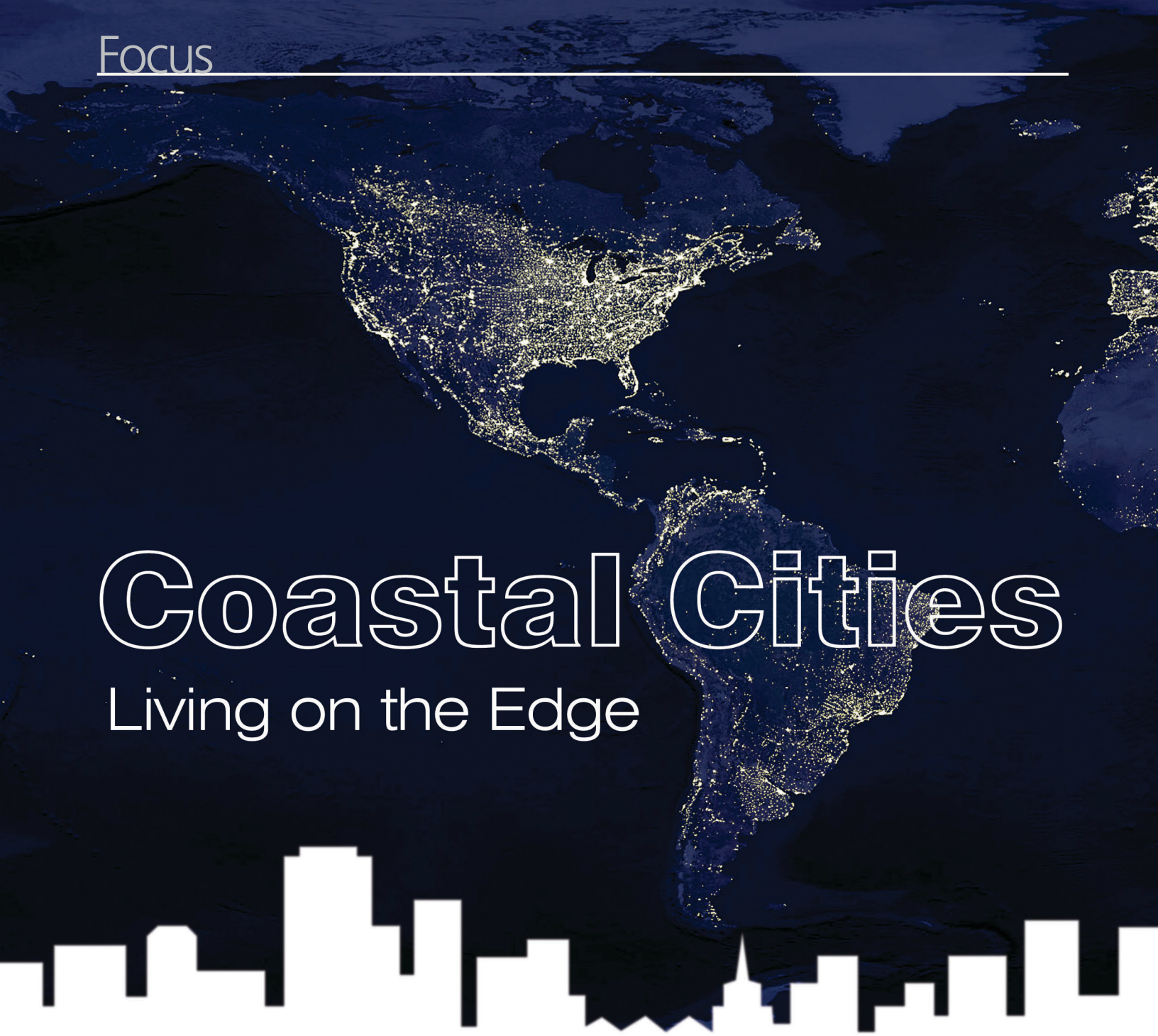


Coastal Cities

Living on the Edge

In one of the greatest human migrations of modern times, people are flocking to coastlines around the world. People in developing countries have relocated from the countryside to towns and cities of every size during the past 50 years. But the most dramatic population growth has occurred in giant coastal cities, particularly those in Asia and Africa. Many experts argue that cities will have to cope with almost all of the population growth to come in the next two decades, and much of this increase will occur in coastal urban centers.

