ENVIRONMENTAL HEALTH PROJECT

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ENVIRONMENTAL HEALTH PROJECT

WASH Reprint: Field Report No. 436

Environmental Health Assessment: An Integrated Methodology for Rating Environmental Health Problems

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SANITATION (IRC)

October 1993

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Prepared jointly by the WASH Project and the PRITECH Project
for the Office of Health, Bureau for Research and Development
U.S. Agency for International Development
under WASH Task No. 315 and
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WASH and EHP

With the launching of the United Nations International Drinking Water Supply and Sanitation Decade in 1979, the United States Agency for International Development (USAID) decided to augment and streamline its technical assistance capability in water and sanitation and, in 1980, funded the Water and Sanitation for Health Project (WASH). The funding mechanism was a multiyear, multimillion-dollar contract, secured through competitive bidding. The first WASH contract was awarded to a consortium of organizations headed by Camp Dresser & McKee International Inc. (CDM), an international consulting firm specializing in environmental engineering services. Through two other bid proceedings, CDM continued as the prime contractor through 1994.

Working under the direction of USAID's Bureau for Global Programs, Field Support and Research, Office of Health and Nutrition, the WASH Project provided technical assistance to USAID missions and bureaus, other U.S. agencies (such as the Peace Corps), host governments, and nongovernmental organizations. WASH technical assistance was multidisciplinary, drawing on experts in environmental health, training, finance, epidemiology, anthropology, institutional development, engineering, community organization, environmental management, pollution control, and other specialties.

At the end of December 1994, the WASH Project closed its doors. Work formerly carried out by WASH is now subsumed within the broader Environmental Health Project (EHP), inaugurated in April 1994. The new project provides technical assistance to address a wide range of health problems brought about by environmental pollution and the negative effects of development. These are not restricted to the water-and-sanitation-related diseases of concern to WASH but include tropical diseases, respiratory diseases caused and aggravated by ambient and indoor air pollution, and a range of worsening health problems attributable to industrial and chemical wastes and pesticide residues.

WASH reports and publications continue to be available through the Environmental Health Project. Direct all requests to the Environmental Health Project, 1611 North Kent Street, Suite 300, Arlington, Virginia 22209-2111, U.S.A. Telephone (703) 247-8730. Facsimile (703) 243-9004. Internet EHP@ACCESS.DIGEX.COM.

WASH Field Report No. 436
PRITECH Report No. HSS-133IR

ENVIRONMENTAL HEALTH ASSESSMENT:

An Integrated Methodology for Rating Environmental Health Problems

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and the PRITECH Project
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by
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October 1993

This activity was jointly conducted by the WASH Project and PRITECH (Technologies for Primary Health Care). PRITECH is operated by Management Sciences for Health, in cooperation with the Academy for Educational Development, Inc.; the Department of International Health, School of Hygiene and Public Health, Johns Hopkins University; the Program for Appropriate Technology in Health; the Centre for Development and Population Activities; and Creative Associates International.

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RELATED WASH REPORTS

Environmental Health Assessment: A Case Study Conducted in the City of Quito and the County of Pedro Moncayo, Pichincha Province, Ecuador. Field Report No. 401. Prepared by Gustavo Arcia, Eugene Brantly, Robert Hetes, Barry Levy, Clydette Powell, José Suárez, and Linda Whiteford. October 1993.

Public Participation in Urban Environmental Management: A Model for Promoting Community-Based Environmental Management in Peri-Urban Areas. Technical Report No. 90. Prepared by May Yacoob, Eugene P. Brantly, and Linda Whiteford. October 1993.

Guidelines for Improving Wastewater and Solid Waste Management. Technical Report No. 88. Prepared by Richard N. Andrews, William B. Lord, Laurence J. O'Toole, L. Fernando Requena, with assistance from Eugene Brantly, Philip Roark, and Fred Rosensweig. August 1993. (Available in English and Spanish.)

The Unique Challenges of Improving Peri-Urban Sanitation. Technical Report No. 86. Prepared by William Hogrewe, Steven D. Joyce, and Eduardo A. Perez. July 1993.

Constraints in Providing Water and Sanitation Services to the Urban Poor. Technical Report No. 85. Prepared by Tova María Solo, Eduardo Perez, and Steven Joyce. March 1993.

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ACRONYMS

A.I.D.	U.S. Agency for International Development (Washington)
EHA	Environmental Health Assessment
BOD	biological oxygen demand
PRITECH	Technologies for Primary Health Care
TSS	total suspended solids
R&D/H	Bureau for Research and Development, Office of Health
USAID	U.S. Agency for International Development (overseas mission)
WASH	Water and Sanitation for Health Project

EXECUTIVE SUMMARY

As developing countries industrialize and their urban populations grow, they confront an increasing array of environmentally related public health problems. The incidence of diseases associated with inadequate sanitation, contaminated water supplies, and solid waste worsen, especially in peri-urban settlements; growth in industrial employment, the use of hazardous materials, traffic congestion, air pollution, cigarette smoking, and other sources of environmental pollutants increase the occurrence of work-related and traffic-related injuries, respiratory diseases, heart disease, and cancer. As a result, policymakers need better tools for setting priorities among these problems to target their resources in a way that will produce the greatest public health benefits.

International donor agencies and professionals in the environmental and health sciences recognize the need to use risk assessment techniques in setting environmental health policies and priorities. Many organizations are currently working to develop analytical tools to help developing countries investigate, characterize, and prioritize environmental health problems. The Office of Health of the Bureau for Research and Development, U.S. Agency for International Development, is contributing to this effort by supporting the development of methods for conducting Environmental Health Assessments (EHAs). This effort has been implemented through two Office of Health projects: the Water and Sanitation for Health (WASH) Project and the Technologies for Primary Health Care (PRITECH) Project.

An EHA examines a broad range of environmental conditions that have adverse health consequences and determines which of the conditions presents the greatest risk to public health. By identifying the most serious environmental health problems in a particular city or village, an EHA provides objective information to help municipalities, national governments, and donor agencies identify new investments, allocate existing resources, and make other decisions to improve environmental conditions.

The EHA methodology integrates three approaches to investigating environmental health problems: health risk assessment, health effects (outcome) assessment, and the ethnographic investigation of health-related behavior. It is a multi-disciplinary approach, using specialists in epidemiology, anthropology, and health-related behavior, in addition to specialists in exposure assessment and risk assessment. An EHA examines the potential health consequences of environmental conditions in eight categories:

- potable water supply
- sanitation and wastewater
- solid waste
- food hygiene

- occupational health
- air pollution (indoor and ambient)
- toxic and hazardous materials
- traffic and household injuries.

This report describes the components of the EHA methodology, including an approach to rating the relative significance of environmental health problems, and describes the types and sources of data needed to conduct an EHA. The report also suggests a typical schedule for conducting an EHA, describes the limitations of the methodology, and identifies the most important aspects of the methodology that require further development.

The EHA methodology described in this document was field-tested in Ecuador in June 1992. Results from the field test are reported in a companion document, Environmental Health Assessment: A Case Study Conducted in the City of Quito and the County of Pedro Moncayo, Pichincha Province, Ecuador. WASH Field Report No. 401; PRITECH Report No. HSS-133IR; October 1993.

