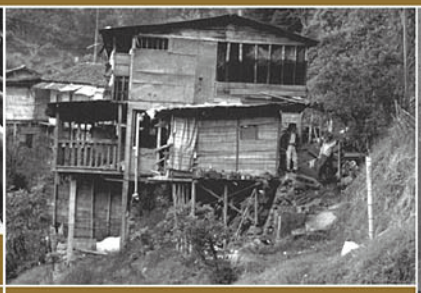
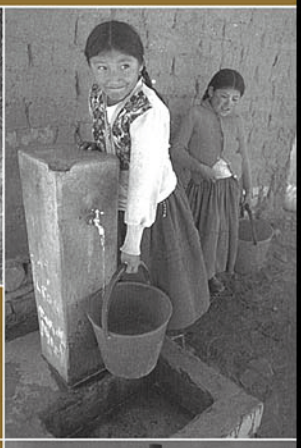
DECISION-MAKING IN ENVIRONMENTAL HEALTH

FROM EVIDENCE TO ACTION

EDITED BY C. CORVALÁN, D. BRIGGS AND G. ZIELHUIS





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FOREWORD

This book evolved from the need to address a number of fundamental questions relating to environmental health for which there were no simple answers. These questions ranged in scope and depth, from issues related to basic statistics on health and the environment to the use of information in the management of problems associated with environmental health. Many of these questions were concerned with the way in which information is, or can be, used to help address environmental health problems, and with the role and value of environmental health indicators. Examples of these questions are:

How can one collect and present information which is useful in shaping and making decisions at the local level?

What does a national indicator (e.g. infant mortality rate or access to water and sanitation) mean in the face of large disparities at the sub-national level?

Why is it not always possible to quantify indicators at the sub-national level, if national-level indicators exist?

What do environmental exposure indicators mean beyond the local level, where people are affected?

Such questions indicate a need to address issues relating to the requirements and use of local-level information. Other questions were of a more technical nature, for example:

What is the health impact in terms of morbidity and mortality of a given environmental exposure?

How does the impact vary according to age, gender, geographical location and socio-economic group?

How are environmental health problems ranked and prioritised at the local level?

Further questions referred to policy and decision-making issues, for example:

How does the environmental health decision-making process operate locally?

How are locally collected data transformed into information and used in decision-making, or if such information is not used, what are the reasons?

This book addresses these and other related issues. It proposes a model for decision-making in environmental health based on the involvement of relevant stakeholders and the use of scientifically sound data and

appropriate analytical methods. It also proposes a framework for understanding environmental health problems and their effects in a manner that allows interdisciplinary and intersectoral approaches to action. Finally, the book recommends the development of local environmental health information systems for the collection of locally relevant data, with emphasis on simplification to avoid overloading such systems.

The link between the environment and human health has been suspected for centuries; there is now widespread consensus that healthy environments are prerequisites for human existence and health. However, the link between development activities and their impact on health and the environment is a more recent issue. At the Earth Summit, held in Rio de Janeiro in 1992, it was recognised that both insufficient development, leading to poverty, and inappropriate development, leading to over-consumption, could result in severe environmental health problems. In all countries, information about health and the environment at different levels (e.g. village, city, province or country) is necessary in order to support the management and decision-making process in relation to environmental health. Providing relevant information, in a form that all those involved can understand and accept, within the constraints of time and other resources, is thus a major challenge. It is not simply a matter of collecting data. In order to be useful, environmental health information should be pertinent, and sufficiently accurate and usable by all those involved in decision-making, from the public to political leaders. The decision-making process requires information that is directly relevant to the task in question, the translation of this information into a consistent and coherent form, and the presentation of the information in a manner that is appropriate and acceptable to the different users. This book addresses these issues in detail.

This book will be useful to researchers in public health, epidemiology and the social sciences. It will also be useful to those working in government institutions concerned with environmental health, particularly those responsible for collecting and analysing data as part of local or national information systems.