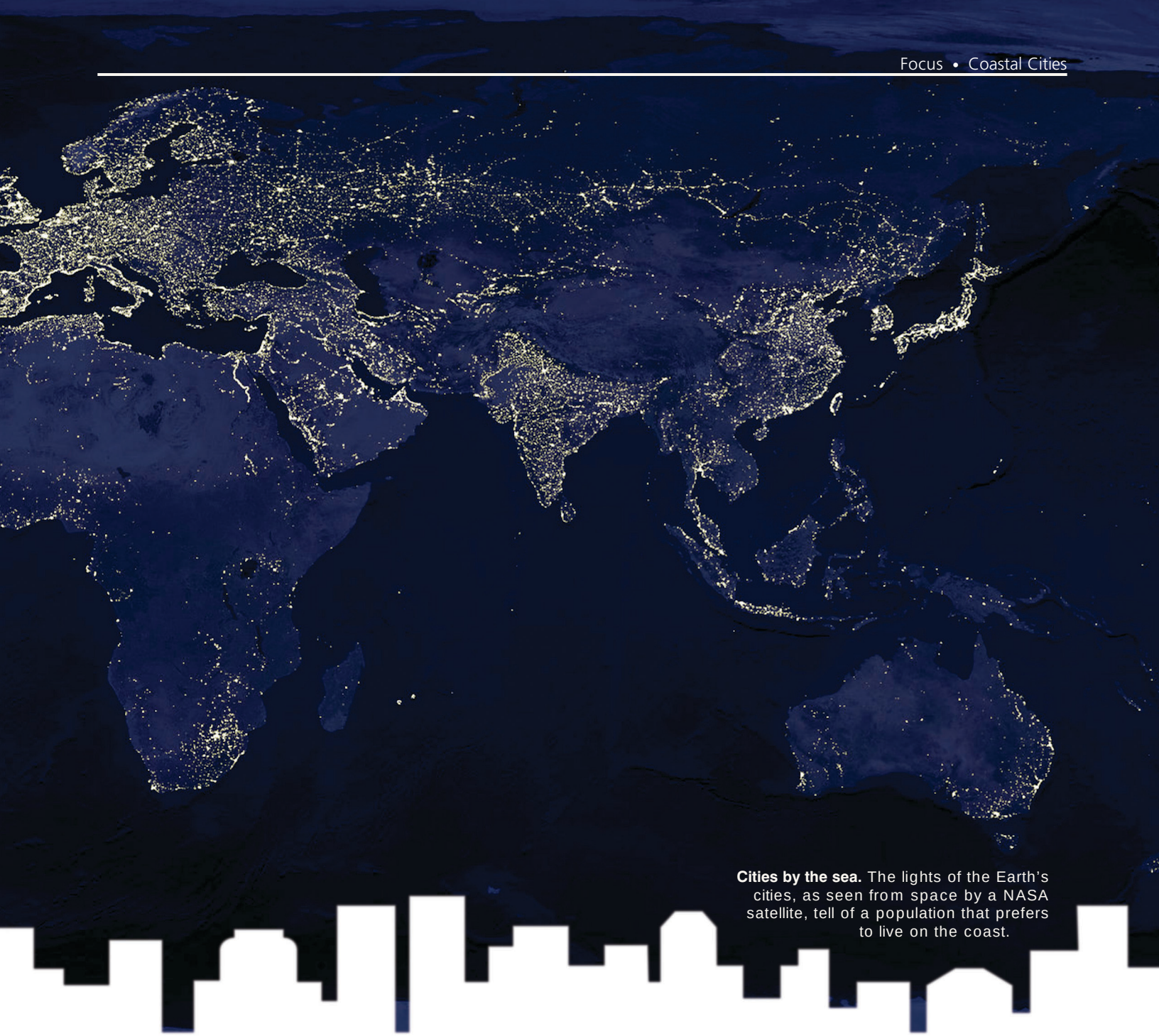
Cities concentrate people and businesses—and their wastes. Yet most large cities around the world lack adequate provisions for treating their domestic and industrial wastes, which pour into coastal waters. At the same time, booming cities are sprawling across coastal environments, destroying important resources. These problems and the scale of population growth are most alarming in the tropics. Some coastal cities in the tropics are doubling their population in just a decade, so the pace of ecosystem change is much greater there.

Cities Take Center Stage

In 1950, New York City was the planet's only "megacity," defined as a city with more than 10 million people. Now there are 17 megacities around the globe, and 14 are located in coastal areas. Eleven of today's megacities are located in Asia, and the fastest-growing ones are located in the tropics. The United Nations (UN) Population Division anticipates four new megacities by 2015, including Tianjin, Istanbul, Cairo, and Lagos. All but Cairo are located on coastlines.

But megacities are just one part of the population boom in coastal areas. Two-fifths of the world's major cities of 1–10 million people are also located near coastlines. In 2001, almost 3 billion people worldwide lived in an urban center—generally defined as a town or city of more than 1,000–2,000 people—and by 2030 that number will likely increase to 5 billion. This population growth will be especially heavy in coastal urban areas of less-developed countries. By contrast, the percentage of people living in cities in North America, South America, Europe, and Japan is expected to remain stable at 75–85%.

NASA, Christopher G. Reuther/EHP



Cities by the sea. The lights of the Earth's cities, as seen from space by a NASA satellite, tell of a population that prefers to live on the coast.

Coastal populations on every continent have exploded as global trade has flowed into coastal nations through international ports, creating jobs and economic growth. The world economy grew more than fivefold between 1950 and 1990. The internationalization of finance, production, and services, plus advances in information technology and cheap labor, reduced physical boundaries around the world. Cities such as São Paulo, Buenos Aires, and Jakarta prospered after deregulation of financial markets, and their urban cores flourished with Western-style, high-income commercial and residential gentrification.

Rapid development and population growth are causing similar problems along shorelines around the world, according to a report in the January–March 2000 issue of *Coastal Management* by Stephen Olsen, director of the Coastal Resources Center at the University of Rhode Island, and Patrick Christie, a research assistant professor at the University of Washington's School of Marine Affairs. Important habitats such as wetlands, coral reefs, sea grasses, and estuaries are being degraded or destroyed. Changes in the volume and quality of freshwater inflows to estuaries have affected water quality. As a result, estuary-dependent fish and shellfish populations and their associated fisheries are declining.

Moreover, fishermen are losing access to their fishing grounds. Resorts, hotels, and condominiums are usually built in attractive bays, inlets, and creeks that fishermen have traditionally used as docking facilities and fishing grounds. In many coastal areas, tourism drives up the cost of shorefront land, making it difficult for fishermen to live and work there. At some point, fishermen lack a place to sustain the infrastructure they need to ply their trade.