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INTRODUCTION

Developing countries throughout the world are experiencing rapid urban population growth and gradual industrialization. These trends greatly influence the public health problems that developing countries confront. The "pre-transition" infectious diseases associated with inadequate sanitation, contaminated water supplies, poor housing, and overcrowded living conditions continue to compromise the health of millions of people, especially in peri-urban settlements. At the same time, increases in industrial employment, use of hazardous materials, traffic congestion, air pollution, and cigarette smoking, among other changes, are increasing the occurrence of "post-transition" diseases, such as work-related and traffic-related injuries, respiratory disease, heart disease, and cancer (Jamison, 1991).

Because of these trends, local and national governments in developing countries face health problems of increasing complexity that compete with other priorities central to achieving sustainable economic development. Developing country officials need to know how to set priorities and make sound policy decisions in the health and environmental sectors. This need has been recognized by international donor agencies and professionals in the environmental and health sciences. Many organizations are working to develop analytical tools to investigate, characterize, and prioritize public health problems.

A.I.D's Office of Health of the Bureau for Research and Development (R&D/H) is participating in this research effort by developing procedures for conducting Environmental Health Assessments (EHAs). This work was implemented under two contracts managed by the Office of Health: the Water and Sanitation for Health (WASH) Project and the Technologies for Primary Health Care (PRITECH) Project. WASH and PRITECH jointly developed this methodology and cooperated in every aspect of the work.

The Environmental Health Assessment methodology described in this document was field-tested and refined by a joint WASH-PRITECH team in Ecuador in June 1992. The results of the field trial are reported in a companion document, Environmental Health Assessment: A Case Study Conducted in the City of Quito and the County of Pedro Moncayo, Pichincha Province, Ecuador. WASH Field Report No. 401; PRITECH Report No. HSS-133IR; October 1993.

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COMPONENTS OF AN ENVIRONMENTAL HEALTH ASSESSMENT

2.1 Definition of Environmental Health Assessment

An EHA, as defined and applied in this task, examines a broad range of environmental conditions that have adverse health consequences and seeks to determine which of the conditions presents the greatest risk to public health. By identifying the most serious environmental health problems in a particular city or village, an EHA provides objective information to help municipalities, national governments, and donor agencies identify new investments, allocate existing resources, and make other decisions that will improve environmental conditions that affect public health. An EHA differs in two important ways from a health risk assessment as it has been applied in the United States and in developing countries (e.g., USAID, 1990).

First, an EHA integrates the following three approaches to investigating public health problems:

- Health risk assessment, as developed and practiced under the sponsorship of the U.S. Environmental Protection Agency, for the study of environmentally related health problems (USEPA, 1987 and 1993);
- Health effects (outcome) assessment, as developed and practiced by epidemiologists (ATSDR, 1992);
- Ethnographic investigation of health-related behavior, as developed and practiced by medical anthropologists (Scrimshaw and Hurtado, 1987).

An EHA uses existing (secondary) data on environmental quality and the occurrence of environmentally related diseases, as well as original (primary) ethnographic data collected by a field study team.

Second, consistent with related programs at the World Health Organization and the World Bank, USAID has defined "environmental health" broadly, to include public health problems associated with all of the following (USAID, 1991):

Pre-transition environmental health problems:	Post-transition health problems:
water supply	air pollution (ambient and indoor)
sanitation and wastewater	occupational health
solid waste	toxic and hazardous materials
food hygiene	traffic and household injuries
vector-borne diseases	

Previous comparative health risk assessments have not addressed such a diverse and large group of environmentally related health problems.

The EHA methodology involves three major innovations vis-a-vis a typical health risk assessment:

- EHA is a multi-disciplinary approach, using specialists in epidemiology, anthropology, and health-related behavior, in addition to specialists in exposure assessment and risk assessment.
- Risk assessment methods designed for use in industrialized countries have been modified to take into account the limited quantity and sophistication of data that are generally available in developing countries.
- Original ethnographic data are collected in focus group discussions, in-depth interviews, and structured observations to help the assessment team understand relevant environmental and health conditions and to compensate for the lack of reliable, quantitative data on environmental conditions and the causes of morbidity and mortality.

2.2 Health Risk Assessment

Risk assessment is defined as the overall procedure by which potential adverse health effects of human exposure to toxic agents are characterized. The U.S. National Academy of Sciences defined risk assessment to consist of four components: hazard identification, exposure assessment, dose-response assessment, and risk characterization (National Research Council, 1983). Information and data from a variety of sources are required for a complete risk assessment. Each of the four components has its own data demands, and those which are most critical in risk assessment in developing countries are in exposure assessment and dose-response assessment.

2.2.1 Hazard Identification

Hazard identification is a qualitative determination of whether human exposure to an agent has the potential to produce adverse effects. It involves an evaluation of all available toxicology data and other relevant biological and/or chemical information for the agent under consideration. Usually hazard identification is conducted prior to an in-country visit and identifies the initial list of environmental concerns. Those issues identified during the hazard identification phase would then be analyzed in detail during the in-country visit. Data for identifying potential hazards would come from local representatives and any secondary sources of information that might be available, such as statistics on environmental conditions and health status and major illnesses and health concerns. Hazard identification in developing countries differs from that conducted in industrialized nations. In industrialized countries, hazard identification focuses on agent-specific data:

- Physico-chemical properties relevant to exposure;
- Sources, routes, and patterns of exposure;
- Structure-activity relationships;
- Metabolic and pharmacokinetic properties;
- Short-term in vivo and in vitro tests;
- Long-term animal studies;
- Human exposure studies;
- Human epidemiological studies.

Although studies on humans provide the most direct evidence for hazard identification, in most instances the majority of information available on toxic effects comes from animal studies. Thus, the identification of agents hazardous to human health usually requires assuming that mammals used in toxicity tests are biologically similar to humans and that the test conditions (e.g., route of exposure, frequency, level and duration of doses) adequately represent exposure conditions for humans. In general, unless human toxicity data or comparative metabolic data exist that refute animal toxicity data, human health effects are inferred from the results of animal studies.

In developing countries, however, hazard identification focuses on more general indicators of health outcomes and environmental conditions since data on specific environmental pollutants are usually not available. For example, the focus may be on evaluating the potential hazards that are typically related to various types of activities or sources. Pre-visit hazard identification should attempt to identify the following:

- Incidence/prevalence of environmentally related infectious diseases;
- Incidence of various cancers;
- Mortality rates (infant, disease-specific, etc.);
- Registries of poisonings and injuries;
- Distributions of the above data by social, spatial, and/or economic categories.

2.2.2 Exposure Assessment

Exposure assessment involves characterizing the nature and site of populations exposed to a toxic agent, and the quantitative or qualitative estimation of the level and duration of their exposure. Since assessing exposure may be difficult in developing countries, appropriate methods must be selected on a case-by-case basis, depending on the available data and the level of sophistication required. Under ideal conditions, exposure assessment should consist of four steps:

- Determining environmental concentrations through source and emissions characterization, monitoring, and/or environmental fate, transport, and deposition modeling;
- Estimating the magnitude, duration, and frequency of human exposure for relevant subpopulations according to geographic distribution and population estimates;
- Estimating the dose received, usually expressed as Maximum Daily Dose for acute, subchronic, or chronic exposures to noncarcinogens, or as a Lifetime Average Daily Dose for carcinogens;
- Characterizing exposed populations and individuals and identifying of subpopulations at a potentially higher risk. The geographic distribution and other characteristics of interest, such as ages, sex, and activity levels of the exposed population should be determined.

