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# A Review of Environmental Health Impacts in Developing Country Cities

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**Urban Management Program**

**Urban Management and The Environment**

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**The World Bank  
Washington, D.C.**

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1818 H Street, N.W.  
Washington, D.C. 20433, U.S.A.

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Manufactured in the United States of America  
First printing August 1992  
Second printing November 1995

The Urban Management Programme (UMP) represents a major approach by the United Nations family of organizations, together with external support agencies (ESAs), to strengthen the contribution that cities and towns in developing countries make toward economic growth, social development, and the alleviation of poverty. The program seeks to develop and promote appropriate policies and tools for municipal finance and administration, land management, infrastructure management, environmental management, and poverty alleviation. Through a capacity building component, the UMP plans to establish an effective partnership with national, regional, and global networks and ESAs in applied research, dissemination of information, and experiences of best practices and promising options.

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### Library of Congress Cataloging-in-Publication Data

A review of environmental health impacts in developing country cities

/ David John Bradley . . . [et al.].

p. cm. — (Urban management program)

Includes bibliographical references.

ISBN 0-8213-2194-3

1. Urban health—Developing countries. I. Bradley, David J.

II. Series.

RA566.5.D44R48 1992

614.4'22724—dc20

92-24094  
CIP

**“Man should not try to conform to the environment created by social and technological innovations; he should instead design environments really adapted to his nature.”**

**Rene Dubos**

## FOREWORD

This paper has been prepared for the Urban Management and Environment component of the joint UNDP/World Bank/UNCHS Urban Management Program (UMP). The UMP represents a major approach by the UN family of organizations, together with external support agencies (ESAs), to strengthen the contribution that cities and towns in developing countries make toward economic growth, social development, and the alleviation of poverty. In addition to its environmental focus, the program seeks to develop and promote appropriate policies and tools for land management, infrastructure development, municipal finance and administration, and poverty reduction. Through a capacity building component, the UMP plans to establish an effective partnership with national, regional, and global networks and ESAs in applied research, dissemination of information, and experiences of best practices and promising solutions.

This research review is part of a series which will be used, in combination with background studies, discussion papers, and case studies, to develop an overall strategic framework paper on Strategic Options for Urban Environment Management. Additional research reports are being prepared on: (i) the local management of wastes from small-scale and cottage industries; (ii) the economic spillover effects of urban environmental problems; (iii) urban environmental data collection; and (iv) the application of remote sensing and geographic information systems to urban environmental planning. Other topics in the discussion paper series will cover urban waste management and pollution control, regulatory and economic instruments for pollution control, land degradation, and the urban environmental planning and management process. Each is designed to provide information on key urban developmental-environmental linkages and/or suggest elements of an environmental management strategy for cities in the developing world. Finally, case studies on priority urban environmental problems are being prepared for São Paulo, Katowice, Tunis, Accra, Jakarta, Tianjin, and the Singrauli region of India; all of these will be inputs to the final paper on strategic options.

This document has been prepared under the auspices of the UNDP/World Bank/UNCHS (Habitat)-sponsored Urban Management Program. The findings, interpretations, and conclusions expressed here are those of the authors and do not necessarily represent the views of the World Bank, the United Nations Development Programme, UNCHS, or any of their affiliated organizations.

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## ACKNOWLEDGMENTS

This paper has been prepared by Professor David Bradley, Head of the Tropical Disease Control Programme, Ms. Carolyn Stephens, Research Fellow of the Urban Health Programme, Dr. Trudy Harpham, Head of the Urban Health Programme, and Dr. Sandy Cairncross, Head of the Environmental Health Programme, at the Departments of Epidemiology and Population Sciences and of Public Health and Policy, London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT, United Kingdom.

