Two Sides of Urban Mexico

Industrial Dualism, Poverty, and Pollution

Source: *Corbis*

Knowledge, Poverty, and Pollution

Mexico's border with the United States runs from the Pacific Ocean to the Rio Grande, then winds southeast with the river until it empties into the Gulf of Mexico near Matamoros. Along this 1,900-mile frontier, thousands of *maquiladora* factories assemble products for duty-free export to the United States. Their explosive growth has provided employment for thousands of young Mexicans, but some factories have also contributed to pollution along both sides of the border.

Some of the worst pollution problems occur in the Paso del Norte region, where the Rio Grande crosses from the United States into Mexico. Here the cities of Ciudad Juárez, Mexico, and El Paso, Texas, flank the river in a high desert valley that is prone to thermal inversions. In the 1980s, air pollution mounted as growth in both cities accelerated. The U.S. Environmental Protection Agency cited El Paso's air quality as substandard, and U.S. environmental groups opposed to the North American Free Trade Agreement (NAFTA) pointed to the region's problems. Better to defer NAFTA, some argued, until Mexican industry could handle pollution problems like those in the Paso del Norte.

But which "Mexican industry"? Some firms handle their pollution problems very well. Cemex (Cementos Mexicanos), for example, operates cement plants all over Mexico while setting a world standard for environmental performance.[1] Cemex's Barrientos facility was the first cement plant in the Americas to receive ISO 14001 certification, and Mexico's Environment Ministry has publicly lauded six Cemex plants for their participation in a voluntary environmental audit program.

In the border region, some maquiladora plants are undoubtedly serious polluters. But many specialize in garment and electronics assembly operations that are less pollution intensive than heavy manufacturing. For example, in 1997 about 80 percent of maquiladora factories were assembly operations (garments, electrical equipment, furniture, auto parts, etc.), 15 percent were in general manufacturing, and 5 percent produced chemicals.[2]

In fact, the worst industrial pollution in Juárez has no direct link to NAFTA or maquiladora production.[3] It comes from small brick kilns, which belch filthy smoke from combustion of scrap wood, old tires, used motor oil, and sawdust laden with toxics (Figure 4.1). The kilns evoke Mexico's historic poverty, not its new prosperity. Most brick makers live near their work sites in cardboard or scrap wood shanties, in which families crowd five to a room. Some 40 percent of the households report the death of at least one child. Even the kiln owners average only three years of schooling, and a quarter are illiterate.

Originally isolated in outlying squatter settlements, the kilns were absorbed by urban sprawl as Juárez expanded. They posed numerous air pollution hazards for their neighbors, principally from fine particles and carbon monoxide but also from volatile organic compounds, nitrogen oxide, sulfur dioxide, and heavy metals.[4] As public awareness of such hazards grew, kiln-related incidents became the largest source of community complaints to the Ciudad Juárez environmental authority.

Technically, the solution was clear: replace scrap fuels with propane or natural gas. However, fierce price competition prevented fuel switching in the crude brick market. Rapid bankruptcy loomed for any kiln operator who used propane, which cost 28 percent more than scrap fuels despite state subsidies. Switching fuels also entailed acquiring a new burner, learning how to use it, and modifying the kiln itself.

Traditional regulation provided little incentive to switch. The local environmental authority was not only understaffed but reluctant to confront the brick makers, many of whom were allied with politically powerful organizations. Some 40 percent belonged to an affiliate of the Partido Revolucionario Institucional (PRI), Mexico's dominant political party. Another 19 percent, in the poorest *colonias*, belonged to the Comite de Defensa Popular (CDP), which had formed to resist the political establishment's attempts to evict squat-

Figure 4.1 Fuel Use and Pollution from Kilns

Two Options for Firing Bricks

Smoke from Scrap Fuel

The Clean Option: Gas Firing

Source: Corbis; Courtesy of Octavio Chavez, Southwest Center for Environmental Research and Policy (SCERP), Instituto Tecnologico y de Estudios Superiores de Monterrey — Campus Ciudad Juarez (ITEMS), and Salud y Desarrollo Comunitario de Ciudad Juarez (SADEC/FEMAP)

ters. This tradition of resistance affected attitudes toward the local environmental agency, based partly on the fear that pollution control would bankrupt the kilns and eliminate jobs for over 2,000 of the poorest people in Juárez.

Public pressure finally broke the regulatory deadlock in the early 1990s. Action was sparked by election of a new municipal president, whose mandate included strong action to reduce pollution from the kilns. He banned dirty fuels and routinely jailed or fined violators. Support came from local and national NGOs, led by the Mexican Federation of Private Community Health and Development Associations (FEMAP). FEMAP and the city authorities launched an aggressive public campaign to educate the brick makers and their neighbors about the health risks from burning scrap. In private meetings, they persuaded the brick makers' organizations to support conversion to propane. Sensing an important business opportunity, local propane suppliers offered the kiln owners free equipment to encourage fuel-switching. Engineers from local universities provided free technical assistance, and engineers from the El Paso Natural Gas Company suggested more efficient kiln designs.

Paradoxically, the controversy over NAFTA also encouraged rapid progress, as transborder pollution became an important pawn in the struggle for public opinion. Anxious to promote the free-trade agreement, the U.S. Government offered technical support for the switch to propane. Motivated partly by NAFTA and partly by rising public interest in pollution control, the Mexican Government and its local PRI affiliate tacitly supported the municipal president's campaign against kiln-based pollution.

