THE NEED FOR AN INTEGRATED URBAN ENVIRONMENTAL POLICY

JAMES W. GILLETT
Cornell University

JANET B. JOHNSON*
University of Delaware

DAVID G. AREY
Southern Illinois University, Carbondale

ROBERT COSTANZA
University of Maryland, Solomons

IAN J. TINSLEY
Oregon State University

JUDITH S. WEIS
Rutgers University, Newark

ARMON F. YANDERS
University of Missouri, Columbia

ABSTRACT: *The myriad of environmental problems facing cities are described and analyzed. The magnitude of the environmental crisis is explored and its causes are identified. In order to remedy environmental problems, an integrated policy approach is required. The tradeoffs between economic development and environmental quality are examined and a strategy to overcome them is proposed.*

INTRODUCTION

Environmental issues are an important dimension of urban policy. With 75% of the nation's population, metropolitan areas are major sources of environmental pollution.

* *Direct all correspondence to: Janet B. Johnson, Department of Political Science and International Relations, University of Delaware, Newark, DE 19716.*

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Aside from sheer volume of pollutants generated, density and other physical features of cities contribute to the severity of urban pollution problems. To the extent that urban environments are degraded, 75% of the nation's population are exposed to or suffer from problems associated with that degradation although the distribution of negative impacts is not even across the metropolitan population. Urban areas present formidable challenges to environmental quality. Many of the threats stem from local and regional environmental problems (waste disposal, water quality and quantity, airshed management, transportation).

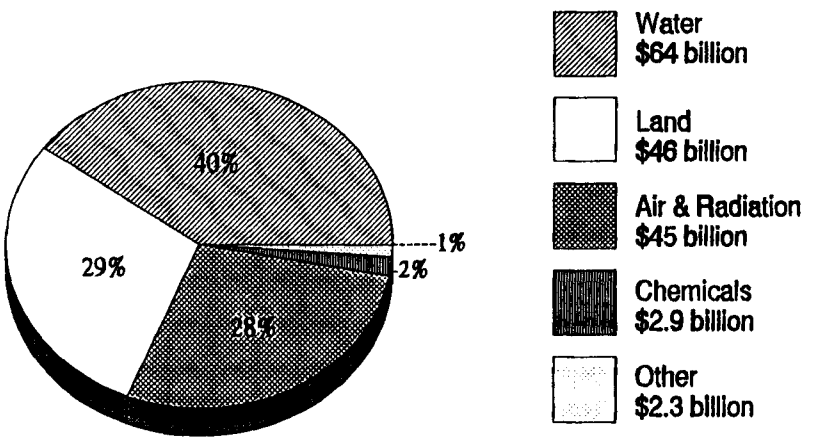
We are also becoming increasingly aware of what metropolitan areas contribute to a linked global system. As the greatest concentrations of human activities and sources of pollution, metropolitan areas are being forced to consider how their endeavors affect the livability of not only their own "nest" but also those of others. Global warming, for example, threatens 40% of the world population living within 10 m of mean sea level and many cities are unlikely to be able to do anything practical about ocean level rise.

At the same time, however, cities and their metropolitan areas have the human resources and institutions that inevitably can and must respond to these opportunities if for no other reason than sheer survival. Urban regions control much of the flow of energy and materials which, when mismanaged, create an offending environment. Cities dominate the economic life, generating huge revenues yet consuming even more as health, welfare, housing, crime, and infrastructure erode under inattention, low priorities, and, most seriously, the demands of so many people.

THE URBAN ENVIRONMENTAL POLICY DILEMMA

If laws alone could assure environmental protection, environmental quality would be much higher. Over the past 20 years, Congress has passed more than 40 antipollution laws, launching more than a dozen major national environmental protection programs. Among the major acts are the Clean Water Act (CWA), the Clean Air Act (CAA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Toxic Substance Control Act (TSCA), the Resources Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as the Superfund, the Occupational Health and Safety Act (OSHA), the Safe Drinking Water Act (SDWA), the Radon Program Development Act, the Marine Protection, Research, and Sanctuaries Act, and the Ocean Dumping Act. Most of these have been amended or expanded since inception and many comparable laws have been passed at the state and local level.

These environmental laws have prompted large expenditures on pollution control. Over the past 20 years, industry and government have spent close to $1 trillion on pollution control. Moreover, in 1991, EPA spent some $115 billion on pollution control projects, a figure which is projected by the GAO to grow by 2000 to $160 billion (General Accounting Office, 1991a). In 1987, the private sector accounted for 63% of total pollution control costs, local governments 22%, EPA about 8%, state governments less than 4%, and federal agencies other than EPA about 3% (General Accounting Office, 1991a). Shares of total pollution control costs in the year 2000, by environmental medium, are shown in Fig. 1.



NOTE: Costs were annualized at 7% in 1986 dollars.
Source: General Accounting Office (1991a), p. 9.

FIGURE 1
Shares of Total Pollution Control Costs in 2000, by Environmental Medium

Despite the many environmental laws and considerable spending, significant environmental problems remain. Pressures on federal, state, and local budgets have resulted in underfunding of agencies charged with developing and implementing environmental controls. For example, despite growth in program responsibilities during the 1980s, EPA's operating budget (excluding Superfund, construction, and the cleanup of leaking underground storage tanks) fell from $1.7 billion in 1979 to $1.0 billion in 1983, rising back to $1.7 billion in 1991 (in constant 1982 dollars) (General Accounting Office, 1991a). This situation has been exacerbated by shifts of programs from the federal to the state or local level and shift of fiscal responsibility from the general revenue base toward an orientation to user fees. According to EPA projections, the year 2000 local government cost will increase from $19 billion a year to over $32 billion (in 1986 dollars) in order to meet federal standards for drinking water and wastewater treatment, among others (General Accounting Office, 1991a).

In response to the constraints on government spending at all levels, particularly to EPA's limited resources and many program responsibilities, the General Accounting Office (1991a) examined a number of approaches to make environmental programs more cost effective. It urged more emphasis on setting budget priorities on the basis of health and environmental risks, measuring environmental outcomes of EPA programs, using market incentives, pollution prevention, and other nonregulatory approaches to pollution control, and addressing the environmental financing needs of state and local governments.