Because many countries do not have detailed environmental monitoring programs and data on environmental concentrations are not available, it is not always possible to conduct a thorough exposure assessment. Even in countries with monitoring programs, data are not necessarily accurate, sufficiently complete, or representative of human exposures. In the absence of environmental data, investigators must evaluate pollutant sources: defining their locations, type, and emissions; and modeling the dispersion and environmental fate of pollutants. Such modeling may be used to estimate environmental concentrations and human exposures. In many instances, ambient conditions and pollutant sources may not be well defined in terms of constituent pollutants or concentrations. As a result, exposure may need to be assessed qualitatively by comparing exposed to non-exposed populations.

Exposure may be heavily influenced by patterns of behavior which may vary significantly among countries or regions according to culture, education, and climate. When conducting an exposure assessment, time-activity patterns (the time people spend in different microenvironments and their activities in those environments) must be evaluated. Important patterns to consider include spatial distributions (commuting), food consumption (e.g., source, such as street vendors), time spent outdoors/indoors, and specific activities (such as swimming). Specific behaviors may also significantly contribute to or minimize exposure: for example, the way people handle water, their personal hygiene, and their source for water.

2.2.3 Dose-Response Assessment

Dose-response assessment is a quantitative process. It defines the relationship between the administered or received dose of a substance (exposure) and the prevalence of an adverse health effect in an exposed population. It also uses a mathematical dose-response model to estimate the probability of occurrence of the effect based on human exposure to the substance. Although biologically plausible models are highly desirable, the mechanisms of action of many toxic substances and chemical mixtures are not well understood. In such instances, statistical models that best represent the available data are used to model dose-response relationships.

If available, dose-response estimates based on adequate human data are preferable to those derived from animal data. In the absence of appropriate human studies, data from studies of animal species that respond most like humans should be used. When several studies are available for a given agent, all biologically and statistically acceptable adequate sets should be presented. The U.S. EPA Risk Assessment Guidelines (1987) recommend placing the greatest emphasis on data sets from long-term animal studies showing the greatest sensitivity in order to account for sensitive human subpopulations. Some analysts, however, might stress using data representing biological similarity to humans over data that indicate the greatest sensitivity.

The use of animal data to estimate risks from human exposure requires at least two major extrapolations: (1) interspecies dose extrapolations to adjust for differences between humans and laboratory animals that may affect the response to the toxic agent and (2) extrapolation of the dose-response relationship observed at the relative high doses used in animal experiments to the much lower doses to which humans are likely to be exposed.

Many of the hazards common in developing countries are not conducive to dose-response assessment. Dose-response assessment has focused on single chemical effects through the use of experimental animal studies. In developing countries, many environmental hazards have a biological component that may confuse or not be amenable to dose-response assessment. Dose-response relationships have not been well defined for biological contaminants from any media. In many cases of exposure to biological agents, the incidence of disease is defined in relation to exposure not to degree of exposure. The development of immunity to biocontaminants may also occur through repeated exposures, confusing a defined dose-response relationship, reducing the anticipated impacts from exposure. The susceptibility of an individual may also influence the dose-response relationship and make a quantitative estimation of incidence difficult. Factors that may affect susceptibility include preexisting illness, exposure to other stressors, and nutritional status. In addition, simultaneous exposure to multiple toxic agents may confuse estimated dose-response relationships.

2.2.4 Risk Characterization

Characterizing risk means estimating the incidence of an adverse effect on a population. Having assessed the nature of the hazard, evaluated the appropriate dose-response coefficients, and estimated the level and magnitude of exposure, the risk to human health from an agent can be estimated. Depending on data quality or the level of sophistication required, risk characterization can go from highly detailed accounts of dose-response relationships and well documented exposure levels for a given population, to a qualitative description based on best guesses about exposure. Under ideal circumstances, risk characterization produces the following:

- An estimate of the probabilities of an adverse effect occurring in the average individual in a population, based on estimated exposure and dose-response factors;
- An estimate of the number of cases of the adverse effect that are likely in the exposed population;

- A discussion of assumptions and uncertainties in the risk estimate.

Risk characterization is highly dependent on data for both exposure assessment and dose-response assessment. Quantitative methods can be applied where there are data available on environmental concentrations in various media and on activity patterns and behavior related to exposure. Likewise, dose-response data would be required either through the use of experimental animal data or, to a lesser degree, human epidemiological evidence. In developing countries, these data are often not available. As a result, there will be some variability among countries as to whether quantitative or qualitative risk characterization is possible.

2.3 Health Effects (Outcome) Assessment

An investigator can use several sources of secondary (already existing) information for data on health outcomes. Morbidity and mortality data may be available through public sources, such as a ministry of health. Individuals within private institutions, such as universities, may also be sources if they conduct research germane to the subject. The investigator may interview those individuals or simply refer to their works. In some instances, when data are not in the required form, manual or computer manipulation of the data may be necessary. This is most likely to happen when the investigator needs data on a different subgroup of the population (denominator data) than in the original data set. In some instances, focus groups or site visits may be appropriate supplements to the investigation.

When an investigator examines secondary data, it is important to know how the data have been gathered. The following five issues should be considered:

1. Have data been generated through an active or passive surveillance system? A passive surveillance system receives incoming data and, therefore, generally suffers from substantial underreporting of cases.

2. Does the investigator have some sense of the timeliness of the data? For example, are there lags in reporting such that the data do not reflect recent trends?

3. Do differential reporting rates exist? Do some areas, districts, or provinces report more completely than others? Are there any factors, such as cost, staffing, or vested interests, which cause such circumstances to exist?

4. Are clear definitions used consistently among all reporting units?

5. What means of case confirmation exists for those reported cases? Are some cases misclassified as non-cases, or vice versa?

In assessing outcomes, the investigator must incorporate into the analysis several basic principles regarding the relationship between cause and effect: consistency of association, strength of association, dose-response relationships, temporal association (and lack of temporal ambiguity), and biologic plausibility. Such considerations will avoid confusion between associations and a true cause-and-effect relationship.

Parts of the environmental health assessment are based on *a priori* knowledge. The investigator may conclude through previous studies or well accepted facts that an environmental or occupational risk leads to a specific outcome. Prior research may show that a particular outcome is clearly and consistently associated with an exposure and that the relationship is also biologically plausible. However, past research has not always been conducted methodically. Some outcomes have not been fully explained scientifically, the lay community may perceive that other etiologies play a major role (for example, toxic dumps or high-voltage power lines), or at times competent researchers have reached different and conflicting conclusions. The investigator must keep an open mind, especially when relying on secondary data.

Another challenge occurs when the exposure and outcome relationship is not a one-to-one relationship. One type of exposure may lead to several outcomes. For example, exposure to lead may cause a variety of neurologic, hematologic, and renal disorders. Variability in outcome may be in part a function of the route of entry, the chemical form of the agent, or the age of the person exposed. In addition, the same health outcome may have several discretely different etiologies. For example, acute respiratory illness may be caused by infectious agents, irritating chemicals, particulates such as cotton dust, or allergens. Moreover, there may be an exacerbation of an underlying disorder, such as chronic bronchitis or asthma. These disorders could just as easily be environmental or occupational.

Dose-response relationships also must be considered. This will be especially difficult where people are exposed to many different agents for varying durations. The investigator may need to obtain records on workers' jobs and associated exposures from workplaces or research groups closely affiliated with an industry or factory.

Missing data should be addressed in any investigation. Identifying the reasons for the lack of data is a good protection against making unfounded conclusions about health outcomes. It is important for the investigator to state his or her assumptions about the missing data and potential impact on the analysis.