The authors would like to thank the following people from the London School of Hygiene and Tropical Medicine for assistance in the preparation of this report: Mike Bailey, Occupational Health Unit; Jackie Burnett, Health policy Unit; Dr. Joseph Figueras, Health Policy Unit; Dr. Alexandre Kalache, Health Policy Unit; Betty Kirkwood, Maternal and Child Epidemiology Unit; Dr. Thierry Mertens, Maternal and Child Epidemiology Unit; Garth Singleton, Health Policy Unit; Ian Timaeus, Centre for Population Studies; Christine Wilson, Tropical Health Epidemiology Unit; Dr. Fabio Zicker, Tropical Health and Epidemiology Unit. Dr. Michael Reichenheim, Institute of Social Medicine, Rio de Janeiro, also provided useful information to the authors.

Helpful comments on an earlier draft were obtained at a World Bank review seminar held in September 1990 and from discussions with World Bank staff, including: Carl Bartone, Janis Bernstein, John Briscoe, Bernhard Liese, James Listorti, Michael Porter, and Jeremy Warford. Other reviewers whose comments are appreciated are: Dr. Greg Goldstein, Environmental Health in Rural and Urban Development and Housing Program, WHO, Geneva; Dr. Jacobo Finkleman, Director of the Pan American Human Ecology and Health Center, Metepec, Mexico; and Dr. Massee Bateman, Water and Sanitation for Health Project, USAID, Washington.

This project was made possible by financial assistance from the World Bank Research Committee, the support of the UNDP/World Bank/UNCHS Urban Management Program and the British Overseas Development Administration's Programmes at the London School of Hygiene and Tropical Medicine.



## **EXECUTIVE SUMMARY**

### **Background**

1. The World Bank is currently assessing the relative health impacts of physical environmental problems in urban areas of developing countries in order better to guide its urban policy and investment decisions. As a contribution, this report reviews and summarizes available literature on health in the urban areas of developing countries. It discusses associations between health and problems of the material environment. The objectives of the report are:

- to produce a classification of environmental variables relevant to urban health in developing countries;

#### **1.1**

- to propose an analytical framework for relating environmental variables to health;
- to review intra-urban differentials in mortality, morbidity and causes of death in developing countries, with particular reference to vulnerable groups;
- to review literature that attempts to link causally urban environmental conditions to health in developing countries; and
- to propose future related research.

### **Review**

2. Over 100 studies are reviewed in this paper to identify emerging patterns and gaps in the environmental health field. Descriptive studies that examine intra-urban differentials in mortality point to the link between poverty and mortality, but without reference to intermediate variables. The larger number of studies that examine intra-urban differentials in morbidity tend to focus on diseases transmitted through the gastrointestinal tract. Studies on intra-urban differentials in respiratory, skinborne and arthropod-borne diseases remain rare. Evidence of intra-urban differentials in nutritional status, however, is plentiful. Poorer groups are at distinct disadvantage.

3. An analysis of causes of death in urban areas presents a picture of urban populations suffering the “worst of both worlds”—a mixture of deaths from infectious and chronic diseases. Data tend to come from countries where both registration of death and urbanization are more advanced.

4. The group most commonly studied is children. An abundance of studies demonstrate a high prevalence of diarrhoea and helminth (parasitic intestinal worm) infections in children of slums, shanty towns and squatter settlements, yet there is a dearth of studies on respiratory infections. The elderly and teenagers are also vulnerable groups, but are neglected in research.

5. Causal studies relating urban environmental conditions and mortality should be interpreted with caution—in some, association of environment and mortality are derived from demographic data, while other studies limit their investigation to a particular age or socioeconomic group.

6. There are several studies linking infant mortality to water quality. Access to an “individual” water supply is also an important variable. The interaction of behavioral factors is noted, including the importance of maternal education. The literature on links between urban environment and mortality is biased toward infant deaths. On adult mortality in urban areas, data indicate that the interaction of psychosocial variables and adult deaths produces a pattern largely idiosyncratic to that city and that people, at that time.

7. The studies analyzing morbidity are more numerous than those tackling causes of mortality in urban areas, but they do not show a comprehensive or uniform pattern of linkages between urban environment and health. Analysis of infant morbidity and its relation to water accessibility, water quality, and sanitation shows some of the strongest associations of environmental variables and disease outcomes. Many studies point to the complex synergism of environmental and social risk factors for disease, and there is much evidence that health outcomes in the urban environment derive ultimately from the socioeconomic more than the physical environment. Poverty remains the most significant predictor of urban morbidity and mortality.