World Health Organization

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Chapter 1*

HEALTH AND ENVIRONMENT ANALYSIS

1.1 Background

Human exposure to pollutants in the air, water, soil and food—whether in the form of short-term, high-level, or long-term, low-level exposure—is a major contributor to increased morbidity and mortality. However, the disease burden attributable to these exposures is not known with any degree of certainty because levels of general environmental pollution fluctuate greatly, methods for analysing the relationships are incompletely developed, and the quality of available data is generally poor. Precise measures of the association between pollution levels and health outcomes are therefore rare. Exposure to environmental pollution is also usually involuntary. People may be unaware of this and/or its possible effects; as a result they may exert little control over their risk of exposure. Biological and chemical agents in the environment are nevertheless responsible for the premature death or disablement of millions of people worldwide every year (WHO, 1992). It has recently been estimated that almost one quarter of the global burden of disease is attributable to environmental factors (WHO, 1997). This estimate, which is based on published data (Murray and Lopez, 1996), was made by attributing an environmental causal fraction to each disease category with a known environmental link. The ability to link health and environmental data, and thereby to determine the relationship between levels of exposure and health effects, is clearly vital to control exposure and protect health. Decision-makers need information on the health effects attributable to environmental pollution in order to assess the implications of their decisions, to compare the potential effects of different decisions and choices, and to develop effective prevention strategies.

Standards and guidelines against which to assess levels of environmental pollution are now widely available. For example, the World Health Organization (WHO) has developed environmental quality guidelines for various pollutants in the air (WHO, 1987), drinking-water (WHO, 1993),

* *This chapter was prepared by C.Corvalán, T.Kjellström, G.Zielhuis and D.Briggs*

food (FAO/WHO, 1989) and workplace (e.g. WHO, 1980, 1986). These guidelines are based on epidemiological and toxicological studies and indicate the maximum environmental levels, or the maximum levels of human exposure, considered acceptable in order to protect human health. Nevertheless, individual susceptibility to pollution varies, to the extent that it is possible that some individuals may experience adverse effects at levels below the maximum recommended levels. Moreover, in many areas of the world these levels are frequently exceeded, in some places by as much as several times the recommended levels, and reduction of human exposure may be difficult or very costly. Adverse effects on human health are therefore likely to continue to be observed in these areas. In such situations, analysis of data on human health and the environment provides a valuable tool for obtaining estimates of the health impact of pollution, which can be used to set priorities for action.

Many epidemiological studies have been undertaken to analyse the relationship between specific forms of environmental pollution and health effects. Most of these studies have been conducted in developed countries, and the methods used may not be applicable to other settings, especially if high quality data are unavailable or too expensive to collect. Major problems often exist in obtaining data on health and particularly on environmental exposure at the individual level. As a consequence, it is normally necessary to rely on so-called "ecological" methods, in which the statistical unit of observation is a population rather than an individual (Rothman, 1986; Beaglehole *et al.,* 1993; see Chapter 6).

A serious limitation in conducting epidemiological studies concerns the measurement of exposure in individuals. Routinely collected environmental data are widely available in most countries and, where relevant, can be used as a proxy for exposure data. For example, monitoring networks provide data on pollution levels at specific sites, which can be used to characterise average exposures for geographical regions. Environmental data are also often compared with guideline values or maximum recommended levels in order to determine levels of compliance with prevailing policies. The data are, however, rarely used to quantify the potential health effects. Equally, although many countries routinely collect data on health outcomes in the form of morbidity and mortality statistics, attempts are rarely made to link the data to environmental or other factors in order to attribute outcomes to their cause.

1.2 Tools for analysis and interpretation

Linking environmental and health data offers considerable benefits, but also poses many dangers if not carefully carried out. In linking such data it is all too easy to overlook the statistical problems and inconsistencies of the

different data sets, or to misinterpret their apparent relationships. Valid linkage thus relies on the use of both valid data and appropriate linkage methods.