Appropriate determination of denominators is essential in any data analysis. Correct choice of denominators allows the investigator to calculate rates and to make comparisons between population groups. As mentioned previously, secondary data may not be in the form required for this assessment. The investigator should refer to census data, carefully noting the subgroups therein.

When using hospital-based data, the investigator must consider the estimated proportion of the population afflicted with an illness or adverse outcome that may never seek health care or that has limited access to clinics and hospitals. In addition, some behaviors or exposures could lead to minor illness, which may not require medical attention. There could be a large number of these minor illnesses, but there may be no record of the impact of this event on the population. Selection bias (which people seek medical care) will affect the numbers of health outcomes recorded at clinics and hospitals. The completeness of reporting systems, the expertise with which diagnoses are made, and the speed at which data are entered into the health information system will also affect the outcome assessment.

Lastly, a number of other biases can affect the data. Reporting bias, for example, occurs because health care providers report diseases differently. Some providers may have better systems for reporting or greater interest in the disease; this is known as diagnostic bias. Misclassification bias is when one disease is mistakenly reported as another; for example, byssinosis may be misdiagnosed and reported as chronic bronchitis or asthma. Detection bias occurs when adequate methods for ascertaining a disease do not exist; for example, cases of pesticide poisoning may not be detected because equipment is not available for measuring cholinesterase activity in blood.

2.4 Collection and Use of Ethnographic Data

To adapt the risk assessment methodology to specific developing countries, an ethnographic component was incorporated. Ethnography—the field study of culturally specific behaviors, values, and social patterns—provides a mechanism to study what people do, how they explain their actions, and what they perceive as meaningful constraints on their behavior. Ethnography combines the use of qualitative and quantitative data, as well as primary and secondary data.

The current application of ethnographic techniques to risk assessment relies heavily on the collection of primary data that tends to be qualitative. While a review of pertinent secondary literature is necessary, the most critical application of ethnographic methodologies to risk assessment rests on the use of the following three techniques used to gather primary data:

- Focus group research;
- In-depth key informant interviews;
- Semi-structured observations.

2.4.1 Focus Group Research

Focus group research is a technique effectively used to gather data in a limited timeframe. A focus group can be defined as a carefully planned discussion designed to obtain information on a specific set of topics (Krueger 1988; Aubel and Mansour 1989; Eng, Naimoli, and Naimoli 1991). Such groups are usually composed of seven to ten people who are carefully selected according to specific criteria. The group should be relatively homogenous to facilitate rapid cross-identification and communication.

Multiple focus groups work best when used to build on the results of previous groups (Debus, 1989). Participants should be selected for their knowledge relative to the research. For example, for health risk assessment, community members with experience in occupational health might be brought together to obtain relevant information.

In order for focus group research to be effective, the investigator must carefully select participants, use locally known and respected assistants, design appropriate research questions and "probe" questions, choose a neutral location for the groups, and use a trained facilitator (Kumar 1987; Scrimshaw and Hurtado 1987).

Analysis of focus group data can take several forms; however, regardless of the level of detail required, the focus groups should be tape recorded and the tapes analyzed for linguistic themes, behavioral categories, perceptions of risks, descriptions of health symptoms, and frequency. Ensuring the careful exchange of information between the facilitator (who could be from outside of the culture being studied) and the community-based assistants is central to the analysis.

2.4.2 In-Depth Key Informant Interviews

These interviews are conducted to obtain information that may be too complex to acquire during a focus group. Key informants are individuals the researcher knows and values for their opinions and insights. They should be living in the community being studied and have knowledge relevant to the issue being researched. Often key informants have provided detailed insight on issues raised through other research techniques.

In-depth interviews may take several hours, or may require multiple visits. The information is carefully noted and cross-indexed with related topics. Researchers also can conduct in-depth interviews of community decision-makers, although they do not serve the same function as interviews with key informants. Key informants help cross-validate other types of information, and they can only work effectively when the researcher has established a history of trust and respect. In-depth interviews with decision-makers, on the other hand, are mainly to gather opinions or to access secondary or quantitative data controlled by the decision-maker's office (such as census data).

2.4.3 Semi-Structured Observations

First-hand on-site observations provide a necessary reliability check on information gathered from other techniques. When people in focus groups describe their behaviors related to garbage disposal, for instance, the researcher should note their descriptions and check if direct observations validate information provided through other means. Research focusing on environmental health risks should incorporate observations of garbage dumps, household refuse removal systems, sanitation facilities, access to drinking water or other household patterns for water retrieval and storage. Food handling practices, such as food purchasing, preparation, and storage, and family and household hygiene practices, such as handwashing and waste removal, also may be observed. Observations might also focus on informal sector occupations, such as home-based shoe repairers, ambulant vendors, and woodworkers, or formal sector occupations, such as textile or metal workers.

2.4.4 Integration of Ethnographic Data

Throughout the project, ethnographic data generated through the focus groups, key informant interviews, and semi-structured observations are integrated into the overall analyses through a variety of techniques. These techniques include discussing information in team meetings, performing written analyses, ranking focus group topics, conducting on-site observations, and cross-editing work with other members of the team.

The focus group research is conducted during the initial phases of the field project, and the information generated is provided to the other members of the team in informal meetings during the early phases of the field study. By the second week in the field, all of the focus groups should be conducted and the data recorded according to the categories used by the other members of the team (such as wastewater, occupational health, air pollution, etc.). As a result of the information provided by the focus groups, team members should visit appropriate field sites, such as homes, workplaces, and garbage dumps. This will give all members of the research team actual on-site experience and will facilitate integration of the ethnographic data.

Toward the final portion of the field study, focus group environmental health risks are ranked and the information incorporated into the team's evaluation of data and the development of an overall ranking system. Also during this period, team members should read each other's work and add information where appropriate. The result of the focus group ranking should then be returned to key informant members of the communities for their feedback and comments. The information is then integrated into the final formal ranking of environmental health risks, determined by the team as a whole.

While ethnographic data can be rich in information, there are some limitations. Selection of the communities from which to draw the focus group participants, the selection criteria used, the scope and loading of the questions, the choice of meeting site, the identities of community-based assistants, and the skill of the facilitator all influence the quality of the information gathered. A careful researcher recognizes the methodological constraints and attempts to control them.

2.4.5 Organizing an Ethnographic Investigation

The following summarizes the activities that should be performed before, during, and after the in-field portion of an assessment in order for the ethnographic investigation to be productive.

Pre-Field Activities:

- Decide on criteria for selection of focus group participants
- Select focus group locations
- Find neutral meeting site
- Arrange for local community members to assist focus group facilitator

- Develop realistic timeframe and budget for focus groups
- Develop appropriate topic-specific questions and associated probes with other team members
- Design analysis structure

Field Activities:

- Meet and screen candidates for community-based assistants
- Train community assistants
- Review meeting sites
- Review selection constraints for participants
- Pretest linguistic appropriateness of questions and probes
- Pretest for sequencing of focus group questions
- Conduct focus groups
- Conduct key informant interviews
- Select criteria for determination of on-site observations
- Do on-site observations
- Analyze focus group and key informant interview data, and results of on-site observations
- Integrate ethnographic data into team data base
- Return ethnographic-based ranking to key informants for their feedback
- Incorporate feedback
- Analyze all data and draft preliminary results
- Cross-edit written draft with other team members
- Write field report
- Present report

Post-Field Activities:

- Meet with project directors and other team members to review conceptual issues and data limitations
- Discuss findings
- Present findings
- Incorporate new information
- Revise according to feedback
- Produce final report

2.5 Integrating and Rating Environmental Health Risks

Rating risks requires comparing a wide variety of health effects that differ in occurrence and severity. Health endpoints may range from an acute disease or illness that is not life threatening to one that causes death. In addition, there may be a wide range of data available for each environmental concern. Where health outcome data are not available, exposure data may have to be used; and where exposure data are not available, surrogates for exposure, such as information on use of a hazardous substance, may have to be used. As a result, the confidence and type of risk estimates may also vary greatly, with some risks being characterized in quantitative terms, while others may be limited to qualitative descriptions. How to compare "apples and oranges" is often a difficult task. As a result, comparative risk assessment is often subjective and relies on professional experience and judgment. This applies to assessing the validity of data and assessing the certainty of conclusions drawn from various studies and data sets as well. Data must be analyzed and integrated before ratings can be prepared.