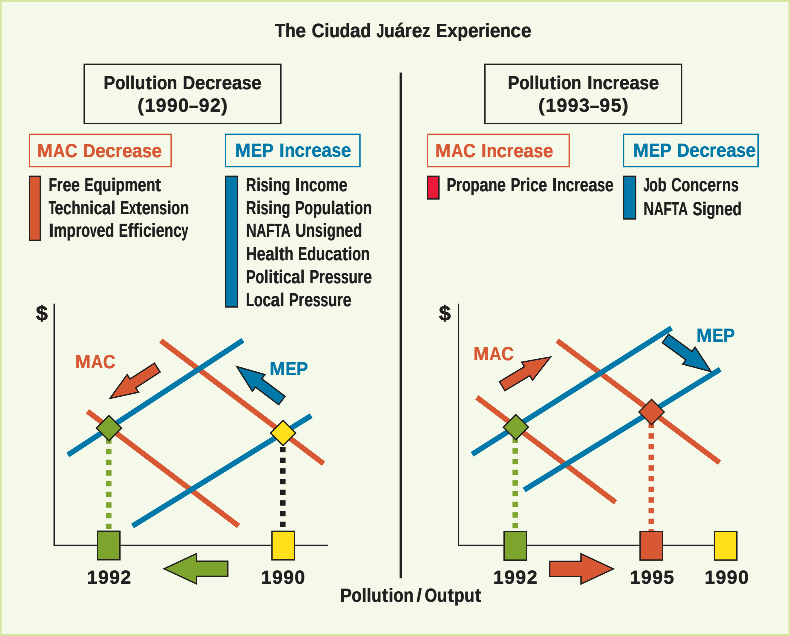
From 1990 to 1992, these forces converged to transform small-scale brick making in Juárez. Over half of the city's 300 brick makers switched to propane firing, and pollution from the kilns dropped sharply. This transformation resonated far beyond Juárez, as it demonstrated the feasibility of pollution control by small-scale industry in the informal economy. However, the triumph was short-lived, as Mexico began eliminating subsidies for basic commodities such as propane under its economic reform program. From 1992 to 1995, the 28 percent cost differential between propane and scrap firing leaped to 162 percent.

Bankruptcies and unemployment loomed as the remaining scrap-fired kilns easily undercut their cleaner competitors, and this seismic shock destroyed the community consensus that had supported conversion to propane. As support from community groups and brick makers' organizations evaporated and the municipal government dropped its punitive enforcement stance, the clean kilns quickly retreated to scrap firing.

Still, community awareness of pollution damage remained, with residents redirecting their efforts into formal and informal pressures to discourage use of the dirtiest scrap fuels—tires, battery cases, and used motor oil. A positive response from many brick makers has kept emissions below their 1990 level, albeit higher than the level after propane conversion.

The Ciudad Juárez story illustrates two ways that public action can reduce industrial pollution. First, environmental education and political mobilization can lead local communities to raise marginal expected pollution penalties (MEP; Figure 4.2). In Juárez, the community fought pollution through formal channels, by filing complaints against the kilns and electing a municipal president who

Figure 4.2 Mexican Brick Makers in the '90s: MAC vs. MEP



tightened enforcement. Informally, community-based NGOs pressured the brick makers' organizations to support conversion to propane. Reversal occurred when national decontrol of propane prices raised marginal abatement costs (MAC) again, but MEP didn't revert to its 1990 level because environmental awareness had grown.

Governments can also cut pollution by providing support for conversion to clean production, thereby lowering marginal abatement costs. This approach is a promising alternative to traditional regulation because it wields a carrot rather than a stick. It may also reduce pollution more cheaply than enforcement of formal regulations, which requires monitoring, data analysis, and, if necessary, police action—all time-consuming and expensive ways to raise MEP.

However, many economists have maintained that public intervention to curb pollution should stop at the factory gate, for a simple and sensible reason: Factory managers know their operations better than regulators, who should simply establish incentives. When CETESB, São Paulo's pollution control authority, launched an aggressive campaign to reduce pollution of the Tiete River, program managers attributed over 50 percent of the improvement to changes in manufacturing processes rather than installation of pollution control equipment.[5] Environmental agencies do not typically promote such changes directly.

This arm's-length regulatory model works effectively when well-informed factory managers can easily revamp their technology as incentives shift. But what happens when plant managers face high conversion costs with little certainty about outcomes? One response might be that fast learners will adjust and expand while others will suffer losses and leave the business. This approach has surface appeal, but it didn't survive the test of experience in Ciudad Juárez, as concern for jobs prompted the community to assist many kiln owners in taking the initial steps toward cleaner production.

Polluters often must make even more fundamental changes in the way they do business to curb emissions. Is technical assistance useful and feasible in more complex situations? An affirmative response requires credible evidence that changes in plant management can significantly reduce pollution, and that governments can help firms make the needed changes at affordable cost. Recent research from Mexico suggests that developing countries can satisfy both conditions.

4.1 Helping Firms Adopt Environmental Management

Certification by the International Standards Organization (ISO) offers one vehicle for pursuing such initiatives. The ISO certifies international auditing firms, which in turn scrutinize the quality of factories' processes according to ISO guidelines. ISO-certified businesses, especially those seeking rapid growth in the international marketplace, enjoy a competitive advantage because they can assure potential customers that they maintain high quality standards. Many leading firms prefer subcontractors that have satisfied ISO requirements.

The latest benchmark, ISO 14001, includes new standards for environmental management systems (EMS) based on thousands of firm-level case histories. According to this benchmark, plants must take the following EMS steps to achieve ISO certification:

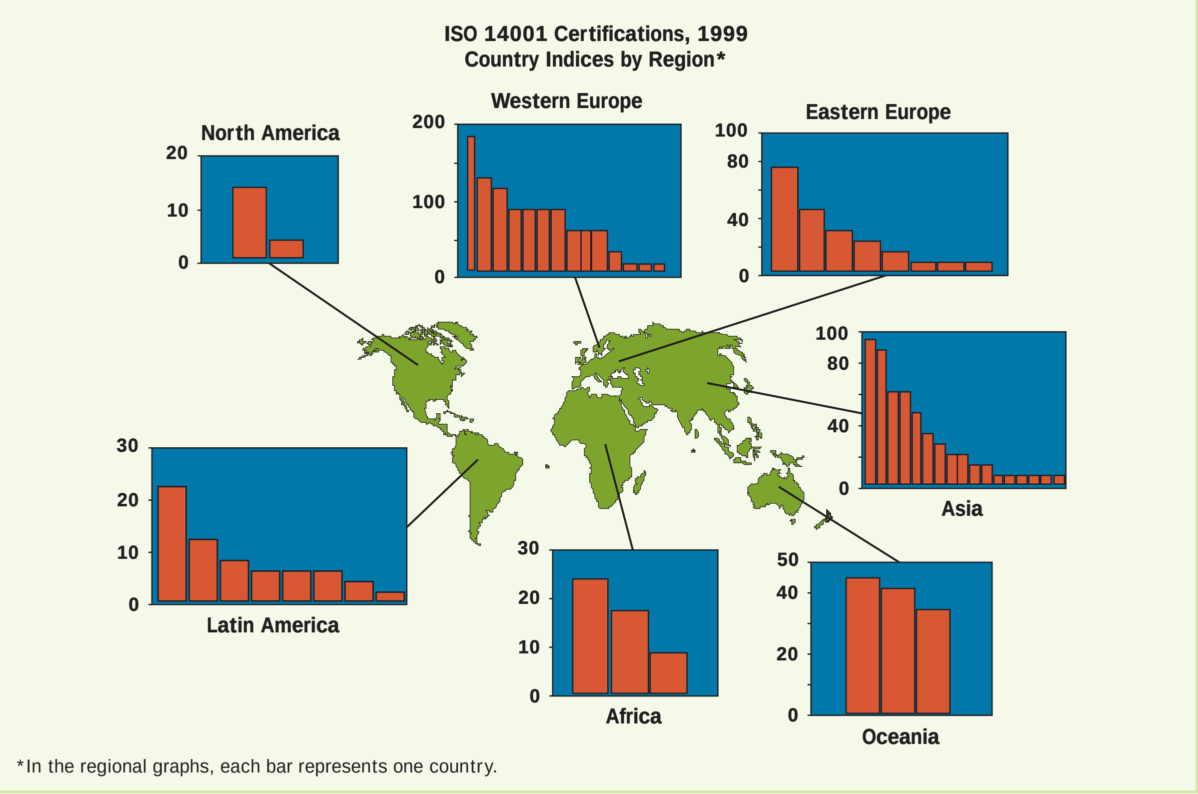
- Perform an initial managerial review to identify environmental issues of concern, such as excessive use of polluting inputs and the potential for a serious environmental accident;
- Establish priorities for action, taking into account factors such as local environmental regulations and potential costs;
- Establish an environmental policy statement, signed by the CEO, that includes commitments to compliance with environ-

