps farmers to manage soils better, curtailing problems like compaction, erosion and salinization. Policies based on integrated land use management, including more stable land tenure systems, become commonplace in most parts of the region. Technological advances prompted by a combination of government incentives and private sector innovations, help improve productivity of degraded land. The slightly higher level of degradation in *Policy First* versus *Sustainability First* reflects slight differences in demand for food — particularly animal products. At the other end of the spectrum, in a *Security First* scenario, a combination of inequitable land distribution, poor farming methods, unfavourable land tenure systems and inefficient irrigation systems leads to declining productivity of grazing and agricultural lands. Better conditions are, however, maintained in the protected areas serving the elite. The concentration of large numbers of people in fragile areas beyond the control of the land-owning elite further contributes to the degradation of land and severe soil erosion. Similar problems arise in a *Markets First* situation as better quality agricultural land is taken over for commodity and cash crop production. The environment suffers as a result as soils are 'mined' and the use of fertilizers and pesticides becomes more extensive. Water resources and aquatic ecosystems are particularly damaged.

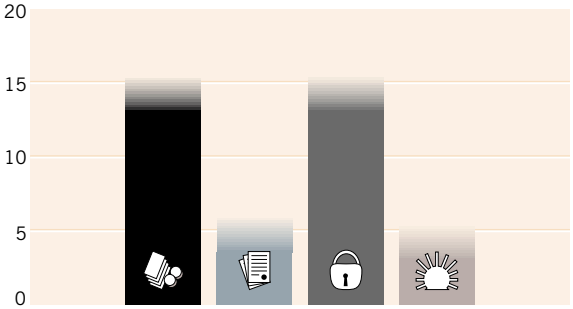
Area with high risk of water-induced soil degradation: Africa (% of total land area)



Africa is at high risk from water-induced soil erosion, except for Northern Africa where low rainfall keeps the risk extremely low. The area under risk grows considerably in all scenarios as a result of intensifying agriculture, combined with adverse consequences of climatic change.

Source: IMAGE 2.2 (see technical annex)

Percentage of 2002 cropland severely degraded by 2032: Africa



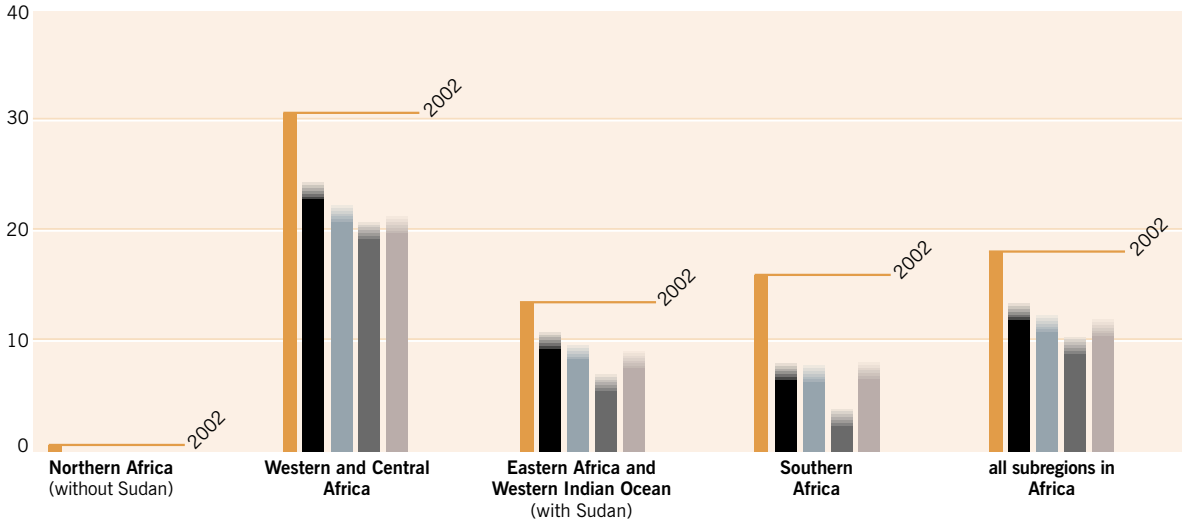
Bars represent the percentage of 2002 cropland that has become so degraded by 2032 that it is of little value for production.

Source: PoleStar (see technical annex)

Forests in flux

Much of the increased demand for food is met by conversion of forests to cropland. This is reflected in both loss of total forest area and increased exploitation of remaining forests (see chart opposite). Patterns of forest loss vary by sub-region. Very little natural forest remains in Northern Africa in any of the scenarios.

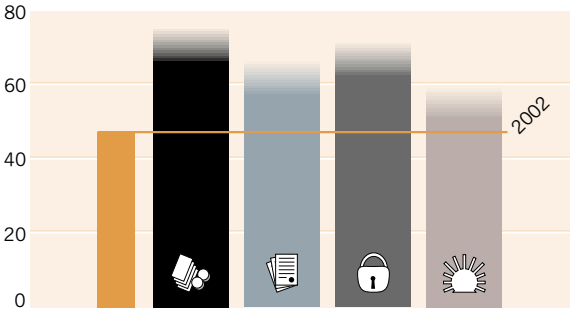
Natural forest, excluding regrowth: Africa (% of total land area)



Conspicuous deforestation can be expected in Africa, especially in a *Security First* scenario.

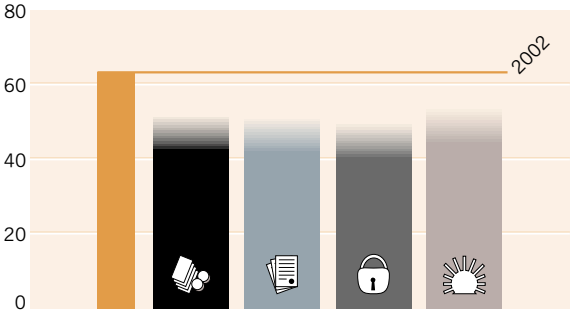
Source: IMAGE 2.2 (see technical annex)

Land area impacted by infrastructure expansion: Africa (% of total land area)



Source: GLOBIO (see technical annex)

Natural Capital Index: Africa



An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity. Pressures on biodiversity increase between 2002 and 2032 in all scenarios.

Source: IMAGE 2.2 (see technical annex)

Key to charts

Elsewhere, the percentage losses are greatest in Southern Africa, but the total losses are higher in Western and Central Africa given their larger forest areas. The lack of political and market controls in a *Security First* scenario, results in the worst forest and woodland losses. Some areas are protected for the exclusive benefit of the elite, but elsewhere forest resources are overexploited for the export market. Poverty leads to overexploitation of the remaining natural forest resources for fuel, food, medicines and shelter. In a *Markets First* world, advances in agricultural efficiency and the efforts of governments and business to protect forests that serve as the backbone of an expanding forest products industry, actually keep the losses somewhat lower than in a *Policy First* world. In the latter scenario, however, benefits from the products of the forest are more broadly shared and the degree of exploitation is not as damaging. Similarly, community-based natural resources management, including reforestation programmes, help to limit the total losses in both *Policy First* and *Sustainability First* scenarios.

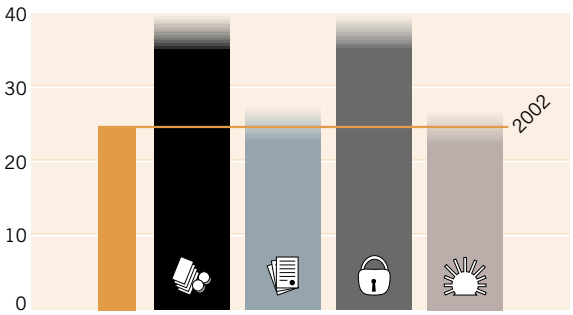
Biodiversity besieged

Along with expanding infrastructure (see chart) and climate changes, land transformations leading to fragmentation and loss of habitats play a key role in determining the future of biodiversity. The combined pressures result in a lowering of Natural Capital Index in all scenarios (see chart). Strenuous efforts are made to control the degree of fragmentation in *Policy First* and *Sustainability First* even as the amount of land

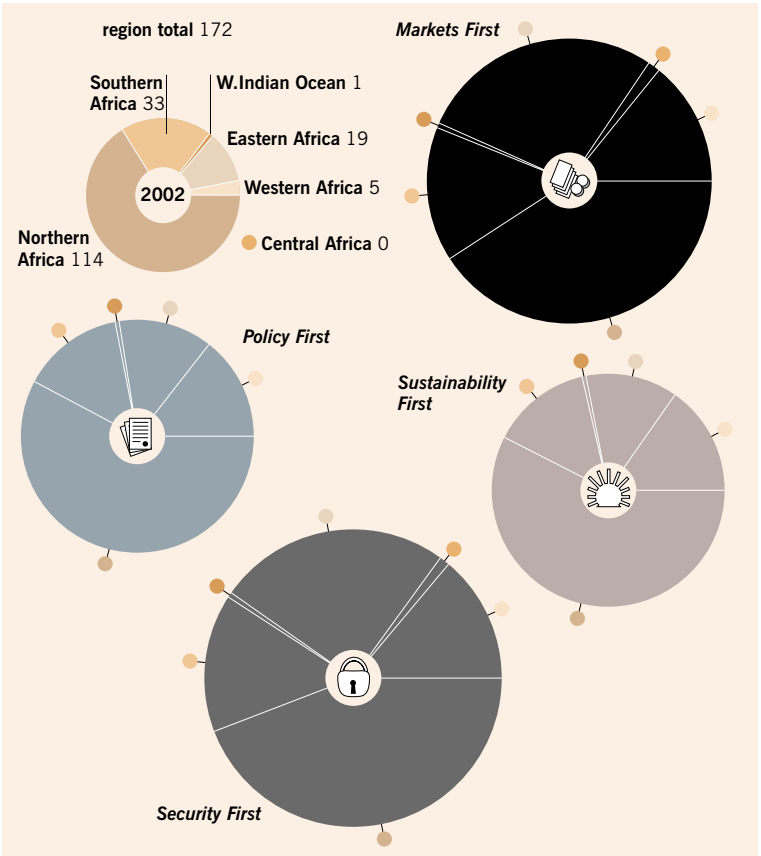
When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress.

Source: WaterGAP 2.1 (see technical annex)

Population living in areas with severe water stress: Africa (%)



Number of people living in areas with severe water stress: Africa (million persons)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: WaterGAP 2.1 (see technical annex)

converted grows to meet the demands of increasingly better-off populations. Even in these cases, biodiversity loss is unavoidable in the short term, particularly from the effects of climate change.

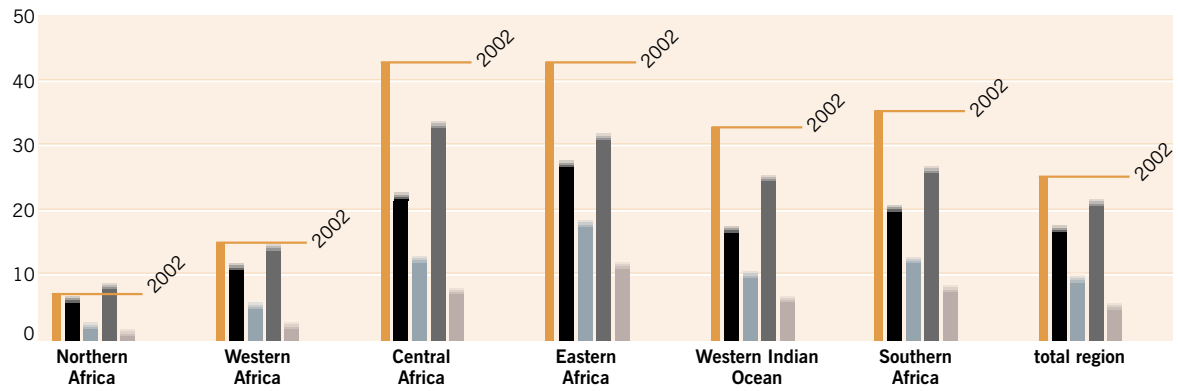
Although policy efforts are not quite so determined in a *Markets First* world, the protection of commercially valuable natural areas and improvements in agricultural technology provide some benefit. In a *Security First* scenario, regulatory and trade mechanisms such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) break down completely, resulting in more illegal trade in endangered species. This setback spurs further loss of biodiversity, both directly and indirectly. As populations of key species are driven to extremely low levels, the ecosystems become increasingly fragile and vulnerable to slight changes in climate and other factors. At the same time, more coercive efforts, including the use of public and private armies, do allow for the protection of strategic areas.

Water and food: gains and strains

With a growing population and economy, the demand for water in the region is expected to grow in all scenarios. Policies regarding water pricing and technological advances may temper this in all scenarios other than *Security First*. Under the *Markets First* scenario, total water withdrawals are expected to nearly double in Africa, with particularly high increases in sub-Saharan Africa. The rise in water use linked to economic growth will outpace any savings on a per unit basis in both agriculture and industry. Similar increases are expected under *Security First* conditions, although conflicts between nations and the generally slow growth in the economy will slow the increased demand somewhat. Controls are largely absent outside of the wealthy enclaves, although pollution from these enclaves is likely to increasingly affect other areas. On both the *Markets First* and the *Security First* horizons, the African population living in areas under severe water stress increases to around 40 per cent (see charts). An especially steep rise in the number and percentage of people affected occurs in Eastern Africa, as rising water withdrawals in the Upper Nile river basin bring it into the severe water stress category under both scenarios.

Water withdrawals increase in most of sub-Saharan Africa under the *Policy First* and *Sustainability First* scenarios, yet by considerably less than in the other two scenarios — due to a combination of technology transfer and additional policies that encourage water savings. With such

Population living with hunger: Africa (%)

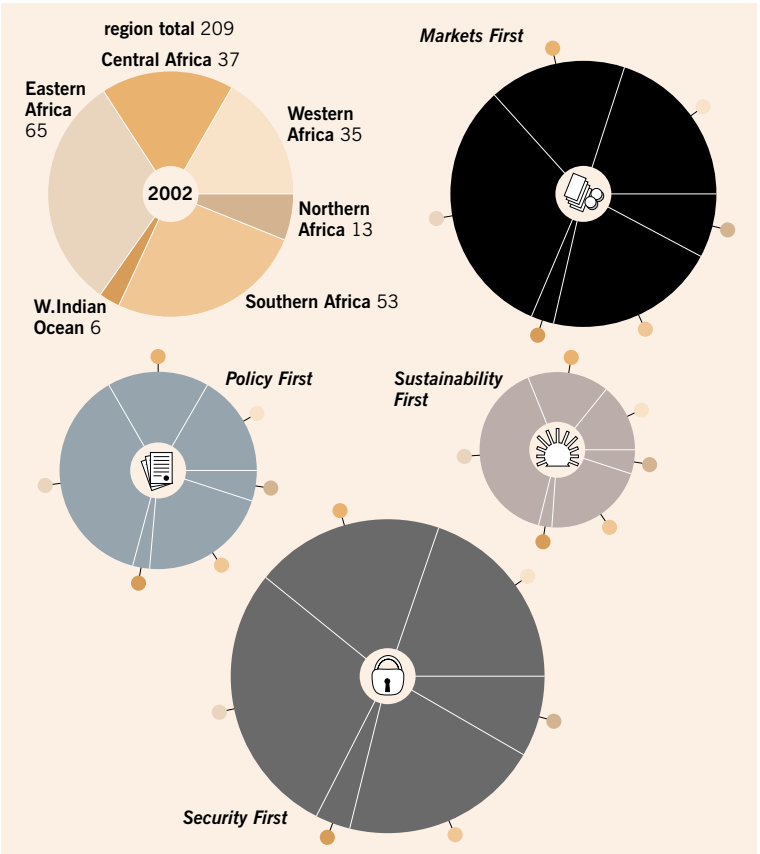


Key to charts

Average incomes rise in all sub-regions, contributing to a drop in the percentage of the population that is hungry. However, rapid population growth can lead to an increase in the hungry population, even as the percentage hungry declines.

Source: PoleStar (see technical annex)

Population living with hunger: Africa (million persons)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: PoleStar (see technical annex)

policies in place, even water withdrawals in Northern Africa are tempered, mainly by restructuring the irrigation sector. Efforts are made to enhance transboundary basin-wide management of water resources, and water quality issues receive particular attention by policy-makers, especially as these are linked to human health. Nevertheless, as population growth continues, the number of people living in areas with severe water stress still doubles in Africa under these two more reform-oriented scenarios.

The net result of all these effects is that the numbers of people living in areas experiencing severe water stress increase in all sub-regions in all scenarios, but most notably in *Markets First* and *Security First*. The percentage of people affected rises only slightly in *Policy First* and *Sustainability First* for the region as a whole, but varies within the region. Southern Africa, for example, sees a decline in these scenarios whereas Western Africa has a marked increase. Under *Markets First* and *Security First* there is an increase in all parts of the region except the Western Indian Ocean islands. In all scenarios, the most striking increases, in terms of percentages of the population affected, occur in Eastern Africa. Arid Northern Africa continues to have the highest percentage of the population impacted, whereas wet Central Africa and the Western Indian Ocean Islands have the fewest. Of course, the ability to cope with the stresses on freshwater supply will differ across the scenarios and sub-regions.

Trends in water and land, along with more broadly distributed economic growth and effective social and economic policies, are reflected in the incidence of hunger in the region (see charts). Although the

percentage of people experiencing hunger falls in all scenarios, the reduction is more than offset by a rise in total population in *Markets First* and *Security First* over this period. In *Security First* the numbers of people at risk rise by more than 50 per cent. Rising inequality in both scenarios serves to negate any benefits of economic growth. Dramatic improvements are possible, though, as seen in *Policy First* and *Sustainability First*. A key here is the broader distribution of economic growth, both between Africa and other regions, but also within Africa itself.

Increased food aid and reduced conflict also have direct effects. The fundamental shifts in *Sustainability First* allow the total numbers to be cut by more than half. Despite the progress made, however, certain sub-regions remain problematic. Most notably, hunger levels in Eastern Africa remain above 10 per cent, even under *Sustainability First*.

Imagine … an Environmental Protection Commission for Africa

The African Union (AU) established by African countries in 2001 to replace the Organization of African Unity launches an African Environmental Protection Commission (AEPC) in the near future. The activities of the African Ministerial Conference on the Environment (AMCEN) are subsumed within the AEPC. The goal of this body is to be an environmental watchdog in the region with powers to monitor and sanction states violating regional and sub-regional environmental agreements and threatening sustainable development in the region.

This is the first time that African countries have a regional organization specifically dealing with environmental issues. Although it falls under the aegis of the AU, the AEPC charter guarantees its autonomy from political influence, though member states contribute directly to its budget. The mandate of the AEPC is to not only promote the adoption of new regional and sub-regional environmental agreements, but also monitor national-level implementation through sub-regional organizations. Strong links are established with the United Nations Environment Programme.

In the case of …

Markets First

- Enforcement of conventions and protocols is compromised by the need to encourage foreign direct investment.
- Rising debt in the region fuels destructive natural resource exploitation in defiance of policy responses to Multilateral Environmental Agreements.
- Delayed impact of AEPC on sub-regional institutions hinders national enforcement of environmental measures.

Policy First

- National governments commit themselves to strengthening AEPC by paying annual dues to the Commission.
- Governments endorse the establishment by AEPC of two standing committees of senior officials responsible for social and economic planning to boost sustainable development policy formulation and implementation.
- Regional, sub-regional and national institutions responsible for the environment are revamped to better respond to the AEPC mandate.

Security First

- Budgetary constraints reduce AEPC to a token force funded by donors. National interests weaken AEPC initiatives, which are overruled by strict insistence on sovereignty claims.
- The role of AEPC remains peripheral at the global level as the environmental agenda continues to be set by rich countries that are reluctant to fund environmental programmes.
- Linkages with similar organizations in other regions are minimal as each region focuses on internal issues.

Sustainability First

- National governments cede some of their authority to the AU and AEPC.
- Traditional environmental programmes are linked to innovative social and economic programmes addressing poverty in rural and urban areas in order to reduce overexploitation of resources.
- The AEPC introduces stringent measures to protect the region's intellectual property rights, thereby strengthening Africa's role in the global biotechnology trade.

The lessons

Regional and global environmental institutions are only as strong as the commitments made to them by national governments. Without continued support, both financially and politically, their efforts are less effective and liable to lose out to conflicting interests. Nations may need to sacrifice some sovereignty in order to achieve broader environmental benefits.

Implications: Asia and the Pacific

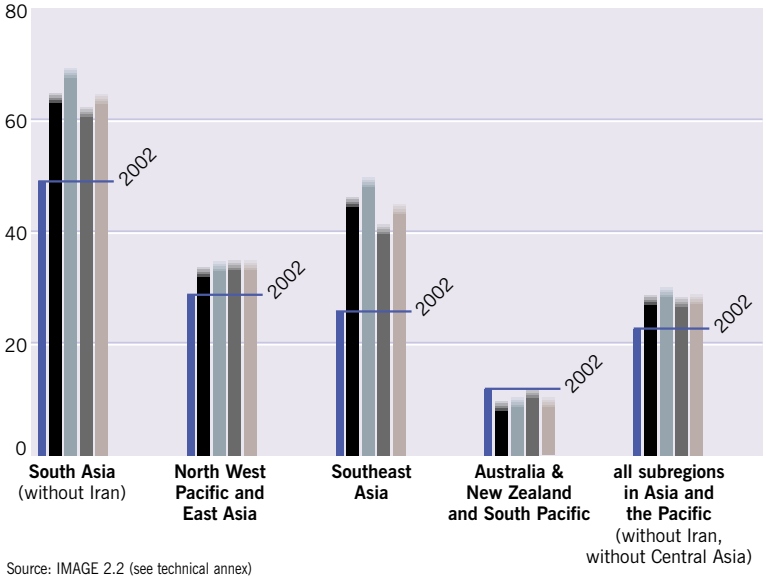
It is no easy matter to generalize about environmental implications of the scenarios for a region as large and varied as Asia and the Pacific. It contains the two most populated countries in the world, India and China, as well as oceanic island nations and the land-locked states of the former Asian republics of the Soviet Union. It includes some of the poorest nations of the world, some of the most dynamic economies of recent times and several industrially advanced OECD countries.