Traditional risk assessment methods use a qualitative matrix for classifying risk levels, depending on (1) the probability of occurrence and (2) the relative severity of an adverse health effect. In general, such methods use three risk levels (low, medium, and high) (Pierson, 1991). The field study conducted in Ecuador (Arcia et al., 1993) used a rating system employing five scoring levels in an attempt to obtain more resolution in levels of severity and probability. These rankings were ultimately combined into a three-tiered summary ranking.

The score for probability of effect (Table 1) is based on the percent of the total population that is likely to be exposed to a hazard and either a qualitative or quantitative estimate of those experiencing an adverse effect. For example, for every 100 people in the city, 75 (75 percent) may be exposed to air pollution. However, only 50 of these 75 people may actually experience an effect (i.e., 66.7 percent of those exposed). Hence, the *probability* of effect is 75% x 66.7% = 50% (probability of effect score = 1). When only qualitative descriptions are available, the descriptive terms "very low" to "very high" can be used.

Table 1

Scoring for Probability of Effect

Probability of Effect (probability of exposure x probability of effect among those exposed)	Score
0-.10 (Very Low)	5
.11-.20 (Low)	4
.21-.30 (Medium)	3
.31-.40 (High)	2
.41-1.00 (Very High)	1

The score for severity of effect (Table 2) reflects the severity of health effects that, in the investigator's judgement, are most likely to occur, based on prior laboratory, clinical, or epidemiological studies. For example, it is known that exposure to certain types of air pollution may lead to serious acute respiratory disorders. These acute disorders may range in severity from reduced ability to exercise to increased incidence of bronchitis. Air pollution may also result in respiratory dysfunction, wherein a person's respiratory capacity may be significantly and permanently reduced, or even more serious and permanent diseases, such as lung cancer. Hence, the severity score is 2.

Table 2

Scoring for Severity of Effect

Severity of Effect (seriousness of impairment x duration)	Score
Very mild	5
Mild	4
Moderate	3
Serious	2
Death	1

Using numerical scores may imply a greater degree of accuracy and certainty than is actually present in the ratings. Subjective elements are inevitably involved in assigning a score for probability of effect and severity of effect. The experienced investigator uses information drawn from experience in other countries, the uncertainty associated with dose-response coefficients for a particular variable, and subjective judgment regarding the percentage of people expected to be exposed. In some cases, the score may be based on the upper limit percent of people likely to be exposed (e.g., ≤ 75 percent), while in other cases, it may be based on a lower limit (e.g., ≥ 50 percent). In some cases, the quantitative estimates are used as a guide and adjustments may be needed when a comparison is made between environmental health problems. For example, when two environmental health concerns are evaluated separately, similar scores may be assigned initially. However, when the two are compared, adjustment may be made to one or the other if professional judgment indicates that the two risks may differ either in severity or probability of effect.

The total score assigned to the environmental risk is the sum of the scores for likelihood of effect and severity of effect. As shown in Table 3, items with high severity and high probability of effect will be grouped on the upper left-hand corner of the matrix. These are the items posing the highest environmental health risk to the population.

After risk ratings have been assigned to all of the problems being evaluated, the ratings should be grouped into low-, medium-, and high-risk categories. The ratings will often cluster naturally into groups and the break-points will be more or less obvious. In the Ecuador field study (Arcia et al., 1993), risk ratings clustered into three groups and risk categories were defined as follows:

Low Risk	9 to 10
Moderate Risk	7 to 8
High Risk	1 to 6

For example, an environmental condition presenting a high probability of effect (i.e., 1) to a toxicant that causes serious permanent damage to an organ system (severity score of 2) would have a total risk score of 3 and be considered a high-risk problem. Conversely, situations ascribing a low probability of effect to toxicants that cause minor health effects would be grouped on the lower right-hand corner of the matrix and would be deemed low-risk problems. Scores along any diagonal, lower left to upper right, would be considered equivalent. High-severity low-probability effects are assumed to be equivalent in overall importance to low-severity high-probability effects, and the scoring system reflects this.

Table 3

Matrix Illustrating Sum of Scores of
Severity of Effect and Probability of Effect

Probability \ Severity	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

2.6 Interpreting Results

The investigator must be cautious in interpreting results from this methodology because it often relies on limited data and best estimates. As better data become available, the methodology should be applied again and rankings redone. Nevertheless, this methodology can provide useful information, especially on the relative priority of environmental health problems.

Investigators should recognize that this methodology has a number of limitations, including the following:

- Some data may be out of date;
- Some data may be for a larger or smaller geographic area than the one targeted;
- Some data may have been collected using varying definitions of illness, injury, or disability;
- Sample data may not be representative of the whole target population.

In addition, this methodology does not take into consideration the relative importance of nonenvironmental health problems nor the resources or approaches for the prevention and control of environmental health problems assessed.

3

CATEGORIES OF ENVIRONMENTAL HEALTH PROBLEMS

3.1 Water Supply

3.1.1 Background

Contaminated drinking water is one of the most important causes of environmentally related disease in developing countries. Biological contamination (bacteria, parasites, viruses) causes infectious diseases including diarrheas, cholera, typhoid, hepatitis, and a variety of parasitic infections. Chemical contaminants may cause kidney and liver disease, cancer, neurological effects, and other health problems. Diarrheal diseases are typically among the top three causes of infant and child mortality in developing countries.

The extent of people's exposure to contaminated drinking water is determined by water usage patterns and the quality of water used. Data on both of these topics are needed to evaluate water's potential impact on health.

3.1.2 Types of Data

Data on water usage patterns should include the following:

- Proportion of population using piped, vended, surface, and ground water and cisterns;
- Number of units or households per water service connection;
- Location of water source(s) with respect to dwellings;
- Personal usage patterns, including per capita consumption and the sources of water used for each application, i.e., ingestion, cooking, bathing, household cleaning, and disposal of human waste;
- Regional usage patterns including domestic, municipal, irrigation, and industry;
- Cost of vended and municipal water.

The reliability of the water service can alter the type and quality of water available and potential exposures. Therefore, data should be obtained on service reliability, including the physical system (e.g., leakage, maintaining positive pressure) and susceptibility to upsets (e.g., power outage) or natural disasters (e.g., flooding). Understanding coping behaviors, such as changes in usage or source during seasonal variations or system failure is also critical, since they may play a large role in disease incidence and may be overlooked if only primary water sources are evaluated.