mental regulations, pollution prevention, and continuous improvement;

- Develop performance targets based on the policy statement (such as reduction of emissions by a set amount over a defined period);
- Implement the environmental management system (EMS) with defined procedures and responsibilities; and
- Measure performance and conduct management audits.

Since the ISO published the preliminary version of 14001 in 1996, factories in both developed and developing countries have rushed to obtain certification. Some 8,000 plants achieved certification by January 1999.[6] Asia leads other developing regions, but Latin America has also seen significant activity, and three African countries (Egypt, Morocco, and South Africa) are represented (Figure 4.3,

Figure 4.3 International Diffusion of ISO 14001



Source: ISO World

Table 4.2).[7] The developed world is split: Western Europe and Japan lead in certifications, while the United States and Canada lag behind many newly industrialized countries that depend heavily on international trade.

A recent World Bank study examined a large sample of Mexican factories to determine whether factories that adopt ISO 14001 procedures reduce pollution (Box 4.1).[8] Almost 50 percent of these factories had adopted few or no procedures necessary for ISO certification, while 18 percent had completed most or all of the required steps (Table 4.1). The research shows that process is important: Plants that have completed most of the ISO 14001 steps comply with pollution regulations far more than plants that have completed few steps.[9]

We also investigated the degree of "environmental mainstreaming": whether the plants had assigned environmental responsibilities to general managers rather than specialized managers, and whether the plants provided environmental training for all workers as well as environmental personnel. The plants varied substantially in their adoption of such practices (Table 4.3). But our research shows that mainstreaming works: Providing environmental training for all plant personnel and assigning environmental tasks to general managers help plants comply with regulations.

Large vs. Small Plants

The Mexico survey suggests that targeting assistance to help smaller plants adopt such procedures would yield the biggest payoff. That's partly because large factories are much better equipped to monitor their own pollution (Figure 4.4). The survey shows that only 5 percent of large plants lacked that capacity. Some 60 percent of small plants could not monitor their air pollution or hazardous waste, while 40 percent lacked the ability to monitor water pollution.[10]

Differences in plant size also affect the rate at which plants adopt ISO-type EMS procedures. Large branch plants with well-educated workers score 70 points higher on our EMS adoption index (Table 4.1) than small, individually owned plants operating with lower-skilled labor.

The Mexico study reveals the consequences of these variations for environmental performance: The regulatory compliance rate is only about 25 percent for small, individually owned plants such as the brick kilns of Ciudad Juárez, whose workers have little education (Figure 4.5). By contrast, the compliance rate is over 70 percent

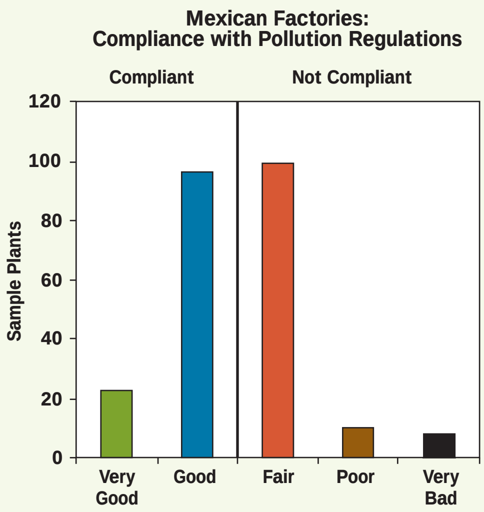
Box 4.1 Environmental Management and Regulatory Compliance in Mexico

To learn more about the role of environmental management in promoting compliance with pollution regulations, the World Bank participated in a survey of Mexican industry with a team of regulators, academics, and industrialists.[11] This team conducted confidential interviews at 236 representative factories in all size classes for four key polluting sectors: food, chemicals, nonmetallic minerals, and metals.

Figure B4.1a shows that about half of the factories regularly fail to comply with Mexican regulations. The study investigated the relationship between compliance and four measures of plant-level environmental management: (1) percent completion of steps like those necessary for ISO 14001 EMS certification, (2) assignment of personnel to environmental tasks, (3) assignment of environmental tasks to general managers rather than use of specialized managers, and (4) environmental training for workers other than specialized personnel.

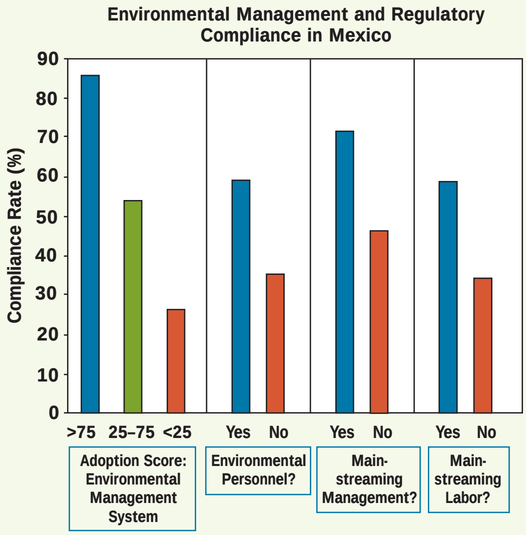
The results (Figure B4.1b) highlight the importance of environmental management and training, particularly the adoption of ISO 14001-type procedures. Some 86 percent of plants with high EMS adoption scores comply with regulations, while only 24 percent of plants with low scores comply. Plants that have assigned personnel to environmental tasks report much higher compliance than others (58 percent vs. 34 percent), as do plants that have mainstreamed environmental concerns among managers (71 percent vs. 47 percent) and workers (59 percent vs. 34 percent).