### **A Hypothetical Urban Health Profile**

8. Notwithstanding the obvious gaps in the information available and the uniqueness of each city’s health status, the review does suggest a stylized urban health profile that provides a useful point of departure for analyzing health conditions in a specific city:

- In contrast to higher income urban dwellers and some rural populations, the urban poor have a lower life expectancy at birth and a higher infant mortality rate.
- The relationship of infant and child mortality to the quality of and access to water and sanitation is significant—children from households using public standposts and cesspools are several times more likely to die of diarrhea than those with in-house piped water and sewerage.
- Urban poor households sometimes have worse nutritional status than rural households, contributing to ill-health related to nutrition.
- Female children in slums are further disadvantaged compared with males in terms of differential nutrition, health care, and mortality.
- When a child from a slum is old enough to move independently about the city, he or she may become increasingly exposed to death associated with violent features of modern urban environments, for example, motor vehicle accidents (5–14 years) and homicides (15–19 years).



- In some cities, for youths and young adults, mortality differentials may be due to communicable disease and violence in males, and obstetric causes for females.
- From 15 years onward, trauma and chronic diseases play a substantial role in mortality and morbidity; one particular problem may be the occupational exposure associated with informal, small scale and cottage industry, and exposure in the home.

9. These hypotheses are open to test: the main challenge is to collect better mortality data, especially regarding the likely causes of death, from cities in the developing world.

### **Recommended Research**

10. This review found few good studies available on intra-urban differentials in morbidity and mortality and linkages to environmental conditions, thus emphasizing the need for increased research in this area. Several promising research approaches are recommended:

1. **Analysis of Demographic and Health Surveys (DHS):** These surveys exist for several countries with sufficiently large urban subsamples to justify further examination of the data for the purpose of intra-urban analysis. Secondary analysis of these large population-based surveys, whose quality has been validated, is recommended as an effective and efficient way of producing more information on the intra-urban differential in health. Given the nature of DHS, these differentials can then be tested for associations with environmental variables such as housing quality, water, and availability of sanitation.
2. **Linkage with Forthcoming Surveys:** Another efficient way to gain more information on the linkages between environmental problems and the health of vulnerable groups is to ensure key questions are included in forthcoming surveys to be undertaken for a variety of reasons.
3. **Increasing the Utility of Routine Surveillance Data:** The statistics normally collected at health facilities could be put to much greater use. Data on the homes of patients, which are rarely filed in a logical form, could be used to assist further data analysis. If death certificates were sorted by postal code this would open up a new area for spatial analysis of this data. Other routinely collected data could also yield better information if records had some simple residential information. The introduction of such a planned use of data could be explored in a medium-sized city to determine the feasibility of the effort.
4. **Informal Occupational Hazards:** Understanding of occupational hazards at the community level in developing countries is minimal. This is particularly the case for small-scale industries and the informal sector. Field studies are needed to assess the scale and the nature of health risks in developing countries. An initial study in one or two cities should be supported to provide an initial estimate, to develop a methodology, and to assess the difficulties of such work.

5. **Urban Air Pollution:** Urban air pollution at both area and household levels requires further understanding. Analysis of air sampling data and studies of domestic air pollution in relation to respiratory infections have recently begun. This area needs more resources for research.
6. **A Possible Model:** To provide an analytical framework, a “model city” is postulated. The model assumes a city of one million people in the developing world, with four social/economic/environmental levels, two sexes, and six age groups. For each of these 48 cells, and on the basis of any available data and informed judgment, estimates are made of the proportion of the total population, the specific death rate, and so the distribution of deaths. For each cell, causes of death are allocated and finally related to environmental changes. The model is described in the annex herein together with the hypothetical data. The attempt to construct a model revealed the inadequacy of existing data sets for developing such a model. Field research is recommended to generate the information needed for building other urban environmental health profiles in one or two developing country cities.