Water quality plays an equally important role in the incidence of disease. Data should be obtained for each source of water; data on water quality at the tap or point of consumption are preferred to data collected at the water source, treatment plant, or point of distribution. Data should be obtained on levels of the following:

- Microorganisms
- Pesticides
- Organic material
- Metals
- Fertilizers
- Biological and chemical oxygen demand

Whenever possible, data on water usage and water quality should be disaggregated with respect to location and socioeconomic categories.

3.2 Sanitation and Wastewater Management

3.2.1 Background

The health risks that result from exposure to contaminated drinking water are, for the most part, traceable to the original sources of the contamination: human and animal feces, and chemical wastes contained in municipal, agricultural, and industrial wastewater discharges. People who do not have adequate sanitation facilities—safe and secure means for disposing of feces—are at risk of direct contact with fecal wastes and exposure via local, contaminated water sources (such as shallow wells). They also impose risks on others downstream who share common water sources. Each of these pathways must be considered in the assessment.

3.2.2 Types of Data

Data should be obtained on the proportion of the population with and without sewer connections. Those without should be categorized by type of sanitation facility: septic tanks, well built and maintained latrines, and inadequate facilities. These data should be disaggregated by neighborhood or city section to the maximum degree possible. Information on the integrity of on-site sanitation systems is also needed, including the frequency of servicing for septic tanks and latrines, and the frequency of flooding or overflow. Furthermore, the existence of adequate sanitation facilities does not necessarily solve the problem of exposure; people must use the facilities and practice appropriate hygiene. Ethnographic methods (interviews, observation) are used to collect data on hygiene behavior.

For those communities with municipal sewerage, the potential for transient exposure to fecal wastes can be evaluated by reviewing data on system reliability, including characteristics of the physical system (for example, capacity and leakage) and susceptibility to upsets (for example, power outages, backups, and flooding).

Where sewage is collected and conveyed to a discharge point, data should be obtained concerning the location of discharges with respect to user populations, the quantity of wastewater discharges, and effluent parameters of the wastewater. Effluent parameters should include the microbial content (fecal and total coliform), the biological oxygen demand (BOD), total suspended solids (TSS), and nitrogen and phosphorus content. If the collected wastewater is treated, information should include data on plant operation and maintenance, type of treatment, and proportion of wastes treated. Exposure pathways resulting from the use of treated wastewater (for example, for irrigation) should also be considered.

Industrial discharges may also contribute to environmental health problems. To evaluate their significance, inventories of these discharges should be obtained, including their location (with respect to population or water use), type of treatment, if any, quantity of the discharge, and effluent parameters outlined above for municipal wastewater discharges. Industrial discharges should also be evaluated for chemical contaminants. In the absence of specific industrial discharge information, data on industries (location, type, chemicals and quantity used, and manufacturing output) may also indicate the potential for harmful exposures.

3.3 Solid Waste

3.3.1 Background

Improperly disposed or controlled solid waste can be an important source of environmental health problems. Solid waste can lead to disease through direct contact (especially for solid waste workers and scavengers), through contamination of groundwater or surface water with hazardous materials, or by becoming a breeding ground for disease vectors (such as mosquitoes and rodents).

3.3.2 Types of Data

Initially, the total quantity of waste generated per capita should be determined. Waste composition should be evaluated to determine the types of wastes discarded. Different wastes vary in their potential for adverse effects and in how they occur. Biological waste materials potentially contain pathogens, which may directly lead to disease, while solid inert materials, such as tires, can act as breeding grounds with indirect impacts. Wastes that contain chemicals with direct exposure potential or indirect exposure potential, by leaching into groundwater, are also dangerous.

Solid waste can result in exposure and adverse effects at various times. Localized accumulation prior to municipal collection can affect those generating the wastes. Data on collection of waste, type of collection service, frequency, and reliability provide valuable information on diverse local exposure patterns. Data on collection can also indicate areas of potential problems, areas of no collection or infrequent collection, and the extent of the problem. These data should be evaluated with on-site observations.

Data should be collected on the disposal of waste (both collected and noncollected), including the location of the disposal and disposal practices. Disposal practices should be evaluated in terms of the extent to which waste is covered and formal methods of rodent, animal, and vector control. Data can be obtained from the agency responsible for solid waste disposal, including maintenance and procedure documents, though the best source of information is direct observation.

Recycling and reclamation of wastes also can result in significant problems. The most obvious relates to those persons who participate in these activities since their contact is greatest. How these wastes are recycled should be evaluated to determine if the potential exists for more dispersed exposure. Direct observation again plays a critical role in data collection since most communities do not have statistics on the number of persons or practices involved.

3.4 Food Hygiene

3.4.1 Background

Contaminated food is a significant cause of environmental health problems. Food may contain biological contaminants or chemical residues (such as pesticides), which may result in a wide range of adverse health effects. To evaluate food as a source of illness or disease, a wide variety of data are needed.

3.4.2 Types of Data

Data on local diet and food consumption patterns are essential and should include the types and quantities of food consumed and whether food is grown locally, or individually, or is imported. Data on dietary patterns may be obtained from health departments, especially nutrition or agricultural department offices. Once dietary patterns have been determined, data on the quality of the food should be obtained, including any food inspection and testing results (such as evidence of metals, microbial, organics, pesticides). These data may be obtained from health department monitoring programs if they exist and can then be used to estimate overall exposures and potential adverse health effects.

Food preparation, which includes cleaning, boiling, and cooking, can exaggerate or minimize exposure. These activities should be evaluated because they can significantly reduce the levels of biological or chemical exposures. Ideally, data on diet and food testing would be available; however, this is typically not the case, so other sources of data must be pursued. Water plays an important role in food preparation, and details on water quality can provide useful information in assessing the hazards related to food. Water use issues to be investigated include irrigation, water source, quantity used, general water quality and availability, and brown water usage in food preparation or cleaning. Pesticide usage (type and quantity) also can reveal the type and extent of chemical contamination in food. In many cases, field observations are essential to understanding the extent of food contamination and resulting exposure.

3.5 Occupational Health and Safety Hazards

3.5.1 Background

Occupational health and safety hazards account for a wide range of illnesses and injuries, ranging from respiratory disorders to neurological problems, from acute injuries to cumulative trauma disorders. In theory, all of these conditions can be prevented. Developing countries face a number of challenges, however, in recognizing, evaluating, treating, and preventing these problems because of inadequate numbers of trained personnel, inadequate institutional development, hazardous industries and wastes imported from developed countries, and nonoccupational endemic diseases.

3.5.2 Types of Data

A rapid investigation of occupational health hazards will necessitate the use of secondary data as the main source of information. Since many developing countries have only recently become aware of occupational health problems, however, they may lack sophistication and experience in data collection and analysis. As a result, reports may not focus on potential risks in the workplace, appropriate health outcomes, or cause-and-effect relationships.

Both public and private institutions can provide data on occupational risks. The Ministry of Health and the Ministry of Labor and their attendant subdivisions usually have repositories of data, and they may monitor occupational hazards. The Ministry of Health is likely to focus on incidence of injuries or resultant health outcomes and illnesses provoked by factors in the workplace, whereas, the Ministry of Labor is likely to be interested in numbers of workers temporarily or permanently disabled. The responsibility for follow-up to these reports may vary from one country to another, however. In private industry, industrial enterprises, research institutes, and universities are likely to investigate specific issues that may have been brought to light by public or private reports. Nevertheless, when an industry conducts occupational health studies, some bias can potentially enter the methodology. Investigation conducted by an independent group, such as a university, may suffer from lack of access to the workplace or lack of funding.