Coastal Growth in the United States

Many Americans are moving from high-density, cold-weather urban centers in the Northeast and Midwest to warm-weather, lower-density, suburban resort communities throughout the Sun Belt, including shorelines from Virginia to Texas, and also to the Pacific Coast, particularly Southern California. Of the 20 fastest-growing U.S. counties, 17 are

coastal. Coastal counties cover less than 20% of the land area of the United States, but today they account for more than half of the nation's population.

According to the December 2001 report *State of the Coast*, published by the National Oceanic and Atmospheric Administration (NOAA), the coastal population will grow to 165 million by 2015, a 50% increase over 1960. But the coastal portion of the U.S. population has remained stable since 1960 and will continue that way. The coastal portion has averaged about 54% of the national population total since 1960, and it's expected to remain the same to 2015.

Along U.S. shores, financial and entertainment centers such as New York and Los Angeles have continued as dominant forces in the world economy. At the same time, these metropolitan areas have seen striking changes in land use patterns since the 1950s. High-density development has boomed near harbors and on barrier islands, where land values are extremely high. But low-density development has also gobbled up land in every coastal watershed, because Americans want to live in lower-density settings. "You see this massive outward flow around the United States," says Kenneth M. Johnson, a demographer and sociologist at Loyola University Chicago. As a result, many metropolitan areas have grown outward physically far more rapidly than their populations have risen.

Greater Los Angeles, for instance, increased its population by 45% between 1970 and 1990, while its urbanized area swelled by nearly 300%. Along the East Coast, dozens of cities, suburbs, and towns have blended together into a super-sized megalopolis along the northeastern corridor. This urbanized area stretches for 500 miles from Boston to Washington, D.C., and contains 50 million people. It continues to expand southeast toward Norfolk, Virginia.

Many rural "recreational" counties experienced high growth rates from 1990 to 1998, according to *The Rural Rebound*, a 1999 study conducted by Johnson for the Population Reference Bureau. Newcomers and tourists poured into places like Beaufort County, South Carolina, home of Hilton Head Island, which had a population increase of just over 40% in the 1990s.

The reasons for these increases are many: the appeal of living near the water and visiting the shoreline, increased tourism, more people with enough household wealth to relocate for retirement, increased second-home purchases, and the chance for people to relocate to attractive coastal areas where they can telecommute or start new businesses or second careers. "Many communities are changing from places that once had small populations in the off season, booming only during the summer, to places that have year-round populations," says Michael Ratcliffe, a geographer with the U.S. Census Bureau.

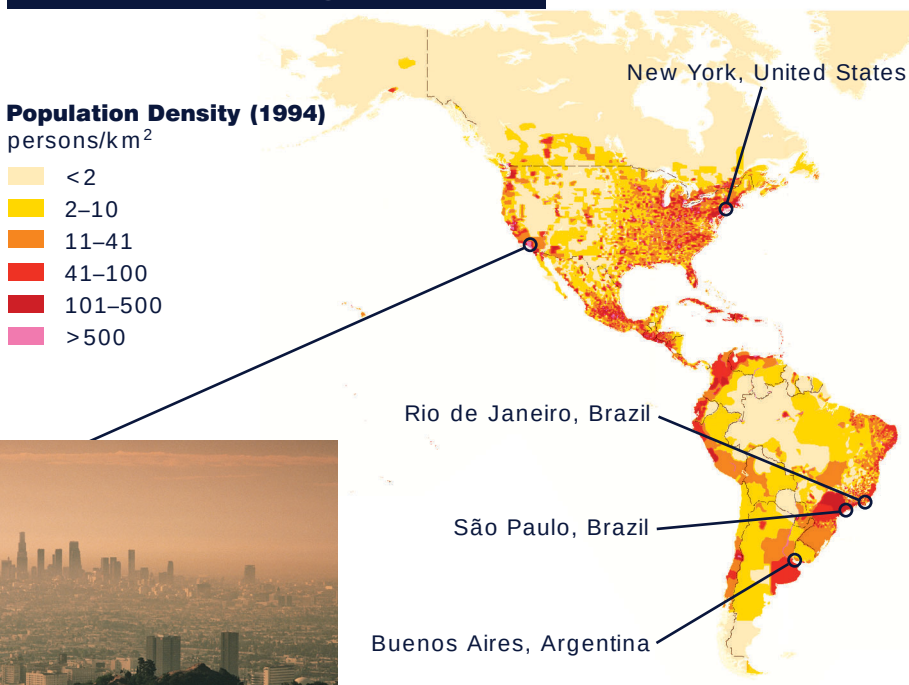
This also means more jobs for workers in services that support all these new coastal residents and visitors. As the need for support services grows, workers move into the area and locate in inland towns farther back from the coast, where property values are lower. New housing, schools, malls, and hospitals are springing up in these sprawling new inland communities to serve the workers.

Worldwide Sprawl

Virtually all metropolitan areas in North America, Western Europe, and Japan are experiencing long-distance "deconcentration"—or urban development that spreads across the landscape—due to the influence of commuting by automobile and to the dispersing effects of information technologies, said Peter Hall, a professor of planning at the University College London's Bartlett School of Architecture and Planning, in 1997 at the first of an annual series of lectures sponsored by the Megacities Foundation, established in 1994 to study the impacts of growing cities. The capabilities of telecommunication have improved, and their costs have increasingly fallen. Businesses no longer rely on meeting clients and customers face-to-face in a downtown business and industrial center; they can often use forms of telecommunication to conduct business. Additionally, until the 1970s, many businesses had to be situated in an urban core, where they could expeditiously ship out products and import supplies and raw materials via a port, river, or railway terminal. But in recent years, transportation systems have become much more based on cars and trucks moving along freeways. When state and national governments built extensive beltways and freeways around metropolitan areas, the logistics for businesses located on the urban/rural fringes were greatly improved.