Two EPA studies (Environmental Protection Agency, 1987; Science Advisory Board, 1990) concluded that federal environmental laws reflect public perception of risks more than the scientific understanding and that EPA's use of resources reflect public priorities.

The EPA scientific studies gave global warming, indoor air pollution, including radon, exposure to chemicals in consumer products, and surface water pollution high risk (either ecological or health) rankings, while hazardous waste sites (active and inactive) and underground storage tanks received lower rankings (General Accounting Office, 1991a). In contrast, the public is most concerned about chemical waste disposal, water pollution, and chemical plant accidents (General Accounting Office, 1991a). Moreover, opinion polls indicate widespread support across all socioeconomic groups in maintaining high environmental quality (Rosenbaum, 1985). The public, although concerned about the costs of cleanup and effects on development, will not accept the abuse of the environment. Thus the stage is set for the instigation of new strategies integrating environmental protection with other actions in urban areas.

This difference in the ranking of risks indicated that a better job needs to be done in informing and educating the public about environmental risks. It also supports the recommendation that EPA improve assessments of environmental outcomes. In numerous areas EPA's data collection and monitoring programs have been found to be wanting due to technical difficulties and cutbacks in programs due to high costs, leadership changes, and the absence of specific statutory mandates or deadlines, making these efforts less competitive with mandated programs and activities (General Accounting Office, 1991a).

Underlying these dilemmas of urban environmental policy is the conflict perceived by some between the cost of environmental control, in money as well as regulation, and the needs of national and metropolitan economies to be competitive in the world economy. Integration of environmental policy with other policy areas must begin with a better understanding of particular issues for water and air quality, solid and hazardous waste, food safety, urban design, and a number of subsidiary matters associated with urban environments. Subsequently, we will address general new approaches bringing these areas into focus with respect to the urban environment.

URBAN ENVIRONMENTAL PROBLEMS

Water

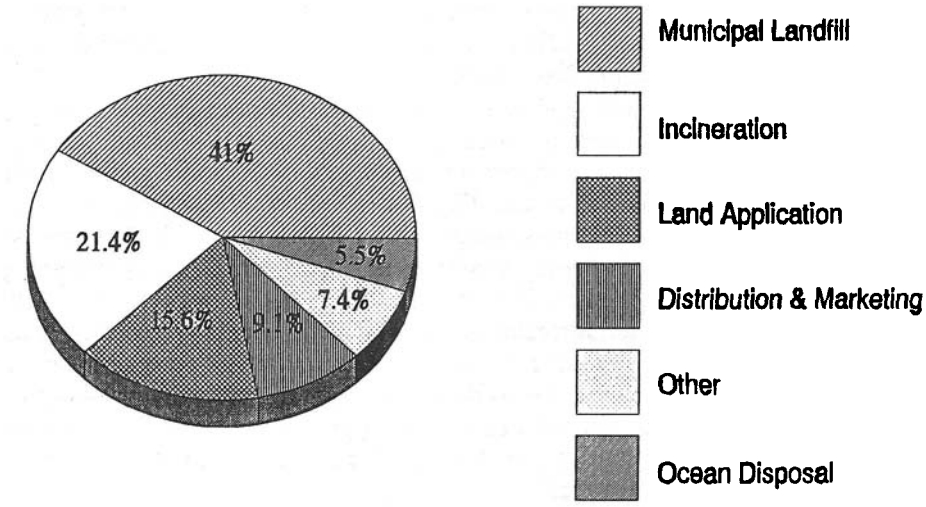
Although 55% of the US population was served by secondary wastewater treatment facilities in 1988 (Environmental Protection Agency, 1990b) and although about 70% of assessed rivers and 80% of assessed lakes are fully fishable and swimmable (Environmental Protection Agency, 1990a), the flow of pollution in the form of excess nutrients and toxic substances into bodies of water around metropolitan areas continues to deny highest and best uses under the Clean Water Act. Many species of fish and invertebrates no longer survive in these waters while those that remain may be diseased or carry elevated burdens of contaminants. A major source of these pollutants is sewage treatment plants, about 30% of impairment of rivers (Environmental Protection Agency, 1990a), and many treatment plants, although vastly improved from two decades ago, inadequately remove either nutrients or toxic materials. Sewage is a major contributor of low dissolved oxygen levels which make water a poor habitat for many species. It also contributes to fecal coliform bacteria, particularly from combined sewage

outflows (i.e., storm sewer, municipal, and industrial wastewater treatment), which restrict shellfishing and recreational swimming. Some 34 billion gallons of wastewater are collected daily by the nation's sewers from homes, commercial establishments, and industry (General Accounting Office, 1991b).

Toxic waste from households and commercial establishments is a serious problem in some locations, one that needs to be examined more closely nationwide. Existing programs target industrial sources of toxic pollution but largely ignore household and commercial discharges (General Accounting Office, 1991b). Household pollutants include detergents, toilet bowl cleaners, motor oil, and drain openers. Photo processors, dry cleaners, and car washes are common commercial sources. The Office of Technology Assessment estimates that household wastewater accounts for about 15% of the regulated toxic pollutants entering treatment plants (General Accounting Office, 1991b). Although industrial discharges are the greatest source of toxic materials entering sewage treatment systems, it is estimated that as these discharges decrease, the proportion of both household and commercial pollutants sent to treatment plants will increase and ultimately account for two-thirds of the toxic matter discharged to treatment plants (General Accounting Office, 1991b).

Removal of toxic substances by treatment plants is expensive. Fortunately, options exist to better manage nonindustrial wastewater and limit their entry into the waste stream. For example, in Palo Alto, California, limits of silver discharges from commercial photo processors, hospitals, and dentists were imposed after it was discovered that the pollutant threatened aquatic habitats in the South San Francisco Bay, potentially saving the city tens of millions of dollars on treatment (General Accounting Office, 1991b). Some states and communities have banned the use of certain chemicals; others have used pollution reduction programs. In 1990, over 800 household hazardous waste collection programs have helped reduce the 267 million gallons of oil improperly disposed of annually (General Accounting Office, 1991b). Finally, product labeling programs, in which products low in environmental risks are given a special seal, aim at consumer education and choice and offer the benefit of reducing pollution of other media besides wastewater.