The future of the environment in the region depends on a number of currently unanswered questions. Can the region recover from the recession of the late 1990s, as all the scenarios apart from *Security First* presume? How are pressures of continued population and urban growth handled — in a relatively hands-off manner as in *Markets First* and *Security First*, or with more hands-on planning and consideration as in *Policy First* and *Sustainability First*? How does technological development fare, especially in relation to the provision of energy? Do abundant coal resources dominate energy production as in the worlds of *Markets First* and *Security First*? How do national, regional and international governance structures develop and regional and international trade regimes evolve?

The specific themes of land, forests, freshwater, urban issues and biodiversity are addressed in more detail and at the sub-regional level in the remainder of this section. The potential impacts of a dramatic decline in the availability of clean freshwater are explored in the box on page 369.

Growing populations, the spread of agriculture and climatic changes imply that the risk of land degradation increases in many parts of the region in all scenarios (see chart). Of particular concern are loss of soil fertility and soil erosion in mountainous areas, which increase downstream sedimentation. The oceanic sub-regions — the South Pacific and Australia and New Zealand — are the least threatened and South and Southeast Asia the most affected. The effect of more rapid climate change in the *Policy First* and *Sustainability First* scenarios implies somewhat higher risk than might be expected, but as the rate of change slows in the longer term compared with *Markets First* and *Security First* conditions, other effects predominate.

Area with high risk of water-induced soil degradation: Asia and the Pacific (% of land areas)

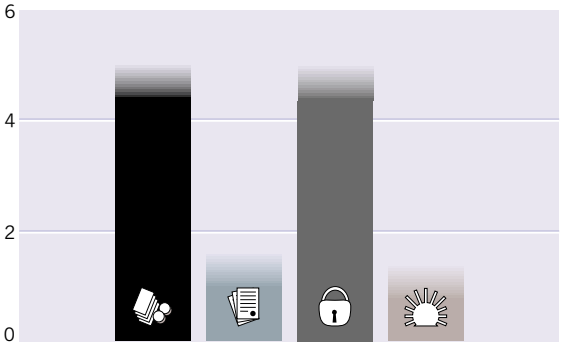


Source: IMAGE 2.2 (see technical annex)

Measures taken in *Policy First* and *Sustainability First* scenarios to improve agricultural practices limit the actual amount of degradation, at least on croplands (see chart). These policies include improvements in land tenure systems and regional cooperation in managing erosion, particularly on steep slopes. In addition, some degraded land is restored. Cropland damage is exacerbated in a *Security First* world, where there is greater reliance on uncontrolled use of chemical fertilizers and less regional and international cooperation. Such agriculture practices decline in the world of *Markets First*, but the sheer volume of economic growth and associated demand leads to degradation as great as in *Security First*.

Key to charts

Percentage of 2002 cropland severely degraded by 2032: Asia and the Pacific



Bars represent the percentage of 2002 cropland that has become so degraded by 2032 that it is of little value for production.

Source: PoleStar (see technical annex)

Key to charts

Markets First

Policy First

Security First

Sustainability First

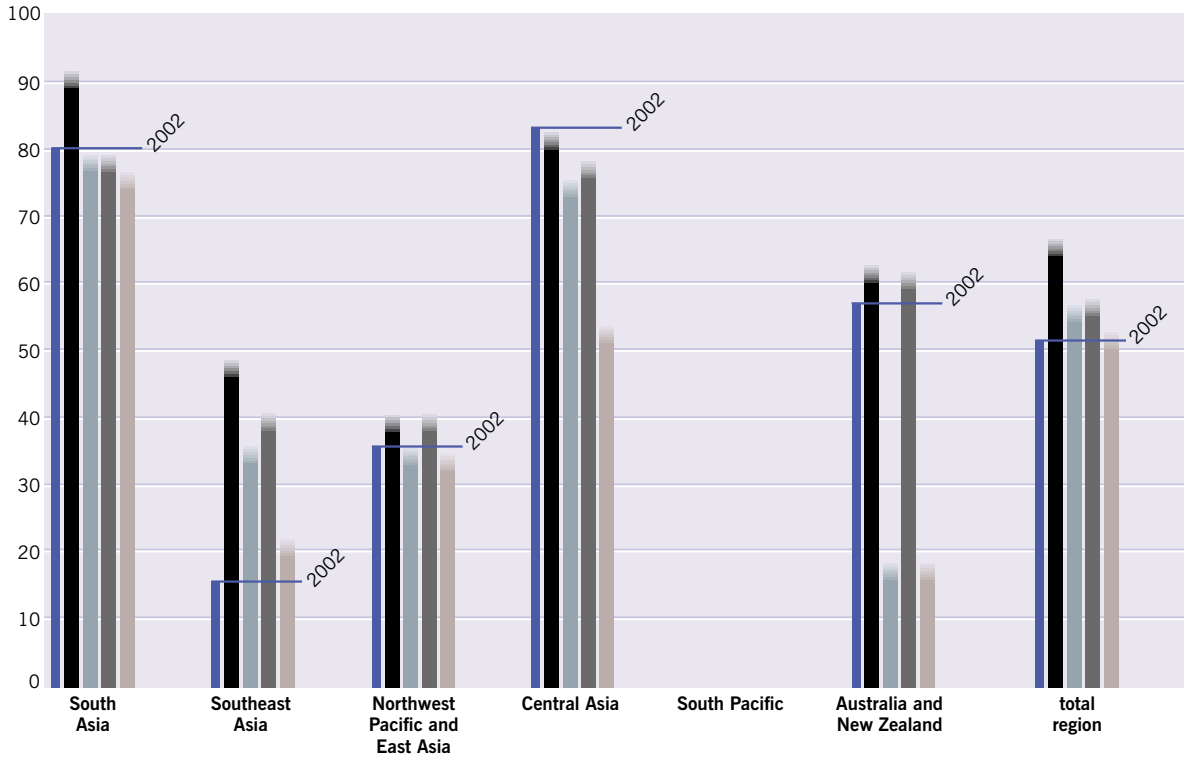
When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress. Nearly 1 700 million of the world's 2 400 million people in areas facing severe water stress live in Asia and numbers are highest in South Asia. Apart from wealthier countries in the region, demand for water rises significantly, with more and more people living in regions suffering from severe water stress.

Source: WaterGAP 2.1 (see technical annex)

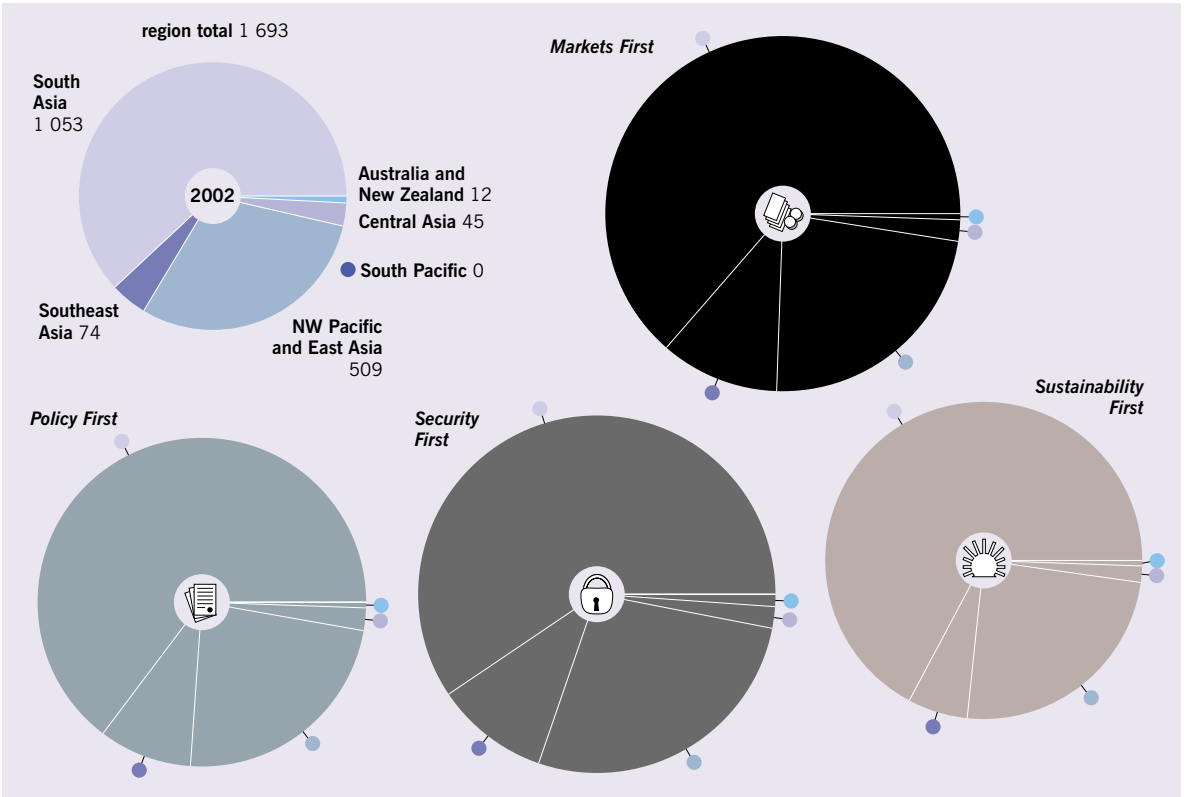
All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: WaterGAP 2.1 (see technical annex)

Population living in areas with severe water stress: Asia and the Pacific (%)



Number of people living in areas with severe water stress: Asia and the Pacific (million persons)



Deforestation and water stress

The risk of land degradation is linked to forest cover. A complex set of forces determines the future of forests in the region. Population growth, including urban expansion in all scenarios and economic improvements in all but a *Security First* situation, lead to mounting demand for agricultural land at the expense of forest area. Efforts to address the problems of mega-cities in the worlds of *Policy First* and *Sustainability First* also increase deforestation as settlement programmes encourage wider dispersal. In a *Security First* world there are added pressures as the poor are pushed onto ever more marginal lands.

These pressures are cushioned to some degree by advances in agricultural technology but the effects differ across scenarios. Advances may be most rapid in *Markets First*, but probably do not have environmental protection as their key goal. More importantly, economic forces such as rising prices for timber and non-timber forest products, which can encourage both deforestation and reforestation, are balanced against reductions in subsidies that have driven conversion of forest and woodlands to agriculture, and other economic instruments introduced to improve conservation. These all influence the area and condition of remaining forests. Market instruments play the biggest role in a world of *Markets First*. These are complemented in the worlds of *Policy First* and *Sustainability First* by government and local programmes to subsidize reforestation and encourage a shift to agroforestry, and by direct efforts to preserve biodiversity.

The net result is that the total area of forest in Asia and the Pacific declines over this period, but this effect differs significantly across sub-regions and scenarios. South and Southeast Asia suffer the most significant losses in total forest area. Whereas Northwest Pacific and East Asia experience a net increase in forest area due to plantations, the total area of undisturbed natural forest declines. In Australia and New Zealand and the South Pacific, the effect of replanting is such that more new forest is created than is used for logging or other production.

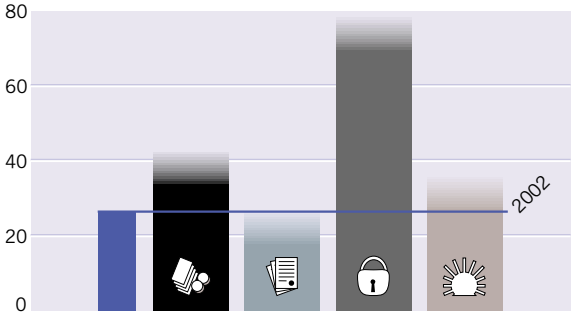
Water stress is presently one of the most contentious problems in Asia and the Pacific, leaving aside the small Pacific Island Countries (PICs), and it remains high on the agenda for the foreseeable future (see opposite). Growth in demand is especially high in a *Markets First* world, but also in *Policy First* and *Sustainability First*, where economic growth is similarly robust. Water pricing and more efficient use of water in agriculture due to advances in biotechnology help to temper this growth. Under the *Markets First* scenario, water withdrawals increase in all sectors, especially when further expansion of irrigated area is assumed. These increases in water withdrawals lead to an expansion of areas with severe water stress in South and Southeast Asia in all scenarios and more people are affected throughout the region. In *Security First* overall growth in demand is moderated by slower economic growth in many sub-regions and no further expansion in irrigated areas, rather than any significant efforts to become more efficient.

Under the *Policy First* and *Sustainability First* scenarios, where effective policies and lifestyle changes combine with greater regional cooperation and technology transfer, water withdrawals remain at current levels or even decrease in most of the rest of Asia. However, with population growth continuing, the number of people living in areas under severe water stress continues to increase across Asia.

Urban areas, especially the growing mega-cities in South, Southeast and East Asia, face many trials in addition to water stress. They include land use pressures, air and water pollution and solid waste overload. All these challenges are related to rapidly growing populations, from both natural growth and rural–urban migration, and increasing economic activity. Trends in local and regional air pollution depend heavily on choices in energy production. If coal continues to dominate, as is likely in a *Security First* situation with reduced trade or in a world of *Markets First* where the cost is what counts, then local air pollution tends to worsen significantly.

The increase is most evident in *Security First*, where little effort is made to control sulphur emissions from stationary sources and nitrogen oxide emissions from stationary and mobile sources (see charts overleaf). The setting and enforcement of regulations prescribing cleaner fuels and fuel uses, cleaner technology and upgraded emission standards, all help to curb these trends in a *Policy First* world. In *Sustainability First*, major efforts towards decentralization with dispersed satellite cities relieve the pressures. This step, combined with better physical planning and management of urban systems, leads to more effective coordination of growth, distribution of clean industry, servicing, handling of pollution streams and housing design.

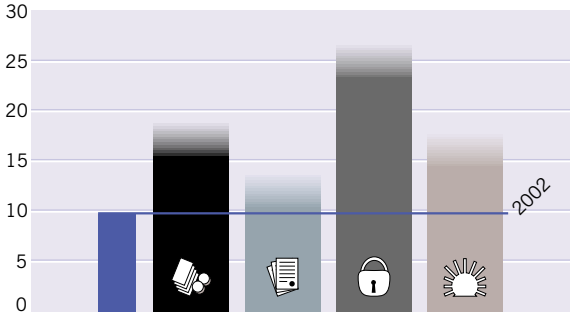
Energy-related sulphur dioxide emissions: Asia and the Pacific (million tonnes sulphur)



Sulphur dioxide emissions increase most rapidly in a *Security First* world because little money is invested to reduce emissions. In the other scenarios, especially in *Policy First* and *Sustainability First*, the increase of SO_2 emissions is less as steps are taken to avoid severe air pollution. In some sub-regions emissions drop below 2002 levels.

Source: AIM (see technical annex)

Energy-related nitrogen oxide emissions: Asia and the Pacific (million tonnes nitrogen)



Nitrogen oxide emissions grow rapidly with the increase of motorization and rise even in a *Policy First* scenario. A very high increase is expected in South Asia in line with the large increase in motor traffic.

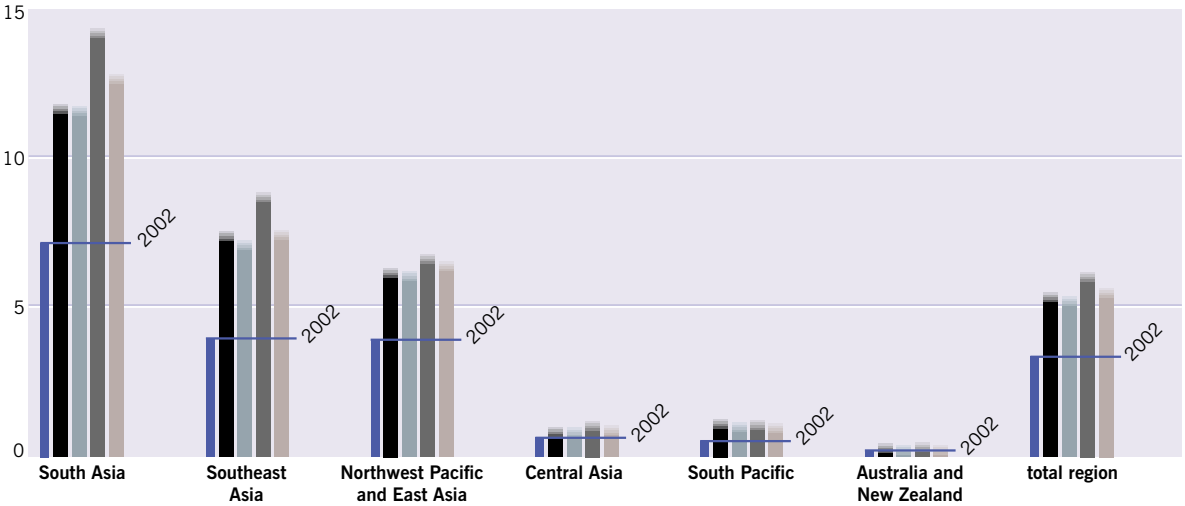
Source: AIM (see technical annex)

These policies help to buffer ill-effects in the *Policy First* and *Sustainability First* scenarios, but the higher levels of economic growth make environmental protection difficult. In all scenarios, the amount of built-over land grows significantly across the region (see chart below).

Similarly, CO_2 emissions and production of solid waste (see opposite) increase in most scenarios. Emission standards, which tend to be weak or lacking in a *Security First* situation, help to limit the growth in air pollutants in the other scenarios, especially in *Policy First*. Emissions of CO_2 increase more rapidly in *Markets First* circumstances because of high economic growth. In *Policy First*, advanced technologies are introduced to reduce CO_2 emissions. Because a *Sustainability First* society shifts from conventional to sustainable lifestyles, CO_2 emissions are somewhat mitigated. On the other hand a *Security First* society holds on to technologies with low energy efficiency. CO_2 emissions increase most rapidly in this scenario everywhere except in Central Asia where low economic activities mitigate CO_2 emissions vis-à-vis *Markets First*. The effects of lifestyle changes are also evident in the lower levels of solid waste production in *Sustainability First*.

Key to charts

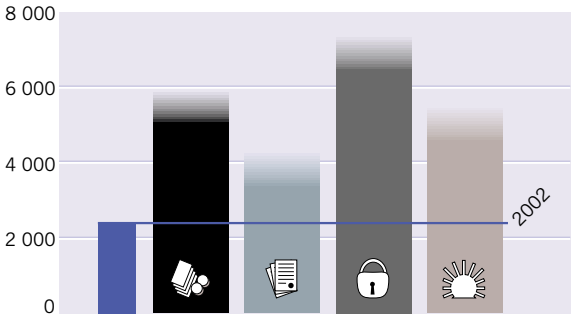
Extent of built-up areas: Asia and the Pacific (% of total land area)



Built-up area expands as both population and built environment per head of population grow. The latter value is among the lowest in the world in Asia, but with rising incomes and expanding infrastructure, each person's footprint, as measured in built land, grows over the course of the scenarios.

Source: PoleStar (see technical annex)

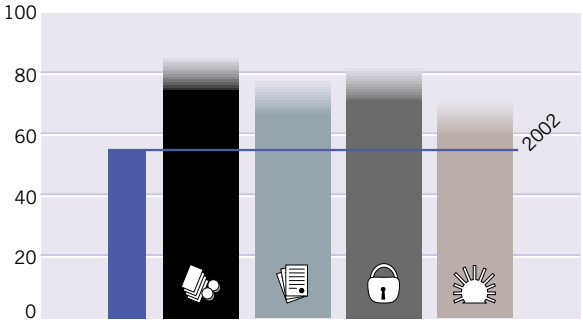
Energy-related carbon dioxide emissions: Asia and the Pacific (million tonnes carbon)



Trends under different scenarios are similar throughout the region and reflect both state of technology and lifestyles.

Source: AIM (see technical annex)

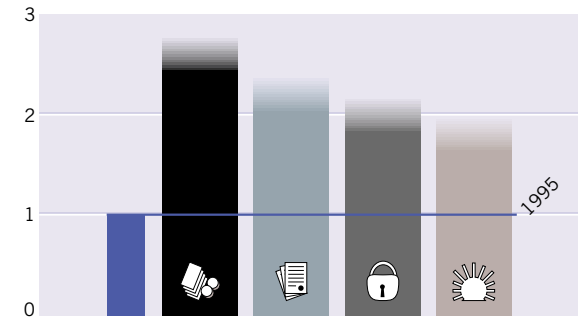
Land area impacted by infrastructure expansion: Asia and the Pacific (% of total land area)



All sub-regions in Asia and the Pacific show a similar pattern between scenarios as infrastructure expands.

Source: GLOBIO (see technical annex)

Municipal solid waste generation: Asia and the Pacific (index related to value of 1 for base year 1995)



Total municipal waste is expected to increase more than 150 per cent by 2032 in South Asia, Southeast Asia and Central Asia in a *Markets First* scenario. Municipal waste generation is closely linked to income level and size of population.