### **Proposed Follow-up**

11. Of the approaches suggested above, detailed research proposals have been prepared for carrying out an analysis of the DHS surveys for three or four countries, and for constructing the urban environmental health profile model for two cities: Accra (Ghana) and São Paulo (Brazil). These activities will be carried out in partnership with in-country researchers, and will be funded by The Natural Resources and Environment Division of the Overseas Development Administration of the United Kingdom.

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## **I. CLASSIFICATIONS OF HEALTH AND ENVIRONMENT: TOWARD A CONVERGENT TAXONOMY**

1.1 Our environment is infinitely complex, and the diseases of man are numerous. To reduce such complexity to manageable form, components of both environment and health must be grouped into categories. Yet physicians and those concerned with the environment have their own distinct approaches to such a classifications. Many approaches have been tried by each group, and these have often been far from mutually compatible. This section discusses the categorization of health and the physical/biological environment, especially the health problems of urbanization. It also moves toward a taxonomy of disease and of environment. Among the extremely complex determinants of urban health, we emphasize four:

- the physical/biological environment;
- disposable income;
- behavior;
- and the availability of quality health care services.

1.2 The effects of these four factors are so closely intertwined that it is misleading to consider them in isolation. In particular, the impact of the physical environment on health is mediated largely by human behavior, and the effects of changing income on both these is very important. Our review and analysis is mainly limited to the physical and biological aspect of the total environment.

### **Categorization of Disease**

1.3 Most systems for disease classification used in official statistics are derived from the *International Classification of Diseases* (ICD), prepared by the World Health Organization (WHO). Because this classification is so detailed, many countries use either a selected list of common items from the ICD, lumping everything else as "other," or only the broader categories. Few of the world's medical practitioners and even fewer health workers have seen the ICD, so errors of categorization are likely to be massive. Nevertheless, the ICD provides the recognized starting point for disease classification.

1.4 Disease classifications are primarily anatomical. Illnesses are grouped by the organ system affected. This reflects the history of medicine and the need to classify illness before the causes of disease were understood. It also reflects medical specialties that tend to be linked to organ systems. Typical examples can be found in the chapter headings of the elaborate *Oxford Textbook of Medicine* and of the more basic *Davidson's Textbook of Medicine* and *Anderson's Pathology*. A reader will note illogical omissions from *The Oxford Textbook of Medicine* because some diseases are traditionally considered surgical. More illuminating are pediatric texts, which often contain a comprehensive view of health and disease for infants and children.

1.5 Communicable diseases are the major exception to an organ system of classification. These have been largely removed from the preceding system, placed in a separate classification, and subdivided on the basis of the biology of the causative agent. Diseases caused by viruses, bacteria, protozoa, and parasitic worms are classified into different subgroups. Microbiology and parasitology dominate the agent system of classification. Because the organ and agent systems exist side by side, and recognizing the fact that little training is given to health professionals on the logic or principles of classification, there is substantial inconsistency of reporting in the compilation of routine statistics, especially by primary health care workers. This is particularly true when only a few categories are permitted.

1.6 Thus abdominal pain and vomiting may be diagnosed as "gastroenteritis," which in fact may be caused by a range of viruses, bacteria, or bacterial toxins, or, much less frequently, to a non-microbial cause. The primary health care worker may record it under "gastrointestinal disease" or under "parasitic and infectious" disease. The first will lump gastrointestinal diseases with diseases of affluence, illnesses of uncertain relation to any socioeconomic variables toxic effects, etc. If in the record category of parasitic and infectious diseases, gastroenteritis joins an enormous bulk of diseases, particularly in the developing world.

1.7 Tuberculosis is another condition that may turn up at various places in a disease classification. Open, infective, pulmonary tuberculosis will usually appear in its own subcategory of infections, but it may often be misclassified with pulmonary diseases (indeed, it logically also belongs there). More often, intestinal tuberculosis will appear in the gastrointestinal disease category together with psoas abscess, while spinal tuberculosis (Pott's disease) will appear in reporting data under either neurological or bone diseases or diseases depending upon the main presenting signs and symptoms. Problems of this sort are typical of routinely reported data!