Reducing toxic discharges into waste will also have a beneficial impact on sewage sludge disposal, another major urban environmental problem. Sewage sludge is composed of the solids extracted from wastewater during the treatment of sewage; it has doubled from the early 1970s to some 7.7 million dry metric tons presently and is projected to double gain by 2000 (General Accounting Office, 1990a). Although sewage sludge can be used as a fertilizer and soil conditioner or disposed of by landfill or incineration, the presence of toxics in sludge limits its beneficial use and raises concerns about the safety of its disposal. (Fig. 2 shows alternative use and disposal practices for municipal sludge in 1989.) Many of the pollutants in sludge have been linked to serious health problems, including cancer and heart failure (General Accounting Office, 1990a). Ocean disposal of sludge was banned in 1991 and landfill capacity, especially in the Eastern states, is limited. Under the Clean Water Act, EPA and the states are supposed to develop and implement permanent sewage sludge programs, but the GAO (1990a) reported serious problems in the development of these programs. A major concern has been whether EPA or the states will have sufficient resources for the program.



Source: *General Accounting Office (1990a), p. 10.*

FIGURE 2
Alternative Use/Disposal Practices for Municipal Sludge

Many communities depend on groundwater for drinking and this resource may be threatened both in terms of quality and quantity (Office of Technology Assessment, 1984). Overuse of groundwater due to increasing population combined with drought and inadequate preservation of recharge areas can result in water supply problem. The quality of groundwater is impaired by a great variety of sources, including underground storage tanks (fuels, cleaning solvents) and leaching of spills, landfills, fertilizers, pesticides, and road deicing salts. While some metropolitan areas such as New York City and the San Francisco Bay area obtain drinking water from high quality reservoir systems at a distance from the central city, other (especially suburban) areas depend on groundwater or treated surface water subject to pollution. In many central cities an aging water distribution system, leaking as much as 30% of the water and picking up contaminants such as lead from pipes and microbes from water intrusions, presents a further complication for health protection. A 20-fold rise in disease attributed to public drinking water supplies (National Research Council, 1987) is related to changes in sanitation of water supplies brought concern about the cancer risk from compounds formed by chlorination.

The nation's 58,000 community water systems are regulated under the Safe Drinking Act passed in 1974 and amended in the 1986. Under the act, EPA is required to establish drinking water standards for certain contaminants. A 1990 GAO study found that despite EPA reports that water systems were largely meeting monitoring requirements and drinking water standards: (1) violations were probably going undetected and unreported by water systems; (2) identified violations are going unreported by states to EPA; (3) enforcement is neither timely nor appropriate against significant

noncompliers; (4) state enforcement actions are often ineffective in returning violators to compliance; and (5) many of the significant violations, some posing serious health risks, have persisted for years (General Accounting Office, 1990b). The GAO concluded that new regulatory requirements added in 1986 and estimated by EPA to add about $2.5 billion in annual compliance costs "will make an already complex problem more difficult for EPA, the states, and water systems" (General Accounting Office, 1990b).

Major gains through water conservation are needed to address the issue of water quantity. Repairing and replacing leaky distribution systems, typically found in our oldest urban areas, is an obvious first step which would also be a major energy loss. Technology for water conservation is available and its use can be encouraged through building codes and water metering. Some communities (for example, Sacramento and Fresno, California) do not meter water use (Smith, 1992). Problems of water quantity are unevenly experienced by metropolitan areas across the country. Effective solutions in some parts of the country require examination of heavy subsidies by the Federal government, particularly of agricultural users (Smith, 1992).

AIR QUALITY

Over 100 million people live in areas where air pollution levels exceed at least one of the six national air quality standards (General Accounting Office, 1989). In many metropolitan areas, such problems as the attainment of standards for ozone, carbon monoxide, nitrogen oxides, and small particulates have not yielded to our best regulatory efforts. Nearly 40 metropolitan areas do not meet the national ambient air quality standard for carbon monoxide established under the Clean Air Act and 96 metropolitan areas violate the standard for ozone (U.S. Bureau of the Census, 1991). Los Angeles exceeded the ozone standard over 120 days in 1989 and the carbon monoxide standard 72 days (U.S. Bureau of the Census, 1991).

Nationally, transportation accounted for 67.3% of the carbon monoxide emissions, 32.8% of the volatile organic compounds, and 40.9% of the nitrogen oxides (precursors of ozone) in 1988 (U.S. Bureau of the Census, 1991). In metropolitan areas, approximately 80% of the carbon monoxide problems are due to motor vehicles (New, 1991). The amendments of 1990 to the Clean Air Act require more stringent controls on emissions from industry, utilities, and motor vehicles. Alternative fuels, increased use of mass transit, parking restrictions, and other curbs on automobile use and emissions will be required to reduce pollution from motor vehicles.

Monitoring air quality in metropolitan areas needs to be improved. The EPA is required under the Clean Air Act to have a national monitoring network. Approximately 4770 monitors are part of this network and approximately 1,220 of them are used to identify air quality trends in major metropolitan areas. According to a GAO (1989) report, the monitoring network was still incomplete due to insufficient funds at the federal, state, and local levels despite EPA regulations requiring that the network be in place no later than July 1982. Additional monitors were expected to be required after 1990 because of population increases: Population determines the required number of monitors. Furthermore, the GAO found that about half of the equipment used in

the nation's air monitoring network had passed or was approaching the end of its useful life and needed to be replaced. Finally, the GAO questioned EPA's quality control measures, thus calling into question the accuracy and reliability of the data collected from the monitoring stations. A sufficient number of accurate monitors placed in metropolitan areas is essential to the design of effective and equitable air pollution control strategies in urban areas.

Central city residents cannot necessarily escape the pollution of outside air by going indoors because the amount, number, and variety of pollutants may be even greater in their homes and offices than outdoors. Solvents from paints, monomers from synthetic materials or coatings, outgasing of foam insulation, emissions from equipment, and even the respired products of human metabolism, all circulated in closed energy efficient buildings, combine to create residential and office environments below the standards for occupational health and safety of workers in chemical plants, environments characterized by high levels of hazardous materials. In addition to chemical threats, communicable disease may be increased directly by recirculation of pathogens (such as *Legionella*) or indirectly by effects on susceptibility of response of the immune system. The complex mixtures of pollutants found in indoor air make diagnosis and treatment confusing and difficult and constitute an added burden to central city dwellers.