Source: AIM (see technical annex)

Bad news for biodiversity

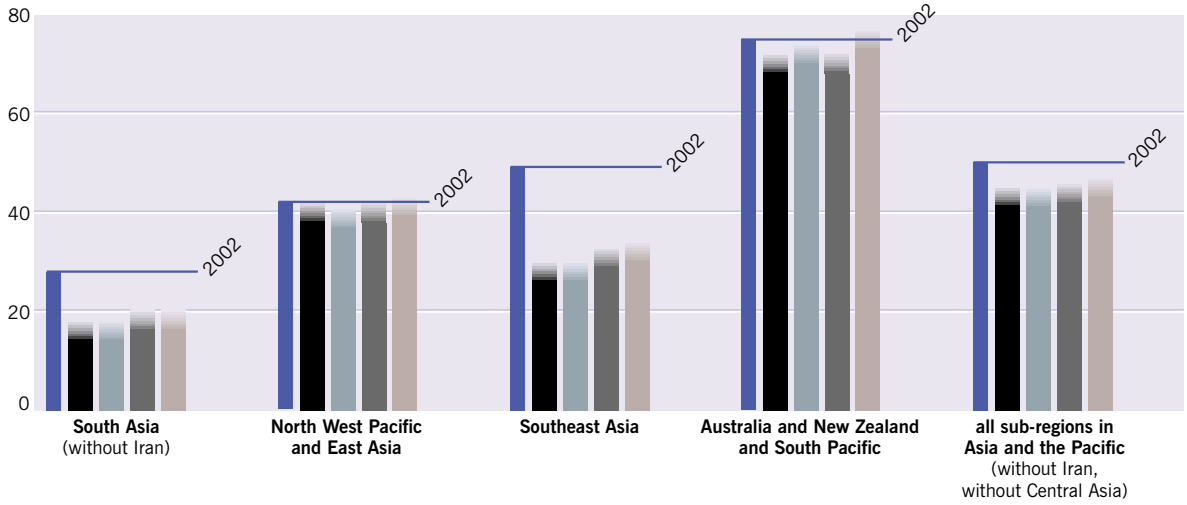
Growing populations, expanding urban and declining forest areas and increasing economic activity put increased pressures on terrestrial and marine biodiversity. The growth in infrastructure alone to meet growing demands has a large and increasingly significant impact across the region in all scenarios (see chart). Better planning, coordination and enforcement of land use policies alleviates this somewhat in *Policy First* and *Sustainability First*. The lack of such policies in a *Security First* world, coupled with higher population growth, leads to impacts almost as large as in *Markets First*, even with much slower economic growth.

At the same time as infrastructure is expanding, changing climate affects biodiversity, resulting in significant reductions in the quantity and quality of natural capital in some sub-regions over the next 30 years. As with other pressures, these differ significantly across the sub-regions, with the most significant pressures on biodiversity occurring in South and Southeast Asia under all scenarios (see overleaf).

Finally, increases in trade affect biodiversity, particularly in the worlds of *Markets First* and *Policy First*. Under *Security First* conditions, reductions in trade and greater control of the exploitation of particular areas may actually benefit biodiversity in these areas, whereas other areas suffer from lack of control.

Some of these pressures on biodiversity are countered in a *Policy First* world by regional cooperation to reduce illegal extraction and establish more protected areas. In a world of *Sustainability First*, advances in technology enable real-time identification and monitoring of biodiversity assets and sensitive ecosystems. Communities are better equipped with knowledge and understanding of the dynamics of environmental systems, tools for strategic assessment and planning. Over time this results in a greater representation of species, communities and genes within protected areas. Maintenance of endemic genetic stocks provides

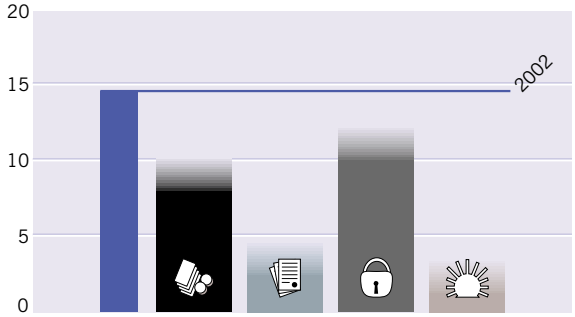
Natural Capital Index: Asia and the Pacific



An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity. Pressures on biodiversity increase between 2002 and 2032 in all scenarios.

Source: IMAGE 2.2 (see technical annex)

Population living with hunger: Asia and the Pacific (%)



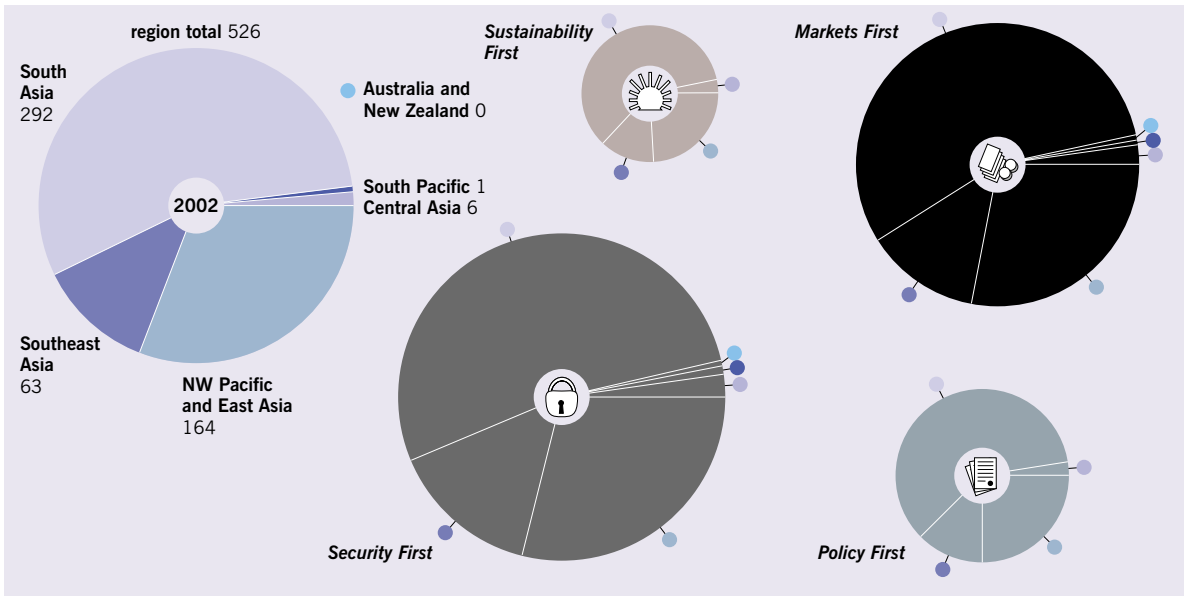
Average incomes rise in all sub-regions, contributing to a drop in the percentage of the population that is hungry. However, rapid population growth can lead to an increase in the incidence of hunger, even as the percentage of people at risk declines.

Source: PoleStar (see technical annex)

valuable source materials for biotechnology advances, captures benefits for local communities and reduces opportunities for invasive species to take over.

Relevant environmental trends, along with the distribution of economic growth and effectiveness of social policies, are reflected in the incidence of hunger in the region (see charts). The percentage of people experiencing hunger remains high in much of the region in *Markets First* and *Security First*. With growing populations, this implies only slight reductions in absolute numbers in the former and small increases in the latter. Dramatic improvements

Population living with hunger: Asia and the Pacific (million persons)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: PoleStar (see technical annex)

Key to charts

Markets First

Policy First

Security First

Sustainability First

are possible, though, as seen in the *Policy First* and *Sustainability First* results where there are steep reductions in both the percentage and the total hungry. In the *Policy First* scenario this is achieved through a combination of relatively high growth and more equitable income distribution. In the *Sustainability First* scenario it comes about as greater equity both between and within countries is reflected in rapid economic growth and a narrowing of income distributions.

Imagine … widespread surface and groundwater contamination in Asia and the Pacific

Rapidly growing populations and economies escalate demand for food and living space, leading to greater intensification of agriculture. More irrigation and fertilizer use in rural areas, together with unimpeded growth of urban centres and mega-cities, mean more competition for water resources between geographic regions and economic sectors. This rivalry reaches crisis proportions around 2010, when the quality of surface and ground waters across the region begins to go into widespread, rapid and accelerating decline. The surface water changes are a reaction by aquatic ecosystems to the cumulative loading of nitrogen and other organic materials from inadequately treated agricultural and municipal solid waste. The impacts on groundwater arise from the run-off of chemical fertilizers and pesticides from agriculture as well as toxic materials from industry. The effect is enhanced by the more rapid extraction of groundwater resources, resulting in a further increase in the concentration of these pollutants in the remaining groundwater as well as increased rates of salt water intrusion in the region's extensive coastal areas.

In the case of …

Markets First

- Some agricultural production is affected and food prices rise significantly, stimulating increasing food trade within the region and imports from other regions.
- Private biotechnology companies compete to provide genetically engineered pollutant-eating bacteria.
- Private companies contract with urban governments to transport uncontaminated water from other regions, including freshwater in the form of icebergs from the Antarctic.

Policy First

- Policies to move industry toward zero emissions production are accelerated.
- Public investment into genetic engineering in order to produce pollutant-eating bacteria increases.
- Water rationing is introduced and water saving devices distributed to urban populations, where treatment is unable to make up for water lost due to quality declines.
- Policies to integrate water resources management into development plans are promoted, with a focus on the integration of land and water related issues within a river basin or water catchment area.

Security First

- Water resources are placed under public and private military control.
- There is a sharp increase in deaths related to water-borne diseases such as cholera.

Sustainability First

- The move toward more organic and low-input sustainable agriculture receives a major boost as producers using these methods cope better with the disruptions and are seen as having a neutral impact on the problem.
- Urban areas that have already implemented advanced water-saving, waste reduction and waste treatment practices expand their campaign to accelerate the introduction of similar practices across the region.

The lessons

It can often take crisis situations to induce necessary changes that lead to more sustainable practices. In any case, coping with issues such as freshwater quantity and quality requires an integrated perspective that recognizes interactions between sectors and the potential for threshold effects in natural systems from cumulative pressures. Part of this shift involves encouraging diversity in agricultural and other economic systems so that when surprises and crises occur, a versatile repertoire enables new strategies to be formed.

Implications: Europe

Over the next 30 years, Europe is dominated by the reintegration of Western, Central and Eastern Europe following the end of the Cold War. In both *Markets First* and *Policy First* worlds, expectations of a significant expansion of the European Union are borne out. This process may stall in a *Security First* scenario or take on a very different form in a world of *Sustainability First*. In all four scenarios, the relationships between those countries within the EU and those outside — notably the Russian Federation — are significant in determining, among other things, the state of the environment in this region. The differences in the evolution of such bodies as the European Environment Agency, which is likely to become much stronger in a world of *Policy First* or *Sustainability First*, also play a role.

Developments in Europe's relationships with other regions are also important. The contrast between greater openness to trade and migration in *Markets First* and *Policy First* worlds and a possible reversal of both in a *Security First* situation, imply significant impacts either way. Similarly, differences in the evolution of multilateral environmental agreements make a conspicuous mark.

Two critical areas of development are agricultural policy and the relationship between climate, energy and transport. They are explored here together with other issues, in the contexts of atmosphere, land, biodiversity, freshwater and coastal and marine areas. Finally, the implications under each scenario of a major food scare brought on by a combination of factors are explored in the box on page 373.

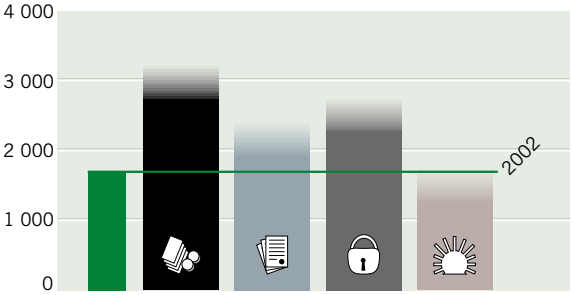
Europe's scope to address the issues of large-scale air pollution and greenhouse gas emissions depends heavily upon developments in the areas of energy use and transportation. Whereas extremely active policies to improve public transportation, for reasons of both pollution and congestion control, and to improve energy efficiency can be expected in *Policy First* and *Sustainability First* worlds, these advances are unlikely in *Security First* or even *Markets First* circumstances. In the *Markets First* case, some economic policies, such as road and carbon taxes, are likely and technological developments will continue to improve the energy use per unit of activity. Growth in volume of travel and economic activity in general is, however, expected to outweigh per unit improvements in response to these policies. In a *Security First* situation, lack of economic development in Central and Eastern Europe restrains energy use in general.

Emissions and land use — turning points

These changes in energy use, along with shifts in fuel use, are reflected in gaseous emissions, notably of carbon dioxide (see chart). There are some striking differences between scenarios and sub-regions. The growth in emissions is quite significant in all regions in *Markets First*, with transport contributing a major share. The economic difficulties in *Security First* for Eastern Europe result in approximately the same level of emissions as in *Policy First*, where more proactive policy action prompts improved energy use and a switch to non-carbon fuels. In a *Sustainability First* situation, strong policy actions and changes in lifestyles, including the willingness of more people to shift to public transport, achieve significant reductions, heralding a turning-point in the battle to reduce human-induced climate change.

Land use change in Europe is affected by decisions related to spatial planning of development and transportation policies. It is also driven by the evolution of agricultural policy, including changes in agricultural trade regimes and the reform of the Common Agricultural Policy. In the *Markets First* scenario, the built-up area grows over time in Western Europe (see opposite). Elsewhere, population decline leads to a stable or modest decrease in the total built-

Energy-related carbon dioxide emissions: Europe (million tonnes carbon)



all subregions in Europe and Central Asia (without Turkey)

In three of the four scenarios, Europe's total carbon dioxide emissions increase, diminishing the chances of eventual climate control. The shorter term target of the Kyoto Protocol may be met in a *Policy First* world, but certainly not in a *Markets First* or a *Security First* scenario.

Source: IMAGE 2.2 (see technical annex)

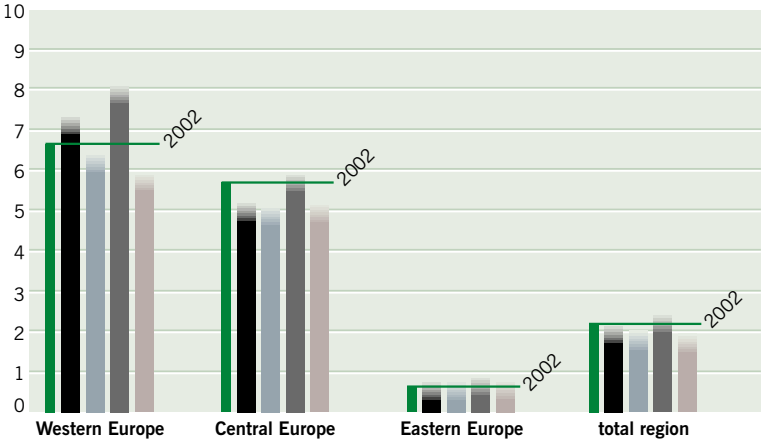
up area in *Markets First* and throughout the region in *Policy First* and *Sustainability First*, where already compact settlement patterns combine with lower population growth to reduce the need for expansion of built-up areas. In *Security First*, rising populations and more sprawling settlements trigger sizeable growth of built-up areas in Western Europe but little increase in the rest of the region.

At the same time, continued development of roads, plantations and other human works will lead to the extension of infrastructure throughout the region and in all scenarios, with a general increase in levels of impact (see chart). Even so, careful policies — including restrictions on the siting of infrastructure — can help to lessen the effect of this expansion. This potential is most evident in Eastern Europe. In *Markets First* and *Security First*, rising pressures to develop resources and infrastructure reduce remaining biodiversity. Impacts include loss of reindeer and wolf populations and of many insects and plants adapted to farmed conditions. To restore lost habitat, particularly where lost agro-ecosystems and wetlands are concerned, would require *Sustainability First* conditions.

These pressures play a role in determining land-based biodiversity in the region. Europe must also contend with the effects of changing climate conditions, including those determined by greenhouse gas emissions that have already occurred. Overall, differences between the various scenarios by 2032 are small, owing to the delayed effect of climatic changes over foregoing decades. Furthermore, in the short term, the greater regional and global reductions in sulphur oxides and other pollutants seen in *Policy First* and *Sustainability First* actually result in faster climate change, increasing the pressure on ecosystems. However, present-day initiatives such as the EU's Natura 2000 take effect and pan-European networks of protected areas and green corridors are launched to protect biodiversity more effectively in *Sustainability First* and possibly in *Policy First*, too. Effective action to rehabilitate former agricultural land as additional habitats for wildlife also plays an important role. This is reflected in the somewhat better results for the Natural Capital Index (see chart overleaf) in *Sustainability First*.

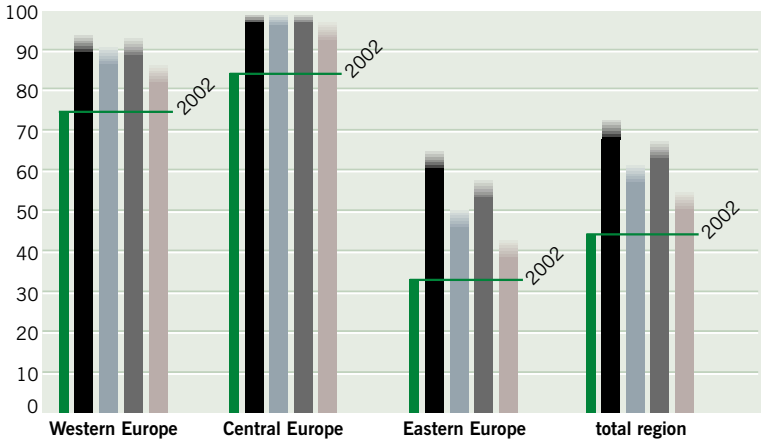
Shifts in agriculture, along with improved technologies, management practices and shifts in crop choices reduce overall water demand in agriculture in all scenarios other than *Security First*. Under the *Markets First* scenario, however, economic development still leads to sharp increases in overall water demand, especially in Eastern and Central Europe. With these increases comes expansion of areas in the severe water stress category. Overall demand in a *Security First* scenario is similar, with the greater population by comparison with *Markets First* somewhat offset by reduced economic activity.

Extent of built-up areas: Europe (% of total land area)



Source: PoleStar (see technical annex)

Land area impacted by infrastructure expansion: Europe (% of total land area)

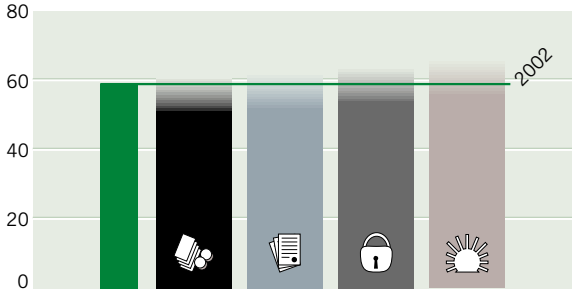


Much of Central and Western Europe has been directly converted to farmland. The few remaining low-disturbance areas are limited to Scandinavia and protected areas, where tourism and recreational development is putting increasingly greater strain on mountain ecosystems. Restoration of former wetlands has begun, but still on a much smaller scale than the continued development of infrastructure.

Source: GLOBIO (see technical annex)

Key to charts

Natural Capital Index: Europe



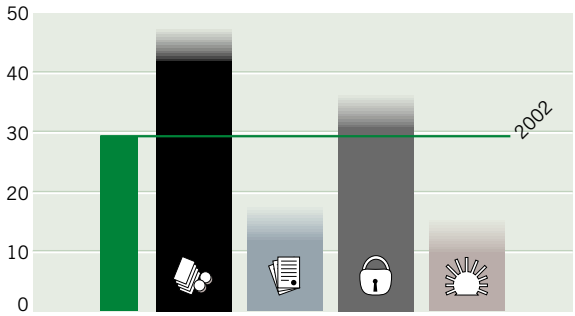
all subregions in Europe and Central Asia (without Turkey)

An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity. As the pressure from agriculture stabilizes and starts to decrease, the general biodiversity situation in Europe over 30 years does not deviate much from the present.

Source: IMAGE 2.2 (see technical annex)

The situation is very different under the *Policy First* and *Sustainability First* scenarios, where structural changes lead to reductions in water withdrawals in all sectors across Europe. Through these continuing efforts to save water, some of the river basins that currently experience severe water stress, no longer do so under these scenarios. With this advance, the number of people who live in areas with severe water stress drops significantly. These changes are most dramatic in *Sustainability First*, where declines in meat consumption augment policies, such as water pricing, introduced in the other scenarios. Differences in the amount of wastewater that is purified and industrial recycling of water amplify the differences between the scenarios. These changes are reflected in the number of persons subject to water stress in the sub-regions across the different scenarios (see charts). Potential problems related to water stress in *Policy First* and *Sustainability First* are reduced by full implementation of the Water Framework Directive and agreements regarding regional seas. Meanwhile, these problems intensify in a *Security First* world,

Population living in areas with severe water stress: Europe (%)



When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress. Water stress in Europe is as much about water quality as it is about water quantity, and due to high water withdrawals many of Europe's waters are severely over-used. However, in regions in which demand for industrial purposes dominates the water use sector, water can often be heavily re-used, mitigating the effects of severe water stress.