Figure B4.1a Mexican Polluters



Source: Dasgupta, Hettige, and Wheeler (1997)

Figure B4.1b EMS and Compliance



Source: Dasgupta, Hettige, and Wheeler (1997)

Table 4.1 Adoption Index for ISO 14001 Procedures by Mexican Factories

Adoption Score	Number of Plants	Percent
$S \leq 25$	111	47.0
$25 < S \leq 50$	45	19.1
$50 < S \leq 75$	38	16.1
$75 < S \leq 100$	42	17.8

Source: Dasgupta, Hettige, and Wheeler (1997)

Table 4.2 ISO 14001 Certification, 1999 by Country and Region

Region/ Country	Number Certified	Index* Value
Africa		
Egypt	15	21
South Africa	21	16
Morocco	2	6
Asia		
Korea	463	95
Malaysia	80	82
Thailand	100	59
Singapore	60	59
Japan	1542	32
Philippines	23	26
Hong Kong	40	24
Turkey	40	20
Indonesia	43	19
India	60	16
China	60	7
Pakistan	2	3
Oceania		
Mauritius	2	47
New Zealand	27	45
Australia	130	34
Latin America		
Costa Rica	2	22
Argentina	37	12
Brazil	65	8
Mexico	27	8
Chile	4	6
Uruguay	1	5
Colombia	3	4
Peru	1	2
E. Europe		
Hungary	31	69
Slovak Rep.	8	40
Slovenia	6	31
Czech Rep.	12	22
Croatia	3	15
Poland	8	6
Rumania	1	3
Russia	1	1
W. Europe		
Denmark	300	175
Sweden	400	172
Ireland	80	121
Finland	130	105
Switzerland	292	93
Austria	180	80
UK	950	78
The Netherlands	300	75
Germany	1100	47
Belgium	120	45
Norway	60	38
Spain	116	20
France	177	12
Italy	100	9
Portugal	7	7
Greece	6	5
North America		
Canada	90	15
USA	210	3

* Index = (Number Certified)/GDP, standardized to the range 1–200.

Table 4.3 Mainstreaming Environmental Management in Mexican Factories

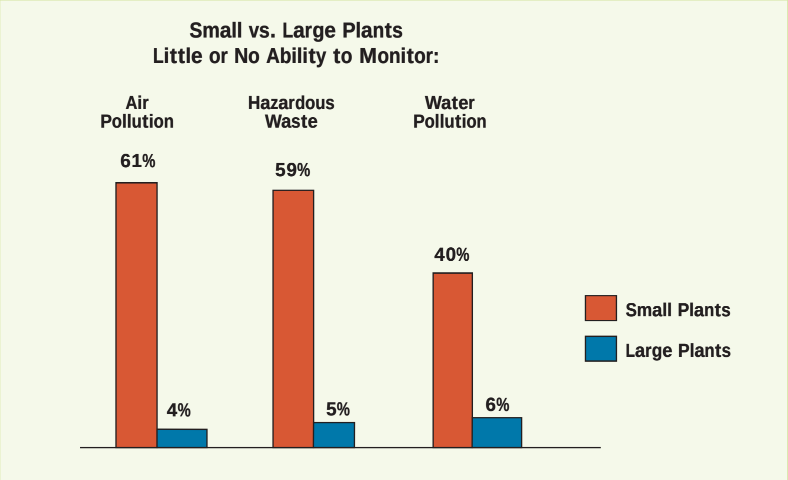
Management strategy	Yes	%	No	%
Environmental training for nonenvironmental workers?	76	32.6	157	67.4
Environment manager also has other responsibilities?	211	93.8	14	6.2

Source: Dasgupta, Hettige, and Wheeler (1997)

for large branch plants of publicly traded firms, which employ many workers with secondary-school education. As Figure 4.5 shows, plant size, firm size and worker education contribute roughly equally to compliance.

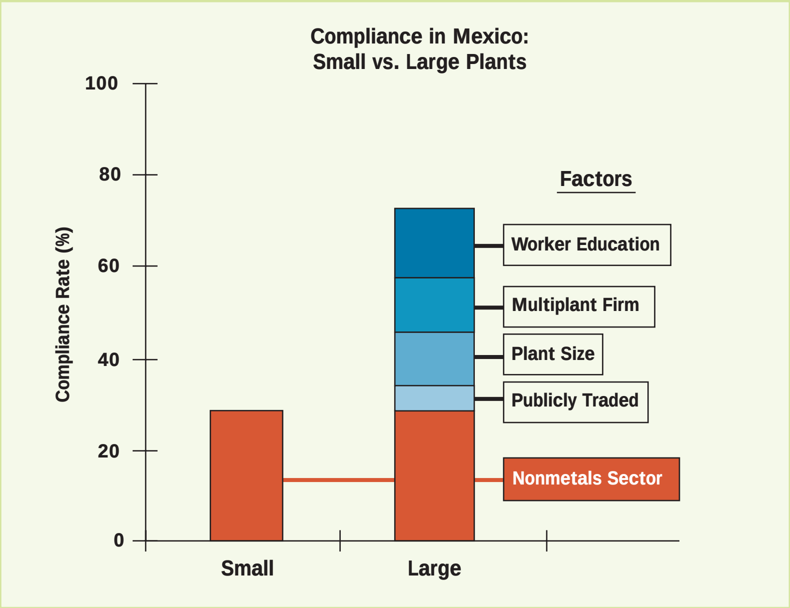
Since many large plants already have EMS capability, government promotion of environmental management should focus on small- and medium-scale enterprises (SMEs). But from a public policy perspective, doing so makes sense only if SMEs actually adopt EMS procedures, and if such intervention reduces pollution more cheaply than conventional regulation. For evidence on this issue, we turn to another recent Mexican project.