SOLID AND HAZARDOUS WASTE

Disposal of solid and hazardous wastes is a major political, economic, and emotional issue in many of our cities even though there have been major advances in waste management (including source separation, recycling, composting, energy recovery, high efficiency incineration, and "secure" land disposal) in contrast with open dumping or

TABLE 1

Commercial Hazardous Waste Facilities and Uncontrolled Toxic Waste Sites in Five Selected County Areas

	Minority Percentage of Population		Operating Commercial Hazardous Waste Facilities			Uncontrolled Toxic Waste Sites		
State/County	State	County	State	County	(%)	State	County	(%)
California/Los Angeles	33.0	46.7	41	14	(34)	916	233	(25)
Illinois/Cook	21.8	37.5	25	8	(32)	846	212	(25)
Michigan/ Wayne	15.7	38.1	21	14	(67)	894	88	(10)
New Jersey/ Essex, Hudson, Union	20.7	39.0	22	9	(41)	910	210	(23)
Ohio/ Cuyahoga	11.7	25.0	48	13	(27)	794	110	(14)

Source: Commission for Racial Justice (1987), p. 18.

TABLE 2

Ten Metropolitan Areas with Greatest Percentage of Blacks Living in Communities with Uncontrolled Toxic Waste Sites (Ranked in order of greatest percentages)

	Percentage of Population Which Lives in Waste Site Areas	
Metropolitan Area	Black	White
1. Memphis, Tennessee	99.8	99.6
2. Chattanooga, Tennessee	99.5	79.2
3. Ft. Lauderdale, Florida	97.0	45.7
4. Charlotte, North Carolina	95.5	72.9
5. Flint, Michigan	95.3	44.0
6. Seattle, Washington	95.2	74.4
7. Raleigh, North Carolina	94.9	74.6
8. Winston-Salem, North Carolina	92.9	65.1
9. Greensboro, North Carolina	92.9	84.8
10. Louisville, Kentucky	92.7	56.6

Source: Commission for Racial Justice (1987), p. 20.

TABLE 3

Six Metropolitan Areas with More Than 100,000 Hispanics Living in Communities with Uncontrolled Toxic Waste Sites (Ranked by number of persons)

Metropolitan Area	Hispanics Living in Toxic Waste Site Areas	Number of Toxic Waste Sites	Percentage of Total Population of Group which Lives in Site Areas	
			Hispanic	White
1. Los Angeles, California*	425,323	60	60.0	35.5
2. Chicago, Illinois	352,125	103	81.3	59.1
3. New York, New York	322,516	77	23.0	23.6
4. Houston, Texas	257,451	152	81.3	57.1
5. San Antonio, Texas	248,515	36	55.1	46.2
6. Albuquerque, New Mexico	107,648	36	75.0	51.6

* Covers geographic area within 900 3-digit zip code
Source: Commission for Racial Justice (1987), p. 20.

burning and uncontrolled incineration common just a decade ago. Material requiring disposal and posing a variety of potential risks and impacts range from paper and yard waste, over 50% of municipal solid waste, to hazardous and toxic chemicals, to high and low level radioactive wastes.

More than half of the US population lives in communities with uncontrolled toxic waste sites (Commission for Racial Justice, 1987). Hazardous waste disposal practices, a problem confronting urban residents in general, constitute a particular threat to racial minorities. Highly populated areas tend to have high levels of commercial hazardous waste facilities and uncontrolled toxic waste sites. This fact has a disproportionate impact on racial and ethnic persons, especially African-Americans who tend to live in urban areas. Furthermore, research shows that the African-American population is

disproportionately concentrated in urban areas with large numbers of toxic waste sites (Commission for Racial Justice, 1987). In major metropolitan areas with the greatest number of uncontrolled sites, Africans-Americans make up more than 20% of the population (Table 1). In ten metropolitan areas more than 90% of the African-American population lives in areas with uncontrolled sites (Table 2). Hispanics are similarly disproportionately proximate to uncontrolled toxic waste sites (Table 3). Location of facilities in rural areas away from population centers, while reducing the risk to large numbers of people, also tends to be racially biased: Large commercial landfills tend to be located in predominantly rural Africa-American communities. The Commission for Racial Justice found that race was more significant than socioeconomic status in the location of such facilities.

In general, research suggests that concerns over potential risks from a hazardous waste facility result in significant distress for residents and their families (Unger, Wandersman, & Hallman, 1992). Attention to residents' distress by government agencies and more research about psychosocial issues associated with living near hazardous waste facilities are needed to inform hazardous waste management policy. As the Commission for Racial Justice argues, the presence of hazardous waste sites compounds the problems of excessive deaths of African-Americans and other racial and ethnic persons in the United States (U.S. Department of Health and Human Services, 1985).

FOOD

The populace of the metropolitan area consumes the majority of foodstuffs in the United States and protection of that food supply is, therefore, of the utmost importance. Although the threat of contaminated food is not limited to urban areas, it is nonetheless a real concern for the metropolitan area dweller because of the magnitude and complexity of the food delivery system. The accidental contamination of food during processing and transport by biological and chemical agents is a very serious threat requiring constant vigilance. On the other hand, the mere presence in food of pesticides and other chemicals from the environment may be a phantom threat, not known to affect human health.

Normally many safeguards in the production and processing of foods protect the consumer, but the effectiveness of these may lead to complacency and the tendency to disregard possible hazards (e.g., it is no longer unusual to eat rare pork due to the success in screening for *Trichinella*). At the same time, advances in the packaging of food for safety and convenience have resulted in undesirable quantities and types of solid wastes. Nondegradable foam packaging and containers of glass, metal, and plastic (which are hard to recycle) have created a serious dilemma in the food and beverage industries. Delivery of a safe wholesome product to the consumer may be at the expense of waste handling and treatment. Local decisions to ban certain containers or require recycling may unacceptably increase risks elsewhere in this complex system.