But sprawl doesn't always happen the same ways in every region. In Pacific Asia—from Indonesia to Japan—regions just outside megacities have grown the fastest in population and land use changes, says Yue-man Yeung, director of the Hong Kong Institute of Asia-Pacific Studies at the Chinese University of Hong Kong. In Jakarta and Manila, land use controls are less stringent in the urban fringe areas, where developers can simply pave over farmland or forestland and easily install infrastructure, rather than purchasing more

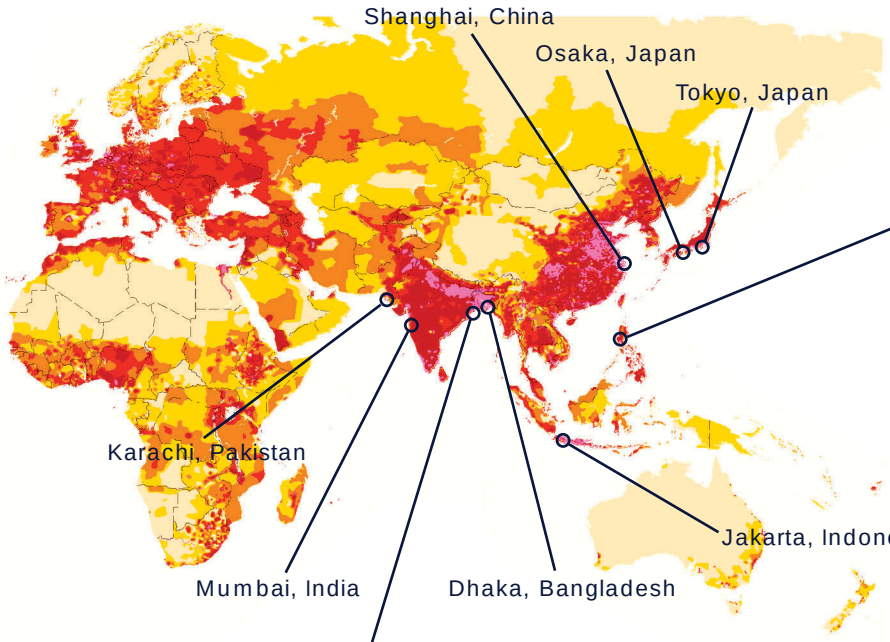
Coastal Megacities



Los Angeles, United States

Source: Natural Resources Conservation Service. World Soil Resources Map Index. Global Population Density—1994. Washington, D.C.: U.S. Department of Agriculture. Available: *http://www.nrcs.usda.gov/technical/worldsoils/mapindx/popden.html* [accessed 9 October 2002].

Photograph: PhotoDisc



Manila, Philippines

Calcutta, India

Photographs, top to bottom: Digital Vision; Mark Henley/Panos Pictures

expensive land in built-up areas, and then tearing out old, decaying infrastructure to install new water and sewer lines and roads. As a result, these giant urban centers spread out and blend into adjacent smaller towns and cities. "The main city interacts and grows with many smaller cities in the surrounding area, with boundaries between them growing increasingly blurred and forming a new entity," says Yeung.

In China's Pearl River Delta, the cities of Hong Kong, Shenzhen, and Guangzhou are becoming a single continuous urban area containing more than 20 million people. Development has been spurred in part by China's first superhighway, the Shenzhen–Guangzhou tollway, which runs for 72 miles through this corridor, one of the fastest-growing regions in the world.

The outward growth of Chinese cities also is different from that of the West. Most major Chinese cities, such as Shanghai, have moved factories out to industrial zones on the urban edges, according to a 6 September 2002 report in *The New York Times*. Inner-city workers have been moved to satellite suburbs, where they live in concrete high-rises. This relocation has freed up land for gentrification at the urban core. Now many urban Chinese, who once bicycled to nearby factories, have to commute by buses or private cars. China has built billions of dollars of expressways to accommodate the increasing traffic.

Threats to Coastal Ecosystems

In February 2002, the Stakeholder Forum for Our Common Future, formerly the UN Environment Development Forum, disseminated *Environment Briefing 3*, which described regional and coastal trends around the world. In many cases, the briefing noted, the loss of coral reefs is an important leading indicator of environmental crisis. For example, 22% of Caribbean coral reefs are effectively destroyed. Another 33% are considered at high risk due to increased runoff and sedimentation from deforestation, and nutrient contributions of sewage from hotels, coastal construction, and mining. In Southeast Asia, 32% of coral reefs have been severely degraded by human activities and global climate change. In central and southern Africa, reefs have been degraded from pollution, sedimentation, overexploitation, and climate change.

These changes could prove disastrous, because the sea life found in coral reefs is so important as a food source. Throughout Southeast Asia, for example, coral reef fisheries provide 10–25% of the protein available to people living along coastlines, according to the 2002 World Resources Institute report *Reefs at Risk in Southeast Asia*.

Many coastal cities are growing rapidly across river deltas, draining wetlands, building on floodplains, cutting coastal forests, and increasing sediment loads into estuaries. Sprawling urbanization across watersheds—which can include areas hundreds of miles inland—harms streams, creeks, and rivers that flow into coastal waters. Rainfall washes pesticides, fertilizers, oil, and other nonpoint-source pollutants off lawns, roads, and parking lots into waterways that flow to the ocean. Rivers have been straightened to accommodate giant oceangoing ships for port traffic, so that the water flow into wetlands and mangrove forests is disrupted.