Numerous methods for data linkage have been developed in many different areas of application. Their suitability for linking environmental and health data, however, is often limited and always needs to be assessed carefully. Two important criteria must be considered in this context. First, the methods must be politically acceptable. This means that they must be simple, inexpensive to implement, and operable with the available data, thus allowing rapid assessment. If the methods are overly complex, requiring extensive resources and collection of large amounts of additional data, few developing countries will be able to apply them, and even in developed countries their use may be costly and result in delays in action. Second, if the results are to be accepted as a basis for action, the methods must be scientifically credible and statistically valid. This means that they should be accurate, sensitive to variations in the data of interest and unbiased. Simple, crude methods should produce results that agree with those obtained from more detailed studies, for which the statistical precision can be quantified.

In practice, these requirements are rarely met in full. If they were, there would hardly be a need for individual-level studies. Nevertheless, simple methods may still have considerable value. Results from ecological studies, for example, are useful if the potential biases can be identified, evaluated and shown to be small. At the very least, the results should help to identify areas or issues requiring more detailed investigation. Countries where detailed, individual-level studies have not been performed also urgently need access to methods which can help to shed light on the extent and health effects of specific forms of environmental pollution. Priority should be given to the development of research capabilities in developing countries for this purpose (Environmental Research, 1993).

Where detailed information on the exposure-response relationship of specific pollutants is available, Quantitative Risk Assessment (QRA) techniques, based on epidemiological data, can be used to estimate the impact of exposure on different populations without the need for new substantive research (for further information, see Romieu *et al.,* 1990; Nurminen *et al.,* 1992; Ostro, 1996). This implies knowledge about exposure, the population at risk and the health effects associated with exposure in the form of a dose-response function derived from epidemiological studies (i.e. pooled study results) (Goldsmith, 1988; Smith, 1988; Hertz-Picciotto, 1995; Smith and Wright, 1995; Wartenberg and Simon, 1995). Because of limitations in available research data, QRA can often be applied only by extrapolating study results from one country

(usually developed) to other countries (usually less developed). The fact that the range of exposure levels and the distribution of other conditions likely to affect health outcomes may differ substantially between populations inevitably limits the validity of this approach. In addition, assessments can only be carried out reliably for pollutants for which well researched exposure-response relationships have been established. Even then, uncertainty regarding the assumed association between environmental pollution levels and the actual exposures in individuals is a major constraint.

QRA remains the only tool available for estimating the health outcomes of environmental pollution in areas where health monitoring is not undertaken, or where the quality of the data collected is poor. It is also the only feasible approach for obtaining crude estimates of health impacts in very large population groups. The development and application of well tested methods of risk assessment is therefore an important priority. It is equally important to describe the risks of exposure which exist to decision-makers and the community in a meaningful way (Rose, 1991).

1.3 Health and Environment Analysis for Decision-Making Project

The Health and Environment Analysis for Decision-Making Project (HEADLAMP) (Corvalán and Kjellström, 1995) is aimed at addressing some of the limitations outlined above in the information currently available to support environmental health policies. Its overall purpose is to make valid and useful information on the local and national health impact of environmental hazards available to decision-makers, environmental health professionals and the community, in order to promote effective action to prevent or reduce environmental health problems. To this end, it is designed to indicate environmental health trends, as a basis for defining appropriate policies and for assessing the value and performance of these policies over time. It also aims to encourage local and national capacity-building, as a means of enabling environmental health issues to be tackled more effectively at the appropriate level.

HEADLAMP takes a deliberately interdisciplinary and intersectoral approach. It uses a combination of methods from environmental epidemiology (including human exposure assessment) and other health and environmental sciences to produce and analyse data, to convert these data into information, and to present this information so that it can be understood and acted upon by those responsible for environmental health protection. Three principles define the HEADLAMP process:

1. HEADLAMP is based on scientifically established relationships between environmental exposure and health effects. This approach has proved successful in surveillance systems for the prevention and control of

occupational diseases, and has been shown to be most effective when based on a sound set of data relating to both exposure and health outcomes (Thacker *et al.*, 1996).