After the furor and fallout from the recent Alar incident had settled, we learned that (a) a relatively innocuous pesticide could be "regulated" by supermarkets and public interest groups without regard to the public interest or technical issues, (b) deregistering

a pesticide (diazinon) with a number of serious problems is very difficult, evidence that there are more problems in the actual administration of pesticide regulation than the agencies and manufacturers care to admit, and (c) the lack of connection between consumers and agricultural producers has reached a nadir in understanding. Urbanization, made feasible by sophisticated agribusiness technology, had, depending on your point of view, turned on its benefactor or refused to be held hostage. This clash has been most evident in the suburbs where agricultural lands abut residential areas but lawn care chemical uses exceed those for agricultural use. Seven hundred thousand homes treated with chlordane or aldrin as a termiticide are potential mini-Superfund sites on Long Island alone. Although surveyed EPA officials rated pesticides near the bottom of their list of concerns, consumers have kept pesticides near the top of theirs.

Integrated pest management (IPM) in agriculture, a process wherein the whole array of crop management practices is keyed to criteria minimizing inputs of chemicals while retaining selected pesticide uses, needs to be extended more effectively to the array of pest management practices in city centers, especially in regard to food sanitation and protection from rodents and other pests. Failure to do so may result in higher exposures to disease organisms and to adventitious mycotoxins (e.g., aflatoxin) from spoilage, while the quantity of food available for improved nutrition will be diminished. Similarly, suburban IMP is needed for lawn care.

OTHER PROBLEMS

The metropolitan environment continues to deteriorate in other ways which are not acute health hazards but are detrimental to the quality of life. One of these, noise pollution, is all-pervading and ranges from the high decibel levels of central city traffic (including the sirens of emergency vehicles) to the background noise in homes and offices caused by air handling equipment, office machines, radios, and conversation. It is difficult to link this form of pollution to specific ailments, but it is clearly an element in stress-related disease and associated with certain types of hearing loss, itself a major health loss claim.

Recent reports about electromagnetic flux as an associated factor in leukemia in children and various occupations have re-elevated concerns about the wiring distribution system for electric power and about household and commercial uses of microwaves. Beyond the technical difficulties of making a more direct connection between these sources and problems, the specter of an enormously costly and complex change in lifestyles, infrastructure, and the way many activities are performed looms over the horizon.

Another nonhealth threat is the deterioration of the aesthetic environment. This may extend from the effects of acid deposition on buildings and statues, making them less visually appealing, to the blight of abandoned buildings and whole neighborhoods that are allowed to sink into decay. Haze and obnoxious odors detract from even the most gracious of views. Indeed, the oases of greenery previously offered by central city parks are showing the negative effects of air and water pollution, neglect, and outright vandalism.

A final threat, flood plain management, has also grown to alarming proportions in metropolitan areas, as was amply demonstrated recently in the Chicago area. Health and safety issues and environmental issues are created by inappropriate land use, by building on and slabbing over soils which could absorb water, and by impacts on storm sewer and sewage treatment facilities. Only the last named has received much attention. If global warming continues, sea rise is expected from mere expansion of water, but the melting of glaciers and polar ice caps could swell sea level even further, vastly surpassing worries from river rise in coastal areas.

UNTOWARD POLLUTION TRADEOFFS

Attempts to deal with all of these problems of pollution of the air, water, and land in and around our metropolitan areas have yet another confounding element. That is, the environment is not separated into convenient compartments, as law and regulation must necessarily be, but is a single complex system. Any effort to control air pollution, for example, by the use of stack gas scrubbers, which then creates a problem of either liquid of solid waste disposal, can only be viewed as a stopgap unless it eventually deals directly with that waste. Some metropolitan areas have devised integrated permitting and similar mechanisms of minimizing these untoward tradeoffs. Others have encountered serious geographic, jurisdictional, and cultural problems in confronting pollution tradeoffs. In the future, increasing attention will have to be paid to pollution problems which cross from one medium to another.

For this reason alone, the waste minimization/product life cycle analysis approach noted earlier (reducing inputs to any medium) has great value and may therefore serve as an integrating principle. This idea forms a key element in the recommendations made by EPA's Science Advisory Board (1990) for the next 20 years. However, this nation is still mired in assumptions of eternally cheap petroleum, abundant land and water, "free" air. Only in the metropolitan areas has evidence to the contrary been brought home forcefully enough in everyday life to begin to make a difference. All of these issues (housing, transportation, utilities, infrastructure) literally compose much of the metropolitan environment. When this environment is inadequate, it should not surprise anyone that the attendant social processes (education, family services, public safety, nutrition, mental and physical health care delivery) become deficient. The environmental portion is linked to social processes by individuals, families, and institutions. These can complete the circle by invigorating a revival of urban life and in the process contribute to global salvation or they can work to continue a downward spiral in the quality of life. Developing answers and actions for urban environmental protection thus forms a process that must look inward to the central city and outward to the planet.

TOWARD AN INTEGRATED POLICY APPROACH

The overriding goals in urban environmental policy must be to: (1) reduce and manage risks to the environment and human health and welfare in an efficient, effective,

economical, and globally sound manner by assuring adequate assessment of the magnitude and nature of risks and development of equitable policies and practices; (2) integrate environmental considerations fully into the development and redevelopment of urban areas from the design of buildings in urban neighborhoods to metropolitan land use and transportation planning; and (3) encourage waste minimization and avoidance of pollution by industry, government, and the public. One means of avoiding a throwaway mentality is to create product life cycle analysis, an examination of the design, production or manufacture, sale, distribution, use, and ultimate disposal in terms of risks to workers, consumers, and the environment.

As a corollary, it is vital to: improve implementation and management of environmental programs, particularly waste minimization and enforcement efforts; provide the research, information, and resources (trained persons, methods, facilities, and means of communication) to accomplish the above in a timely manner; and create an informed public, a cadre of motivated professionals, and knowledgeable, involved elected officials.

ECONOMICS OF THE EQUATION

It might seem that maintaining or enhancing environmental quality in our most congested and polluted cities is in direct conflict with economic development and other policy goals. More stringent environmental controls generally are required of industry and business in severely polluted urban areas (e.g., Los Angeles) and the cost of waste disposal typically is higher in our major cities. As Wolman and his colleagues argue in their contribution on economic development, metropolitan "economic health depends upon the competitiveness of the products produced in a region: Can it produce and bring to market its goods and services at a lower cost than other areas?" Environmental pollution in urban areas is often the result of the competition to limit the costs of production; environmental regulation adds to those costs.