Public sources also include the social security bureau, which registers workers in the formal sector; however, workers in the informal sector, who may be at greater risk for occupational hazards, are not registered within the social security bureau. The workers' compensation bureau maintains records of workers injured on the job, but its records may be incomplete for a variety of reasons. Moreover, workers are reluctant to report job-related injuries or illnesses in fear of losing wages or jobs.

The nature of occupational health hazards makes for a challenging assessment of risks in the workplace. Foremost is basic knowledge of the processes involved within a particular industry. Because industries have several steps from raw product to finished product, the investigator needs to know what exposures exist at each step and which workers are at risk. This challenge is compounded by delays between exposure and outcome, such as in cancers, where outcome may not be manifested until several years after exposure, and by dose-response uncertainties. In addition, when sick employees drop out, the healthy worker effect occurs. Remaining workers are not yet affected by the exposure to the degree of those absent. This is a form of selection bias. It is difficult to track cohorts of exposed workers over several years because of out-migration patterns. Such tracking can be made easier depending on the employer's record keeping and the specific information those records contain, such as exact nature of job, materials (such as chemicals or machinery) used in the job, and changes in processing and procedures by the company or industry over time.

Reporting systems on occupational health in developing countries are limited because of lack of funding, staffing, and interest level. In addition, higher priorities divert resources to other activities. Consequently, surveillance systems for occupational hazards are usually passive and hampered by underreporting and lack of monitoring for quality control of data collection, case confirmation, case follow-up, and intervention follow-back. For a system to work, adverse health outcomes must be recognized and offending agents detected. (This can lead to detection bias.) There must also be a mechanism for reporting the event. (Misclassification bias of either exposure or outcome can occur at this stage.) Also required is a mechanism for analyzing, disseminating, and using the data obtained.

When large industries have their own clinics, the investigator may be able to extract data on site. However, when workers must seek care at outside institutions and clinics, only a careful data search through records will reveal which outcomes are job-related. In many instances, it is useful to visit the site under study. This allows direct observation of the types of processes performed, the kinds of safety measures recommended, and whether these measures are implemented.

3.6 Traffic Hazards

3.6.1 Background

As a city's population grows, the number of vehicles and traffic-related hazards increase. Some cities experiencing rapid urbanization may find that an increase in traffic-related accidents and deaths strains the medical care delivery system.

Urban and rural areas handle traffic hazards differently. Urban areas tend to document vehicle registration and traffic accidents better than rural areas. The nature of accidents differs as well. Population and vehicular density may create higher risks for urban areas, whereas rural areas may be affected by lax regulation of traffic safety. Where public transportation is heavily used, although there may be less accidents, more people are involved per accident. Geographic conditions also can cause accidents; for example, mountainous areas may present hazardous driving conditions.

3.6.2 Types of Data

Several sources of information about traffic hazards may exist, depending on how organized the local police and transportation safety agencies are. The investigator should be aware that some of these agencies' data bases may use geographic units of analysis that differ from the ones of interest. In some instances, investigation may require either a manual search through police documents or a computer-assisted search for data relevant to the unit of analysis, such as by city, province, or region. In addition, records of the Division of Motor Vehicles and traffic deaths recorded in a government statistics unit can provide useful data.

The investigator must be aware that police and municipal offices may collect and tabulate data in formats that are useful to them but not necessarily applicable to epidemiologic research purposes. As an example, police may want traffic accident data correlated with geographic location of accident or vehicle type. In contrast, the investigator may find the cross-tabulation of type of accident (pedestrian or vehicular) with type of injury or occurrence of death to be more pertinent. As another example, the age distribution of victims of traffic accidents is not always available in annual police reports; it may require manual searches of individual police reports. This kind of information may be useful to an investigator seeking age-specific morbidity and mortality data that reflect high-risk populations on the road: the young or elderly pedestrian, who may lack judgment or agility in crossing streets, as well as the adolescent or aging driver who may misjudge road situations that require quick action.

The investigator should attempt to collect the following types of data for a chosen geographic unit:

- Numbers and types of traffic accidents—injuries and deaths;
- Descriptive information (time, place, and person) on injuries and deaths;

- Number of accidents involving vehicles (collisions);
- Number of accidents involving pedestrians and vehicles;
- Number of noncollision accidents;
- Cause-specific data (for example, drunkenness, speeding);
- Denominator data on numbers of vehicles, drivers, and pedestrians.

If the data are available and the investigator has the time, he or she should consider a trends assessment of traffic hazards. It may be instructive to examine the impact of population density and vehicle density on the rates of motor vehicle accidents.

There are some challenges to data collection and analysis due to the inherent limitations in the information system. For example, deriving denominator data may require computer-assisted manipulation when repositories have provincial-based data sets and the study researches municipal-based statistics. As another example, hospital discharge records may code the main diagnostic category rather than an underlying cause, so it may be hard to determine that a patient with a fractured femur was injured in a traffic accident.

Because annual traffic safety reports may group data for reporting purposes, some categories may be collapsed, hiding the nature of certain relationships. As an example, aggregated data might not indicate which accidents have led to injuries and which have not; they are simply totalled. Accidents that do not result in either injury or death may not be reported, and reporting from multiple centers may differ.

3.7 Air Pollution (Outdoor and Indoor)

3.7.1 Background

Outdoor and indoor air pollution cause much sickness and some deaths. Sulfur dioxide, oxides of nitrogen, particulates, and other outdoor air pollutants cause a variety of health problems, from respiratory tract irritation to exacerbation of the symptoms of chronic obstructive pulmonary disease. In recent years, it has been recognized that indoor air is often contaminated with a variety of dusts, fumes, and gases, ranging from carbon monoxide to asbestos, from tobacco smoke to formaldehyde. These indoor air pollutants may also cause significant acute and chronic health problems.

3.7.2 Types of Data

An assessment of air pollution should consider (a) the nature of pollutants and the levels and durations of exposure to them and (b) the occurrence of respiratory ailments in relation to air quality (and other factors).

Sources of information about indoor air pollution are usually limited to census data on residents per household (crowding), data on home ventilation, home size (number of rooms), and cooking and heating fuels used in the home. Information on smoking can supplement these sources.

Sources of outdoor air pollution data are primarily the reports generated by local air quality monitoring stations. These reports should include locally used standards for air quality.

In the data analysis, the investigator must consider the following: location of monitoring stations; air sample collection (methods, volumes sampled, timing and frequency); and laboratory analysis techniques. Location of monitoring stations is critical to representative sampling of air quality. In some instances, instruments are placed for convenience, not scientific validity. The methodology of air sampling is critical. Air samples must be collected in a standardized fashion: for specified volumes and durations of collection, and at specified frequencies. Variations overestimate or underestimate true values. Lastly, the laboratory methods used in analysis should be scrutinized. Standards for laboratory procedures must be followed exactly.

It is often difficult to demonstrate the adverse health effects of poor air quality. However, both acute respiratory disease and exacerbation of chronic respiratory disease increase with air pollution. The situation is complex; the investigator can make projections from other situations, but must consider the extent of smoking and underlying chronic respiratory disease. A trends assessment with seasonal variations may help elucidate this, but the investigator will have a difficult time supporting the hypothesis that a certain percentage of illness is directly related to air pollution over a particular period of time.

3.8 Hazardous Substances (Nonoccupational exposures)

3.8.1 Background

As developed countries are becoming more aware of the adverse health effects of some chemicals used in industry, agriculture, and the home, they are starting to study or monitor the use and exposure to these chemicals as well as related health effects.