2. HEADLAMP makes use of environmental health indicators to assess and monitor the environmental health situation, to help define the actions which need to be taken, and to inform those concerned. The indicators are chosen according to the issue requiring investigation, which in turn determines the data and method needed. The development of appropriate environmental health indicators is clearly integral to the HEADLAMP approach.
3. As far as possible, HEADLAMP uses routinely collected data. A major advantage of this approach is its cost-effectiveness. Data collection is expensive, and it is therefore important to obtain the maximum value from data through their repeated and effective use. To measure the relevant environmental health indicators, it may also be necessary to collect additional data. In these situations HEADLAMP encourages the use of appropriate, low-cost techniques.

The key to HEADLAMP is clearly information. Attempts to use information to support health intervention and policy are not new. Current health information systems, however, have been criticised because of the extra demands they impose on health workers, their tendency to centralise information (often in ways which make it inaccessible to many potential users), the failure to analyse adequately the collected data for use in planning, the aggregation of data which masks areas where action is required, and the failure to build links with other sectors (de Kadt, 1989). HEADLAMP is designed to avoid these weaknesses and limitations. It brings together not only the different sectors but also the many different stakeholders involved, including the community and local decision-makers. It builds upon existing health and environmental information systems and promotes the use of existing data, thereby allowing a feedback process to data collectors regarding its quality and the need for additional data. It also encourages data to be translated into information which can be used by different stakeholders and can act as an aid to decision-making. Moreover, HEADLAMP operates at the local level, avoiding problems of information centralisation and aggregation at higher levels. Through the implementation of the Programme of Action for Sustainable Development (Local Agenda 21) (United Nations, 1993), local governments are likely to take the lead role on environmental health at the local level (Williamson, 1996). HEADLAMP is thus a potentially useful tool for action at this level.

1.4 The HEADLAMP process

HEADLAMP has been developed as a practical methodology to address the adverse effects of specific environmental conditions on human health at the local level. Application of the HEADLAMP process follows three stages, as follows (see Figure 1.1):

1. *Definition of the problem*. The issue(s) to be addressed may be defined initially in many different ways: for example, through the concerns of the local community, as a result of local investigations, or as a consequence of priorities set at a wider level (e.g. as a local response to a National Environmental Health Action Plan). In each case, however, an essential prerequisite is a set of known links (validated by previous research) between a defined environmental factor and its associated health outcomes. Basic information needed to address this issue is identified at this stage. The participation of all relevant stakeholders concerned is also necessary, because the process is intersectoral, and aims to draw together not only the health agencies but also other sectors related to the problems at hand. Together, these various stakeholders can help to redefine the issue in clearer terms and to provide practical guidance and help in developing an appropriate methodology and locating relevant data.
2. *Compilation, assessment and quantification of relevant environmental health indicators*. During this stage, detailed data requirements are specified, taking account of the specific setting in which the analysis is being conducted, and the limitations of data availability. These data are obtained as far as possible from available routine data sources, but may be supplemented where necessary through the implementation of purposely designed, rapid surveys. Once collected, these data are then processed and analysed to provide information on the environmental health issues of concern. The variables produced through this process comprise the environmental health indicators. Depending on the problem and/or feasibility of obtaining all the relevant data, environmental health indicators may be derived either from health data (e.g. specific morbidity rates attributable to definable environmental factors) or environmental data (e.g. pollution levels with known human health implications). Where appropriate, these indicators are then linked (usually at an aggregate level) to provide further information on the environmental health situation.
3. *Formulation and implementation of appropriate policies*. At thisstage,the trends and patterns shown by the environmental health indicators are interpreted and, based on this interpretation, appropriate