Tradeoffs between urban economic development and environmental protection are not the only source of conflict affecting environmental policies in urban areas. Environmental protection is expensive for city governments, not just the private sector. Wastewater treatment, solid waste disposal, and supplying safe public drinking water cost cities and their taxpayers. City governments face compliance costs as polluters and enforcement costs as administrators and implementors of local, state, and federal environmental regulations. Costs to local governments have been increasing as the federal government cuts back on grants but at the same time requires local governments to implement and enforce federally mandated programs. Funds spent on the environment compete with other demands for limited revenues within metropolitan areas.

Conflict is not, however, the only way to view the needs for environmental quality and economic development. As is stated in the chapter examining economic development policy, "Over the long haul, an area's competitiveness will be determined by the characteristics of the area itself: the quality and quantity of its labor force and entrepreneurial talent, the quality of its infrastructure, the age and productivity of its capital stock, its access to regional and national transportation networks, etc."

Environmental quality should be added to this list. An unhealthy environment diminishes the quality of an area's labor force and adds to the cost of employee health care. For some urban residents, lack of access to adequate health care and health problems relating to exposure to environmental pollution may limit their participation in the labor force. This is an issue of special concern for urban minorities. Urban political theory suggests that amenities like environmental quality enhance competitiveness by helping retain and attract productive workforces (Peterson, 1981). Quality of life indexes which include environmental components confirm this perspective (Gould, 1986).

Proponents of "green" or sustainable cities attack the notion of a conflict between economic development and environmental quality on other grounds. Instead of conflicting with other policy goals, the separation of urban residents from nature and the natural environment contributes to urban social ills, they argue. Severe urban pollution problems signal that economic growth as practiced in the past is not sustainable (Lowe, 1992).

Finally, it may be argued that consideration of environmental issues in urban areas in conjunction with urban economic development offers opportunities rather than constraints. The effects of urban pollution problems are not confined to urban areas; they are global. Cities and metropolitan areas contain the bulk of human and economic activities: Changes made here will have a substantial impact on the global environment. Nowhere is this more evident than in the areas of urban transportation and energy consumption, carbon monoxide emission, and the prospects of global warming.

TRANSPORTATION, URBAN DESIGN, AND ENVIRONMENTAL POLICY

Although it is not possible to detail a fully developed integrated environmental policy, it is possible to explore an example in the relationship between environmental policy and urban design questions. There is an increasing concern that the environment cannot sustain current patterns of urban growth (Lowe, 1992; World Resources Institute, 1992). In the United States, key issues are the inefficient use of land, the concomitant role of the automobile in transportation, and the lack of contact of many urban residents with the natural environment. These issues are extremely important aspects of the urban environment because they are linked to other crucial urban issues such as housing, crime, and employment. Future urban development and redevelopment provide the opportunity to include environmental considerations in urban design decisions.

In particular, energy efficiency is vital both for reducing regulated pollutants in urban areas and for reducing the United States's massive carbon dioxide emissions associated with global warming. The US ranks first among nations with 17.2% of the world's CO_2 emissions (World Resources Institute, 1990). Transportation accounts for 32% of US carbon dioxide emissions, buildings (including heating and appliances) 36%, and industry 32%. Cars, appliances, and commercial buildings use 20-33% more energy per unit of activity and US industries use 10-25% more than in most other industrialized countries (World Resources Institute, 1992).

Some recent research shows that there is a significant potential for reducing automobile use and gasoline consumption and that urban structure is fundamentally linked to gasoline consumption in cities (Newman & Kenworthy, 1989). This research

challenges earlier studies based on simulations or econometric models which did not consider urban form, concluding that the potential for reducing gasoline consumption was limited (Newman & Kenworthy, 1989). Per capita gasoline consumption in ten US cities was found to vary by 40% between cities like Houston and New York and was clearly correlated with the intensity of land use (both population density and job density) in inner and outer urban areas. New York, whose inner area contains more than 40 people per acre and 20 jobs per acre has a per capita gasoline consumption of 153 gallons: in Manhattan it drops to 90 gallons per person, while in the exurban areas of Denver, residents consume 1,043 gallons per person per year. Availability of central city parking and roads was also highly significant.

Newman and Kenworthy argue that the theoretical potential for fuel savings is 20-30% if cities like Houston and Phoenix were to become more like Boston or Washington, D.C., in urban structure. This would require a modest increase in the intensity of urban activity and the provision of a basic rail system.

These findings fit with the argument presented by Lowe (1992, p. 122) that city land use defines its transportation system and that "by failing to see land use planning as a transportation strategy, many of the world's cities have allowed the automobile to shape them." Toronto, Canada, is the exception to this pattern where transit has been used to guide urban development. Toronto is less car dependent and has strong subcenters of intense development located around transit stations. Portland, Oregon, is an example of a city in the United States which has grown quickly yet complactly due to conscious urban design and transport decisions. Since the 1970s, the volume of cars entering the downtown has remained the same while the number of jobs has increased by 50%; 43% of all Portland commuters to downtown ride buses and use a light rail system. Air quality has improved: The number of air quality violations has dropped from one every three days in the early 1970s to zero in 1989 (Lowe, 1992). The Portland example illustrates the importance of strong, environmentally focused land use and transportation planning.

Evidence suggests that automobile use is related to the lack of other alternatives and primary concern by transportation planners for accommodating the automobile. Each year, 97% of the miles traveled by US residents in their cars are for trips of 11 miles or less (World Research Institute, 1992). Some of these trips could be accomplished by bicycle or walking. The 1991 highway bill passed by Congress makes bicycle and pedestrian projects eligible for federal funding over the next six years. It requires each state to have a bicycle-pedestrian coordinator and to develop regional transportation plans that include biking and walking. Despite these opportunities, reorienting transportation planners may be difficult in some areas. Bicyclists in Pennsylvania and in Philadelphia in particular are complaining about the Pennsylvania Department of Transportation's "bikes as toys" attitude. The bicycle-pedestrian coordinator is reported as not being sure what this agency is doing for bicyclists and that he prefers a jog (McCullough, 1992).

To achieve efficiency in transport in urban areas, Lowe argues, urban areas need to develop new land use controls. These include:

(1) Changing zoning based on segregating land uses. Integrating land uses would permit closer proximity of shopping, jobs, and residences.

(2) Allowing more dense urban development to promote alternatives to cars. Seventeen dwellings per hectare is enough to support reasonably frequent bus service; 22 dwellings are enough for light rail service; and 37 dwellings will support express bus service reached by foot.