Coastal wetlands—salt marshes and tidal flats in temperate areas, and mangrove forests in tropical regions—provide food, habitat, and nurseries for 80–90% of the world's marine fish and shellfish. Many fish and shellfish species spawn in the near-shore ocean. Their young migrate into estuaries and wetlands, where the larvae feed on detritus. Later, as adults, they migrate back to the coastal ocean. By disrupting these wetland habitats, poorly planned coastal developments have often reduced commercially important fish populations that rely on these areas. Moreover, aquaculture expansion has destroyed 3 million hectares of mangrove forests, including 65% of Mexico's mangroves.

A variety of studies during the past decade have shown that when more than 10% of the acreage of a watershed is covered in roads and other hard surfaces, the rivers and streams within the watershed become seriously degraded, according to the 2002 Pew Oceans Commission report *Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States*. The report states that "by virtually every measure of ecosystem health, the streams, creeks, marshes, and rivers surrounded by hardened watersheds are less diverse, less stable, and less productive than those in natural watersheds."

Many estuaries worldwide are also damaged to some degree by untreated or inadequately treated domestic and industrial waste.

Untreated wastewater contributes pathogens, toxic contaminants, suspended solids, organic wastes, and dissolved nutrients such as nitrogen and phosphorus. Organic wastes can significantly reduce the biological oxygen available in waterways, causing fish kills.

Most coastal cities in Asia discharge all of their domestic and industrial wastes directly into the sea without any treatment, writes Yihang Jiang, a program officer with the UN Environment Programme, in a 2001 special megacities issue of *Ocean & Coastal Management*. In Shanghai, only 58% of urban households are connected to public sewage systems; in Mumbai, only 51% are connected. Jakarta's centralized wastewater system reaches only about 3% of its population, according to Tusy A. Adibroto, director of that city's Centre for the Assessment and Application of Environmental Technology. About 97% of the population still have individual treatment such as septic tanks, and in many cases the individual treatment does not follow local regulations. Of 30,000 factories in Jakarta, about 10% have wastewater treatment.

Many developing nations fail to treat domestic or industrial wastewater because they lack the necessary funds, technology, and human resources, says Yeung. "The experience and expertise are available in the international community, but access to these is expensive and out of reach of many large cities in the developing world. You also need people who are at a certain stage of development to be able to manage, operate, and maintain these facilities."

Even many developed nations do not treat their domestic sewage. In 1996, 48% of coastal cities on the Mediterranean Sea lacked centralized sewage treatment, according a 2000 European Environment Agency report, *State and Pressure of the Marine and Coastal Mediterranean Environment*.

Most municipal wastewater treatment plants in the United States handle both domestic sewage and industrial wastes. During primary treatment, large solids in sewage are screened or settled. Secondary treatment uses aeration and bacterial action to reduce pathogens, most contaminant solids, and about 85% of organic material and suspended solids. Then wastewater is disinfected with chlorine, ozone, or ultraviolet radiation. With advanced or tertiary treatment, wastewater is further processed by flocculation, coagulation, clarification, or filtration. The Clean Water Act requires that wastewater treatment facilities achieve the standards of secondary treatment. The problem is that secondary treatment can remove only about one-third of wastewater nitrogen.

In coastal waters, nitrogen is the principal cause of eutrophication. During the process of eutrophication, excess nitrogen spurs growth of aquatic plants that eventually die, sink, and decay, depleting the water's oxygen supply and suffocating many kinds of sea life. "Nutrients are a bigger problem than toxic compounds in most of the developed world, at least for water quality issues," says Robert Howarth, an ecologist at Cornell University on leave at the Woods Hole Marine Biological Laboratory. "Nutrients are not nearly as well regulated and controlled." Nutrient pollution has damaged sea grass beds, coral reefs, and coastal ponds, and degraded water quality in poorly flushed bays and estuaries.

In September 2001, the U.S. Environmental Protection Agency (EPA) released its *National Coastal Condition Report*, in which it points out that eutrophication in estuarine waters is increasing throughout much of the United States. Every U.S. coastal area is in "poor" eutrophic condition, except for the Southeast, which is in "fair" condition, and Alaska and Hawaii, which were not evaluated.

The single largest source of nitrogen in U.S. coastal waters is agricultural activity, says Howarth. Emissions from cars, trucks, and coal-fired energy plants are the second major source. When fossil fuels are burned, nitrogen compounds are released into the atmosphere and fall back into waterways via acid rain, adding significant amounts of nitrogen to some coastal waters. Most nitrogen from cars, trucks, and other vehicles is localized, traveling a short distance into local waters. By contrast, nitrogen from tall power plant smokestacks can travel many hundreds of miles. Sewage is also an important nitrogen source, and in some estuaries, such as Long Island Sound and the Hudson estuary off Manhattan, it is the largest contributor, says Howarth.

But declining coastal resources can rarely be blamed on a single human impact. In the case of coral reefs, for example, *Reefs at Risk* warns that overfishing, destructive fishing practices, and intensive development in coastal areas all pose threats. Some fishermen use blast fishing to capture live fish for restaurants and the aquarium trade. Current fishing levels and methods are unsustainable. Massive deforestation and the construction of roads, airports, channels, ports, and buildings have also damaged reefs by adding sediment and nutrient loads to waterways. Increased sediments can smother corals;

Mumbai, India

Mark Henley/Panos Pictures

excess nutrients can encourage an overgrowth of algae on coral reefs.