Recognition of adverse health effects associated with hazardous substances and hazardous wastes may be delayed for many reasons, including lack of health information, ignorance, reluctance to report cases, and lack of awareness of reporting systems. People may be unaware of the manifestations of illness caused by an exposure to a hazardous substance. In some instances, the symptoms may be dismissed as flu or general malaise. People may not know where to report information on health effects apparently due to hazardous substances. Occasionally, the local media are the first to learn of clusters of adverse events.

Even though the number of potentially hazardous substances is great, the investigator may be restricted to studying a few specific hazardous substances because of limited information. Rapid assessment may dictate focusing on one or two important and prevalent hazardous substances, such as pesticides and lead.

3.8.2 Types of Data

Agricultural institutions, poison centers, and government data bases on morbidity and mortality are sources of information; however, their coding systems may not be specific for the hazardous substance of interest.

Limitations to effective reporting include lack of recognition by patient or clinician of toxic effect, lag time between exposure and effect, underreporting, "healthy worker" (survival) effect, reluctance to report cases for economic reasons, and lack of access or availability to health care.

4

PLANNING AN ENVIRONMENTAL HEALTH ASSESSMENT

4.1 Staffing

The consultant team should include an expert in risk assessment, an epidemiologist or other health professional experienced in the collection and analysis of health outcome data, and an anthropologist to organize the collection of ethnographic data. The team should also include one or more local consultants to identify and gather data before the team arrives, and one or more local contacts to help establish an "in" to those communities where the ethnographic investigation will be conducted. It may be appropriate to include other expatriate professionals who have worked in the locale if they can help access data or communicate the results of the study to policymakers in relevant agencies. This staffing pattern assumes that the consultant team will conduct all aspects of the EHA. Longer-term efforts to conduct the assessment in collaboration with host country professionals and thereby transfer the relevant skills would need to include additional personnel and time for training, collaboration, and evaluation.

4.2 Schedule

An EHA of the scope described in this report can be conducted in approximately four to six months from initial planning through final reporting (see Table 4). The time required and the extent of the analysis depend on the amount of data available. Collecting original data on environmental conditions will generally improve the analysis and extend its duration. Collaborating with host country professionals to conduct a collaborative assessment would take longer, but will have important payoffs. More time would also be required and more benefits realized by increasing the amount of effort devoted to collecting ethnographic data and getting community organizations involved in the assessment.

Table 4

Suggested Schedule for an Environmental Health Assessment

Time Required	Step
4-6 weeks	Define geographical and technical scope of analysis, prepare assessment plan, and identify team.
2 weeks	Team leader and local consultants meet with local officials, sector professionals, and community leaders to identify environmental health problems of concern. Define data collection requirements for the assessment.
6-8 weeks	Local consultants identify and gather data, regularly consulting with other team members. Refine scope and conduct preliminary data analyses. Prepare analytical models and worksheets for problems being identified. Identify local assistants and make arrangements for ethnographic investigation.
1 week	Consultant team meets to review summaries of available data and plan field assessment.
3-4 weeks	Full team conducts the assessment. Preliminary results are developed and communicated in departure debriefings.
2-4 weeks	Local consultants gather supplemental data as required to fill gaps in analysis. Review and revise in-field analyses as required, complete final report.

5

CONCLUSIONS

Health risk assessment techniques were originally developed to predict the long-term public health impact of environmental health problems with long latency periods, such as cancer. Predictive methods are needed because the impact of exposure to carcinogens cannot be measured directly. Over time, environmental regulatory institutions in the United State have moved beyond the initial use of risk assessment for setting individual standards and are now using comparative risk assessment as an important tool for establishing priorities and setting public policy. More and more, public officials, private advocates, and academicians are urging that risk assessment be adopted as a basic framework for setting environmental health policy.

A.I.D. is exploring the potential for using comparative risk assessment techniques to help developing country governments set priorities in their environmental health programs. A.I.D. has sponsored two risk assessment studies to date: the first in Bangkok, Thailand, conducted in 1990 and sponsored by the Office of Housing, in collaboration with the U.S. Environmental Protection Agency; the second in Quito, Ecuador, conducted in 1992 by the Office of Health.

Using risk assessment techniques in developing countries presents several challenges that have not been confronted to the same degree in applications in the United States. The most important of these are summarized in Table 5. A.I.D.'s risk assessment studies in Bangkok and Quito have involved first attempts to deal with some of these challenges. This report has described the approaches used in the EHA in Quito to evaluate infectious diseases and injuries, as well as cancer; to use interviews, focus groups, and observations as a critical source of information for augmenting the minimal quantitative data available on environmental quality and exposure; and to deal with the limitations in data accessibility. Other challenges will be addressed in future efforts, particularly the need to transfer risk assessment skills to host country institutions, as well as to involve community groups and nongovernmental organizations in the conduct, interpretation, and use of risk assessments. These challenges define the context for A.I.D.'s continuing effort to develop risk assessment methods that are appropriate for use in developing countries.

The authors of this report believe that the EHA methodology holds much promise. It has been developed with the specific intent of adapting the rationale and approach of health risk assessment to developing countries. It has been tested in an urban and a rural setting, where it proved helpful in identifying and prioritizing environmental health problems (Arcia et al., 1993). It should now be applied in other developing countries to assist those countries in assessing and prioritizing their environmental health problems.

Table 5

Methodological Issues in Environmental Health Assessment for Developing Countries

ISSUE	RESPONSE	APPLICATION
Scope of assessment includes infectious diseases, for which there are no dose-response models.	• Use clinical data to estimate disease rates. • Use ethnographic data to estimate and confirm significance of impact.	Bangkok & Quito Quito only
All three types of data will not be available: sources, exposures, and outcomes.	• Combine risk assessment and epidemiologic methods. • Use ethnographic techniques also.	Bangkok & Quito Quito only
Data are not computerized and are not accessible easily. They are aggregated at inappropriate geographic levels.	• Involve local consultants. • Allow long period for up-front data gathering.	Bangkok & Quito Quito only
Assumptions for determining exposure may be inappropriate due to cultural differences.	• Conduct special studies and use ethnographic methods to describe health-related behavior.	Attempted in Quito study
Assessment must reflect local judgments and policy choices.	• Involve local institutions in design, conduct, and interpretation of study.	Future direction
Donors cannot perform all of the assessments needed.	• Develop domestic inst'l capacity for risk assessment.	Future direction
Involving community groups in conduct and use of a study makes environmental management more effective.	• Involve communities and NGOs in design, conduct, interpretation, and use of study.	Future direction

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The Environmental Health Project (EHP) provides technical assistance to USAID missions and bureaus and other development organizations in nine areas: tropical diseases, water and sanitation, wastewater, solid waste, air pollution, hazardous waste, food hygiene, occupational health, and injury. It is part of the Office of Health and Nutrition's response to requests from USAID missions and bureaus for an integrated approach to addressing environment-related health problems. In addition to EHP, this effort includes an Environmental Health Requirements Contract and a PASA (Participating Agency Support Agreement) with the U.S. Centers for Disease Control and Prevention. A wide range of expertise is made available by EHP through a consortium of specialized organizations (see list below). In addition to reports on its technical assistance, EHP publishes guidelines, concept papers, lessons learned documents, and capsule reports on topics of vital interest to the environmental health sector. For information on the reports available, contact EHP headquarters.

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