(3) Allowing apartments in single family houses. The 1985 estimates indicated that 12 to 18 million US homes have surplus space available for apartments, but zoning in many communities prohibits apartments in single family homes. Changing this policy would also help alleviate affordable housing shortages in some communities and would help reduce property tax burdens for homeowners.

(4) Changing zoning which requires parking garages and car parks that lure drivers and deter pedestrians by increasing distances between buildings.

(5) Changing street designs to allow for bike lanes and sidewalks.

While the link between environmental quality and urban design is most obvious in the case of air quality and the automobile, there is increasing concern among urban planners and environmentalists that the design of cities and environmental quality are inexorably and intimately linked in many ways (Gordon, 1990; Stren, White, & Whiting, 1992; Lowe, 1992). In arguing for more open space in heavily populated urban areas, advocates of green cities point out that open space performs productive and environmental as well as recreational and aesthetic functions. These include impoundment of stormwater, modification of urban climate, renovation of wastewater, and wildlife habitat (Hough, 1990). Community gardens in depressed urban neighborhoods enhance a sense of pride, personal control, and social cohesion as well as providing food (Hough, 1990). New York City has 700-800 community gardens and there are more than two million gardeners in US cities (Lowe, 1992).

PROGRAMS FOR INTEGRATED ENVIRONMENTAL POLICY

Extensive new legislation generally is not required to improve and protect the urban environment. Rather, in order to accomplish these goals, a variety of programs must be restructured, reoriented, or in some instances created and then focused on issues of urban environmental protection. These programs clearly must be integrated with efforts in housing, economic development, nutrition, health care delivery, transportation and infrastructure management, education and child development, and other programs affecting and determining the urban environment. In addition, we would hope for less reliance on litigation and confrontation and increased attention to mediation and modification of the short-run incentives consistent with the long-term goals needed to solve our urban environmental problems effectively and equitably.

The scientists and students in academic institutions are a major resource for programs in environmental protection. Interdisciplinary teams are readily formed and many institutions have strong traditions in applied basic research and public service. Academics review and analyze policy, regulation, and risk management and assessment methodologies. The universities have demonstrated their ability to execute long-term research on a wide range of subjects, both practical and theoretical. Without the autonomy and latitude provided by universities, less progress would have been achieved in health, ecological, and global matters lacking potential for profit.

New Approaches: Investigate and develop new approaches to environmental protection which avoid social traps and employ economic and other value measures to alter behavior.

Even if current legislation, education, research, and enforcement were all improved and optimized throughout society, a number of problems in protecting the urban environment would remain, simply because the structure of the problem is a social trap (Constanza, 1987). These traps include situations where the adverse outcome is deferred (lung cancer from air pollution), distant (acid deposition), hidden (groundwater contamination), falling on other parties (sewage outfall), or unknown (actual risk from a suspected carcinogen). Many of the issues noted commonly affect urban life sooner or later, but there are few incentives to avoid creation of the problem in the first place. Unfortunately, much of environmental pollution is a direct product of a throwaway society, one in which invisible emissions are neglected when effects are not immediate and obvious.

A number of policy analysts and environmental scientists are calling for a new set of approaches to the foregoing adverse impacts and risks by establishing systems which either change the behavior of those causing the problems or tax the consequences earlier in the process. In a sense, the current Superfund program has features of this approach (taxing commodity chemical producers in order to clean up abandoned chemical wastes), although that program falls far short of producing adequate revenues to meet needs and the tax does not necessarily fall on those causing the problem. Most of these new approaches urge use of econometric analysis of the value of the damaged resource and costs of mitigation of impacts, then linking user fees, taxes, etc., for the polluting or damaging activity to that analysis. Alternatively, the polluter might develop a "mitigation bank" of activities (Zagata, 1987) which would offset future impacts by increasing or enriching the present environment.

In this same vein, the emphasis on waste minimization redirects efforts to the source of the problem. Currently, the rewards are limited to achieving lower costs and liabilities. If this high priority effort is to succeed, however, society must devise means of reinforcing this behavior and all of the ancillary thought processes required. Through all of the talk from many political leaders about the environment in recent years, the need for an attitudinal change did not come across very clearly. Hence, it is imperative that the universities fill this leadership gap.

One means to overcome a throwaway mentality is to promote a product life cycle analysis. A number of major firms are heavily committed to this type of process. Importantly, it deliberately avoids traps and thus becomes cost effective in terms of economic, social, and technical aspects and eventually becomes self-sustaining.

Many of these approaches might be enacted administratively, but some would require new legislation. More importantly, they would change the nature of how problems are approached, including presumptions about the innocence of offending parties, responsibility for research on risk, and when society is to face the outcome of an issue. Different emphases in research and education would be required as well, although much progress has been made in evaluation of intangible losses. In any case, the connections between polluting sources and regulatable outcomes would receive the attention needed to confront solutions more realistically and avoid implicit traps.

Education: Place greater emphasis on organizing environmental studies curricula and on undergraduate scientific instruction for nonscience majors.

As analyzed by Weis (1990), the "recent upsurge in interest in the environment...[likely] will improve the employment situation of environmental scientists," but the universities themselves must face hard questions in curriculum management, department organization, facilities for training and research, and faculty staffing regarding disciplinary v. environmental studies. At the very least, the formal work of teaching environmental science will be enhanced by better communication within and between universities (and their disciplinary units) regarding curriculum and using workshops and colloquia to invigorate the academic enterprise and achieve proper breadth.

Because so much of the university in a central city is dedicated to the social sciences, there is a tendency to let the dichotomy with respect to science grow as a gulf in the students' (and faculty's) minds. On the other hand, as Glaze (1989) noted in his editorial, "environmental sciences must be 'canonized' into the structure of universities." One way of making a pronounced impact would be to increase the teaching of these courses to nonscience majors. This would make it clear that a university education is intended to bring its students to a level of environmental literacy that permits participation of educated citizens in a real and meaningful manner.

Delivery of Public and Classroom Education: Create positive programs developing adequate numbers of technical experts, including minorities, to carry out environmental protection and to educate the public regarding risks and their management.