Figure 4.4 Plant Size and Monitoring Capacity



Source: Wells (1996)

Figure 4.5 Plant Size and Compliance in Mexico



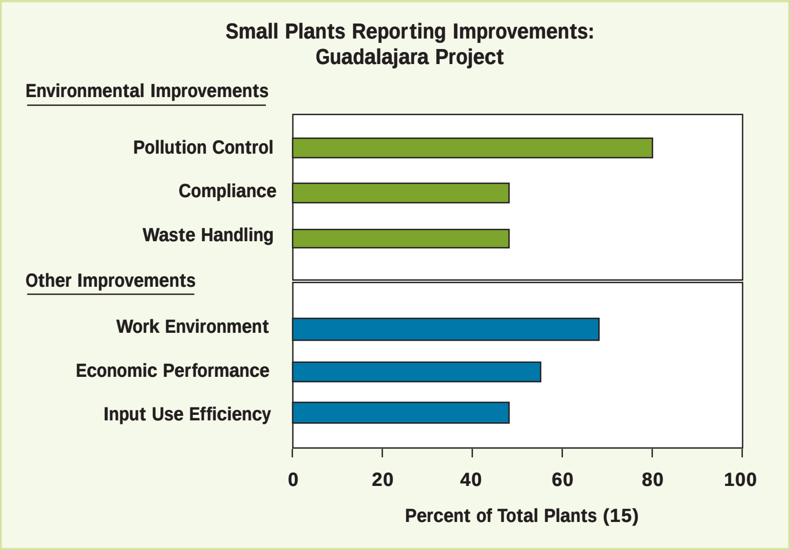
Source: Dasgupta, Hettige, and Wheeler (1997)

Lessons from Guadalajara

Monitored experiments in promoting EMS within plants remain rare; one notable exception is a recent project in Guadalajara, Mexico, that tested whether SMEs could successfully adopt environmental management systems. Eleven large companies, many of them multinationals, agreed to provide assistance to 22 small- and medium-scale suppliers who were interested in improving their environmental performance. The project, which enlisted the private sector, local academic institutions, the Mexican Government, and the World Bank, entailed several two-month cycles of intensive training, implementation, and review sessions.[12]

After nine months of implementation, the 15 SMEs remaining in the project rated their degree of EMS adoption on a 20-point scale. In May 1997, the average adoption score was effectively zero. By February 1998, average scores had increased to around 16 points for environmental planning and 11 points for EMS implementation. About 80 percent of the plants reported lower pollution, and nearly 50 percent reported improved compliance and waste handling. Many also reported improved work environments, more efficient use of materials, and better overall economic performance (Figure 4.6).

Figure 4.6 Results From Adoption of ISO 14001



Source: Ahmed, Martin, and Davis (1998)

The Guadalajara project showed that SMEs can successfully adopt EMS—with assistance. These plants will probably sustain the changes, because the project covered the fixed costs of adjusting to an environmental management system; the incremental costs of operating an EMS should be much lower. Participating SMEs have also altered their internal communications to provide constant feedback on environmental problems and solutions. Once formed, this new business culture will not easily disappear.

The Guadalajara project reduced pollution by lowering marginal abatement costs (MAC) rather than raising marginal expected pollution penalties, as in conventional regulation. The evidence suggests that this alternative approach was cost competitive. The project's total cost was around $200,000. Because about 10 plants realized significant benefits, the unit cost was approximately $20,000 per plant.[13] To compare the project (an investment) with conventional regulation (an annual flow of costs), we use the discounting approach. We employ a 10 percent discount rate and assume that a reduction in MAC from EMS adoption is sustainable. This yields an annualized cost of $2,000 per factory in perpetuity.

To estimate the cost of future projects in Guadalajara, we assume that local consultant fees are about 25 percent of fees charged by the international consultants in the pilot program. The implied unit cost is $5,000 per plant, or $500 in annualized costs—roughly equivalent to a month's wages for a skilled worker in urban Mexico. To achieve similar results each year, conventional regulation would almost certainly require equal or greater time and costs devoted to monitoring, record keeping, and enforcement. What's more, traditional regulation is less likely to yield the economic benefits of EMS stemming from greater overall efficiency. We conclude that promoting EMS among SMEs compares favorably with attempting to regulate these enterprises by conventional means.

Because they have been monitored and evaluated systematically, both the Ciudad Juárez project and the Guadalajara project provide important new information about the power of government-supported learning to reduce pollution by SMEs. The Ciudad Juárez project revealed the feasibility of improving pollution control in informal-sector, low-technology enterprises operated by some of urban Mexico's poorest, least-educated workers. Farther south, the Guadalajara project showed the feasibility of encouraging EMS adoption by somewhat more sophisticated small- and medium-scale subcontractors to large firms. In both Ciudad Juárez and Guadalajara, project funds financed the development of local consulting skills that will contribute to future pollution-reduction initiatives in the private sector.

4.2 Who's Complaining about Pollution?

In Ciudad Juárez, effective regulation required feedback to kiln owners from the surrounding community. This is not an isolated case. Despite their putative independence, pollution control agencies respond to the demands of the political institutions that determine their budgets and, ultimately, their legitimacy. Political leaders, in turn, respond to citizen complaints from communities affected by pollution.

Regulators also have an administrative reason to heed community protests: Monitoring is costly and agencies' budgets are lean in developing countries, so they cannot remain fully informed about all polluters. As a result, regulators often focus resources on responding to citizen complaints. For example, the pollution control agency of Brazil's Rio de Janeiro State devotes nearly 100 percent of its inspection resources to complaints. After setting aside 50 percent of its resources for targeting priority polluters, São Paulo's pollution control agency allocates the remainder to complaints. In Indonesia, the national pollution control agency has few inspectors but allocates much of their time to complaints. China's provincial and local regulators respond annually to more than 100,000 citizen complaints.[14]

Although complaints are a valuable source of low-cost information, regulation based on complaints may suffer from serious biases. Plaintiffs may lack enough information to distinguish between "nuisance" emissions and those that are truly hazardous. Colorless, odorless toxics and heavy metals may escape notice altogether. Furthermore, some individuals or communities may simply complain more, regardless of the objective situation. If regulators automatically respond to complaints, aggressive plaintiffs may capture most of the available resources.