1.8 Disability is often more relevant than disease, but there is a limited correlation between a classification of disease and one of disability, though there is an international classification of impairments and disabilities. The medical classification of disability can be related to a classification of disability in terms of its economic effects, but these are culture-dependent.

### **Categorization of Environment**

1.9 The definition of environment is generally socially constructed. If we ask a mountaineer, a sanitary inspector, and a conservationist what they mean by "the environment" we shall get very diverse answers. The biologist's definition of environment is probably the most logical and usable and consists of the world outside ourselves, that is to say the physical and natural environments. For present purposes this is probably sound, although the reader is likely to disagree. Note that "urbanization" is more than just construction and habitation of structures. Formally, everything other than the genome either is or bears the mark of the environment. Narrowing the scope of inquiry is a matter of convenience more than logic, so it is best to look widely at first.

## **A Relevant Taxonomy**

1.10 What we seek here is an etiological classification of disease, particularly one that reflects environmental causes. To match it we also need a disease-oriented or, even better, a health-oriented, classification of environment. The discussion in Section III highlights the difficulty of such an endeavor because causation can be multiple, variable, hard to measure, and sometimes, simply, unknown. Without understanding something about symptomatic mechanisms, even good correlations between environment and disease are not useful to the planner. For example, a study of the Luo in Kenya showed that relocation to an urban area causes an almost immediate rise in the blood pressure of an adult male. Without knowing the mechanism—which in this case is believed to be related to an increase in the salt content of the diet—such information cannot benefit the urban planner.

1.11 In the case of water resource changes, it has been found that a taxonomy of communicable disease based on the environmental interventions most relevant to control rather than the biology of the agent has become well established and presumably useful (White, Bradley, and White 1972). This is relevant to some disease problems of urbanization, but we shall also attempt to apply similar principles to the classification of urban health problems.

1.12 We suggest that, for the purpose of urban planning as it affects health, a useful classification may be as set out in Table 1–1, which considers the environment strictly in relation to man. We do not consider this as an adequate view of the environment for other purposes, nor do we subscribe to the position that the environment's value is only in relation to man. Our aim here is to relate the environment of the city to human health. One primary analysis is of environment as a resource, as a hazard, and as ambience.

1.13 This has some use as a classification since it groups together matters requiring similar types of intervention. We suggest that environmental components may be categorized as:

- where the environment is providing a resource for urban inhabitants;
- where the environment is acting primarily as a hazard (from the health viewpoint);
- and where the environment outside the home forms the ambience to which man has to adapt.

1.14 The issues raised by each category differ: for resources, the practical questions concern availability, access, and cost; for hazards, issues involve the form of contact with people, prevention, containment, or failing that, amelioration; for ambience which cannot be changed, the issues concern protection (shelter)—from extremes of temperature and rainfall—and adaptation.

**Table 1-1. Proposed Environmental Classification for Health Analysis**

---

**Environment as:**

**Resource — availability, access, cost:**

- \* Water
- \* Health care
- \* Food
- \* Cooking facilities
- \* Shelter

**Hazard - route of entry, prevention, containment, amelioration:**

- \* Pollution
  - inevitable (personal wastes)
  - partly inevitable (domestic, some industrial)
  - preventable (occupational, locational)
- \* Trauma
- \* Vectors

**Ambience — protection, adaptation:**

- \* Weather
    - temperature, humidity
    - surface water
  - \* Other people
  - \* Other animals
- 

1.15 These broad categories are shown in Table 1-1 with the specific environmental components grouped under the appropriate heading. The qualities of each primary category may be modified by how it is perceived, by our ability to influence or modify the environment, and by the spatial scale over which we are thinking.

1.16 We now set out several other environmental classifications which are progressively more influenced by their relation to diseases. As the classifications become easier to relate to the cause of specific diseases, they become less satisfactory from an environmental viewpoint.