Coastal Management in the United States

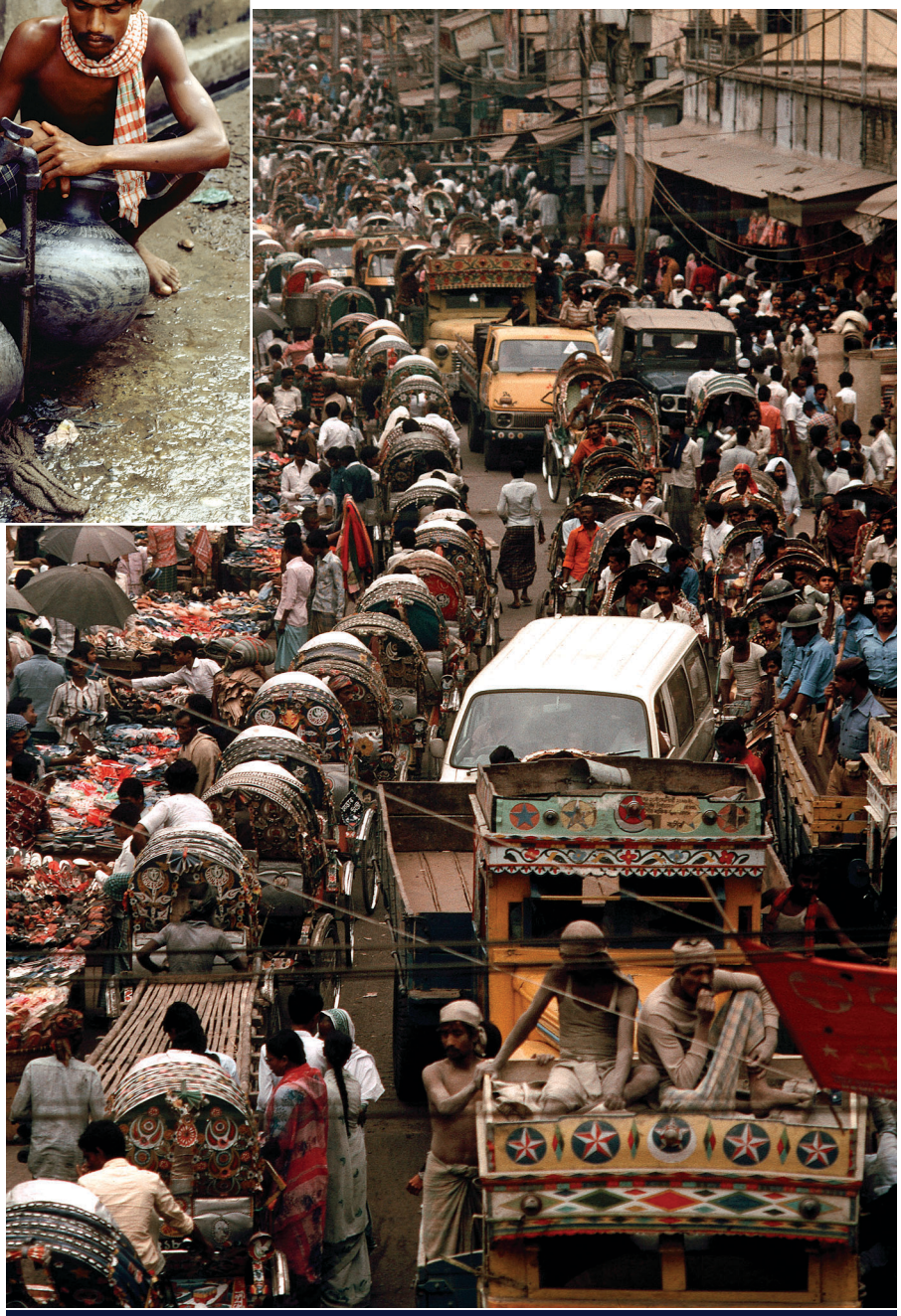
Managing development in coastal zones is so difficult partly because these regions cross so many physical, social, and regulatory boundaries. Urbanized coastal watersheds are affected by numerous competing economic sectors, which can include tourism, fisheries, agriculture, aquaculture, forestry, manufacturing, oil and gas extraction, waste disposal, marine transportation, and real estate development.

Yet most governments manage each sector separately—assuming they regulate them at all. One agency regulates fisheries; another regulates gas and oil exploration; yet another regulates forestry. U.S. coastal management is shared among numerous federal agencies, including NOAA, the EPA, the U.S. Army Corps of Engineers, and the Federal Emergency Management Agency, plus various agencies within the Department of the Interior. "Our institutions are organized into sectors, and they generally have a difficult time integrating their efforts," says Christie. Meanwhile, local, regional, and national agencies often fail to collaborate on coastal management issues.

One advantage of U.S. coastal zone governance is that state agencies have significant authority in a state–federal partnership. The Coastal Zone Management Act (CZMA), passed initially in 1972, provides federal funds to states, which in turn manage their coastal areas in accordance with a set of federal guidelines. Although all states participating in the CZMA must address coastal non-point-source pollution, each state's coastal zone management is unique, with distinct priorities that address local conditions. Some focus on nutrient reduction in coastal waters; others focus on permitting development projects. But insiders believe that, although some state programs attempt to develop a vision for their coast and implement it, others are little more than permitting programs for development. This has led to a common criticism of the CZMA—that it is insufficiently performance-based.

"The Coastal Zone Management Act is a good framework, but we don't really have any coherent coastal national strategy or plan," says Timothy Beatley, an associate professor of urban and environmental planning at the University of Virginia and coauthor of the book *An Introduction to Coastal Zone Management*. "Federal agencies seem to be operating in isolation, and at times at cross purposes." Beatley says the United States needs a national coastal strategy that would involve the collaboration of all the federal agencies that affect coastal zones: "We should come up with a vision about the coastal zone describing what the coast should be like by 2030 or 2050, with targets and desired outcomes."