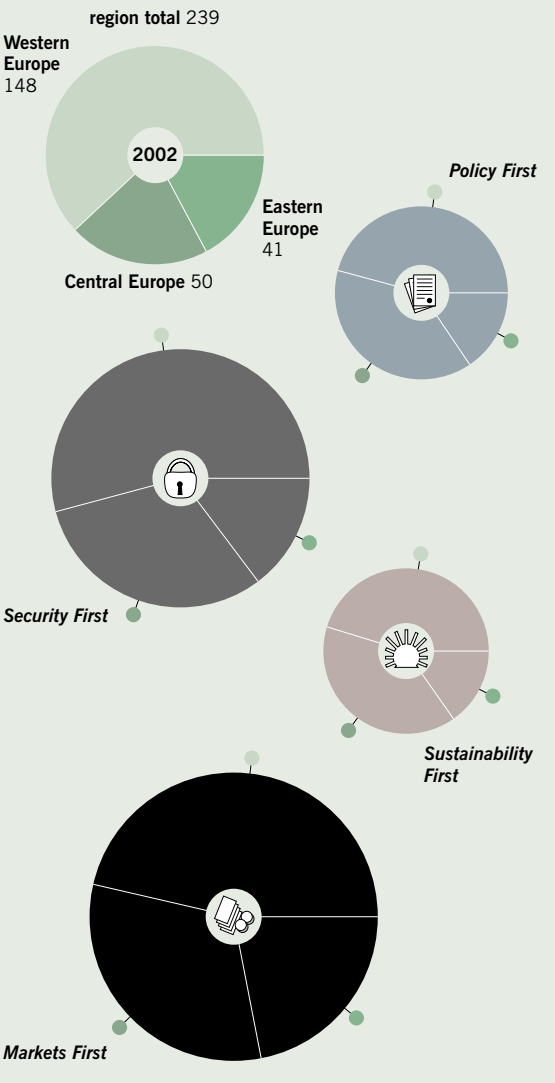
Source: WaterGAP 2.1 (see technical annex)

leading to conflict over water and contamination from uncontrolled industrial activity and the inability to deal with the legacies of former lax policies.

Coastal concerns

Coastal and marine environments are also a key concern in Europe. In a world of *Markets First*, tourism exercises an ever-increasing pressure on coastal zones throughout the region, leading to an

Number of people living in areas with severe water stress: Europe (million persons)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: WaterGAP 2.1 (see technical annex)

increase of local environmental problems such as salinization. In addition, second homes exercise a considerable footprint in some areas such as the Baltic. Specifically in Eastern Europe, coastal zones are increasingly left to local authorities to manage, with somewhat unpredictable outcomes.

Under *Policy First* conditions, governments acquire some coastal zones in Western Europe for full protection status. In Eastern Europe, basic legislation regarding coastal zone protection is put in place and zoning plans are revitalized. In a *Security First* situation, coastal zones in Western Europe see a continuation of industrial development, tourism development, airport construction and other infrastructure. In Central Europe, coastal zones remain by and large as they were in 2002.

In Eastern Europe, coastal zones may be re-militarized, restricting access, but also used for new port development. On balance, pressures remain at approximately the same level as in 2002. In *Sustainability First*, integrated coastal zone management schemes based on voluntary partnerships and participatory arrangements, significantly improve coastal environments.

Key to charts


Markets First


Policy First


Security First


Sustainability First

Imagine … a major food scare in Europe

A major food scare breaks out in Europe in the middle of the 2010s, reminiscent in some respects of the Spanish cooking oil disaster in the 1980s or the BSE crisis in the 1990s. But this crisis is on a much larger scale and so is its psychological impact. It erupts with simultaneous outbreaks of death and illness among young children in various parts of Western and Central Europe. With casualties growing, the cause remains elusive for at least a year. Speculation is widespread about a link with genetically modified organisms or biotransplants, but there is no conclusive evidence. Eventually, the cause is found to be a hitherto uncommon mycotoxin. It turns out that a fungus in many cereals, the emergence and spread of which appears related to the changing climate, produces this toxin. Unfortunately, the news does little to diminish the problem for a culture that relies on bread as a staple food.

In the case of . . .


Markets First

- Consumer distrust rises in Western and Central Europe. This leads to agricultural demise in countries for which the EU is a key export market in the 2010s, such as Argentina, Ukraine, Romania, Latvia and Kenya.
- Stricter certification schemes are put in place, stimulated by initiatives by transnational corporations.


Policy First

- There is European-wide coordination on issues such as sharing the burden of the costly recall of cereals and a rush programme to develop alternative bases for common children's food, many of which rely on the affected cereals. Heavy reliance is set on early warning systems and regulation of developments in biotechnology to avoid similar outbreaks in the future.
- There is a renewed global effort to address climate change.


Security First

- Initial fears of a biological weapons attack cause several nations to place themselves on military alert.
- Xenophobic reactions to illegal immigrants increase as they are seen as potential carriers of exotic viruses.
- Trade disputes increase, stemming from fears of other possible outbreaks.


Sustainability First

- Efficient support systems, notably at local level, help to minimize deaths and to optimize treatment of victims.
- Ongoing agricultural reforms, which are further accelerated in the aftermath, help reduce the spread of the fungus.

The lessons

The roots of many environmental crises can lie in the very complexity of human and natural systems and their interactions. Recognizing this and remaining alert to unexpected developments can help to reduce shocks and to respond to crises when they occur. Foresight, early warning and flexible response provisions can play key roles.

Implications: Latin America and the Caribbean

The future of the environment in Latin America and the Caribbean is driven by many internal and external factors that differ across the four scenarios. At the heart of issues such as economic growth, social development and environmental health are the region's internal policies and its unbalanced relationship to its neighbours to the north. An increasingly integrated Western Hemisphere is envisioned in both *Markets First* and *Policy First* scenarios. Greater cooperation, but in a less formal setting is expected in *Sustainability First*. Developments in regional and international trade regimes have both positive and negative effects. The greatly increased trade posited in a world of *Markets First* opens the door to bigger exports of agricultural and forest products. While these may be beneficial economically, they also put increased pressure on resources. More care is taken to consider social and environmental impacts in both *Policy First* and *Sustainability First*.

Internally, evolving governance concerns and the issues of poverty, inequality and urbanization in large part determine environmental developments in the region. Major issues to be confronted by the region include deforestation, water shortages and land degradation. All these issues are explored here, focusing on the themes of land, forests, coastal and marine areas, biodiversity and urban areas. The box on page 379 explores the possible impacts in the region of a major world recession.

Forests — a mixed fate

Land and forest degradation as well as forest fragmentation remain among the most relevant environmental issues in this region in all scenarios. The patterns of conversion of forests to pasture and agricultural land vary by scenario and sub-region. Just as important as the total forest area is the level of exploitation of the forests.

Significant loss of forest area occurs in a *Markets First* scenario. This scenario also sees much greater exploitation of existing forests. In a *Security First* world, the control over forest resources by transnational companies that create cartels in association with the national groups in power, promote the growth of some forest areas, but this is not enough to stop net deforestation. Private control of forests also leads to occasional violent resistance from forest dwellers and nearby settlers who need access to the forests to meet their daily needs.

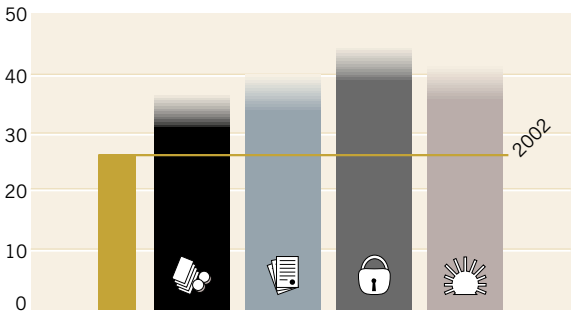
More effective management remedies some of these problems in *Policy First*. In this scenario, policies to promote forest plantations are enacted and institutional strengthening creates better forest control, reducing illegal extraction of timber from native forests and promoting sound forest management practices for commercial production. However, deforestation remains a problem and pressures also arise on forests from the desire to be more self-sufficient in food production. Unsound deforestation stops almost completely in *Sustainability First*. Policies addressing the restoration of degraded forests through the natural regeneration of forest ecosystems are implemented as the value of forest services is internalized by world markets. Moreover, the use of alternative fuels to firewood is now more scientifically and economically feasible, while commercial use of forests under forest management certification regimes has turned out to be highly profitable.

Changes in land cover pose risks for land degradation (see chart opposite). In *Markets First* and *Security First* worlds, the agricultural frontier continues to expand into rainforest ecosystems. This expansion is driven by large commercial livestock farming and industrial cropping, along with influxes of immigrants attracted by these developments and by new infrastructure projects. Exacerbated by drought, many more desertification hotspots are evident by 2032. Land tenure reforms ameliorate these drivers in *Policy First* and *Sustainability First* but not in the other scenarios. However, enforcement of direct and indirect regulations does lead to improvements in controlling soil erosion, dramatically reducing the amount of cropland lost to degradation. In addition, some degraded land is restored, leading to markedly lower net rates than in *Markets First* or *Security First* (see opposite).

Cities sprawl

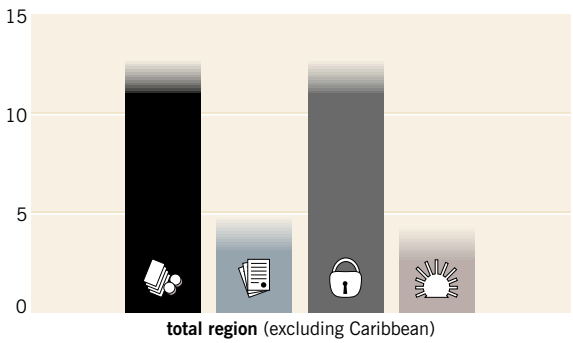
Prominent among other land use changes is the continued growth of urban areas (see opposite). Built-up area per person continues to grow in the *Markets First* scenario, tending towards the sprawling settlement patterns of North America. Despite relatively compact settlement patterns in *Policy First* compared to *Markets First*, higher income growth is

Area with high risk of water-induced soil degradation: Latin America and the Caribbean (% of total land area)



Source: IMAGE 2.2 (see technical annex)

Percentage of 2002 cropland severely degraded by 2032: Latin America and the Caribbean



Bars represent the percentage of cropland that has become so degraded by 2032 that it is of little value for production.

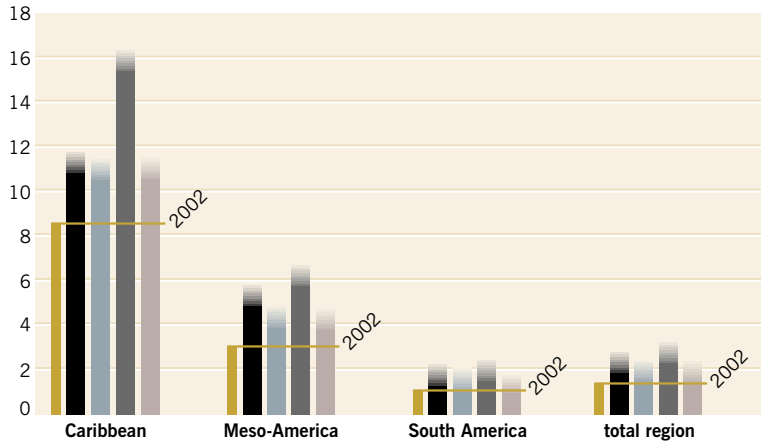
Source: PoleStar (see technical annex)

accompanied by a more rapid expansion in built-up land. As a result, the built-up area in *Policy First* is only slightly below *Markets First*. Unplanned expansion and rapid population growth lead to substantial growth in built-up area in *Security First*. In *Sustainability First*, as in *Policy First*, a tendency towards compact settlement patterns is offset by more rapid economic expansion. However, the offset is only partial and total built-up area grows least in this scenario.

Expansion of urban conditions raises problems of water quality, waste management, air pollution and general sprawl throughout much of Latin America. Economic driving forces continue to attract people to the cities, especially in *Markets First*. Without improved planning and organization, the environmental pressures on urban areas, especially in mega-cities, continue to grow as the rates of population growth outpace that of infrastructure development. This effect is stepped up in a *Security First* world, where the affluent increasingly withdraw into their enclaves, denying the poor access to safe drinking water, sanitation and health services. The quality and quantity of water and the disposal of solid waste are major worries in the small island countries and territories of the Caribbean. Unchecked air pollution has serious and costly health impacts, especially for urban populations (see chart overleaf).

In a world of *Policy First*, measures to curb urban migration and to improve public transportation systems and the collection, disposal and recycling of domestic

Extent of built-up areas: Latin America and the Caribbean (% of total land area)



Source: PoleStar (see technical annex)

and industrial wastes, diminish — but do not eliminate — the vulnerability of cities and their inhabitants to human-induced and natural disasters. More success is achieved in a world of *Sustainability First*. Air pollution declines due to effective regulation and targeted technological progress. The dissemination of sound knowledge and scientific advice, and the transfer of appropriate technology, further improve waste management. Waste generation declines in relative terms and its quality and composition allows for higher rates of reuse, recycling and use in energy production. Finally, more equitable distribution of income and

Key to charts

Source: IMAGE 2.2 (see technical annex)

Key to charts

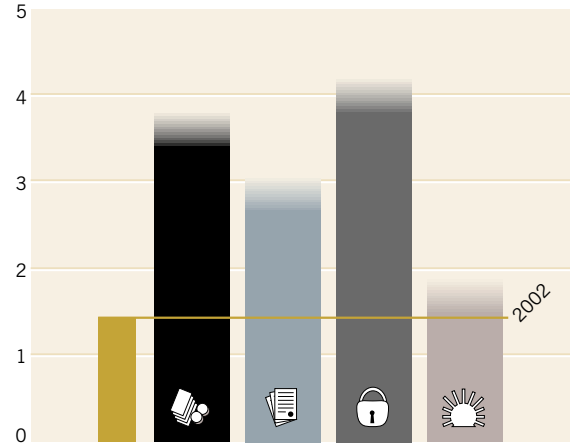
Markets First

Policy First

Security First

Sustainability First

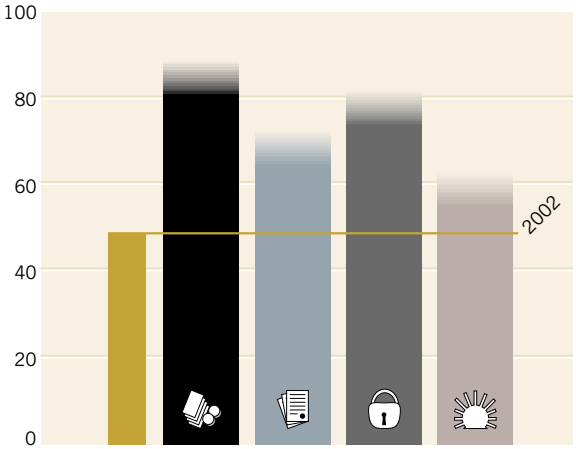
Energy-related nitrogen oxide emissions: Latin America and the Caribbean (million tonnes nitrogen)



Increased industrial exploration for oil, gas and minerals accelerates road construction, which in places encourages encroachment into forests and subsequent conversion of land to plantations and farmland. Conversion of tropical rainforest to farmland and for ranching purposes constitutes one of the greatest threats to biodiversity.

Source: GLOBIO (see technical annex)

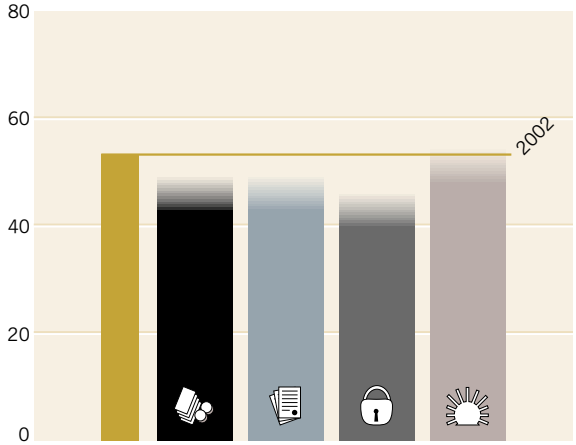
Land area impacted by infrastructure expansion: Latin America and the Caribbean (% of total land area)



An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity.

Source: IMAGE 2.2 (see technical annex)

Natural Capital Index: Latin America and the Caribbean



wealth between urban and rural areas has a moderating effect on rural-to-urban migration.

Ecosystems and species at risk

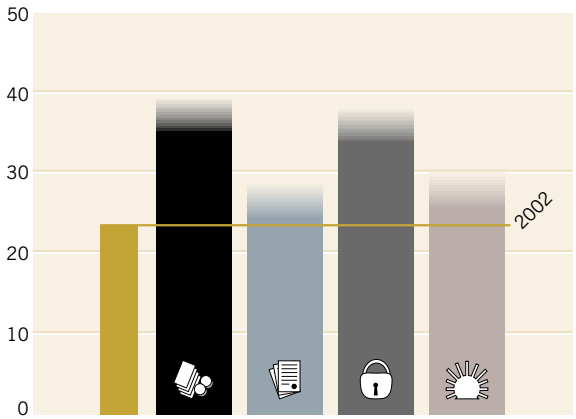
All of the above factors, along with the expansion of infrastructure (see chart) and changing climate, influence biodiversity in the region. The loss of forest area leads to decreases in natural capital and in land-based biodiversity in all but a *Sustainability First* scenario (see chart). In *Policy First* conditions, improved monitoring and management of critical ecosystems in the protected areas help to conserve biodiversity. However, the continued demands and somewhat higher economic growth than in a *Markets First* situation work against these changes.

Better knowledge of — and keener concern for — ecological systems foster more effective stewardship of both marine and terrestrial biodiversity in *Sustainability First*. Innovative approaches help many previously threatened species to recover. From both the scientific and aesthetic perspectives, biodiversity has been given a high value, widening the number of species available for pharmaceutical and food purposes. New areas have also been incorporated into the national protected areas systems for the protection of biodiversity, as well as to provide environmental services and recreation. In both *Markets First* and *Security First* scenarios there is likely to be extreme degradation and even destruction or disappearance of unique ecosystems and some endangered species.

Shadow over seas and coasts

In *Markets First*, the uncontrolled expansion of coastal settlements, proliferation of tourist resorts, uncontrolled discharge of wastes into oceans, expansion of aquaculture and lack of strong regulations and enforcement over fisheries all pose dangers for the marine and coastal environment, especially for small islands in the region. In *Policy First*, some pressure on fisheries is reduced by direct regulation efforts and the implementation of market-based instruments, but still the biomass of certain inshore species drops significantly. In a *Security First* situation, reduced economic activity may outweigh the lack of controls, sparing some areas from these effects. More integrated ecosystem management schemes, such as coastal and river basin management plans, including surveillance systems and the control

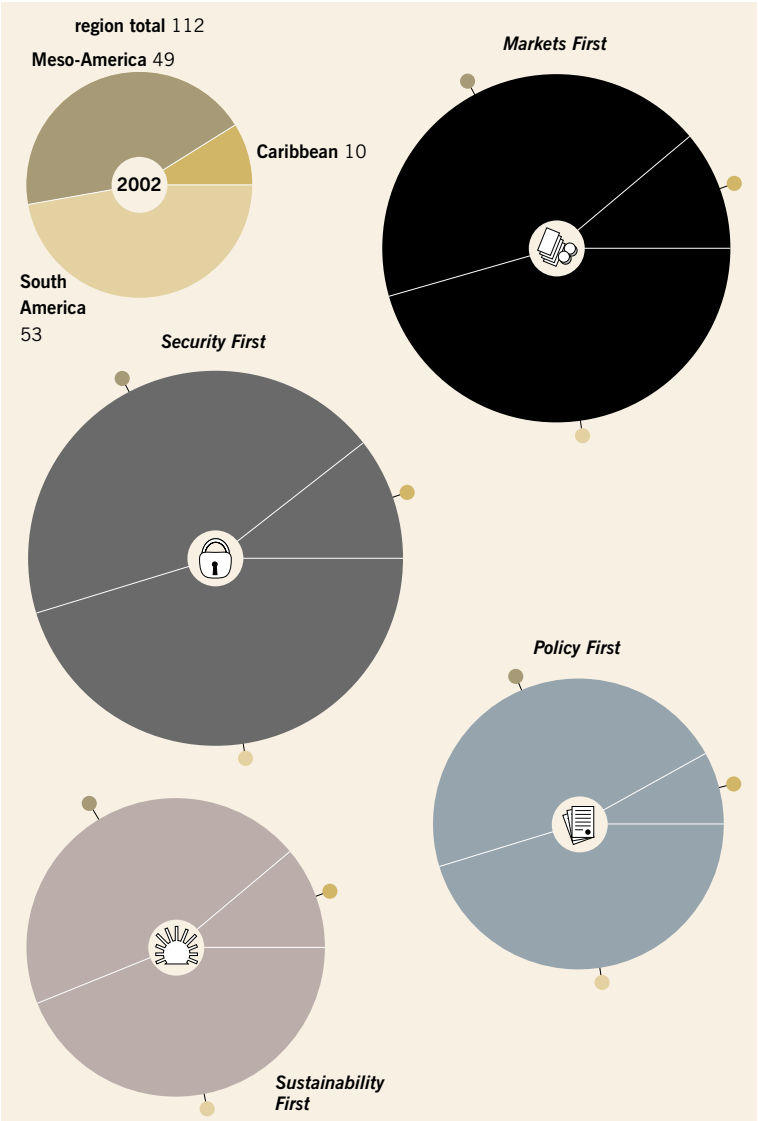
Population living in areas with severe water stress: Latin America and the Caribbean (%)



When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress.

Source: WaterGAP 2.1 (see technical annex)

Number of people living in areas with severe water stress: Latin America and the Caribbean (million persons)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios. In Latin America about a quarter of the total population — more than 100 million people — are estimated to live in water stressed areas, mostly in Mexico, Argentina and countries along the Western coastline of the continent.