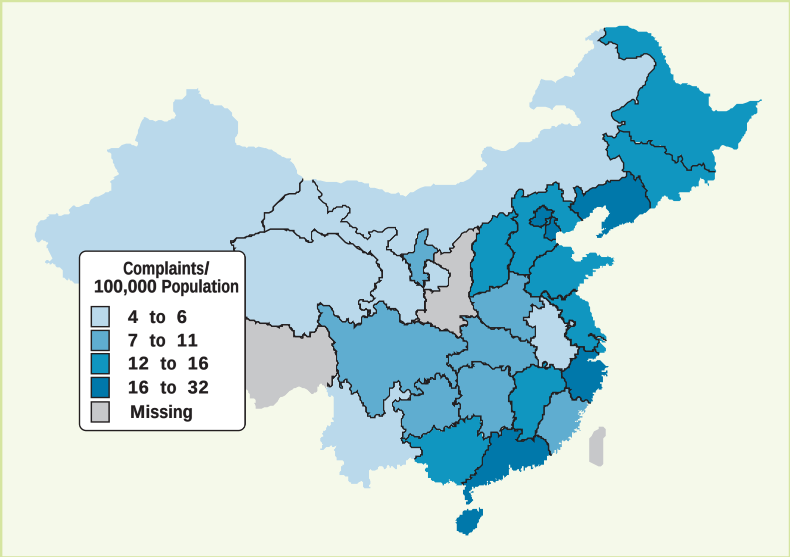
World Bank researchers have used new data from China to learn more about the links between complaints, environmental conditions, and the characteristics of communities.[15] China's citizens are far from passive about pollution from neighboring factories. From 1987 to 1993 the nation's environmental authorities recorded over 130,000 complaints per year, mostly related to air, water, and noise pollution. These complaints generated action: In almost all provinces, agency response rates varied from 70 to 100 percent. Responding to so many complaints absorbed much of regulatory inspectors' time.

But Figure 4.7 shows that the propensity to complain varies considerably across China's provinces. In 1993, Shanghai and Tianjin reported some 30 complaints per 100,000 individuals, but Gansu, Xinjiang, and Inner Mongolia reported less than 5 complaints per 100,000. The incidence of complaints was generally highest in the urban industrial centers of east China, lower in the middle provinces, and lowest in the western hinterlands, the least-developed region.

To assess the factors influencing these provincial differences, we analyzed the impacts of pollution, income, and education on the incidence of complaints. Holding income and education constant, we found that provinces with high emissions reported 75 percent more complaints than lightly polluted provinces. However, this effect applied only to highly visible pollutants such as particulates.

Holding pollution and education constant, we found complaints in high-income provinces 110 percent more numerous than in low-income provinces. Another recent study shows that such complaints induce local regulators to raise the air pollution levy, thereby lowering industry's air pollution intensity.[16] Box 4.2 illustrates the consequences for 50 Chinese cities: Richer areas that complain more have significantly cleaner air.[17]

Figure 4.7 Regional Distribution of Complaints



Source: Dasgupta and Wheeler (1996)

Holding pollution and income constant, we found the complaint rate 90 percent higher in poor provinces with high literacy than in poor provinces with low literacy. Rich provinces with different literacy rates also varied in their incidence of complaints (Figure 4.8). Overall, the impact of literacy on citizen complaints is striking—roughly equivalent to a doubling of income or a tenfold increase in air pollution.

Why the silence from low-literacy regions, even if their average incomes and environmental conditions are comparable to those in other areas? Contributing factors may include poorer information about local pollution and health damage, lower capacity to organize for political action, and reluctance to confront better-educated officials. Because complaints drive much of the regulatory process, this silence has serious environmental consequences.

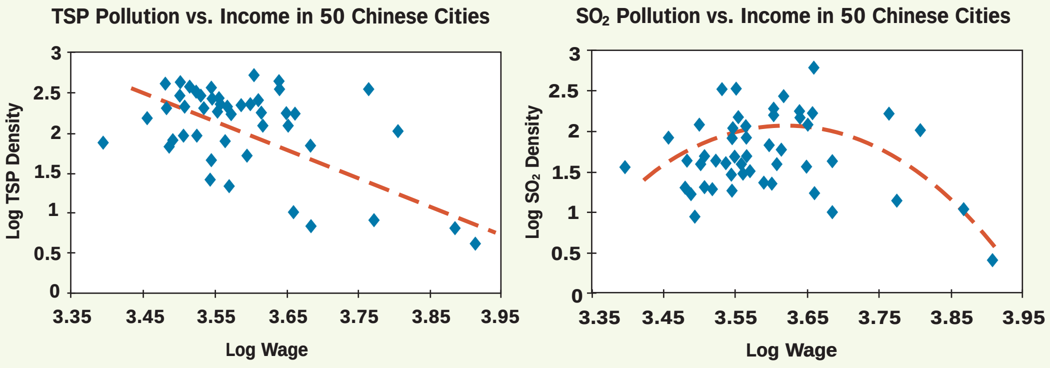
The same effects have emerged in other countries. One study found that economic development, a proxy for income and literacy, strongly affects regulatory inspections of Indian factories. Another study documented the positive relationship between economic development and pollution control by paper mills in Thailand, India, Bangladesh, and Indonesia.[18] A World Bank study found that pollution-intensive activities cluster in poor areas of Brazil. And in a study of

Box 4.2 In China the Poor Get More . . . Pollution

Poverty is a curse, but the poor might hope for at least one compensation: Since richer areas have more industrial production, they might well have more pollution. Unfortunately, the inhabitants of China's poor regions have no such consolation. Figure B4.2 displays the relationship between average wages and emissions density (or emissions per unit area, a reasonable proxy for atmospheric pollution concentration) in 50 Chinese cities. For suspended particulates (TSP), pollution density clearly rises as wages fall. The poorest cities also have higher densities of SO_2 emissions than the richest cities, although the graph suggests that emissions density rises from poor to middle-income cities and then falls to the lowest levels in the richest areas.

Why this tragic association between poverty and pollution? Richer areas do have higher levels of industrial production, but production in those areas is also much cleaner because citizen feedback is stronger (Figure 4.8) and regulation is tighter. Also, industrial facilities in areas with unskilled workers generally operate at lower efficiency and create more waste. The scale of industrial production in a given region therefore plays second fiddle to pollution intensity in China.