Few state programs have influence over urban and regional plans in coastal watersheds. In many states, local governments have almost exclusive authority over land use planning. The result is that many municipalities and counties in the nation's coastal zones can establish comprehensive plans for future development without consulting any state coastal zone programs. According to Christopher Mann, director of ocean and coastal policy for the Pew Oceans Commission, a key role for states is to require baseline growth management planning by their municipalities, provide technical and financial assistance to accomplish



Dhaka, Bangladesh

Heldur Netocny/Panos Pictures

this, and require and assist with coordination among municipalities.

State and federal agencies sometimes don't cooperate, either. An important element of the CZMA is that all federal activity within or outside of a state's coastal zone has to be consistent with the state's management programs. In other words, federal agencies are supposed to coordinate their activities with those of state coastal agencies. Yet "most states don't include fisheries in their coastal management plans for reasons of history and turf," says Mann. "If the federal government is doing something wrong in fisheries management"—from the state's point of view—"states can't use consistency authority to bring the federal management plan in line."

Now some regulators and nongovernmental organizations are calling for regional management of coastal resources that is place-based or ecosystem-based. "You'd have the fish experts and water experts and bird habitat experts all sitting around the table, looking at the whole watershed and discussing what is best for an ecosystem," says Debra Hernandez, chairwoman of the Coastal States Organization (which represents the governors of U.S. coastal states and territories) and director of policy and program development for South Carolina's Office of Ocean Coastal Resource Management. She notes, however, that there are practical limits to this kind of resource management: coastal ecosystems are affected by air pollution and local land use decisions along watersheds often hundreds of miles inland. Mann says the Pew Oceans Commission will issue a report in early 2003 calling for area-based ocean governance plans that would provide a coordinating mechanism to focus all relevant policies on the highest priorities within an ecosystem.

With all their faults, U.S. coastal zone programs have a distinct advantage over those of many other nations: the United States invests about $50 million per year in state programs established by the CZMA. Moreover, the EPA's estuarine management programs provide $47 million per year to states. In most cases, individual states provide an additional 50% in matching funds for these programs. By contrast, developing nations usually do not have such financial resources.

Efforts Elsewhere in the World

Other nations face challenges similar to those of the United States. Many coastal nations have rapid, chaotic development along coastlines. Government often does not manage it or even keep track of it; government simply lacks basic information about the development that is occurring along the coast.

During the mid-1980s, China loosened its "top-down" regulation of land use to encourage economic growth. But as the national government stepped back from regulatory enforcement, it left a power vacuum, because local and provincial governments had only limited—or sectoral—authority over coastal and marine resources. Local agencies, in particular, had overlapping jurisdictions and poor cooperation. The result was unchecked development in the coastal zone, especially with regard to aquaculture, which has been largely unregulated.

But since the mid-1990s, the Chinese central government has taken steps to regain its authority over coastal land use. In August 2002, the Chinese National People's Congress passed a national zonation scheme for the entire coast called the Sea Area Use Law. Provincial and local governments will be instructed to pass regulations consistent with this national policy.

But it may prove difficult over the short term for the central government to regain its influence over China's rapidly expanding coastal economy. "There are tremendous turf issues that have to be resolved," says Jonathan Justi, Asia program manager for NOAA's National Ocean Service. "There are strong private-sector interests versus government interests, and there are government sectors that have conflict among themselves. The private-sector interests are much stronger today, and they move pretty aggressively."

Nevertheless, China has already made some progress in addressing turf issues. For example, in the late 1990s, China moved to restructure its provincial regulatory system, merging its ocean and fisheries agencies, says Justi. These merges were an attempt to integrate important functions in China's marine management structure.

The 1992 UN Conference on Environment and Development, or Earth Summit, helped to build interest in swift changes occurring along the world's coastlines. This conference also promoted integrated coastal management (ICM), a set of ideals and principles, as a response to these changes. ICM emerged from successful aspects of the U.S. programs established under the CZMA. Governments that set up ICM programs encourage participation by a wide variety of stakeholders across economic sectors.

To manage dynamic coastal environments effectively, ICM programs must draw on the knowledge of fishermen and other local users, exploring the natural, social, and economic conditions that prevail there. During the ICM process, fishermen, port officials, representatives from tourism and hotel associations, and many other stakeholders discuss management options with regulators from coastal resource agencies. ICM programs use various management tools and processes—

Shanghai, China

Mark Henley/Panos Pictures

establishment of marine protected areas, fisheries regulation, and upland forestry management, among others—to ensure sustainable use of resources for the benefit of local communities.

In ICM's ideal manifestation, sector-by-sector management of coastal resources would still exist. Fishery managers would continue working on fishery allocations, but an ICM program would take primary responsibility for the effects of land-based pollution sources on fishery nursery areas. This would happen by taking action against polluters, but perhaps more importantly by setting up permitting programs for development.