Source: WaterGAP 2.1 (see technical annex)

of land-based sources of pollution that affect inland and marine waters, ease the situation in *Policy First* and still more so in *Sustainability First*.

Food and water fears

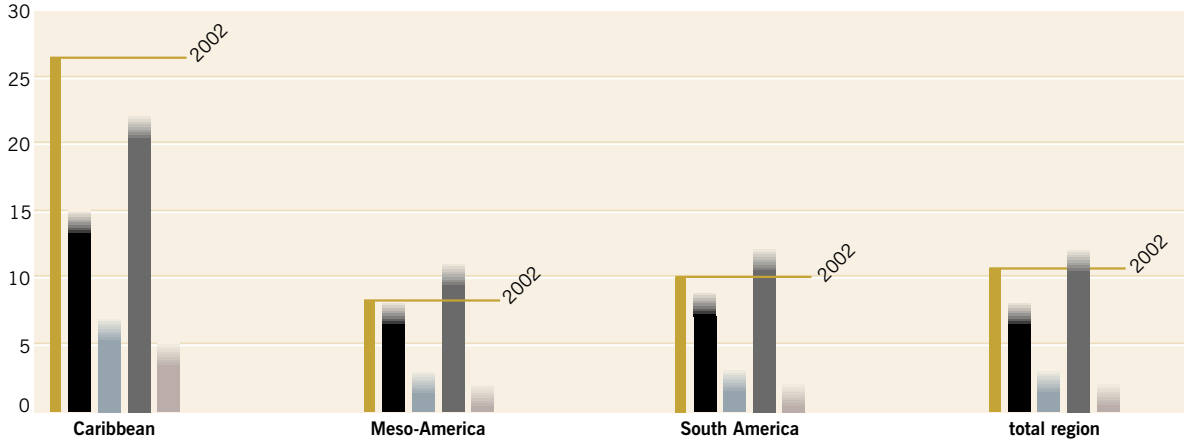
The scenarios also have important implications for the provision of basic needs that are related to the broader environmental impacts. While global climate change affects the availability of freshwater, growing populations and increased economic activity, particularly in agriculture, lead to increased demand for freshwater in most scenarios. Similarly, more people live in areas experiencing water stress in all scenarios (see charts). Under the *Markets First* and *Security First* scenarios, the area affected by severe water stress increases in Meso-America and the Caribbean, while it remains constant in South America. Nevertheless when population growth is factored in, numbers of people living in areas with severe water stress increase by a factor of two to three. The number of people living in areas with severe water stress is also on the rise under the *Policy First* and *Sustainability First* scenarios, despite total water withdrawals staying roughly at current levels. In *Policy First* circumstances, reforms in the pricing of water and shifts in subsidies, and technological improvements have a positive effect on addressing demands.

Similarly, the size of, and ability to meet, demands for food in the different scenarios reflects a combination of shifts in supply and demand, which can be influenced by social, environmental and economic policies. Average incomes rise in all regions, contributing to a drop in the percentage of the population that is hungry. In the *Markets First*

Rise in average incomes and improvement in equity are key factors in reducing hunger in *Policy First* and *Sustainability First* scenarios.

Source: PoleStar (see technical annex)

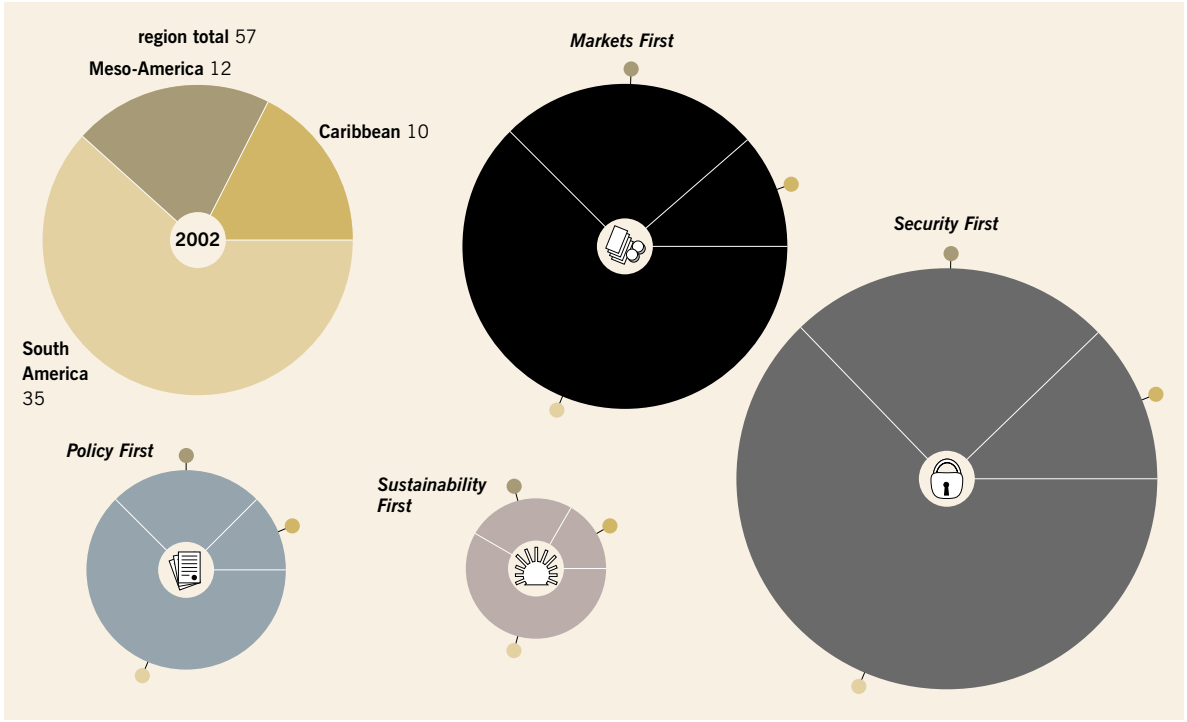
Population living with hunger: Latin America and the Caribbean (%)



All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios.

Source: PoleStar (see technical annex)

Population living with hunger: Latin America and the Caribbean (million persons)



Key to charts


Markets First


Policy First


Security First


Sustainability First

scenario, the relatively high inequality in Latin America today is moderated somewhat as regional patterns converge towards those of the industrialized regions. Nevertheless, the benefits of growth and narrowing income distribution are not enough to offset the growth in population and total numbers rise. In the *Policy First* scenario, a combination of relatively high growth and comparatively equitable income distributions leads to a sharp drop in the percentage hungry, as well as in the total. In the *Security First* scenario, diverging income distributions lead to a worsening in both the percentage and the total who are hungry in the region as a whole. In the *Sustainability First* scenario, greater equity both between and within countries is reflected in rapid economic growth and narrowing income distributions, leading to a strong decline in both the percentage and the total who are hungry (see charts).

Imagine … effects on Latin America and the Caribbean of a profound world recession

A profound economic recession starts in the industrialized world and soon spreads around the world, destabilizing most of the leading developing economies. The flow of capital between the developed and developing countries changes direction as international investors move financial assets back home or to wealthier countries. Local capital is moved towards more attractive and safe destinations. Serious fiscal and trade deficits force governments to implement restrictive policies to reduce expenses and imports while encouraging more exports. Environmental budgets are among the first to be cut and exploitation of natural raw materials is intensified to boost export earnings, though with little effect on employment. Social expenditures are also cut drastically.

In the case of …

Markets First

- Public and private sector expenditures are cut and funds reallocated among sectors to favour exports. Overall production is significantly reduced. Treasury officials neglect issues that they regard as low priority, not least environmental and social programmes, and those relating to compliance with environmental law.
- Adverse social effects include increases in poverty and inequality and a rising flood of migrants.
- Virtually uncontrolled exploitation of natural resources runs to extremes. The Amazon Basin and other rainforest areas are ruthlessly exploited and invaded by migrants from depressed areas. New desertification hotspots appear and numbers of people in areas under water stress expand. Fishing and aquaculture thrive, heedless of environmental impacts.

Policy First

- New policies boost production of exports and import substitutes and raise the region's competitiveness.
- International agreements on environment and labour standards among countries of the region are consolidated.
- Although the recession harms all sectors of the economy and sets back environmental and social progress — especially in least-developed countries — the region is well-placed to overcome the crisis.

Security First

- Impacts of recession are most keenly felt in mega-cities. Unprecedented levels of unemployment prompt migration from relatively urbanized sectors of cities to the outskirts and to sites exposed to landslides, floods and other risks. People grow increasingly vulnerable to outbreaks of infectious diseases.
- Domestic and industrial solid waste overload becomes a major environmental hazard.
- In rural areas, poverty and loss of environmental quality create a vicious spiral. Land degradation intensifies and desertification hotspots increase.

Sustainability First

- The events and aftermath of 11 September 2001, joined to the outcomes of the Johannesburg Summit, spark awareness of anti-poverty and pro-environment imperatives and governments commit themselves to change. By 2010, the world and the region are both firmly set on a path towards sustainability.

The lessons

Pressure to produce exports is best directed onto activities that are founded on sustainable production practices. Impacts of recession on employment can be lessened, health problems can be minimized and the tide of economic and environmental migrants can be stemmed without resorting to destructive or exploitative practices. Even so, it may sometimes take negative impacts caused by overexploitation of natural resources to create the awareness that production systems relying on them for raw materials need to be improved along more sustainable lines.

Key to charts

Markets First

Policy First

Security First

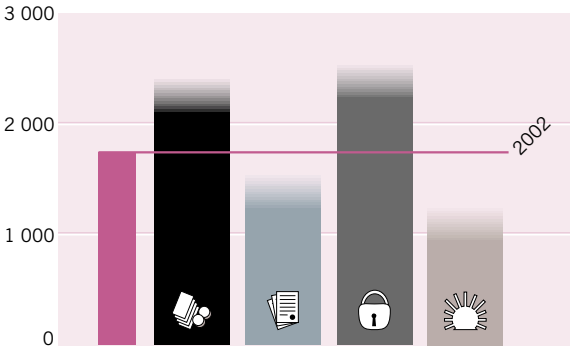
Sustainability First

Implications: North America

The North American region is one of the world's least densely populated and consists of just two countries, both advanced industrial economies undergoing a transition to more information-based systems. Both have relatively long records of environmental management. For these reasons, more than perhaps any other region, the environmental impacts of the four scenarios on this region are reflected as much in its influence on inter-regional and global issues. A more internationally engaged North America, as in the worlds of *Policy First* and *Sustainability First*, has a strikingly positive effect on environmental impacts at a global level and in other regions. Similarly, a North America that is only engaged at an economic level, as in a world of *Markets First*, or with only selected groups in other regions, as in a *Security First* world, has big and often negative impacts.

Environmental impacts still occur within the region, however, and these vary between scenarios. This section takes a look at a number of these in the areas of the atmosphere, urban areas, water stress, land degradation, land-based biodiversity and coastal and marine areas. The specific issue of potential water stress in the mid-continent and its wider repercussions is explored in the box on page 383.

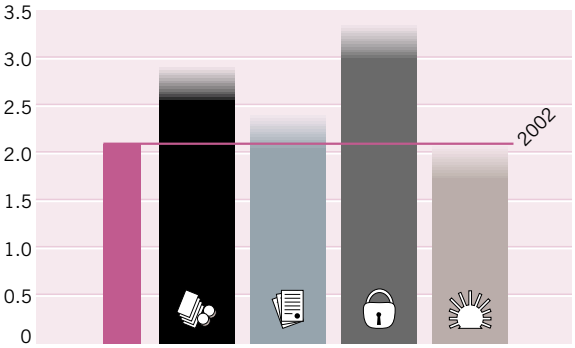
Energy-related carbon dioxide emissions: North America (million tonnes carbon)



To a large extent, policies to reduce emissions in *Policy First* and *Sustainability First* can harvest co-benefits with other policy imperatives.

Source: IMAGE 2.2 (see technical annex)

Extent of built-up areas: North America (% of total land area)



Source: PoleStar (see technical annex)

Emissions pendulum

As a predominant emitter of greenhouse gases, North America plays a major role in determining the future climate of the planet. In *Markets First* the region's refusal to participate notably hampers international efforts to control emissions of these gases. The region remains the highest emitter on a per person basis and also among the highest in absolute terms (see chart). This happens despite overall improvements in energy efficiency stimulated by increasing fuel prices and general technological advance. Transportation-related emissions show the sharpest increase as motor fuel gains a greater share of total energy consumption, pushing up total emissions as it does so. The collapse of parts of the transport infrastructure and the growing restriction of ownership of fossil-fuel-powered vehicles to the elite in *Security First* are not enough to counteract the overall impacts of expanding population, resulting in even greater increases in emissions in this scenario.

In a world of *Policy First*, North America's success in implementing policies to reduce carbon emissions in an economically efficient manner leads to reductions in the region's contribution to global emissions. Nevertheless, emissions per person remain relatively high, at over twice the world average. Emissions from transport and other sources decline through a combination of increased fuel efficiency and greater use of public transport. Even more spectacular results are seen in a world of *Sustainability First* as greenhouse gas emissions plummet, a goal thought to be unrealistic just a few decades earlier. This transformation is due to technological advances, but more importantly to changes in lifestyle reflected in reductions in per person energy use to the point where it is only slightly higher than that in other developed countries.

One of the most visible impacts of reliance on the automobile is urban sprawl — low urban population densities with heavy reliance on personal transport. The dominance of the automobile culture is also a major factor in local air pollution. These issues continue to plague many cities in the region in both *Markets First*

and *Security First*. In the *Markets First* scenario, the built-up area expands over time (see chart opposite), continuing an upward trend in the region, albeit more slowly than in the past. Combined with rising population, the built environment per person expands significantly.

In *Security First*, faster population increase and sprawling settlements lead to even greater growth in built-up areas. Here, the sprawling urban spaces that are the legacy of the 20th century are further burdened with a decaying infrastructure. Waste treatment declines steeply and water-borne diseases spread. Populations also rise in the *Policy First* scenario, but a tendency towards more compact settlements stabilizes the built-up area. In *Sustainability First*, the values of the scenario are reflected in much more compact settlements than in the past, or in the other scenarios. Combined with relatively smaller populations, the built-up area declines as the scenario unfolds.

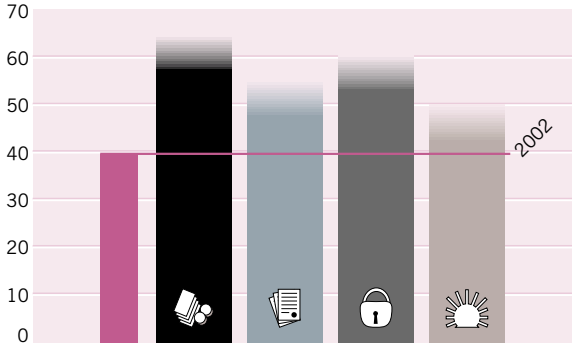
A *Policy First* world sees the built-up environment creating less pressure on land resources and ecosystems (see chart). More effort is put into repairing ageing infrastructure, particularly in the inner cities. In Canada, large land areas continue to be set aside for indigenous people, with likely positive future outlook for many of the ecosystems involved. However, very extensive mining, hydropower, oil and gas development projects, along with forest road construction continue to reduce wilderness areas. In *Security First* and *Markets First*, exploration processes increase substantially, not least in Alaska, Yukon and Quebec, although these inroads are slightly smaller in the former scenario due to lower economic growth.

Going further in a world of *Sustainability First*, the great urban centres of North America begin a slow process of reorganization in response to the popular desire for greater proximity of home, work, commerce and leisure activity. For many, the 'towns within cities' that begin to emerge from the process by 2032 provide an attractive balance between access to a lively culture and the immediacy of a small community. Others opt for greater access to green spaces, leading to small towns dispersed around larger metropolitan centres, connected by advanced transport systems.

Continued advances in information technology expand the options for living and working arrangements and a diverse range of lifestyle choices emerges. A common feature of most of these lifestyles is that they are far less resource intensive, automobile-dependent and stressful than their 20th century antecedents.

Land area impacted by infrastructure expansion: North America (% of total land area)

Source: GLOBIO (see technical annex)



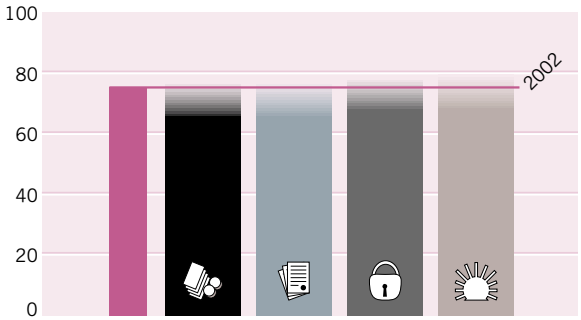
People enjoy a strong sense of affiliation with their local, national and global communities.

Climatic change and the introduction of exotic species pose additional threats to land-based biodiversity in the region. Although natural forest area remains relatively constant in the region in all scenarios, in some cases there is swift expansion of plantations, built areas and agricultural land, with associated infrastructure. This is particularly the case under the *Markets First* scenario with its strong economic growth. The diverse biota found in wetlands also continues to be threatened by conversion and degradation of these ecosystems.

Natural vegetation in much of the region, particularly in the north, is threatened by changes in climate. There are slightly greater impacts of climate change in *Policy First* and *Sustainability First* scenarios, reflecting the short-term effects of efforts to reduce other pollutants, especially sulphur dioxide, in addition to greenhouse gases. However, over the next 30 years the climate change situation is dominated by the momentum built up before 2002 and there is little overall difference in Natural Capital Index between the scenarios (see chart overleaf). The full effects of climate change will be apparent only after 2032.

Biodiversity in coastal and marine ecosystems also faces threats from infrastructure development, pollution and climate change. In the cases of *Sustainability First* and *Policy First*, the slower growth in infrastructure and significant changes in agricultural policy lead to important reductions in land-based sources of pollution. The effects of climatic changes lag somewhat behind those on land-based biodiversity, because of the slower changes in water temperature, but significant threshold effects

Natural Capital Index: North America



An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity.

Source: IMAGE 2.2 (see technical annex)

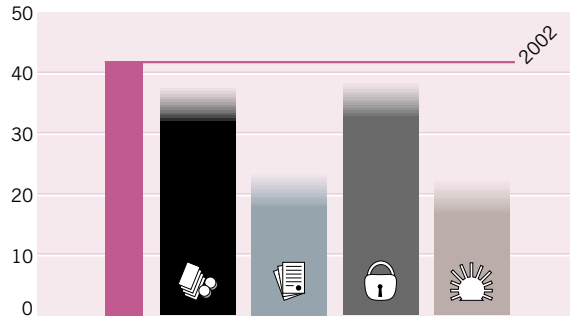
Key to charts

may play a role here. In fisheries, greater cooperation both within the region and with other regions in *Policy First* and *Sustainability First* contributes to the preservation and restoration of important fish stocks. Some of the pressure on marine resources is reduced by the expansion of aquaculture in these scenarios, as well as in *Markets First*. The potential for international conflicts over marine resources within the region and with other regions is high in *Security First*, with negative implications for the health of aquatic ecosystems.

Water withdrawals ease

Certain areas of North America, particularly the southwest of the United States, are already subject to high levels of water stress. Without strong action to reduce water use, this is likely to grow with population increases and shifts in geographic distribution. Local policies, such as water pricing, can significantly affect demand. In addition, international policies related to agricultural trade can strongly affect crop type and therefore, irrigation requirements and water use. Advanced technologies, including biotechnologies to develop more water efficient crops and improve irrigation efficiency, can also have a striking effect. Total water withdrawals decrease under the *Policy First* and *Sustainability First* scenarios, where structural changes lead to reduced withdrawals in all sectors across North America.

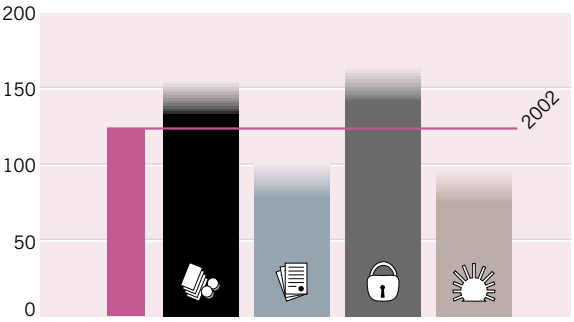
Population living in areas with severe water stress: North America (%)



When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress. In many of the river basins of the western United States, home to over 100 million people, withdrawals currently exceed these limits.

Source: WaterGAP 2.1 (see technical annex)

Number of people living in areas with severe water stress: North America (million persons)



Source: WaterGAP 2.1 (see technical annex)

Under *Markets First* and *Security First* conditions, the number of people living in areas with severe water stress increases with population growth although there is a decline in percentage of population affected. Regulatory efforts in *Policy First* and *Sustainability First* lead to much more significant decreases in percentages as well as reductions in total numbers (see chart).

Imagine … increased water stress in mid-continental North America

A number of trends point to increased vulnerability of large areas of mid-continental North America to water stress. These include continued draw down of major aquifers and indications of chemical contamination. At the same time, climate models point to mid-continental drying and lowering of both lake and river levels. An extended hot, dry period starting midway through the 2010s exacerbates these trends. The demand for irrigation water increases at the same time as its availability declines. Transport on the Great Lakes and on major rivers such as the Mississippi, faces disruption.