Figure B4.2 Income and Air Pollution

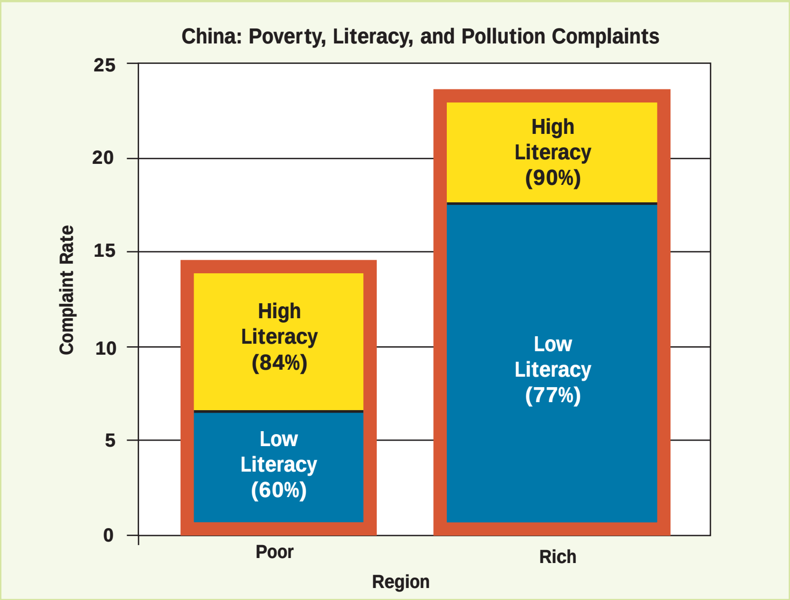


Source: SEPA

Indonesia, researchers found that factories in municipalities in the bottom quartile of income and postprimary schooling have organic water pollution intensity 15 times the level of plants in communities in the top quartile of income and education.[19]

Recent research on Brazil found that although pollution-intensive activities are more prevalent in poor municipalities, overall pollution problems are much worse in affluent municipalities because the volume of industrial production is much larger (Box 2.2).[20]

Figure 4.8 Literacy and Complaints



Nevertheless, studies of Rio de Janeiro and São Paulo have shown that pollution-intensive industry dominates the poorer municipalities within these metropolitan regions. Even in cases where richer areas are more polluted, poor residents of those regions suffer the greatest exposure.

4.3 Redefining Environmental Injustice

In the United States, the belief that polluters in poor, uneducated communities face laxer regulation and operate at higher levels of pollution intensity has catalyzed a political movement for environmental justice. Its goal is equal environmental quality for all citizens, regardless of their income, education, or ethnicity.

The concept of environmental justice has strong intuitive appeal for developing countries as well, as so many poor citizens suffer from pollution. Yet what appears to be clear evidence of environmental injustice can also reflect broader economic problems. For example, environmental problems can reflect the economics of location. Decades of research have shown that urban land values are affected by a variety of factors, including residents' exposure to pollution. Both land values and housing rents are lower in polluted areas, which are also likely to be areas where industry concentrates. Cheaper housing and industrial job opportunities give the poor a double incentive to locate in more polluted areas, even if they are fully informed about health risks.

Social, political, and historical factors have generated severe income inequality in many developing regions. Yet where poverty is the root cause of pollution exposure, invoking environmental injustice can backfire. Suppose, for example, that a movement against environmental injustice targets a large polluting factory located in the middle of a poor residential area. Neighboring families are well aware of the pollution, but they have located there because rents are cheap and the factory offers jobs for semiskilled workers. The environmental justice movement succeeds, and the plant's managers reduce pollution by shifting to a process that uses preassembled components and requires more educated labor. The air and water in the surrounding neighborhood become noticeably cleaner, and pollution-related illnesses fall.[21]

After the victory celebrations, however, other changes occur. Because the area is much cleaner, land values and rents rise. The poorest residents have little choice but to pack their belongings and move, since they can no longer afford shelter in the area. Their job opportunities also decline, because the factory no longer needs much semiskilled labor. Some of their neighbors accept the higher rents, but they have to find new jobs in other parts of the city. To continue working, they spend more hours jammed into buses and other vehicles, risking their lives on congested, polluted roads. In the aftermath of the movement's supposed success, its intended beneficiaries are worse off, because it has confused an income-inequality problem with environmental injustice.

What, then, is environmental injustice? In our view, two different concepts are well worth considering. First, the government could assume responsibility for maintaining a minimum decent standard of environmental quality for all citizens. This would resemble a public commitment to universal primary education. Failure to maintain the minimum decent standard would be defined as environmental injustice, warranting corrective action. This would include conventional pollution regulation, but could also mean programs that promote access to safe water and basic sanitation for poor communities.

A second concept would apply where people suffer from pollution because of ignorance as well as poverty. Governments should provide environmental education to all communities, so failure to inform poor neighborhoods about dangerous pollution would qualify as injustice. The Ciudad Juárez case shows how effective public education can be. Very poor people in the *colonias* supported regulation of the kilns after an education campaign persuaded them that the health benefits would compensate for the additional risk of unemployment and higher rents. The program worked because it targeted serious polluters and provided assistance for their conversion to propane firing. Better-informed *colonias* continued to support cleaner production after propane price decontrol, but concern for jobs shifted their focus to pressure for cleaner scrap fuels.

Ciudad Juárez demonstrated the power of public education to promote environmental change even when poverty remains unaltered. In our view, this is an important arena in which the struggle for environmental justice should be joined.

References

Afsah, S., B. Laplante, and D. Wheeler, 1997, “Regulation in the Information Age: Indonesian Public Information Program For Environmental Management,” World Bank, March.

Ahmed, K., P. Martin, and S. Davis, 1998, “Mexico: The Guadalajara Environmental Management Project,” World Bank, September.

Blackman, A., and G. Bannister, 1998a, “Pollution Control in the Informal Sector: The Ciudad Juárez Brickmakers’ Project,” *Natural Resources Journal*, Vol. 37, No. 4, 829–56.

———, 1998b, “Community Pressure and Clean Technology in the Informal Sector: An Econometric Analysis of the Adoption of Propane by Traditional Mexican Brickmakers,” *Journal of Environmental Economics and Management*, Vol. 35, No. 1, 1–21.

Chávez, O., 1995, “Alternative Fuels for Brick-Makers, CD Juárez, Mexico Project,” Southwest Center for Environmental Research and Policy (SCERP). Reproduced from the SCERP Web site at *http://www.civil.utah.edu/scerp/brickmaker/brickmaking.html*.

Dasgupta, S., H. Hettige, and D. Wheeler, 1997, “What Improves Environmental Performance? Evidence from Mexican Industry,” World Bank Development Research Group Working Paper, No. 1877, December.

Dasgupta, S., R. Lucas, and D. Wheeler, 1998, “Small Plants, Pollution and Poverty: Evidence from Mexico and Brazil,” World Bank Development Research Group Working Paper, No. 2029, November.