1.17 In the same way that most classifications of infectious disease are categorized by the biology of the agent rather than the relationship to the host, most environmental classifications are ordered by the structure of the physical world and its properties: air, water, soil, sunlight, temperature, and humidity. Such classifications can be found in many books on ecology, geography and "the environment."

1.18 One influential ecological text (Andrewartha and Birch 1955) took a more imaginative approach and classified the environment into:

- a) weather (temperature, humidity, rainfall, surface water).



**Table 1-2. An Environmental Taxonomy Related to Disease Patterns**

|  |                        |
|--|------------------------|
| <b>Water-wastes complex</b>              | <b>Other people</b>    |
| domestic water                           | crowding               |
| excreta                                  | organic pollution      |
| drainage                                 | trauma                 |
| surface water                            | inorganic pollution    |
| water-related vectors                    |                        |
| solid wastes                             | <b>Other organisms</b> |
| solid waste-related vectors              | domestic animals       |
| rodents                                  | stock                  |
|  | vectors                |
| <b>Shelter and the built environment</b> | <b>Weather</b>         |
| housing                                  | temperature            |
| cooking facilities                       | humidity               |
| sanitary facilities                      | natural disasters      |
| health care facilities                   | other extreme events   |
| transport system                         |                        |
| air pollution                            |                        |
| <b>Food</b>                              |                        |
| food supply                              |                        |
| food hygiene                             |                        |
| markets                                  |                        |
| slaughterhouses                          |                        |
| food processing plants                   |                        |

- b) food (including food, drinking water and possibly cooking facilities).
- c) a place to live (shelter, perhaps health care facilities).
- d) organisms of the same kind (crowding and pollution).
- e) other organisms of different kinds (predators and pathogens).

1.19 The reasons behind this classification had much to do with the then contemporary ecological polemics, but this categorization is valuable because it reflects the environment in relation to the organism under consideration. The Andrewartha and Birch approach is more helpful than others for urban environmental health purposes because it takes into consideration the effects of urban population densities (overcrowding) and population growth. However, a more relevant environmental grouping of items must also include the standard topics addressed in public health and environmental engineering, this is attempted in Table 1-2.

1.20 Table 1-3 presents a classification based on interventions related to the effects on disease. It is the closest example of an environmental classification to disease problems that we have, as reported in standard categories and in medical certification of the causes of death. It is clear that

**Table 1-3. Environmental Determinants of Health Problems**

- 
- I. Determinants of ingested health problems.**
    - 1. Domestic water supply
    - 2. Sanitation—excreta disposal
    - 3. Hygienic facilities (soap availability, privacy, etc.)
    - 4. Food hygiene
    - 5. Markets
    - 6. Slaughterhouses
    - 7. Cooking facilities
    - 8. Fuel
    - 9. Industrial pollutants
  - II. Determinants of other organisms and of the functioning of I.**
    - 1. Drainage
    - 2. Surface water
    - 3. Solid wastes
  - IIa. Consequences, especially of II, in the environment.**
    - 1. Rodents
    - 2. Insect vectors
    - 3. Nuisance insects
    - 4. Intermediate host snails
  - III. Determinants of the inhaled health problems.**
    - 1. Crowding
    - 2. Domestic air pollution: stoves
    - 3. Community air pollution
    - 4. Industrial air pollution
    - 5. Transport related air pollution
  - IV. Proximal determinants of environmental stress.**
    - 1. Household temperature
    - 2. Household humidity
    - 3. Protection from rainfall
    - 4. Protection of possessions
    - 5. Transport facilities: vehicles and roads
  - V. Determinants of the bases of IV, III, II, I.**
    - 1. Weather
  - VI. Determinants of trauma and toxicity**
    - 1. Transportation systems
    - 2. Availability of weapons
    - 3. Industry—activities
    - pollution to air and water
  - VII. Determinants of nutritional state.**
    - 1. Foods: availability, access and cost
  - VIII. Other environmental health problems**
    - 1. Domestic animals
  - IX. Modifiers of the effects of the above**
    - 1. Health care facilities
-