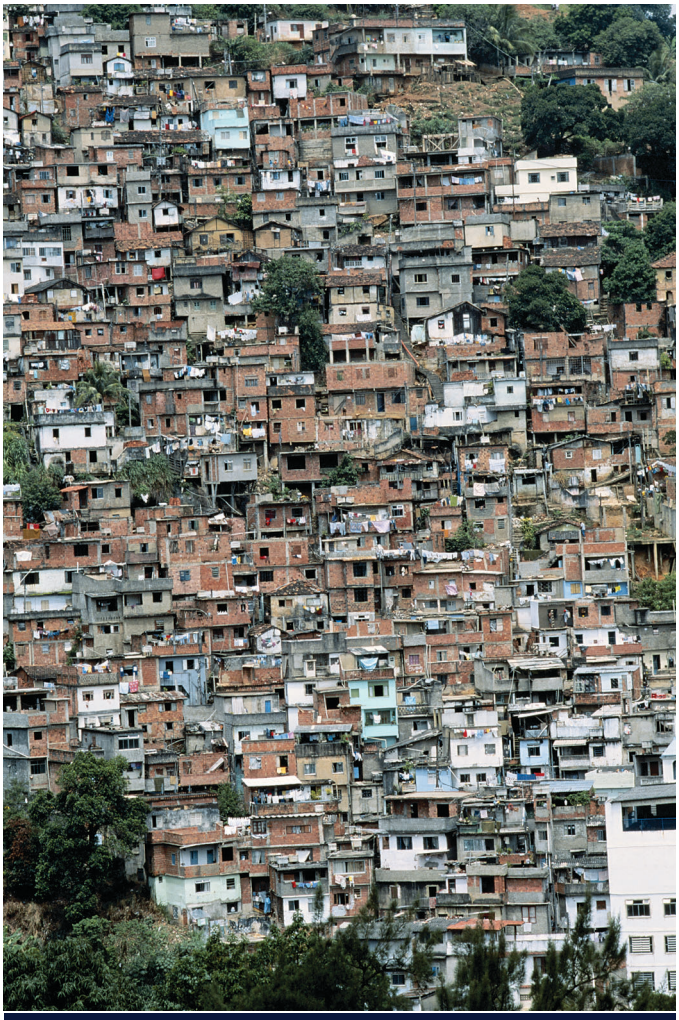
Since the Earth Summit, multilateral banks have supported ICM efforts around the world. The Inter-American Development Bank invested $60 million for the period 1993–1996 in ICM programs in developing countries. The World Bank earmarked an estimated $500 million for ICM efforts for the period 1996–2004. A number of Global Environment Facility projects rely on ICM principles to meet their objectives, according to Olsen and Christie.

China has been experimenting with ICM in pilot projects that are cofunded by international organizations leveraged with domestic funds, says Justi. One ICM demonstration site is the Xiamen coastal area, a project supported by the Global Environment Facility, the UN Development Programme, and the International Maritime Organization. Before implementing its new Sea Area Use Law, China intended to test ICM concepts at demonstration sites such as Xiamen to collect information about coordinated management of marine resources. The goal of the Xiamen project was to demonstrate the feasibility of preventing sea pollution without jeopardizing economic growth. The Xiamen project has established plans to relocate shrimp culture pens away from shipping lanes and sensitive environmental areas, to develop areas into ecological resort towns, and to protect remaining endangered marine flora and fauna.

The Baseline 2000 survey, conducted by senior research associate Jens Sorensen of the University of Massachusetts Boston Urban Harbors Institute, found 380 ICM programs in 92 nations and semisovereign states. Nevertheless, "few really good ICM programs are in place," says Guy Jobbins, a research fellow in coastal management at University College London. Still, ICM is a management process, and it's difficult to say what is "successful," because in many places the process is still in early stages.

"It's important to have mutual learning based on mutual respect, a process that breaks down barriers to authority," says Jobbins. "Technocrats don't know everything, and think they do." In some countries, however, regulators refuse to listen to local people. "They say, 'You're an ignorant peasant—go away, stop bothering me.'"

It's common for ICM projects in developing countries to falter soon after funding from development banks has ended. "Many of these ICM institutions and processes cease to exist rather quickly after external support is withdrawn," says Christie. "Time and again, when the funding is used up, interesting ICM processes collapse. There have been successes in ICM, but a lot of failures as well." Reasons for the failures are complex, with a variety of historical, sociological, and economic factors including disparities of wealth, lack of communication among agencies, and bureaucratic turf battles. Christie and a team of researchers are studying seven sites in the Philippines and two in Indonesia to learn more about the barriers to successful ICM projects.



Rio de Janeiro, Brazil

Stone

At the World Summit on Sustainable Development, held in Johannesburg, South Africa, 26 August–4 September 2002, nations agreed to make several efforts regarding oceans and fisheries, including some that apply to coastal cities. For one, nations will encourage the use of the "ecosystem management" approach for the sustainable development of the oceans. This approach recognizes that modifications in one aspect of an ecosystem can affect other areas and people's livelihoods. Nations also agreed to develop and facilitate by 2012 the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, and the establishment of marine protected areas consistent with international law and based on scientific information. They also agreed to establish by 2004 a regular process under the UN for global reporting and assessment of the state of the marine environment. Justi notes that the summit acknowledged the importance of ICM. "As far as recognizing ICM [being] a starting point [goes], it's being recognized at the highest levels," he says.

More than ever, coastal environments are affected by pollution flowing hundreds of miles downstream from sewage treatment plants, subdivisions, and farms, and across air currents from power plant smokestacks. Today, there is a growing consensus that coastal management needs a more integrated approach across economic sectors, across inland watersheds and marine resources, and across regulatory agencies and institutions.

If there is any good to come from the devastation being wrought on the Earth's coastal zones, perhaps it is that greater concentrations of people and industry usually lower the costs of providing the infrastructure that reduces environmental contamination—it's much less expensive per capita to build a sewer treatment plant and sewer lines for a densely populated city than for a sprawling small town, for example. As more people move to cities in the developing world, this could be an opportunity to provide crucial infrastructure and services that will protect the environment rather than destroy it.

John Tibbetts