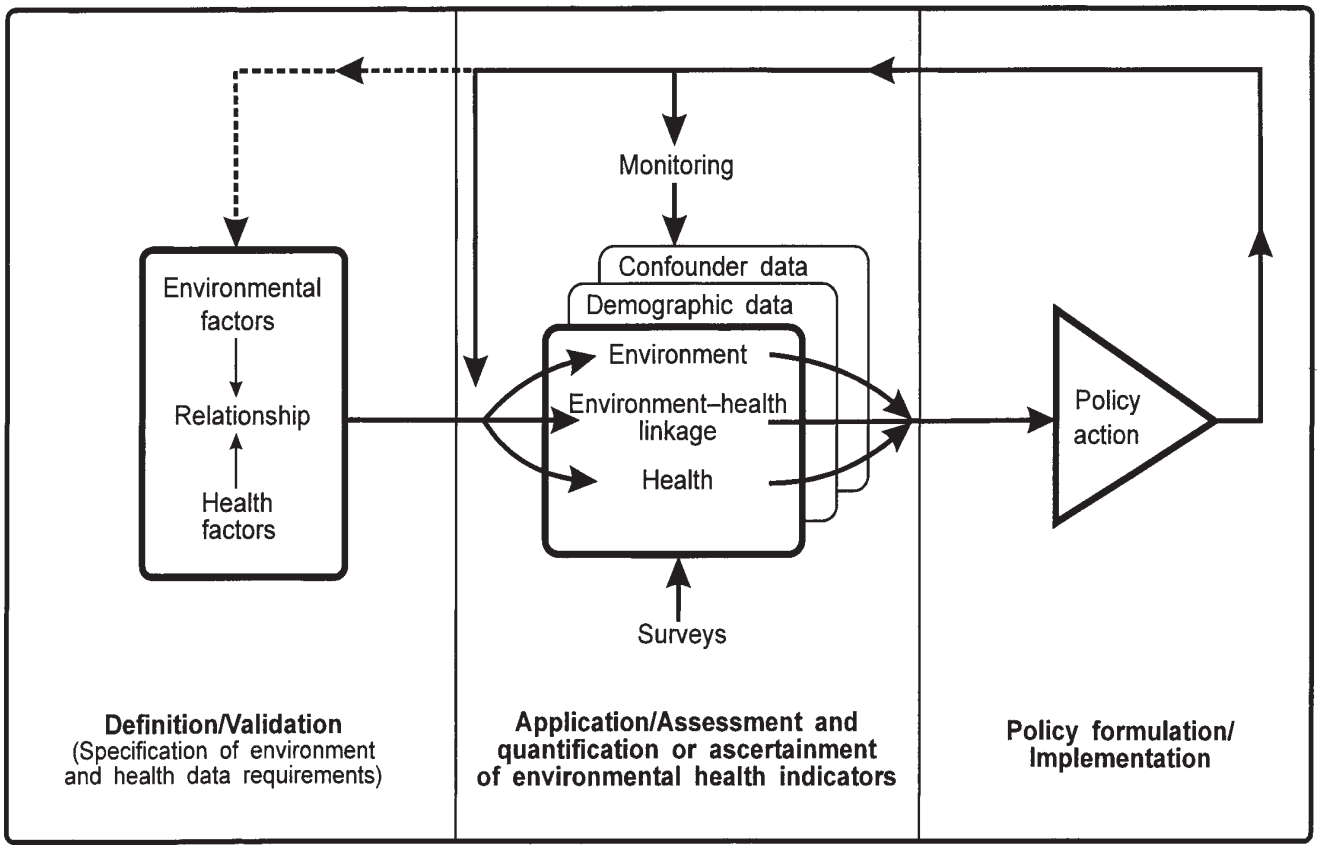

Figure 1.1 The HEADLAMP