There is a great need for increased public education and understanding of environmental issues. On the one hand, frequently there is an overreaction by the public to the hazards posed by a particular problem, forcing local officials into inappropriate action. On the other hand, those with a vested interest may make statements which lead to a false sense of public security and a lack of concern about issues which need action. In both cases, the response is not commensurate with the magnitude of the problem. Within the universities are both the expertise on technical issues and the ability to communicate those issues to the general public. University personnel, in contrast to those of the regulatory agencies, may be more likely to be trusted by the public and to have developed teaching skills to communicate effectively.

There is a serious shortage of specialists in the environmental sciences. Before the end of this century, a substantial number of professionals who entered these fields in the 1960s and early 1970s will be retiring. Many have already entered administrative and managerial positions, some are no longer active researchers, and others may have been attracted to new challenges, such as biotechnology. Making the right matches between funding sources, goals, and the interests of students, professors, and society is at least part of the challenge in planning for resources for environmental protection.

Economic, social, and political conditions make minority groups prime targets for exposure to the impacts of environmental pollutants, on the job, at home, and in their outdoor environment. However, we have been decreasingly effective in recruiting minorities to the physical and biological sciences, much less environmental engineering, chemistry, and toxicology programs. To deliver information to these communities and involve them appropriately in environmental management, credible sources familiar with the cultural and social implications of toxic exposure and response are required.

At the heart of environmental protection, however, is a heavy reliance on technical expertise in biology, chemistry, statistics, engineering, atmospheric sciences, and geology, plus the requirement for systems analysis, policy development, and environmental law. The need for this expertise requires a greater effort in bringing bright and interested students from high school into the more difficult programs of science, technology, and social sciences at the college level, then attracting them to graduate and professional degree programs at at least twice the present ratio.

Interdisciplinary programs in environmental sciences that aim to provide students with the ability to understand environmental problems and the skills to solve them are frequently not well supported in universities, because these efforts run against the grain of university structure. Difficulties arise in philosophy, faculty, students, and curriculum. These problems are particularly acute in programs that compete with the home departments of faculty members.

Although the forgoing emphasizes the production of technical expertise, it is very important to keep in mind the educational role of the university in environmental issues for undergraduates entering the affairs of the city and nation in other areas. Interest is high and can be exploited, but the situation requires that we also intensify efforts to develop in these students skills for complex problem solving through group interactions, careful and thoughtful analysis (including development of goals, objectives, and means), critical thinking, and clarity of oral and written expression. We would rather not wait until they are appointed to the zoning board or become CEOs of manufacturing firms or are elected to county government before starting their environmental education. Indeed, education's most rudimentary element, learning how to learn, has never been more crucial in time or place, especially in regard to the environment. As a corrolary, the universities must initiate or continue interactions with local school systems to nuture the scientific interest and environmental sensibilities of young people.

Research for Understanding Complex Problems: Provide resources, including facilities and equipment, for interdisciplinary research on complex environmental issues and basic science and develop stronger programs between academic institutions in and outside of metropolitan areas.

Resources must be directed at improving means of understanding complex phenomena (such as the fate of chemicals in soil and groundwater, the effects of mixtures of chemicals on behavior and immune response, and how behavior affects exposure), tradeoffs of risk between management of pollutants in different environmental media, and related technically difficult areas. Lack of information and understanding contributes directly to confusion, apathy, and inaction. Interdisciplinary studies, involving physical and biological scientists, engineers, and social and political scientists, are needed to address the nature and perception of the problems, possible solutions, and management choices.

A number of compendia of research priorities have been evolved by scientific and lay groups (Fava, Adams, Lason, Dickson, & Bishop, 1987; Science Advisory Board, 1990). At the heart of most of these are calls for basic studies into the processes involved in specific problems and applied investigations of the problems and proposed solutions. Data must be gathered for assessments and models must be tested in both theory and practice. Safety is the practical certainty that injury will not occur and risk is the

probability that some activities are not safe. Because we often operate from a position of limited knowledge of the uncertainty of risk, risks may be overblown or taken unnecessarily. Research expanding that knowledge and lowering uncertainty is key to reducing risks and reduced risk is the key to a healthier and more attractive metropolitan area environment.

A major concern in many institutions is the deterioration of facilities and equipment for teaching and especially for the kinds of research required to deal with the urban environment. The gains of the 1960s have been eroded seriously by time, technical advances, and new concepts. Present efforts to upgrade and/or replace worn and outmoded instruments and laboratories need to be intensified. Facilitation of development of pilot plants and small scale research structures is also needed to augment and hasten improvements in various technologies, such as waste management and waste minimization. Finally, funding of environmental research must be increased to the point where university administrators have an incentive to direct their own capital and operating funds to improvements. Environmental protection research must compete successfully with such lucrative areas as computers and biotechnology.

Effective Implementation and Enforcement: Increase funding for assistance in compliance with, and local and state enforcement and prosecution of, environmental laws and increase efforts to enhance the quality of civil service.

The best laws, and the best intentions to fulfill them, are meaningless unless there are resources to accomplish these aims. These resources include not only the fiscal and human components, but also the clear resolution within all levels of government of accomplish the goals already set forth. Furthermore, if improved effectiveness of government is to be a major social goal, then means of enhancing the quality of civil service should have high priority. Such would include increased professional development, competitive pay and working conditions, and, perhaps most importantly, creation of an attitude of respect for those in public service.

We know that much of environmental protection stems simply from the stewardship of the individual and corporation, rather than enforcement per se. That spirit is invoked in activities such as waste minimization and seeking innovative means to improve the urban environment. Those ethical and economic carrots, however, may be difficult to employ without at least some stick to prod along those thoughtless laggards (other than us, of course). The sureness and fairness of enforcement may be as vital as any other part of the system and they cannot occur in underfunded, understaffed agencies with excessive mandates.

CONCLUSIONS

A high quality urban environment for the 1990s seems to have strong popular support but demands integration with actions in many arenas of human endeavor. The strategy recommended here endorses integrated policies implemented through tangible incentives, backed by solid research, and sure and equitable enforcement. In particular, avenues of waste minimization and toxcity reduction must be explored to avoid social traps for transportation, energy, land use, housing, and health care as well as education programs and other social processes. Protecting the physical and human environments

of urban centers offers economic, ecological, and psychological benefits vital to the success of these programs. At the same time, the strategies of integration of processes must also deal with effective integration of minority and ethnic communities within urban areas. Personal and corporate stewardship and education play key roles in this integration.

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