In the case of …

Markets First

- Widespread introduction of water pricing and the removal of agricultural subsidies have already led to the reduction of agriculture in the region, somewhat reducing pressures on water demand.
- Deals are struck to explore transport of water from the Great Lakes or even more remote sources, to increase water levels in the Mississippi River system.
- Amounts of goods transported by road increase.
- Production loss drives more intensive farming elsewhere in the United States, such as California's Central Valley, fuelling water conflicts there. Higher water prices almost everywhere hit marginal businesses and the poor.
- The region increases imports from abroad to meet domestic shortfalls. This move boosts economies in some producer countries but also makes local and national food security problems worse in situations where land is taken out of the local food production system to meet export demands or quotas.

Policy First

- Research and legislative efforts are implemented to encourage the introduction of more efficient irrigation methods such as drip irrigation.
- Processes of reform are accelerated to introduce water pricing and begin to reduce agricultural subsidies.
- Initiatives are launched throughout the region to enhance rail transport.
- There is a new push for a strong international climate stabilization treaty.
- Energy efficiency, renewable energy and forest conservation programmes are promoted and speeded up.
- Bio-engineered cultivars that yield more 'crop per drop' are researched, developed and introduced faster.

Security First

- Competing interests in the United States and Canada contest plans for big-scale transfer of water from the Great Lakes.
- A powerful farm lobby continues to oppose reform in the system of agricultural supports and water subsidies.
- Knock-on effects of water diversions aggravate long-standing Mexico–United States rows over shared water resources.
- Falling food exports and rising prices for food commodities on the world market contribute to food shortages, heightening geopolitical tension and giving rise to violence in hotspot areas.

Sustainability First

- A shift to rain-fed crops and restoration of much of the region to its original tall grass prairie is accelerated.
- Efforts to enhance rail transport throughout the region are introduced.
- There is a more rapid shift away from meat-based diets, allowing more efficient land uses for human food rather than animal fodder.
- Consumer movements call for and galvanize more dispersed, sustainable and localized farming systems.
- There is a fundamental re-think of lifestyles, economic development and social policy, responding to an emerging awareness that intensive use of capital, water and chemicals by agri-business cannot be sustained, as well as to awareness of parallel problems in other economic sectors and environmental frameworks.

The lessons

Many — if not all — economic systems depend heavily on natural systems but regrettably the latter are too often taken for granted or assumed to be unlimited or easily replaceable. Given the inherent variability and mutability of natural systems, policies should be designed to reduce excessive levels of dependence, especially in the presence of potential threshold effects whereby small changes can prompt catastrophic effects.

Implications: West Asia

West Asia is characterized by relatively high population growth rates, heavy economic dependence on oil production, fairly severe water stress and pockets of conflict or unrest. Developments in all these respects, along with the promotion of technological advances in areas such as desalination and biotechnology, vary markedly between the four scenarios. As in other regions, these shifts are largely driven by trends and events in the areas of governance and culture, and in relations between nations within and outside the region. Possible outcomes in terms of environmental impacts are considered in more detail below for land, freshwater, biodiversity, urban areas and coastal and marine resources. The repercussions of an extended drought in the region are explored in the box on page 389.

Vulnerable land

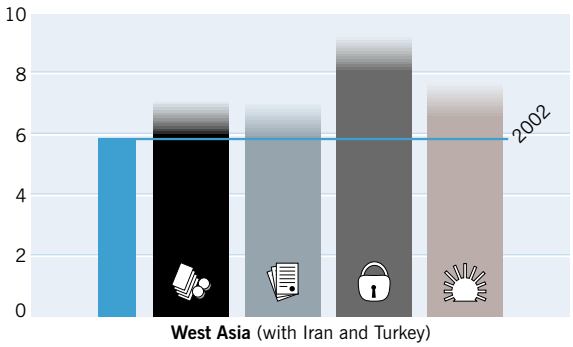
Pressures on West Asia's limited arable lands are driven by the ever-expanding food demands of a growing population and expansion of other land uses, including urbanization, industrial activities, infrastructure and tourism. In *Markets First* and *Security First* scenarios, transfer of arable land to these sectors continues in the absence of effective arable land protection policies. The built-up area expands (see chart) in step with growth in population. Built environment per person continues to grow in *Markets First*, with sprawling settlement patterns.

Rapid population growth and unplanned expansion lead to even greater growth in built-up area in a *Security First* world. In *Sustainability First* and *Policy First*, more rapid economic expansion is partially offset by a tendency towards compact settlement patterns. Expansion of built-over land in *Sustainability First* is the smallest among all four scenarios.

The land that remains in agriculture is susceptible to water-induced soil degradation (see chart). In *Policy First*, implementation of a regional food demand management strategy results in more food being imported from other regions. This spares arable land from increased pressure for local food production. In

Key to charts

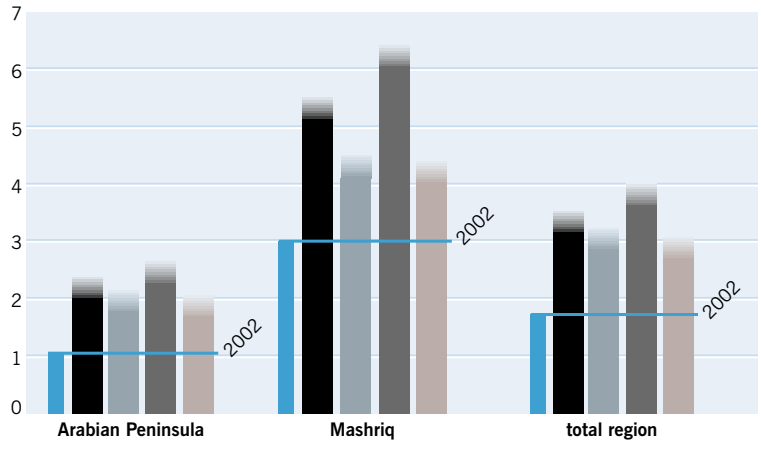
Area with high risk of water-induced soil degradation: West Asia (% of total land area)



Water-induced soil degradation continues to be a risk throughout the region.

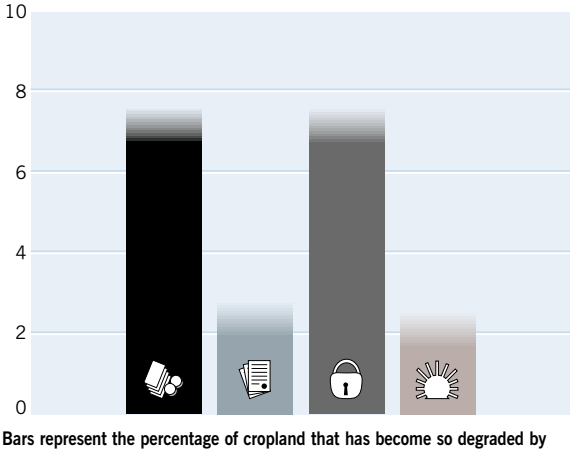
Source: IMAGE 2.2 (see technical annex)

Extent of built-up areas: West Asia (% of total land area)



Source: PoleStar (see technical annex)

Percentage of 2002 cropland severely degraded by 2032: West Asia



Bars represent the percentage of cropland that has become so degraded by 2032 that it is of little value for production.

Source: PoleStar (see technical annex)

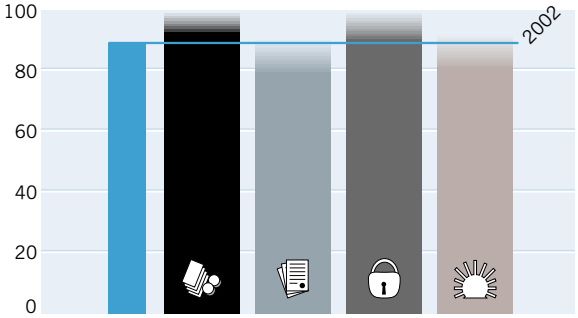
Sustainability First, there is slightly more land susceptible to soil degradation than in either the *Policy First* or *Markets First* scenarios because more arable land is kept in production. The greatest risk is in a *Security First* situation, where management is poorest and more marginal land is used.

Coping with land and water problems

In all scenarios except *Security First*, some forms of land use planning and effective arable land protection policies are implemented to prevent actual degradation of the extremely scarce cultivable land in the region. As a result, the rate of land degradation and loss slows down and gradually stabilizes. In a *Markets First* scenario, the available cropland is managed more carefully than in the past, in the interest of protecting agricultural markets. However, population and economic growth more than counteract these efforts (see chart opposite). Land conservation in *Policy First* and *Sustainability First* leads to much slower cropland degradation. In addition, some degraded land is restored, leading to substantially lower net rates than in *Markets First* or *Security First*. In *Sustainability First* reductions in population growth and well-researched advances in biotechnology and genetic engineering further offset these pressures.

Water stress in West Asia continues to increase as water demands exceed available water resources, owing to population growth and expansion of different development sectors (see charts). In *Markets First* and *Security First*, deteriorating water quality and increasing competition between sectors, users or both, hampers food production and leads to conflicts (mainly between the domestic and agricultural sectors), increasing water-related health problems. Water withdrawals are slightly higher in *Security First*, due to more water-cooled thermal electricity production. Improved irrigation efficiency and minor shifts in irrigated areas (under *Markets First* only) lead to decreasing water withdrawals for irrigation. In total, water withdrawals increase slightly under both scenarios, leading to an increase in areas with severe water stress and affecting over 200 million people. Demand management and conservation policies are introduced gradually in *Markets First* as the degree of water scarcity rises in individual countries but there is no strategic water resources planning in a *Security First* world. In this scenario, water scarcity reaches its highest levels in the Arabian Peninsula, in terms of

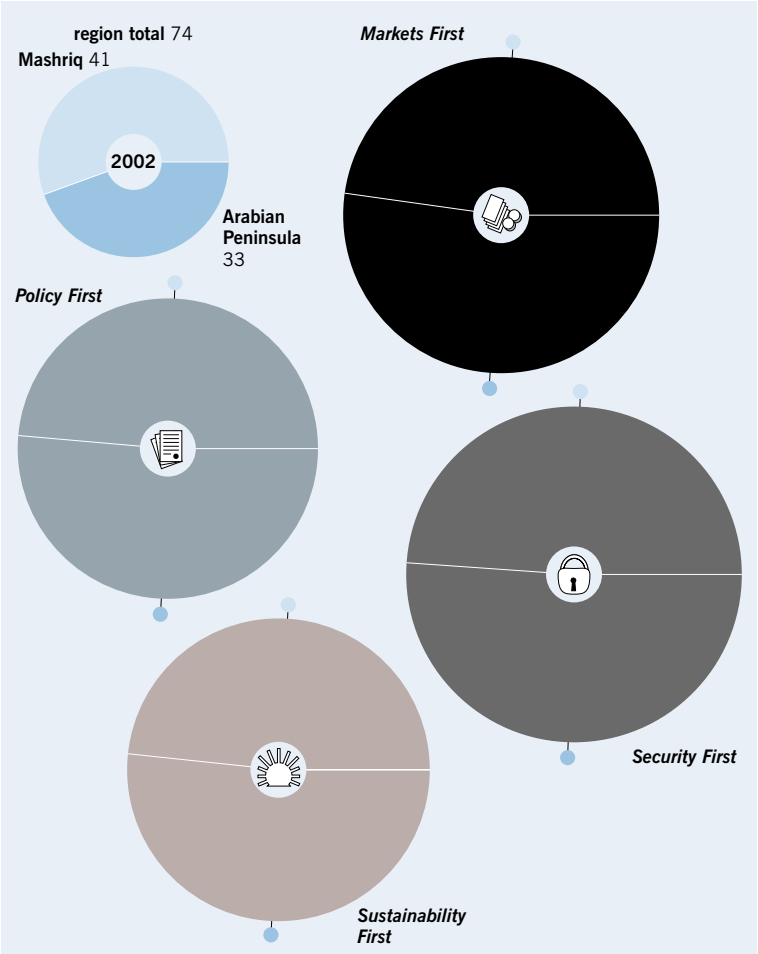
Population living in areas with severe water stress: West Asia (%)



When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress.

Source: WaterGAP 2.1 (see technical annex)

Number of people living in areas with severe water stress: West Asia (million persons)

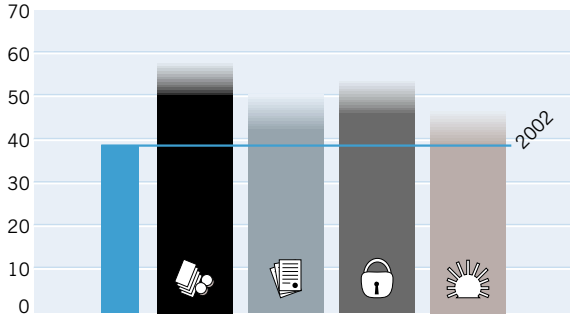


All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios. West Asia is one of the most water stressed regions of the world, with over 80 per cent of its area under severe water stress and over 70 million people (or nearly 90 per cent of the region's total population) living in these areas. In both sub-regions, the irrigation sector dominates the total water withdrawals, both under current conditions as well as under all four scenarios.

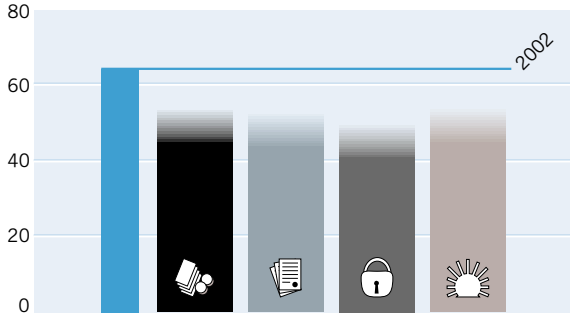
Source: WaterGAP 2.1 (see technical annex)

Source: GLOBIO (see technical annex)

Land area impacted by infrastructure expansion: West Asia (% of total land area)



Natural Capital Index: West Asia



West Asia (with Iran and Turkey)

An index of 100 is the situation when total land area is undomesticated and all pressures are below the minimum threshold (see technical annex). Reduction in the Natural Capital Index indicates habitat loss and increasing pressure on terrestrial and aquatic biodiversity. Biodiversity is severely impacted between 2002 and 2032 in all scenarios, but especially under *Security First*.

Source: IMAGE 2.2 (see technical annex)

the number of the population affected, and groundwater resources, the principal source of water in this sub-region, are depleted and deteriorate to the extent that they are no longer directly usable.

Under the *Policy First* and *Sustainability First* scenarios, reductions in irrigated areas in the region, combined with structural changes in the way water is used in industry, lead to reductions in total water withdrawals. Accordingly some river basins drop out of the severe water stress category. In *Policy First*, the area under water stress is stabilized by adopting strategic water resources management to increase water use efficiency and resource protection. A major policy shift, from 'supply augmentation' towards 'demand management and conservation' occurs. This shift is achieved through water pricing, awareness and education campaigns, enforcement of legislation and management of marginal water, as well as more efficient allocation of water resources among the competing economic sectors. In *Sustainability First*, the increase of freshwater made available by desalination technology, wide application of biotechnology in the field of food production and decrease in population growth rate in the region, help to counteract the effects of additional demand related to higher economic growth. In both scenarios, however, water scarcity persists and affects growing numbers of people as water demand continues to exceed available water resources.

The impact of water stress in the different scenarios also depends on relations between individual countries in West Asia and on West Asia's relations with other regions. About 60 per cent of surface water resources originate from outside the region. In *Security First*, countries sharing river basins fail to sign conventions and agreements on sharing and management of water resources, including surface and groundwater, or on monitoring their quantity and quality. In *Markets First*, equitable sharing of surface water resources among such countries might eventually be reached, limiting conflicts and tension. This shift also helps overall development, increases agricultural production and reduces uncertainty in planning. Even so, construction of dams in upstream countries continues, curbing downstream flows, increasing tension in the region and impacting river and marine ecosystems downstream. This situation is exacerbated by cyclical droughts common to the region. In *Security First*, conflicts and tension increase within the region, as well as with countries outside the region, eventually leading to water wars. These concerns ease in *Policy First* and *Sustainability First* as countries negotiate agreements on the equitable sharing of surface water resources.

Such steps are taken further in *Sustainability First*. A total catchment management approach is widely adopted and conventions agreed on sharing and managing groundwater resources to safeguard both quantity and quality. There is also greater cooperation between countries on dam construction, including environmental impact assessments that look at potential impacts on downstream parts of the river and marine ecosystems.

Natural capital leaks away

West Asia also faces increasing pressures on its biodiversity. Infrastructure expands in all scenarios (see chart), destroying and fragmenting the region's ecosystems. These pressures lead to steady decline in populations of wild species, a growing list of

Key to charts


Markets First


Policy First


Security First


Sustainability First

threatened species and an overall and continual loss of biodiversity. These trends are counteracted to some degree in *Policy First* and *Sustainability First* circumstances by implementing land use management plans to reduce human pressures on natural ecosystems. Other counter measures include legislation protecting biodiversity and endangered species as well as regulating the introduction of foreign and genetically modified organisms. Only slower economic growth in *Security First* keeps the expansion of infrastructure and its impacts below that of *Markets First*.

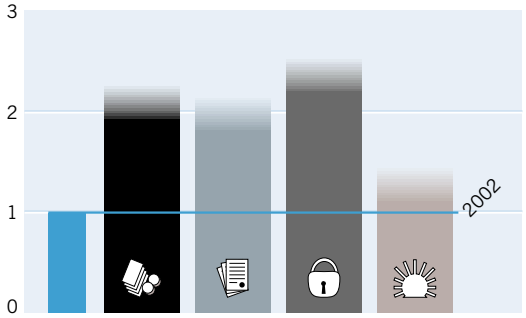
Other problems, particularly climate change, join with these pressures to diminish natural capital in the region in all scenarios. In *Policy First*, present efforts to enlarge protected areas continue and may reach international targets. In addition, regional cooperation and transboundary reserves are established between neighbouring countries. Public awareness is stimulated through botanical gardens and museums. These efforts go further in *Sustainability First* where there is greater local control of resources. The extent of protected areas reaches target levels, halting depletion of biological resources. Furthermore, the region witnesses an increase in cooperative regional research, investment and sustainable use of genetic and biological resources through the use of advanced technology. However, even here the efforts are not enough to fully counteract the effects of changing climate (see chart opposite).

The somewhat slower onset of climate change in *Markets First* means that the losses to natural capital are somewhat less than in *Policy First* and *Security First*. In *Security First*, the introduction of foreign and genetically modified species carries on unregulated, posing a major additional threat to indigenous species in the region. Moreover, efforts already under way become increasingly ineffective under declining economic and environmental conditions and food insecurity. Significantly, many indigenous biological resources in the region could be completely lost.

Differences in population growth, urban planning and zoning, rural area development and the situation of refugees all influence the level, type and impact of urbanization across the region. Rapid unplanned urbanization and high population concentrations caused by rapid population growth, rural to urban migration and the increase in refugee numbers are

Energy-related nitrogen oxide emissions: West Asia (million tonnes nitrogen)

Source: IMAGE 2.2 (see technical annex)



West Asia (with Iran and Turkey)

factors in both *Markets First* and *Security First*. All have negative environmental and health consequences in terms of local air pollution (see chart), add to waste production and encourage encroachment on limited agricultural and recreational areas. Basic healthcare, sanitation and infrastructure facilities fail to cope.

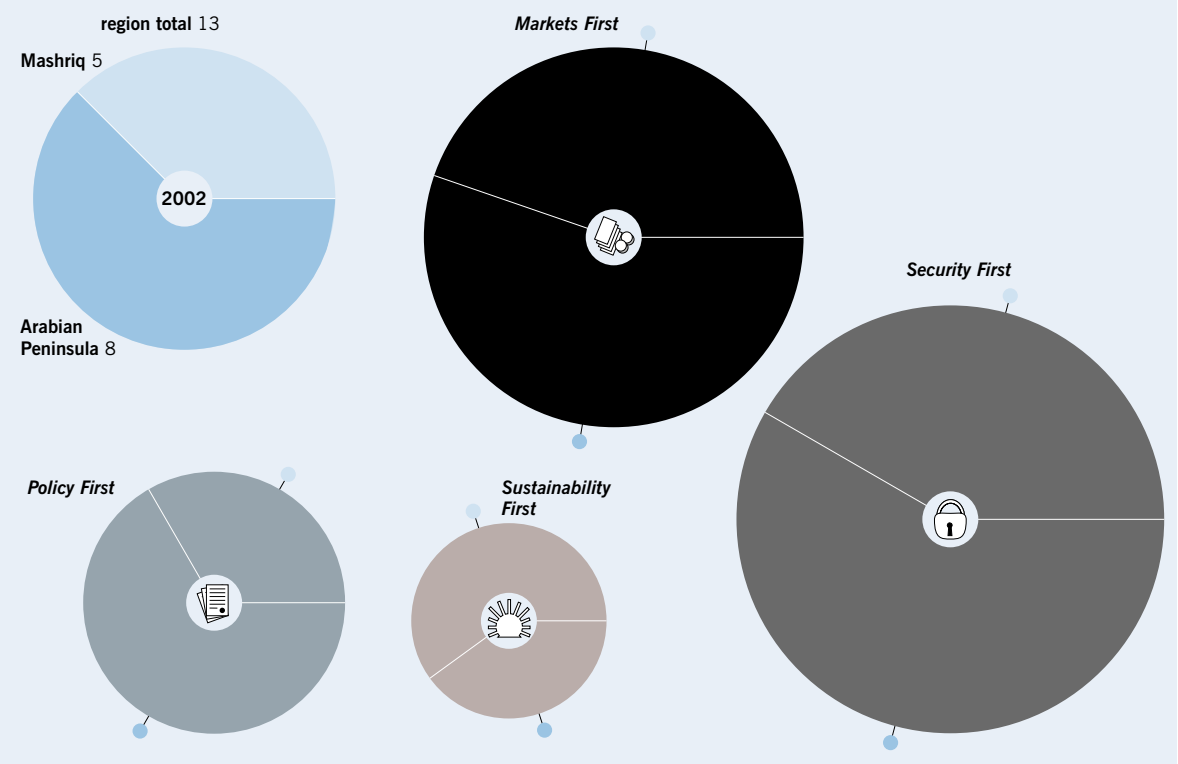
More effective urban planning and zoning prevail in *Policy First* and *Sustainability First* scenarios. Rural to urban migration is reduced conspicuously by well-planned integrated development of rural areas. In *Sustainability First*, rural area development includes environmental considerations to minimize encroachment and loss of agricultural and recreational lands, stimulating some reverse migration. Finally, in the Mashriq, the environmental and health problems associated with refugee centres are solved as part of the resolution of conflicts in the region.