Dasgupta, S., H. Wang, and D. Wheeler, 1997, "Surviving Success: Policy Reform and the Future of Industrial Pollution in China," World Bank Policy Research Department Working Paper, No. 1856, October.

Dasgupta, S., and D. Wheeler, 1996, "Citizen Complaints As Environmental Indicators: Evidence From China," World Bank Policy Research Department Working Paper, No. 1704, November.

Hamson, D., 1996, "Reducing Emissions from Brick Kilns in Ciudad Juárez: Three Approaches," Border Environment Research Reports, No. 2, Southwest Center for Environmental Research and Policy (SCERP), June. Reproduced from the SCERP Web site at *http://www.civil.utah.edu/scerp/docs/berr2.html.*

Hartman, R., M. Huq, and D. Wheeler, 1997, "Why Paper Mills Clean Up: Determinants of Pollution Abatement in Four Asian Countries," World Bank Policy Research Department Working Paper, No. 1710, January.

Hettige, H., M. Huq, S. Pargal, and D. Wheeler, 1996, "Determinants of Pollution Abatement in Developing Countries: Evidence from South and Southeast Asia," *World Development,* Vol. 24, No. 12, 1891–1904.

Ostro, B., 1994, "The Health Effects of Air Pollution: A Methodology With Applications to Jakarta," World Bank Policy Research Department Working Paper, No. 1301, May.

Pargal., S., M. Huq, and M. Mani, 1997, "Inspections and Emissions in India: Puzzling Survey Evidence on Industrial Water Pollution," World Bank Development Research Group Working Paper, No. 1810, August.

Pargal, S., and D. Wheeler, 1996, "Informal Regulation of Industrial Pollution in Developing Countries: Evidence From Indonesia," *Journal of Political Economy*, Vol. 104, No. 6, 1314 + .

Petzinger, T., 1996, "Mexican Cement Firm Decides to Mix Chaos into Company Strategy," *Wall Street Journal*, December 13.

Stotz, E., 1991, "Luta Pela Saude Ambiental: A AMAP Contra Cortume Carioca, S.A., Una Experiencia Vitoriosa," V. V. Valla and E. N. Stotz (eds.) *Participacao Popular, Educacao e Saude,* Rio de Janeiro, 133–60.

Wang, H., and D. Wheeler, 1996, "Pricing Industrial Pollution in China: An Econometric Analysis of the Levy System," World Bank Policy Research Department Working Paper, No. 1644, September.

——— 1999, "China's Pollution Levy: An Analysis of Industry's Response," presented to the Association of Environmental and Resource Economists (AERE) Workshop, "Market-Based Instruments for Environmental Protection," John F. Kennedy School of Government, Harvard University, July 18–20.

Wells, R., 1996, "Prevención y Control de la Contaminación en la Industria Mexicana: Reporte de Una Encuesta," (Lexington, Mass: The Lexington Group), December.

End Notes

1. See Petzinger (1996) for a report on Cemex's innovative role in Mexican business.

2. Statistics reported by Mexico's Secretariat for Commerce and Industrial Promotion (SECOFI) at *http://www.nafta-mexico.org/export.htm*.

3. Our discussion of the Ciudad Juárez case draws heavily on two papers by Allen Blackman and Geoffrey Bannister (1998a,b), which document the authors' extensive primary research and econometric analysis. Our thanks to Allen Blackman for additional discussion of Ciudad Juárez in a series of personal communications. For additional information about the brick kiln pollution problem, see Hamson (1996) and Chávez (1995).

4. Blackman and Bannister (1998a) cite a study of brick makers in Saltillo, Mexico, that finds that 47 percent of subjects tested had "abnormal" pulmonary functions. See Ostro (1994) for detailed discussion of the impacts on health of particulates.

5. Interviews with CETESB staff.

6. Reinhard Peglau of the Federal Environmental Agency, Republic of Germany, provided these estimates. They are reproduced by ISO World at *http://www.ecology.or.jp/isoworld/english/analy14k.htm*.

7. To control for extreme scale differences, such as between Costa Rica and China, we divided each country's total certifications by its GDP, and standardized the result on a scale from 1 to 200.

8. See Dasgupta, Hettige, and Wheeler (1997).

9. The study recognizes the possibility of reverse causation: Once other factors have convinced plant managers to comply with regulations, they could implement the ISO 14001 steps as part of the improvement process. However, this would not imply that the ISO 14001 steps caused the improvement. The research (Dasgupta, Hettige, and Wheeler, 1997) uses standard econometric techniques to adjust for this problem.

10. See Wells (1997).

11. Participants included Mexico's National Environment Ministry (SEMARNAP), the Monterrey Institute of Technology, and the Mexican National Association of Industries. Both the survey questionnaire and the data are available online at *http://www.worldbank.org/nipr/work_paper/1877/survey/index.htm*.

12. This summary is based on a World Bank report by Ahmed, Martin, and Davis (1998).

13. The final project report estimates the cost of the pilot project to be $135,000, excluding the time and travel costs of World Bank staff. Including these factors would increase the estimated cost to around $200,000.

A second approach would apportion the cost among all 15 participating plants, lowering the apparent cost per plant. However, measured benefits were apparently zero for 5 plants, so this approach would yield the same result as the first, because the expected value of results per plant would be lowered proportionately.

14. Complaint-response systems in Brazil, China, and Indonesia are familiar to the authors from collaborative work with FEEMA, CETESB, BAPEDAL, and China's State Environmental Protection Agency (SEPA).

15. See Dasgupta and Wheeler (1996). Data linking environmental conditions, pollution complaints, and community characteristics in China are available online at *http://www.worldbank.org/nipr/data/china/status.htm #Province.*

16. See Wang and Wheeler (1999).

17. See Wang and Wheeler (1996) and Dasgupta, Wang, and Wheeler (1997).

18. See Pargal, Huq, and Mani (1997) and Hartman, Huq, and Wheeler (1997).

19. See Dasgupta, Lucas, and Wheeler (1998) and Pargal and Wheeler (1996).

20. See Dasgupta, Lucas, and Wheeler (1998).

21. In extreme cases, the targeted plant may simply move away. Stotz (1991) describes such a case for a tannery in Rio de Janeiro, Brazil. Environmental regulators in Rio have reported to the authors that middle-income residents led the movement against the plant; lower-income families were far more reluctant to act, because they valued the tannery as a source of employment.