Associated with the differences in land use and freshwater management, as well as other developments, the scenarios also differ in their implications for coastal and marine areas. Under the *Policy First* and *Sustainability First* scenarios, member states in the Arabian Gulf ratify the Convention for the Prevention of Marine Pollution from Ships (MARPOL) 73/78 and other established protocols, establish waste oil reception facilities and declare the Regional Organization for the Protection of the Marine Environment (ROPME) Sea Area a Special Area, which reduces oil pollution significantly. The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities is strictly implemented, controlling and significantly reducing sewage releases into the sea.

All the pie charts show total region impacts. The top left pie shows the current situation, the relative size of the others reflects the magnitude of impacts by 2032 under the four scenarios. Average incomes rise in all regions, contributing to a drop in the percentage of the population that is hungry, but in *Markets First* and *Security First*, the benefits of growth are not enough to offset the growth in population and the total number of people affected by food shortages.

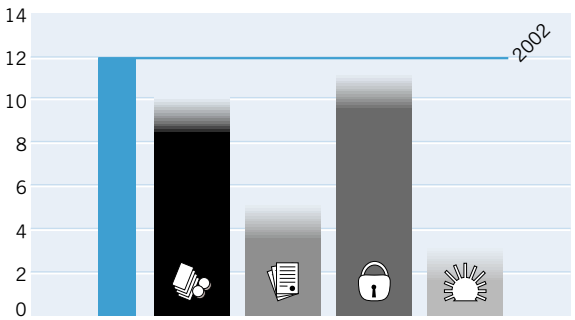
Source: PoleStar (see technical annex)

Population living with hunger: West Asia (million persons)



Source: PoleStar (see technical annex)

Population living with hunger: West Asia (%)



Key to chart


Markets First


Policy First


Security First


Sustainability First

These environmental trends, along with more broadly distributed economic growth and effective social policies, are reflected in the incidence of hunger in the region (see charts). In both *Markets First* and *Security First*, the levels of hunger are still near 10 per cent in 2032. In the *Markets First* scenario, relatively high inequality persists, limiting the improvements that can be achieved from economic growth. In the *Security First* scenario, divergent income distributions worsen the situation even more. Combined with the population growth, the numbers of persons experiencing hunger increase by half in *Markets First* and approximately double in *Security First*. In *Policy First* and *Sustainability First*, a combination of relatively high economic growth and comparatively equitable income distributions leads to a sharp drop in the percentage hungry, as well as in the total.

Imagine … a major seven-year drought in West Asia

An extended drought occurs, starting late in the first decade of the century. A significant drop in groundwater resources has affected major aquifers in the region since the mid-1990s. Growing scarcity of irrigation and clean drinking water in the Mashriq sub-region leads to more dependency on food imports in the Gulf Cooperation Council (GCC) countries and proliferation of hunger and poverty in Mashriq countries and Yemen. As approximately 60 per cent of surface water resources in the region originate from outside, the potential exists for disagreements to escalate between countries over shared and depleted water resources.

In the case of …

Markets First

- Water resources policies focusing almost exclusively on 'supply augmentation' prove unwise in this drought-prone region. There is some movement towards demand management but this is not implemented quickly enough to avert major water shortages.
- There is mass dependency on desalination facilities in GCC countries.
- Cash crops in irrigated areas are halved, resulting in major deficits in locally grown food.
- New, genetically engineered, more drought-tolerant crops are introduced.
- Water-related health problems proliferate.

Policy First

- Sweeping institutional reforms strengthen authorities in charge of water resources management.
- An existing policy focus on demand management, conservation and protection makes it relatively easy to introduce prompt additional measures that help eke out water supplies while drought conditions persist.
- Remedial instruments and programmes are introduced, including water pricing mechanisms, awareness and education campaigns, legislation to strengthen powers of enforcement, measures to boost the management of marginal waters, and codes to enable efficient water resources allocation among competing economic sectors.
- Economic integration and regional cooperation help modify agricultural policies in the Arabian Peninsula and reduce water consumption in the agricultural sector.
- Temporary agreements deal with the problems of shared water resources and help enhance regional stability.

Security First

- Competition and conflicts between sectors and users increase, leading to social unrest.
- There are widespread signs of increase in the rate of desertification and deterioration of biological resources combined with extinction of some species due to over-hunting and habitat destruction.
- Water-related health problems proliferate.
- Political instability and conflicts in the region mount, leading to open war over water resources, threatening regional and international stability.

Sustainability First

- Strategic regional water resource and river basin management planning reduce impacts of drought, in turn enhancing the efficiency of water use, resource protection and water resources augmentation.
- Major institutional reforms further consolidate the authority of water resources management bodies. Previous policy shifts in favour of 'demand management and conservation' ease the way for additional measures to eke out water supplies.
- More freshwater is made available by desalination technology in the GCC countries, increasingly using alternative and renewable energy sources, such as solar and wind power, to run desalination plants.
- There is widespread application of biotechnology to crop production, to boost drought resistance and yields.
- More equitable sharing of surface and groundwater resources is achieved as riparian countries sign and ratify treaties to that effect. This process is helped by the resolution of the Arab–Israeli conflict.

The lessons

Developments not directly related to the environment, such as improvements in regional cooperation, can have a major impact on environmental issues. Similarly, the ways in which one environmental issue is tackled can have significant impacts on others, for instance the choice of renewable energy sources to power desalinization works reduces fossil-fuel burning. Experience and adoption of a mixed set of policy instruments allows greater flexibility to react swiftly in times of unexpected and increased environmental stress.

Implications: the Polar Regions

Far more than in other regions, the environmental future of the polar regions is largely determined by global developments. The Arctic and Antarctic share various environmental concerns with other regions and with one another.

Despite shared concerns, the two sub-regions that make up the *GEO-3* Polar Region are very different in geographical circumstances, in their degree of isolation from major centres of population and human activity and in their legal status. In addition, unlike the Antarctic, the Arctic has a permanent human population, including indigenous peoples (see Chapter 2).

Carving up the Arctic

The evolution of governance structures for the Arctic and Antarctic determines, to a large extent, the environmental futures of the region. In a *Markets First* scenario, the Arctic Council does not live up to its goals and has limited impact on policy decisions affecting the Arctic and its constituent states. In the early 21st century, land-claim agreements are reached with all indigenous groups, giving them varying degrees of ownership and rights to Arctic resources. Multinational entrepreneurs negotiate legally binding agreements with local populations and indigenous people's organizations for the rights to exploit the resources in exchange for cash and the promise of long-term local employment. However, much of this promised benefit does not play out and the local populations can do little to enforce the agreements.

In *Policy First*, the Council partially lives up to its goals and its advice has significant impact on policy decisions affecting the region. The Council's working groups and its observers successfully facilitate a vibrant environmental ethic and networks — especially among younger people — throughout the circumpolar world. Agreements reached between multinational entrepreneurs and local populations not only make provision for cash outlays and employment in exchange for exploration and production rights but also guarantee long-term management, part ownership and profit sharing rights. Where needed, the Council is effective in guaranteeing the latter are adhered to.

In *Security First*, a highly splintered, factional circumpolar world emerges, in which the United States, the Russian Federation, the Nordic states, and Canada compete to protect their respective northlands and their prized resources. Further splintering leaves power in the hands of an elite of commercial stakeholders. Some areas are subjected to ruthless exploitation and resource depletion. Local and indigenous peoples are increasingly marginalized. Unanimity of purpose is ruptured within communities of indigenous peoples, as key members of these communities and some of their organizations join forces with the multinational stakeholders. Although many people living in the Arctic gain a measure of economic independence, their existence becomes unstable.

In *Sustainability First*, the Arctic Council becomes a forceful advocate for the new thinking about sustainable livelihoods. Strong social and environmental support networks are established throughout the circumpolar world. An overall conservation and development plan for the region is agreed and partly implemented by Arctic states. It includes a system of protected areas to ensure the continuing survival and development of Arctic biodiversity and heritage. The Arctic peoples strengthen traditional alliances and modern international partnerships to serve the common good as well as specific interests.

Southern legal regime

In a *Markets First* scenario, the Antarctic legal regime responds to some emerging issues yet increasingly runs up against entrenched stakeholder positions on points such as sovereignty and freedom of commercial access. There is a gradual addition of states, regional economic groupings and other international entities to the Antarctic Treaty System but most states continue to remain outside. Developing states are still (in effect) excluded from the system by lack of technology and funds. The Antarctic is increasingly penetrated by 'pirate' operators beyond the effective legal control of individual states or of international regimes. These operators are increasingly able to 'regime-pick' to sanction their particular activity.

In a *Policy First* situation, the Antarctic legal regime recognizes the need to adopt new agreements and harmonize regional legal and global approaches. This stimulates new membership and new forms of membership, including non-state entities. Administering regional agreements becomes more

complex as membership grows and the increasing involvement of developing countries highlights the need to address equity issues such as burden-sharing and technology-sharing, in appropriate ways.

Under *Security First*, the Antarctic legal regime essentially collapses as a result of rivalry between claimant states seeking to secure their putative rights, and other advanced technology states and entities that do not recognize those rights. In practice a small number of very large corporations and powerful states operate Antarctica as a joint franchise. The wider international community contests the legitimacy of this deal, but is unable to challenge the new hegemony to any practical effect.

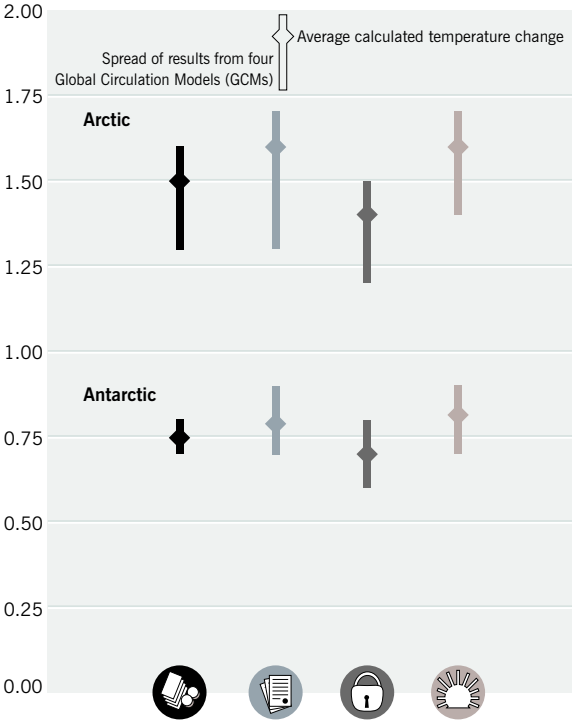
In *Sustainability First*, the Antarctic legal regime initially continues its gradual development. By the century's third decade, however, piecemeal changes are no longer seen as sufficient. With more fundamental shifts in international norms under way, it becomes possible to tackle some of the key issues, including the claims to sovereignty in Antarctica and policies of the high seas. As resolution of these issues becomes feasible, the possibility arises of a more fundamental revision of the Antarctic legal regime. Under a new legal structure, no property rights can be assigned to any part of the continent or its resources.

Heating up

These differences, combined with the impacts on polar areas of activities and processes in other parts of the world, translate into a varied range of environmental implications under the four scenarios. Large increases in average polar temperatures are to be expected in all the scenarios, especially in the Arctic (see chart). *Policy First* and *Sustainability First* feature the highest increases up to 2032, reflecting the rapid abatement of emissions of sulphur oxides under these scenarios. Warming in Antarctica is less pronounced on account of the ocean currents in the area.

In *Security First*, both areas suffer from proliferation of illegal production of ozone depleting substances, which obliterates the gains made earlier, in the late 20th and early 21st centuries. Likewise, chemical pollutants originating from outside the region increase significantly in *Security First* due to weak regulation and in *Markets First*, where economic growth is higher. In *Policy First* and *Sustainability First*, efforts to phase out pollutants effectively terminate these problems.

Change in average temperature: Polar regions (°C per ten years)



Large increases in average polar temperature are to be expected for each of the scenarios, especially in the Arctic. The graph clearly shows that the change of temperature between 2002 and 2032 is far larger than the uncertainty.

Source: IMAGE 2.2 (see technical annex)

Safety-nets for fish stocks

A key area of concern in both regions is the health of fish and other marine stocks. The effects of a crash in Antarctic krill are examined in the box on page 393. There is a big increase in the number and sophistication of vessels employed, and harvesting increases massively in both the Antarctic and the Arctic in *Markets First*. The very rapid rate of industrial exploitation and abandonment of targeted fisheries means that management responses often lag behind events. Continued depletion of target populations leads to some population crashes and adverse impacts on associated species.

In *Policy First*, the Antarctic marine ecosystem is placed under ever-increasing pressure as fishing proves the hardest resource activity to manage. Stark choices between commercial and development imperatives on the one hand, and environmental and ethical considerations on the other, prove difficult to reconcile. Underwater setting of lines and other technological developments eliminate seabird by-catch, but other forms of by-catch are unaffected and target stocks continue to be exploited beyond sustainable limits. In the Arctic, provision is made for

traditional local fisheries and for the engagement of local communities in international Arctic fisheries. Total collapse of any single fishery is averted using stringent harvesting quotas, limited entry schemes, and enforceable bilateral regimes.

In *Security First*, illegal, unregulated and unreported fishing activities cease under direct pressure from the powerful new interests regulating the region. Exploitation of marine living resources by the new interests takes off, however, and rises to very high levels. Self-interest sees attempts to manage this activity at sustainable levels, with approaches including fish-farming and biotechnology. The ecological and economic consequences of this shift are still unresolved by 2032. In the Arctic, fishing rights are unilaterally withdrawn from all but the Arctic states. However, overfishing has already exacted a heavy toll and desperate conservation measures may be too late to secure the resources for the future.

In *Sustainability First*, fish and marine mammals are rigorously defended against overexploitation. Quotas are reasonable and the resource base is healthy. Penalties for abuse are severe — and robustly enforced. One option being explored is to cap catches but set initial limits at a liberal level, then scale down from this level over a period of several decades. In the Antarctic, rights to fisheries are incrementally transferred from developed to developing world fleets. In the Arctic, local communities now manage most of the fisheries and potentially harmful practices such as trawling are outlawed in most areas.

Wildlife rearguard

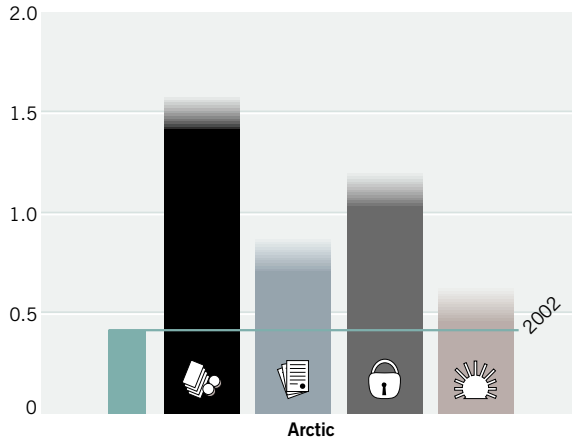
Infrastructure developments, often related to fishing and tourism in both the Arctic and the Antarctic, and to oil, gas and other mineral development in the Arctic, expand significantly in a *Markets First* world (see chart for the situation in the Arctic). In the Antarctic, this includes spontaneous private colonization by a limited number of economically and technology-rich individuals or entities. In the Arctic, habitats of wide-ranging species, such as the caribou, reindeer, grizzly bear and musk ox are severely fragmented and encroached upon. All Arctic wildlife is substantially affected either directly or indirectly from the disruption of the food chain, from habitat loss and from the insidious impacts of climate change. Excessive hunting further reduces some of the populations to biologically unsustainable levels.

In *Policy First*, these pressures are kept in check, although effects of decades of warming — on land and sea — are visible over large expanses. Responsible planning decisions have prevailed and wildlife habitat has remained relatively intact. In many cases this is due to the improved effectiveness of habitat management, particularly in protected areas which are now integrated into circumpolar and north–south networks. The numbers and size of protected areas have increased significantly, but many sites still have inadequate regulations on mineral, oil and gas exploration and extraction and hydropower generation. Hunting is sustainable in most parts of the Arctic and quotas are based on much improved scientific evidence.

Security First sees permanent residence in Antarctica becoming possible for personnel employed by industries active in the area and as a status symbol for the wealthy. Numbers of endemic wildlife in the Arctic plummet, the food chain is disrupted and genetic diversity is weakened due to habitat degradation and fragmentation. Opportunistic alien species able to survive in the warming climate have filled available niches. However, even they are having a hard time due to contamination by wastes and habitat destruction.

In *Sustainability First*, biodiversity hot spots and habitats are protected and large areas are set aside as national parks or nature reserves to help wildlife cope with climate change. Small, regulated subsistence hunts are still allowed in accordance with agreements negotiated with indigenous peoples. The public does not tolerate poaching. Residence in the Antarctic is denied for anything other than specifically agreed purposes, generally scientific research.

Land area impacted by infrastructure expansion: Arctic (% of total land area)



Key to chart


Markets First


Policy First


Security First


Sustainability First

The Arctic holds the largest remaining undisturbed — but highly sensitive — wilderness in the world.

Source: GLOBIO (see technical annex)

In the Arctic, the condition of the boreal forests differs markedly between scenarios. Large areas of forest in the region have come under stress from rapid climate change, leading to long-term shifts in temperature and precipitation, as well as to increasing incidence of fires. Continued and increasing levels of logging in *Markets First* and *Security First* further exacerbate these pressures. Most notably, in *Security First* muddy plains and clear-cut forested areas have replaced many of the once vast pristine landscapes.

Imagine… a crash in circumpolar Antarctic krill stocks

Clear signs emerge that circumpolar Antarctic krill (*Euphausia superba*) stocks are crashing. The immediate cause is believed to be commercial over-harvesting, but the picture is complicated by simultaneous sea-ice changes and rises in ultraviolet radiation levels, both of which are believed to affect krill population dynamics. There is evidence of serious adverse impacts on breeding success of Antarctic birds, seals and cetaceans within a few seasons, leading to serious concerns over the viability of populations of higher predators. Indications of severe damage to stocks of other marine species — initially evident through declining stocks of fin-fish and squid — raise concern about the stability of the entire Antarctic marine ecosystem, and knock-on effects on other ecosystems in and around the sub-region. Dramatic falls in catches of krill and commercial fisheries stocks that prey on krill, result in widespread reduction in fishing activity and collapse of the fishing industry in some areas. The treaties, institutions and other international arrangements set up to conserve and manage the fishery are seen as having failed. Public concern runs high at the prospect of threats to charismatic wildlife species such as penguins, seals and whales.

In the case of…

Markets First

- Some regulatory steps are taken, but market mechanisms are the prime response measures used — reducing krill demand by raising prices, and harvesting by raising costs.
- Harvesting switches to other species, including those that are not dependent upon krill themselves and may be competitors. Where these responses fail, the fishing industry abandons the area.
- It is widely presumed that krill stocks will in time recover, and that the adverse knock-on effects will turn out to be reversible.

Policy First

- Moratoria on krill harvesting are agreed to allow stock recovery.
- These steps are accompanied by reductions in fisheries activities across all target species.
- Major research effort is directed to understanding what has happened and underpinning policy responses.
- The regulatory regime for the marine environment is revised.

Security First

- Measures are taken to ban some operators from the region as a way to curb pressures on krill stocks.
- Market mechanisms are employed when they underpin the interests of key stakeholders in the region.
- In a bid for short-term 'use-it-or-lose-it' exploitation, harvesting switches to other species, including those expected to decline steeply as a result of krill stock collapse.
- Active management of the marine environment begins by seeding new krill stocks (including genetically modified types), enhancing nutrient levels and depressing predators or competitors.

Sustainability First

- There is an immediate closure of all krill fisheries pending recovery of stocks.
- Substantial reductions in other fisheries are introduced as a precautionary measure — although directed harvesting of particular predator populations is considered in some areas.
- A renewed effort is made to understand the functioning of the Antarctic marine environment.
- Negotiation begins for a new legal regime to manage the marine environment and regulate more limited harvesting when stocks have recovered.

The lessons

Existing knowledge of many natural systems is limited, including the thresholds for resource exploitation, beyond which systems collapse. Such thresholds may be reached in a comparatively sudden way. It makes sense, therefore, to continue efforts to improve understanding, but also to take a precautionary approach where baseline data are lacking, where uncertainty is high and where irreversible impacts are possible. This course of action may avoid the need to take more drastic action in the event of a system crash.

UNEP, Pramkaew, Still Pictures

Lessons from the future

As we step back into the world in which we live now, a number of important lessons arise from the foregoing scenarios that can help to provide general policy guidance.

LESSON ONE

Contrasting yet plausible stories can be told for how the world and its regions will develop in the next 30 years; each has fundamentally different implications for the environment.

Earlier chapters of *GEO-3* have outlined important and very specific changes that emerged over the past 30 years, and there is no reason to believe that the next 30 will be any less dynamic. Using scenarios, it is possible to tell strongly contrasting but plausible stories about how the world and its regions might develop in the future. None of the stories requires exotic surprises to materialize and elements of each of the four scenarios can already be discerned in today's world. In appreciating the scenarios, it is important to realize that, in real life, they are not mutually exclusive. A given region may experience all four or a combination of several at once. And although

the scenarios have been presented as fairly uniform across the world, it is clear that not all regions have experienced, are experiencing, or will experience the same developments.

Examining the environmental implications casts a spotlight on the differences across scenarios, regions and issues. These variations have been illustrated in the narratives, the quantitative material and the differing outcomes of particular events or trends.

Sustainability First implies the most positive environmental outlook of the four scenarios. *Markets First* and *Security First* conjure up much more pessimistic pictures, but for very different reasons. This contrast is reflected in the issues that come most conspicuously to the fore in each scenario. For example, water shortages are generally more of a problem in *Markets First*, reflecting increasing resource demand, whereas urban pollution and loss of biodiversity are more marked in *Security First*, reflecting a lack of effective environmental policies. *Policy First* falls somewhere in between — some of the environmental targets are met, through a mainly top-down approach, whereas it is unrealistic to make significant progress on others without a broader commitment to change.

LESSON TWO

There can be significant delays between human actions, including policy decisions, and associated impacts on the environment, specifically:

- **much of the environmental change that will occur over the next 30 years has already been set in motion by past and current actions**
- **many of the effects of environmentally relevant policies put into place over the next 30 years will not be apparent until long afterwards.**

Social and economic systems can be notoriously slow to change. The basic infrastructure of modern society, including transportation and energy systems, cannot be refashioned rapidly without great expense. Financial and political systems, and basic behaviour patterns also tend to exhibit overpowering inertia. Furthermore, even when social systems change, resulting in reduced pressures on the environment, time lags in natural systems can delay the ultimate response to these changes. Therefore, it is important to consider not only the state of the environment at the end of the time horizon for these scenarios, but also the trends.

This proviso is perhaps most clearly seen in the case of climate change impacts, which differ minimally between the scenarios in most regions over the next 30 years. This is because much of the climatic change expected to occur over the next 30 years is the result of actions that have already been taken. It is not surprising that the issues which stand out as the most difficult to tackle — halting land degradation, preserving biodiversity and ensuring access to freshwater — are all linked to climate change among other factors. The intractable nature of these impacts is also related to the fact that they are driven by fundamental human demands and are not easily amenable to technical fixes.

LESSON THREE

Achieving widely agreed environmental and social goals will require dramatic and coordinated action starting now and continuing for a number of years. Steps must include policies based on prevention and adaptation.

The environmental implications of the various scenarios illustrate the legacy of the past decades and the level of effort that will be needed to reverse powerful trends. These challenges can only be met with robust and coordinated action at all levels of government and among many different sectors of society. The scenarios also demonstrate that it can take many years for important social and environmental indicators to diverge from one another. Given the likelihood that large numbers of people will continue to be vulnerable to environmental change, even where the scenarios point to eventual achievement of environmental goals, adaptation policies will be needed to complement mitigation policies. Among other reasons, these may be necessary to meet social goals, minimize the transient effects of environmental change, prevent irreversible losses, and maintain the enthusiasm for the necessary social and political will to achieve the long-term goals.

LESSON FOUR

Important linkages exist between different environmental issues and between environmental and broader social issues. It follows that:

- **policy can be made more effective by looking for synergies or 'co-benefits'**
- **care must be taken to avoid conflicts between policies.**

The scenarios presented here demonstrate the importance of interlinkages between the environmental, social, economic and political spheres, both within and across regions. The complex interplay between human and natural systems calls for approaches that treat social, economic and environmental concerns in an integrated fashion.

Positive synergies between policies can be maximized. For example, well-designed policies can simultaneously address issues such as climate change, transport, and urban and regional air pollution. Thus, ambitious climate policies could serve as a cornerstone of modern, integrated environmental programmes in many situations.

In other cases, connections imply potential conflicts. The large-scale introduction of modern biofuels in certain regions as a substitute for fossil fuels, a feature of the *Policy First* scenario, could have adverse implications for biodiversity and agriculture in these areas. Similarly, the use of biotechnology and genetic engineering to improve agricultural productivity could, rather than reducing the demand for agricultural land, lead to a dramatic expansion if organisms are genetically modified to be able to thrive in areas currently unsuitable for widespread crop production or grazing. This outcome would have serious implications for biodiversity and land management.

There is a need to be aware of both the small and the large-scale effects of policies, particularly those related to the introduction of new technologies. On a small scale, stimulating better technology to deliver the same services with less resource use is clearly a robust policy that makes sense in almost any conceivable scenario. If scaled up, however, two possible drawbacks arise. First, the improved efficiency may induce an increased level of activity (such as additional travelling in improved motor vehicles), which outweighs the gains achieved by better technology (in this instance lower fuel consumption or lower pollution emissions per kilometre travelled). Second, new technologies that increase dependence, either on other countries or on the technology itself, can increase vulnerability of regions to disruptions in, or misuse of, these technologies.

LESSON FIVE

The establishment of strong institutions for environmental governance is a prerequisite for almost all other policies.

A fundamental distinction between the four scenarios lies in the existence and effectiveness of strong institutions for environmental governance. The scenarios represent largely different political attitudes, citizen values and degrees of acceptance of (or action against) inequality. The political will and vision of governments and other authorities determine, above all else, whether environmentally sustainable development comes within reach worldwide. Where strong institutions for

Reflections on the use of scenarios

For this Global Environment Outlook a scenario approach has been chosen that deliberately emphasizes the possibility of many different futures rather than the probability of any single one. None of the four scenarios that has been presented should be viewed as more or less likely than the others, or as a reference scenario from which the others represent variants. Recent experience and reflections upon issues such as insufficient information (ignorance), the complexity of human and natural systems (surprise), and the ability of humans to choose (volition), suggests that for longer range policy thinking it is not only disingenuous to presume we can know the most likely future, but that it is also detrimental to good policy making because it unnecessarily narrows our vision (Raskin and Kemp-Benedict 2002).

The process also revealed some of the challenges in such a scenario exercise. The choice to begin with global archetypes aided in the effort to create sets of nested global and regional scenarios that were consistent with each other. At the same time, this choice arguably limited the range of scenarios that might have arisen had the regional scenario teams been able to operate more independently. The efforts to combine narrative scenarios with quantitative information coming out of models and other analytical tools also drew attention to the need to use consistent assumptions in the two approaches. The quantitative underpinning certainly helped to stimulate the development of the narrative scenarios and provided both consistency checks and powerful means of depicting the differences between the four scenarios in the different regions. It remains apparent, though, that the existing quantitative tools are limited in their ability to capture the richness of narrative scenarios, particularly where these involve significant departures from the current situation.

environmental governance are absent, as in *Security First*, or afforded a lower status than other institutions, as in *Markets First*, improvements in environmental conditions are less likely to occur. As the range of concerns traverses the local to the global, so must these institutions. Furthermore, as all sectors of society are, in some way, both responsible for and impacted by the status of natural and human systems, these institutions must reach across these sectors. Thus, not only formal governments, but also business, NGOs and other elements of civil society must play a role, individually and in partnership, in establishing and maintaining these institutions.

LESSON SIX

Ensuring timely access to accurate information is a robust policy, as it:

- **allows for early warning of environmental problems**
- **can stimulate voluntary action by business and industry**
- **can support formal and informal market-based mechanisms that promote good environmental conduct.**

Ensuring and stimulating timely access to information is crucial not only for keeping abreast of the current state of environmental and social systems and trends in both, but also for coordinating action to address emerging or existing problems. Efforts are required to ensure that key public information remains accessible, and that more flows are established. A fundamental message, from *Policy First* and *Sustainability First* in particular, is that information can both encourage voluntary action and increase the effectiveness of other policies. The flow of accurate information can therefore actively support other policies. Conversely, as *Security First* most notably shows, when economic and political relations polarize, the control of information can be an important instrument of power.

LESSON SEVEN

Not all policy instruments are appropriate for all situations.

It is clear that there are particular policy instruments that are more in accordance with different types of worlds. For example, market-based instruments such as capping and trading systems for curbing pollutants will find a niche in a world that resembles *Markets First*, whereas ambitious zoning and other spatial planning measures would not go down so well. Similarly, eco-labelling will be suited to a world that resembles *Sustainability First*, but forcibly restricting access to protected areas would be much less suitable. This same argument implies that the most appropriate choice of policy instruments can vary between different regions or at different times. Careful selection of specific and appropriate policy instruments is clearly very important.

The final lesson from the scenarios presented in this chapter may be one of perspective.

LESSON EIGHT

The achievement of environmental goals will require decisive action, will encounter unforeseen eventualities and will not happen overnight. Fortunately or unfortunately, much of the success or failure of this endeavour is in our hands.

The four scenarios show that the future is not something that we should wait for passively. Rather, the choices we have made in the past, those we are currently making and those we will make in the future all strongly influence in which world we will live. There will be many branch points when stakeholders will have the opportunity to turn in one direction or another, whether towards *Markets First* or towards *Policy First*, *Security First*, *Sustainability First* or another, as yet unimagined, scenario. Being aware of threats, opportunities and the possible outcomes of different choices is a prerequisite to effective policy making.

Technical annex

The quantitative results presented in this chapter were developed to illustrate the narrative scenarios and to provide an indication of their likely environmental implications. These results were derived using a range of analytical tools, in consultation with regional experts. They emphasize general trends and differences between scenarios, rather than precise levels of impact. This technical annex outlines the scenario development process followed for *GEO-3*, and presents summary descriptions of the analytical tools employed, and the indicators presented in the chapter. More extensive information, including more detailed data tables and figures, is presented in Raskin and Kemp-Benedict (2002) and in a separate technical report (RIVM and UNEP, in press).

The scenario development process

Drawing from previous work of the Global Scenario Group (see Raskin and Kemp-Benedict 2002), four global storylines were designed by a core scenario team of global and regional experts. An initial quantification for a small set of indicators was prepared at the level of the GEO sub-regions. Teams in each of the seven major GEO regions then elaborated the storylines at regional level and provided input to the quantitative analyses, particularly with respect to key driving forces. The results of the regional efforts were used to refine the global narratives and to undertake the subsequent quantitative analyses associated with the scenario narratives. Further refinement of both the narratives and the quantitative analyses was achieved through an iterative process involving the core scenario team and the modelling groups. During the development process the work underwent two formal rounds of review and was scrutinized at a special workshop with a group of scenario experts from around the world.

Quantitative analytical tools

AIM (Asian Pacific Integrated Model) is an integrated environment-economy model developed by the National Institute for Environmental Studies (NIES) and Kyoto University, Japan, to assess future scenarios of socio-economic development and environmental change in Asia and the Pacific as well as at global level. The set of AIM modules was developed primarily for assessing effects of climate change policies and climate change impacts, but it can also be applied to other environmental fields such as air pollution, water resources, land use change and ecosystem assessment. With externally derived socio-economic data as input, the model estimates future environmental conditions of 42 countries in Asia and the Pacific. The ecosystem module uses a latitude-longitude grid with a spatial resolution of 2.5 x 2.5 minutes to facilitate policy analyses. The model has been extensively reviewed and frequently used by the IPCC. More information about AIM is available at http://www-cger.nies.go.jp/ipcc/aim/

GLOBIO (Global methodology for mapping human impacts on the biosphere) is a simple transparent global model developed under the GLOBIO project, coordinated by the Norwegian Institute for Nature Research (NINA), UNEP-GRID-Arendal, UNEP-WCMC and UNEP/DEWA. It is used to visualize, at a scale of 1 x 1 km, the cumulative impacts on biodiversity and ecosystem function of growth in human resource demand and associated infrastructure development. The model provides a statistical risk assessment of probability of human impacts using buffer zones from infrastructure that vary with type of human activity and density of infrastructure, region, vegetation, climate and sensitivity of species and ecosystems. Satellite imagery is used to derive overviews of cumulative impacts of ongoing development. Future scenario situations are derived from data on existing infrastructure, historic growth rates of infrastructure, availability of petroleum and mineral reserves, vegetation cover, population density, distance to coast and projected development. More information on GLOBIO can be found at http://www.globio.info and in UNEP 2001.

IMAGE 2.2 (Integrated Model to Assess the Global Environment) is a dynamic integrated assessment model for global change developed by the National Institute for Public Health and the Environment (RIVM), The Netherlands. IMAGE quantifies the consequences of different future developments for a broad range of environmental issues. Driving forces are modelled for 17 world regions, partly via the WorldScan general equilibrium model. Impacts are calculated over long time frames (typically 100 years), and with a high spatial resolution (0.5 x 0.5 degree latitude-longitude grid). Long historical series are used to calibrate the model and place future developments in perspective. The model has been extensively reviewed and frequently used by the IPCC. More information about IMAGE is available at http://www.rivm.nl/image/ and in Alcamo and others (1998) and IMAGE Team (2001a and 2001b).

PoleStar is a comprehensive and flexible software tool for sustainability studies developed by the Stockholm Environment Institute (SEI), Boston Centre, USA. Rather than being a rigid model, the software provides an adaptable accounting framework and modelling environment for mounting economic, resource and environmental information and for examining alternative development scenarios. PoleStar has been used in a number of international assessments, including quantification of the scenarios of the Global Scenario Group (GSG). Technical documentation on PoleStar and details of the GSG scenarios can be found online at http://www.seib.org/polestar and http://www.gsg.org

WaterGAP 2.1 model (Water — Global Assessment and Prognosis) is the first global model that computes both water availability and water use on the river basin scale. WaterGAP, developed by the Center for Environmental Systems Research (CESR), University of Kassel, Germany, has two main components, a Global Hydrology Model and a Global Water Use Model. The Global Hydrology Model simulates the characteristic macro-scale behaviour of the terrestrial water cycle to estimate water availability. The Global Water Use Model consists of three main sub-models that compute water use for the domestic, industry and agriculture sectors. All computations cover the entire land surface of the globe on a 0.5 x 0.5 degree latitude-longitude grid. A global drainage direction map then allows the analysis of the water resources situation in all large drainage basins worldwide. For a more detailed description of the model see Alcamo and others (2000) and Center for Environmental Systems Research (2002).

Note: *Any discrepancies between the GEO-3 regions and sub-regions and the regions represented in data sets used to generate charts and other figures are noted with the individual graphics.*

Variables

Variables charted or mapped in the Outlook section of *GEO-3* are (in alphabetical order) as follows.

Area with high risk of water-induced soil degradation indicates the land area that is at high risk from water erosion under a specific form of land use. The sensitivity to water erosion is computed from the soil and terrain characteristics, rainfall erosivity and land cover. In global terms, water erosion is the most serious form of land degradation and it is irreversible. Whether erosion actually occurs depends on implementation of soil conservation measures at farm and landscape levels.

Source: IMAGE 2.2; Hootsmans and others 2001. For definition of erosion risk see UNEP/ISRIC 1991

Atmospheric concentrations of carbon dioxide presents the global CO_2 concentration in the atmosphere as the net balance between CO_2 emissions from fossil fuel combustion, industrial production, deforestation and CO_2 uptake by mature and regrowing vegetation, and by the oceans.

Source: AIM for Asia and the Pacific; IMAGE 2.2 for other regions and global chart; De Vries and others 2001

Carbon dioxide emissions covers emissions from land use, industrial production and energy use. Emissions from industrial sources include the emissions from non-energy use of fossil fuels (mainly feedstocks) and industrial activities. Land-

use sources of carbon dioxide include burning forest biomass (after deforestation) and fuelwood, and releases by waste processes after disposal of consumer goods such as paper, furniture and building materials.

Source: AIM for Asia and the Pacific; IMAGE 2.2 for other regions and global chart; De Vries and others 2001

Change in average temperature, 2002–32. Given the uncertainties in the regional distribution of temperature increase, this graph is based on results from four different Global Circulation Models (GCMs) in combination with IMAGE 2.2. For each of the GCMs, the spatially differentiated pattern of temperature change for a reference scenario (1 per cent per annum growth in equivalent greenhouse gas concentration from 1990 onwards) was taken, north of 66°N and south of 66°S latitude. This pattern was then scaled on the basis of global average temperature changes for each of the scenarios as calculated by IMAGE 2.2. Finally, the average temperature change for the Arctic and Antarctic was calculated. The GCMs used are HadCM2, ECHAM4, CSIRO Mk2 and CGCM1. The GCM results were taken from the IPCC Data Distribution Centre for Climate Change and Related Scenarios for Impacts Assessment (IPCC-DCC 1999).

Source: four GCMs and IMAGE 2.2

Change in selected pressures on natural ecosystems 2002–32. For the ecosystem quality component, see the explanation of the Natural Capital Index. Values for the cumulative pressures were derived as described under Natural Capital Index. The maps show the relative increase or decrease in pressure between 2002 and 2032. 'No change' means less than 10 per cent change in pressure over the scenario period; small increase or decrease means between 10 and 50 per cent change; substantial increase or decrease means 50 to 100 per cent change; strong increase means more than doubling of pressure. Areas which switch between natural and domesticated land uses are recorded separately.

Source: IMAGE 2.2

Ecosystems impacted by infrastructure expansion reflects the probability of human impact on biodiversity based on distances to different types of infrastructure, such as roads, dams and other utilities. Impact zones vary according to climate, vegetation and political region.

Source: GLOBIO

Energy-related carbon dioxide emissions are total CO_2 emissions from all energy uses.

Source: AIM for Asia and the Pacific; IMAGE 2.2 for other regions and global chart; De Vries and others 2001

Energy-related nitrogen oxide emissions are total NO_x emissions from all energy uses.

Source: AIM for Asia and the Pacific; IMAGE 2.2 for other regions and global chart; De Vries and others 2001

Energy-related sulphur dioxide emissions are total SO_2 emissions from all energy uses.

Source: AIM for Asia and the Pacific; IMAGE 2.2 for other regions and global chart; De Vries and others 2001

Extent of built-up areas includes land cleared and altered for businesses, residences, roads, parking lots, parks, landfills, burial grounds and other similar uses. A combination of different sources was used to arrive at regional estimates for built-up land.

Source: Polestar

Global temperature change is the average increase of global temperature, expressed in degrees per ten years. The rate of temperature change is important since sensitive ecosystems may not be able to adapt at high rates. Research has shown that, at rates larger than 0.1 °C per ten years, extensive damage to ecosystems is probable (Vellinga and Swart 1991).

Source: IMAGE 2.2

Land area impacted by infrastructure expansion. See note under *Ecosystems impacted by infrastructure expansion*, above.

Source: GLOBIO

Municipal solid waste generation is an index of solid waste generation from household and commercial sources. Total solid waste generation in the Asia and Pacific region in the year 1995 has been allocated an index value of 1. Index values for 2032 under each scenario relate to the index for the base year.

Source: AIM

Natural Capital Index is a measure for terrestrial and aquatic biodiversity of natural ecosystems and agricultural land. The index is calculated as the product of habitat area times ecosystem quality, expressed as a percentage. The habitat area is taken as the percentage of remaining surface of natural ecosystems. Ecosystem quality is approximated from four pressure factors that are considered to have a major influence on biodiversity and for which global data are available. Based on literature, for each pressure factor a range is defined from no effect to complete deterioration of habitats if the maximum value is exceeded over a long time. Pressure factors are population density (min-max: 10–150 persons per km^2), primary energy use (min-max: 0.5–100 peta Joules per km^2), rate of temperature change (min-max: 0.2–2.0 °C in a 20 year period) and restoration time for exhausted agricultural land, livestock area and deforested zones in re-conversion towards natural, low-impacted ecosystems (min-max: 100–0 restoration time). The proxy for ecosystem quality is a reversed function of these pressures, calculated as a percentage of the low-impacted baseline state. The higher the pressure, the lower the quality. Finally, the percentages for habitat area and quality are multiplied, resulting in a pressure-based Natural Capital Index. The calculations were carried out on a detailed latitude-longitude grid, before aggregation to sub-regions and regions.

Source: IMAGE 2.2; ten Brink 2000 and 2001, ten Brink and others 2000

Natural forest, excluding regrowth is the area of mature forests (excluding plantations) that has not been harvested using clear cutting since 1972.

Source: IMAGE 2.2

Potential increase in nitrogen loading on coastal ecosystems. At the sub-regional aggregation level employed in GEO, nitrogen loading can be taken as a proxy for a wider range of land-based pollution on the coastal ecosystems. The potential growth of the subregional nitrogen load under each of the scenarios has been estimated by rating the change in determinants such as sewage inputs and level of treatment, fertilizer use and airborne emissions, on a ten-point scale.

Source: IMAGE 2.2; van Drecht and others (in press)

Percentage of 2002 cropland that is severely degraded by 2032 represents cropland so degraded that it is of little value for production. The degraded area is expressed as a percentage of land that was under crops in 2002.

Source: Polestar

Population living in areas with severe water stress. Water stress is measured by the 'withdrawal-to-availability' ratio (wta-ratio). This ratio captures how much of the average annual renewable water resources of a river basin are withdrawn for human purposes in the domestic, industry and agricultural sectors. In principle, the higher the ratio, the more intensively the water in a river is used; this reduces either water quantity or water quality or even both for downstream users. Commonly it is assumed that when the wta-ratio in a river basin exceeds 0.4, or 40 per cent, the river basin experiences severe water stress.

Source: WaterGAP 2.1

Population living with hunger refers to the incidence of chronic under-nutrition in developing and transitional regions (using 1995 data based on FAO estimates), the incidence of food insecurity in the United States and estimates for other countries based on income distribution. Hunger patterns are determined in the scenarios by changes in income, income distribution and population.

Source: PoleStar

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